Hands-on lab:

Working with managed relational databases in the cloud

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February 13th, 2020 - NoCOUG 2020 Winter Conference:
Amazon RDS for Oracle Boot Camp

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Amazon Web Services at NoCOUG 2020

Presentation	RDS Oracle - New Features	Thu, Feb 13 9:30 AM – 10:15 AM
Workshop	AWS Cloud Database Workshop - Managed HA and DR	Thu, Feb 13 10:30 AM – 2:00 PM
Presentation	AWS Database Migration Service	Thu, Feb 13 2:00 PM – 4:00 PM

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Lab requirements

- Computer with internet access
- AWS account
  https://aws.amazon.com
- OTN account (optional)
- Disable any firewalls or VPN (optional)
- SQL Developer (optional)

NOTE:
Be sure to delete resources at the conclusion of the lab!

WIFI: RC Guest
Password: rosewood

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Agenda

- **Create an Instance**
- Modify and Instance
- Upgrade and Instance
- Backup and Restore
- Managed HA and DR
- Best Practices

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Console: create an RDS Oracle instance

- Login to the AWS Console
  https://console.aws.amazon.com
- Select region "US West (Oregon)"
- Search for RDS
- Click "Get Started"
- "Launch a DB Instance"

Option	Value
Edition	Oracle EE
Use case	Dev/Test
License	BYOL
Version	12.2.0.1.ru-2019-07.rur-2019-07.r1
Class	db.t3.small
Multi-AZ	No
Identifier	<pick a name>
Public	Yes

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Managing AWS resources

- AWS Console
- Command Line Tools
- Software Development Kit (SDK)
- AWS CloudFormation

https://aws.amazon.com/tools

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CLI: Create an RDS Oracle instance

```
$ aws rds create-db-instance \
--engine oracle-ee \
--license-model license-included \
--engine-version 12.2.0.1.ru-2019-07.rur-2019-07.r1 \
--db-instance-class db.t3.small \
--no-multi-az \
--storage-type gp2 \
--allocated-storage 30 \
--db-instance-identifier ${USER}-oracle-ee-test1 \
--master-username xxxxx \
--master-user-password abcdef123 \
--publicly-accessible \
--db-name ORCL \
--port 1521 \
--backup-retention-period 7 \
--region us-west-2
```

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Python: Create an RDS Oracle instance

```
import boto3
rds = boto3.client('rds', 'us-west-2')
db = rds.create_db_instance(
  Engine='oracle-se2',
  LicenseModel='license-included',
  EngineVersion='12.2.0.1.ru-2019-07.rur-2019-07.r1',
  DBInstanceClass='db.t3.small',
  MultiAZ=False,
  StorageType='gp2',
  AllocatedStorage=30,
  DBInstanceIdentifier='oracle-ee-test',
  MasterUsername='xxxxx',
  MasterUserPassword='abcdef123',
  PubliclyAccessible=True,
  DBName='ORCL',
  Port=1521,
  BackupRetentionPeriod=7
)
```

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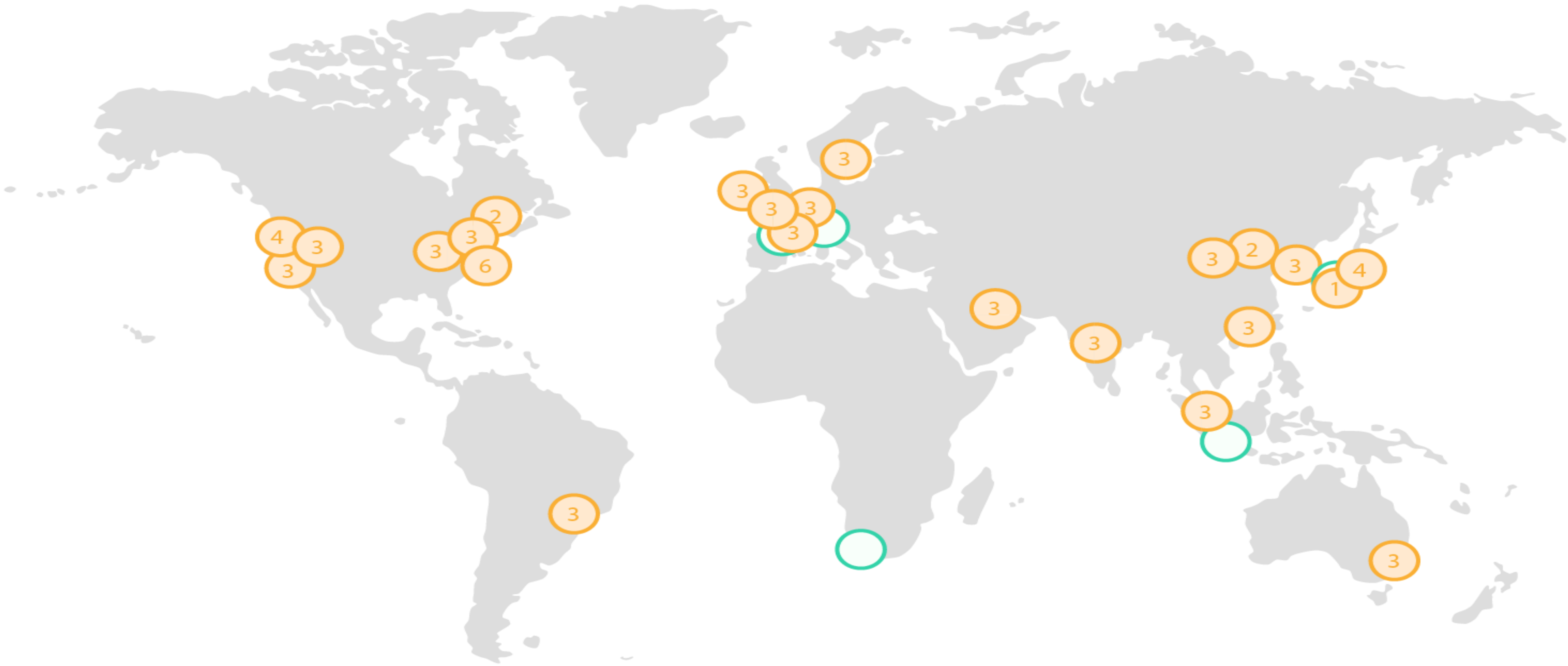
AWS global infrastructure (Feb 2020)



