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DAT 319

S&P Dow Jones Indices' AWS journey to Amazon Aurora

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AWS

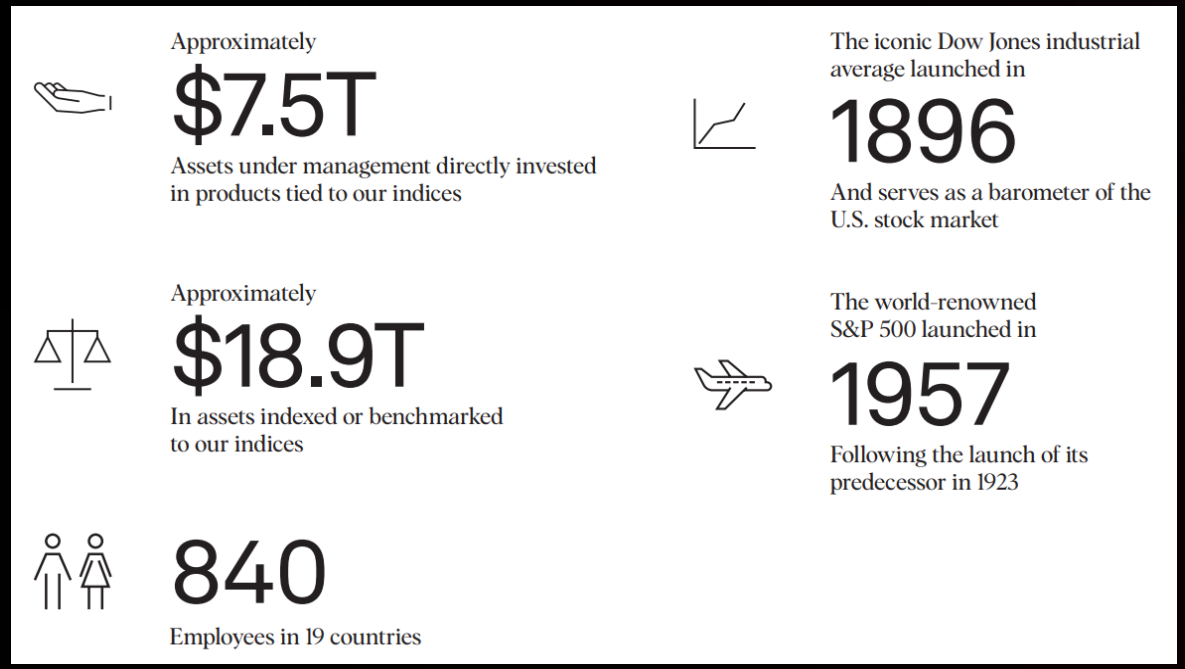
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Agenda

- S&P DJI business overview
- S&P DJI applications
- Rehost and replatform to AWS
- Amazon Aurora overview
- Modernize with Amazon Aurora
- Achieving efficiency through automation

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S&P DJI business overview



Global index families covering the equity, fixed income, and commodity markets, Strategy and thematic indices including ESG, factors, new economies and multi-asset indices. Custom index solutions including calculation and benchmark administration services

We are the world leaders in several Global Benchmarking indices

Our solutions range from core ESG and low-carbon climate approaches to thematic and fixed income strategies

Strategy and thematic indices including ESG, factors, new economies and multi-asset

From index ideation to creation to commercialization, we offer an unmatched breadth of insights and solutions

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S&P DJI Application Suite

Index Calculation System for Equities

Index Calculation System for Fixed Income

Index Calculation System for Derivatives

Index Calculation System for Commodities

Index Data Services and Web Services
www.spindices.com

Global Real Time Index Calculation System

Custom Index Calculation System

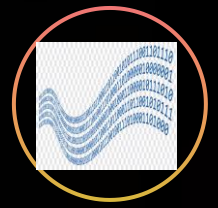
Strategic and Thematic Indices

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Database scale & operational challenges



