This repo will house coursework from the AWS training class from A Cloud Guru for the Solutions Architect Associate Certification as well as course notes.

**Section 2: AWS - 10,000 Feet Overview**

This section will cover a top-level overview on the AWS services tested in the Solutions Architect exam.

* AWS officially launched in 2006
* By the numbers, AWS services have grown from 82 in 2011 to over 1300+ in 2017

**Terminology**

* What is a Region? A Region is a physical location in the world which consists of two or more AZ's
* What is an AZ? An AZ (Availability Zone) is simply a data center
* What is an Edge Location? Edge Locations are endpoints for AWS which are used for caching content. Typically this consists of CloudFront, Amazon's CDN (Content Delivery Network)

**Compute Service**

* EC2 (Elastic Compute Cloud) - Virtual machines inside the AWS platform
* EC2 container service - Run and manage Docker containers at scale
* Elastic Beanstalk - For developers who do not understand AWS who just want to upload their code
* Lambda - A code uploaded to the cloud where you can control when it executes (no need to worry about physical or virtual machine)
* Lightsail - Amazon's VPN (virtual private network) service essentially a watered-down version of EC2
* Batch - Used for batch computing in the cloud

**Storage Service**

* S3 (Simple Storage Service) - An object based- storage where we can upload files into buckets in the cloud
* EFS (Elastic File System) - A network-attached service
* Glacier - Data archival service
* Snowball - Way to bring in large amounts of data into the AWS data center
* Storage Gateway - Virtual Machines which will replicate information back to S3

**Database Services**

* RDS (Relational Database Service) - Service which works with MySQL, PostgreSQL, Oracle
* DynamoDB - For non-relational databases
* ElastiCache - A way of caching commonly queried items from a database
* Redshift - Built for data warehousing

**Migration Services**

* AWS Migration Hub - Tracking service which allows application tracking during migration
* Application Discovery Service - Automated set of tools which not only detects what applications we have but also tracks the dependencies for our application
* Database Migration Service - A way to visualize migrations in action
* Server Migration Service - Helps migrate physical and virtual servers to the cloud
* Snowball - Also a migration tool as well as a storage service

**Networking & Content Delivery**

* VPC (Virtual Private Cloud) - Essentially a virtual data center where we can configure things such as firewalls, AZ's, etc.
* CloudFront - Stores information closer to the users and uses a CDN to distribute content on a global scale
* Route 53 - Amazon's DNS service which is highly scaleable
* API Gateway - Is a way of creating our own APIs for our services to talk to
* Direct Connect - A way of running a dedicated line from a data center into Amazon which will directly connect into a VPC

**Developer Tools**

* CodeStar - Project management service
* CodeCommit - Source control service or place to store code
* CodeBuild - Once service is ready, this service will compile, run tests, and produce software packages which will enable deployment
* CodeDeploy - Service which automates deployments to EC2 instances, on premise instances, and lambda functions for example
* CodePipeline - Continuous delivery pipeline which will automate the steps required to release software
* X-Ray - Debug service which will help find root causes and performance bottlenecks
* Cloud9 - IDE environment which will allow development on the cloud

**Management Tools**

* CloudWatch - Monitoring service
* CloudFormation - Way of scripting infrastructure
* CloudTrail - Used to log changes to the AWS environment (turned on by default and stores logs for a week)
* Config - Monitors the entire AWS environment
* OpsWorks - Similar to Elastic Beanstalk but more robust and is good tool to automate environments
* Service Catalog - A way of managing catalogs of IT services which are approved to use on AWS
* Systems Manager - A resource manager, typically used for EC2
* Trusted Advisor - Will give advice across multiple disciplines
* Managed Services - A manage service for things such as EC2 instances and auto scaling

**Media Services**

* Elastic Transcoder - Resizes videos to be compatible on multiple platforms
* MediaConvert - File-based video transcoding service with broadcast grade features
* MediaLive - Broadcast grade video processing service
* MediaPackage - Prepares and protects videos for delivery over the internet
* MediaStore - Storage service optimized for media
* MediaTailor - Allows the ability to do ads on broadcast grade media

**Machine Learning**

* SageMaker - Makes it easy to use deep learning
* Comprehend - Sentiment analysis around data
* DeepLens - Artificially aware camera
* Lex - A way of communicating with customers
* Machine Learning - Service to build machine learning projects
* Polly - Takes text and turns it into speech
* Rekognition - Recognizes objects of interest in images and videos
* Amazon Translate - Translation service
* Amazon Transcribe - Transcribe service

**Analytics**

* Athena - Allows SQL queries or files in S3 bucket
* EMR (Elastic Map Reduce) - Used for processing large amounts of data
* CloudSearch - Search service for AWS
* ElasticSearch Service - Search service for AWS
* Kinesis - A way of ingesting large amounts of data into AWS
* Kinesis Video Streams - Allows ingesting of large amounts of data from video streams
* QuickSight - Amazon's business intelligence tool
* Data Pipeline - A way of moving data between different AWS services
* Glue - Used for ETL (Extract Transform and Load)

**Security & Identity & Compliance**

* IAM (Identity Access Management) - Amazon's IAM service
* Cognito - Device authentication service
* GuardDuty - Monitors for malicious activity on the AWS account
* Inspector - An agent installed on services such as EC2 to check vulnerabilities
* Macie - Scan S3 buckets for PII (Personal Identity Info)
* Certificate Manager - Way of managing SSL certificates
* CloudHSM - Service which offers dedicated bits of hardware used to store keys
* Directory Service - Way of integrating Microsoft active directory services with AWS services
* WAF (Web Application Firewall) - A layer 7 firewall which stops cross-site scripting or SQL injections
* Shield - Service which helps mitigate DDoS attacks
* Artifact - Portal service which allows downloads of compliance reports

**Mobile Services**

* Mobile Hub - Management console for mobile apps
* Pinpoint - Uses targeted push notifications to drive mobile engagement
* AWS AppSync - Updates data in web and mobile applications in real-time
* Device Farm - A way of testing apps on real-life devices
* Mobile Analytics - Analytics service for mobile

**AR/VR**

* Sumerian - Used for AR, VR and 3D application design, allows you to use a common set of tools to create environments

**Application Integration**

* Step Functions - A way of managing different Lambda functions
* Amazon MQ - A way of queuing messages
* SNS (Simple Notification Service) - Notification service if an account goes over some limit
* SQS (Simple Queue Service) - Queue service which is used for decoupling infrastructure
* SWF (Simple Workflow Service) - Workflow service which creates a workflow map for some processes

**Customer Engagement**

* Connect - Essentially is a call center in the cloud
* Simple Email Service - Very scaleable service which helps send emails to customers

**Business Productivity**

* Alexa For Business - Can use for a variety of business services and tasks
* Chime - Video conferencing similar to Google hangout
* WorkDocs - A drop box for AWS
* WorkMail - Similar to Office 365

**Desktop & App Streaming**

* Workspaces - A VDI (virtual desktop infrastructure) solution (running an operating system on AWS cloud)
* AppStream 2.0 - A way to actually stream applications to your desktop

**Internet of Things**

* iOT - A way of having thousands or millions of devices sending back data i.e. sensor data such as temperature or humidity to a controller
* iOT Device Management - Used for managing a ton of devices through the AWS service
* Amazon FreeRTOS - Operating system service for microcontrollers
* Greengrass - Software that lets your run local compute, messaging, data caching, sync, and ML inference capabilities for connected devices in a secure way

**Game Development**

* GameLift - Service to help develop games in the AWS cloud

**Section 2 Quiz**

**1. What is an AWS region?**

* A region is a geographic area that consists of different AZ's. Each region has at least two AZ's.

**2. What does an AWS region consist of?**

* An independent collection of AWS computing resources in a defined geography.

**3. Which statement best describes AZ's?**

* Distinct locations from within an AWS region that are engineered to be isolated form failures.

**4. An AWS VPC is a component of which AWS service?**

* Networking Service

**5. What is a VPC?**

* Virtual Private Cloud

**6. Which AWS service is specifically designed to run a developer's code on an infrastructure that is automatically provisioned to host that code?**

* Elastic Beanstalk

**7. Which AWS service allows you to run code without having to worry about provisioning any underlying resources (such as virtual machines, databases, etc.)**

* Lambda

**8. Amazon's highly scaleable DNS service is known as \_\_\_\_\_\_\_\_.**

* Route 53

**9. Which AWS compute service is specifically designed to assist you in processing large data sets?**

* Elastic Map Reduce

**10. What is the difference between Elastic Beanstalk & CloudFormation?**

* Elastic Beanstalk automatically handles the deployment, from capacity provisioning, load balancing, auto-scaling to application health monitoring based on the code you upload to it, where as CloudFormation is an automated provisioning engine designed to deploy entire cloud environments via a JSON script.

**11. Which AWS service uses a CDN to distribute content around the world?**

* CloudFront

**12. Which of the following AWS solutions offers durable, available storage for flat files?**

* S3

**13. Which of the following AWS services would be the best choice for long term data archival?**

* Glacier

**14. Which AWS service offers the following database engines: SQL, MySQL, MariaDB, PostgreSQL, Aurora, and Oracle?**

* RDS

**15. Which of the following AWS services is used primarily for data warehousing?**

* Redshift

**16. Which AWS service is used for collating large amounts of data streamed from multiple sources?**

* Kinesis

**17. You need to add users to your AWS account and set password rotation policies for these new users. Which AWS service would best fit your requirements?**

* IAM

**18. You need to supply auditors with logs detailing the individual users that provision specific resources on your AWS platform. Which service would best meet this need?**

* CloudTrail

**19. You need a configuration management service that enables your system administrators to configure and operate your web applications using Chef. Which AWS service would best suit your needs?**

* Opsworks

**20. Your digital media agency needs to convert their media files in to different formats to suit different devices. Which AWS service should you consider using to meet these needs?**

* Elastic Transcoder

**Section 3: Identity Access Management (IAM)**

This section will cover an in-depth overview on the IAM service.

**IAM Overview**

* Centralized control of your AWS account
* Shared Access to your AWS account
* Identity Federation (including Active Directory, Facebook, LinkedIn, etc.)
* Multifactor Authentication
* Provide temporary access for users/devices and services where necessary
* Allows you to set up your own password rotation policy
* Integrates with many different AWS services
* Supports PCI DSS Compliance

**Critical Terms**

* Users - End Users
* Groups - A collection of users under one set of permissions
* Roles - You create roles and can then assign them to AWS resources
* Policies - A document that defines one (or more permissions)

**IAM - Lab**

* IAM does not have a region as it is global Steps to set up IAM on AWS are as follows:

1. Delete root access keys
2. Activate MFA on root account
3. Create individual IAM users
4. Use groups to assign permissions
5. Apply an IAM password policy

* IAM roles are a secure way to grant permissions to entities that you trust.

**Create a Billing Alarm - Lab**

* We can create a billing alarm by navigating to CloudWatch and configuring alarms for billing

**What Have We Learned?**

* IAM consists of the following:

1. Users
2. Groups
3. Roles
4. Policy Documents

* IAM is universal, it does not apply to regions at this time
* The "root account" is simply the account created on AWS account setup. This account has complete Admin access
* New users have no permissions when first created
* New users are assigned Access Key ID and Secret Access Keys when first created
* Access Key ID & Secret Access Keys are not the same as a password and you cannot use them to login to the console. You can use these keys to access AWS via the APIs and CLI however
* You only get to view the Access Key ID & Secret Access Keys once. If lost will need to be regenerated.
* Always setup MFA (Multifactor Authentication) on the root account
* It is possible to create and customize the password rotation policies

**Section 3 Quiz**

**1. Which statement best describes IAM**

* IAM Allows you to manage users, groups, roles, and their corresponding level of access to the AWS platform

**2. Which of the following is NOT a feature of IAM?**

* Allows you to set biometric authentication, so that no passwords are required

**3. Power User Access allows \_\_\_**

* Access to all AWS services except for management of groups and users within IAM

**4. What level of access does the "root" account have?**

* Administrator Access

**5. You are a solutions architect working for a large engineering company who are moving their existing legacy hardware to AWS. You have configured their first AWS account and you have set up IAM. Your company will be primarily based out of West Germany, however they will have a small subsidiary operating out of South Korea and you will need an AWS environment configured there as well. Which of the following statements is true;**

* You will need to configure Users and Policy Documents only once, as these are applied globally

**6. You have a client who is considering moving to AWS services and do not yet have an account. What is the first thing the company should do to set up an AWS Account?**

* Set up an account using their company email address

**7. You are a security administrator working for a hotel chain. You have a new member of staff who has started as a systems administrator and they will need full access to the AWS console. You have created the user account and generated the access key id and the secret access key. You have moved this user into the group where the other administrators are and you have provided the new user with their secret access key and their access key id. However when they go to log in to the AWS console, they cannot sign in. What could be the cause of this?**

* You cannot log in to the AWS console using the Access Key ID and Secret Access Key, instead you must generate a password for the user and supply the user with this password, as well as the unique link to sign in to the AWS console

**8. What is an additional way to secure IAM for both the root login and new users alike?**

* Implement MFA for all accounts

**9. By default when you create a new user in the IAM console, what level of access do they have?**

* No access to all AWS services

**10. In what language are policy documents written in?**

* JSON

**Section 4: AWS Object Storage and CDN - S3, Glacier and CloudFront**

This section will cover an in-depth overview on the S3 (Simple Storage Service) service.

**What is S3?**

* S3 provides developers and IT teams with secure, durable, highly-scalable object storage. Amazon S3 is easy to use, with a simple web services interface to store and retrieve any amount of data from anywhere on the web
* S3 is a safe place to store your files
* S3 is an object-based storage
* The data is spread across multiple devices and facilities

**S3 - The Basics**

* S3 is Object-based - i.e. allows you to upload files
* Files can be from 0 Bytes to 5 TB
* There is unlimited storage
* Files are stored in Buckets
* S3 is a universal namespace - names must be unique globally
* URLs look like <https://s3-eu-west-1.amazonaws.com/>
* When you upload a file to S3 you will receive a HTTP 200 code if the upload was successful

**Data Consistency Model for S3**

* Read after Write consistency for PUTS of new Objects
* Eventual Consistency for overwrite PUTS and DELETES (can take some time to propagate)

**S3 is a Simple Key-value Store**

Objects consist of the following:

* Key (this is the name of the object)
* Value (this is the data and is made up of a sequence of bytes)
* Version ID (important for versioning)
* Metadata (Data about data you are storing)
* Sub resources:
  + Access Control Lists
  + Torrent

**S3 - The Basics (Continued)**

* Built for 99.99% availability for the S3 platform.
* Amazon guarantee 99.9% availability
* Amazon guarantee 99.99999999999% durability for S3 information (11 x 9s)
* Tiered storage available
* Lifecycle Management
* Versioning
* Encryption
* Secure your data using Access Control Lists and Bucket Policies

**S3 - Storage Tiers/Classes**

* S3 Standard: 99.99% availability, 99.9999999999% durability, stored redundantly across multiple devices in multiple facilities, and is designed to sustain the loss of 2 facilities concurrently
* S3 - IA: (Infrequently Accessed): For data that is accessed less frequently, but requires rapid access when needed. Lower fee than S3 but you are charged a retrieval fee
* S3 One Zone - IA: Want a lower-cost option for infrequently accessed data but do not require the multiple AZ data resilience
* Glacier: Very cheap but used for archival only. Expedited, Standard or Bulk. A standard retrieval time takes 3-5 hours

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**Figure 4-1. S3 Storage classes and info**

**S3 - Charges**

In S3, we are charged for:

* Storage
* Requests
* Storage Management Pricing
* Data Transfer Pricing
* Transfer Acceleration

**What is S3 Transfer Acceleration?**

AWS S3 Transfer Acceleration enables fast, easy, and secure transfers of files over long distances between your end users and an S3 bucket. Transfer Acceleration takes advantage of AWS CloudFront's globally distributed edge locations. As the data arrives at an edge location, data is routed to AWS S3 over an optimized network path.

**Create and S3 Bucket - Exam Tips**

* Buckets are a universal name space
* Upload an object to S3 receives a HTTP 200 code on success
* S3, S3-IA, S3 Reduced Redundancy Storage
* Encryption
  + Client Side Encryption
  + Server Side Encryption
    - Server side encryption with Amazon S3 Managed Keys (SSE-S3)
    - Server side encryption with KMS (SSE-KMS)
    - Server side encryption with Customer Provided Keys (SSE-C)
* Control access to buckets using either a bucket ACL or using Bucket Policies
* **By default buckets are private and all objects stored inside them are private**

**S3 - Versioning Exam Tips**

* Stores all versions of an object (including all writes and even if you delete an object)
* Great backup tool
* Once enabled, versioning cannot be disabled, only suspended
* Integrates with Lifecycle rules
* Versioning's MFA Delete capability, which uses multi-factor authentication, can be used to provide an additional layer of security

**S3 - Cross Region Replication Exam Tips**

* Versioning must be enabled on both the source and destination buckets
* Regions must be unique
* Files in an existing bucket are not replicated automatically. All subsequent updated files will be replicated automatically
* You cannot replicate to multiple buckets or use daisy chaining
* Delete markers are replicated
* Deleting individual versions or delete markers will not be replicated
* Understand what Cross Region Replication is at a high level

**S3 - Lifecycle Management Lab**

* Can be used in conjunction with versioning
* Can be applied to current versions and previous versions
* Following actions can now be done:
  + Transition to the Standard - Infrequent Access Storage Class (30 days after creation date)
  + Archive to the Glacier Storage Class (30 days after IA)
  + Permanently Delete

**What is a CDN?**

A CDN (content delivery network) is a system of distributed servers (network) that delivers webpages and other web content to a user based on the geographic locations of the user, the origin of the webpage and a content delivery server.

**CloudFront - Key Terms**

* Edge Location - The location where content will be cached. This is separate to an AWS region/AZ
* Origin - The origin of all the files that the CDN will distribute. This can be either an S3 Bucket, an EC2 Instance, and Elastic Load Balancer or Route 53
* Distribution - The name given the CDN which consists of a collection of Edge Locations

**What is CloudFront?**

Amazon CloudFront can be used to deliver your entire website, including dynamic, static, streaming, and interactive content using a global network of edge locations. Requests for your content are automatically routed to the nearest edge location, so content is delivered with the best possible performance.

Amazon CloudFront is optimized to work with other services such as S3, EC2, Elastic Load Balancing, and Route 53. CloudFront also works seamlessly with any non-AWS origin server, which stores the original, definitive versions of your files.

**CloudFront - Key Terms (Continued)**

* Web Distribution - Typically used for websites
* RTMP - Used for media streaming

**CloudFont - Exam Tips**

* Understand the key terms: Edge Location, Origin, Distribution, Web Distribution, and RTMP
* Edge locations are not just READ only, you can write to them too
* Objects are cached for the life of the TTL (time to live)
* You can clear cached objects but you will be charged

**Securing your buckets**

* By default, all newly created buckets are **private**
* You can setup access control to your buckets using:
  + Bucket Policies
  + Access Control Lists
* S3 buckets can be configured to create access logs which log all requests made to the S3 bucket. This can be done to another bucket

**Encryption**

There are four types of Encryption for S3:

* In transit:
  + SSL/TLS
* At rest:
  + Server Side Encryption
    - S3 Managed Keys - SSE-S3
    - AWS Key Managed Service, Managed Keys - SSE-KMS
    - Server Side Encryption with Customer Provided Keys - SSE-C
  + Client Side Encryption

**Storage Gateway**

AWS Storage Gateway is a service that connects an on-premises software appliance with cloud-based storage to provide seamless and secure integration between an organization's on-premises IT environment and AWS's storage infrastructure. The service enables you to securely store data to the AWS cloud for scalable and cost-effective storage.

AWS Storage Gateway's software appliance is available for download as a VM (virtual machine) image that you install on a host in your data center. Storage Gateway supports either VMware ESXi or Microsoft Hyper-V. Once you've installed your gateway and associated it with your AWS account through the activation process, you can use the AWS Management Console to create the storage gateway option that is right for you.

**Four Types of Storage Gateways**

* File Gateways (NFS)
* Volumes Gateway (iSCSI)
  + Stored Volumes
  + Cached Volumes
* Tape Gateway (VTL)

**File Gateway**

Files are stored as objects in your S3 buckets, accessed through a Network File System (NFS) mount point. Ownership, permissions, and timestamps are durably stored in S3 in the user-metadata of the object associated with the file. Once objects are transferred to S3, they can be managed as native S3 objects, and bucket policies such as versioning, lifecycle management, and cross-region replication apply directly to objects stored in your bucket.

[![A screenshot of a cell phone

Description automatically generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RDgRXhpZgAATU0AKgAAAAgABAE7AAIAAAAHAAAISodpAAQAAAABAAAIUpydAAEAAAAOAAAQyuocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAFN0ZXZlbgAAAAWQAwACAAAAFAAAEKCQBAACAAAAFAAAELSSkQACAAAAAzk3AACSkgACAAAAAzk3AADqHAAHAAAIDAAACJQAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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**Figure 4-2. Sample S3 file gateway architecture**

**Volume Gateway**

The volume interface presents your applications with disk volumes using the iSCSI block protocol

Data written to these volumes can be asynchronously backed up as point-in-time snapshots of your volumes, and stored in the cloud as Amazon EBS snapshots.

Snapshots are incremental backups that capture only changed blocks. All snapshot storage is also compressed to minimize your storage charges.

**Volume Gateway - Stored Volumes**

Stored volumes let your primary data locally, while asynchronously backing up that data to AWS. Stored volumes provide your on-premises applications with low-latency access to their entire datasets, while providing durable, off-site backups. You can create storage volumes and mount them as iSCSI devices from your on-premises application servers. Data written to your stored volumes is stored on your on-premises storage hardware. This data is asynchronously backed up to S3 in the form of EBS (Amazon Elastic Block Store) snapshots. 1GB - 16 TB in size for Stored Volumes.