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Choosing regions

- Latency
- Data sovereignty
- Feature availability
- Price

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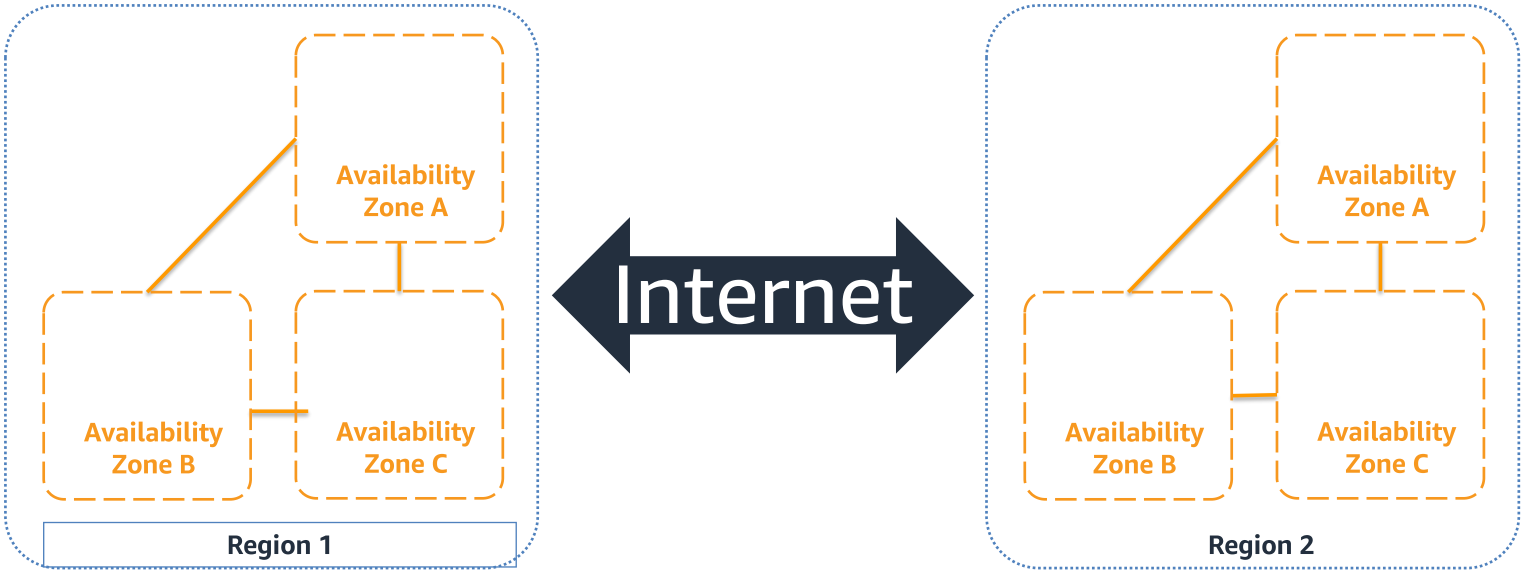
Availability Zones



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Amazon Virtual Private Cloud (VPC)

- Logical isolation
- Public or private
- AWS PrivateLink
- Strong access control and auditing

https://www.youtube.com/watch?v=3qln2u1Vr2E
YouTube: “AWS re:Invent 2015 NET403”

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Console: connect to your instance

- Find your instance
- Copy “Endpoint”
- Start SQL Developer (or client of choice) and create a new connection

Option	Value
Hostname	<your endpoint>
Port	1521
SID	ORCL
Username	<master user>
Password	<master password>

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Console: authorize VPC access

- Find your instance
- ”Security group rules”
- Click on “rds-launch-wizard” group
- ”Inbound” tab → “Edit” → “Add Rule”
- Search “what is my IP”

Option	Value
Type	Oracle-RDS
Protocol	TCP
Port	1521
Source	<your IP address>

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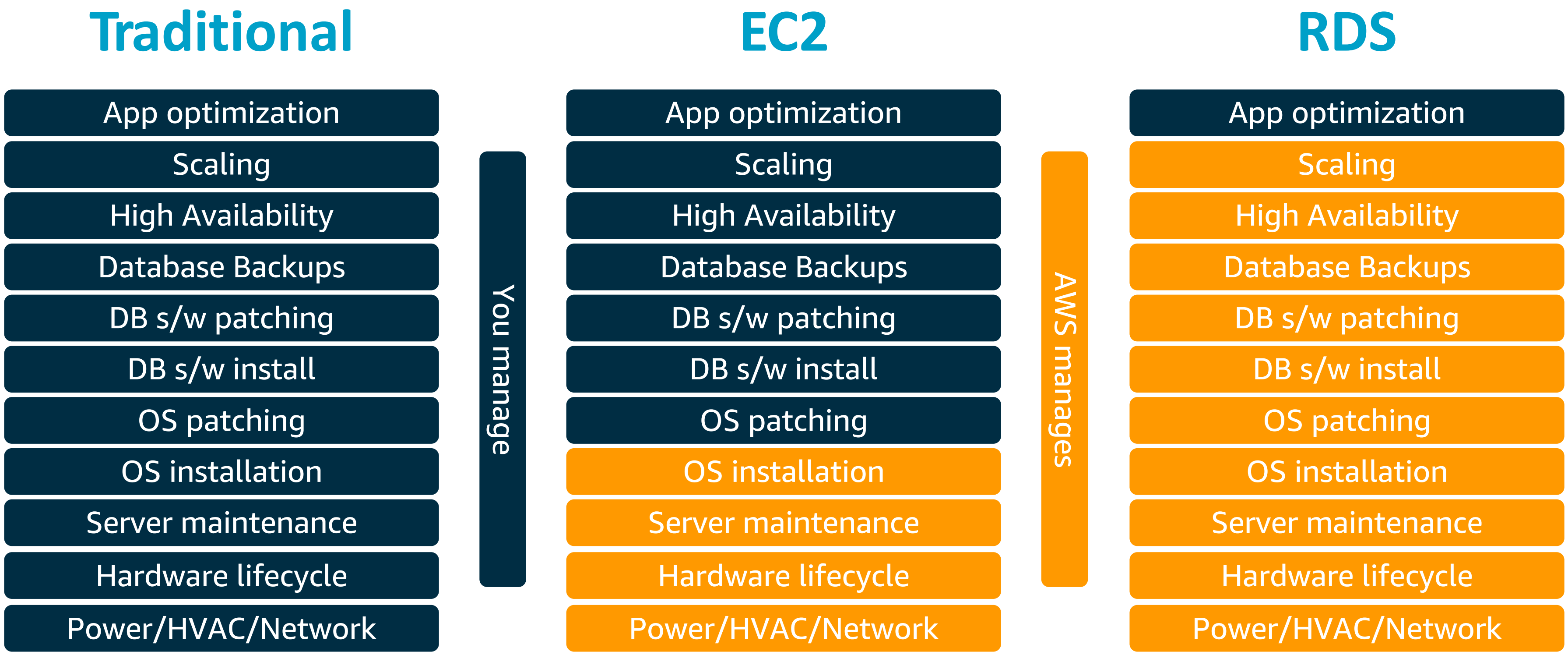
Undifferentiated heavy lifting



Traditional	EC2	RDS
App optimization	App optimization	App optimization
Scaling	Scaling	Scaling
High Availability	High Availability	High Availability
Database Backups	Database Backups	Database Backups
DB s/w patching	DB s/w patching	DB s/w patching
DB s/w install	DB s/w install	DB s/w install
OS patching	OS patching	OS patching
OS installation	OS installation	OS installation
Server maintenance	Server maintenance	Server maintenance
Hardware lifecycle	Hardware lifecycle	Hardware lifecycle
Power/HVAC/Network	Power/HVAC/Network	Power/HVAC/Network

