**What is a Database?**

A system that stores and manages your data.

**Types of Databases:**

**-Relational Databases (SQL):** Tables with schema and relationships.

**-Non-Relational Databases (NoSQL):** Flexible, schema-less, not based on SQL tables.

**Databases on EC2 Instances:**

**Single EC2 (Not Recommended):**

All tiers (Web, App, DB) on a single EC2.

High risk: one failure = full application crash.

**Separate EC2s (Better):**

Web + App on one EC2.

Database on another EC2.

Spread across different Availability Zones to improve fault tolerance.

Still risks downtime, higher data transfer costs across AZs.

**When to Use EC2 for Databases**

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| --- | --- |
| **✅ Use EC2 When...** | **❌ Avoid EC2 Because...** |
| Need OS-level access    Require advanced DB tuning    Vendor demands EC2    Unsupported DB versions on RDS  Need custom OS or DB | OS-level management required  Full admin overhead  Requires strong Linux knowledge  No built-in RDS features  No automated backups or failover  Manual setup of backups & disaster recovery    Performance may lag behind RDS |

**Prefer RDS Over EC2**

RDS is managed, scalable, and automated.

Handles backups, high availability, patching, etc.

Saves time, avoids admin overhead, and increases reliability.

AWS is heavily investing in R&D to improve RDS constantly.

**Demo: Hosting MariaDB on EC2**

**Install MariaDB:**

sudo su

yum install mariadb-server wget -y

systemctl enable mariadb

systemctl start mariadb

yum update -y

**Set Environment Variables:**

export DB\_NAME=ec2db

export DB\_PASSWORD=admin123456

export DB\_USER=ec2dbuser

export DB\_ROOT\_PASSWORD=rootpassword

**Database Setup (via setup script or CLI commands):**

Create database

Create user & grant privileges

Flush privileges

Cleanup setup script

**Amazon RDS (Relational Database Service)**

RDS is a managed database service (DBaaS) by AWS.

Supports multiple engines: MySQL, MariaDB, PostgreSQL, Oracle, SQL Server, Aurora.

Simplifies backup, patching, scaling, and monitoring.

**EC2 to RDS Database Migration**

Step-by-step database migration from EC2 (MariaDB) to Amazon RDS.

Used mysqldump to take a .sql dump from EC2.

Connected to RDS using its endpoint and imported the dump file using the mysql CLI.

Verified successful migration by querying the tables on RDS.

**RDS Multi-AZ (High Availability)**

Multi-AZ = High Availability, not Fault Tolerance.

Synchronous replication: writes occur simultaneously on the primary and standby replicas.

In case of failure in the primary, AWS automatically fails over to the standby within 60–120 seconds.

**Drawbacks:**

Not usable for scaling read workloads.

Comes with additional cost (essentially double).

Not fault-tolerant (some downtime during failover).

Backups in Multi-AZ are taken from the standby, reducing impact on the primary.

**Backup & Restore:**

Automated backups:

First snapshot is a full copy, subsequent are incremental.

Store data every 5 minutes using transaction logs.

Can restore to any point-in-time in the retention window (up to 35 days).

**Manual snapshots:**

Must be cleaned up manually.

Do not expire automatically.

**RPO & RTO Concepts**

RPO (Recovery Point Objective): How much data you can afford to lose (e.g., 1 hour of lost data if last backup was at 6 AM and failure at 7 AM).

RTO (Recovery Time Objective): How long it takes to recover after failure (e.g., 30 minutes to restore a DB).

**RDS Read Replicas**

Used for performance, not availability.

Asynchronous replication: primary writes first, then updates read replicas.

Can be in same region or cross-region (for global read scalability).

Up to 5 read replicas per instance.

Do not improve RTO; meant for read scaling only.

**Important Takeaways :**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Feature** | **Purpose** | **Sync/Async** | **Impact on Perfomance** | **Access Type** |
| **Multi-AZ** | High Availability | Synchronous | No performance gain | Only used on failover |
| **Read Replica** | Read Scalability | Asynchronous | Improves performance | Read-only |
| **Automated Backup** | Data Recovery | N/A | Some interruption (unless Multi-AZ) | N/A |
| **Manual Snapshot** | Manual Recovery Point | N/A | No automatic cleanup | N/A |