[![A screenshot of a cell phone

Description automatically generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RDgRXhpZgAATU0AKgAAAAgABAE7AAIAAAAHAAAISodpAAQAAAABAAAIUpydAAEAAAAOAAAQyuocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAFN0ZXZlbgAAAAWQAwACAAAAFAAAEKCQBAACAAAAFAAAELSSkQACAAAAAzAyAACSkgACAAAAAzAyAADqHAAHAAAIDAAACJQAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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**Figure 4-3. Sample S3 volume gateway stored volumes architecture**

**Volume Gateway - Cached Volumes**

Cached volumes let you use S3 as your primary data storage while retaining frequently access data locally in your storage gateway. Cached volumes minimize the need to scale your on-premises storage infrastructure, while still providing your applications with low-latency access to their frequently accessed data. You can create storage volumes up to 32 TB in size and attached to them as iSCSI devices from your on-premises application servers. Your gateway stores data that you write to these volumes in S3 and retains recently read data in your on-premises storage gateway's cache and upload buffer storage. 1 GB - 32 TB in size for Cache Volumes

[![A screenshot of a cell phone

Description automatically 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ABk/wo/wCEb0P/AKA9h/4DJ/hWjuo3UAZ3/CN6H/0B7D/wGT/Cl/4RzRP+gPYf+Ayf4VobqN1AGf8A8I5on/QHsP8AwGT/AApP+Eb0P/oD2H/gMn+FaO6jdQBnf8I3of8A0B7D/wABk/wo/wCEb0P/AKA9h/4DJ/hWjuo3UAZ3/CN6H/0B7D/wGT/Cj/hG9D/6A9h/4DJ/hWjuo3UAZ3/CN6H/ANAew/8AAZP8KP8AhG9D/wCgPYf+Ayf4Vo7qN1AGd/wjeh/9Aaw/8Bk/wo/4RvQ/+gPYf+Ayf4Vo7qN1AGYfDGhmRXGk2QK9MQKP6VpxxrEgSJVRQMBQMAUbqN1ADqSk3UbqAFxRik3UbqAFxRik3UbqAFxRik3UbqAFxRik3UbqAFxRik3UbqAFxRik3UbqAFxRik3UbqAFxRik3UbqAFxRik3UbqAFxRik3UbqAFxRik3UbqAFxRik3UbqAFxRik3UbqAFxRik3UbqAFxRik3UbqAFxRik3UbqAFxRik3UbqAFxRik3UbqAFxRik3UbqAFxRik3UbqAFxRik3UbqAHUo6UzdShuKAKolwOc0ecPeiigA84e9HnD3oooAPOHvR5w96KKAF83PrQZDRRQAeYaPMNFFAB5ho8w0UUAHmGjzDRRQAeYaPMNFFAB5ho8w0UUAHmGjzDRRQAeYaPMNFFAB5ho8w0UUAHmGjzDRRQAeYaPMNFFAB5ho8w0UUAHmGjzDRRQAeYaPMNFFAB5ho8w0UUAHmGjzDRRQAeYaPMNFFAB5ho8w0UUAHmGjzDRRQAeYaPMNFFAB5ho8w0UUAHmGjzDRRQAeYaPMNFFAB5ho8w0UUAHmGjzDRRQAeYaPMNFFAB5ho8w0UUAHmGjzDRRQAeYaPMNFFAB5ho8w0UUAHmGjzDRRQAeYaPMNFFAB5ho8w0UUAHmGjzDRRQAeYaPMNFFAB5ho8w0UUAHmGjzDRRQAeYaPMNFFAB5ho8w0UUAHmGjzDRRQAeYaPMNFFAB5ho8w0UUAHmGjzDRRQAeYaPMNFFAB5ho8w0UUAHmGjzDRRQAeYaPMNFFAB5ho8w0UUAHmGjzDRRQAeYaPMNFFAB5ho8w0UUAHmGjzDRRQAeYaPMNFFAB5ho8w0UUAHmGjzDRRQAeYaPMNFFAB5ho8w0UUAHmGjzDRRQAeYaPMNFFAB5lOEnFFFAH//Z)](https://github.com/stevenxchung/AWS-CSAA-ACloudGuru/blob/master/Section%2004%20--%20AWS%20Object%20Storage%20and%20CDN%20-%20S3,%20Glacier%20and%20CloudFront/volume-gateway-cached-volumes.jpg)

**Figure 4-4. Sample S3 volume gateway cached volume architecture**

**Volume Gateway - Tape Gateway**

Tape Gateway offers a durable, cost-effective solution to archive your data in the AWS Cloud. The VTL interface it provides lets your leverage your existing tape-based backup application infrastructure to store data on virtual tape cartridges that you create on your tape gateway. Each tape gateway is preconfigured with a media changer and tape drives, which are available to your existing client backup applications as ISCSI devices. You add tape cartridges as your need to archive your data. Supported by NetBackup, Backup Exec, Veeam etc.

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Description automatically generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RDgRXhpZgAATU0AKgAAAAgABAE7AAIAAAAHAAAISodpAAQAAAABAAAIUpydAAEAAAAOAAAQyuocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAFN0ZXZlbgAAAAWQAwACAAAAFAAAEKCQBAACAAAAFAAAELSSkQACAAAAAzkzAACSkgACAAAAAzkzAADqHAAHAAAIDAAACJQAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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0oNABijFLQaAExRikyaXJoAMUYpaKAExRijJpMmgBcUYpRRQAmKMUE0mTQAuKMUCloATFGKDSZNAC4oxQDS0AJijFKabk0ALijFJk06gBMUYpaTJoAMUYpMmnDpQAmKMUtITQAYoxSZNKKADFGKWkNABijFJk0oPNABijFLQaAExRikyaMmgBcUYoyaWgBMUYpabk0ALijFJk06gApD1oooASlFFFAC0h6UUUAJQOtFFADqD0oooAbRRRQA6iiigBp60UUUAOHSiiigBD1pKKKAFFLRRQAh6UlFFAAOtOoooAKbRRQAU6iigApp60UUAFKOlFFAC0hoooASlFFFAC0h6UUUAJQOtFFADqKKKAG0UUUAOooooAaetFFFACjpS0UUAIaSiigBR1paKKAA9KbRRQADrTqKKACm0UUAFOHSiigApp60UUAFKKKKAFpDRRQAlKOtFFAC0HpRRQA2iiigB1FFFADaKKKAHDpRRRQAh60lFFACiloooAQ0lFFACjrS0UUAB6U2iigAp1FFABTT1oooAKcOlFFABSHrRRQAlKKKKAFpD0oooASgdaKKAHUHpRRQA2iiigAHWnUUUAFNoooAKdRRQB//9k=)](https://github.com/stevenxchung/AWS-CSAA-ACloudGuru/blob/master/Section%2004%20--%20AWS%20Object%20Storage%20and%20CDN%20-%20S3,%20Glacier%20and%20CloudFront/volume-gateway-tape-gateway.jpg)

**Figure 4-5. Sample S3 volume gateway tape gateway architecture**

**Storage Gateway - Exam Tips**

* File Gateway - For flat files, stored directly on S3
* Volume Gateway:
  + Stored Volumes - Entire dataset is stored on site and is asynchronously backed up to S3
  + Cached Volumes - Entire dataset is stored on S3 and the most frequently accessed data is cached on site
* Gateway Virtual Tape Library (VTL)
  + Used for backup and uses popular backup applications like NetBackup, Backup Exec, Veeam etc.

**Import/Export Disk**

AWS Import/Export Disk accelerates moving large amounts of data into and out of the AWS cloud using portable storage devices for transport. AWS Import/Export Disk transfers your data directly onto and off of storage devices using Amazon's high-speed internal network and bypassing the Internet.

**Types of Snowballs**

* Snowball
* Snowball Edge
* Snowmobile

**Snowball**

* Snowball is a petabyte-scale data transport solution that uses secure appliances to transfer large amounts of data into and out of AWS. Using Snowball addresses common challenges with large-scale data transfers including high network costs, long transfer times, and security concerns. Transferring data with Snowball is simple, fast, secure, and can be as little as one-fifth the cost of high-speed Internet.

80 TB snowball in all regions. Snowball uses multiple layers of security designed to protect your data including tamper-resistant enclosures, 256-bit encryption, and an industry-standard Trusted Platform Module (TPM) designed to ensure both security and full chain-of-custody of your data. Once the data transfer job has been processed and verified, AWS performs a software erasure of the Snowball appliance.

**Snowball Edge**

AWS Snowball Edge is a 100 TB data transfer device with on-board storage and compute capabilities. You can use Snowball Edge to move large amounts of data into and out of AWS, as a temporary storage tier for large local datasets, or to support local workloads in remote or offline locations.

Snowball Edge connects to your existing applications and infrastructure using standard storage interfaces, streamlining the data transfer process and minimizing setup and integration. Snowball Edge can cluster together to form a local storage tier and process your data on-premises, helping ensure your applications continue to run even when they are not able to access the cloud.

**Snowmobile**

AWS Snowmobile is an Exabyte-scale data transfer service used to move extremely large amounts of data to AWS. You can transfer up to 100 PB per Snowmobile, a 45-foot long ruggedized shipping container, pulled by a semi-trailer truck. Snowmobile makes it easy to move massive volumes of data to the cloud, including video libraries, image repositories, or even a complete data center migration. Transferring data with Snowmobile is secure, fast, and cost effective.

**Snowball - Exam Tips**

* Understand what Snowball is
* Understand what Import/Export is
* Snowball can:
  + Import to S3
  + Export to S3

**What is S3 Transfer Acceleration?**

S3 Transfer Acceleration utilizes the CloudFront Edge Network to accelerate your uploads to S3. Instead of uploading directly to your S3 bucket, you can use a distinct URL to upload directly to an edge location which will then transfer that file to S3. You will get a distinct URL to upload to.

**Summary**

* Know the core fundamentals of S3:
  + Key (name)
  + Value (data)
  + Version ID
  + Metadata
  + Access control lists
* Object based storage only (for files)
* **Not suitable to install an operating system on**
* Remember that S3 is Object based i.e. allows you to upload files
* Files can be from 0 bytes to 5 TB
* There is unlimited storage
* Files are stored in buckets
* S3 is a universal namespace, that is, names must be unique globally
* Sample URL: <https://s3-eu-west-1.amazonaws.com/>
* Read after Write consistency for PUTS of new Objects
* Eventual Consistency for overwrite PUTS and DELETES (can take some time to propagate)

**Summary - S3 Storage Tiers/Classes**

* Know the different storage tiers/classes:
  + S3 Standard
  + S3-IA
  + S3 One Zone-IA
  + Glacier

**Summary - S3 Versioning**

* Stores all versions of an object (including all writes and even if you delete an object)
* Great backup tool
* Once enabled, cannot be disabled, only suspended
* Integrates with Lifecycle rules
* Versioning's MFA Delete capability, which uses multi-factor authentication, can be used to provide an additional layer of security
* Cross Region Replication, requires versioning enabled on the source bucket

**Summary - S3 Lifecycle Management**

* Can be used in conjunction with versioning
* Can be applied to current versions and previous versions
* Following actions can now be done:
  + Transition to the Standard - Infrequent Access Storage Class (128 Kb and 30 days after the creation date)
  + Archive to the Glacier Storage Class (30 days after IA, if relevant)
  + Permanently Delete

**Summary - CloudFront**

* Edge Location - This is the location where content will be cached. This is separate to an AWS AZ
* Origin - This is the origin of all the files that the CDN will distribute. This can be either an S3 Bucket, an EC2 Instance, an Elastic Load Balancer or Route 53
* Distribution - This is the name given the CDN which consists of a collection of Edge Locations. There are different types:
  + Web Distribution - Typically used for websites
  + RTMP - Used for media streaming
* Edge locations are not just READ only, you can write to them too
* Objects are cached for the life of the TTL (Time to Live)
* You can clear cached objects but you will be charged

**Summary - Securing your buckets**

* By default, all newly created buckets are PRIVATE
* You can setup access control to your buckets using:
  + Bucket Policies
  + Access Control Lists
* S3 buckets can be configured to create access logs which log all requests made to the S3 bucket. This can be done to another bucket

**Summary - Encryption**

* In Transit:
  + SSL/TLS
* At Rest:
  + Server Side Encryption
    - S3 Managed Keys - SSE-S3
    - AWS Key Management Service, Managed Keys - SSE-KMS
    - Server Side Encryption with Customer Provided Keys - SSE-C
  + Client Side Encryption

**Summary - Storage Gateway**

* File Gateway - For flat files, stored directly on S3
* Volume Gateway:
  + Stored Volumes - Entire dataset is stored on site and is asynchronously backed up to S3
  + Cached Volumes - Entire dataset is stored on S3 and the most frequently accessed data is cached on site
* Gateway Virtual Tape Library (VTL)
  + Used for backup and uses popular backup applications like NetBackup, Backup Exec, Veeam etc.

**Summary - Snowball**

Types of snowball:

* Snowball
* Snowball Edge
* Snowmobile

**Summary - S3 Transfer Acceleration**

* You can speed up transfers to S3 using S3 transfer acceleration. This costs extra and has the greatest impact on people who are in a faraway location

**S3 Static Websites**

* You can use S3 to host static websites
* Serverless
* Very cheap, scales automatically
* STATIC only, cannot host dynamic sites

**Summary - Last Few Tips**

* Write to S3 - HTTP 200 code for a successful write
* You can load files to S3 much faster by enabling multipart upload
* Read the S3 FAQ before taking the exam. It comes up A LOT!

**Section 4 Quiz**

**1. S3 has what consistency model for PUTS of new objects**

* Read After Write Consistency

**2. What is AWS Storage Gateway?** It's an on-premise virtual appliance that can be used to cache S3 locally at a customer’s site

**3. One of your users is trying to upload a 7.5GB file to S3 however they keep getting the following error message - "Your proposed upload exceeds the maximum allowed object size.” What is a possible solution for this?**

* Design your application to use the multi-part upload API for all objects

**4. What does RRS stand for when talking about S3?**

* Reduced Redundancy Storage

**5. You have been asked by your company to create an S3 bucket with the name "acloudguru1234" in the EU West region. What would be the URL for this bucket?**

* <https://s3-eu-west-1.amazonaws.com/acloudguru1234>

**6. What is Amazon Glacier?**

* An AWS service designed for long term data archival

**7. What does S3 stand for?**

* Simple Storage Service

**8. You are a solutions architect who works with a large digital media company. The company has decided that they want to operate within the Japanese region and they need a bucket called "testbucket" set up immediately to test their web application on. You log in to the AWS console and try to create this bucket in the Japanese region however you are told that the bucket name is already taken. What should you do to resolve this?**

* Bucket names are global, not regional. This is a popular bucket name and is already taken. You should choose another bucket name

**9. What is the availability on RRS?**

* 99.99%

**10. What is the durability on RRS?**

* 99.99%

**11. What is the durability on S3?**

* 99.999999999%

**12. What is the availability on S3?**

* 99.99%

**13. What is the minimum file size that I can store on S3?**

* 0 bytes

\*\*14. The difference between S3 and EBS is that EBS is object based where as S3 is block based.

* False

**15. S3 has eventual consistency for which HTTP Methods?**

* Overwrite PUTS and Deletes

**16. You work for a busy digital marketing company who currently store their data on premise. They are looking to migrate to AWS S3 and to store their data in buckets. Each bucket will be named after their individual customers, followed by a random series of letters and numbers. Once written to S3 the data is rarely changed, as it has already been sent to the end customer for them to use as they see fit. However on some occasions, customers may need certain files updated quickly, and this may be for work that has been done months or even years ago. You would need to be able to access this data immediately to make changes in that case, but you must also keep your storage costs extremely low. The data is not easily reproducible if lost. Which S3 storage class should you choose to minimize costs and to maximize retrieval times?**

* S3-IA

**17. You need to use an Object based storage solution to store your critical, non-replaceable data in a cost effective way. This data will be frequently updated and will need some form of version control enabled on it. Which S3 storage solution should you use?**

* S3

**18. You work for a health insurance company who collects large amounts of documents regarding patients’ health records. This data will be used usually only once when assessing a customer and will then need to be securely stored for a period of 7 years. In some rare cases you may need to retrieve this data within 24 hours of a claim being lodged. Which storage solution would best suit this scenario? You need to keep your costs as low as possible.**

* Glacier

**19. You run a meme creation website that frequently generates meme images. The original images are stored in S3 and the meta data about the memes are stored in DynamoDB. You need to store the memes themselves in a low cost storage solution. If an object is lost, you have created a Lambda function that will automatically recreate this meme using the original file in S3 and the metadata in DynamoDB. Which storage solution should you consider to store this non-critical, easily reproducible data on in the most cost effective solution as possible?**

* S3-RRS

**20. You run a popular photo sharing website that is based off S3. You generate revenue from your website via paid for adverts, however you have discovered that other websites are linking directly to the images on your site, and not to the HTML pages that serve the content. This means that people are not seeing your adverts and every time a request is made to S3 to serve an image it is costing your business money. How could you resolve this issue?**

* Remove the ability for images to be served publicly to the site and then use signed URLs with expiry dates

**Section 5: EC2 - The Backbone of AWS**

This section will cover an in-depth overview on the AWS Elastic Compute Cloud (EC2) service.

**What is EC2?**

Amazon EC2 (Elastic Cloud Compute) is a web service that provides resizable compute capacity in the cloud. Amazon EC2 reduces the time required to obtain and boot new server instances to minutes, allowing you to quickly scale capacity, both up and down, as your computing requirements change.

EC2 changes the economics of computing by allowing you to pay only for capacity that you actually use. EC2 provides developers the tools to build failure resilient applications and isolate themselves from common failure scenarios.

**EC2 Options**

* On Demand - Allows you to pay a fixed rate by the hour (or by the second) with no commitment
* Reserved - Provides you with a capacity reservation and offers a significant discount on the hourly charge for an instance. 1 year or 3 year terms
* Spot - Enables you to bid whatever price you want for instance capacity, providing for even greater savings if your applications have flexible start and end times
* Dedicated Hosts - Physical EC2 server dedicated for you use. Dedicated Hosts can help you reduce costs by allowing you to use your existing server-bound software licenses

**On Demand**

* Perfect for users that want the low cost and flexibility of EC2 without any up-front payment or long-term commitment
* Applications with short term, spiky, or unpredictable workloads that cannot be interrupted
* Applications being developed or tested on EC2 for the first time

**Reserved**

* Applications with steady state or predictable usage
* Applications that require reserved capacity
* Users can make up-front payments to reduce their total computing costs even further
  + Standard RIs (up to 75% off on-demand)
  + Convertible RIs (up to 54% off on-demand) feature the capability to change the attributes of the RI as long as the exchange results in the creation of Reserved Instances of equal or greater value
  + Schedule RIs are available to launch within the time window you reserve. This option allows you to match your capacity reservation to a predictable recurring schedule that only requires a fraction of a day, week, or month

**Spot**

* Applications that have flexible start and end times
* Applications that are only feasible at very low compute prices
* Users with an urgent need for large amounts of additional computing capacity

**Dedicated Hosts**

* Useful for regulatory requirements that may not support multi-tenant virtualization
* Great for licensing which does not support multi-tenancy or cloud deployments
* Can be purchased on-demand (hourly)
* Can be purchased as a Reservation for up to 70% off the on-demand price

**EC2 Instance Types**

[![A screenshot of a cell phone

Description automatically generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RDgRXhpZgAATU0AKgAAAAgABAE7AAIAAAAHAAAISodpAAQAAAABAAAIUpydAAEAAAAOAAAQyuocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAFN0ZXZlbgAAAAWQAwACAAAAFAAAEKCQBAACAAAAFAAAELSSkQACAAAAAzkzAACSkgACAAAAAzkzAADqHAAHAAAIDAAACJQAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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**Figure 5-1. EC2 instance types, specialties and use cases**

**What is EBS?**

Amazon EBS (Elastic Block Storage) allows you to create storage volumes and attach them to EC2 instances. Once attached, you can create a file system on top of these volumes, run a database, or use them in any other way you would use a block device. EBS volumes are placed in a specific AZ where they are automatically replicated to protect you from the failure of a single component.

**EBS Volume Types**

* General Purpose SSD (GP2)
  + General purpose, balances both price and performance
  + Ratio of IOPS per GB with up to 10,000 IOPS and the ability to burst up to 300 IOPS for extended periods of time for volumes at 3334 GB and above
* Provisioned IOPS SSD (101)
  + Designed for I/O intensive applications such as large relational or NoSQL databases
  + Use if you need more than 10,000 IOPS
  + Can provision up to 20,000 IOPS per volume
* Throughput Optimized HDD (ST1)
  + Big data
  + Data warehouses
  + Log processing
  + Cannot be a boot volume
* Cold HDD (SC1)
  + Lowest cost storage for infrequently accessed workloads
  + File server
  + Cannot be a boot volume
* Magnetic (Standard)
* Lowest cost per GB of all EBS volume types that is bootable. Magnetic volumes are ideal for workloads where data is accessed infrequently, and applications where the lowest storage cost is important

**EC2 Exam Tips**

* Know On-Demand, Reserved, Spot, and Dedicated Host EC2 services
* If a Spot instance is terminated by EC2, you will not be charged for a partial hour of usage. However, if you terminate the instance yourself, you will be charged for the complete hour in which the instance ran
* Know FIGHT DR MC PX acronym (EC2 instance types, specialties and use cases)
* SSD:
  + General Purpose SSD - Balance price and performance for a wide variety of workloads
  + Provisioned IOPS SSD - Highest performance SSD volume for mission-critical low-latency or high-throughput workloads
* Magnetic:
  + Throughput Optimized HDD - Low cost HDD volume designed for frequently accessed, throughput-intensive workloads
  + Cold HDD - Lowest cost HDD volume designed for less frequently accessed workloads
  + Magnetic - Previous generation. Can be boot volume

**EC2 Lab Summary**

* Termination Protection is turned off by default, you must turn it on
* On an EBS-backed instance, the default action is for the root EBS volume to be deleted when the instance is terminated
* EBS root volumes of your DEFAULT AMI's cannot be encrypted. You can also use a third party tool (such as bit locker) to encrypt the root volume, or this can be done when creating AMI's in the AWS console or using the API

**Security Group Basics**

* All inbound traffic is blocked by default
* All outbound traffic is allowed
* Changes to security groups take effect immediately
* You can have any number of EC2 instances within a security group
* You can have multiple security groups attached to EC2 instances
* Security groups are STATEFUL (network access control lists are STATELESS):
  + If you create an inbound rule allowing traffic in, that traffic is automatically allowed back out again
* You cannot block specific IP addresses using security groups, instead use Network Access Control Lists
* You can specify allow rules but not deny rules

**Volumes and Snapshots**

* Volumes exist on EBS:
  + Virtual Hard Disk
* Snapshots exist on S3
* Snapshots are point in time copies of volumes
* Snapshots are incremental - this means that only the blocks that have changed since your last snapshot are moved to S3

**Snapshots of Root Device Volumes**

* To create a snapshot for EBS volumes that serve as root devices, you should stop the instance before taking the snapshot
* However, you can take while the instance is running
* You can create AMI's from EBS-backed instances and snapshots
* You can change EBS volume sizes on the fly, including changing the size and storage type
* Volumes will ALWAYS be in the same AZ as the EC2 instance
* To move an EC2 volume from one AZ/Region to another, take a snap or an image of it, then copy it to the new AZ/Region

**Volume vs Snapshots - Security**

* Snapshots of encrypted volumes are encrypted automatically
* Volumes restored from encrypted snapshots are encrypted automatically
* You can share snapshots, but only if they are unencrypted
  + These snapshots can be shared with other AWS accounts or made public

**RAID, Volumes and Snapshots**

* RAID - Redundant Array of Independent Disks
  + RAID 0 - Striped, No Redundancy, Good Performance
  + RAID 1 - Mirrored, Redundancy
  + RAID 5 - Good for reads, bad for writes, AWS does not recommend ever putting RAID 5's on EBS
  + RAID 10 - Striped and Mirrored, Good Redundancy, Good Performance

**Snapshots of a RAID array**

* Problem - Take a snapshot, the snapshot excludes data held in the cache by applications and the OS. This tends not to matter on a single volume, however using multiple volumes in a RAID array, this can be a problem due to interdependencies of the array
* Solution - Take an application consistent snapshot
  + Stop the application from writing to disk
  + Flush all caches to the disk
  + Ways to accomplish these tasks above:
    - Freeze the file system
    - Unmount the RAID array
    - Shutting down the associated EC2 instance

**EBS vs Instance Store**

* All AMIs are categorized as either backed by EBS or backed by instance store
* For EBS volumes - The root device for an instance launched from the AMI is an EBS volume created from an EBS snapshot
* For instance store volumes - The root device for an instance launched from the AMI is an instance store volume created from a template stored in S3

**EBS vs Instance Store - Exam Tips**

* Instance store volumes are sometimes called Ephemeral Storage
* Instance store volumes cannot be stopped. If the underlying host fails, you lose your data
* EBS backed instance can be stopped. You will not lose the data on this instance if it is stopped
* You can reboot both, you will not lose your data
* By default, both ROOT volumes will be deleted on termination, however with EBS volumes, you can tell AWS to keep the root device volume

**Types of Load Balancers**

Three types of load balancers:

* Application load balancer - Are best suited for load balancing of HTTP and HTTPS traffic. They operate at Layer 7 and are application-aware. They are intelligent, and you can create advanced request routing, sending specified requests to specific web servers
* Network load balancer - Are best suited for load balancing of TCP traffic where extreme performance is required. Operating at the connection level (Layer 4), network load balancers are capable of handling millions of requests per second, while maintaining ultra-low latencies. Use for extreme performance
* Classic load balancer - Are the legacy ELB (Elastic Load Balancers). You can load balance HTTP/HTTPS applications and use Layer 7-specific features, such as X-Forwarded and sticky sessions. You can also use strict Layer 4 load balancing for applications that rely purely on the TCP protocol

**Load Balancer Errors**

* Classic Load Balancers - If your application stops responding the ELB responds with a 504 error. This means that the application is having issues. This could be either at the Web Server layer or at the Database Layer. Identify where the application is failing and scale it up or out where possible

**ELB Exam Tips**

* 3 types of load balancers:
  + Application load balancers
  + Network load balancers
  + Classic load balancers
* 504 error means that the gateway has timed out. This means that the application not responding within the idle timeout period.
  + Trouble shoot the application. Is it the Web Server or Database Server?
* If you need the IPv4 address of your end user, look for the X-Forwarded-For-Header

**Elastic Load Balancers Lab**

* Instances monitored by ELB are reported as “In Service” or “Out of Service”
* Health Checks - Check the instance health by talking to it
* ELBs have their own DNS name. You are never given an IP address
* Read the ELB FAQ for Classic Load Balancers

**CloudWatch EC2 Lab**

* Standard Monitoring - 5 minute
* Detailed Monitoring - 1 minute
* What can I do with CloudWatch?
  + Dashboards - Create awesome dashboards to see what is happening with your AWS environment
  + Alarms - Allows you to set Alarms that notify you when particular thresholds are hit
  + Events - CloudWatch events helps you respond to state changes in your AWS resources
  + Logs - CloudWatch logs helps you aggregate, monitor, and store logs

**The AWS Command Line and EC2**

* When we configure AWS via command line we are actually storing credentials locally on the EC2 instance
* Using user credentials is not safe and storing them on EC2 instances is not recommended

**Using IAM roles with EC2**

* Roles help secure credentials in AWS EC2
* Remember that all roles are global so there is no need to create a new role in another Region

**S3 CLI and Regions**

* You can now actually attach a role to an EC2 instance via CLI or AWS console

**Using Bootstrap Scripts**

* Bash scripts are always passed in the Advanced Details tab
* We use #!/bin/bash to start the bash script
* Bash scripts allows us to automate our web servers

**EC2 Instance Metadata**

Instance metadata is data about your instance that you can use to configure or manage the running instance. Instance metadata is divided into categories.