You manage

AWS manages

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Modifying RDS instances

- Online
  - Storage, Multi-AZ*
  - Dynamic parameters and options
- Offline
  - Compute, version upgrade, reboot/failover
  - Static parameters and options
- Apply immediately or in maintenance window

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Console: scale compute (offline)

- Find your instance
- Instance actions
- Click “Modify”
- Modify instance class
- Click “Continue”
- Select “**Apply immediately**”
- Click “Modify DB instance”

Option	Value
Class	db.t3.medium

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Console: scale storage (online)

- Find your instance
- Instance actions
- Click “Modify”
- Modify allocated storage
- Click “Continue”
- Select “**Apply immediately**”
- Click “Modify DB instance”

Option	Value
Storage	50 GB

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RDS Multi-AZ

- Managed high availability
- Synchronous physical replication
- Secondary instance in physically distinct infrastructure
- Oracle (Standard end Enterprise Editions), PostgreSQL, MySQL, MariaDB
- Automatic monitoring and failover

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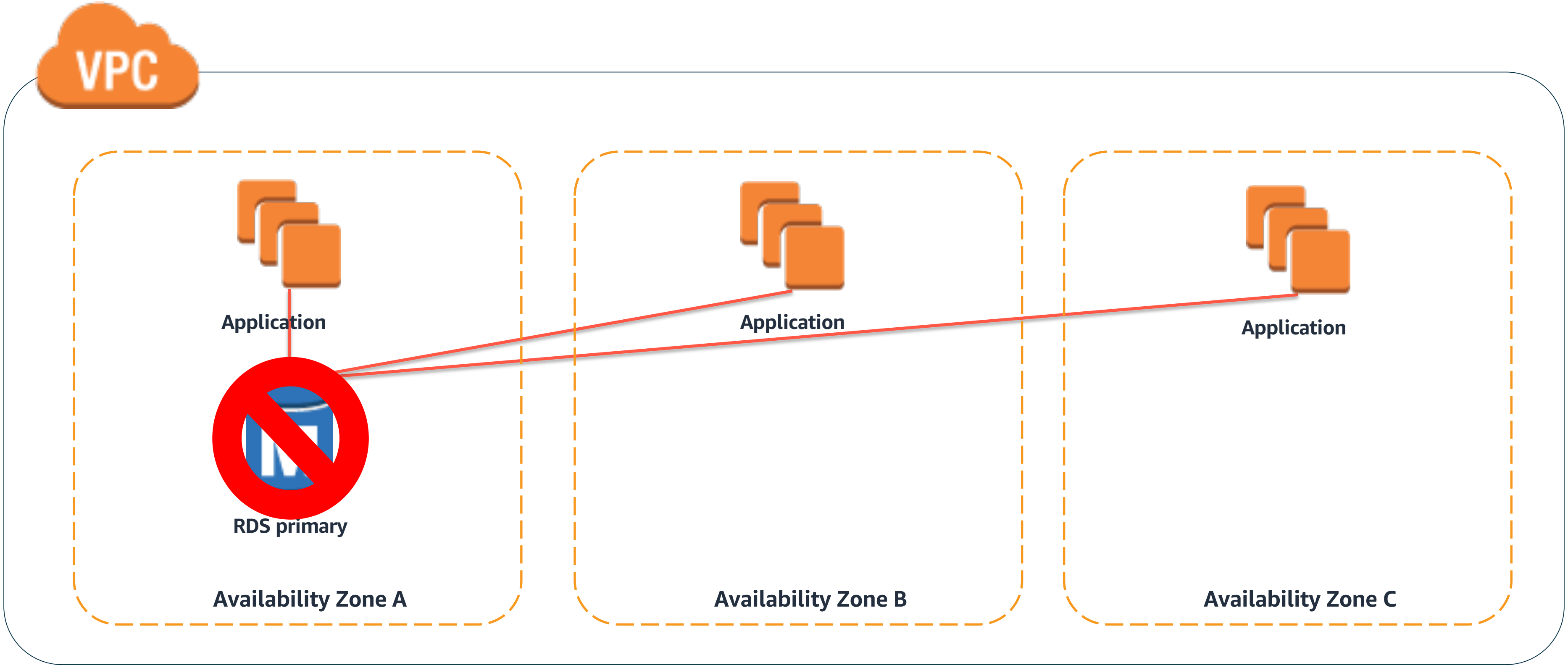
RDS Single-AZ



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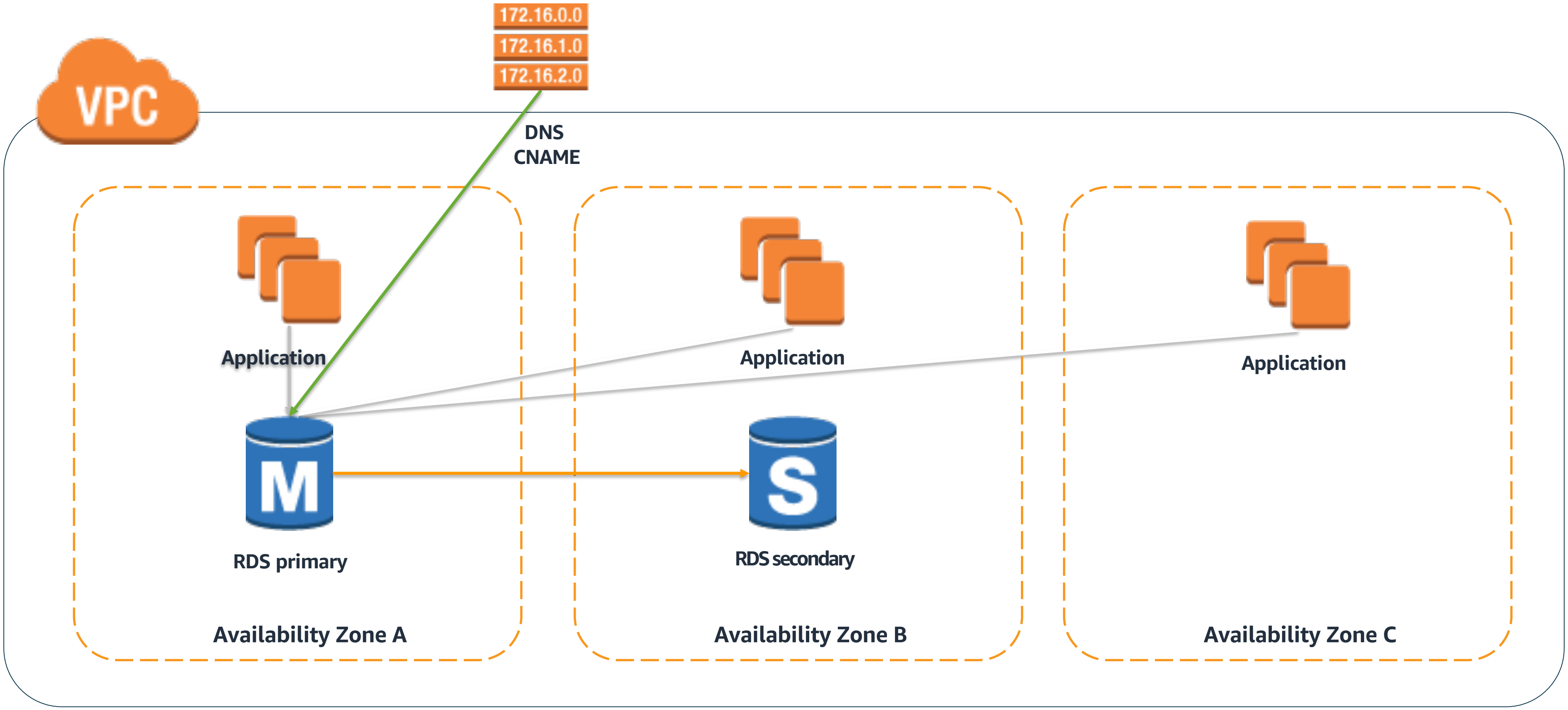
RDS Multi-AZ



