

AWS

S U M M I T

Migrating Your Databases to AWS: Deep Dive on Amazon RDS and AWS Database Migration Service

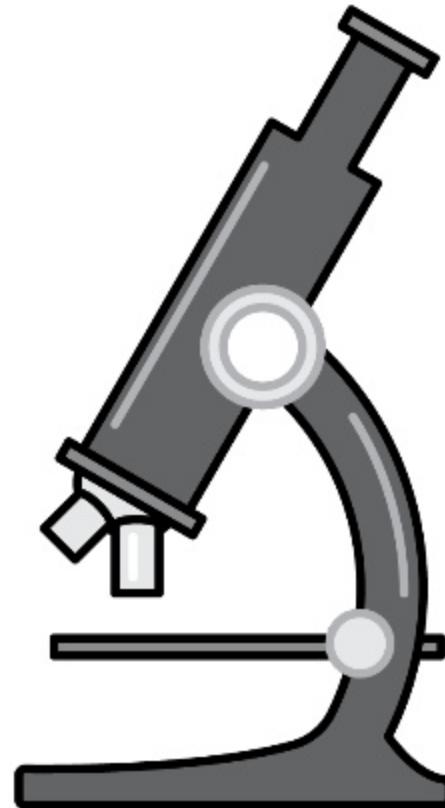
Prahlad Rao, Solutions Architect AWS

August 17, 2017



What to expect

- Amazon RDS overview (super quick)
 - Security
 - Metrics and monitoring
 - High availability
 - Scaling on RDS
 - Backups and snapshots
- AWS Database Migration Service
- Q&A!



Amazon Relational Database Service (Amazon RDS)



No infrastructure management



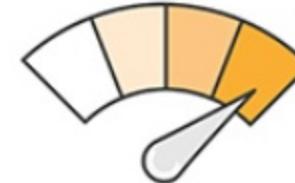
Cost-effective



Application compatibility



Instant provisioning



Scale up/down

Amazon RDS engines

Commercial

ORACLE®



Microsoft
SQL Server

Open source



PostgreSQL



MariaDB

Amazon Aurora



Selected Amazon RDS customers



Instacart



SHOP
DIRECT

e-reverse.com

KAPLAN



BANDAI NAMCO Studios



{Fiksu}



F Flipboard



UCAS

illumina®

ST. JAMES'S PLACE
WEALTH MANAGEMENT

HEARST corporation

OPEN
UNIVERSITIES
AUSTRALIA

ZIFF
DAVIS

Unilever

infor

atgmedia

medidata

outsystems®

baool

MarketShare

UMUC
University of Maryland University College

true money

ROVIO

Fairfax Media

vessel

Selected Amazon Aurora customers



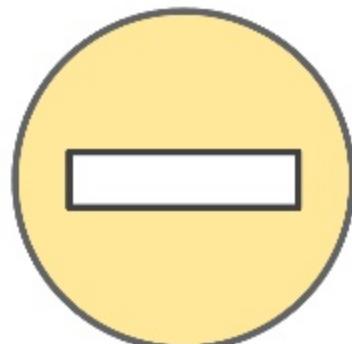
Trade-offs with a managed service

Fully managed host and OS

- No access to the database host operating system
- Limited ability to modify configuration that is managed on the host operating system
- No functions that rely on configuration from the host OS

Fully managed storage

- Max storage limits
 - Microsoft SQL Server—4 TB
 - MySQL, MariaDB, PostgreSQL, Oracle—6 TB
 - Aurora—64 TB
- Growing your database is a process

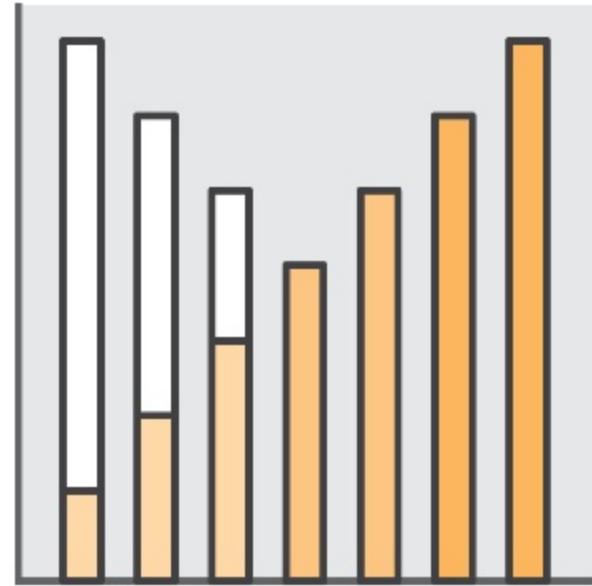


Security and compliance

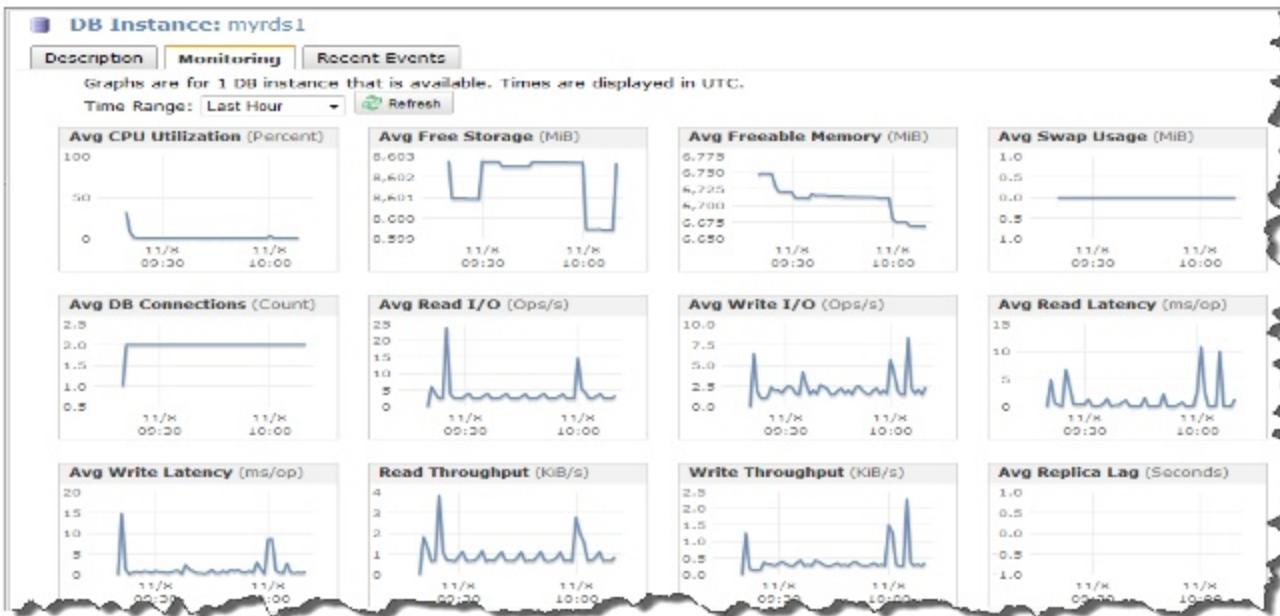


- Network isolation
- Database instance IP firewall protection
- AWS IAM based resource-level permission controls
- Encryption at rest using AWS KMS or Oracle/Microsoft TDE
- SSL protection for data in transit
- Assurance programs for finance, healthcare, government and more

Metrics and monitoring



Standard monitoring



Amazon CloudWatch metrics for Amazon RDS

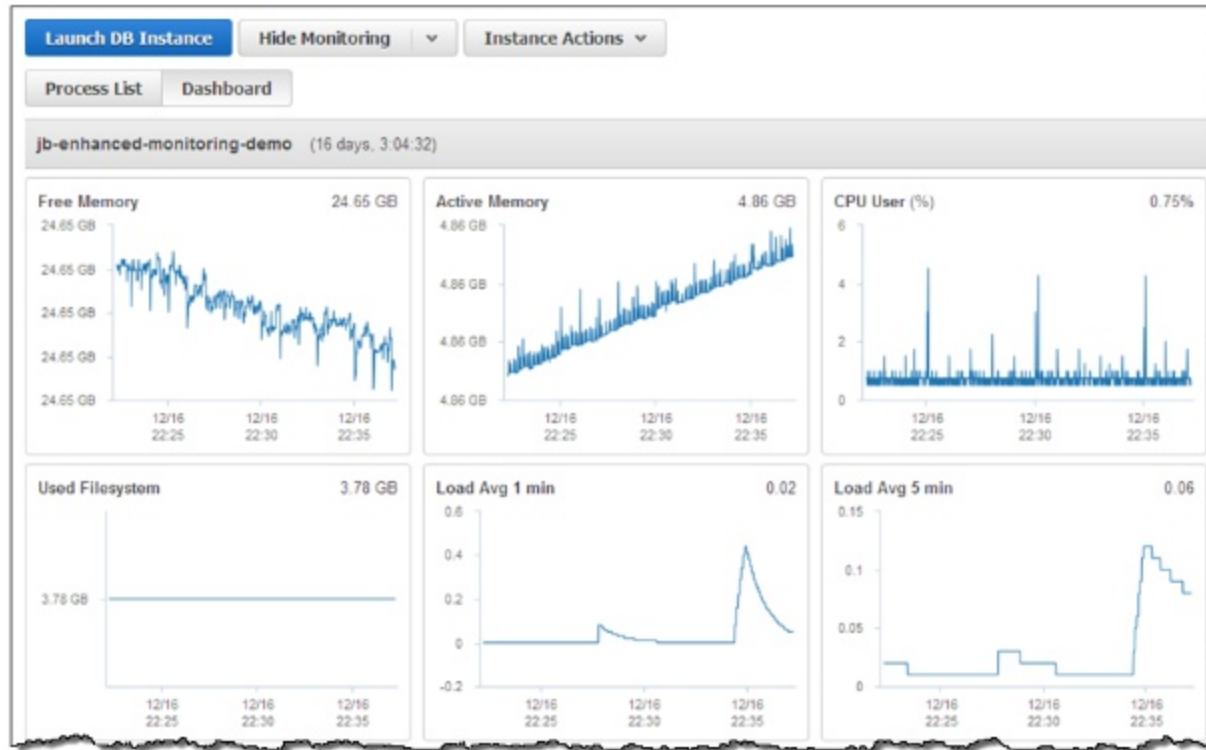
- CPU utilization
- Storage
- Memory
- Swap usage
- DB connections
- I/O (read and write)
- Latency (read and write)
- Throughput (read and write)
- Replica lag
- Many more

Amazon CloudWatch Alarms

- Similar to on-premises custom monitoring tools

Enhanced monitoring

Access to over 50 new CPU, memory, file system, and disk I/O metrics as low as 1 second intervals



Monitoring

Enable Enhanced Monitoring Yes

Monitoring Role

Granularity

I authorize RDS to create the IAM role rds-monitoring-role.