Although you can only access instance metadata and user data from within the instance itself, the data is not protected by cryptographic methods. Anyone who can access the instance can view its metadata. Therefore, you should take suitable precautions to protect sensitive data (such as long-lived encryption keys). You should not store sensitive data, such as passwords, as user data.

You can also use instance metadata to access user data that you specified when launching your instance. For example, you can specify parameters for configuring your instance, or attach a simple script. You can also use this data to build more generic AMIs that can be modified by configuration files supplied at launch time. For example, if you run web servers for various small businesses, they can all use the same AMI and retrieve their content from the Amazon S3 bucket you specify in the user data at launch. To add a new customer at any time, simply create a bucket for the customer, add their content, and launch your AMI. If you launch more than one instance at the same time, the user data is available to all instances in that reservation.

EC2 instances can also include dynamic data, such as an instance identity document that is generated when the instance is launched.

For more information on EC2 instance metadata see the AWS EC2 guide on [Instance Metadata and User Data](https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/ec2-instance-metadata.html).

**Autoscaling Lab**

An important take away is that you can have instances spread across multiple AZs and even if you lose two of those AZ out of three you still won't have an outage. Route 53 can also help further protect from regional failure by detecting failure and redirecting traffic to other parts of the world.

**EC2 Placement Groups**

There are two types of placement groups:

* Clustered Placement Group - A grouping of instances within a single AZ. Placement groups are recommended for applications that need low network latency, high network throughput, or both. Only certain instances can be launched into a clustered placement group
* Spread Placement Group - A group of instances that are each placed on distinct underlying hardware. Spread placement groups are recommended for applications that have a small number of critical instances that should be kept separate from each other

Things to review before the exam:

* A clustered placement group can't span multiple AZ
* A spread placement group can span multiple AZ
* The name you specify for a placement group must be unique within your AWS account
* Only certain types of instances can be launched in a placement group (Compute Optimized, GPU, Memory Optimized, Storage Optimized)
* AWS recommend homogenous instances within placement groups
* You can't merge placement groups
* You can't move an existing instance into a placement group. You can create an AMI from your existing instance, and then launch a new instance from the AMU into a placement group

**What is EFS?**

Amazon EFS (Elastic File System) is a file storage service for Amazon EC2 instances. Amazon EFS is easy to use and provides a simple interface that allows you to create and configure file systems quickly and easily. With EFS, storage capacity is elastic, growing and shrinking automatically as you add and remove files, so your applications have the storage they need, when they need it.

**EFS Features**

* Supports the Network File System version 4 (NFSv4) protocol
* You only pay for the storage you use (no pre-provisioning required)
* Can scale up to the petabytes
* Can support thousands of concurrent NFS connections
* Data is stored across multiple AZ's within a region
* Read After Write Consistency

Use case for EFS:

* Using EFS as a file server or a central repository for your files within your EC2 instances
* Can set restrictions which will be reflected across all EC2 instances
* EFS allows multiple EC2 instances to connect to it whereas EBS can only mount to a single EC2 instance

**What is Lambda?**

AWS Lambda is a compute service where you can upload your code and create a Lambda function. AWS Lambda takes care of provisioning and managing the servers that you use to run the code. You don't have to worry about operating systems, patching, scaling, etc. You can use Lambda in the following ways:

* As an event-driven compute service where the AWS Lambda runs your code in response to events. These events could be changes to data in an Amazon S3 bucket or an Amazon DynamoDB table
* As a compute service to run your code in response to HTTP requests using Amazon API Gateway or API calls made using AWS SDKs

Lambda is an encapsulation of the following:

* Data Centers
* Hardware
* Assembly Code/Protocols
* High Level Languages
* Operating Systems
* Application Layer/AWS APIs
* AWS Lambda

**How is Lambda Priced?**

* Number of requests:
  + First 1 million requests are free. $0.20 per 1 million requests thereafter
* Duration:
  + Calculated from the time your code begins executing until it returns or otherwise terminates, rounded up to the nearest 100 ms. The price depends on the amount of memory you allocate to your function. You are charged $0.00001667 for every GB-second used

**Why is Lambda Cool?**

* No servers!
* Continuous scaling!
* Super cheap!

**Lambda - Exam Tips**

* Lambda scales out (not up) automatically
* Lambda functions are independent, 1 event = 1 function
* Lambda is serverless
* Know what services are serverless!
* Lambda function can trigger other lambda functions, 1 event can = x functions if functions trigger other functions
* Architectures can get extremely complicated, AWS X-ray allows you to debug what is happening
* Lambda can do things globally, you can use it to back up S3 buckets to other S3 buckets etc.
* Know triggers

**Build a Serverless Page**

Below is a schematic of how the lambda serverless website will work with Route 53, API Gateway, Lambda, and S3. The steps are as follows:

1. Get IP address
2. Route 53 returns IP address
3. Get web page from S3
4. Return static/dynamic content
5. Get request to API Gateway
6. Forward request to Lambda
7. Return data to user

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**Figure 5-2. Lambda serverless web schematic**

**Using Polly**

Below is a schematic of how Polly will be set up in AWS. Polly converts text into an MP3 file.

[![A screenshot of a cell phone

Description automatically generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RDgRXhpZgAATU0AKgAAAAgABAE7AAIAAAAHAAAISodpAAQAAAABAAAIUpydAAEAAAAOAAAQyuocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAFN0ZXZlbgAAAAWQAwACAAAAFAAAEKCQBAACAAAAFAAAELSSkQACAAAAAzMzAACSkgACAAAAAzMzAADqHAAHAAAIDAAACJQAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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ooAKKKKACiiigAra8Hf8j1oX/YRt//AEYtYtbXg7/ketC/7CNv/wCjFoA+4z1ooPWigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAqan9v/s2b+yPI+2YHlfaCdgOeScc9M15hL8VNd0TWZ7HX9KglSDzv31oGxL5UQLgE9MORz/dPtXrVNMaHqinr1HrQB5tD8Y4ZL6ys30K6E14UEZSQOmXbanzAdCwf/vmn618RdZ0TxRqcUmlQzaNZSpb/AGlm8oJI6xld0hJGPnbPy8YHrXooijGMRqNvTCjilaNGVgyKQ3UEdaAPN4/ileareQWWj6ZbwTXEkcQe8ucBGlgaRDgDH3lxjOTjoMiu90ldRXTIhrT273uT5ht1ITqcAZ56Yq15UYORGmcg/dHWn0AFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFcN4r8L6j9uGqaTcapdie6j+22MN55eYAuCsXI2nIQnkZAPPNdzRQB5fJF8S5LuaGzeaztd5CNIIJDGoDbApOS2QFDFudx44pt0/xWaRfJ8tI0nRSUSFmkQhmLYJHAJVCM5+Ukdanfxd4usPFeqyXOj3U2itKqWWLYttVJFSRsL8xyGZhkdF4rPg8Y+OdS1aF5NHuLOKOONmtord18wloScswI6NIMDkAHNIDc07T/G39qPJqWpXbR3FhcKERYRHbzbz5fAGfu4IPPPWk8Hjx5Hq9lH4hMxsVtQs5n8k5by15ynzF9+/PbbjvVjwrd+J/E08OqarM+kwWsu1rOO2ZFugUBOd/zDax28ddp9a7imAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQB41+0t/wAiLpf/AGER/wCi3r5nr6Y/aW/5EXS/+wiP/Rb18z0AFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUABooNFABRRRQAUUUUAFFFFABRRRQAUUUUAFbXg7/ketC/7CNv/wCjFrFpyO8UivGzI6kFWU4IPqDQB990V8J/8JBrP/QXv/8AwJf/ABo/4SDWf+gvf/8AgS/+NAH3ZRXwn/wkGs/9Be//APAl/wDGj/hINZ/6C9//AOBL/wCNAH3ZRXwn/wAJBrP/AEF7/wD8CX/xo/4SDWf+gvf/APgS/wDjQB92UV8J/wDCQaz/ANBe/wD/AAJf/Gj/AISDWf8AoL3/AP4Ev/jQB92UV8J/8JBrP/QXv/8AwJf/ABo/4SDWf+gvf/8AgS/+NAH3ZRXwn/wkGs/9Be//APAl/wDGj/hINZ/6C9//AOBL/wCNAH3ZRXwn/wAJBrP/AEF7/wD8CX/xo/4SDWf+gvf/APgS/wDjQB92UV8J/wDCQaz/ANBe/wD/AAJf/Gj/AISDWf8AoL3/AP4Ev/jQB92UV8J/8JBrP/QXv/8AwJf/ABo/4SDWf+gvf/8AgS/+NAH3ZRXwn/wkGs/9Be//APAl/wDGj/hINZ/6C9//AOBL/wCNAH3ZRXwn/wAJBrP/AEF7/wD8CX/xo/4SDWf+gvf/APgS/wDjQB92UV8J/wDCQaz/ANBe/wD/AAJf/Gj/AISDWf8AoL3/AP4Ev/jQB92UV8J/8JBrP/QXv/8AwJf/ABo/4SDWf+gvf/8AgS/+NAH3ZRXwn/wkGs/9Be//APAl/wDGj/hINZ/6C9//AOBL/wCNAH3ZRXwn/wAJBrP/AEF7/wD8CX/xo/4SDWf+gvf/APgS/wDjQB92UV8J/wDCQaz/ANBe/wD/AAJf/Gj/AISDWf8AoL3/AP4Ev/jQB92UV8J/8JBrP/QXv/8AwJf/ABo/4SDWf+gvf/8AgS/+NAH3ZRXwn/wkGs/9Be//APAl/wDGj/hINZ/6C9//AOBL/wCNAH3ZRXwn/wAJBrP/AEF7/wD8CX/xo/4SDWf+gvf/APgS/wDjQB92UV8J/wDCQaz/ANBe/wD/AAJf/Gj/AISDWf8AoL3/AP4Ev/jQB92UV8J/8JBrP/QXv/8AwJf/ABo/4SDWf+gvf/8AgS/+NAH3ZRXwn/wkGs/9Be//APAl/wDGj/hINZ/6C9//AOBL/wCNAH3ZRXwn/wAJBrP/AEF7/wD8CX/xo/4SDWf+gvf/APgS/wDjQB92UV8J/wDCQaz/ANBe/wD/AAJf/Gj/AISDWf8AoL3/AP4Ev/jQB92UV8J/8JBrP/QXv/8AwJf/ABo/4SDWf+gvf/8AgS/+NAH3ZRXwn/wkGs/9Be//APAl/wDGj/hINZ/6C9//AOBL/wCNAH3ZRXwn/wAJBrP/AEF7/wD8CX/xo/4SDWf+gvf/APgS/wDjQB92UV8J/wDCQaz/ANBe/wD/AAJf/Gj/AISDWf8AoL3/AP4Ev/jQB92UV8J/8JBrP/QXv/8AwJf/ABo/4SDWf+gvf/8AgS/+NAH3ZRXwn/wkGs/9Be//APAl/wDGj/hINZ/6C9//AOBL/wCNAH3ZRXwn/wAJBrP/AEF7/wD8CX/xo/4SDWf+gvf/APgS/wDjQB92UV8J/wDCQaz/ANBe/wD/AAJf/Gj/AISDWf8AoL3/AP4Ev/jQB9D/ALS3/Ii6Z/2ER/6LevmerV1qd/fRhL2+ubhFOQs0zOAfXBNVaACiiigAooooAKKKKACiiigAooooAKKKKACiiigAoorrF8NWr2ejQLKrS3jNNcXCk4jjGBj8+PrQBydFas+hzJq15ZoHHkFjHuU5kUPtyP8AParMvhO7jiLLNCxDspBbHA245991AGCaK1p/Dl5BbtMXgdFUsxV+gAB/qPzFFAGX5b/3G/Kjy3/uN+VFFXyiuHlv/cb8qPLf+435UUUcoXDy3/uN+VHlv/cb8qKKOULh5b/3G/Kjy3/uN+VFFHKFw8t/7jflR5b/ANxvyooo5QuHlv8A3G/Kjy3/ALjflRRRyhcPLf8AuN+VHlv/AHG/KiijlC4eW/8Acb8qPLf+435UUUcoXDy3/uN+VHlv/cb8qKKOULh5b/3G/Kjy3/uN+VFFHKFw8t/7jflR5b/3G/KiijlC4eW/9xvyo8t/7jflRRRyhcPLf+435UeW/wDcb8qKKOULh5b/ANxvyo8t/wC435UUUcoXDy3/ALjflR5b/wBxvyooo5QuHlv/AHG/Kjy3/uN+VFFHKFw8t/7jflR5b/3G/KiijlC4eW/9xvyo8t/7jflRRRyhcPLf+435UeW/9xvyooo5QuHlv/cb8qPLf+435UUUcoXDy3/uN+VHlv8A3G/KiijlC4eW/wDcb8qPLf8AuN+VFFHKFw8t/wC435UeW/8Acb8qKKOULh5b/wBxvyo8t/7jflRRRyhcPLf+435UeW/9xvyooo5QuHlv/cb8qPLf+435UUUcoXDy3/uN+VHlv/cb8qKKOULh5b/3G/Kjy3/uN+VFFHKFw8t/7jflR5b/ANxvyooo5QuHlv8A3G/Kjy3/ALjflRRRyhcPLf8AuN+VHlv/AHG/KiijlC4eW/8Acb8qPLf+435UUUcoXDy3/uN+VHlv/cb8qKKOULh5b/3G/Kjy3/uN+VFFHKFw8t/7jflR5b/3G/KiijlC4eW/9xvyo8t/7jflRRRyhcPLf+435UeW/wDcb8qKKOULh5b/ANxvyo8t/wC435UUUcoXDy3/ALjflR5b/wBxvyooo5QuHlv/AHG/Kjy3/uN+VFFHKFw8t/7jflR5b/3G/KiijlC4eW/9xvyo8t/7jflRRRyhcPLf+435UeW/9xvyooo5QuHlv/cb8qPLf+435UUUcoXDy3/uN+VHlv8A3G/KiijlC4eW/wDcb8qPLf8AuN+VFFHKFw8t/wC435VoyaxqUmkxacWIgi4G1MMRnOCeuM84ooo5QuVJp7y4uDPcSTySkY8xyS351H++wB+8wBjHNFFHKFxQ1wqOq+YFcbWHPIyDj9BRRRSsFz//2Q==)](https://github.com/stevenxchung/AWS-CSAA-ACloudGuru/blob/master/Section%2005%20--%20EC2%20-%20The%20Backbone%20of%20AWS/polly-setup.jpg)

**Figure 5-3. Overview of Polly application**

**EC2 Summary**

Below are the major subsections in Section 5 worth going over before the exam.

**Exam Tips - EC2**

* Know the differences between:
  + On Demand
  + Spot
  + Reserved
  + Dedicated Hosts
* Remember with spot instances:
  + If you terminate the instance, you pay for the hour
  + If AWS terminates the spot instance, you get the hour it was terminated in for free
* Know the EC2 instance types as shown in Figure 5-1

**Exam Tips - EBS**

* EBS Consists of:
  + SSD, General Purpose - GP2 - (up to 10,000 IPOS)
  + SSD, Provisioned IOPS - IO1 - (more than 10,000 IOPS)
  + HDD, Throughput Optimized - ST1 - Frequently accessed workloads
  + HDD, Cold - SC1 - Less frequently accessed data
  + HDD, Magnetic - Standard - Cheap, infrequently accessed storage
* You cannot mount a single EBS volume to multiple EC2 instances; instead use EFS

**Exam Tips - EC2 Lab**

* Termination Protection is turned off by default, you must turn it on
* On an EBS-backed instance, the default action is for the root EBS volume to be deleted when the instance is terminated
* EBS-backed root volumes can now be encrypted using AWS API or console or you can use a third party tool to encrypt the root volume
* Additional volumes can also be encrypted

**Exam Tips - Volumes vs Snapshots**

* Volumes exist on EBS:
  + Virtual hard disk
* Snapshots exist on S3
* You can take a snapshot of a volume, this will store that volume on S3
* Snapshots are point in time copies of volumes
* Snapshots are incremental. This means that only the blocks that have changed since your last snapshot are moved to S3
* It may take some time to create the first snapshot

**Exam Tips - Volumes vs Snapshots - Security**

* Snapshots of encrypted volumes are encrypted automatically
* Volumes restored from encrypted snapshots are encrypted automatically
* You can share snapshots, but only if they are unencrypted
  + These snapshots can be shared with other AWS accounts or made public

**Exam Tips - Snapshots of Root Device Volumes**

* To create a snapshot for Amazon EBS volumes that serve as root devices, you should stop the instance before taking the snapshot

**Exam Tips - EBS vs Instance Store**

* Instance store volumes are sometimes called Ephemeral Storage
* Instance store volumes cannot be stopped. If the underlying host fails, you lose your data
* EBS backed instance can be stopped. You will not lose the data on this instance if it is stopped
* You can reboot both, you will not lose your data
* By default, both ROOT volumes will be deleted on termination, however with EBS volumes, you can tell AWS to keep the root device volume

**How to take Snapshots of a RAID array**

* Problem - Take a snapshot, the snapshot excludes data held in the cache by applications and the OS. This tends not to matter on a single volume, however using multiple volumes in a RAID array, this can be a problem due to interdependencies of the array
* Solution - Take an application consistent snapshot
  + Stop the application from writing to disk
  + Flush all caches to the disk
  + Ways to accomplish these tasks above:
    - Freeze the file system
    - Unmount the RAID array
    - Shutting down the associated EC2 instance

**Exam Tips - Amazon Machine Images**

AMIs are regional. You can only launch an AMI from the region in which it is stored. However you can copy AMIs to other regions using the console, command line, or the Amazon EC2 API

**Exam Tips - CloudWatch Lab**

* Standard Monitoring - 5 minute
* Detailed Monitoring - 1 minute
* CloudWatch is performance monitoring
* CloudTrail is for auditing

**What can I do with CloudWatch?**

* Dashboards - Create awesome dashboards to see what is happening with your AWS environment
* Alarms - Allows you to set Alarms that notify you when particular thresholds are hit
* Events - CloudWatch events helps you respond to state changes in your AWS resources
* Logs - CloudWatch logs helps you aggregate, monitor, and store logs

**Exam Tips - Roles Lab**

* Roles are more secure than storing your access key and secret access key on individual EC@ instances
* Roles are easier to manage
* Roles can be assigned to an EC2 instance AFTER it has been provisioned using both the command line and the AWS console
* Roles are universal - you can use them in any region

**Exam Tips - Instance Metadata**

* Used to get information about an instance (such as public IP)

**Exam Tips - EFS Lab**

* Supports the Network File System version 4 (NFSv4) protocol
* You only pay for the storage you use (no pre-provisioning required)
* Can scale up to the petabytes
* Can support thousands of concurrent NFS connections
* Data is stored across multiple AZ's within a region
* Read After Write Consistency

**What is Lambda?**

AWS Lambda is a compute service where you can upload your code and create a Lambda function. AWS Lambda takes care of provisioning and managing the servers that you use to run the code. You don't have to worry about operating systems, patching, scaling, etc. You can use Lambda in the following ways:

* As an event-driven compute service where the AWS Lambda runs your code in response to events. These events could be changes to data in an Amazon S3 bucket or an Amazon DynamoDB table
* As a compute service to run your code in response to HTTP requests using Amazon API Gateway or API calls made using AWS SDKs

**What is a Placement Group?**

There are two types of placement groups:

* Clustered Placement Group - A grouping of instances within a single AZ. Placement groups are recommended for applications that need low network latency, high network throughput, or both. Only certain instances can be launched into a clustered placement group
* Spread Placement Group - A group of instances that are each placed on distinct underlying hardware. Spread placement groups are recommended for applications that have a small number of critical instances that should be kept separate from each other

**Section 5 Quiz**

**1. EBS Snapshots are backed up to S3 in what manner?**

* Incrementally

**2. Do Amazon EBS volumes persist independently from the life of an Amazon EC2 instance, for example, if I terminated an EC2 instance, would that EBS volume remain?**

* Only if instructed to when created

**3. Can I delete a snapshot of an EBS Volume that is used as the root device of a registered AMI?**

* No, you must deregister the AMI before being able to delete the root device

**4. A placement group can be deployed across multiple Availability Zones.**

* False

**5. While creating the snapshots using the command line tools, which command should I be using?**

* ec2-create-snapshot

**6. Can you attach an EBS volume to more than one EC2 instance at the same time?**

* No

**7. A placement group is ideal for**

* EC2 instances that require high network throughput and low latency across a single AZ

**8. Using the console, I can add a role to an EC2 instance, after that instance has been created and powered up.**

* True

**9. I can change the permissions to a role, even if that role is already assigned to an existing EC2 instance, and these changes will take effect immediately.**

* True

**Section 6: Route 53**

This section will cover an in-depth overview on the AWS Route 53 service.

**What is DNS?**

DNS is used to convert human friendly domain names into an IP (Internet Protocol) address.

* IP addresses are used by computers to identify each other on the network
* IP addresses commonly come in 2 different forms, IPv4 and IPv6

**IPv4 vs IPv6**

* IPv4 space is a 32 bit field has over 4 billion (4,294,967,296) different addresses
* IPv6 had an address space of 128 bits which is 340 undecillion addresses

**Top Level Domains**

* The last word in a domain name represents the top level domain name (i.e. the .com in google.com) whereas the second word in a domain name is known as the second level domain name (i.e. acloud.guru)
* Top level domain names are controlled by the IANA (Internet Assigned Numbers Authority) in a root zone database which is essentially a database of all available top level domains

**Domain Registrars**

* A registrar is an authority that can assign domain names directly under one or more top-level domains. Each domain name becomes registered in a central database known as the WhoIS database.

**SOA (Start of Authority) Record**

* The SOA records stores information about:
  + The name of the server that supplied that data for the zone
  + The administrator of the zone
  + The current version of the data file
  + The default number of seconds for the time-to-live file on resource records

**NS Records**

* NS (Name Server) records are used by top level domain servers to direct traffic to the content DNS server which contains the authoritative DNS records

**A Records**

* The address record is used by a computer to translate the name of the domain to an IP address

**TTL**

* The length that a DNS record is cached on either the resolving server or the users own local PC is to the value of the TTL (Time To Live) in seconds.