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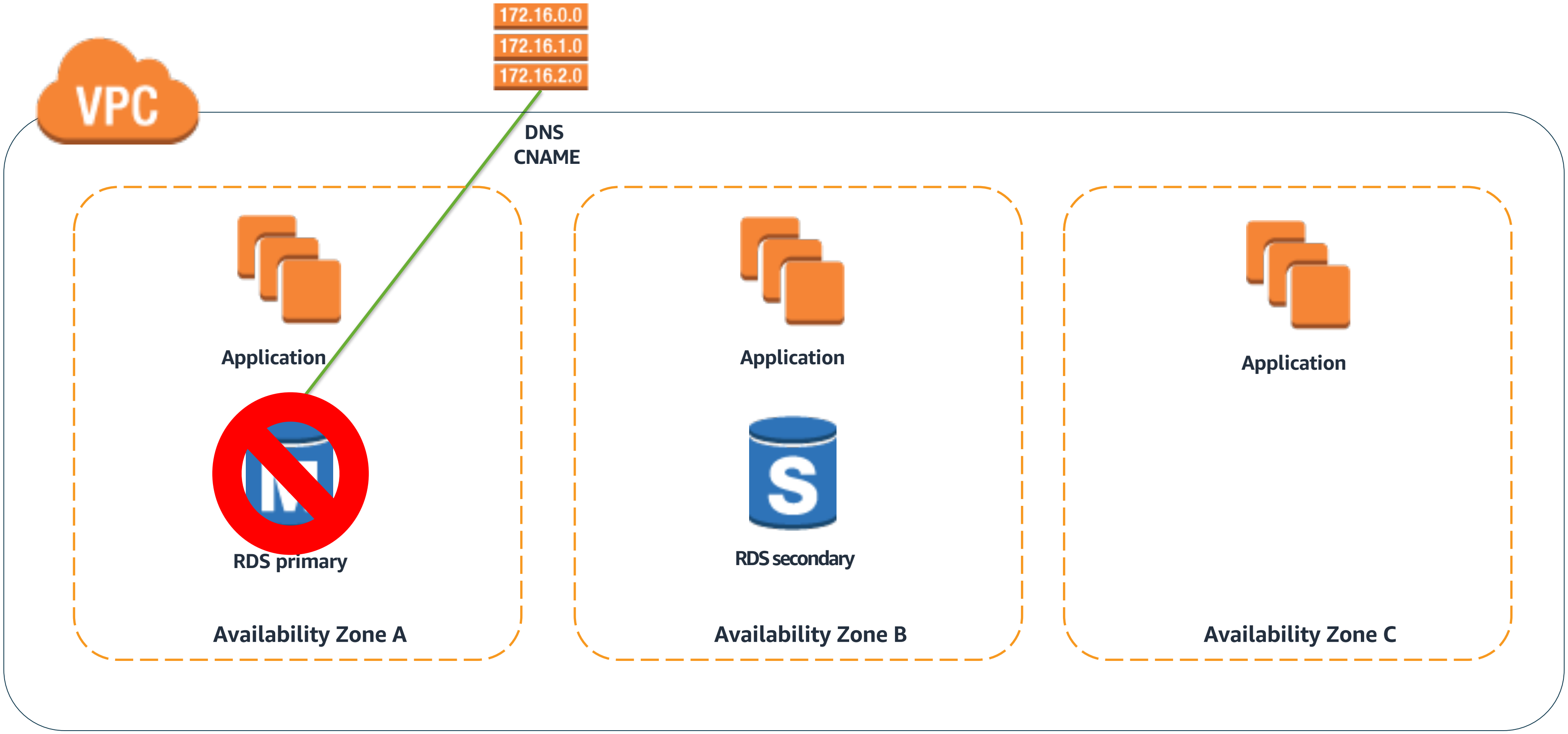
RDS Multi-AZ



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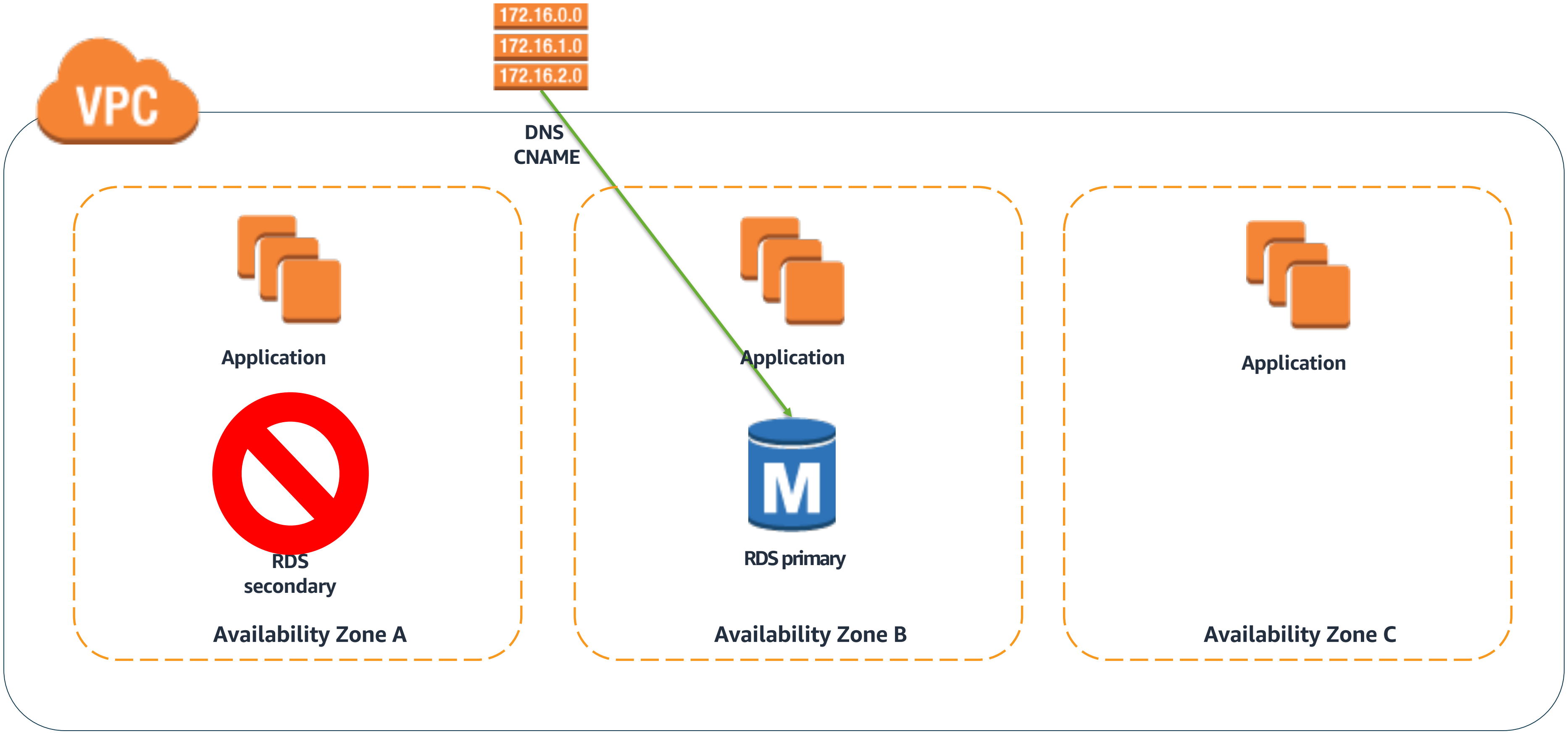
RDS Multi-AZ