Introducing *Performance Insights*

Guided discovery of performance problems



- Targeting “Ease of Use” for non-experts
- Database load: is core metric

Database load and database metrics used by DBAs and tools

Phased delivery started in Q1 2017 (Preview) and throughout 2017

- Aurora, MySQL/MariaDB, PostgreSQL, Commercial Engines

Performance Insights at a glance

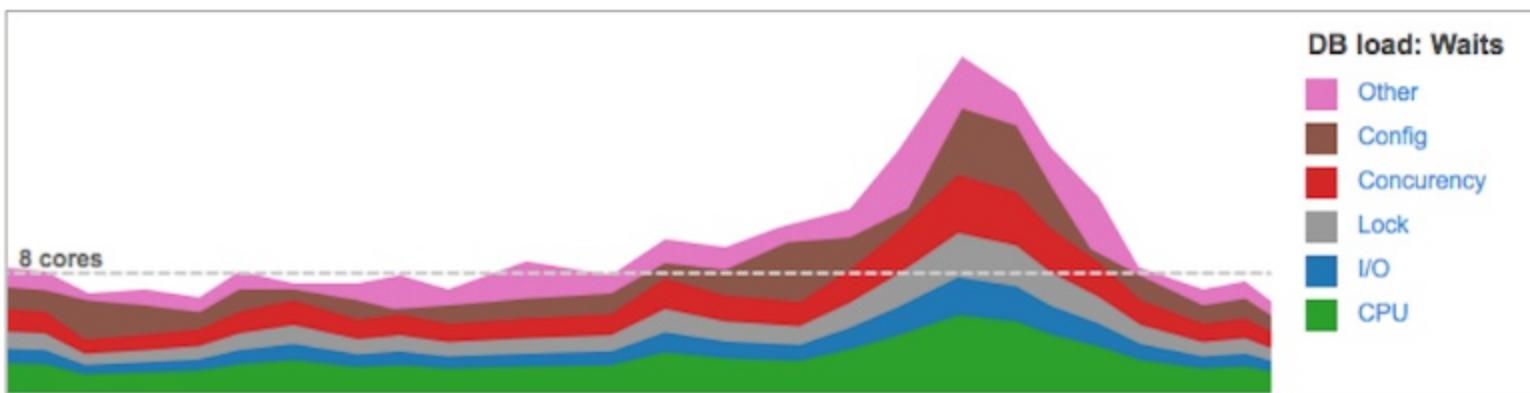
Automates sampling of data

Exposes data via API

Provides UI to show database load



Database load:



AWS Services RDS DMS EMR Edit eichbaum @ awsdbux N. Virginia Support

RDS Dashboard Instances Clusters Reserved Purchases Snapshots Security Groups Parameter Groups External Licenses Option Groups Subnet Groups Events Event Subscriptions Notifications 18

Launch DB Instance Show Monitoring Instance Actions Filter: All Instances Search DB Instances... Viewing 100 of 100 DB Instances

Engine DB Instance Status CPU DB Load Maintenance Class VF

MySQL ashkma... MySQL test-pira... Aurora wenlian... Aurora test-rest... Aurora test-enh... Aurora test-aum... Aurora test-aum... Aurora restorer... Aurora nktestau... Aurora jeftrugg... Aurora hotlix-m...

RDS Dashboard Instances Find by instance name Name demo-db-1 demo-db-2 demo-db-3 demo-db-4 demo-db-5 demo-db-6

demo-db-1 Metrics Close Tutorial

Last 60 minutes

SQL Waits Sessions Users Hosts

DB load: Write Other Config Durability Lock IO CPU

Performance metrics Total CPU Connection Reads Writes

Find by SQL statement ID

Showing X of X

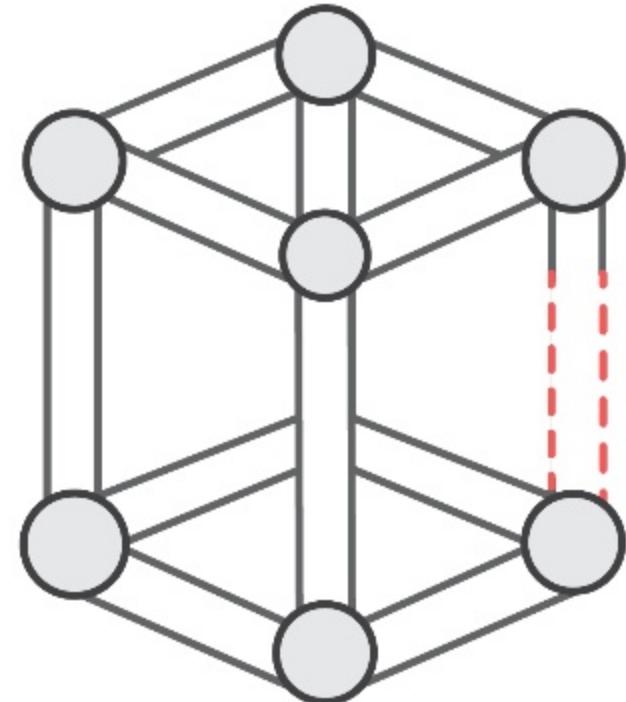
ID DB load Query

- 6937082015668780 SELECT * FROM 'PRODUCTS' WHERE 'CATEGORY' = ? AND 'SPECIAL' = ? LIMIT ?
- CA4BB448NEA3B128 UPDATE 'DSZ'.'INVENTORY' SET 'QUAN_IN_STOCK' = ?, 'SALES' = ? WHERE 'PROD_ID' = ?
- 0051D481680F061A SELECT * FROM 'PRODUCTS' WHERE MATCH ('ACTOR') AGAINST (?) LIMIT ?
- C38P0D780663805 SELECT 'QUAN_IN_STOCK', 'SALES' FROM 'DSZ'.'INVENTORY' WHERE 'PROD_ID' = ?
- 8F261004B01208C0 SELECT * FROM 'PRODUCTS' WHERE MATCH ('TITLE') AGAINST (?) LIMIT ?

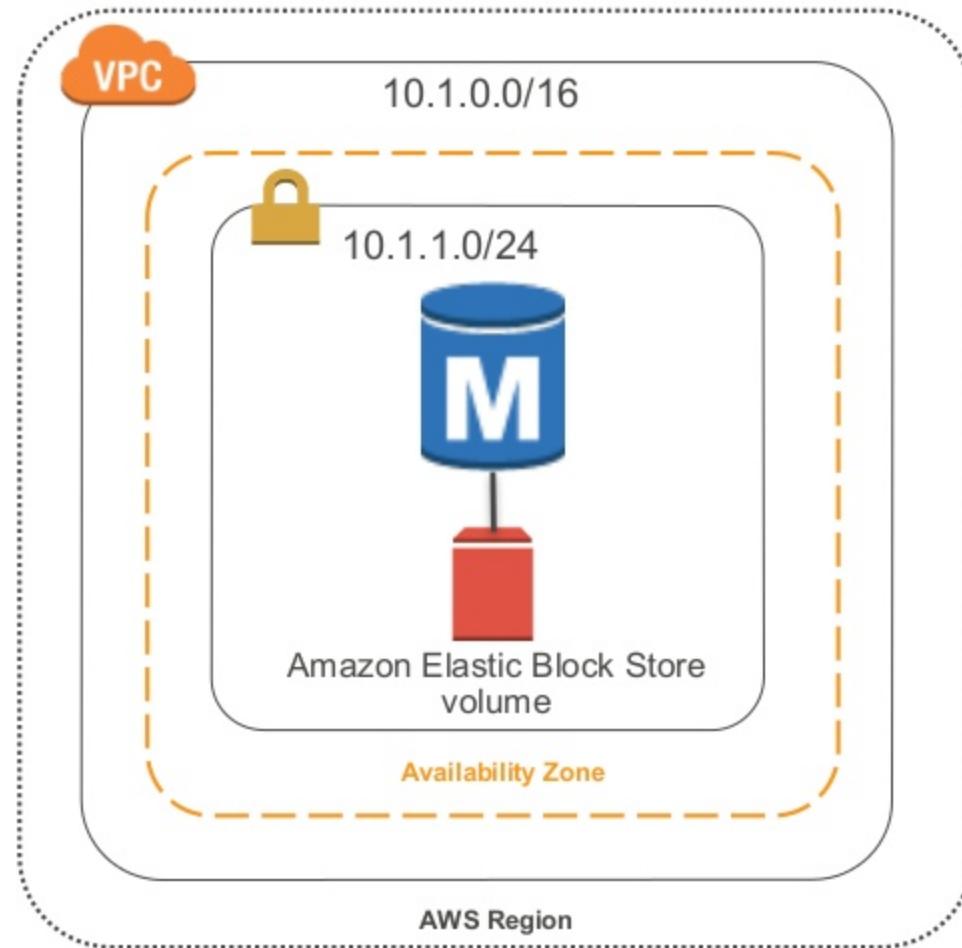
Feedback English

The screenshot shows the AWS RDS Dashboard. On the left, there's a sidebar with various navigation links like Instances, Clusters, and Notifications (with 18 items). The main area displays a list of DB instances, mostly Aurora, with names like 'ashkma...', 'test-pira...', 'wenlian...', etc. A large orange arrow points from the bottom-left towards the detailed monitoring view on the right. The monitoring view for 'demo-db-1' shows performance metrics over the last 60 minutes, including CPU, IO, and network usage. Below this is a table of recent SQL statements with their execution details.