**CNames**

* A CName (Canonical Name) can be used to resolve one domain name to another

**Alias Records**

* Alias records are used to map resource record sets in your hosted zone to Elastic Load Balancers, CloudFront distributions, or S3 buckets that are configured as websites
* Unlike a CName, an alias record can't be used for naked domain names (zone apex record). It must be either an A record or an alias.

**DNS 101 Exam Tips**

* ELBS do not have pre-defined IPv4 addresses; you resolve to them using a DNS name
* Alias record vs CName
* Always choose alias record over a CName

**Common DNS Types**

* SOA records
* NS records
* A records
* CNames
* MX records
* PTR records

**Routing Policies Available on AWS**

There are several different routing policies on AWS

* Simple routing
* Weighted routing
* Latency-based routing
* Failover routing
* Geolocation routing
* Multivalue answer routing

**Simple Routing Policy - Lab**

If you choose simple routing policy you can only have one record with multiple IP addresses. If you specify multiple values in a record, Route 53 returns all values to the user in a random order.

**Weighted Routing Policy - Lab**

Weighted routing policies let you split your traffic based on different weights assigned (e.g. you can set 20% of your traffic to go to US-EAST-1 and then 80% to go to EU-WEST-1).

**Latency Routing Policy - Lab**

Latency based routing allows you to route you traffic based on the lowest network latency for you end user (i.e. which region will give them the fastest response time). To use latency-based routing, you create a latency resource record set for the EC2 (or ELB) resource in each region that hosts your website. When Route 53 receives a query for your site, it selects the latency resource record set for the region that gives the user the lowest latency. Route 53 then responds with the value associated with that resource record set.

**Failover Routing Policy - Lab**

Failover routing policies are used when you want to create an active/passive set up. For example, you may want your primary site to be in EU-WEST-2 and your secondary DR site in AP-SOUTHEAST-2.

* Route 53 will monitor the health or your primary site using a health check
* A health check monitors the health of your end points

**Geolocation Routing Policy - Lab**

Geolocation routing lets you choose where your traffic will be sent based on the geographic location of your users.

**Multivalue Routing**

If you want to route traffic approximately randomly to multiple resources, such as web servers, you can create one multivalue answer record for each resource and, optionally, associate a Route 53 health check with each record. If you create a dozen multivalue answer records, Route 53 responds to DNS queries with up to eight healthy records in response to each DNS query.

**DNS Exam Tips**

Make sure to go over the sections above (mainly routing policy sections) before taking the exam.

**Section 6 Quiz**

**1. Does Route 53 support MX Records?**

* Yes

**2. Route 53 is named so because**

* The DNS Port is on Port 53 and Route 53 is a DNS Service

**3. Route 53 does not support zone apex records (or naked domain names)**

* Incorrect

**4. Route53 is Amazon's DNS Service**

* True

**5. There is a limit to the number of domain names that you can manage using Route 53.**

* True and False. There is a limit of domain names, however this limit can be raised by contacting AWS support.

**Section 7: Databases on AWS**

This section will cover an in-depth overview on databases on AWS.

**What is a relational database?**

Relational databased are what most of us are all used to. They have been around since the 70's (think traditional spreadsheet):

* Database
* Tables
* Row
* Fields (columns)

[![A screenshot of a cell phone

Description automatically generated](data:image/jpeg;base64,/9j/4RDgRXhpZgAATU0AKgAAAAgABAE7AAIAAAAHAAAISodpAAQAAAABAAAIUpydAAEAAAAOAAAQyuocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAFN0ZXZlbgAAAAWQAwACAAAAFAAAEKCQBAACAAAAFAAAELSSkQACAAAAAzU5AACSkgACAAAAAzU5AADqHAAHAAAIDAAACJQAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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**Figure 7-1. Example of a traditional relational database**

**Relational Database Types**

There are several of relational database types:

* SQL server
* Oracle
* MySQL server
* PostgreSQL
* Aurora
* MariaDB

**Non-relational Databases**

A non-relational database consists of the following:

* Database
  + Collection -> Table
  + Document -> Row
  + Key value pairs -> Fields

[![A close up of text on a black background

Description automatically generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RDgRXhpZgAATU0AKgAAAAgABAE7AAIAAAAHAAAISodpAAQAAAABAAAIUpydAAEAAAAOAAAQyuocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAFN0ZXZlbgAAAAWQAwACAAAAFAAAEKCQBAACAAAAFAAAELSSkQACAAAAAzEyAACSkgACAAAAAzEyAADqHAAHAAAIDAAACJQAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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**Figure 7-2. Example of a non-relational database**

**What is Data Warehousing?**

* Used for business intelligence. Tools like Cognos, Jaspersoft, SQL Server Reporting Services, Oracle Hyperion, SAP NetWeaver
* Used to pull in very large and complex data sets. Usually used by management to do queries on data (such as current performance vs targets, etc.)

**OLTP vs OLAP**

* OLTP (Online Transaction Processing) differs from OLAP (Online Analytics Processing) in terms of the types of queries you will run
* OLTP: Pulls up a row of data such as name, date, delivery address, delivery status, etc.
* OLAP: Find net profit for EMEA and Pacific for the Digital Radio Product:
  1. Pulls in large number of records
  2. Sum of radios sold in EMEA
  3. Sum of radios sold in Pacific
  4. Unit cost of radio in each region
  5. Sales price of each radio
  6. Sales price - unit cost
* Data warehousing databases use different type of architecture both from a database perspective and infrastructure layer

**What is ElastiCache?**

* ElastiCache is a web service that makes it easy to deploy, operate, and scale an in-memory cache in the cloud. The service improves the performance of web applications by allowing you to retrieve information from fast, managed, in-memory caches, instead of relying entirely on slower disk-based databases
* ElastiCache supports two open-source in-memory caching engines:
  + Memcached
  + Redis

**AWS Database Types - Summary**

* RDS - OLTP
  + SQL
  + MySQL
  + PostgreSQL
  + Oracle
  + Aurora
  + MariaDB
* DynamoDB - No SQL
* Redshift - OLAP
* ElastiCache - In Memory Caching

**RDS - Backups, Mult-AZ, and Read Replicas**

* There are two different types of backups for AWS
  + Automated backups
  + Database snapshots
* Automated backups allow you to recover your database to any point in time within a "retention period"
* The retention period can be between one and 35 days. Automated backups will take a full daily snapshot and will also store transaction logs throughout the day. When you do a recovery. AWS will first choose the most recent daily back up, and then apply transaction logs relevant to that day. This allows you to do a point in time recovery down to a second, within the retention period

**Automated Backups**

* Automated backups are enabled by default. The backup data is stored in S3 and you get free storage space equal to the size of your database. SO if you have an RDS instance of 10 GB, you will get 10 GB worth of storage
* Backups are taken within a defined window. During the backup window, storage I/O may be suspended while your data is being backed up and you may experience elevated latency

**Snapshots**

DB Snapshots are done manually (i.e. they are user initiated) and are stored even after you delete the original RDS instance, unlike automated backups.

**Restoring Backups**

Whenever you restore either an automatic backup or a manual Snapshot, the restored version of the database will be a new RDS instance with a new DNS endpoint.

**Encryption**

* Encryption at rest is supported for MySQL, Oracle, SQL Server, PostgreSQL, MariaDB, and Aurora. Encryption is done using AWS KMS (Key Management Service). Once your RDS instance is encrypted, the data stored at rest in the underlying storage is encrypted, as are its automated backups, read replicas, and snapshots
* At the present time, encrypting an existing DB instance is not supported. To use Amazon RDS encryption for an existing database, you must first create a snapshot, make a copy of that snapshot and encrypt the copy

**What is Multi-AZ?**

Any changes to an RDS in US-EAST-1A for example will be synchronously replicated in another instance in US-EAST-1B for example where US-EAST-1B is an exact copy of US-EAST-1A.

[![A picture containing drawing, clock, sign

Description automatically generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RDgRXhpZgAATU0AKgAAAAgABAE7AAIAAAAHAAAISodpAAQAAAABAAAIUpydAAEAAAAOAAAQyuocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAFN0ZXZlbgAAAAWQAwACAAAAFAAAEKCQBAACAAAAFAAAELSSkQACAAAAAzM1AACSkgACAAAAAzM1AADqHAAHAAAIDAAACJQAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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**Figure 7-3. Example of a Multi-AZ setup for AWS RDS**

**What is Multi-AZ RDS?**

* Multi-AZ allows you to have an exact copy of your production database in another AZ. AWS handles the replication for you so when your production databases is written to, this will automatically be synchronized to the stand by database
* In the event of planned database maintenance, DB instance failure, or an AZ failure, Amazon RDS will automatically failover to the standby so that database operations can resume quickly without administrative intervention
* **Multi-AZ is for disaster recovery only**, it is not primarily used for improving performance. For performance improvement you need Read Replicas

**Multi-AZ Databases**

Multi-AZ databases are available for the following:

* SQL server
* Oracle
* MySQL server
* PostgreSQL
* MariaDB

**What is a Read Replica?**

Read replicas allow you to have a read-only copy of your production database. This is achieved by using asynchronous replication from the primary RDS instance to the read replica. You use read replicas primarily for very read-heavy database workloads.

[![A picture containing clock

Description automatically generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RDgRXhpZgAATU0AKgAAAAgABAE7AAIAAAAHAAAISodpAAQAAAABAAAIUpydAAEAAAAOAAAQyuocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAFN0ZXZlbgAAAAWQAwACAAAAFAAAEKCQBAACAAAAFAAAELSSkQACAAAAAzQzAACSkgACAAAAAzQzAADqHAAHAAAIDAAACJQAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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eeUV6H/wAIFpP/AD+zf99r/hR/wgWk/wDP7N/32v8AhR9SreX3h9cpef3HnlFeh/8ACBaT/wA/s3/fa0f8IFpP/P7N/wB9r/hR9SreX3h9cpef3HnlFeh/8IFpP/P7N/32v+FH/CBaT/z+zf8Afa0fUq3l94fXKXn9x55Wvp3hu+1bTZLuwCymN9pizhjx1Haus/4QLSf+f2b/AL7Wt3Q9GttFtZIbSVpVd9xLEHB/CtqOBk5WqbeplVxsVG9Pc8imglt5THPG0bqcFXGCKZXs+o6RY6rCUvrdZOOG6MPoa818S6HZaPcbbS/SYk8wHl0+pHFY4jCSo63ujWhio1Xa1mYVA60UDrXGdh0U/wDx8P8AWrln/wAe5/3qpz/8fD/Wrln/AMe5/wB6vfpbo8OexNRRRXUZGx/EaKP4jRXWcoVb0v8A5CC/7p/lVSrel/8AIQX/AHT/ACpS2GjcooorMDI1j/j6T/crC1n/AJAV9/1x/wDZhW7rH/H0n+5WFrP/ACAr7/rj/wCzCs8R/u8vQ1o/xY+pwFFFFfKH0oUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABXQeE/8Aj6n/ANwfzrn66Dwn/wAfU/8AuD+dc2K/hM68H/Hieozf8ikv+6Kr+FP9ZP8AQVYm/wCRSX/dFV/Cn+sn+gr5J/wZep9n/wAvo+hn+If+Q3N+H8hXUaJ/yBbb/c/qa5fxD/yG5vw/kK6jRP8AkC23+5/U1WI/hRJw/wDFkchqv/IXuv8Aroa6fwz/AMgcf9dGrmNV/wCQvdf9dDXT+Gf+QOP+ujVWJ/hIjDfxWa9FFFeceiFFFFACjrXztqP/ACFLr/rs/wD6Ea+iR1r521H/AJCl1/12f/0I19Dku8/kfN59tT+f6Fer2ma1f6Q7tp9y8Qfh1HRvqKo0V9BKMZq0lc+bjKUHeLszv9G+JE66gq6gqRWKpjai5bPt7n8q7zT7t9YgY3VpG1pIqyRPkMGB52svZh+VeCVs2HibU7RLeBL2SOKFsoQeEz1JHf6V5GKy2MvepaM9rCZrOHu1tUe7A5UFRxxgdKTcFwZCFyQOtYmj+Jbe8sIHu5I0aQlVkVwyyEHGePuk9cHpVtkvjq8MUSlLGOJmeRmyXY9F/DrXzbpOMmp6H1CrRlFOGtzznX/F7xeLRcJEsiW52tFuIBZSQOfyyPWsy/8AHOpX1s8JCxqzFwwJLISexPIFQ+NIltvEk1sobMACF3OWk77iffP5YrAr7Cjh6LhGXL0Pia2Krqco83Vm1/wl2tNdrcSXsrsAPlLHaeMdKrW2t3lqrLFIwR1Addxw3v7H3FZ1FdCo01okc3tqrd3Jm1/wlWofZIIGKkRAAtk7nx93J9s1BceItUul2z3cjrtVcbj/AA9KzKKFRprZDdeq95M6FvGuqvp0dmxiKIu0koPnGMDd68VWsvEt5Y289uiRPBcSCSWNl4bnOPpWPRUrD0krKI/rFZvm5tTRu9burm6e4V3ikdmJKuTgN/Dz2p9tr91Yzh7E+QFj8sKp6A9fzrLoqnSg1ZolVaid0zbbxPctqk120MbJMpQwOSygHqBnpUU3iXUZfICymJLcbYkjYgKM5x15rJopexp9h+3q/wAx0knjS8uUb7dDHcSCXzYnLMDGewGD0q3YeKNQ1jWIUuJIwTKzrvbC89FyegzXIVqeHLY3muQ26zRwtKGRXkAKgkEdDWNWhSjTbsdFHEVpVIx5r6nu8DSyRo8yhCVG6Mc7W7896Rw3nExy/MIz+7PTPYnvVOG4Xyzp1jPGby2iQvvU457n64J/GrN3d21jatPeyIiquWJIGcc8ev0r43llzWS+R9xzx5bt6InVWwN/LDrjpXPeJ/GFloEMkPmbr0pmOMLu/E9h+NcT4v8AHL395CNBu7iGFEy7D5dzf/WripZZJ5WkmdpHY5ZmOSa9vC5U3adb7jwMZnCV6dD7/wDI1tc8T6jr7L9sl2xIABEhIX6+5rHoor6CEIwjyxVkfNznKpLmk7sK0tK/1Nx/wGs2tLSv9Tcf8BrpofxEc1f+Gy/F/rk/3h/OtVvvH61lRf65P94fzrVb7x+te7S6njzG1csP+Wn4VTq5Yf8ALT8K6YfEYz2LlFFFdJgB6Vu6b/yD4/x/nWEelbum/wDIPj/H+dRLYEWqbL/qJP8AcP8AKnU2X/USf7h/lULcDmf4a4/xZ/yGF/64r/M12H8Nch4s/wCQwn/XFf5muDM/4S9T0Mv/AIj9DDoyR0oor589sXJ9T+dGT6n86SigAyfU/nRk+p/OiigBcn1P50ZPqfzpKKADJ9T+dLk+p/OkooAXJ9T+dJk+p/OiigAyfU/nXX+FvEdloehz/amZ5mlykSDJPHr0ArkKK1pVZUpc0TKpSjVjyyOh1bxnqWpbkib7LCf4Yzyfqa54kk5JyfU0UVM6kpu8ncqEIwVooKB1ooHWoLOin/4+H+tXLP8A49z/AL1U5/8Aj4f61cs/+Pc/71e/S3R4c9iaiiiuoyNj+I0UfxGius5Qq3pf/IQX/dP8qqVb0v8A5CC/7p/lSlsNG5RRRWYGRrH/AB9J/uVhaz/yAr7/AK4/+zCt3WP+PpP9ysLWf+QFff8AXH/2YVniP93l6GtH+LH1OAFFAor5Q+lCiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAK6Dwn/AMfU/wDuD+dc/W34Znjgu5fNcLuXAz9a5sUm6TsdWEaVaNz1ab/kUl/3RVfwp/rJ/oKfNdW//CLpEJ4/MKjC7xk/hTPCn+sn+gr5NpqjK/c+zTTrRt2M/wAQ/wDIbm/D+QrqNE/5Att/uf1Ncv4h/wCQ3N+H8hXUaJ/yBbb/AHP6mniP4URYf+LI5DVf+Qvdf9dDXT+Gf+QOP+ujVzGq/wDIXuv+uhrp/DP/ACBx/wBdGqsT/CRGG/is16KKK849EKKKKAFHWvnbUf8AkKXX/XZ//QjXv97qNpp0RlvJ0iUDPLcn6V8/XrrLf3Eicq0rMD7Emvosli1zt+R8znsotwSeupDRRRX0J82FFFFAE0F1Lb8RuduclM8E/SvQNE+JMgt2TUYleRejb9o2gYH1Oa85orlr4WlXVpo6sPi62Hd6bNTxHqo1rxDdX6LsSRgFHsAAP5Vl0UV0RiopRRzyk5ScnuwoooqiQooooAKKKKACiiigAooooAKs6feyadfxXcAUvEwYBhxVailKKkrMqMnFqS3R64fGvh6yspdVsysl5clTcQjIkLY9+w9elec694ivdfud92QsSsTHEvRM/wA6yaK46GDp0HzLV92dmIx1XEJRei7IKKKK7ThCiiigArS0r/U3H/Aazalt7hreQMMlf4lz1FaUpKM02Z1YuUGkbkX+uT/eH861W+8frWRbusrROnRiD+ta7feP1r3qLTV0eLO6eo2rlh/y0/CqdXLD/lp+FdUPiMZ7FyiiiukwA9K3dN/5B8f4/wA6wj0rd03/AJB8f4/zqJbAi1TZf9RJ/uH+VOpsv+ok/wBw/wAqhbgcz/DXIeLP+Qwn/XFf5muk1HUY9Ns/NlG4nhUBwWNcJdXMt3cNNO252615eZ1YtKmtz1cBTkm5vYiooorxD1gooooAKKKKACiiigAooooAKKKKACiiigAooooAKB1oooA6Kf8A4+H+tXLP/j3P+9WLZXRmHlyHMgGdxP3hW1Z/8e5/3q93DzU7NHi1YuGjJqKKK7DA2P4jRR/EaK6zlCrel/8AIQX/AHT/ACqpVvS/+Qgv+6f5UpbDRuUUUVmBkax/x9J/uVha1/yAb7/rl/7MK3NY/wCPlM/3K4HxBrP2p2tLZiIVOHIP3z/hXNjKsadBp7s6sLTlOqmuhhCiiivmT6AKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAoBwcjiiigC3bajNb3CSszSbOgJrt9B8c6fp8Mr3KyeYw4VVyK89orlrYWnXVpHXQxlbDv3GekSaqutOb9E2LL0X6cV3Oif8gW2/wB3+prw6w1i4sQFU7ox/Ca6R/iPexadFa2MKxlFwXPWvIxOX1Z2jDY9vC5nSgnKpub2q/8AIXuv+uhrp/DP/IHH/XRq4e0uZLyziuJ23yyKGdvU13Hhn/kDj/ro1cGLXLTSPRwj5p37o16KrXuo2mnQmW8nSJB3Y1wWu/E1AGh0aMk9DK4/lXNQwlau/cR04jGUcOvffyO9vdRtNOhMt5OkSj+82M1wWvfExV3Q6NHu7ea/GPwrgb/Vb3U5jJezvIT2J4/KqdfQYbKadPWpq/wPm8TnFWp7tL3V+Jc1DVb3U5jJezvKSc4J4H4VToor2IxUVZHiSk5O7CiiimIKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKALNjd/ZZ1J5QsN3tz1FdRFcw3S74JA49uo/CuOp0crxOHjYqw7g114fFSo6PVHLWw6qarRnZVcsP+Wn4Vy9rrzLhbtN4/vr1rpNJniuVdoJA444HX8q9qhiKdR6M8utRnBao0KKXa390/lRtb+6fyru5o9zj5X2Erd03/AJB8f4/zrD2t/dP5VcfXdP0fTEN7OA/OIl5dufT/ABrOpUhFXbKjCUnZI2qzNY1zT9Jtn+1zr5jIQsS8s3HpXFav47vbzdHp6/ZIj/FnLn8e1ctJI8sheVmd26sxyTXkVswS0pfeejRwL3qMsahfy6jdGabjsqjooqrRRXkNuTuz1kklZBRRRSGFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAA4ORXQ6XqUMkPlzOqSluh4B/GueorajWlRldGVWlGqrM7WiuWtdTubXAVt6f3G5FbVpq1tdEKx8qT0c8H6GvYo4unU0ejPLqYacNd0dN/EaKXBPIBIPQijaf7p/KvVUo9zz+ViVb0v/kIL/un+VVdp/un8qs2DpBdiSZljjVTlnOAOPU0pSjbcFF32N2myyxwxtJM6xooyWY4A/GuT1fx7aWpaLS0+1SDjzDwg+nc1xGpazf6tJuvbhnGeEHCj8K8utj6cNIas7aWCnPWWiOh8X+Job2T7Npcu9Nu2SUDGeegrkKKK8arVlVlzSPYp040o8sQooorI0CiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooA0bHWrmywobdGP4TXTJ8RJbPRxbWEBWbcSXfoM+lcRRXNUwtGo7yR1U8XXpK0ZFzUNVvdUmMt7O0jH1PFU6KK3jFRVkc0pOTuwoooqhBRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUAkdCR9KKKAF3t/eb86N7f3m/OkooAXe395vzpCSTk8miigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAXe394/nRvb+8350lFAC72/vN+dBYkYJJHuaSigLBRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQB//2Q==)](https://github.com/stevenxchung/AWS-CSAA-ACloudGuru/blob/master/Section%2007%20--%20Databases%20on%20AWS/read-replica.jpg)

**Figure 7-4. Example of a read replica (depicted in blue) setup on AWS**

**Read Replica Databases**

Read Replica databases are available for the following:

* MySQL server
* PostgreSQL
* MariaDB
* Aurora

In addition, read replica databases:

* Are used for scaling **not** for disaster recovery
* Must have automatic backups turned on in order to deploy a read replica
* Can have up to five read replica copies of any database
* Can have read replicas of read replicas (can create latency issues)
* Will have its own DNS end point
* **Can** have read replicas that have Multi-AZ
* **Can** create read replicas of Multi-AZ source databases
* Can be promoted to be their own databases. This breaks the replication however
* Can have a read replica in a second region

**What is DynamoDB?**

Amazon DynamoDB is a fast and flexible NoSQL database service for all apps that need consistent, single-digit millisecond latency at any scale. It is a fully managed database and supports both document and key-value data models. Its flexible data model and reliable performance make it a great fit for mobile, web, gaming, ad-tech, IoT, and many other apps.

**DynamoDB**

* Stored on SSD storage
* Spread across three geographically distinct data centers
* Eventual consistent reads (default)
  + Consistency across all copies of data is usually reached within a second. Repeating a read after a short time should return the updated data (best read performance)
* Strongly consistent reads
  + A strongly consistent read returns a result that reflects all writes that received a successful response prior to the read

**DynamoDB Pricing**

* Provisioned throughout capacity
  + Write throughput $0.0065 per hour for every 10 units
  + Read throughput $0.0065 per hour for every 50 units
* Storage costs of $0.25 GB per month

**What is Redshift**

Amazon Redshift is a fast and powerful, fully managed, petabyte-scale data warehouse service in the cloud. Customers can start small for just $0.25 per hour with no commitments or upfront costs and scale to a petabyte or more for $1,000 per terabyte per year, less than a tenth of most other data warehousing solutions.