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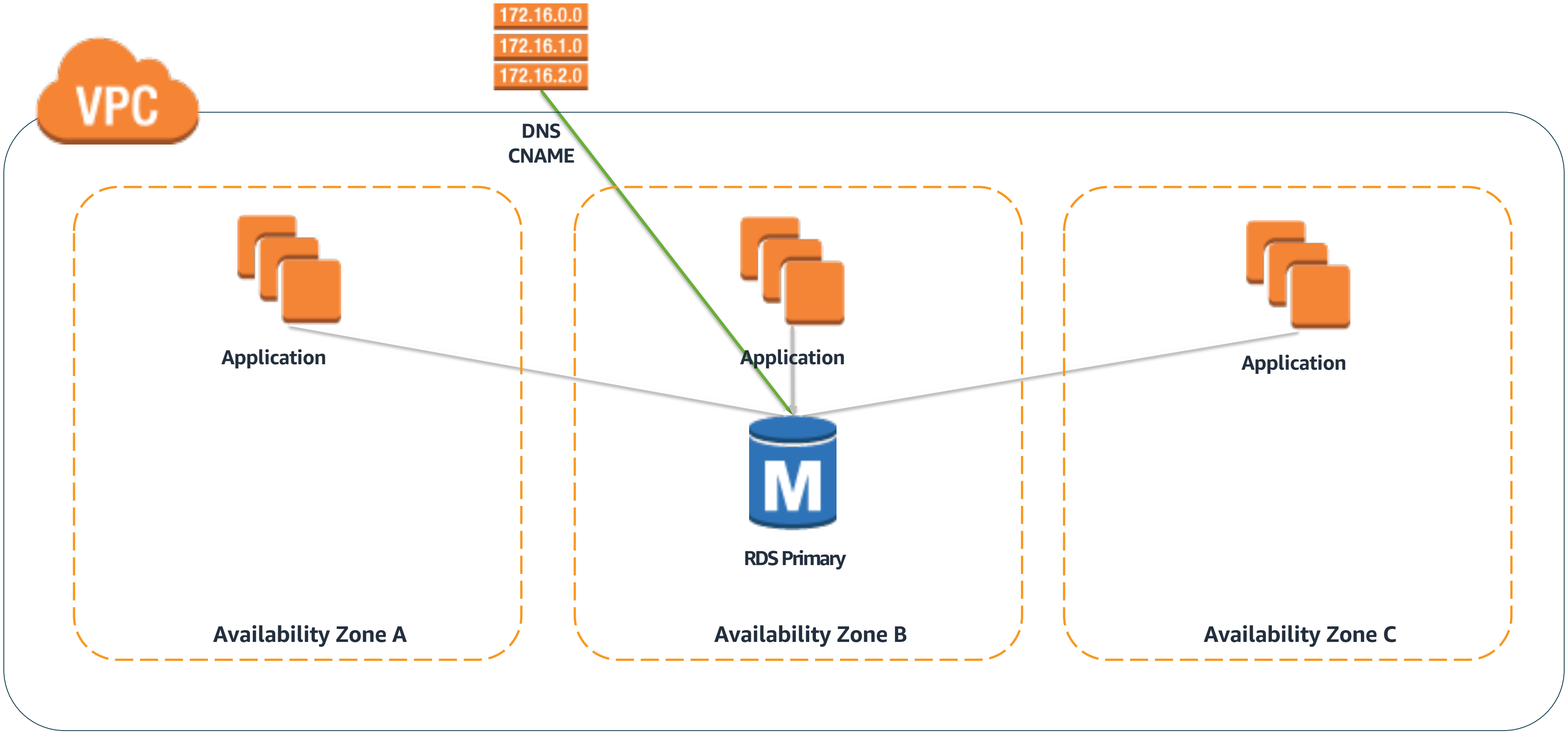
RDS Multi-AZ



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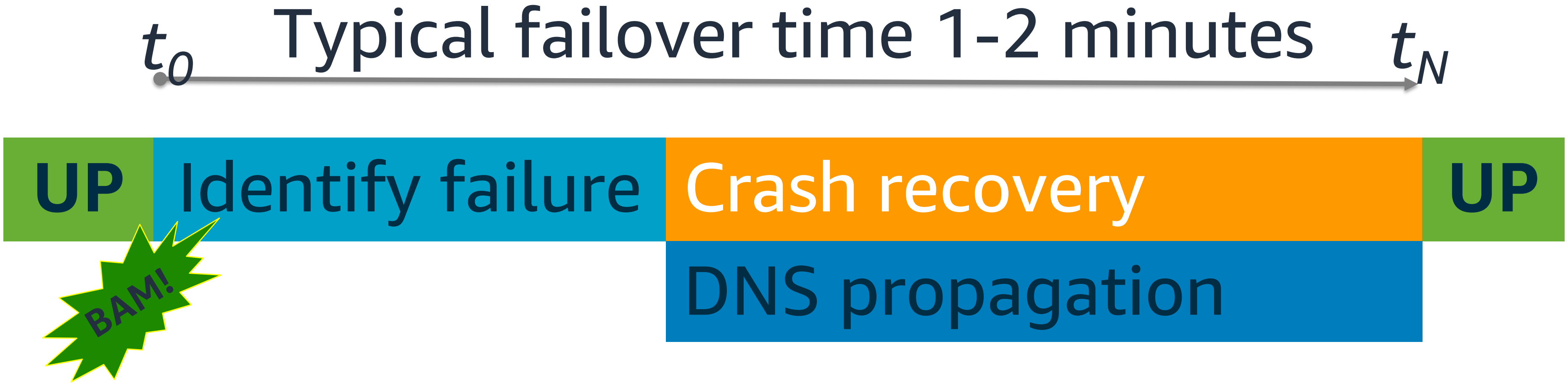
RDS Multi-AZ



t_0 Typical failover time 1-2 minutes t_N

UP

Identify failure

Crash recovery

UP

DNS propagation

BAM!