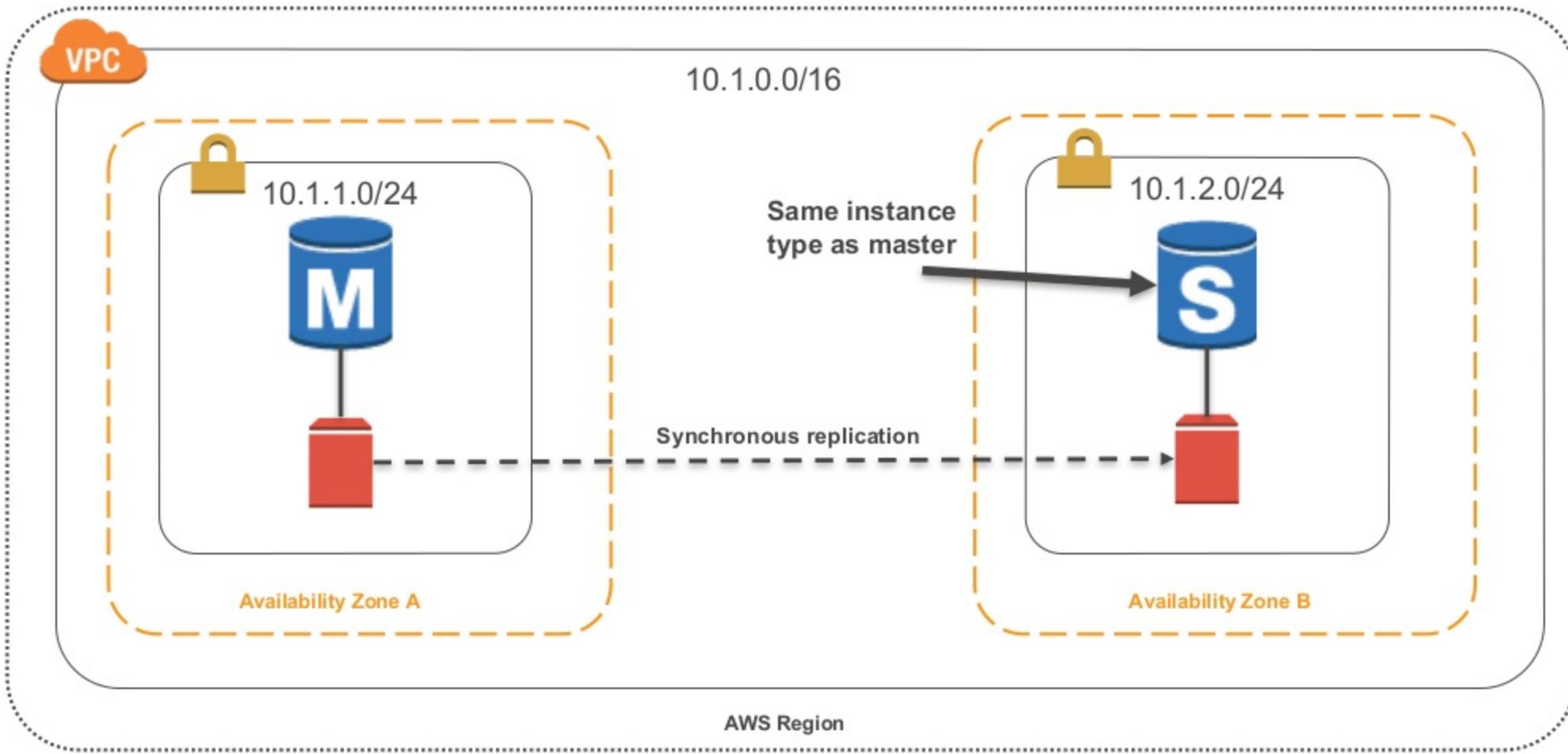
High availability



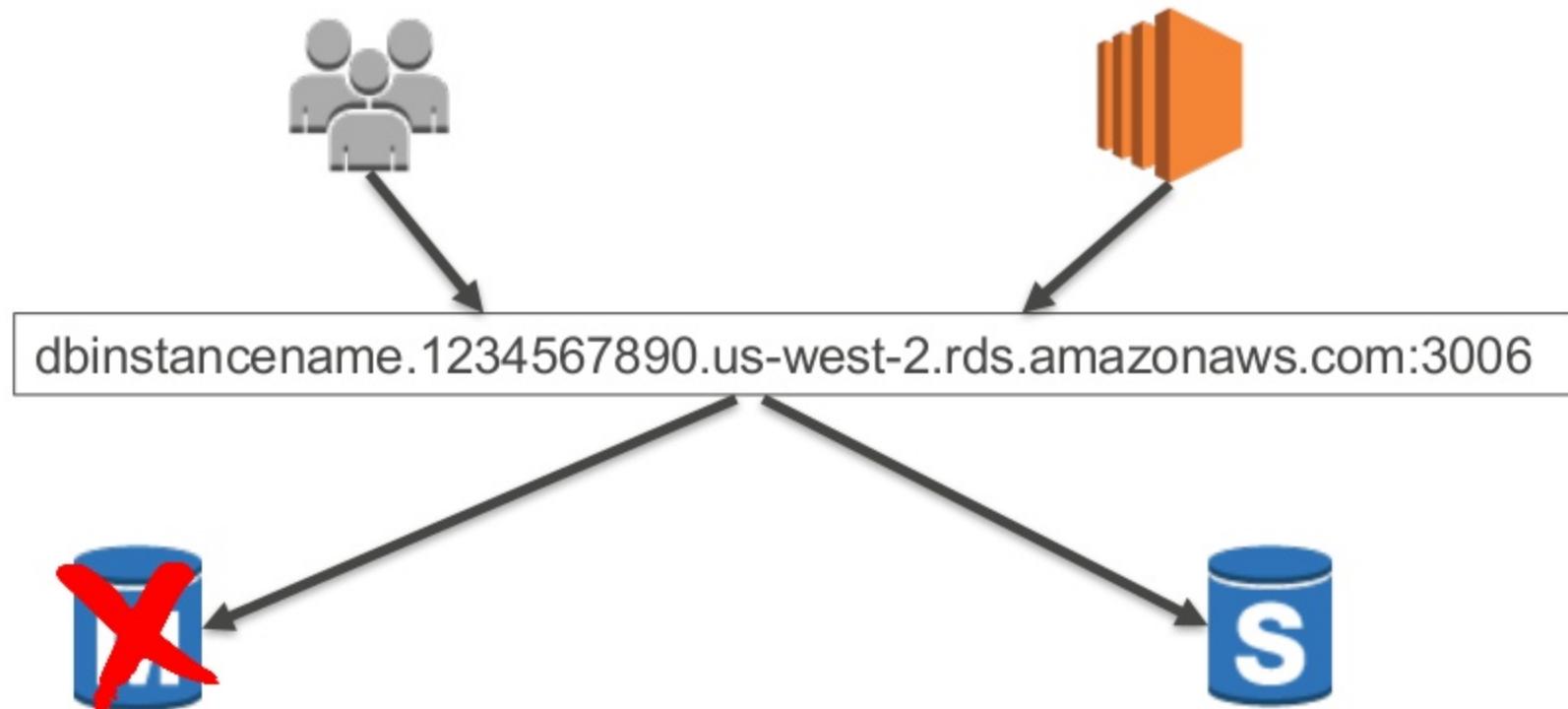
Minimal deployment—single Availability Zone



High availability—Multi-AZ

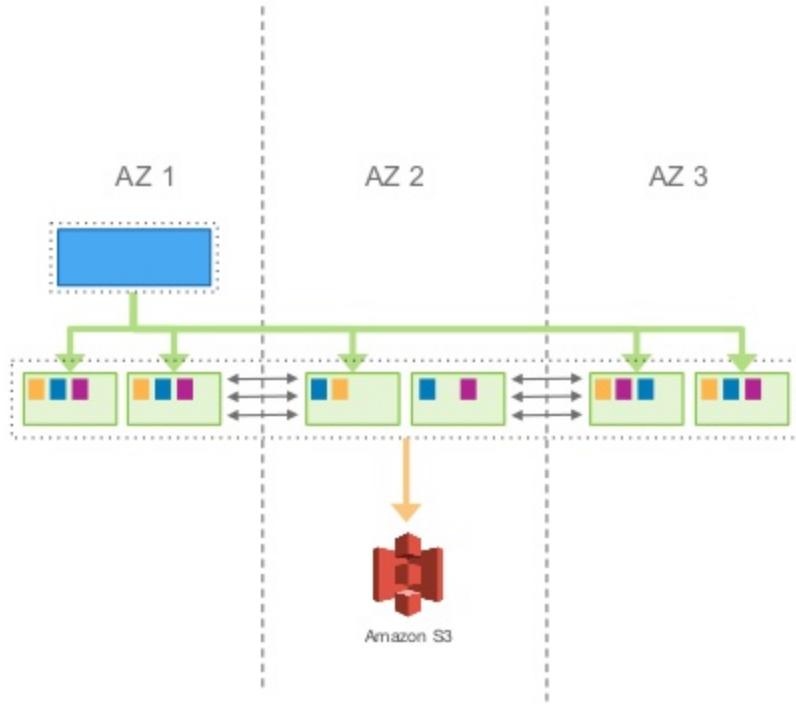


High availability—Multi-AZ to DNS



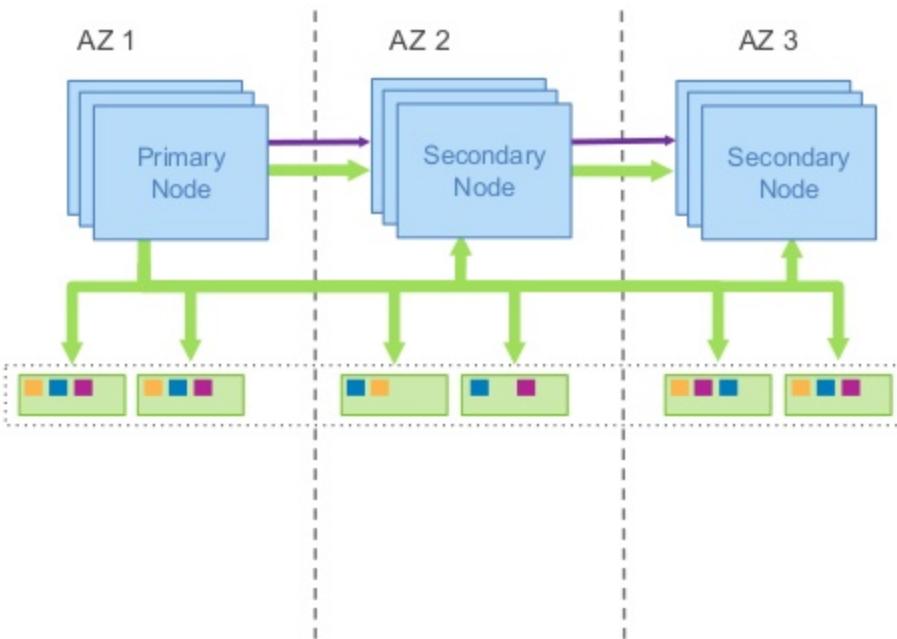
High availability—Amazon Aurora storage

- Storage volume automatically grows up to 64 TB
- Quorum system for read/write; latency tolerant
- Peer-to-peer gossip replication to fill in holes
- Continuous backup to Amazon S3 (built for 11 9s durability)
- Continuous monitoring of nodes and disks for repair
- 10 GB segments as unit of repair or hotspot rebalance
- Quorum membership changes do not stall writes