**Redshift Configuration**

* Single Node (160 GB)
* Multi-node
  + Leader Node (manages client connections and receives queries)
  + Compute Node (store data and perform queries and computations up to 128 compute nodes)

**Redshift - 10 Times Faster**

* **Columnar Data Storage**: Instead of storing data as a series of rows, Amazon Redshift organizes the data by column. Since only the columns involved in the queries are processed and columnar data is stored sequentially on the storage media, column-based systems require far fewer I/O, greatly improving query performance
* **Advanced Compression**: Columnar data stores can be compressed much more than row-based data stores because similar data is stored sequentially on disk. In addition, Redshift does not require indexes or materialized view and so uses less space than traditional relational database systems. When loading data into an empty table, Redshift automatically samples your data and selects the most appropriate compression scheme
* **MPP (Massive Parallel Processing)**: Redshift automatically distributes data and query load across all nodes

**Redshift Pricing**

* Compute node hours (total number of hours you run across all your compute nodes for the billing period, you are billed for 1 unit per node per hour)
* Backup
* Data transfer (only within a VPC)

**Redshift Security**

* Encrypted in transit using SSL
* Encrypted at rest using AES-256 encryption
* By default Redshift takes care of key management
  + Manage your own keys through HSM
  + AWS KMS

**Redshift Availability**

* Currently only available in 1 AZ
* Can restore snapshots to new AZ's in the event of an outage

**What is ElastiCache?**

ElastiCache is a web service that makes it easy to deploy, operate, and scale an in-memory cache in the cloud. The service improves the performance of web applications by allowing you to retrieve information from fast, managed, in-memory caches, instead of relying entirely on slower disk-based databases.

**Types of ElastiCache**

* Memcached
  + A widely adopted memory object caching system
* Redis
  + A popular open-source in-memory key-value store that supports data structures such as sorted sets and lists.

**ElastiCache Exam Tips**

* Typically will be given a scenario where a particular database is under a lot of stress/load. You may be asked which service you should use to alleviate the load.
* ElastiCache is a good choice if your database is particularly read heavy and not prone to frequent changing
* Redshift is a good choice if the reason your database is feeling stress is because management keeps running OLAP transactions on it, etc.

**What is Aurora?**

Amazon Aurora is a MySQL-compatible, relational database engine that combines the speed and availability of high-end commercial databases with the simplicity and cost-effectiveness of open source databases. Amazon Aurora provides up to five times better performance than MySQL at a price point one tenth of that of a commercial database while delivering similar performance and availability.

**Aurora Scaling**

* Start with 10 GB, scales in 10 GB increments to 64 TB (storage auto scaling)
* Compute resources can scale up to 32vCPUs and 244 GB of memory
* Two copies of your data is contained in each AZ, with minimum of three AZ
* Aurora is designed to transparently handle the loss of up to two copies of data without affecting database write availability and up to three copies without affecting read availability
* Aurora storage is also self-healing. Data blocks and disks are continuously scanned for errors and repaired automatically

**Aurora Replicas**

* Two types of replicas are available
* Aurora replicas (currently 15)
* MySQL Read Replicas (currently five)

**AWS Database Types - Summary**

* RDS - OLTP
  + SQL
  + MySQL
  + PostgreSQL
  + Oracle
  + Aurora
  + MariaDB
* DynamoDB - NoSQL
* Redshift - OLAP
* ElastiCache - In memory caching
  + Memcached
  + Redis

**DynamoDB vs RDS**

* DynamoDB offers "push button" scaling, meaning that you can scale your database on the fly, without any down time
* RDS is not so easy and you usually have to use a bigger instance size or to add a read replica

**Section 7 Quiz**

**1. What AWS DB platform is most suitable for OLTP?**

* RDS/DynamoDB

**2. When replicating data from your primary RDS instance to your secondary RDS instance, what is the charge?**

* No charge, it's free

**3. What AWS service is best suited for non-relational databases?**

* DynamoDB

**4. When you add a rule to an RDS security group you do not need to specify a port number or protocol?**

* False

**5. If you are using Amazon RDS Provisioned IOPS storage with MySQL and Oracle database engines what is the maximum size RDS volume you can have by default?**

* 16 TB

**6. What happens to the I/O operations while you take a database snapshot**

* I/O operations to the database are suspended for the duration of the snapshot

**7. What AWS service is best used for Business Intelligence Tools/Data Warehousing?**

* Redshift

**8. In RDS when using multiple availability zones, can you use the secondary database as an independent read node?**

* No

**9. Amazon's ElastiCache uses which two engines?**

* Redis and Memcached

**10. By default, the maximum provisioned IOPS capacity on an Oracle and MySQL RDS instance (using provisioned IOPS) is 30,000 IOPS.**

* Limits change over time

**Section 8: VPC**

This section will cover an in-depth overview on AWS VPC.

**What is a VPC?**

Think of a VPC (Virtual Private Cloud) as a virtual data center in the cloud. A VPC lets you provision a logically isolated section of the AWS cloud where you can launch AWS resources in a virtual network that you define. You have complete control over you virtual networking environment, including selection of your own IP address range, creation of subnets, and configuration of route tables and network gateways.

[A screenshot of a cell phone

Description automatically generated](https://github.com/stevenxchung/AWS-CSAA-ACloudGuru/blob/master/Section%2008%20--%20VPC/aws-vpc.jpg)

**Figure 8-1. Diagram of a VPC setup on AWS**

**What can you do with a VPC?**

* Launch instances into a subnet of your choosing
* Assign custom IP address ranges in each subnet
* Configure route tables between subnets
* Create internet gateway and attach it to our VPC
* Much better security control over your AWS resources
* Instance security groups
* Subnet network ACLs (access control lists)

**Default VPC vs Custom VPC**

* Default VPC is user friendly, allowing you to immediately deploy instances
* All subnets in default VPC have a route out to the internet
* Each EC2 instance has both a public and private IP address

**Peering VPC**

* Allows you to connect one VPC with another via a direct network route using private IP addresses
* Instances behave as if they were on the same private network
* You can peer VPC's with other AWS accounts as well as with other VPC's in the same account
* Peering is in a star configuration: i.e. one central VPC peers with 4 others. No transitive peering

**VPC - Exam Tips**

* Think of a VPC as a logical datacenter in AWS
* Consists of IGW (Virtual Private Gateways), route tables, network access control lists, subnets, and security groups
* 1 Subnet = 1 AZ
* Security groups are stateful; network access control lists are stateless
* **No transitive peering**

**Exam Tips - Network ACLs**

* Your VPC automatically comes with a default network ACL and by default it allows all outbound and inbound traffic
* You can create custom network ACLs. By default each custom network ACL denies all inbound and outbound traffic until you add rules
* Each subnet in your VPC must be associated with a network ACL. If you do not explicitly associate a subnet with a network ACL, the subnet is automatically associated with a network ACL
* You can associate a network ACL with multiple subnets; however, a subnet can be associated with only one network ACL at a time. When you associate a network ACL with a subnet, the previous associate is removed
* Network ACLs contain a numbered list of rules that is evaluated in order, starting with the lowest numbered rule
* Network ACLs have separate inbound and outbound rules, and each rule can either allow or deny traffic
* Network ACLs are stateless; responses to allow inbound traffic are subject to the rules for outbound traffic (and vice versa)
* Block IP addresses using network ACLs not security groups

**VPC Flow Logs**

* VPC Flow Logs is a feature that enables you to capture information about the IP traffic going to and from network interfaces in your VPC. Flow log data is stored using Amazon CloudWatch Logs. After you've created a flow log, you can view and retrieve its data in Amazon CloudWatch Logs.
* Flow logs can be created at 3 levels:
  + VPC
  + Subnet
  + Network interface level

**Exam Tips - VPC Flow Logs**

* You cannot enable flow logs for VPCs that are peered with your VPC unless the peer VPC is in your account
* You cannot tag a flow log
* After you've created a flow log, you cannot change its configuration; for example, you can't associate a different IAM role with the flow log

**Not all IP traffic is monitored**

* Traffic generated by instances when they contact the Amazon DNS server. If you use your own DNS server, then all traffic to that DNS server is logged
* Traffic generated by a Windows instance for Amazon Windows license activation
* Traffic to the reserved IP address for the default VPC router
* DHCP traffic

**Exam Tips - NATs vs Bastions**

* NAT (Network Address Translation) is used to provide internet traffic to EC2 instances in private subnets
* Bastion is used to securely administer EC2 instances (using SH or RDP) in private subnets

**Exam Tips - NAT Instances**

* When creating a NAT instance, disable source/destination check on the instance
* NAT instances must be in a public subnet
* There must be a route out of the private subnet to the NAT instance, in order for this to work
* The amount of traffic that NAT instances can support depends on the instance size. If you are bottlenecking, increase the instance size
* You can create high availability using auto scaling groups, multiple subnets in different AZs, and a script to automate failover
* Behind a security group

**Exam Tips - NAT Gateways**

* Preferred by the enterprise
* Scale automatically up to 10 GBs
* No need to patch
* Not associated with security groups
* Automatically assigned a public IP address
* Remember to update your route tables
* No need to disable source/destination checks
* More secure than a NAT instance

**Exam Tips - ALB's**

* You will need at least two public subnets in order to deploy an ALB (Application Load Balancer)

**Section 8 Quiz**

**1. Security groups act like a firewall at the instance level whereas \_\_\_ are an additional layer of security that act at the subnet level.**

* ACLs

**2. How many VPC's am I allowed in each AWS Region by default?**

* Five

**3. VPC stands for:**

* Virtual Private Cloud

**4. How many internet gateways can I attach to my custom VPC?**

* One

**5. You have a VPC with both public and private subnets. You have 3 EC2 instances that have been deployed in to the public subnet and each has internet access. You deploy a 4th instance using the same AMI and this instance does not have internet access. What could be the cause of this?**

* The instance needs either an Elastic IP address/Public IP address assigned to it

**Section 9: Application Services**

This section will cover an in-depth overview on AWS Application Services.

**What is SQS?**

* Amazon SQS (Simple Queueing Service) is a web service that give you access to a message queue that can be used to store messages while waiting for a computer to process them
* SQS is a distributed queue system that enables web service applications to quickly and reliably queue messafes that one component in the application generates to be consumed by another component. A queue is a temporary repository for messages that are awaiting processing
* Using SQS you can decouple the components of an application so they run independently, easing message management between components
* Any component of a distributed application can store messages in the queue. Messages can contain up to 256 KB of text in any format. Any component can later retrieve the messages programmatically using the SQS API
* The queue acts as a buffer between the component producing and saving data, and the component receiving the data for the processing. This means that the queue resolves issues that arise if the producer is producing work faster than the consumer can process it, or if the producer or consumer are only intermittently connected to the network

**Queue Types**

There are two types of queue:

* Standard queues (default)
* FIFO queues (first-in-first-out)

**Standard Queues**

A standard queue is the default AWS SQS type. A standard queue lets you have nearly-unlimited number of transaction per second. Standard queues guarantee that a message is delivered at least once. However, occasionally (because of the highly-distributed architecture that allows high throughput) more than one copy of a message might be delivered out of order. Standard queues provide the best-effort ordering which ensures that messages are generally delivered in the same order as they are sent.

**FIFO Queues**

The most important features of FIFO queue is the FIFO (first-in-first-out) delivery and exactly-once processing: the order in which messages are sent and received is strictly preserved and a message is delivered once and remains available until a consumer processes and deletes it; duplicates are not introduceds into the queue. FIFO queues also support message groups that allow multiple ordered message groups within a single queue. FIFO queues are limited to 300 TPS (transactions per second) but have all the capabilities of standard queues.

**SQS Key Facts**

* SQS is pull-based, not pushed-based
* Messages are 256 KB in size
* Messages can be kept in the queue from one minute to 14 days
* Default retention period is four days
* SQS guarantees that you messages will be processed at least once

**SQS Visibility Timeout**

* The visibility timeout is the amount of time that the messages is invisible in the SQS queue after a reader picks up that message
* Default visibility timeout is 30 seconds
* Increase it if your task takes > 30 seconds
* Maximum is 12 hours

**SQS Long Polling**

* SQS long polling is a way to retrieve the messages from your SQS queues
* While the regular short polling returns immediately, long polling does not return a response until a message arrives in the message queue, or the long poll times out
* Long polling can save money

**Exam Tips - SQS**

* SQS is a distributed messages queueing system
* Allows you to decouple the components of an application so that they are independent
* Pull-based not push-based
* Standard queue (default): best-effort ordering; message delivered at least once
* FIFO queues (first-in-first-out) - ordering strictly preserved, message delivered once, no duplicates, e.g. good for banking transactions which need to happen in strict order
* Visibility timeout
  + Default is 30 seconds - increase if your task takes > 30 seconds to complete
  + Max is 12 hours
* Short polling - returned immediately even if no messages are in the queue
* Long polling - polls the queue periodically and only returns a response when a message is in the queue for the timeout is reached

**SWF**

Amazon SWF (Simple Workflow Service) is a web service that makes it easy to coordinate work across distributed application components. SWF enables applications for a range of use cases.

**SWF Workers**

Workers are programs that interact with SWF to get tasks, process received tasks, and return the results.

**SWF Decider**

The decider is a program that controls the coordination of tasks, i.e. their ordering, concurrency, and scheduling according to the application logic.

**SWF Workers and Deciders**

* The workers and the decider can run on cloud infrastructure, such as AWS EC2, or on machines behind firewalls. SWF brokers the interactions between works and the decider. It allows the decider to get consistent views into the progress of tasks and to initiate new tasks in an ongoing manner
* At the same time SWF stores tasks, assigns them to workers when they are ready, and monitors their progress. SWF ensures that a task is assigned only once and is never duplicated. Since AWS maintains the application's state durably, workers and deciders don't have to keep track of execution state. They can run independently and scale quickly

**SWF Domains**

* Your workflow and activity types and the workflow execution itself are all scoped to a domain. Domains isolate a set of types, executions, and task lists from others within the same account
* The parameters are specified in JSON format

**How long for workflows?**

Maximum workflow can be one year and the value is always measured in seconds

**SWF vs SQS**

* SWF presents a task-oriented API, whereas SQS offers a message-oriented API
* SWF ensures that a task is assigned only once and is never duplicated, with SQS you need to handle duplicated messages and may also need to ensure that a message is processed only once
* SWF keeps track of all the task and events in an application with SQS you need to implement you own application-level tracking, especially if your application uses multiple queues

**What is SNS?**

* AWS SNS (Simple Notification Service) is a web service that makes it easy to set up, operate, and send notifications from the cloud. It provides developers with highly scalable, flexibile, and cost-effective capability to publish messages from an application and immediately deliver them to subscribers or other applications
* SNS allows you to group multiple recipients using topics. Topic is an "access point" for allowing recipients to dynamically subscribe for identical copies of the same notification. One topic can support deliveries to multiple endpoint types
* To prevent messages from being lost, all messages published to SNS are stored redundantly across multiple AZs

**SNS Benefits**

* Instantaneous, push-based delivery (no polling)
* Simple APIs and easy integration with applications
* Flexible message delivery over multiple transport protocols
* Inexpensive, pay-as-you-go model with no up-front costs
* Web-based AWS management console offers the simplicity of a point-and-click interface

**SNS vs SQS**

* Both messaging services in AWS
* SNS - Push
* SQS - Polls (Pulls)

**SNS Pricing**

* User pay $0.50 per 1 million Amazon SNS Request
* $0.06 per 100,000 notification deliveries over HTTP
* $0.75 per 100 notification deliveries over SMS
* $2.00 per 100,000 notification deliveries over Email

**Elastic Transcoder**

* Media transcoder in the cloud
* Convert media files from their original source format in to different formats that will play on smartphones, tablets, PCs, etc
* Provides transcoding presets for popular output formats, which means that you do not need to guess about which settings work best on particular devices
* Pay based on the minutes that you transcode and the resolution at which you transcode

**What is API Gateway?**

API Gateway is a fully managed service that makes it easy for developers to publish, maintain, monitor, and secure APIs at any scale.

**What is API Caching?**

API caching can reduce the number of calls made to your endpoint and also improve latency of the requests to your API. When you enable caching for a stage, API Gateway caches responses from your endpoint for a specified TTL (time-to-live) period, in seconds. API Gateway then responds to the request by looking up the endpoint response from the cache instead of making a request to your endpoint.

**What can API Gateway do?**

* Low cost and efficient
* Scales effortlessly
* You can throttle requests to prevent attacks
* Connect to CloudWatch to log all requests

**Same Origin Policy**

In computing, the same-origin policy (web app security model) states that a web browser permits scripts contained in a first web page to access data in a second web page but only if both web pages have the same origin.

**Cross-Origin Resource Sharing (CORS)**

* CORS is one way the server at the other end (not the client code in the brower) can relax the same-origin policy
* Cross-origin resource sharing (CORS) is a mechanism that allows restricted resources (e.g. fonts) on a web page to be requested from another domain outside the domain from which the first resource was served
* Error - "Origin policy cannot be read at the remote resource?" - You need to enable CORS on API Gateway

**Exam Tips - API Gateway**

* Remember what API Gateway is at a high level
* API Gateway has caching capabilities to increase performance
* API Gateway is low cost and scales automatically
* You can throttle API Gateway to prevent attacks
* You can log results to CloudWatch
* If you are using JavaScript/AJAX that uses multiple domains with API Gateway, ensure that you have enabled CORS on API Gateway

**What is streaming data?**

* Streaming data is data that is generated continuously by thousands of data sources, which typically send in the data records simultaneously and in small sizes (KB)
* Streaming data includes:
  + Purchases from online stores
  + Stock prices
  + Game data
  + Social network data
  + Geospatial data
  + IoT sensor data

**What is Kinesis?**

Amazon Kinesis is a platform on AWS to send your streaming data to. Kinesis makes it easy to load and analyze streaming data.

**What are the core Kinesis Services?**

* Kinesis Streams
* Kinesis Firehose
* Kinesis Analytics

**Kinesis Streams**

* Kinesis Streams consist of shards
  + Five transactions per second for reads, up to a maximum total data read rate of two 2 Mbps and up to 1,000 records per second for writes, up to a maximum toala data write rate of 1 Mbps
  + The data capacity of your stream is a function of the number of shards that you specify for the stream. The total capcity of the stream is the sum of the capacities of its shards

**Kinesis Firehose**

Amazon Kinesis Data Firehose is the easiest way to reliably load streaming data into data stores and analytics tools. It can capture, transform, and load streaming data into Amazon S3, Amazon Redshift, Amazon Elasticsearch Service, and Splunk, enabling near real-time analytics with existing business intelligence tools and dashboards you’re already using today. It is a fully managed service that automatically scales to match the throughput of your data and requires no ongoing administration. It can also batch, compress, transform, and encrypt the data before loading it, minimizing the amount of storage used at the destination and increasing security.

**Kinesis Analytics**

Amazon Kinesis Data Analytics is the easiest way to process streaming data in real time with standard SQL without having to learn new programming languages or processing frameworks. Amazon Kinesis Data Analytics enables you to query streaming data or build entire streaming applications using SQL, so that you can gain actionable insights and respond to your business and customer needs promptly.

**Exam Tips - Kinesis**

* Know the difference between Kinesis Streams and Kinesis Firehose
* Understand what Kinesis Analytics is

**Section 9 Quiz**

**1. What does Amazon SWF stand for?**

* Simple Work Flow

**2. What does Amazon SES stand for?**

* Simple Email Service

**3. What happens when you create a topic on Amazon SNS?**

* An Amazon Resource Name is created

**4. What is the difference between SNS and SQS?**

* SNS is a push notification service, whereas SQS is a message systemn that requires worker nodes to poll the queue

**5. What application service allows you to decouple your infrastructure using messaged based queues?**

* SQS

**6. What does a "domain" refer to in Amazon SWF?**

* A collection of related workflows

**7. By default, EC2 instances pull SQS messages from an SQS queue on a FIFO (First In First out) basis.**

* False

**8. Amazon's SQS service guarantees a message will be delivered at least once.**

* True

**9. Amazon SWF ensures that a task is assigned only once and is never duplicated.**

* True

**10. Amazon SWF restricts individuals to use specific programming languages.**

* False

**Section 10: The Real World**

There are no lecture notes in this section, only a real life example on how to build a website using AWS and WordPress.

**Section 11: The Well Architected Framework**

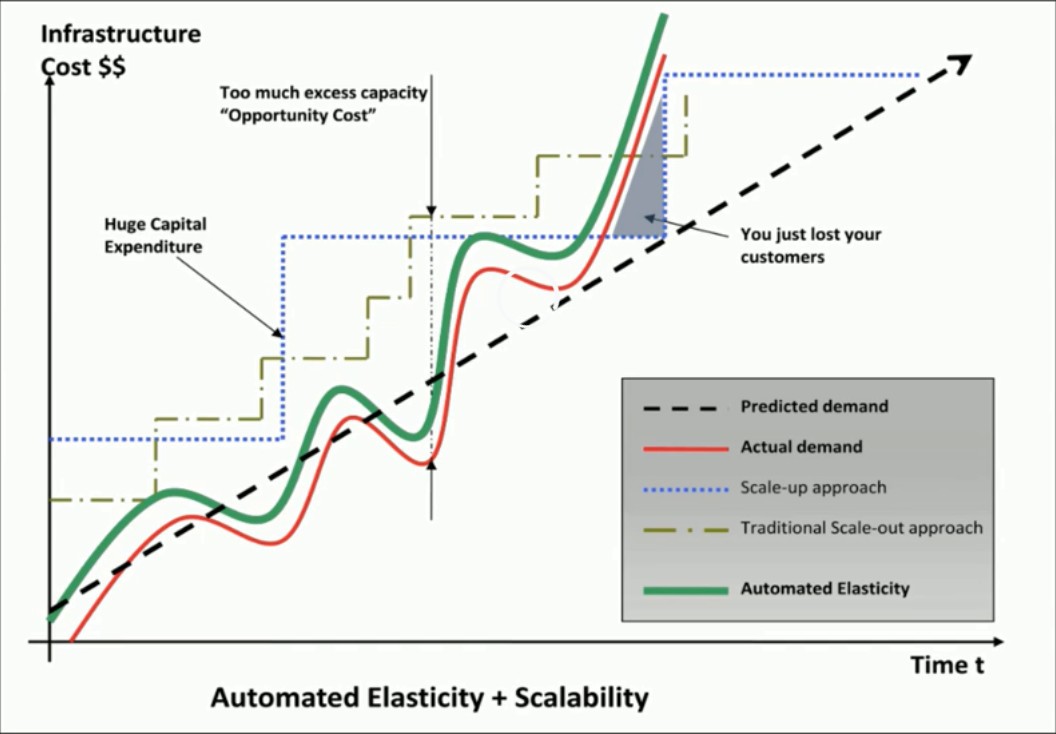
This section will cover an in-depth overview on AWS Application Services.

**Business Benefits of Cloud**

* Almost zero upfront infrastructure investment
* Just-in-time infrastructure
* More efficient resource utilization
* Usage-based costing
* Reduced time to market

**Technical Benefits of Cloud**

* Automation - "Scriptable infrastructure"
* Auto-scaling
* Proactive scaling
* More efficient development lifecycle
* Improved testability
* Disaster recovery and business continuity
* "Overflow" the traffic to the cloud

[](https://github.com/stevenxchung/AWS-CSAA-ACloudGuru/blob/master/Section%2011%20--%20The%20Well%20Architected%20Framework/elasticity.jpg)

**Figure 11-1. Infrastructure cost vs time**

**Design for Failure**

Rule of thumb: be a pessimist when designing architectures in the cloud; assume things will fail. In other words, always design, implement and deploy for automated recovery from failure.

**Decouple Your Components**

The key is to build components that do not have tight dependencies on each other, so that if one component were to die, sleep, or remain busy for some reason, the other components in the system are built so as to continue to work as if no failure is happening.

**Implement Elasticity**

The cloud brings a new concept of elasticity in your applications. Elasticity can be implemented in three ways:

1. Proactive cyclic scaling: periodic scaling that occurs at fixed interval (daily, weekly, monthly, and quarterly)
2. Proactively event-based scaling: scaling just when you are expecting a big surge of traffic requests due to a scheduled business event (new product launch, marketing campaigns)
3. Auto-scaling based on demand. By using a monitoring service, your system can send triggers to take appropriate actions so that it scales up or down based on metrics (utilization of the servers or network i/o for instance)

**Secure Your Application**

Depending on your setup, securing your application is important, see Figure 11-2 on application security at different levels of the application.

