Introducing the new Amazon RDS Multi-AZ deployment option

Pandit Prasad, Principal Product Manager, RDS
Vijay Karumajji, Senior Database Specialist
04/25/2022
Agenda

• Overview of Amazon RDS Multi-AZ
• Overview of Amazon RDS Multi-AZ with one standby
• Deeper dive & benefits of Amazon RDS Multi-AZ with two readable standbys
• Demo of RDS Multi-AZ with two standbys
• Comparison of availability options on Amazon RDS
• Q&A
Amazon RDS Multi-AZ

Highly available, durable relational databases deployed across up to three Availability Zones (AZs)

<table>
<thead>
<tr>
<th>Database</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>MySQL</td>
<td>System upgrades like operating system patching or database instance scaling applied first on standby to increase availability</td>
</tr>
<tr>
<td>MariaDB</td>
<td>Backup taken from the standby</td>
</tr>
<tr>
<td>PostgreSQL</td>
<td>DB instance endpoint remains the same after a failover</td>
</tr>
<tr>
<td>SQL Server</td>
<td>If failure, unavailability duration limited to the time failover takes to complete</td>
</tr>
<tr>
<td>Oracle</td>
<td>99.95% monthly uptime service level agreement (SLA)</td>
</tr>
</tbody>
</table>

© 2022, Amazon Web Services, Inc. or its Affiliates. All rights reserved.

Postgres, PostgreSQL and the Slonik Logo are trademarks or registered trademarks of the PostgreSQL Community Association of Canada, and used with their permission.
Customize high availability for your workload’s need with 2 Amazon RDS Multi-AZ deployment options

Amazon RDS Multi-AZ with one standby

Amazon RDS Multi-AZ with two readable standby DB instances (Multi-AZ DB Cluster)
Amazon RDS Multi-AZ with one standby
Amazon RDS Multi-AZ with one standby: How it works

Region

Availability Zone “a”
- App servers
- RDS for PostgreSQL primary

Availability Zone “b”
- App servers
- RDS for PostgreSQL secondary

Availability Zone “c”
- App servers

Sync/physical replication

Amazon RDS automation

© 2022, Amazon Web Services, Inc. or its Affiliates. All rights reserved.
Amazon RDS Multi-AZ with one standby replication:

Write latency = cumulative latency of
(( EBS write of primary + acknowledgement )
+ ( EBS write of standby instance+ remote acknowledgement ))

Amazon RDS Multi-AZ with one standby: Secondary failures

- **Region**
  - Availability Zone “a”
    - App servers
    - RDS for PostgreSQL primary
  - Availability Zone “b”
    - App servers
    - RDS for PostgreSQL secondary
  - Availability Zone “c”
    - App servers

- **Sync/physical replication**

- **Amazon RDS automation**
Amazon RDS Multi-AZ with one: Primary failover process

- Availability Zone “a”
  - App servers
  - RDS for PostgreSQL primary

- Availability Zone “b”
  - App servers
  - RDS for PostgreSQL secondary

- Availability Zone “c”
  - App servers

Sync/physical replication

Amazon RDS automation
Amazon RDS Multi-AZ with one standby: Primary failover process

- Region
  - Availability Zone “a”
    - App servers
    - RDS for PostgreSQL primary
  - Availability Zone “b”
    - App servers
    - RDS for PostgreSQL primary
  - Availability Zone “c”
    - App servers

Amazon RDS automation
Amazon RDS Multi-AZ with one standby: Primary failover process

Region

Availability Zone “a”
- App servers
- RDS for PostgreSQL secondary

Availability Zone “b”
- App servers
- RDS for PostgreSQL primary

Availability Zone “c”
- App servers

Sync/physical replication

Amazon RDS automation
Amazon RDS Multi-AZ with two readable standbys
Amazon RDS Multi-AZ with two readable standby DB instances

Highly available, durable relational databases deployed across 3 Availability Zones (AZs)

MySQL
(version 8.0.28)

PostgreSQL
(version 13.4)