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Console: scale storage (error)

- Find your instance
- Instance actions
- Click “Modify”
- Unable to modify allocated storage for 6 hours

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Console: high availability (online*)

- Find your instance
- Instance actions
- Click “Modify”
- Modify Multi-AZ
- Click “Continue”
- Select “**Apply immediately**”
- Click “Modify DB instance”

Option	Value
Multi-AZ	Yes

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RDS Multi-AZ

- Primary in one AWS Availability Zone (AZ)
- Secondary in a different AZ
- Synchronous replication between Primary and Secondary
- AWS monitors database and will automatically fail-over
- Zero data loss

- Used for all RDS Linux based engines
- Multi-AZ can be added or removed at any time (online – no outage)
- Can be used with Oracle Standard Editions

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Console: create option group

- Go to Option groups
- Click “Create group”
- Click ”Create”

Option	Value
Name	<name>
Description	<description>
Engine	oracle-**ee**
Version	**12.2**

- Select group
- Click “Add option”
- Select “Apply Immediately”
- Click “Add Option”

Option	Value
Option	**NATIVE_NETWORK_ENCRYPTION**

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Console: associate groups

- Find your instance
- Instance actions
- Click “Modify”
- Modify parameter and option groups
- Click “Continue”
- Select “Apply immediately”
- Click “Modify DB instance”

Option	Value
DB Parameter Group	<group name>
Option group	<group name>

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Working with parameter groups

- Test carefully
- Use expressions (e.g. {DBInstanceClassMemory*3/4})
- Apply to multiple instances
- Dynamic parameters apply immediately
- Static parameters require a reboot (**not** failover)

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Console: modify parameters

- Go to parameter groups
- Select group
- Parameter group actions → "Edit"
- Click "Save changes"

Option	Value
Parameter	cursor_sharing
Value	SIMILAR

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Console: reboot

- Find your instance
- Instance actions
- Click “Reboot”
- Click “Reboot”

Option	Value
Reboot with Failover?	No

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CLI: modify instance

```
aws rds modify-db-instance --db-instance-identifier ${USER}-oracle-ee-test1 \
--db-instance-class db.t3.small --apply-immediately

aws rds modify-db-instance --db-instance-identifier ${USER}-oracle-ee-test1 \
--allocated-storage 50 \
--multi-az \
--apply-immediately

aws rds modify-db-instance --db-instance-identifier ${USER}-oracle-ee-test1 \
--db-parameter-group-name test-pg-ee-122 \
--option-group test-og-ee-122 \
--apply-immediately

aws rds reboot-db-instance \
--db-instance-identifier ${USER}-oracle-ee-test1 \
--no-force-failover
```

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Break!?

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Upgrading

- You choose what and when
- RDS does the work
- Major version upgrades – 11.2 → 12.1 → 12.2 → 18C → 19C
- Minor version upgrades – 12.1.0.2.v15 → 12.1.0.2.v16
- Outage depends largely on instance class and type of upgrade
- New minor versions quarterly
  search “RDS Oracle engine release notes”

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Console: upgrade

- Find your instance
- Instance actions
- Click “Modify”
- Modify engine version
- Click “Continue”
- Select “Apply immediately”
- Click “Modify DB instance”

Option	Value
Version	12.2.0.1.ru-2019-10.rur-2019-10.r1

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RDS pricing

- Pay for what you use
- Compute time
- Storage
- Data transfer

Search for “AWS calculator”, or go to https://calculator.s3.amazonaws.com/index.html

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Backups

System/automatic

- Run daily
- Specify daily backup window (30 minutes)
- Specify backup retention (0-35 days)
- Includes archived redo logs

Manual

- Run on-demand
- Retained until explicitly deleted

- RMAN Backups
  - Database
  - Archivelogs

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Backups and redo

- ARCHIVELOG mode when automated backups enabled (>0 days)
    - Archived logs automatically backed up to S3
    - ARCHIVE_LAG_TARGET set to 5 minutes (or less)
    - Kept for backup retention days
- NOARCHIVELOG mode when automated backups disabled (0 days)
- Default log size is 4 x 128 MB
- Backups inherit encryption, can be copied/shared

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Backup process

- EBS snapshots
- Always incremental
- Uses Oracle hot backup mode
- I/O freeze (<1 second) to instantiate snaphot
    - Single-AZ – Database I/O freezes briefly
    - Multi-AZ – Snapshot taken on secondary
- Latency can increase when modifying blocks being backed up

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Restore

- Always creates a new instance with a new endpoint
- Can restore to the state of any snapshot (system or automatic)
- Can restore to any point in time during retention window – typically up to 5 minutes ago
- Restored instances are fully accessible while data is loading

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Console: take a snapshot

- Find your instance
- Instance actions
- Click “Take snapshot”
- Assign a name
- Click “Take Snapshot”

Option	Value
Snapshot name	<name>

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Console: point-in-time restore

- Find your instance
- Instance actions
- Click “Restore to point in time”
- Choose options
- Click “Launch DB instance”

Option	Value
Identifier	<new name>

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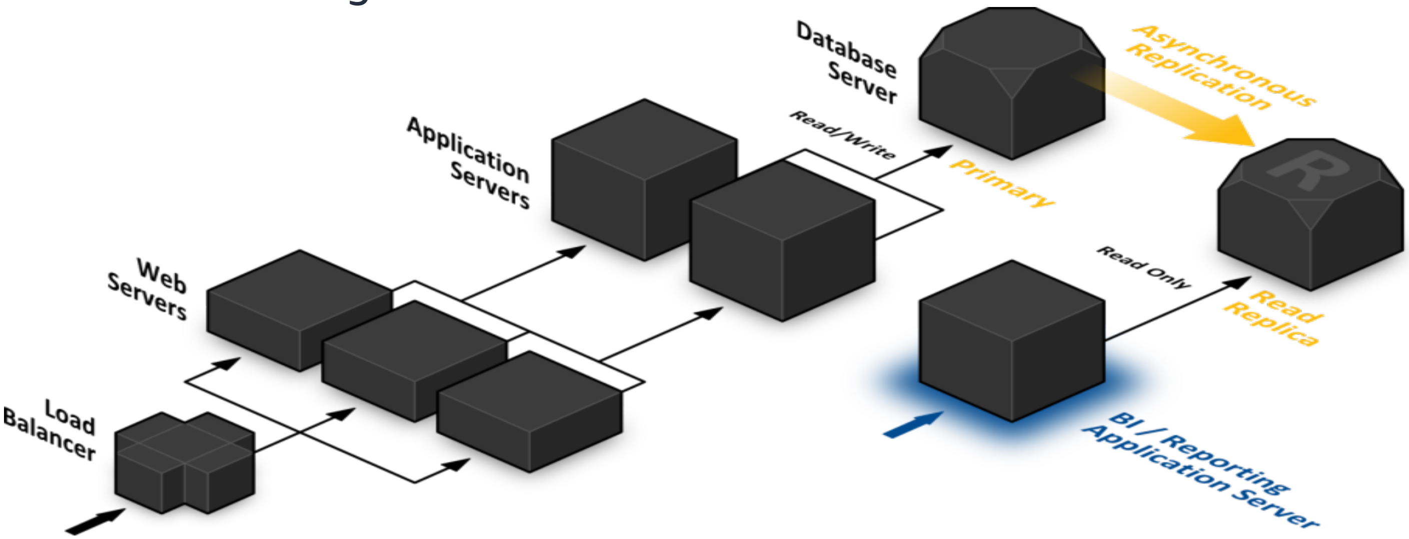
Why would I use Read Replicas?