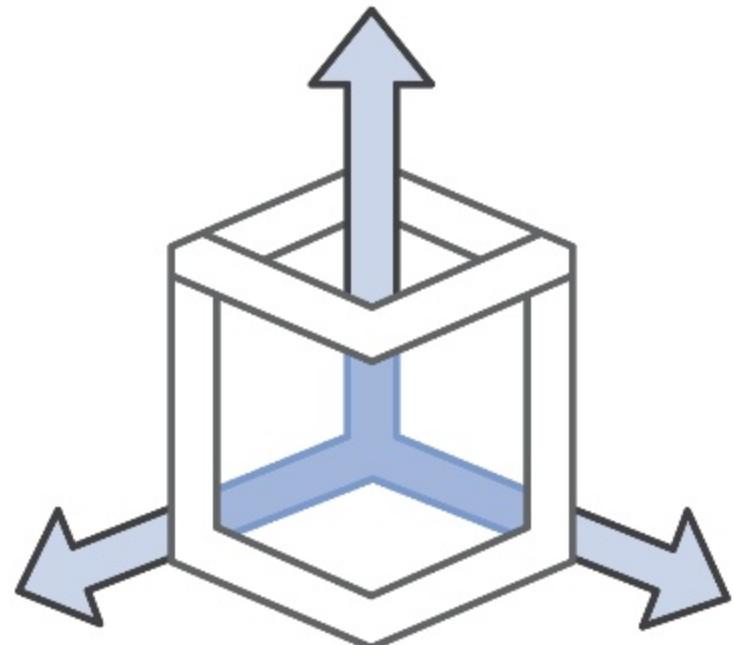


High availability—Aurora nodes

- Aurora cluster contains primary node and up to 15 secondary nodes
- Failing database nodes are automatically detected and replaced
- Failing database processes are automatically detected and recycled
- Secondary nodes automatically promoted on persistent outage, no single point of failure
- Customer application can scale out read traffic across secondary nodes



Scaling on RDS



Read Replicas

Bring data close to your customer's applications in different Regions

Relieve pressure on your master node for supporting reads and writes

Promote a Read Replica to a master for faster recovery in the event of disaster



Read Replicas

Within a Region

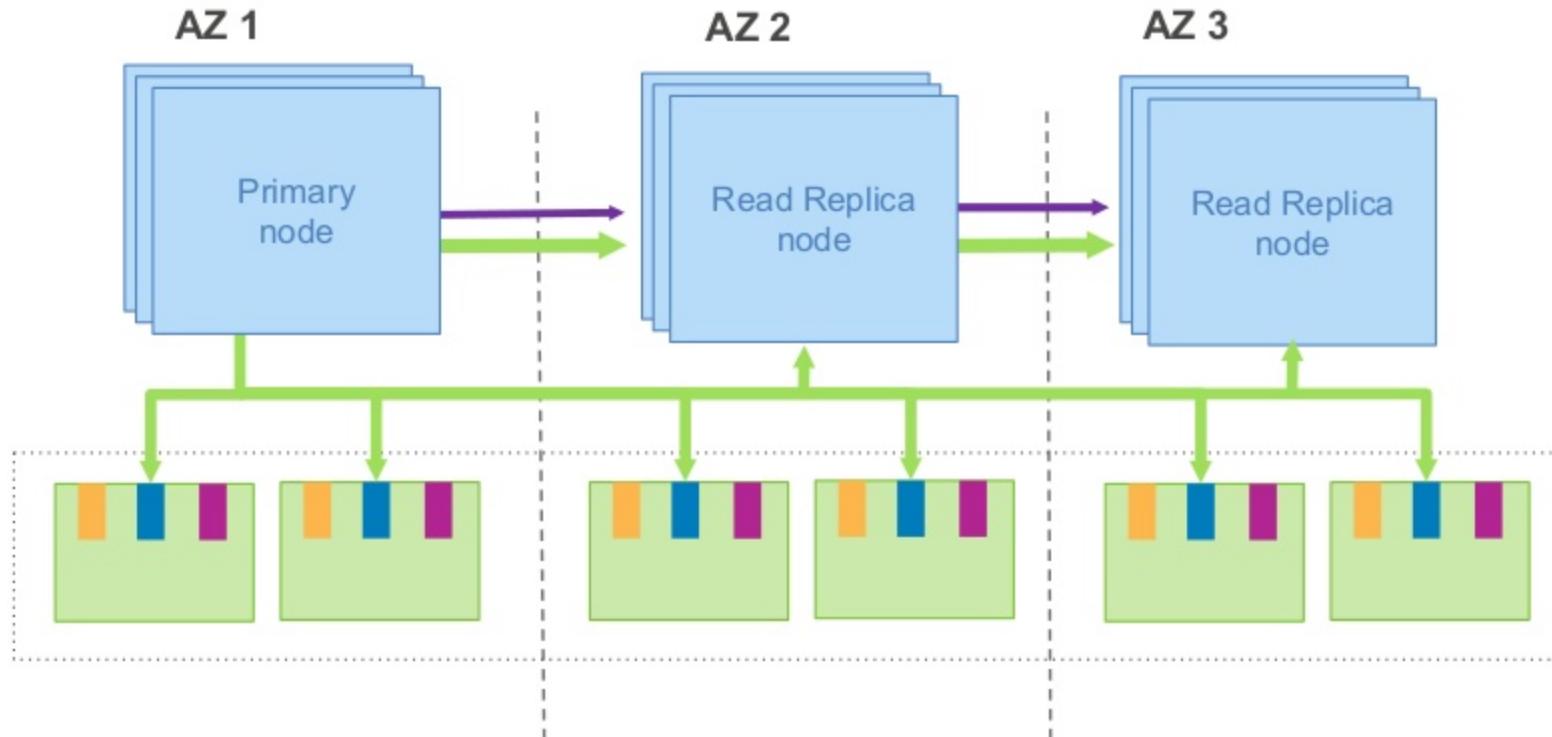
- MySQL
- MariaDB
- PostgreSQL
- Aurora

Cross-Region

- MySQL
- MariaDB
- PostgreSQL
- Aurora



Read Replicas for Amazon Aurora



Read Replicas—Oracle and SQL Server

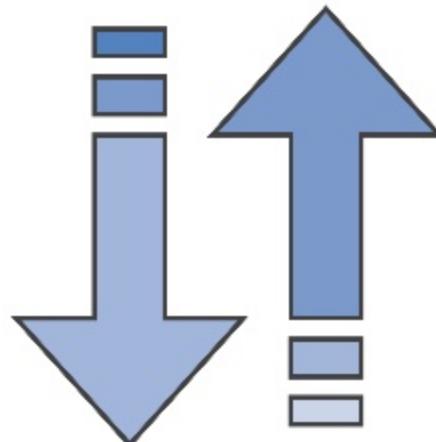
Options

- Oracle GoldenGate
- Third-party replication products
- Snapshots



Scaling up—or down

- Handle higher load or lower usage
- Control costs



Scaling up—or down

AWS Management Console

Instance Actions ▾

- See Details
- Create Read Replica
- Promote Read Replica
- Take Snapshot
- Restore to Point in Time
- Migrate Latest Snapshot
- Modify**
- Reboot
- Delete

Modify DB Instance: sg-cli-test

Instance Specifications

DB Engine Version: MySQL 5.6.27 (default)

DB Instance Class: db.m4.large — 2 vCPU, 8 GiB RAM

Multi-AZ Deployment: No

Storage Type: General Purpose (SSD)

Allocated Storage*: 600 GB

Apply Immediately

Scaling—single Availability Zone

With single Availability Zone (AZ) deployment, the master takes an outage

Alarms and Recent Events

TIME (UTC-7)	EVENT
Mar 26 7:01 AM	DB instance restarted
Mar 26 7:00 AM	Finished applying modification to DB instance class
Mar 26 6:53 AM	Applying modification to database instance class

Scaling—Multi-AZ

With Multi-AZ, the standby gets upgraded first

Alarms and Recent Events

TIME (UTC-7)	EVENT
Mar 26 6:34 AM	Finished applying modification to DB instance class
Mar 26 6:28 AM	Multi-AZ instance failover completed
Mar 26 6:28 AM	DB instance restarted
Mar 26 6:28 AM	Multi-AZ instance failover started
Mar 26 6:20 AM	Applying modification to database instance class

Scaling—automation

AWS CLI

```
aws rds modify-db-instance --db-instance-identifier sg-cli-test --db-instance-class db.m4.large --apply-immediately
```

Scheduled CLI—cron

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

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

Scaling—automation

Scheduled—AWS Lambda

No server but still runs on a schedule!

```
import boto3

client=boto3.client('rds')

def lambda_handler(event, context):
    response=client.modify_db_instance(DBInstanceIdentifier='sg-cli-test',
                                       DBInstanceClass='db.m4.xlarge',
                                       ApplyImmediately=True)

    print response
```

Scaling—automation

Metrics-based scaling

- Amazon CloudWatch and AWS Lambda!



Scaling—automation

```
import boto3
import json

client=boto3.client('rds')

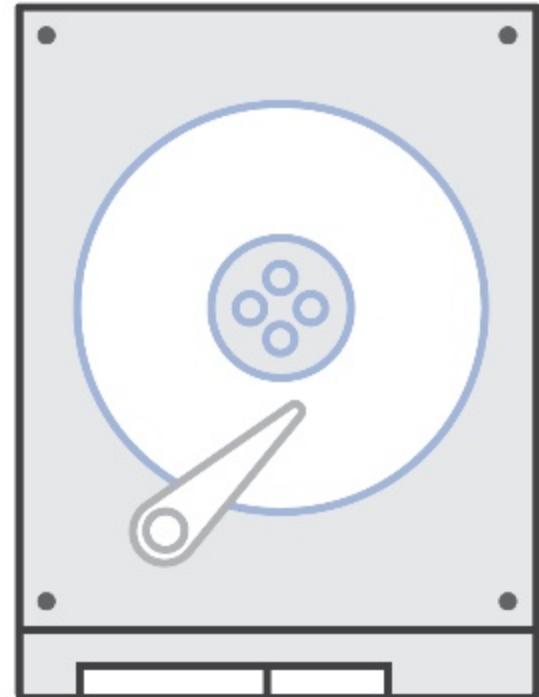
def lambda_handler(event, context):

    message = event['Records'][0]['Sns']['Message']
    parsed_message=json.loads(message)
    db_instance=parsed_message['Trigger']['Dimensions'][0]['value']
    print 'DB Instance: ' + db_instance

    response=client.modify_db_instance(DBInstanceIdentifier=db_instance,
                                       DBInstanceClass='db.m4.large',
                                       ApplyImmediately=True)

    print response
```

Backups and snapshots



Backups

MySQL, PostgreSQL, MariaDB, Oracle, SQL Server

- Scheduled daily backup of entire instance
- Archive database change logs
- 35-day retention for backups
- Multiple copies in each Availability Zone where you have instances for a deployment

Aurora

- Automatic, continuous, incremental backups
- Point-in-time restore
- No impact on database performance
- 35 day retention



Restoring

- Restoring creates an entire new database instance
- You define all the instance configuration just like a new instance

Restore DB Instance

You are creating a new DB Instance from a source DB Instance at a specified time. This new DB Instance will have the default DB Security Group and DB Parameter Groups.

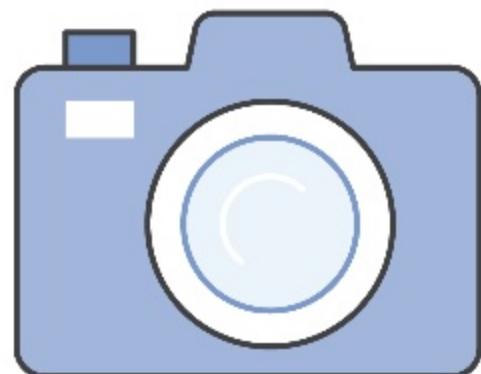
This feature is currently supported for InnoDB storage engine only. If you are using MyISAM, refer to details [here](#).