Nearly 200 databases
Size from 500GB to 15TB



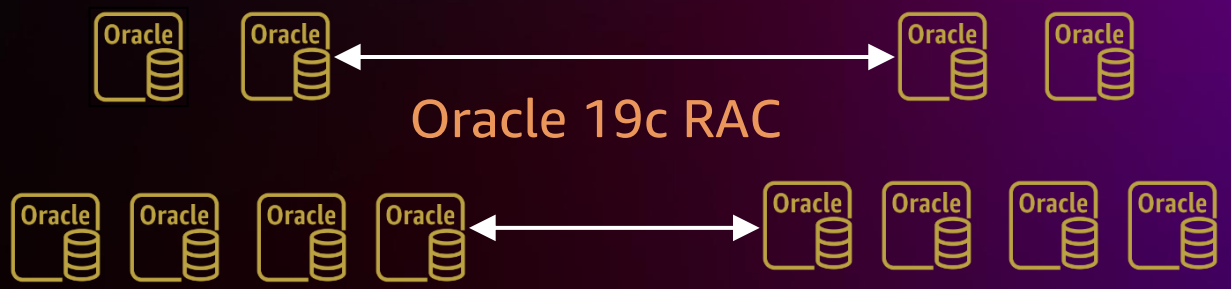
Data: real-time, historical, transactional

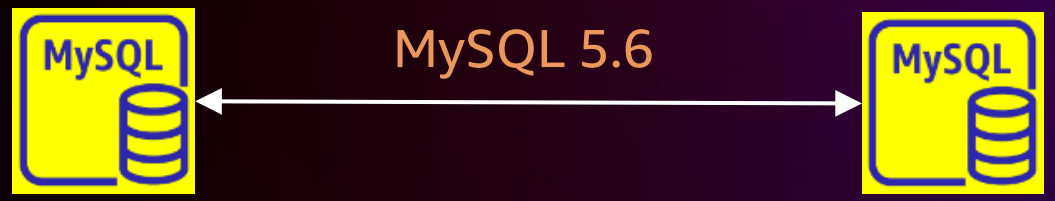


Security: NPI (highly confidential data)



Backups to NAS
DB refreshes, maintenance and monitoring







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Journey to AWS Cloud – Lift & shift