- Relieve pressure on your source database with additional read capacity
- Bring data close to your applications in different regions
- Promote a Read Replica to a master for faster recovery in the event of disaster
- Upgrade a Read Replica to a new engine version



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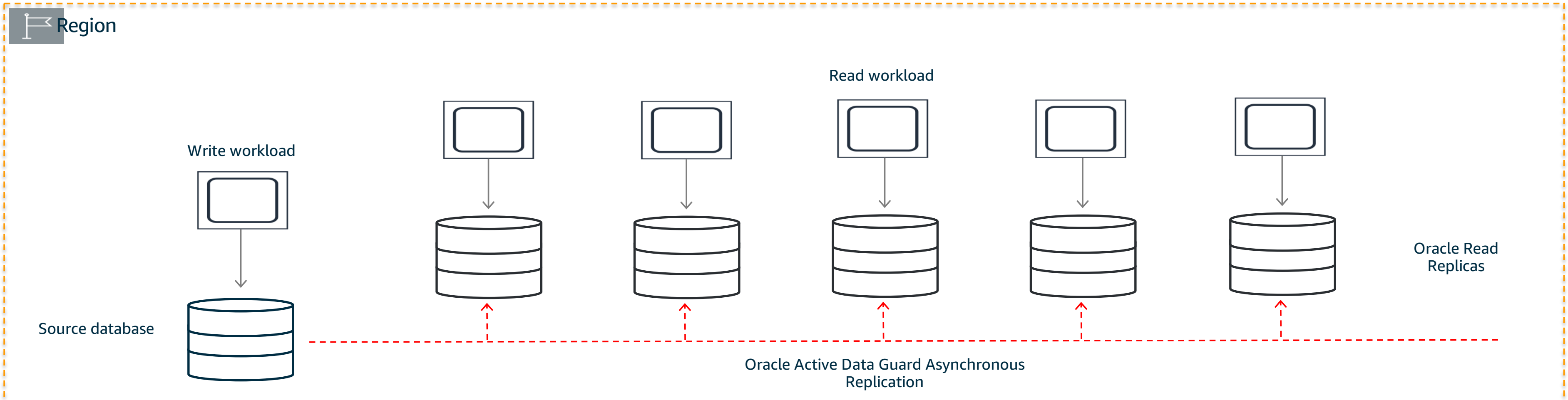
Why would I use Read Replicas?

- Use in-region Read Replicas
    - For scalability of read workload
    - To relieve pressure on your source database with additional read capacity
- Create up to 5 replicas per source database
- Monitor replication lag in Amazon CloudWatch or RDS console
- A replica can be promoted to a new standalone database



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Multi-AZ vs. Read Replicas?

Multi-AZ configurations	Read Replicas
• Synchronous replication – highly durable	• Asynchronous replication – highly scalable
• Only primary instance is active at any point in time	• All replicas are active and can be used for read scaling
• Backups can be taken from secondary	• No backups configured by default
• Always in two Availability Zones within a Region	• Can be within an Availability Zone, Cross-AZ, or cross-region
• Database engine version upgrades happen on primary	• Database engine version upgrades independently from source instance
• Automatic failover when a problem is detected	• Can be manually promoted to a standalone database

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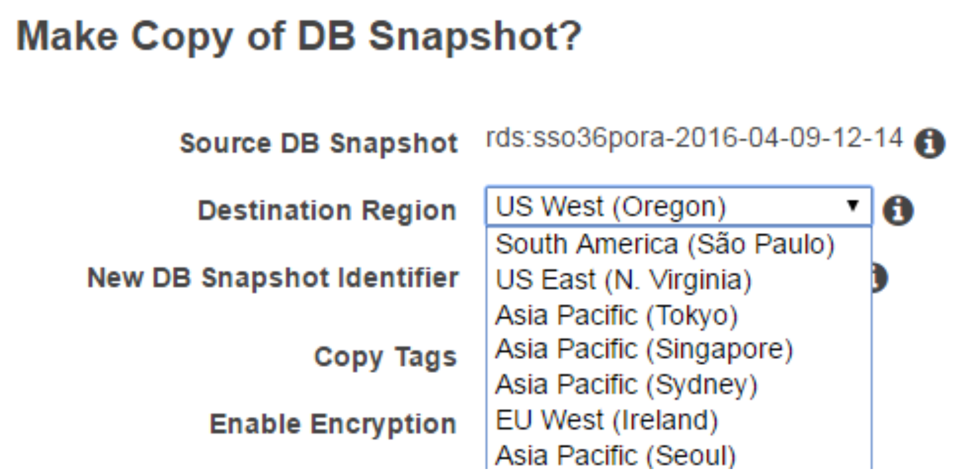
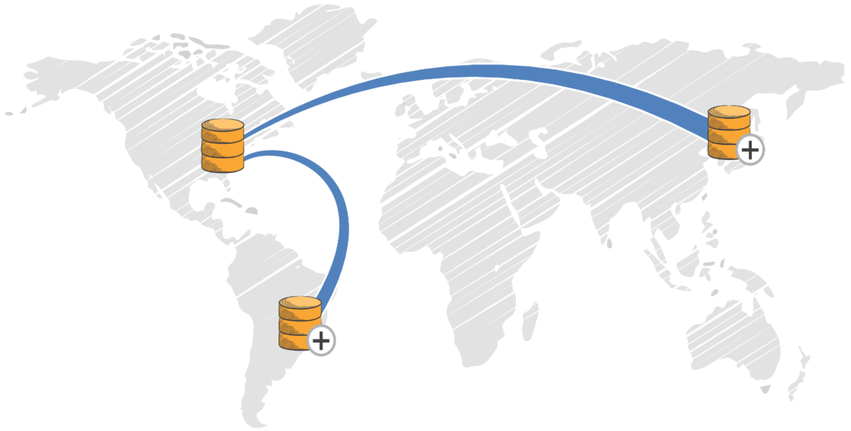
Cross-region disaster recovery

- Choose cross-region snapshot copy for greater durability, ease of migration
- Copy a database snapshot to a different AWS Region
- Restore in the case of a regional disaster
- Or use it to migrate a database to a different region



Make Copy of DB Snapshot?