Use Latest Restorable Time March 8, 2016 at 12:10:00 PM UTC-8

Use Custom Restore Time : : UTC-8

Snapshots

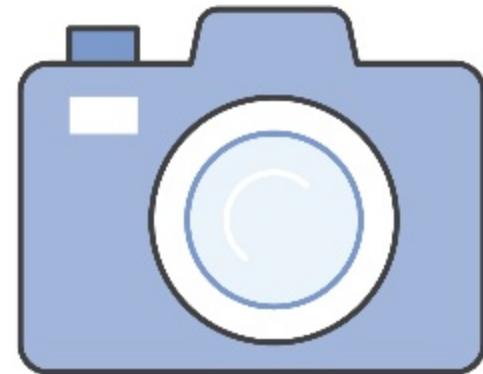
- Full copies of your Amazon RDS database that are different from your scheduled backups
- Backed by Amazon S3
- Used to create a new RDS DB instance
- Remain encrypted if using encryption



Snapshots

Use cases

- Resolve production issues
- Nonproduction environments
- Point-in-time restore
- Final copy before terminating a database
- Disaster recovery
- Cross-Region copy
- Copy between accounts



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Database migration: The journey

How can I get to the cloud?

How will my on-premises data migrate to the cloud?

How can I make it transparent to my users?

Afterwards, how will on-premises and cloud data interact?

How can I integrate my data assets within AWS?

Can I get help moving off of commercial databases?

Migration used to be cost + complexity + time

Commercial data migration and replication software

Complex to set up and manage

Application downtime

Database-engine-specific application code

What are AWS DMS and AWS SCT?

AWS Database Migration Service (DMS) easily and securely migrates and/or replicate your databases *and* data warehouses to AWS



AWS Schema Conversion Tool (SCT) converts your commercial database and data warehouse schemas to open source engines or AWS-native services, such as Amazon Aurora and Redshift

We have migrated over 21,000 unique databases. And counting...

Migration options

If you're not switching engines and can take downtime:

- SQL Server: bak file import
- MySQL: read replicas
- Oracle SQL Developer, Data Pump, Export/Import
- PostgreSQL: pg_dump
- SAP ASE: bcp

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When should I use AWS DMS and AWS SCT?



When to use AWS DMS and AWS SCT?

Modernize



Modernize your database tier –

- Commercial to open-source
- Commercial to Amazon Aurora

Modernize your Data Warehouse –

- Commercial to Redshift

Migrate



- Migrate business-critical applications
- Migrate from Classic to VPC
- Migrate data warehouse to Redshift
- Upgrade to a minor version
- Consolidate shards into Aurora

Replicate



- Create cross-Region Read Replicas
- Run your analytics in the cloud
- Keep your dev/test and production environment sync

When to use AWS DMS and AWS SCT? **Modernize**

Modernize your database tier

- Commercial to open source
- Commercial to Amazon Aurora

ORACLE



Modernize your warehouse

- Commercial to Redshift

TERADATA



ORACLE

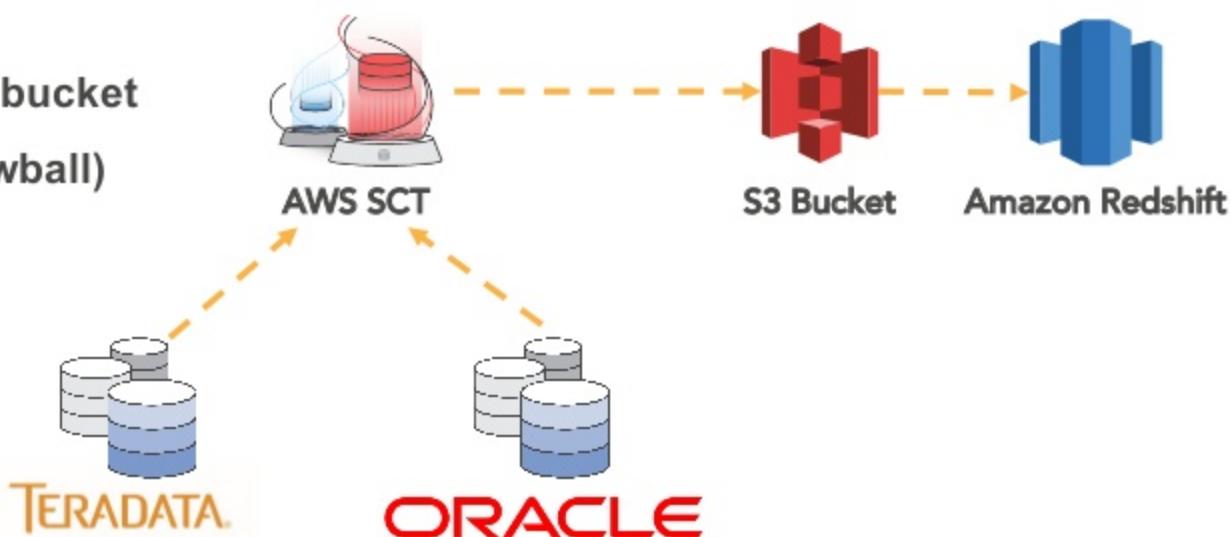


Amazon Redshift

New AWS SCT Data Extractors

Extract data from your data warehouse* and migrate to Amazon Redshift

- Extracts through local migration agents
- Data is optimized for Redshift and saved in local files
- Files are loaded to an Amazon S3 bucket (through network or Amazon Snowball) and then to Amazon Redshift



* 1st release supports Oracle v11 and up and Teradata v14 and up

Why use AWS DMS and AWS SCT?



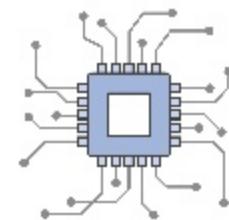
Remove barriers
to entry



Near-zero
downtime



Secure



Easy to use, but
sophisticated...



Allow DB
freedom



Keep a leg in
the cloud



Cost effective

AWS

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How does it work?



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Database migration process

STEP 1:



Source: Oracle Database
on-premises, in EC2 or RDS

AWS Schema Conversion Tool

Target: Amazon Aurora
Database

STEP 2:



Source: Oracle Database
on-premises, in EC2 or RDS

AWS Database Migration Service

Target: Amazon Aurora
Database

AWS SCT guidance

Summary | Action Items

Save to CSV | Save to PDF

Database Migration Assessment Report

amazon web services

Source Database
Microsoft SQL Server 2014 - 12.0.4422.0 (x64)
Jul 27 2015 16:56:19
Copyright (c) Microsoft Corporation
Express Edition (64-bit) on Windows NT 6.1 <x64> (Build 7601: Service Pack 1) (Hyper-V)

Executive Summary

We completed the analysis of your SQL Server source database and estimate that 94% of the database storage objects can be converted automatically or with minimal changes if you select MySQL as your migration target. Database storage objects include schemas, tables, columns, constraints, indexes, sequences, synonyms, user define types and types. Database code objects include functions, procedures, packages, triggers, views, materialized views, events, SQL scalar functions, SQL inline functions, SQL table functions, attributes, variables, constants, table types, private types, cursors, exceptions, parameters and other objects. Based on our analysis of SQL syntax elements of your source database schema, we estimate that 94% of your entire database schema can be converted automatically to MySQL. The syntax analysis takes into account the size, complexity and importance of the database objects that can be automatically converted to your selected database target. To complete the migration, we recommend 80 conversion action(s) ranging from simple tasks to medium-complexity actions to significant conversion actions.

Database Objects with Conversion Actions for MySQL

Of the total 179 database storage object(s) in the source database, we were able to identify 169 (94%) database storage object(s) that can be converted automatically or with minimal changes to MySQL.

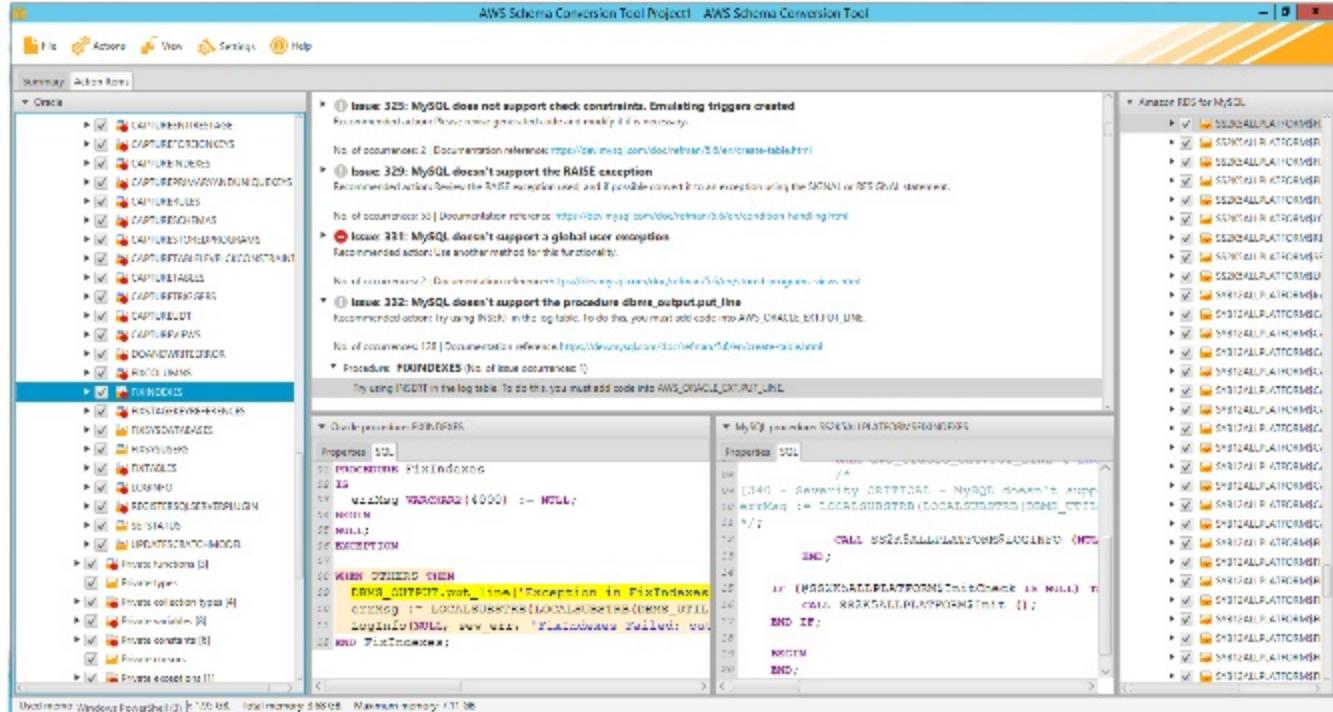
10 (6%) database storage object(s) required 50 medium- and 10 significant user action(s) to complete the conversion.