[A screenshot of a cell phone

Description automatically generated](https://github.com/stevenxchung/AWS-CSAA-ACloudGuru/blob/master/Section%2011%20--%20The%20Well%20Architected%20Framework/secure-app.jpg)

**Figure 11-2. Application security at different levels**

**What is a well architected framework?**

This has been developed by the Solution Architecture team based on their experience with helping AWS customers. The well architected framework is a set of questions that you can use to evaluate how well your architecture is aligned to AWS best practices.

**Five Pillars of The Well-Architected Framework**

* Security
* Reliability
* Performance efficiency
* Cost optimization
* Operational excellence

**Structure of each Pillar**

* Design principles
* Definition
* Best practices
* Key AWS services
* Resources

**General Design Principles**

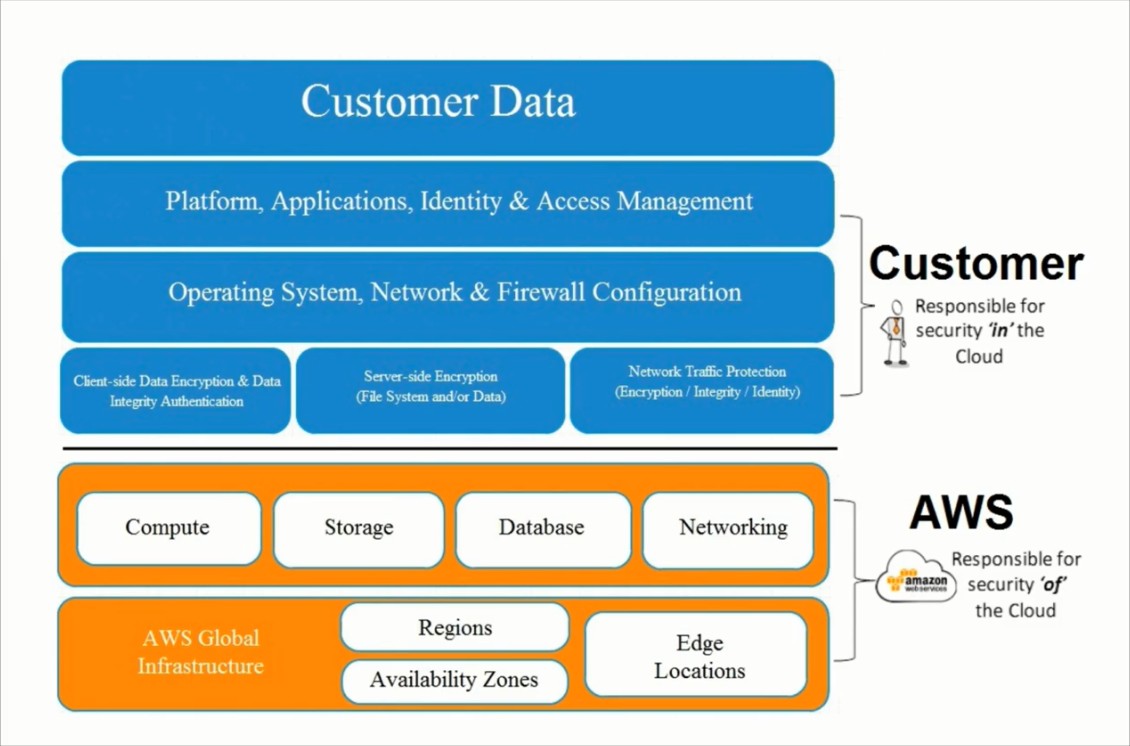
* Stop guessing your capacity needs
* Test systems at production scale
* Automate to make architectural experimentation easier
* Allow for evolutionary architectures
* Data-driven architectures
* Improve through game days

**Pillar One - Security Design Principles**

* Apply security at all layers
* Enable traceability
* Automate responses to security events
* Focus on securing your system
* Automate security best practices

**Pillar One - AWS Shared Responsibility Model**

Shown in Figure 11-3 is the AWS shared responsibility model between AWS and the customer. Although the scope of responsibility differs for AWS vs the customer, each party has equal responsibility in securing data.

[](https://github.com/stevenxchung/AWS-CSAA-ACloudGuru/blob/master/Section%2011%20--%20The%20Well%20Architected%20Framework/aws-shared-res.jpg)

**Figure 11-3. AWS shared responsibility model**

**Pillar One - Security Definition**

Security in the cloud consist of 4 areas:

1. Data protection
2. Privilege management
3. Infrastructure protection
4. Detective controls

**Pillar One - Best Practices - Data Protection**

* Before you begin to architect security practices across your environment, basic data classification should be in place. You should organize and classify your data into segments. You should implement a least privilege access system so that people are only able to access what they need. However, most importantly you should encrypt everything where possible, whether it be at rest or in transit.
* In AWS the following practices help to protect your data:
  + AWS customers maintain full control over their data
  + AWS has designed storage system for exceptional resiliency
  + AWS makes it easier for you to encrypt your data and manage keys, including regular key rotation, which can be easily automated natively by AWS or maintained by a customer
  + Detailed logging is available that contains important content, such as file access and changes
  + Versioning which can be part of a larger data lifecycle management process, can protect against accidental overwrites, deletes, and similar harm
  + AWS never initiates the movement of data between regions. Content is placed in a region will remain in that region unless the customer explicitly enables a feature or leverages a service that provides that functionality

**Pillar One - Best Practices - Data Protection Questions**

* How are you encrypting and protecting your data at rest?
* How are you encrypting and protecting your data in transit? (SSL)

**Pillar One - Best Practices - Privilege Management**

Privilege management ensures that only authorized and authenticated users are able to access your resources, and only in a manner that is intended. It can include:

* ACLs (Access Control Lists)
* Role-based access controls
* Password management (such as password rotation policies)

**Pillar One - Best Practices - Privilege Management Questions**

* How are you protecting access to and use of the AWS root account credentials
* How are you defining roles and responsibilities of system users to control human access to the AWS management console and APIs?
* How are you limiting automated access (such as from applications, scripts, or third-party tools or services) to AWS resources?
* How are you managing keys and credentials

**Pillar One - Best Practices - Infrastructure Protection**

Outside of cloud, this is how you protect your data center. RFID controls, security, lockable cabinets, CCTV, etc. Within AWS they handle this, so really infrastructure protection exists at a VPC level.

**Pillar One - Best Practices - Infrastructure Protection Questions**

* How are you enforcing network and host-level boundary protection?
* How are you enforcing AWS service level protection?
* How are you protecting the integrity of the operating systems on your Amazon EC2 instances?

**Pillar One - Best Practices - Detective Controls**

You can use detective controls to detect or identify a security breach. AWS services to achieve this include:

* AWS S3
* AWS Config
* AWs Glacier
* AWS CloudTrail
* AWS CloudWatch

**Pillar One - Best Practices - Detective Controls Questions**

* How are you capturing and analyzing AWS logs?

**Pillar One - Key AWS Services**

* Data protection
  + You can encrypt you data both in transit and at rest using EBS, S3, and RDS
* Privilege management
  + IAM, MFA
* Infrastructure protection
  + VPC
* Detective controls
  + AWS CloudTrail, AWS Config, AWS CloudWatch

**Pillar One - Security Exam Tips**

Security in the cloud consist of 4 areas:

1. Data protection
2. Privilege management
3. Infrastructure protection
4. Detective controls

Also review each questions section within Pillar One.

**Pillar Two - The Reliability Pillar**

The reliability pillar covers the ability of a system to recover from service or infrastructure outages/disruptions as well as the ability to dynamically acquire computing resources to meet demand.

**Pillar Two - Reliability Design Principles**

* Test recovery procedures
* Automatically recover from failure
* Scale horizontally to increase aggregate system availability
* Stop guessing capacity

**Pillar Two - Reliability Definition**

Reliability in the cloud consists of three areas:

* Foundations
* Change management
* Failure management

**Pillar Two - Best Practices - Foundations**

* Before architecting any system, you need to make sure you have the prerequisite foundations. In traditional IT one of the first things you should consider is the size of the communications link between your HQ and your data center. If you under evaluate this link, it can take three to six months to upgrade which can cause a huge disruption to your traditional IT estate
* AWS handles most of the foundations for you. The cloud is designed to be essentially limitless meaning that AWS handle the networking can compute requirements themselves. However, they do set service limits to stop customers from accidentally over-provisioning resources

**Pillar Two - Best Practices - Foundations Questions**

* How are you managing AWS service limits for your account?
* How are you planning your network topology on AWS?
* Do you have an escalation path to deal with technical issues?

**Pillar Two - Best Practices - Change Management**

* You need to be aware of how change affects a system so that you can plan proactively around it. Monitoring allows you to detect any changes to your environment and react. In traditional systems, change control is done manually and are carefully coordinated with auditing
* AWS makes things a lot easier, you can use CloudWatch to monitor your environment and services such as auto scaling to automate change in response to changes on your production environment

**Pillar Two - Best Practices - Change Management Questions**

* How does your system adapt to changes in demand?
* How are you monitoring AWS resources?
* How are you executing change management?

**Pillar Two - Best Practices - Failure Management**

You should always architect your systems with the assumptions that failure will occur. You should become aware of these failures, how they occurred, how to respond to them and then plan on how to prevent these from happening again.

**Pillar Two - Best Practices - Failure Management Questions**

* How are you backing up your data?
* How does your system withstand component failures?
* How are you planning for recovery?

**Pillar Two - Key AWS Services**

* Foundations
  + IAM, VPC
* Change management
  + AWS CloudTrail
* Failure management
  + AWS CloudFormation

**Pillar Two - Reliability Exam Tips**

Reliability in the cloud consists of three areas:

* Foundations
* Change management
* Failure management

Also review each questions section within Pillar Two.

**Pillar Three - The Performance Efficiency Pillar**

The performance efficiency pillar focuses on how to use computing resources efficiently to meet your requirements and how to maintain that efficiency as demand changes and technology evolves.

**Pillar Three - Performance Efficiency Design Principles**

* Democratize advanced technologies
* Go global in minutes
* Use server-less architectures
* Experiment more often

**Pillar Three - Performance Efficiency Definition**

Performance efficiency in the cloud consists of four areas:

1. Compute
2. Storage
3. Database
4. Space-time trade-off

**Pillar Three - Best Practices - Compute**

* When architecting your system it is important to choose the right kind of server. Some applications require heavy CPU utilization, some require heavy memory utilization, etc
* AWS servers are virtualized and at the click of a button (or API call). You can change the type of server in which your environment is running on. You can even switch to running with no servers at all and use AWS Lambda

**Pillar Three - Best Practices - Compute Questions**

* How do you select the appropriate instance type for your system?
* How do you ensure that you continue to have the most appropriate instance type as new instance types and features are introduced?
* How do you monitor your instances post launch to ensure they are performing as expected?
* How do you ensure that the quantity of your instances matches demand?

**Pillar Three - Best Practices - Storage**

The optimal storage solutions for your environment depends on a number of factors. For example:

* Access method - block, file or object
* Patterns of access - random or sequential
* Throughput required
* Frequency of access - online, offline or archival
* Frequency of update - worm, dynamic
* Availability constraints
* Durability constraints
* At AWS the storage is virtualized. In S3 you can have 11 x 9's durability, cross region replication, etc. In EBS you can choose between different storage mediums (such as SSD, magnetic, PIOPS, etc). You can also easily move volumes between the different types of storage mediums

**Pillar Three - Best Practices - Storage Questions**

* How do you select the appropriate storage solution for your system?
* How do you ensure that you continue to have the most appropriate storage solution as new storage solutions and features are launched?
* How do you monitor your storage solution to ensure it is performing as expected?
* How do you ensure that the capacity and throughput of your storage solutions matches demand?

**Pillar Three - Best Practices - Database**

* The optimal database solution depends on a number of factors, do you need database consistency, do you need high availability, do you need No-SQL, and do you need DR etc?
* You get a lot of options in AWS; RDS, DynamoDB, Redshift, etc

**Pillar Three - Best Practices - Database Questions**

* How do you select the appropriate database solution for your system?
* How do you ensure that you continue to have the most appropriate database solution and features as new database solution and features are launched?
* How do you monitor your databases to ensure performance is as expected?
* How do you ensure the capacity and throughput of your databases matches demand?

**Pillar Three - Best Practices - Space-time Trade-off**

* You can use services such as RDS to add read replicas, reducing the load on your database and creating multiple copies of the database. This helps to lower latency
* You can use Direct Connect to provide predictable latency between your HQ and AWS
* You can use the global infrastructure to have multiple copies of your environment, in regions that is closest to your customer base
* You can also use caching services such as ElastiCache or CloudFront to reduce latency

**Pillar Three - Best Practices - Space-time Trade-off Questions**

* How do you select the appropriate proximity and caching solutions for your system?
* How do you ensure that you continue to have the most appropriate proximity and caching solutions as new solutions are launched?
* How do you monitor your proximity and caching solutions to ensure performance is as expected?
* How do you ensure that the proximity and caching solutions you have matches demand?

**Pillar Three - Key AWS Services**

* Compute
  + Auto scaling
* Storage
  + EBS, S3, Glacier
* Database
  + RDS, DynamoDB, Redshift
* Space-time Trade-off
  + CloudFront, ElastiCache, Direct Connect, RDS Read Replicas, etc.

**Pillar Three - Performance Efficiency Exam Tips**

Performance efficiency in the cloud consists of four areas:

1. Compute
2. Storage
3. Database
4. Space-time trade-off

Also review each questions section within Pillar Three.

**Pillar Four - The Cost Optimization Pillar**

Use the cost optimization pillar to reduce your costs to a minimum and use those savings for other parts of your business. A cost-optimized system allows you to pay the lowest price possible while still achieving your business objectives.

**Pillar Four - Cost Optimization Design Principles**

* Transparently attribute expenditure
* Use managed services to reduce cost of ownership
* Trade capital expense for operating expense
* Benefit from economies of scale
* Stop spending money on data center operations

**Pillar Four - Cost Optimization Definition**

Cost optimization in the cloud consists of four areas:

1. Matched supply and demand
2. Cost-effective resources
3. Expenditure awareness
4. Optimizing over time

**Pillar Four - Best Practices - Matched Supply and Demand**

Try to optimally align supply with demand. Don't over or under provision, instead as demand grows, so should your supply of compute resources. Think of things like auto scaling which scale with demand. Similarly in a server-less context, use services such as Lambda that only execute when a requests comes in.

**Pillar Four - Best Practices - Matched Supply and Demand Questions**

* How do you make sure your capacity matches but does not substantially exceed what you need?
* How are you optimizing your usage of AWS services?

**Pillar Four - Best Practices - Cost-effective Resources**

Using the correct instance type can be key to cost savings.

**Pillar Four - Best Practices - Cost-effective Resources Questions**

* Have you selected the appropriate resource types to meet your cost targets?
* Have you selected the appropriate pricing model to meet your cost targets?
* Are there managed services (higher-level services than EC2, EBS, and S3) that you can use to improve your ROI?

**Pillar Four - Best Practices - Expenditure Awareness**

You no longer have to go out and get quotes in physical servers, choose a supplier, have those resources delivered, installed, and made available with cloud. You can provision things within seconds. However, this comes with issues as many organizations have different teams, each with their own AWS accounts. Being aware of what each team is spending and where is crucial to any well architected system. You can use cost allocation tags to track this, billing alerts as well as consolidated billing.

**Pillar Four - Best Practices - Expenditure Awareness Questions**

* What access controls and procedures do you have in place to govern AWS costs?
* How are you monitoring usage and spending?
* How do you decommission resources that you no longer need, or stop resources that are temporarily not needed?
* How do you consider data-transfer charges when designing your architecture?

**Pillar Four - Best Practices - Optimizing Over Time**

AWS moves fast. There are hundreds of new services. A service that you chose yesterday may not be the best service to be using today. You should keep track of the changes made to AWS and constantly re-evaluate your existing architecture.

**Pillar Four - Best Practices - Optimizing Over Time Questions**

* How do you manage and/or consider the adoption of new services?

**Pillar Four - Key AWS Services**

* Matched supply and demand
  + Auto scaling
* Cost-effective resources
  + EC2 (reserved instances), AWS trusted advisor
* Expenditure awareness
  + CloudWatch Alarms, SNS
* Optimizing over time
  + AWS blog, AWS trusted advisor

**Pillar Four - Cost Optimization Exam Tips**

Cost optimization in the cloud consists of four areas:

1. Matched supply and demand
2. Cost-effective resources
3. Expenditure awareness
4. Optimizing over time

Also review each questions section within Pillar Four.

**Pillar Five - Operational Excellence Pillar**

* The operational excellence pillar includes operational practices and procedures used to manage production workloads
* This includes how planned changes are executed, as well as responses to unexpected operational events
* Change execution and responses should be automated. All processes and procedures of operational excellence should be documented tested, and regularly reviewed

**Pillar Five - Operational Excellence Design Principles**

* Perform operations with code
* Align operations processes to business objectives
* Make regular, small, incremental changes
* Test for responses to unexpected events
* Learn from operational events and failure
* Keep operation procedures current

**Pillar Five - Operational Excellence Definition**

There are three best practice areas for operational excellence in the cloud:

* Preparation
* Operation
* Response

**Pillar Five - Best Practices - Preparation**

* Effective preparation is required to drive operational excellence
* Operation checklists will ensure that workloads are ready for production
* Operation and prevent unintentional production promotion without effective preparation
* Workloads should have:
  + Runbooks - operations guidance that operation teams can refer to so they can perform normal daily tasks
  + Playbooks guidance for responding to unexpected operational events. Playbooks should include response plans, as well as escalation paths and stakeholder notifications
* CloudFormation can be used to ensure that environments contain all required resources when deployed in production and that the configuration of the environment is based on tested best practices, which reduces the opportunity for human error
* Implementing auto scaling, or other automated scaling mechanisms, will allow workloads to automatically respond when business-related events affect operational needs
* Services like AWS Config with the AWS Config rules feature create mechanisms to automatically track and respond to changes in your AWS workloads and environments
* It is also important to use feature like tagging to make sure all resources in a workload can be easily identified when needed during operations and responses

**Pillar Five - Best Practices - Preparation Questions**

The following questions focus on preparation considerations for operational excellence:

* What best practices for cloud operations are you using?
* How are you doing configuration management for your workload?

**Pillar Five - Best Practices - Operations**

* Operations should be standardized and manageable on a routine basis. The focus should be on automation, small frequent changes, regular quality assurance testing, and defined mechanisms to track, audit, rollback, and review changes. Changes should not be large and infrequent, they should not require scheduled downtime, and they should not require manual execution. A wide range of logs and metrics that are based on key operational indications for a workload should be collected and reviewed to ensure continuous operations
* In AWS you can set up a continuous integration/continuous deployment (CI/CD) pipeline. Release management processes, whether manual or automated, should be tested and be based on small incremental changes, and tracked versions. You should be able to revert changes that introduce operational issues without causing operational impact

**Pillar Five - Best Practices - Operations Questions**

The following questions focus on operations considerations for operational excellence:

* How are you evolving your workload while minimizing the impact of change?
* How do you monitor your workload to ensure it is operating as expected?

**Pillar Five - Best Practices - Responses**

* Responses to unexpected operational events should be automated. This is not just for alerting but also for mitigation, remediation, rollback, and recovery
* In AWS, there are several mechanisms to ensure both appropriate alerting and notification in response to unplanned operational events, as well as automated responses

**Pillar Five - Best Practices - Responses Questions**

The following questions focus on operations considerations for operational excellence:

* How do you respond to unplanned operational events?
* How is escalation managed when responding to unplanned operational events?

**Pillar Five - Key AWS Services**

**Preparation**: AWS Config provides a detailed inventory of your AWS resources and configuration, and continuously records configuration changes. AWS Service Catalog helps to create a standardized set of service offerings that are aligned to best practices. Designing workloads that use automation with services like Auto Scaling and SQS are good methods to ensure continuous operations in the event of unexpected operational events.

**Operations**: AWS CodeCommit, CodeDeploy, and CodePipeline can be used to manage and automate code changes to AWS workloads. Use AWS SDKs or third-party libraries to automate operational changes. Use AWS CloudTrail to audit and track changes made to AWS environments.

**Reponses**: CloudWatch alarms can be used to set thresholds for alerting and notification. CloudWatch events can trigger notifications and automated responses.

**Pillar Five - Operational Excellence Exam Tips**

There are three best practice areas for operational excellence in the cloud:

* Preparation
* Operation
* Response

Also review each questions section within Pillar Five.

**Summary of The Well Architected Framework**

Review each "Exam Tips" section in each pillar as well as the "Questions" section in each pillar.

**Section 11 Quiz (Mega Quiz)**

**1. Amazon SWF is designed to help users:**

* Coordinate synchronous and asynchronous tasks

**2. In RDS, what is the maximum value I can set for my backup retention period?**

* 35 Days

**3. Automated backups are enabled by default for a new DB Instance?**

* True

**4. Amazon RDS does not currently support increasing storage on a \_\_\_\_ Db instance**

* SQL Server

**5. In what circumstances would I choose provisioned IOPS in RDS over standard storage?**

* If you use production online transaction processing

**6. Amazon's S3 is:**

* Object based storage

**7. In S3 with RRS the availability is:**

* 99.99%

**8. Amazon's EBS volumes are:**

* Blocked based storage

**9. If I want to run a database on an EC2 instance, which is the most recommended Amazon storage option?**

* EBS

**10. In S3 the durability of my files is:**

* 99.999999999%

**11. Can you access Amazon EBS Snapshots?**

* Yes, through the AWS APIs/CLI and AWS console

**12. A \_\_\_\_\_\_\_\_\_\_ is a document that provides a formal statement of one or more permissions.**

* Policy

**13. In a default VPC, all Amazon EC2 instances are assigned 2 IP addresses at launch, what are these?**

* Private IP address and public IP address

**14. If an Amazon EBS volume is the root device of an instance, can I detach it without stopping the instance?**

* No

**15. If you want your application to check whether a request generated an error then you look for an \_\_\_\_\_\_ node in the response from the Amazon RDS API**

* Error

**16. EC2 instances can have credentials stored on them so that the instances can access other resources (such as S3 buckets) and AWS recommends that you do this instead of assigning roles.**

* False

**17. Can I move a reserved instance from one region to another?**

* No

**18. In S3 RRS the durability of my files is:**

* 99.99%

**19. In RDS, changes to the backup window take effect:**

* Immediately

**20. In RDS what is the maximum size for a Microsoft SQL Server DB Instance with SQL Server Express edition?**

* 10 GB per database

**21. In S3 what does RRS stand for?**

* Reduced Redundancy Storage

**22. Can I "force" a failover for any RDS instance that has Multi-AZ configured?**

* Yes

**23. What does EBS stand for?**

* Elastic Block Storage

**24. You can conduct your own vulnerability scans within your own VPC without alerting AWS first?**

* False

**25. Reserved instances are available for multi-AZ deployments.**

* True

**26. Amazon's Glacier service is a Content Distribution Network which integrates with S3.**

* False

**27. MySQL installations default to port number:**

* 3306

**28. If an Amazon EBS volume is an additional partition (i.e. not the root volume), can I detach it without stopping the instance?**

* Yes, although it may take some time

**29. Every user you create in the IAM systems starts with \_\_\_\_\_**

* No Permissions

**30. You can RDP or SSH in to an RDS instance to see what is going on with the operating system.**

* False

**31. When creating a new security group, all in bound traffic is allowed by default.**

* False

**32. To save administration headaches, Amazon recommend that you leave all security groups in web facing subnets open on port 22 to 0.0.0.0/0 CIDR, that way you can connect where ever you are in the world.**

* Incorrect

**33. What are the four levels of AWS premium support?**

* Basic, Developer, Business, Enterprise

**34. As the AWS platform is PCI DSS 1.0 compliant, I can immediately deploy a website to it that can take and store credit card details. I do not need to get any kind of delta accreditation from a QSA.**

* False

**35. To help you manage your Amazon EC2 instances you can assign your own metadata in the form of:**

* Tags

**36. Which statement best describes Availability Zones?**

* Distinct locations within an AWS region that are engineered to be isolated from failures

**37. The service to allow Big Data Processing on the AWS platform is known as AWS "Elastic Big Data".**

* False

**38. Individual instances are provisioned in:**

* Availability Zones

**39. When using a custom VPC and placing an EC2 instance in to a public subnet, it will be automatically internet accessible (i.e. you do not need to apply an elastic IP address or ELB to the instance).**

* False

**40. What is the underlying Hypervisor for EC2?**

* Xen

**41. The AWS platform is certified PCI DSS 1.0 compliant**

* True

**42. The AWS platform consists of how many regions currently?**

* 14

**43. How many copies of my data does RDS - Aurora store by default?**

* 6

**44. Amazon's product debut conference is held in Las Vegas each year and is known as:**

* Re-Invent

**45. What is the difference between Elastic Beanstalk & CloudFormation?**

* Elastic Beanstalk automatically handles the deployment, from capacity provisioning, load balancing, auto-scaling to application health monitoring based on the code you upload to it, whereas CloudFormation is an automated provisioning engine designed to deploy entire cloud environments via a JSON script

**46. In RDS, you are responsible for maintaining OS & Application security patching, antivirus etc.**

* False

**47. What is the maximum response time for a Business Level Premium Support Case?**

* 1 Hour

**48. When I create a new security group, all outbound traffic is allowed by default.**

* True

**49. What types of RDS databases are currently available?**

* Oracle, SQL, MySQL, Postgres

**50. I can enable multifactor authentication by using:**

* IAM

**51. When deploying databases on your own EC2 instances, it is recommended that you deploy these on magnetic storage rather than SSD storage as you get better performance.**

* False

**52. AWS DNS service is known as:**

* Route 53

**53. Auditing user access/API calls etc across the entire AWS estate can be achieved by using:**

* CloudTrail

**Section 12: Additional Exam Tips**

This section will cover additional exam tips from previous sections.

