This study guide demonstrates the lesson from *Introduction to RDS*.
My full AWS Architect Associate course can be found here:
https://www.udemy.com/course/ultimateaws/?referralCode=7ED214B795C444141361

Understanding AWS Relational Database Service (RDS) Study Guide

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1. Introduction to AWS RDS

The AWS Relational Database Service (RDS) is a **managed database service** that simplifies the setup, operation, and scaling of relational databases in the cloud. Unlike managing databases on EC2 instances, where you handle the underlying infrastructure and software manually, RDS automates many common administrative tasks such as backups, software patching, and failure recovery.

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2. EC2 vs. RDS: A Comparison

2.1 EC2: A Self-Managed Service

- **Flexibility**: EC2 provides complete control over the instance, including:
  - Choice of operating system (Linux, Windows, etc.).
  - Installing and managing any software, including database engines.
- **Responsibilities**:
  - Manual patching of the operating system and database engine.
  - Configuring backups and disaster recovery mechanisms.
  - Monitoring system health and performing upgrades.

2.2 RDS: A Managed Service

- **Ease of Use**: RDS abstracts the underlying infrastructure and automates most administrative tasks.
- **Responsibilities Handled by AWS**:
  - Database engine updates and patches.
  - Automated backups and snapshots.
  - High availability through Multi-AZ deployments.
  - Failure detection and recovery.

Key Concept:
RDS is ideal for those who want the power of relational databases without the overhead of managing the infrastructure.

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3. Database Engines Supported by RDS

RDS supports a variety of popular relational database engines, including:

- **MySQL**: Open-source, widely used for web applications.
- **MariaDB**: A fork of MySQL with additional features and improvements.
- **PostgreSQL**: Known for its advanced features and standards compliance.
- **Oracle**: Suitable for enterprise-grade applications.
- **Microsoft SQL Server**: Popular for Windows-based applications.
- **Amazon Aurora**: AWS's proprietary database engine, offering high performance and compatibility with MySQL and PostgreSQL.

Note: Aurora is designed to provide high availability, scalability, and durability, making it a preferred choice for many modern applications.

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4. Automated and Manual Backups

4.1 Automated Backups

- RDS automatically performs daily backups of your database and retains them for **7 days by default** (configurable up to 35 days).
- Backups include a snapshot of the underlying **EBS volume**.
- When a database is terminated, these backups can be retained if needed.

4.2 Manual Snapshots

- A manual snapshot is a user-initiated backup that is retained until explicitly deleted.
- Useful for creating point-in-time backups before major changes or migrations.
- **Persistence**: Manual snapshots are not automatically deleted and provide long-term retention.

Key Concept:
Automated backups provide continuous protection for recent data, while manual snapshots offer flexibility for specific use cases.

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5. Database Migration with AWS DMS

The **AWS Database Migration Service (DMS)** is a tool designed to simplify database migrations.

Key Features:

- **Migrate Existing Databases**: Move production databases to RDS with minimal downtime.

- **Cross-Engine Migrations**: Convert schemas and data from one database engine to another using the **Schema Conversion Tool**.
    - Example: Migrate an Oracle database to Amazon Aurora.
- **Continuous Replication**: Keep source and destination databases synchronized during migration.

Key Concept:
AWS DMS is particularly valuable when transitioning on-premises or EC2-hosted databases to RDS.

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6. High Availability with Multi-AZ RDS

Multi-AZ (Availability Zone) deployment enhances the reliability and availability of your RDS instance.

How Multi-AZ Works:

- AWS creates a **primary RDS instance** in one availability zone and a **standby replica** in another.
- The standby replica is automatically updated with changes from the primary instance.
- If the primary instance fails, **DNS automatically redirects traffic** to the standby replica, ensuring minimal downtime.

Key Benefits:

- Automatic failover in case of hardware or network issues.
- Increased resilience against regional failures.

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7. Scaling with Read Replicas

Read replicas allow you to scale **read-heavy workloads** by creating read-only copies of your database.

Key Characteristics:

- **Read-Only Copies**: Replicas cannot be used for write operations.
- **Location Options**:
    - Same availability zone.
    - Different availability zone.
    - Different AWS region (cross-region replication).
- **Workload Offloading**: Direct read queries to replicas while keeping write queries on the primary database.