Figure: Conversion statistics for database storage objects

Object Type	Total Count	Action Breakdown
Schema(1)	1	Automatically Converted
Table(19)	19	Automatically Converted
Column(137)	90	Automatically Converted
Constraint(22)	22	Simple Actions
		Medium-complexity Actions
		Significant Actions

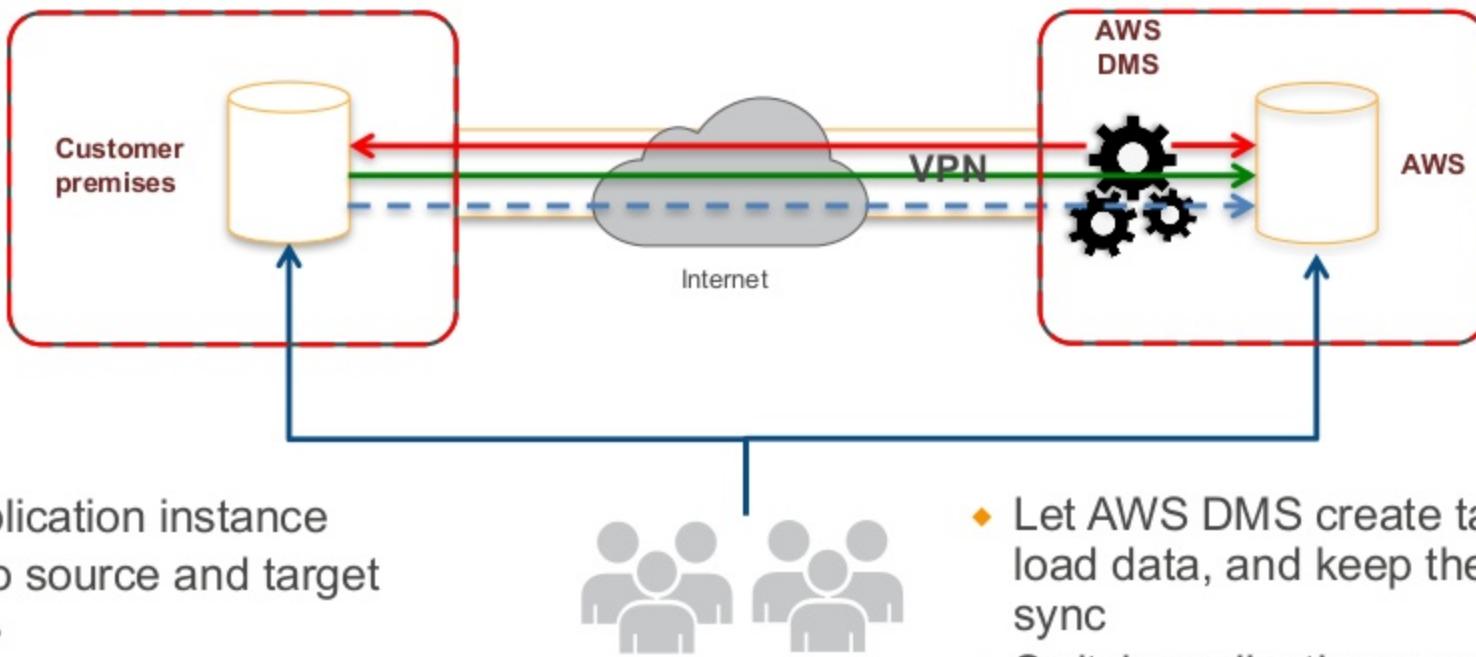
Legend: Objects Automatically Converted (Green), Objects with simple actions (Light Blue), Objects with medium-complexity actions (Yellow), Objects with significant actions (Orange)

AWS SCT helps with converting tables, views, & code



- Sequences
- User-defined types
- Synonyms
- Packages
- Stored procedures
- Functions
- Triggers
- Schemas
- Tables
- Indexes
- Views
- Sort and distribution keys

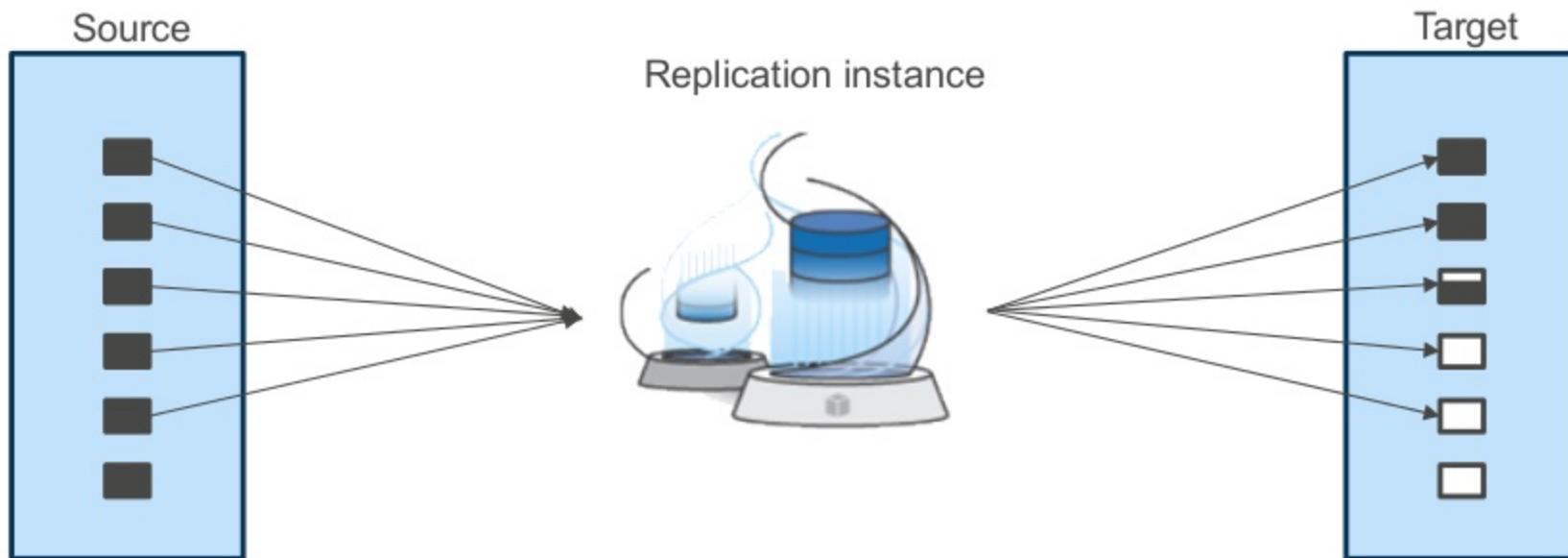
Keep your apps running during the migration



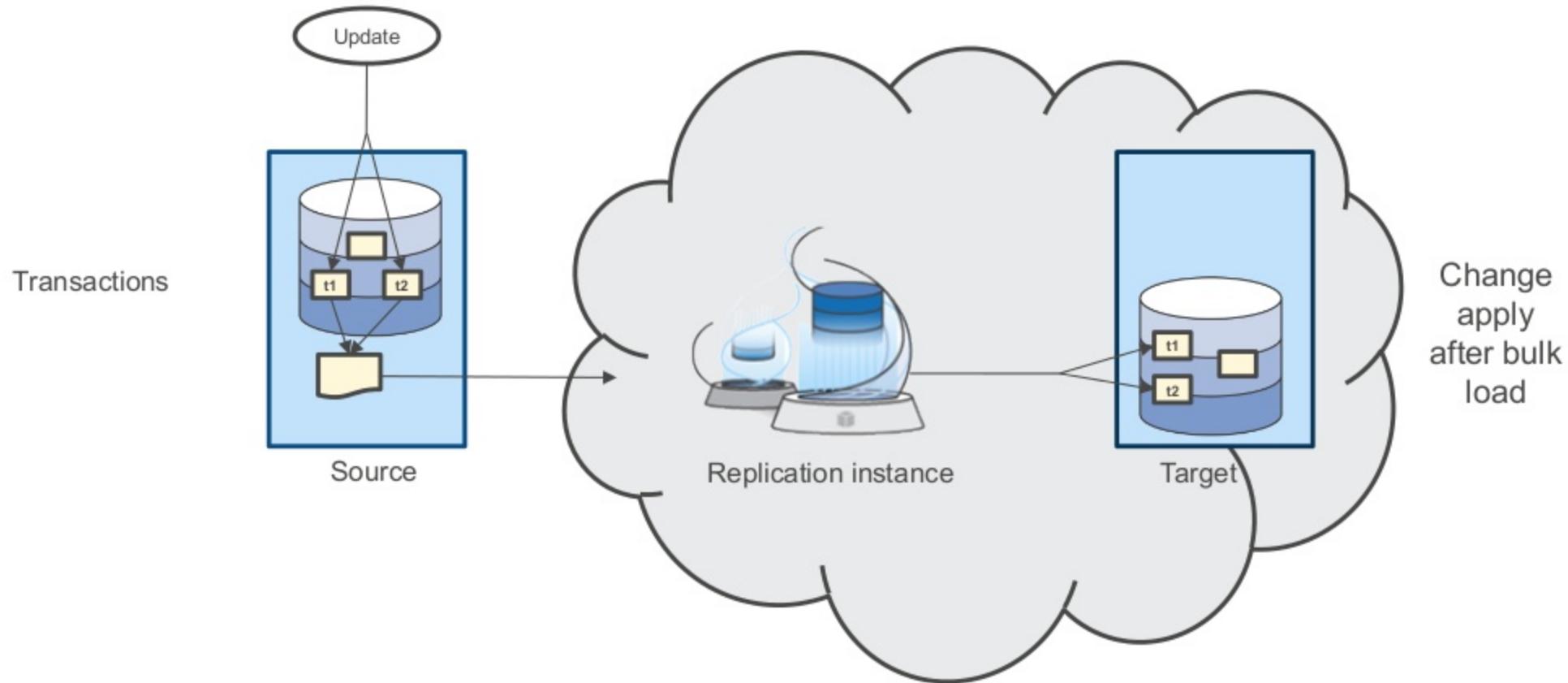
- Start a replication instance
- Connect to source and target databases
- Select tables, schemas, or databases

- Let AWS DMS create tables, load data, and keep them in sync
- Switch applications over to the target at your convenience