**What is Kinesis?**

* Amazon Kinesis is a fully managed service for real-time processing of streaming data at massive scale. You can configure hundreds of thousands of data producers to continuously put data into an Amazon Kinesis stream
* Think Kinesis when:
  + Consuming big data
  + Stream large amounts of social media, news feeds logs, etc. into the cloud
* Process large amounts of data:
  + Redshift for business intelligence
  + Elastic map reduce for big data processing

**EC2 - EBS Backed vs Instance Store**

* EBS backed volumes are persistent
* Instance Store backed volumes are not persistent (ephemeral)
* EBS volumes can be detached and reattached to other EC2 instances
* Instance store volume cannot be detached and reattached to other instances - they exist only for the life of that instance
* EBS volumes can be stopped; data will persist
* Instance store volumes cannot be stopped - if you do this the data will be wiped
* EBS backed = store data long-term
* Instance store = should not be used for long-term data storage

**OpsWorks**

* Orchestration Services that uses Chef
* Chef consists of recipes to maintain a consistent state
* Look for the term "chef" or "recipes" or "cook books" and think OpsWorks

**Elastic Transcoder**

* Media transcoder in the cloud
* Convert media files from their original source format into different formats that will play on smartphones, tablets, PC's, etc
* Provides transcoding presets for popular output formats, which means that you do not need to guess about which setting work best on particular devices
* Pay based on the minutes that you transcode and the resolution at which you transcode

**SWF Actors**

* Workflow Starters - An application that can initiate a workflow
* Deciders - Control the flow of activity tasks in a workflow execution
* Activity Workers - Carry out the activity tasks

**EC2 - Get Public IP Address**

* Need to query the instances metadata:
  + curl <http://169.254.169.254/latest/meta-data/>
  + wget <http://169.254.169.254/latest/meta-data/>
  + Key thing to remember is that it is an instances **metadata** no user data

**What is AWS Organizations?**

* AWS Organizations is an account management service that enables you to consolidate multiple AWS accounts into an organization that you create and centrally manage
* Available in two feature sets:
  + Consolidated billing
  + All features

**Advantages of Consolidated Billing**

* One bill per AWS account
* Very easy to track charges and allocate costs
* Volume pricing discount

**AWS Organizations and Consolidated Billing - Best Practices**

* Always enable multi-factor authentication on root account
* Always use a strong and complex password on root account
* Pay account should be used for billing purposes only. Do not deploy resources in to paying account

**AWS Organizations and Consolidated Billing - Notes**

* Linked accounts
  + 20 linked accounts only
* Billing alerts
  + When monitoring is enabled on the paying account the billing data for all linked accounts is included
  + You can still create billing alerts per individual account
* CloudTrail
  + Per AWS account and is enabled per region
  + Can consolidate logs using an S3 bucket:
    1. Turn on CloudTrail in the paying account
    2. Create a bucket policy that allows cross account access
    3. Turn on CloudTrail in the other accounts and use the bucket in the paying account

**AWS Organizations and Consolidated Billing - Exam Tips**

* Consolidated billing allows you to get volume discounts on all your accounts
* Unused reserved instances for EC2 are applied across the group
* CloudTrail is on a per account and per region basis but can be aggregated into a single bucket in the paying account
* AWS Organizations allows you to:
  + Centrally manage policies across multiple AWS accounts
  + Control access to AWS services
  + Automate AWS account creation and management
  + Consolidate billing across multiple AWS accounts

**What is Cross Account Access?**

Cross account access makes it easier for you to work productively within a multi-account AWS environment by making it easy for you to switch roles within the AWS Management Console. You can now sign into the console using your IAM user name then switch the console to manage another account without having to enter another username and password.

**What are Tags?**

* Key value pairs attached to AWS resources
* Metadata (data about data)
* Tags can sometimes be inherited
  + Auto scaling, CloudFormation, and Elastic Beanstalk can create other resources

**What are resource groups?**

* Resource groups make it easy to group your resources using the tags that are assigned to them
* Resource groups contain information such as:
  + Region
  + Name
  + Health checks
* Specific information
  + For EC2 - Public and private IP addresses
  + For ELB - Port configurations
  + For RDS - Database engine etc

**AWS Resource Groups**

There are two types of AWS resource groups:

* Classic resource groups
* AWS systems manager

**What is VPC Peering?**

* VPC Peering is simply a connection between two VPCs that enables you to route traffic between them using private IP addresses. Instances in either VPC can communicate with each other as if they are within the same network. You can create a VPC peering connection between your own VPCs, or with a VPC in another AWS account within a **single region**
* AWS uses the existing infrastructure of a VPC to create a VPC peering connection; it is neither a gateway nor a VPN connection, and does not rely on a separate piece of physical hardware. There is no single point of failure for communication or a bandwidth bottleneck

**VPC Peering Limitations**

* VPC peering does not support transitive peering relationships
* You cannot create a VPC peering connection between VPCs in different regions
* You cannot create a VPC peering connection between VPCs that have matching or overlapping CIDR blocks

**Direct Connect**

AWS Direct Connect makes it easy to establish a dedicated network connection from your premises to AWS. Using AWS Direct Connect, you can establish private connectivity between AWS and your data center, office, or co-location environment, which in many cases can reduce your network costs, increase bandwidth throughput, and provide a more consistent network experience than internet-based connections.

**Direct Connect Benefits**

* Increase bandwidth
* Increate reliability
* Reduce costs when using large volumes of traffic

**How is Direct Connect different from a VPN?**

* 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

**Direct Connect Connections**

* Connections are available in:
  + 1 Gbps
  + 10 Gbps
* Sub 1 Gbps can be purchased through AWS direct connect partners
* Uses Ethernet VLAN trunking (802.1Q)

**Security Token Service (STS)**

* Grants users limited and temporary access to AWS resources. Users can come from three sources:
  + Federation (typically Active Directory)
    - Uses SAML (Security Assertion Markup Language)
    - Single sing on allows users to log into AWS console without assigning IAM credentials
    - Grants temporary access based off the users Active Directory credentials. Does not need to be a user in IAM
  + Federation with Mobile Apps
    - Use Facebook/Amazon/Google or other OpenID providers to log in
  + Cross Account Access
    - Lets users from one AWS account access resources in another

**Understanding Key Terms**

* Federation
  + Combining or joining a list of users in one domain (such as IAM) with a list of users in another domain (such as Active Directory, Facebook, etc)
* Identity Broker
  + A service that allows you to take an identity from point A and join it (federate it) to point B
* Identity Store
  + Services like Active Directory, Facebook, Google, etc
* Identities
  + A user of a service like Facebook, etc

**STS - Exam Tips**

* Develop an Identity Broker to communicate with LDAP and AWS STS
* Identity Broker always authenticates with LDAP first, **then** with AWS STS
* Application then gets temporary access to AWS resources

**Active Directory Integration**

* Can you authenticate with Active Directory?
  + Yes, using SAML
* Which is done first, SAML to authenticate against Active Directory or Active Directory then SAML credentials?
  + We always authenticate with Active Directory first then receive the SAML

**What is a Workspace?**

* A Workspace is a cloud-based replacement for a traditional desktop.
* Quick facts:
  + Workspaces are persistent
  + All data on the D:\ is backed up every 12 hours
  + You do not need an AWS account to login to workspaces
  + Windows 7 experience provided by Windows Server 2008 R2
  + By default, you will be given local admin access so you can install your own apps
  + By default, users can personalize their workspaces but can be locked down by an admin

**What is Docker?**

* Docker is a software platform that allows you to build, test, and deploy applications quickly
* Docker is highly reliable: you can quickly deploy and scale applications into any environment and know your code will run
* Docker is infinitely scalable: running Docker on AWS is a great way to run distributed applications at any scale
* Docker packages software into standardized units called Containers:
  + Containers allow you to easily package an application's code, configurations, and dependencies into easy to use building blocks that deliver environmental consistency, operational efficiency, developer productivity, and version control

**Virtualization vs Containerization**

* Traditional virtualization has density compromises
* Docker achieves higher density, improved portability by removing the per container Guest OS

**Containerization Benefits**

* Escape from dependency hell
* Consistent progression from Dev -> Test -> QA -> Prod
* Isolation - performance or stability issues with App A in container A, will not impact App B in container B
* Much better resource management
* Extreme code portability
* Micro services

**Docker Components**

* Docker image
* Docker container
* Layers/Union file system
* Dockerfile
* Docker Daemon/Engine
* Docker client
* Docker registries/Docker hub

**About ECS**

* AWS ECS (EC2 Container Service) is a highly scalable, fast, container management service that makes it easy to run, stop, and manage Docker containers on a cluster of EC2 instances. ECS lets you launch and stop container-based applications with simple API calls, allows you to get the state of your cluster from a centralized service, and gives you access to many familiar EC2 features
* ECS is a regional service that you can use in one or more AZs across a new, or existing VPC to schedule the placement of containers across your cluster based on your resource needs, isolation policies, and availability requirements
* AWS ECS eliminates the need for you to operate your own cluster management and configuration management systems, or to worry about scaling your management infrastructure
* ECS can also be used to create a consistent deployment and build experience, manage and scale batch and ETL workloads, and build sophisticated application architectures on a micro services model

**About Containers**

* Containers are a method of operating system virtualization that allows you to run an application and its dependencies in resource-isolated processes
* Containers have everything the software needs to run - including libraries, system tools, code and runtime
* Containers are created from a read-only template called an image

**What's a Docker Image?**

* An image is a read-only template with instructions for creating a Docker container. It contains:
  + An ordered collection of root filesystem changes and the corresponding execution parameters for use within a container runtime
* An image is create from a Dockerfile, a plain text file that specifies the components that are to be included in the container
* Images are stored in a registry, such as Docker Hub or AWS ECR

**Container Registries**

AWS ECR (EC2 Container Registry) is a managed AWS Docker registry service that is secure, scalable, and reliable. ECR supports private Docker repositories with resource-based permissions using AWS IAM so that specific users or EC2 instances and access repositories and images. Developers can use the Docker CLI to push, pull, and manage images.

**ECS Task Definitions**

* A Task Definition is required to run Docker containers in ECS
* Task Definitions are text files in JSON format that describe one or more containers that form your application
* Some of the parameters you can specify in a task definition include:
  + Which Docker images to use with the containers in your task
  + How much CPU and memory to use with each container
  + Whether containers are linked together in a task
  + The Docker networking mode to use for the containers in your task
  + What ports from the container are mapped to the host container instance
  + Whether the task should continue to run if the container finishes or fails
  + The command the container should run when it is started
  + What environment variables should be passed to the container when it starts
  + Any data volumes that should be used with the containers in the task
  + What IAM role your tasks should use for permissions

**ECS Services**

* An ECS service allows you to run and maintain a specified number (desired count) of instances of a task definition simultaneously in an ECS cluster
* Think of services like auto scaling groups for ECS

**ECS Clusters**

* An ECS cluster is a logical grouping of container instances that you can place tasks on. When your first use the ECS service, a default cluster is created for you, but you can create multiple clusters in an account to keep your resources separate
* Concepts:
  + Clusters can contain multiple different container instance types
  + Clusters are region-specific
  + Container instances can only be part of one cluster at a time
  + You can create IAM policies for you clusters to allow or restrict users' access to specific clusters

**ECS Scheduling**

* Service Scheduler:
  + Ensures that the specified number of tasks are constantly running and reschedules tasks when a tasks fails
  + Can ensure tasks are registered against an ELB
* Custom Scheduler
  + You can create your own schedulers that meet your business needs
  + Leverage third-party schedulers, such as Blox
* The ECS schedulers leverage the same cluster state information provided by the ECS API to make appropriate placement decisions

**ECS Container Agent**

* The ECS container agent allows container instances to connect to your cluster. ECS container agent is included in the ECS optimized AMI but you can also install it on any EC2 instance that supports the ECS specification. The ECS container agent is only supported on EC2 instances
* Pre-installed on special ECS AMIs
* Linux-based:
  + Works with Amazon Linux, Ubuntu, Red Hat, CentOS, etc
  + Will **not** work with Windows

**ECS Security**

* IAM Roles:
  + EC2 instances use an IAM role to access ECS
  + ECS tasks use an IAM role to access services and resources
* Security groups attach at the instance-level (i.e. the host and not the task or container)
* You can access and configure the OS of the EC2 instances in your ECS cluster

**ECS Limits**

* Soft limits:
  + Default clusters per region = 1000
  + Default instances per region = 1000
  + Default services per region = 500
* Hard limits
  + One load balancer per service
  + 1000 task per service
  + Max 10 containers per task definition
  + Max 10 tasks per instance (host)

**ECS - Exam Tips**

* ECS - Amazon's managed EC2 container service which allows you to manage Docker containers on a cluster of EC2 instances
* Containers are a method of operating system virtualization that allows you to run an app and its dependencies in resource-isolated processes
* Containers are created from a read-only template called an Image
* An Image is a read-only template with instructions for creating a Docker container
* Images are stored in a Registry, such as Docker Hub or AWS ECR
* ECR is a managed AWS Docker registry service

**ECS - Exam Tips Continued...**

* A Task Definition is required to run Docker containers in ECS
* Task Definitions are text files in JSON format that describe one or more containers that form your app
* Think of a Task Definition as a cloud formation template but for Docker
* ECS service allows you to run and maintain a specified number of instances of a task definition simultaneously in an ECS cluster
* Think of services like auto scaling groups for ECS
* ECS clusters are a logical grouping of container instances that you can place tasks on

**ECS - Exam Tips Continued...**

* Clusters can contain multiple different container instance types
* Clusters are region-specific
* Container instances can only be part of one cluster at a time
* You can create IAM policies for you clusters to allow or restrict users' access to specific clusters
* You can schedule ECS in two ways
  + Service scheduler
  + Customer scheduler
* Use ECS agent to connect to ECS instances to your ECS cluster (**Linux only**)
* IAM with ECS to restrict access
* Security groups operate at the instance level not at the task or container level

**Section 12 Quiz**

**1. You are a solutions architect working for a company that specializes in ingesting large data feeds (using Kinesis) and then analyzing these feeds using Elastic Map Reduce (EMR). The results are then stored on a custom MySQL database which is hosted on an EC2 instance which has 3 volumes, the root/boot volume, and then 2 additional volumes which are striped into a RAID-0 set. Your company recently had an outage and lost some key data and have since decided that they will need to run nightly backups. Your application is only used during office hours, so you can afford to have some down time in the middle of the night if required. You decide to take a snapshot of all three volumes every 24 hours. In what manner should you do this?**

* Stop the EC2 instance and take a snapshot of each EC2 instance independently. Once the snapshots are complete, start the EC2 instance and ensure that all relevant volumes are remounted

**2. What are the valid methodologies for encrypting data on S3?**

* Server Side Encryption (SSE)-S3, SSE-C, SSE-KMS, or a client library such as S3 Encryption Client

**3. In Identity and Access Management, when you first create a new user, certain security credentials are automatically generated. Which of the below are valid security credentials?**

* Access Key ID, Secret Access Key

**4. Amazon Web Services offer 3 different levels of support, which of the below are valid support levels?**

* Enterprise, Business, Developer

**5. You are a solutions architect working for a large digital media company. Your company is migrating their production estate to AWS and you are in the process of setting up access to the AWS console using Identity Access Management (IAM). You have created 5 users for your system administrators. What further steps do you need to take to enable your system administrators to get access to the AWS console?**

* Generate a password for each user created and give these passwords to your system administrators

**6. Amazon S3 buckets in all Regions provide which of the following?**

* Read-after-write consistency for PUTS of new objects AND eventually consistent for overwrite PUTS & DELETES

**7. What function of an AWS VPC is stateless?**

* Network Access Control Lists

**8. Which of the following services allows you root access (ie you can login using SSH)?**

* Elastic Map Reduce

**9. When trying to grant an amazon account access to S3 using access control lists what method of identification should you use to identify that account with?**

* The email address of the account or the canonical user ID

**10. You are a solutions architect working for a large oil and gas company. Your company runs their production environment on AWS and has a custom VPC. The VPC contains 3 subnets, 1 of which is public and the other 2 are private. Inside the public subnet is a fleet of EC2 instances which are the result of an auto scaling group. All EC2 instances are in the same security group. Your company has created a new custom application which connects to mobile devices using a custom port. This application has been rolled out to production and you need to open this port globally to the internet. What steps should you take to do this, and how quickly will the change occur?**

* Open the port on the existing security group. Your EC2 instances will be able to communicate over this port immediately

**11. Which of the following is not supported by AWS Import/Export?**

* Export to Amazon Glacier

**12. Which of the following is not a service of the security category of the AWS trusted advisor service?**

* Vulnerability scans on existing VPCs

**13. You work for a market analysis firm who are designing a new environment. They will ingest large amounts of market data via Kinesis and then analyze this data using Elastic Map Reduce. The data is then imported in to a high performance NoSQL Cassandra database which will run on EC2 and then be accessed by traders from around the world. The database volume itself will sit on 2 EBS volumes that will be grouped into a RAID 0 volume. They are expecting very high demand during peak times, with an IOPS performance level of approximately 15,000. Which EBS volume should you recommend?**

* Provisioned IOPS (PIOPS)

**14. What are the different types of virtualization available on EC2?**

* Para-Virtual (PV) & Hardware Virtual Machine (HVM)

**15. Which of the following is not a valid configuration type for AWS Storage gateway?**

* Gateway-accessed volumes

**16. You have started a new role as a solutions architect for an architectural firm that designs large sky scrapers in the Middle East. Your company hosts large volumes of data and has about 250Tb of data on internal servers. They have decided to store this data on S3 due to the redundancy offered by it. The company currently has a telecoms line of 2Mbps connecting their head office to the internet. What method should they use to import this data on to S3 in the fastest manner possible?**

* AWS Import/Export

**17. You are designing a site for a new start up which generates cartoon images for people automatically. Customers will log on to the site, upload an image which is stored in S3. The application then passes a job to AWS SQS and a fleet of EC2 instances poll the queue to receive new processing jobs. These EC2 instances will then turn the picture in to a cartoon and will then need to store the processed job somewhere. Users will typically download the image once (immediately), and then never download the image again. What is the most commercially feasible method to store the processed images?**

* Store the images on S3 RRS, and create a lifecycle policy to delete the image after 24 hours

**18. You are hosting a website in Ireland called aloud.guru and you decide to have a static DR site available on S3 in the event that your primary site would go down. Your bucket name is also called “acloudguru”. What would be the S3 URL of the static website?**

* [https://acloudguru.s3-website-eu-west-1.amazonaws.com](https://acloudguru.s3-website-eu-west-1.amazonaws.com/)

**19. Which of the following is NOT a valid SNS subscribers?**

* SWF

**20. You are appointed as your company's Chief Security Officer and you want to be able to track all changes made to your AWS environment, by all users and at all times, in all regions. What AWS service should you use to achieve this?**

* CloudTrail

**Section 13: Extra Quizzes**

**Mega Quiz 2**

**1. You have a high performance compute application and you need to minimize network latency between EC2 instances as much as possible. What can you do to achieve this?**

* Create a placement group with an Availability Zone and place the EC2 instances within that placement group

**2. True or False? Amazon S3 buckets in all Regions provide read-after-write consistency for PUTS of new objects and eventual consistency for overwrite PUTS and DELETES.**

* True

**3. Placement Groups can be created across 2 or more Availability Zones.**

* False

**4. You can add multiple volumes to an EC2 instance and then create your own RAID 5/RAID 10/RAID 0 configurations using those volumes.**

* True

**5. You are creating your own relational database on an EC2 instance and you need to maximize IOPS performance. What can you do to achieve this goal?**

* Add multiple additional volumes with provisioned IOPS and then create a RAID 0 stripe across those volumes

**6. Which of the services below do you get root access to?**

* EC2 & Elastic MapReduce

**7. Using SAML (Security Assertion Markup Language 2.0) you can give your federated users single sign-on (SSO) access to the AWS Management Console.**

* True

**8. You can have 1 subnet stretched across multiple availability zones.**

* False

**9. When you create new subnets within a custom VPC, by default they can communicate with each other, across availability zones.**

* True

**10. It is possible to transfer a reserved instance from one Availability Zone to another.**

* True

**11. You have an EC2 instance which needs to find out both its private IP address and its public IP address. To do this you need to:**

* Retrieve the instance Metadata from <http://169.254.169.254/latest/meta-data/>

**12. To retrieve instance metadata or user data you will need to use the following IP Address:**

* [http://169.254.169.254](http://169.254.169.254/)

**13. Amazon S3 buckets in all regions provide read-after-write consistency for PUTS of new objects.**

* True

**14. Amazon S3 buckets in all regions do not provide eventual consistency for overwrite PUTS and DELETES.**

* False

**15. Amazon S3 provides:**

* Unlimited Storage

**16. In order to enable encryption at rest using EC2 and Elastic Block Store you need to:**

* Configure encryption when creating the EBS volume

**17. You can select a specific Availability Zone in which to place your DynamoDB Table**

* False

**18. When creating an RDS instance you can select which availability zone in which to deploy your instance.**

* True

**19. Amazon's Redshift uses which block size for its columnar storage?**

* 1024 KB / 1 MB

**20. You run a website which hosts videos and you have two types of members, premium fee paying members and free members. All videos uploaded by both your premium members and free members are processed by a fleet of EC2 instances which will poll SQS as videos are uploaded. However you need to ensure that your premium fee paying members videos have a higher priority than your free members. How do you design SQS?**

* Create two SQS queues, one for premium members and one for free members. Program your EC2 fleet to poll the premium queue first and if empty, to then poll your free members SQS queue

**21. You have uploaded a file to S3. What HTTP code would indicate that the upload was successful?**

* HTTP 200

**22. You are hosting a MySQL database on the root volume of an EC2 instance. The database is using a large amount of IOPS and you need to increase the IOPS available to it. What should you do?**

* Add 4 additional EBS SSD volumes and create a RAID 10 using these volumes

**Scenario Based Questions**

**1. You have been asked to create VPC for your company. The VPC must support both Internet-facing web applications (i.e. they need to be publicly accessible) and internal private applications (i.e. they are not publicly accessible and can be accessed only over VPN). The internal private applications must be inside a private subnet. Both the internet-facing and private applications must be able to leverage at least three Availability Zones for high availability. At a minimum, how many subnets must you create within your VPC to achieve this?**