- Gain up to 2x faster transaction commit latency
- Automatically fail over in typically under 35 seconds
- Increase read capacity
- Maximize performance and scalability by splitting read and write
Amazon RDS Multi-AZ with two readable standbys: How it works

AZ 1

Primary database instance

AZ 2

Readable standby instance

AZ 3

Readable standby instance

Amazon EBS

Primary database instance

SSD

SSD

SSD

Write commit path

Commits writes on primary only after first standby acknowledges writing to SSD

Moves data asynchronously to Amazon EBS for durability

Serves reads from memory cache or from Amazon EBS
Amazon RDS Multi-AZ with two readable standbys:

**Improved write performance**

Amazon RDS for MySQL – OLTP read/write

1.7–2.3x TPS increase

p50 write latency reduced up to 2x
What happens during the failover?

Typical failover time is 1–2 minutes

- Detect failure
- Crash recovery
- DNS propagation
Improved fail over times

Typically 60–120 seconds

Typically under 35 seconds

No crash recovery step

Note: Duration of failover depends on replication lag

Amazon RDS Multi-AZ with two readable standbys
Amazon RDS Multi-AZ with two readable standbys:

Additional read capacity from reader endpoint
Amazon RDS Multi-AZ Replica Lag

Understand and mitigate replica lag that can occur with specific workloads

Common causes of replica lag

- High write concurrency or heavy batch updating on the writer DB instance
- Heavy read workload that is using resources on one or more reader DB instances
- Transactions that modify large amounts of data or DDL statements

Mitigating Replica Lag

- Reducing the load on your writer DB instance
- Avoid long running transactions such as DDL
- Use flow control to reduce replica lag
Amazon RDS Multi-AZ Flow Control

Manage the replica lag with flow control

Flow control for MySQL

- Enabled by default using the dynamic parameter `rpl_semi_sync_master_target_apply_lag`
- Parameter specifies the desired upper limit of replica lag.
- Default value is 120 seconds
- To disable flow control, set this parameter to its maximum value of 86400 seconds (one day).

Flow control for PostgreSQL

- Enabled by default using the dynamic parameter `flow_control.target_standby_apply_lag`
- Flow control is deployed as an extension.
- Default value is 120 seconds
- Turn off flow control by removing the extension from the `preload_shared_libraries` and rebooting your DB instance.
DEMO

1. Create Multi-AZ DB cluster with two readable standby
2. Failover process
3. Additional read capacity from reader endpoint
# Amazon RDS Multi-AZ with two readable standbys

## Supported instance types

<table>
<thead>
<tr>
<th>Graviton2 M6gd</th>
<th>Graviton2 R6gd</th>
</tr>
</thead>
<tbody>
<tr>
<td>General purpose instances</td>
<td>Memory-optimized instances</td>
</tr>
<tr>
<td>2 vCPU/8 GiB RAM ⇒ 64 vCPU 256 GiB RAM</td>
<td>2 vCPU/16 GiB RAM ⇒ 64 vCPU 512 GiB RAM</td>
</tr>
<tr>
<td>NVMe SSD instance store</td>
<td>NVMe SSD instance store</td>
</tr>
<tr>
<td>High-performance networking</td>
<td>High-performance networking</td>
</tr>
<tr>
<td>Good for running CPU-intensive workloads</td>
<td>Good for query-intensive workloads or high connection counts</td>
</tr>
</tbody>
</table>

© 2022, Amazon Web Services, Inc. or its Affiliates. All rights reserved.
Amazon RDS Multi-AZ with two readable standbys

**Supported storage volumes**

Provisioned IOPS (io1)

- SSD storage
- Auto scale up to 64 TiB
- Single-digit millisecond latencies
- Maximum of 80,000 IOPS
- Delivers within 10% of the IOPS performance, 99.9% of the time
- High performance and consistency

**Additional storage options in the future**
Getting started with Amazon RDS Multi-AZ
Create Multi-AZ deployments in AWS CLI