Application stack

Web servers

Application servers

Middleware servers

File servers

Database servers

Oracle 19c

MySQL 5.6

MongoDB 4.7

Operations

Backups to S3 buckets

HA/DR; Cross Region

Database monitoring

Database security

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Replatform to Amazon RDS

Oracle 19c RDS

MySQL 8.1 RDS

Aurora MySQL 8.1

Read replicas

Cloning DBs for refresh

Auto scaling

Security

Automate provisioning

CFTs, AMIs

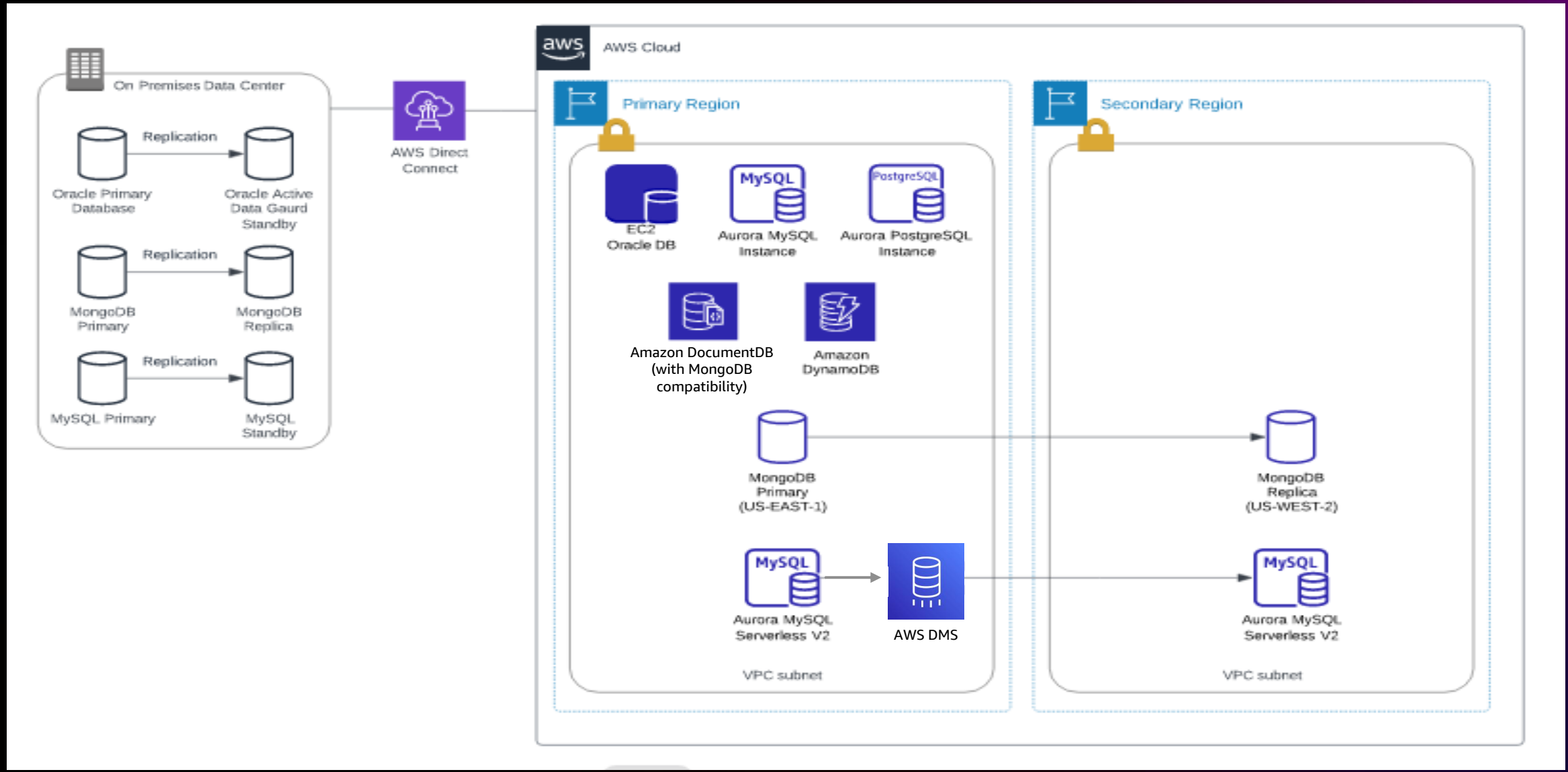
Jenkins, CI/CD

Failover/Failback automation using Jenkins

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Hybrid infrastructure



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Amazon Aurora

ENTERPRISE DATABASE AT OPEN-SOURCE PRICE

Delivered as a **managed** service



- Drop-in compatibility with MySQL and PostgreSQL
- Simplicity and cost-effectiveness of open-source databases
- Throughput and availability of commercial databases
- Simple pay-as-you-go pricing

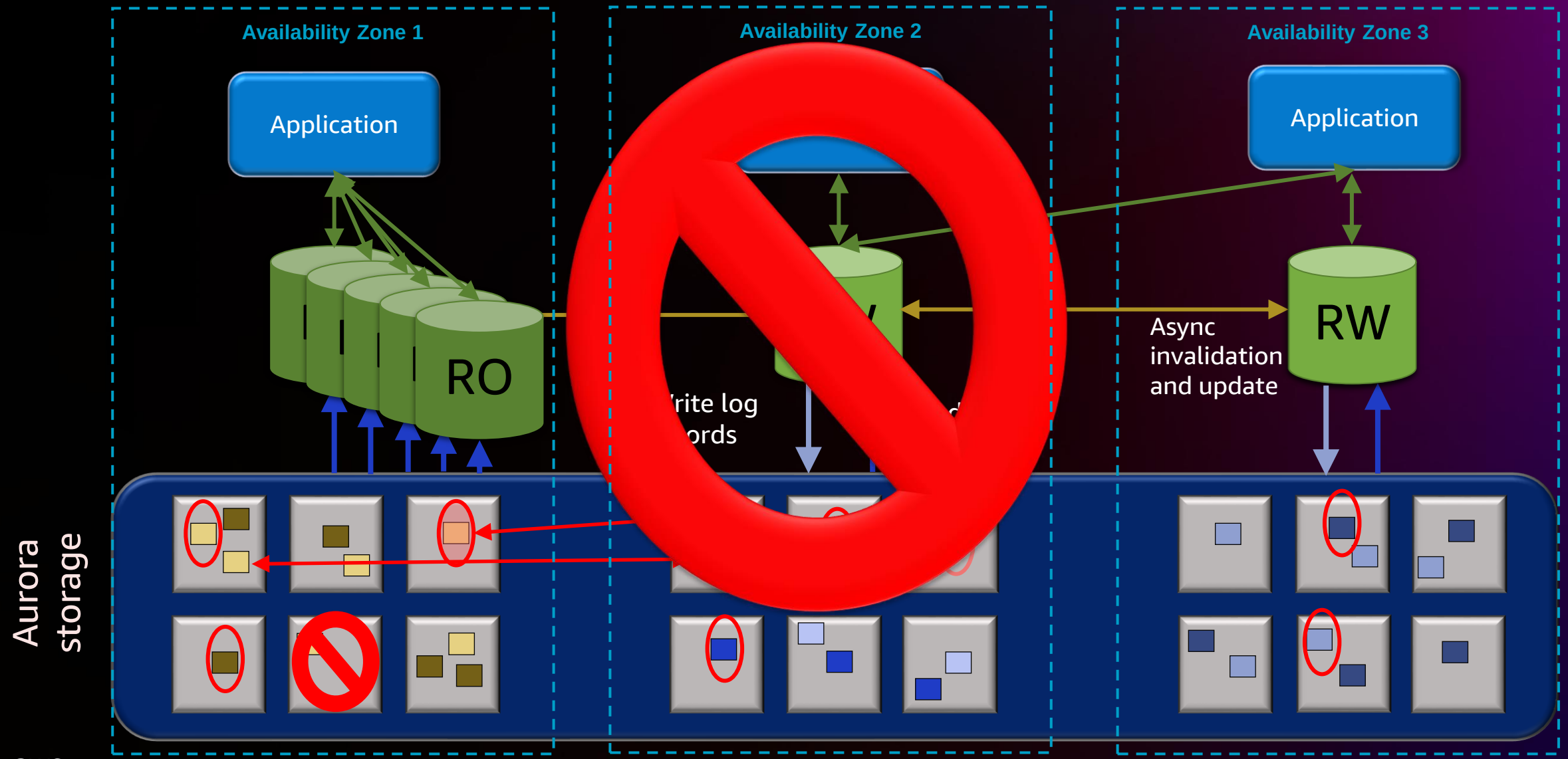
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Basic architecture