Limitations:

- Read replicas do not provide high availability (no automatic failover).
- Primarily used for **performance improvement**, not disaster recovery.

Key Concept:
Use read replicas to handle increased read traffic, reducing the load on the primary database.

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8. RDS Features Summary

Feature	Description
Managed Service	Automates backups, updates, patching, and failure recovery.
Backup Options	Includes automated daily backups and user-initiated manual snapshots.
Multi-AZ	Provides high availability by maintaining a standby replica in a separate AZ.
Read Replicas	Scales read-heavy workloads by creating read-only copies of the database.
Supported Engines	MySQL, MariaDB, PostgreSQL, Oracle, Microsoft SQL Server, and Amazon Aurora.
Database Migration	AWS DMS enables seamless migrations with minimal downtime.

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9. Use Cases for RDS

1. **Web Applications**: Host relational databases for dynamic websites and content management systems.
2. **Enterprise Applications**: Use Oracle or SQL Server for ERP or CRM systems.
3. **Data Migration**: Migrate on-premises databases to RDS using DMS for scalability and reduced maintenance.
4. **Scaling**: Use read replicas to handle increased workloads without modifying the primary database.

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10. Best Practices for Using RDS

- **Enable Multi-AZ** for production databases to ensure high availability and disaster recovery.
- Use **automated backups** to maintain data integrity and **manual snapshots** for critical events.
- **Monitor performance** using Amazon CloudWatch metrics for RDS, such as CPU utilization and read/write IOPS.
- **Optimize costs** by selecting the right instance type and enabling **Reserved Instances** for predictable workloads.
- **Use IAM roles and security groups** to restrict database access and enhance security.

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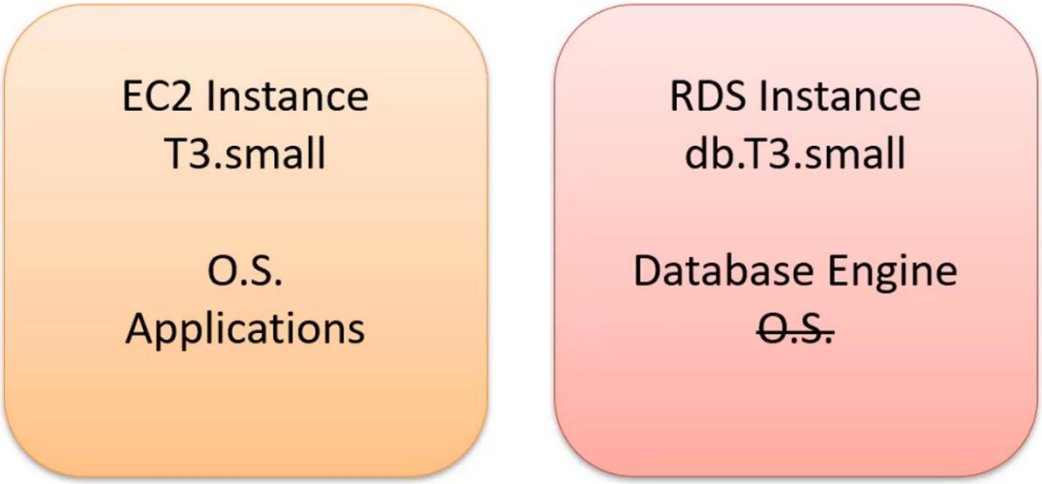
11. Summary

AWS RDS is a robust and scalable solution for relational database management in the cloud. By automating administrative tasks, providing high availability options, and offering seamless integration with other AWS services, RDS allows developers and administrators to focus on their applications instead of managing the underlying infrastructure. Whether you need to migrate existing databases, ensure high availability, or scale out read-heavy workloads, RDS provides the tools and flexibility to meet your needs.