* 6

**2. You work for a cosmetic company which has their production website on AWS. The site itself is in a two-tier configuration with web servers in the front end and database servers at the back end. The site uses using Elastic Load Balancing and Auto Scaling. The databases maintain consistency by replicating changes to each other as and when they occur. This requires the databases to have extremely low latency. Your website needs to be highly redundant and must be designed so that if one availability zone goes offline and Auto Scaling cannot launch new instances in the remaining Availability Zones the site will not go offline. How can the current architecture be enhanced to ensure this?**

* Deploy your site in three different AZ's within the same region. Configure the Auto Scaling minimum to handle 50 percent of the peak load per zone

**3. You working in the media industry and you have created a web application where users will be able to upload photos they create to your website. This web application must be able to call the S3 API in order to be able to function. Where should you store your API credentials whilst maintaining the maximum level of security.**

* Don't save your API credentials. Instead create a role in IAM and assign this role to an EC2 instance when you first create it

**4. You are a systems administrator and you need to monitor the health of your production environment. You decide to do this using Cloud Watch, however you notice that you cannot see the health of every important metric in the default dash board. Which of the following metrics do you need to design a custom cloud watch metric for, when monitoring the health of your EC2 instances?**

* Memory usage

**5. You are a student currently learning about the different AWS services. Your employer asks you to tell him a bit about Amazon's glacier service. Which of the following best describes the use cases for Glacier?**

* Infrequently accessed data & data archives

**6. You work for a toy company that has a busy online store. As you are approaching Christmas, you find that your store is getting more and more traffic. Your web tier is behind an Auto Scaling group, but you notice that it is frequently scaling, sometimes multiple times in an hour, only to scale back down after peak usage. You need to keep Auto Scaling from scaling up and down so rapidly. Which of the following options would help you to achieve this?**

* Modify the Auto Scaling group cool-down timers & modify the Amazon CloudWatch alarm period that triggers your Auto Scaling scale down policy

**7. You work in the genomics industry and you process large amounts of genomic data using a nightly Elastic Map Reduce (EMR) job. This job processes a single 3 Tb file which is stored on S3. The EMR job runs on 3 on-demand core nodes and four on-demand task nodes. The EMR job is now taking longer than anticipated and you have been asked to advise how to reduce the completion time?**

* You should reduce the input split size in the MapReduce job configuration and then adjust the number of simultaneous mapper tasks so that more tasks can be processed at once

**8. By definition a public subnet within a VPC is one that:**

* In its routing table it has at least one route that uses an Internet Gateway (IGW)

**9. You have been asked to identify a service on AWS that is a durable key value store. Which of the services below meets this definition?**

* Simple Storage Service (S3)

**10. You are a security architect working for a large antivirus company. The production environment has recently been moved to AWS and is in a public subnet. You are able to view the production environment over HTTP however when your customers try to update their virus definition files over a custom port, that port is blocked. You log in to the console and you allow traffic in over the custom port. How long will this take to take effect?**

* Immediately

**11. You are a solutions architect working for a biotech company who is pioneering research in immunotherapy. They have developed a new cancer treatment that may be able to cure up to 94% of cancers. They store their research data on S3, however recently an intern accidentally deleted some critical files. You've been asked to prevent this from happening in the future. What options below can prevent this?**

* Enable S3 versioning on the bucket & enable Multifactor Authentication (MFA) on the bucket

**12. You run an automobile reselling company that has a popular online store on AWS. The application sits behind an Auto Scaling group and requires new instances of the Auto Scaling group to identify their public and private IP addresses. How can you achieve this?**

* Using a Curl or Get Command to get the latest meta-data from <http://169.254.169.254/latest/meta-data/>

**13. You are a solutions architect who has been asked to do some consulting for a US company that produces re-useable rocket parts. They have a new web application that needs to be built and this application must be stateless. Which three services could you use to achieve this?**

* RDS, DynamoDB & ElastiCache

**14. Your company has decided to set up a new AWS account for test and dev purposes. They already use AWS for production, but would like a new account dedicated for test and dev so as to not accidentally break the production environment. You launch an exact replica of your production environment using a CloudFormation template that your company uses in production. However CloudFormation fails. You use the exact same CloudFormation template in production so the failure is something to do with your new AWS account. The CloudFormation template is trying to launch 60 new EC2 instances in a single availability zone. After some research you discover that the problem is:**

* For all new AWS accounts there is a soft limit of 20 EC2 instances per region. You should submit the limit increase form and retry the template after your limit has been increased

**15. You work for a famous bakery who are deploying a hybrid cloud approach. Their legacy IBM AS400 servers will remain on premise within their own datacenter however they will need to be able to communicate to the AWS environment over a site to site VPN connection. What do you need to do to establish the VPN connection?**

* Assign a public IP address to your Amazon VPC Gateway

**16. You work for a major news network in Europe. They have just released a new app which allows users to report on events as and when they happen using their mobile phone. Users are able to upload pictures from the app and then other users will be able to view these pics. Your organization expects this app to grow very quickly, essentially doubling its user base every month. The app uses S3 to store the media and you are expecting sudden and large increases in traffic to S3 when a major news event takes place (as people will be uploading content in huge numbers). You need to keep your storage costs to a minimum however and it does not matter if some objects are lost. Which storage media should you use to keep costs as low as possible?**

* S3 - Reduced Redundancy Storage (RRS)

**17. You have developed a new web application in us-west-2 that requires six Amazon Elastic Compute Cloud (EC2) instances running at all times. You have three availability zones available in that region (us-west-2a, us-west-2b, and us-west-2c). You need 100 percent fault tolerance if any single Availability Zone in us-west-2 becomes unavailable. How would you do this, each answer has 2 answers, select the answer with BOTH correct answers.**

* Answer 1 - Us-west-2a with six EC2 instances, us-west-2b with six EC2 instances, and us-west-2c with no EC2 instances. Answer 2 - Us-west-2a with three EC2 instances, us-west-2b with three EC2 instances, and us-west-2c with three EC2 instances

**18. You need to add a route to your routing table in order to allow connections to the internet from your subnet. What route should you add?**

* Destination: 0.0.0.0/0 --> Target: your Internet gateway

**19. You work for a construction company that has their production environment in AWS. The production environment consists of 3 identical web servers that are launched from a standard Amazon Linux AMI using Auto Scaling. The web servers are launched in to the same public subnet and belong to the same security group. They also sit behind the same ELB. You decide to do some test and dev and you launch a 4th EC2 instance in to the same subnet and same security group. Annoyingly your 4th instance does not appear to have internet connectivity. What could be the cause of this?**

* Assign an elastic IP address to the fourth instance

**20. With which AWS orchestration service can you implement Chef recipes?**

* OpsWorks

**Final Practice Exam**

**1. You are a solutions architect working for a large pharmaceutical company who are involved in high performance computing to develop new drugs to treat arthritis. You are helping them to design a new application which will need to keep network traffic the lowest latency possible while leveraging very high CPU performance. They would like to place this solution on to the AWS platform and are looking for your recommendations. Which of the following do you suggest?**

* CPU optimized EC2 instances deployed into placement groups

**2. You work for an automotive company which is migrating their production environment in to AWS. The company has 4 separate segments, Dev, Test, UAT & Production. They require each segment to be logically isolated from each other. What VPC configuration should you recommend?**

* A separate VPC for each segment. Then create VPN tunnels from your HQ to each VPC so the appropriate teams can each speak to their dedicated VPC

**3. By default how many VPCs can you have per region in your AWS account?**

* 5

**4. Which of the following is not associated with Identity Access Management Service?**

* Workspaces

**5. You are designing a new application for a financial company that will utilize spot EC2 instances as and when they meet a certain price point. These EC2 instances will analyze data and the output their analysis to the root volume. You need to store this data in a persistent form of storage so that if the spot instances are terminated by Amazon, you will not lose your data. You need to choose the lowest cost service. Where should you store your data?**

* S3

**6. Which of the following is not a responsibility of Amazon’s under the shared responsibility model?**

* OS level patching for EC2

**7. In regards to EC2 which of the following is not a customer’s responsibility under the shared responsibility model?**

* Decommissioning and destruction of storage media

**8. Which of the following is true when writing to S3?**

* All regions provide read-after-write consistency for PUTS of new objects in your Amazon S3 bucket and eventual consistency for overwrite PUTS and DELETES

**9. You are solutions architect working for a busy ecommerce store. Due to your organizations unique security requirements, you decide to utilize EC2 running a MySQL database, rather than using RDS. You need to architect this EC2 instance to maximize your disk IO. Which of the following would give you the best disk performance?**

* Add 2 x additional PIOPS SSD volumes and create a RAID 0. Install MySQL to this RAID 0 partition

**10. Which of the following services do you get OS level access to?**

* EC2 & Elastic Map Reduce (EMR)

**11. You are designing an AWS solution for a new customer and they want to use their active directory credentials in order to sign in to the AWS management console. What kind of authentication response is required in order for users to authenticate with the AWS security token service (STS).**

* Security Assertion Markup Language 2.0 (SAML 2.0)

**12. You are designing a new VPC for a customer and you need to deploy your EC2 instances in to multiple availability zones. What is the minimum number of subnets that you require to achieve this objective?**

* 2 Subnets with each subnet in an independent AZ

**13. You are creating a new VPC with 3 subnets in 3 separate availability zones. You require instances in each subnet to be able to communicate to each other by default. What additional steps should you take in order to achieve this objective.**

* You do not need to do anything, by default all subnets can communicate with each other using the main route table

**14. You have an EC2 instance which needs to find out both its private IP address and its public IP address using a script. Which of the below should you include in the script to discover this information.**

* Retrieve the instance Metadata from <http://169.254.169.254/latest/meta-data/>

**15. You are an AWS architect and you require encryption at rest for additional volumes attached to your EC2 instance. What is the quickest and most efficient way to achieve this?**

* Configure encryption when creating the EBS volume

**16. You are designing a web application for a new social media start up and have recommended using DynamoDB for the database due to its superior performance. You need to ensure that your database has redundancy. What additional steps should you do?**

* Nothing, DynamoDB all data is automatically replicated across multiple availability zones

**17. What block size does Redshift use when storing its data in columnar storage?**

* 1024 KB

**18. You are designing an application for a furniture retailer. A component of the application takes pictures of the furniture for sale and generates thumb nail images which then need to be stored persistently. The business can tolerate it if some images are lost as they can be regenerated. The thumbnails will need to be retrieved immediately when the application requests them. What is the cheapest option to do this?**

* Using S3 RRS

**19. You run a website which hosts videos and you have two types of members, premium fee paying members and free members. All videos uploaded by both your premium members and free members are processed by a fleet of EC2 instances which will poll SQS as videos are uploaded. However you need to ensure that your premium fee paying members videos have a higher priority than your free members. How should you design your application.**

* Create two SQS queues, one for premium members and one for free members. Program your EC2 fleet to poll the premium queue first and if empty, to then poll your free members SQS queue

**20. You are designing an image sharing website that will distribute images across the world. You need to maximize performance so that your end users can download frequently accessed images as fast as possible. What AWS technology should you implement?**

* CloudFront

**21. You are putting together a WordPress site for a local charity and you are using a combination of Route 53, Elastic Load Balancers, EC2 & RDS. You launch your EC2 instance, download WordPress and setup the configuration files connection string so that it can communicate to RDS. When you browse to your URL however, nothing happens. Which of the following could NOT be the cause of this?**

* You have locked port 22 down to your specific IP address therefore users cannot access your site using HTTP/HTTPS

**22. You have uploaded a file to S3, what HTTP code would indicate that the upload was successful?**

* HTTP 200

**23. You have created a custom VPC with 3 subnets, 2 private, 1 public. You deploy 3 EC2 instances in to your public subnet and attach Elastic IP addresses to these instances. You then deploy an EC2 instance in to your private subnet and then attempt to apply security patches to this instance, however it has no internet connectivity. What can you do to give this instance internet access?**

* Deploy a NAT to the public subnet and then update the main route table to send traffic via the NAT to the private subnet

**24. Amazon SWF is designed to help users to do which of the following?**

* Coordinate synchronous and asynchronous tasks

**25. What service can you use to audit user access & API calls across your AWS environment?**

* CloudTrail

**26. Under the shared responsibility model for S3 which of the following is NOT a responsibility of Amazons?**

* Configuration of individual bucket policies

**27. Under the shared responsibility model for DynamoDB which of the following is NOT a responsibility of Amazons?**

* Restricting access of DynamoDB so that only the customers web application in EC2 can write data to it

**28. You are a Solutions Architect working for a major European oil company. You are designing a new web application which will need to access data stored in DynamoDB. You need to do this as securely as possible, without storing any credentials on a long term basis. How would you achieve this?**

* Use AWS Identity and Access Management roles for the EC2 Instances that need to make the API calls

**29. You are a solutions architect working for a large cell phone company in the US. Your CSO has engaged a third party security company to conduct a security audit of your company to make sure it is not liable to hacking. The third party security company would like to conduct a penetration test on your AWS estate. Would this be allowed by AWS?**

* Yes, however you need to get permission from Amazon first by raising a ticket

**30. AWS help provide protection against some forms of traditional network attacks. Which of the following is not protected against by AWS?**

* Social Engineering

**31. Placement Groups can be created across 2 or more Availability Zones.**

* False, Placement Groups are restricted to a single Availability Zone

**32. You have three AWS accounts (A, B & C) which share data. In an attempt to maximize performance between the accounts, you deploy the instances owned by these three accounts in "eu-west-1b". During testing, you find inconsistent results in transfer latency between the instances. Transfer between accounts A and B is excellent, but transfers between accounts B and C, and C and A, are slower. What could be the problem?**

* The names of the AZs are randomly applied, so 'eu-west-1b' is not necessarily the same physical location for all three accounts

**33. Your company has hired a young and enthusiastic accountant. After reviewing the AWS documentation and usage graphs, he announces that you are wasting vast amounts of money running servers for a full hour instead of spinning them up only when they are needed and down again as soon as they are idle for 1 minute. He cites the AWS claim that you only pay for what you use, and that as a senior engineer, you should be more conscious of wasting company money. How do you respond?**

* You thank him for his concern, and advise him that he has misinterpreted the pricing document: Instances are billed by the full hour, and partial hours are billed as such. Additionally, storage charges are incurred even if the Db instance sits idle. Taking into account productivity losses, stopping and restarting Db instances may actually result in additional costs. As such, your solution is fine as it now stands.

**34. Your company is moving their 10TB data warehouse to the cloud. Taking into account your company's 100Mbps connection, which service would most quickly get your data into AWS?**

* Amazon Snowball

**35. You have been monitoring a sensitive auto scaling group, and you expect it to scale-in as you enter a period of holiday downtime. The auto scaling group is distributed over three AZs (AZ - A & -B have two instances each, and AZ -C has three instances). All instances have different CPU and Memory utilization, and all instances have been running for a different number of days. All instances come from different versions of a root AMI, and all instances have different numbers of sessions connected. Which instance will be the 1st to shut down?**

* The instance in AZ -C that has the oldest launch configuration will terminate first, Auto Scaling scales-in according to a hierarchy of decisions. Please see the link for further details: <http://amzn.to/2lSm9k6>

**36. Auto Scaling is a tool used to create fault-tolerant and cost-effective architectures.**

* True, auto scaling improves availability and will keep your infrastructure at the size needed to run your application

**37. What is the maximum Visibility Timeout of an SQS message in a FIFO queue?**

* 12 hours

**38. A client who is using EC2 believes that someone other than approved administrators is trying to gain access to her Linux web app instances, and she asks what sort of network access logging can be added to the system. Which of the following might you recommend?**

* Make use of an OS level logging tools such as IP tables and log events to CloudWatch or S3

**39. Your company likes the idea of storing files on AWS. However, low-latency service of the last few days of files is important to customer service. Which Storage Gateway configuration would you use to achieve both of these ends?**

* Gateway-Cached volumes - retain a copy of frequently accessed data subsets locally. Cached volumes offer a substantial cost savings on primary storage and minimize the need to scale your storage on-premises

**40. You have a MySQL database running on an EC2 instance in a private subnet. You can connect via SSH, but you are unable to apply updates to the database server via the NAT instance. What might you do to remedy this problem?**

* Ensure that "Source/Destination Checks" is disabled on the NAT instance

**41. Amazon SQS keeps track of all tasks and events in an application.**

* False, with SQS, you must implement your own application-level tracking, especially if your application uses multiple queues

**42. When editing permissions (policies and ACLs), to whom does the concept of the "Owner" refer?**

* The "Owner" refers to the identity and email address used to create the account AWS account

**43. Your company provides an online image recognition service and uses SQS to decouple system components. Your EC2 instances poll the image queue as often as possible to keep end-to-end throughput as high as possible, but you realize that all this polling is resulting in both a large number of CPU cycles and skyrocketing costs. How can you reduce cost without compromising service?**

* Enable long polling by setting the ReceiveMessageWaitTimeSeconds to a number > 0. SQS long polling doesn’t return a response until a message arrives in the queue, reducing your overall cost over time. Short polling WILL return empty responses

**44. You need to store some easily-replaceable objects on S3. With quick retrieval times and cost effectiveness in mind, which S3 storage class should you consider.**

* S3 - RRS, you should use S3 - RRS. You want to minimize your retrieval time, so you should not use Glacier (and there is no such thing as S3 - Provisioned IOPS)

**45. You are a solutions architect working for a busy media company with offices in Japan and the United States. Your production environment is hosted both in US-EAST-1 and AP-NORTHEAST-1. Your European users have been connecting to the production environment in Japan, and are seeing the site in Japanese rather than in English. You need to ensure that they view the English language version. Which of the routing policies below could help you achieve this?**

* Geolocation, the aim is to direct sessions to the host that will provide the correct language. Geolocation is the best option because it is deterministic. While latency-based routing will usually direct the client to the correct host, connectivity issues with the US Regions might direct traffic to AP. In this case, the word "ensure" is operative: users MUST connect to the English-language site. Watch the wording in the exam: a requirement may be presented very casually in the wording of the question. However, understanding that requirement is mandatory if you're going to arrive at the correct answer

**46. Although your application customarily runs at 30% usage, you have identified a recurring usage spike (>90%) between 8pm and midnight daily. What is the most cost effective way to scale your application to meet this increased need?**

* Use Proactive Cyclic Scaling to boost your capacity at a fixed interval

**47. You work for a popular media outlet about to release a story that is expected to go viral. During load testing on the website, you discover that there is read contention on the database tier of your application. Your RDS instance consists of a MySQL database on an extra-large instance. Which two of the following approaches would be best to further scale this instance to meet the anticipated increase in traffic your viral story will generate?**

* Use ElastiCache to cache the frequently read, static data

**48. Following advice from your consultant, you have configured your VPC to use dedicated hosting tenancy. A subsequent change to your application has rendered the performance gains from dedicated tenancy superfluous, and you would now like to recoup some of these greater costs. How do you revert to Default hosting tenancy?**

* Create AMIs of all your instances. Create a new VPC with Default as the hosting tenancy attribute, and use them to create new instances using Default tenancy

**49. Which URL format does S3 support in pointing to bucket "mynewbucket"?**

* [http://mynewbucket.s3-aws-region.amazonaws.com](http://mynewbucket.s3-aws-region.amazonaws.com/)

**50. You are developing a web application, and you are maintaining separate sets of resources for your alpha, beta, and release environments. Each version runs on Amazon EC2 with an EBS volume. You use Elastic Load Balancing to manage traffic and Amazon Route 53 to manage your domain. What's the best way to check the health and status of all three groups of services simultaneously?**

* Create a resource group containing each set of resources and view all three environments from a single, group dashboard

**51. Your company has just purchased another company. As part of the merger, your team has been instructed to cross connect the corporate networks. You run all your confidential corporate services and Internal DNS in a VPC. The merged company has all their confidential corporate services and Internal DNS on-premises. After establishing a Direct-Connect service between your VPC and their on premise network, and confirming all the routing, firewalls, and authentication, you find that while you can resolve names against their DNS, the other company services is unable to resolve names against your DNS servers. Why might this be?**

* By design, AWS DNS does not respond to requests originating from outside the VPC

**52. How is the Public IP address managed in an instance session via the instance GUI/RDP or Terminal/SSH session?**

* The Public IP address is not managed on the instance: It is, instead, an alias applied as a network address translation of the Private IP address

**53. You have been engaged by a company to design and lead a migration to an AWS environment. The team is concerned about the capabilities of the new environment, especially when it comes to avoiding bottlenecks. The design calls for about 20 instances (C3.2xLarge) pulling jobs/messages from SQS. Network traffic per instance is estimated to be around 500 Mbps at the beginning and end of each job. Which network configuration should you plan on deploying?**

* Spread the Instances over multiple AZs to minimize the traffic concentration and maximize the fault tolerance

**54. You are a consultant planning to deploy DynamoDB across three AZs. Your lead DBA is concerned about data consistency. Which of the following do you advise the lead DBA to do?**

* To ask the development team to code for strongly consistent reads. As the consultant, you will advise the CTO of the increased cost

**55. You successfully configure VPC Peering between VPC-A and VPC-B. You then establish an IGW and a Direct-Connect connection in VPC-B. Can instances in VPC-A connect to your corporate office via the Direct-Connect service, and connect to the Internet via the IGW?**

* VPC peering does not support edge to edge routing

**56. You are reviewing Change Control requests, and you note that there is a change designed to reduce wasted CPU cycles by increasing the value of Visibility Timeout attribute. What does this mean?**

* When a consumer instance retrieves a message, that message will be hidden from other consumer instances for a fixed period

**57. You manage a Ruby on Rails application that lives on a cluster of EC2 instances. Your website occasionally experiences brief, strong, and entirely unpredictable spikes in traffic that overwhelm your EC2 instances’ resources and freeze the application. As a result, you're losing recently submitted requests from end users. You use Auto Scaling to deploy additional resources to handle the load during spikes, but the new instances don't spin-up fast enough to prevent the existing application servers from freezing. Which of the following will provide the most cost-effective solution in preventing the loss of recently submitted requests?**

* Use Amazon SQS to decouple the application components and keep the requests in queue until the extra Auto-Scaling instances are available. Neither increasing the size of your EC2 instances nor maintaining additional EC2 instances is cost-effective, and pre-warming an ELB signifies that these spikes in traffic are predictable. The cost-effective solution to the unpredictable spike in traffic is to use SQS to decouple the application components

**58. You're building out a single-region application in us-west-2. However, disaster recovery is a strong consideration, and you need to build the application so that if us-west-2 becomes unavailable, you can fail-over to us-west-1. Your application relies exclusively on pre-built AMI's. In order to share those AMI's with the region you're using as a backup, which process would you follow?**

* Copy the AMI from us-west-2, manually apply launch permissions, user-defined tags, and Amazon S3 bucket permissions of the default AMI to the new instance, and launch the instance. AWS does not copy launch permissions, user-defined tags, or Amazon S3 bucket permissions from the source AMI to the new AMI

**59. At the monthly product meeting, one of the Product Owners proposes an idea to address an immediate shortcoming of the product system: storing a copy of the customer price schedule in the customer record in the database. You know that you can store large text or binary objects in DynamoDB. You give a tentative OK to do a Minimal Viable Product test, but stipulate that it must comply with the size limitation on the Attribute Name & Value. Which is the correct limitation?**

* The Name must not exceed 64 KB and the Value must not exceed 255 KB

**60. To save money, you quickly stored some data on the root volume of an EC2 instance and shut it down for the weekend. When you returned on Monday and restarted your instance, you discovered that your data was gone. Why might that be?**

* The root volume was ephemeral, block-level storage. Data on an instance store volume is lost if an instance terminates. The most likely answer is that the EC2 instance was backed by an instance store volume. Instance store volumes are ephemeral, meaning that they exist ONLY in conjunction with their accompanying EC2 instance.