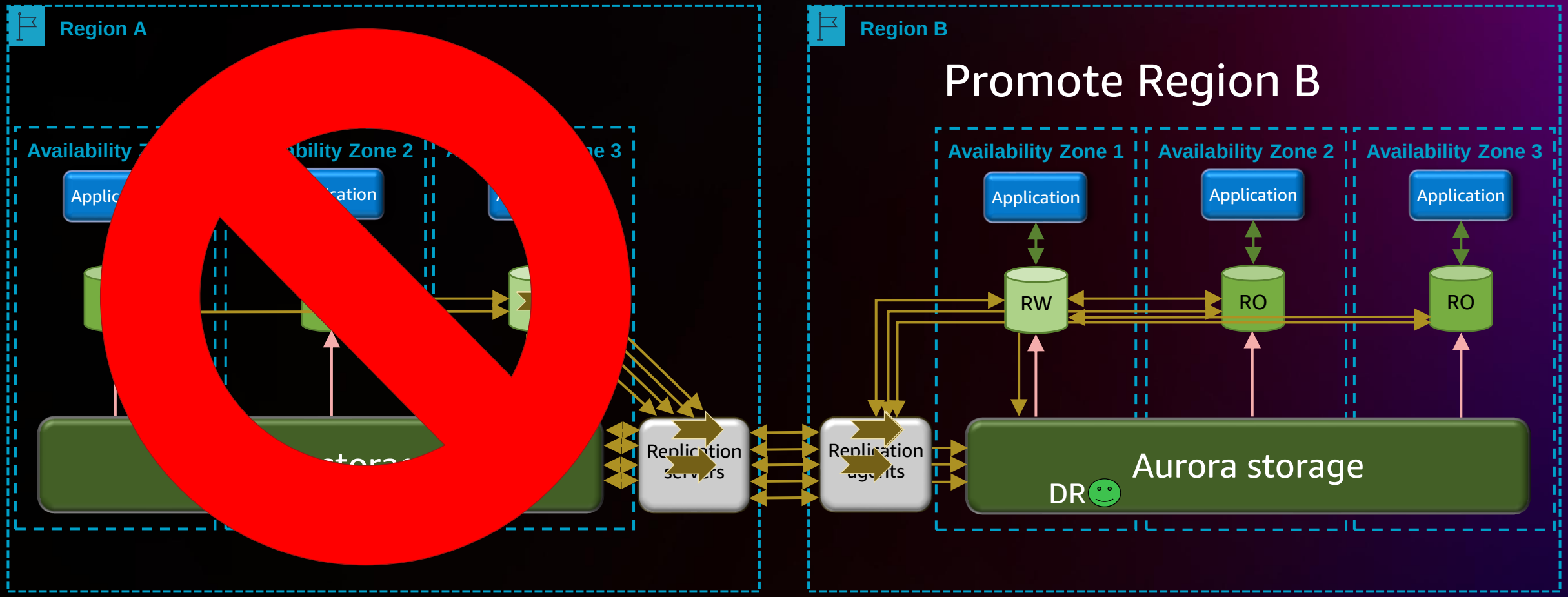
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Aurora storage and replicas