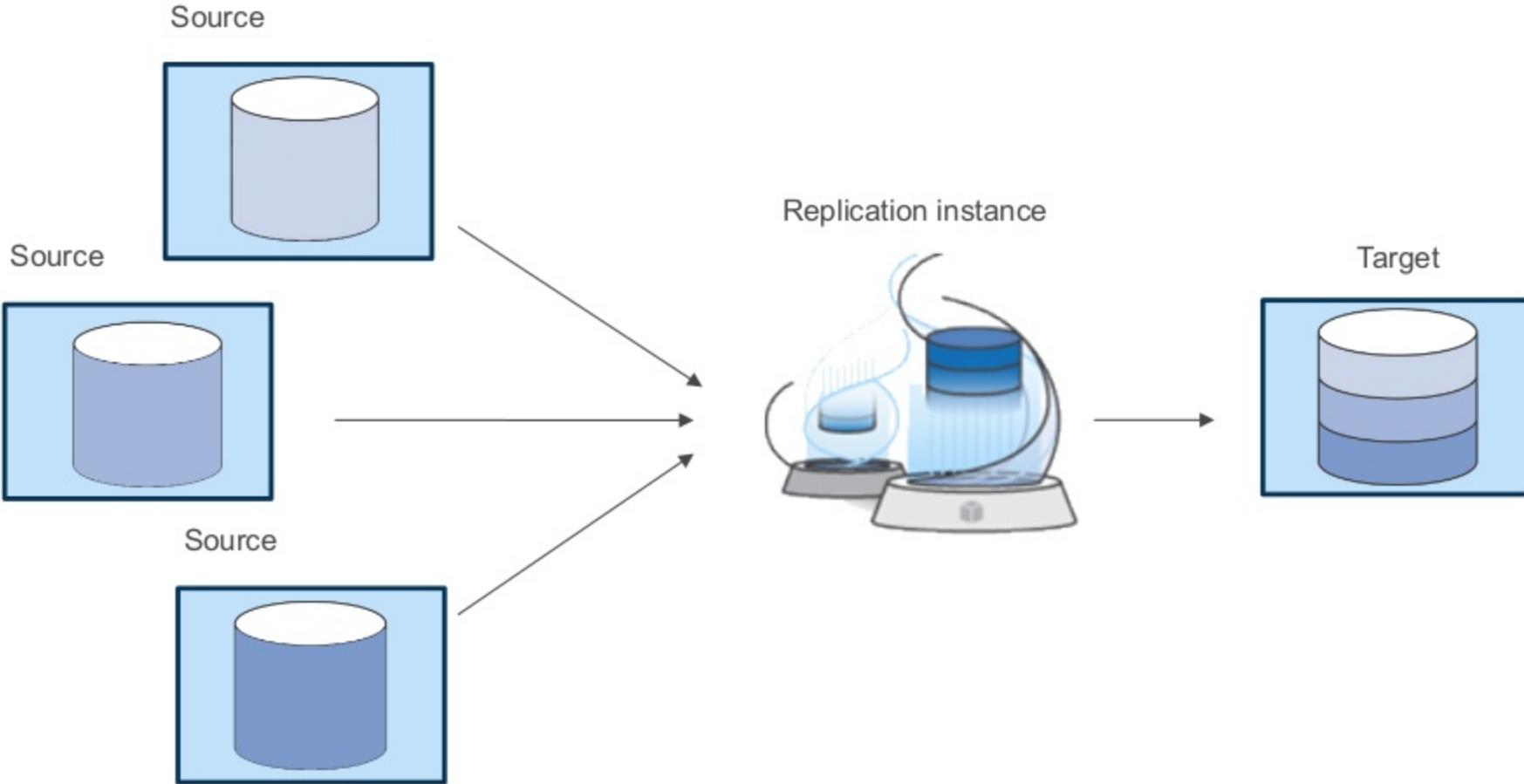
Load is table by table



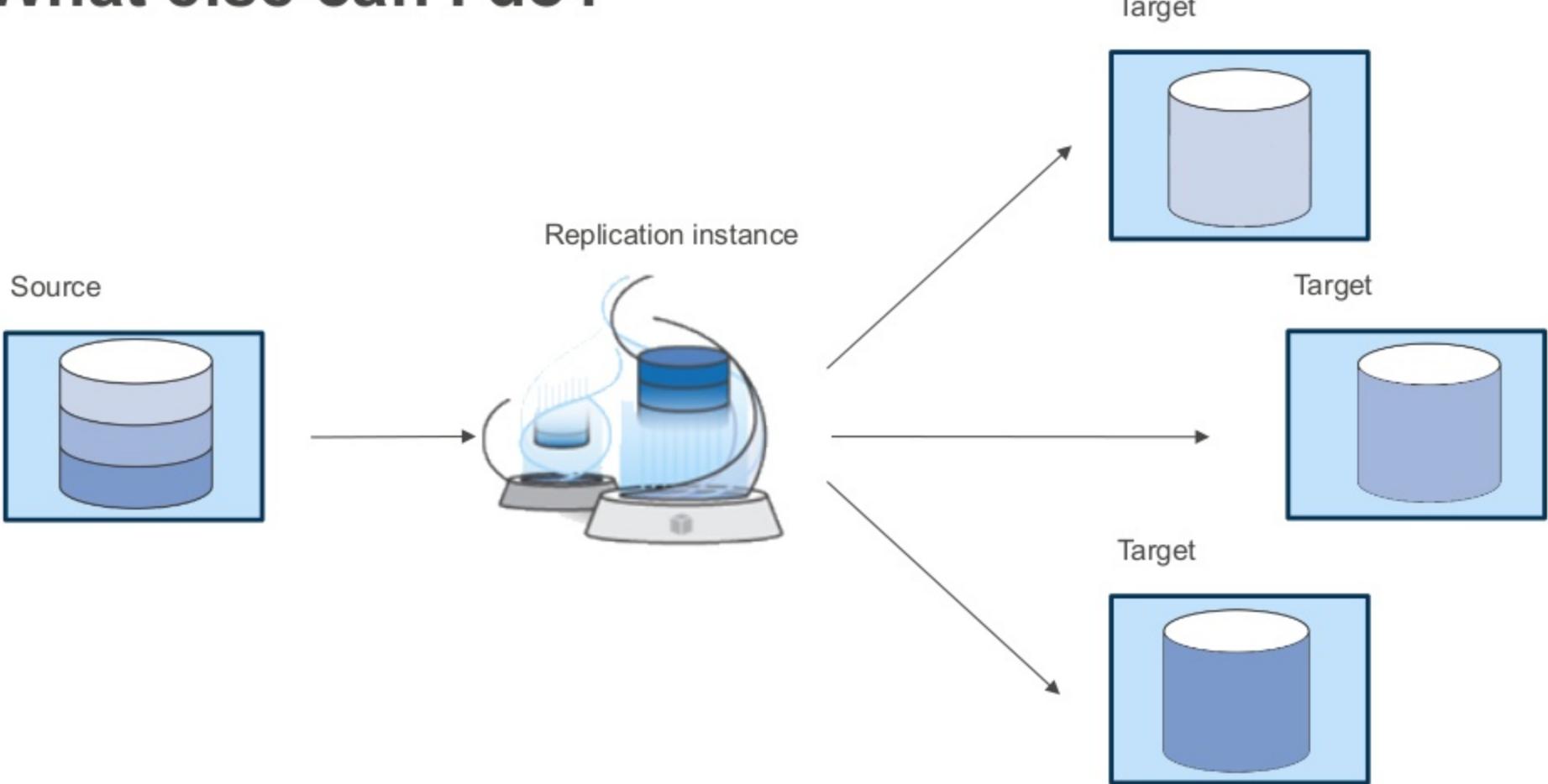
Change data capture (CDC) and apply



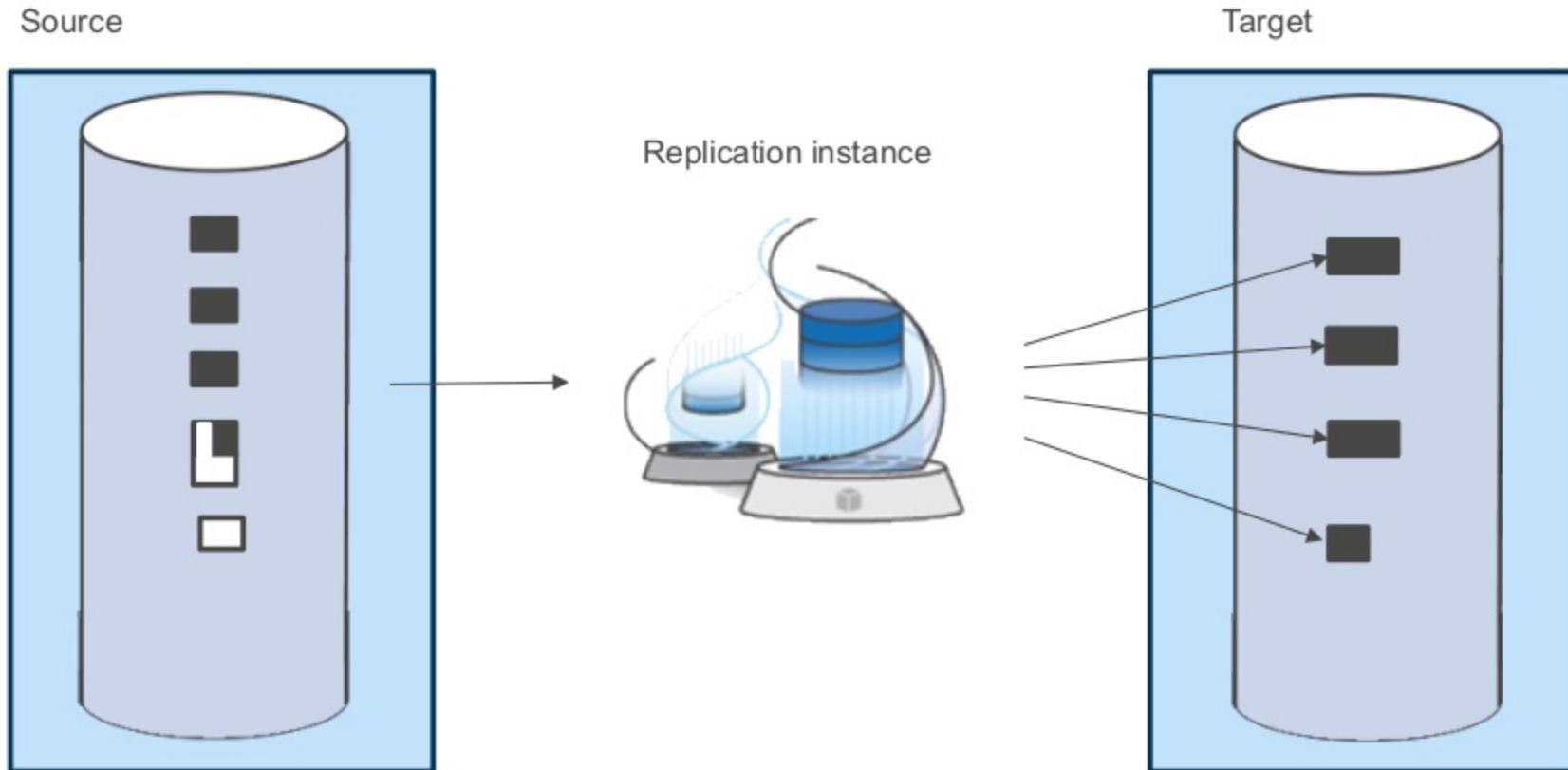
What else can I do?