See slides below:

Relational Database Service (RDS)



RDS Automated Backups

- Volume level snapshot
- You can specify the retention policy (default is 7 days)
- When you terminate an instance the backups can be retained

Relational Database Service (RDS)

- Industry standard relational database
- Common database administration tasks are performed automatically
- Supports MySQL, MariaDB, PostgresQL, Oracle, SQL, and Aurora.
- Shell access unavailable because it's a managed service
- AWS provides backups, software patching, failure detection, and recovery

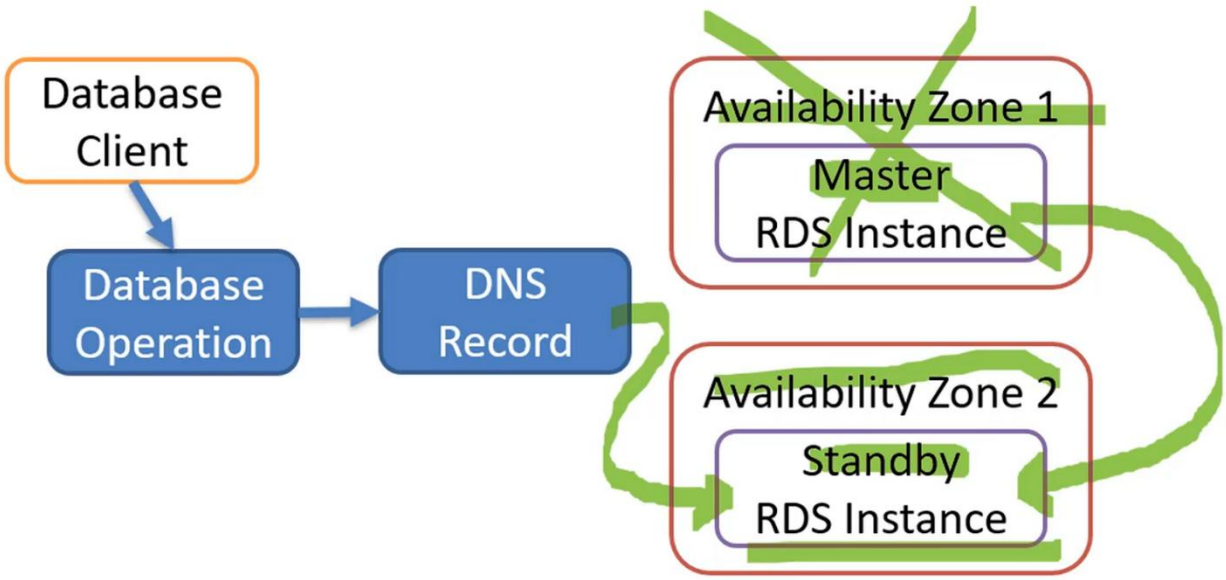
RDS Snapshots

- Can be used to take a manual snapshot at any time
- Backs up the entire instance
- Kept until you manually delete them

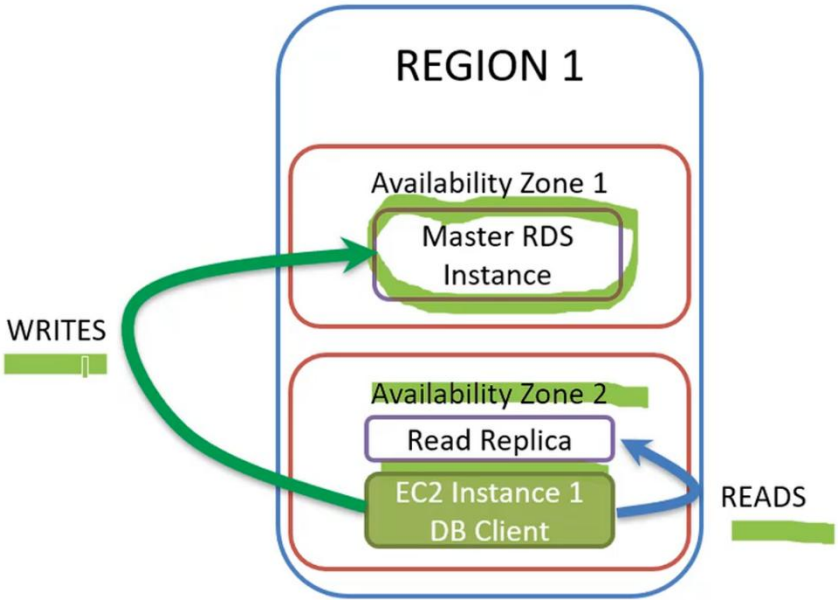
Database Migration Service

- Migrate a production DB onto AWS
- Ensures that any changes while data is in-flight are consistent
- Allows you to convert the source database schema automatically
- Example – Oracle database can be converted to an open source database like Aurora

Multi-AZ RDS Diagram



RDS Read Replica Diagram



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