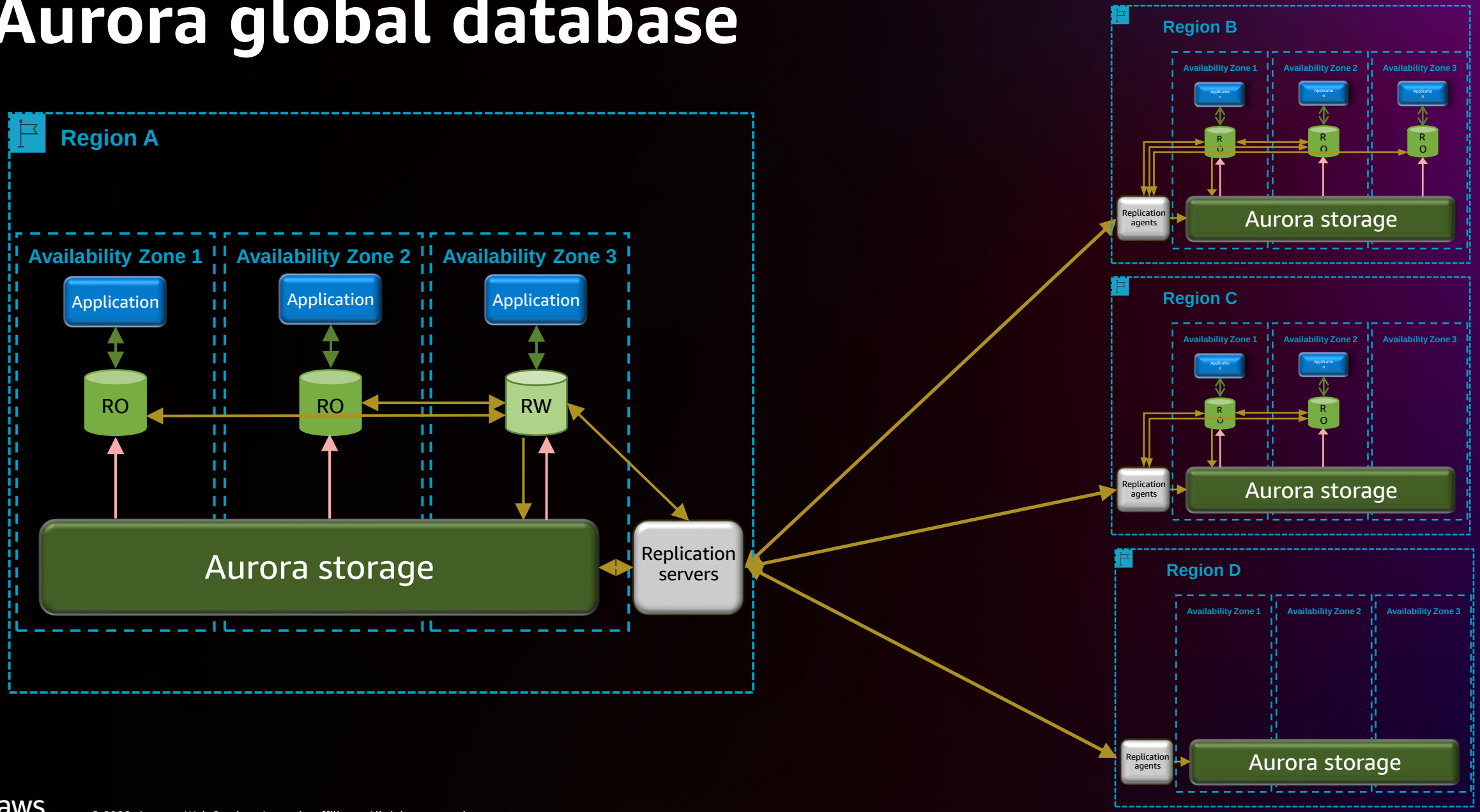
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Aurora global database