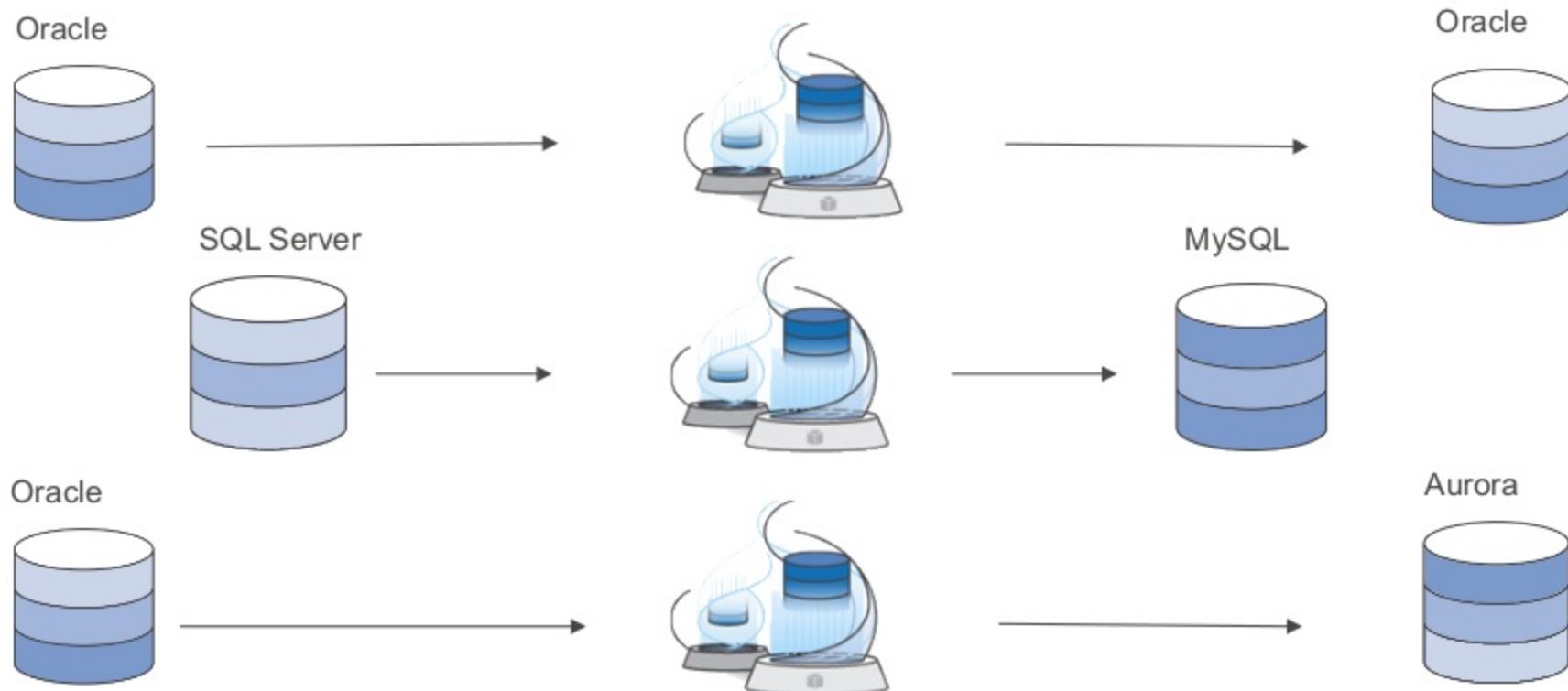
What else can I do?



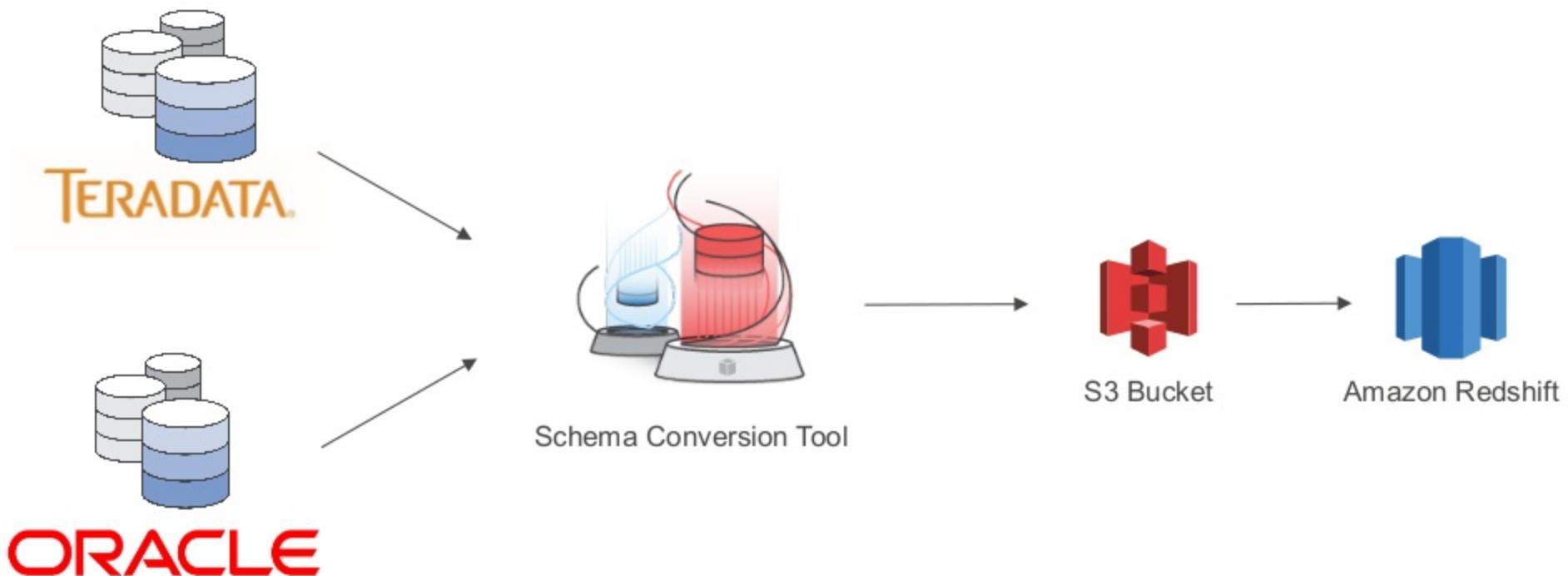
Take it all—or not



Homogenous or heterogeneous



Warehouses as well



AWS

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What have others done?



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Our customers...



hotelbeds
it's how we work



shaadi.com®
The World's Largest Matrimonial Service



Heterogeneous migration



Oracle private DC to RDS PostgreSQL migration

Used the AWS Schema Conversion Tool to convert their database schema

Used on-going replication (CDC) to keep databases in sync until they reached the cutover window

Benefits:

- Improved reliability of the cloud environment
- Savings on Oracle licensing costs
- SCT Assessment Report let them understand the scope of the migration

Scale up migration



RDS MySQL to Amazon Aurora Migration

Used DMS with on-going replication (CDC) to migrate the data

Benefits:

- Aurora handles their larger data storage requirements. Per regulations they are storing 120 TB of data for 2 years
- Reduced cost and improved performance when compared to large MySQL instances

Homogeneous migration



RDS MySQL on EC Classic to VPC
Database ran an end-user application so could not take downtime
70 RDS instances have been migrated
Benefits:

- Leveraging CDC, they could decrease outage per database to less than 5 mins
- 70 RDS instances have been seamlessly migrated

Split migration



35 million members on its site

Many interdependent applications built over the last 15 years with unique high IOPS requirements

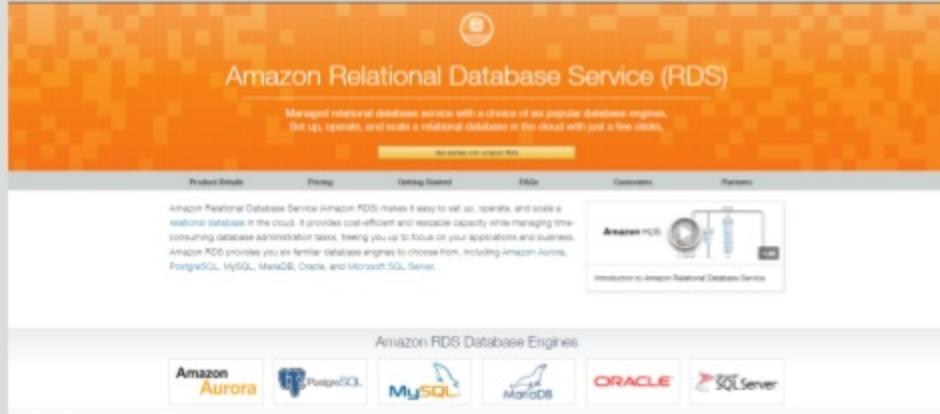
Migration from legacy cloud service to AWS

Combination of migration to MySQL on EC2 and Amazon Aurora

Benefits:

- AWS DMS reduced the time required to migrate our databases by 40 percent
- Realized 55 percent cost savings by moving some DBs to Amazon Aurora

For more information



The screenshot shows the Amazon RDS product page. The top navigation bar includes links for Home, Products, Database, Pricing, Software, Support, Customers, Partners, Company, Help, and More. The main heading is "Amazon Relational Database Service (RDS)". Below it, a sub-headline reads: "Manage relational database service with a choice of six popular database engines. Set up, operate, and scale a relational database in the cloud with just a few clicks." A yellow button labeled "Get Started with Amazon RDS" is visible. The page features a "Product Details" section with tabs for Product Details, Pricing, Getting Started, FAQ, Customers, and Partners. It also includes a "Amazon RDS Database Engines" section listing Amazon Aurora, PostgreSQL, MySQL, MariaDB, Oracle, and SQL Server.

RDS Product Page

aws.amazon.com/rds



The screenshot shows the AWS Database Migration Service product page. The top navigation bar includes links for Home, Products, Database, Pricing, Software, Support, Customers, Partners, Company, Help, and More. The main heading is "AWS Database Migration Service". Below it, a sub-headline reads: "Migrate your databases to AWS with zero downtime. More than 20,000 databases have been migrated using AWS Database Migration Service." A yellow button labeled "Get Started with AWS Database Migration Service" is visible. The page features a "Pricing" section with tabs for Pricing, Schema Comparison Tool, FAQ, Getting Started, Customer Testimonials, and Partners. It also includes a detailed description of the service's capabilities, mentioning homogeneous migrations between Oracle and Oracle, as well as heterogeneous migrations between different database platforms like Oracle to Amazon Aurora or Microsoft SQL Server to MySQL. The service supports continuous data replication with high availability.

DMS Product Page

aws.amazon.com/dms

Join us tomorrow, 4/19 at 2:30 PM in Room 3000 for
“Deep Dive on Amazon Aurora”



**Remember to complete
your evaluations!**

AWS

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Thank you!