**Multi-AZ DB instance**

One standby

```bash
aws rds create-db-instance
  --db-instance-identifier demo-instance
  --db-instance-class db.r6g.xlarge
  --engine mysql
  --engine-version 8.0.28
  --master-user-password password
  --master-username demo_dba
  --port 3306
  --backup-retention-period 1
  --allocated-storage 1000
  --storage-type io1
  --iops 10000
  --db-subnet-group-name demo-sng
  --multi-az
```
Migration options: Snapshot restore

Migrating from existing Amazon RDS deployment

```bash
aws rds create-db-snapshot
  --db-instance-identifier my-dbinstance
  --db-snapshot-identifier my-snapshot

aws rds restore-db-cluster-from-snapshot
  --db-cluster-identifier my-new-multi-az-dbcluster
  --snapshot-identifier my-snapshot
  --engine mysql
  --db-cluster-instance-class db.r6gd.xlarge
```
Migration options

Live migration

AWS Database Migration Service

Comparing Amazon RDS availability options
## Amazon RDS availability options

<table>
<thead>
<tr>
<th></th>
<th>Single-AZ</th>
<th>Multi-AZ (one standby)</th>
<th>Multi-AZ (two readable standbys)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Additional Read capacity</strong></td>
<td>Limited: the read capacity is limited to your primary</td>
<td>Limited: Your standby DB instance is only a passive failover target for high availability</td>
<td>Two standby DB instances act as failover targets and serve read traffic</td>
</tr>
<tr>
<td><strong>Lower latency (higher throughput) for transaction commits</strong></td>
<td></td>
<td></td>
<td>Up to 2x faster transaction commits compared to Amazon RDS Multi-AZ with one standby</td>
</tr>
<tr>
<td><strong>Automatic failover duration</strong></td>
<td>Not available</td>
<td>As quickly as 60 seconds</td>
<td>Typically under 35 seconds</td>
</tr>
<tr>
<td></td>
<td>Single-AZ</td>
<td>Multi-AZ (one standby)</td>
<td>Multi-AZ (two readable standbys)</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Higher resiliency to AZ outage</strong></td>
<td>In the event of an AZ failure, you risk data loss (RPO up to 5mins).</td>
<td>In the event of an AZ failure, your workload will automatically failover to the up-to-date standby</td>
<td>Two standby DB instances act as failover targets and serve read traffic</td>
</tr>
<tr>
<td><strong>Lower jitter for transaction commits</strong></td>
<td>No optimization for jitter</td>
<td>Sensitive to impairments on the write path</td>
<td>Uses the 2-of-3 write quorum: insensitive to up to one impaired write path</td>
</tr>
</tbody>
</table>
Amazon RDS Multi-AZ with two readable standby DB instances

Highly available, durable relational databases deployed across 3 Availability Zones (AZs)

<table>
<thead>
<tr>
<th>MySQL</th>
<th>PostgreSQL</th>
</tr>
</thead>
<tbody>
<tr>
<td>(version 8.0.28)</td>
<td>(version 13.4)</td>
</tr>
</tbody>
</table>

- **Gain up to 2x faster transaction commit latency**
- **Automatically fail over in typically under 35 seconds**
- **Increase read capacity**
- **Maximize performance and scalability by splitting read and write**

Postgres, PostgreSQL and the Slonik Logo are trademarks or registered trademarks of the PostgreSQL Community Association of Canada, and used with their permission.
Next steps:

If you are interested in getting started with Amazon RDS Multi-AZ, get started in the Amazon RDS Console.

If you are interested in learning more about Amazon RDS Multi-AZ below are some resources you can use:

• AWS News Blog: Amazon RDS Multi-AZ with two readable standbys
• 2021 re:Invent session: Enabling HA and durability with Amazon RDS (customer: Robinhood)
• AWS Databases Blog: Amazon RDS under the hood: Multi-AZ
• AWS Online Tech Talk: Achieving HA and Durability with Multi-AZ on Amazon RDS
• Video tutorial: How to configure your Amazon RDS database instances for HA
Thank You