Database

Relational Database Service (RDS)

- Relational DB PaaS (almost PaaS).
- Supported engine options: MySQL, PostgreSQL, Oracle, Microsoft SQL, MariaDB, Amazon Aurora.
- each DB engine has a set of parameters in a DB parameter group that control the behavior of the databases that it manages.
- Multi-AZ: synchronous replica in secondary AZ.
- ACID Compliance: transactions must be ACID compliant or be Atomic, Consistent, Isolated and Durable (ACID) to ensure data integrity.
- Billing options: on-demand and reserved instance.
- Bring your own licenses supported on Oracle.
- Automated or manual backups.
- Automated or manual upgrades.
- Can be placed in a VPC to have control on the network and security.

RDS Multi-AZ:

- Synchronous replica in secondary AZ. Master-Standby relationship.
- The standby replica is invisible.
- DB snapshots taken against the replica instance.
- AWS manages DNS for failover.
- Multi-AZ is different from an RDS read replica.

RDS Read Replica:

- Read only instance, for load offloading.
- Created from a snapshot of the master instance.
- Asynchronous replication.
- Up to 5 read replicas to each DB Instance.
- Same or different AZ. Same or different region.
- Read Replicas in a different region is supported only on MariaDB, MySQL, Oracle, or PostgreSQL. Not supported on MS-SQL.
- For MS SQL, the source DB instance must be a Multi-AZ deployment with Always On Availability Groups (AGs). This is an Enterprise Edition feature.
- For some DB engines, you can transform a read replica to a normal independent instance: promote to master.

RDS Automated Backups:

- Automated daily incremental volume snapshot of your entire DB instance (VM), not just the DBs.
- Backups are stored in Amazon S3.
- Automated backups occur daily during the preferred backup window.
- If you don’t specify a preferred backup window, RDS assigns a default 30-minute backup window that is selected at random from an 8-hour block of time for each AWS Region.
- Retention: Up to 35 days. Default: 1 day.
- Deleting an RDS instance deletes the automated snapshots but not the manual snapshots.
- RDS uploads transaction logs for DB instances to Amazon S3 every 5 minutes. RPO is therefore 5mn.

RDS Restore:

- You cannot restore to an existing instance.
- Customized DB parameters and SGs are not restored.
- RDS combines daily backups with transaction logs to restore the DB instance (point-in-time recovery).
- You can Restore up to the last five minutes.
- Third party backup and restore process and options are different.

Amazon Aurora:

- A MySQL and PostgreSQL-compatible relational database built for the cloud.
- With some workloads, Aurora can deliver up to 5x the throughput of MySQL and up to 3x the throughput of PostgreSQL.
- The underlying storage grows automatically as needed.
- Automatic clustering, replication, and storage allocation.
- An Aurora Cluster is composed of :
  - DB instances: up to 16.
  - A cluster volume that manages the data for those DB instances.

- Aurora cluster volume:
  - A storage volume that spans multiple AZs, with each AZ having 2 copies of the DB cluster data.
  - Each data chunk (10GB) is written in 6 copies: 3 AZs, 2 copies per AZ.
  - Supports loss of 2 copies.
  - Based on SSD disks.
  - Automatically grows and shrinks as the amount of data in your database increases or lowers.
  - Can grow to a maximum size of 128 tebibytes (TiB).
  - You are only charged for the space that you use in an Aurora cluster volume. -Two types of DB instances make up an Aurora DB cluster:
  - Primary DB instance: Read and Write. One per cluster.
  - Aurora Replica: Read only. Up to 15 per cluster.
- Replicas can be placed in other AZs.
- Aurora automatically fails over to an Aurora Replica.
- Aurora multi-master clusters: all DB instances have read/write capability.
- Clusters are created in a VPC. Security Groups can be used.
- Storage can be encrypted.

Aurora Global Database:

- A feature that allows a single Amazon Aurora database to span multiple AWS regions.
- Composed of a primary DB cluster in one Region, and up to 5 read-only secondary DB clusters in different Regions.
- Enables fast local reads in each region.
- Asynchronous replication. Replication latency: 1 sec (RPO = 1s).
- Manual failover: a secondary region can be promoted to full read/write capabilities in less than 1 minute (RTO = 1mn).

Aurora Serverless:

- An on-demand, autoscaling configuration for Aurora.
- Automatically starts up, shuts down, and scales capacity up or down based on your application’s needs.
- Advantages: Similar than provisioned Aurora, Scalable, Cost-effective.
- Does not support Global databases, multi-master, replicas, …

Amazon DynamoDB

- Complete PaaS NoSQL DB with high scalability and low latency.
- Automatically and synchronously replicates data across 3 AZs.
- Not ideal for Joins and complex transactions.
- All items with the same partition key value are stored together (physical storage), in sorted order by sort key value.

DynamoDB Capacity modes:

- Amazon DynamoDB has two read/write capacity modes for processing reads and writes on your tables:
  - On-demand: pay-per-request.
  - Provisioned: default.
- The mode can be changed.
- Provisioned mode :
  - free-tier eligible,
  - puts limits for cost predictability,
  - supports auto scaling
  - supports reserved capacity.
- Capacity Units:
  - You specify throughput requirements in terms of capacity units.
  - A read capacity unit (RCU) represents one strongly consistent read per second, or two eventually consistent reads per second, for an item up to 4 KB in size.
  - A write capacity unit (WCU) represents one write per second, for an item up to 1 KB in size.

DynamoDB Accelerator (DAX):

- A managed in-memory cache for DynamoDB.

DynamoDB Global Tables:

- Provide a fully managed solution for deploying a multiregion, multi-active database.
- A DynamoDB global table consists of multiple replica tables (one per Region) that DynamoDB treats as a single unit.
- All replicas are Read/Write.
- Newly written items are usually propagated to all replica tables within a second.
- When doing a read, your application can choose between "eventually consistent" (default) and "strongly consistent" reads.
- If your application requires strongly consistent reads, it must perform all of its strongly consistent reads and writes in the same Region. DynamoDB does not support strongly consistent reads across Regions.
- If applications update the same item in different regions, the last writer wins.
- Failover: You can apply custom business logic to determine when to redirect requests to other Regions.

DynamoDB Backup: Two types of backups:

- on-demand backup:
  - full backups of your tables for long-term archival.
  - All on-demand backups are cataloged, discoverable, and retained until explicitly deleted.
  - Can be scheduled using AWS Backup.
- continuous automatic backups:
  - enables Point-in-time Restore (PITR),
  - you can restore to any time between 5 minutes and 35 days. Both types support cross-region restores.

Performance: RDS vs DynamoDB:

- DynamoDB can handle higher rates for read/write operations (10K+ operations per second).
- DynamoDB can scale with sharding. RDS has a single node/shard.

Amazon ElastiCache:

- Managed In-memory caching service.
- Choice of engines: Memcached or Redis.

Memcached:

- simple features,
- multithreaded (sharding).
- low maintenance,
- easy horizontal scaling with Auto Discovery.

Redis:

- Has much more features than Memcached.

Amazon RedShift:

- Fully managed petabyte-scale relational data warehouse service. Amazon Redshift Spectrum:
- Enables you to query and retrieve structured and semistructured data from files in Amazon S3 without having to load the data into Amazon Redshift tables. Amazon Neptune:
- A fully managed graph database service. Amazon DocumentDB:
- A fully managed database service for MongoDB-compatible databases in the cloud.