Source DB Snapshot	rds:sso36pora-2016-04-09-12-14
Destination Region	US West (Oregon) ▾
New DB Snapshot Identifier	
Copy Tags	
Enable Encryption	



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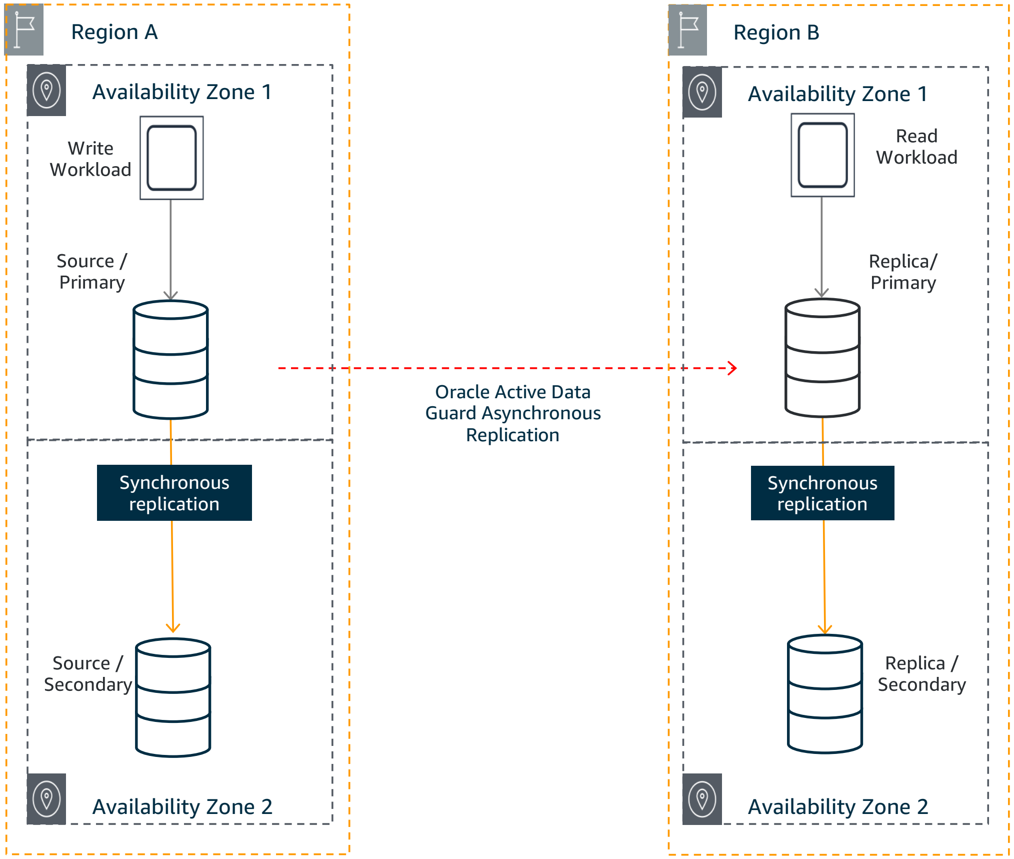
Cross-region Read Replicas

- Use cross-region Read Replicas:
  - •To bring data closer to the users
  - •As a standby database for recovery in the event of disaster
  - •For scalability of read workload
  - •To relieve pressure on your source database with additional read capacity
- Replicas can be in Multi-AZ configuration to reduce recovery time



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Best practices

- Security, security, security
- Understand licensing
- Scale up
- Scale down
- Clean up after yourselves
- Test

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Test all the things!

- Application compatibility
- Workload – all use cases
- Failover
- Parameters
- Upgrades

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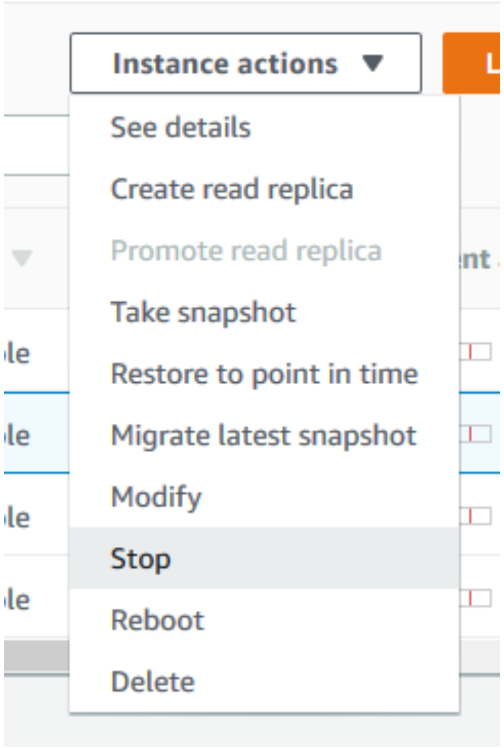
Can I stop my database when not in use?

- Stop and start a running database instance from the console or CLI
- Available for Single-AZ and Multi-AZ DB instances
- While instance is stopped, you pay only for storage
- Backup retention window is maintained while stopped
- Instances are restarted after 7 days
    - Pending maintenance operations are applied
    - Instances can be stopped again if desired

```
#Shut down at 8:00 PM on Friday
0 20 * * 5 /home/ec2-user/scripts/stop_rds.sh

#Start up at 4:00 AM on Monday
0 4 * * 1 /home/ec2-user/scripts/start_rds.sh
```



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Oracle on RDS vs EC2

- RDS
  - Focus on application development/tuning
  - Managed high availability, backups, and infrastructure
  - Simplified licensing
- EC2
  - Full control over the database
  - Additional infrastructure configurations
  - More version/edition/feature flexibility

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Where to go from here

- Repeat all of the lab steps, but for PostgreSQL or MySQL
  - Learn new database engines without having to learn how to install, configure, secure, backup, etc.

- Try out Database Migration Service
  - https://aws.amazon.com/dms
  - https://aws.amazon.com/dms/hands-on-lab

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Where to go from here

- https://aws.amazon.com/free
- https://aws.amazon.com/documentation/rds
- https://aws.amazon.com/rds/customers
- https://aws.amazon.com/compliance
- https://aws.amazon.com/iam
- https://www.youtube.com/watch?v=Y33TviLMBFY

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Console: delete unused instances

- Find your instance
- Instance actions
- Click “Delete”
- Choose final snapshot options
- Click “Delete”

Option	Value
Create final snapshot	No

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Console: delete snapshots

- Go to snapshots
- Select manual snapshot(s)
- In “Actions”, click “Delete Snapshot”
- Click “Delete”

Note: system snapshots should automatically disappear a few minutes after you delete your instance

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Q&A

Amit Grover

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Thank you!

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