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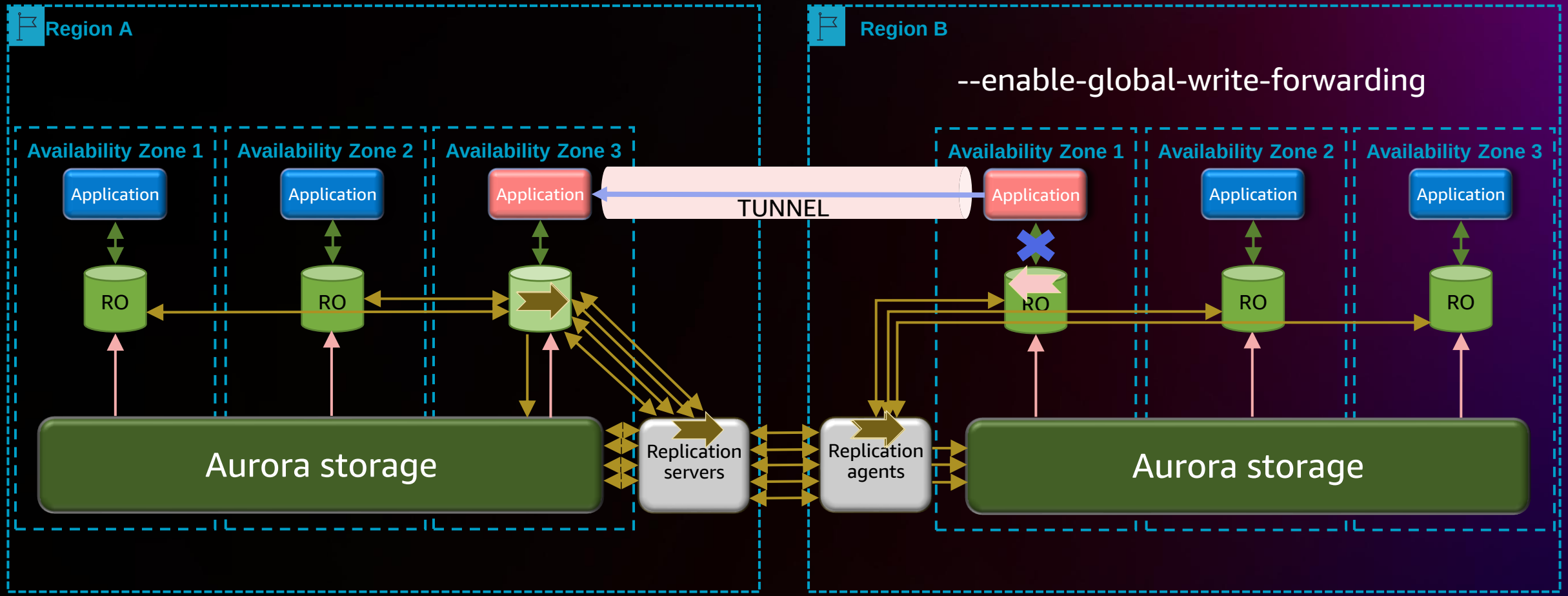
Aurora global database



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Aurora global database

WRITE FORWARDING

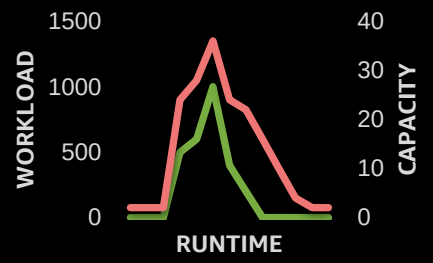


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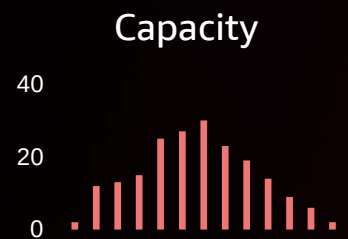
Aurora Serverless v2



An auto-scaling configuration for Amazon Aurora that now supports even the most demanding applications and database workloads



Scales instantly to hundreds-of-thousands of transactions in a fraction of a second



Scale in fine-grained increments to provide just the right amount of database capacity



Full breadth of Aurora capabilities including multi-AZ, global database

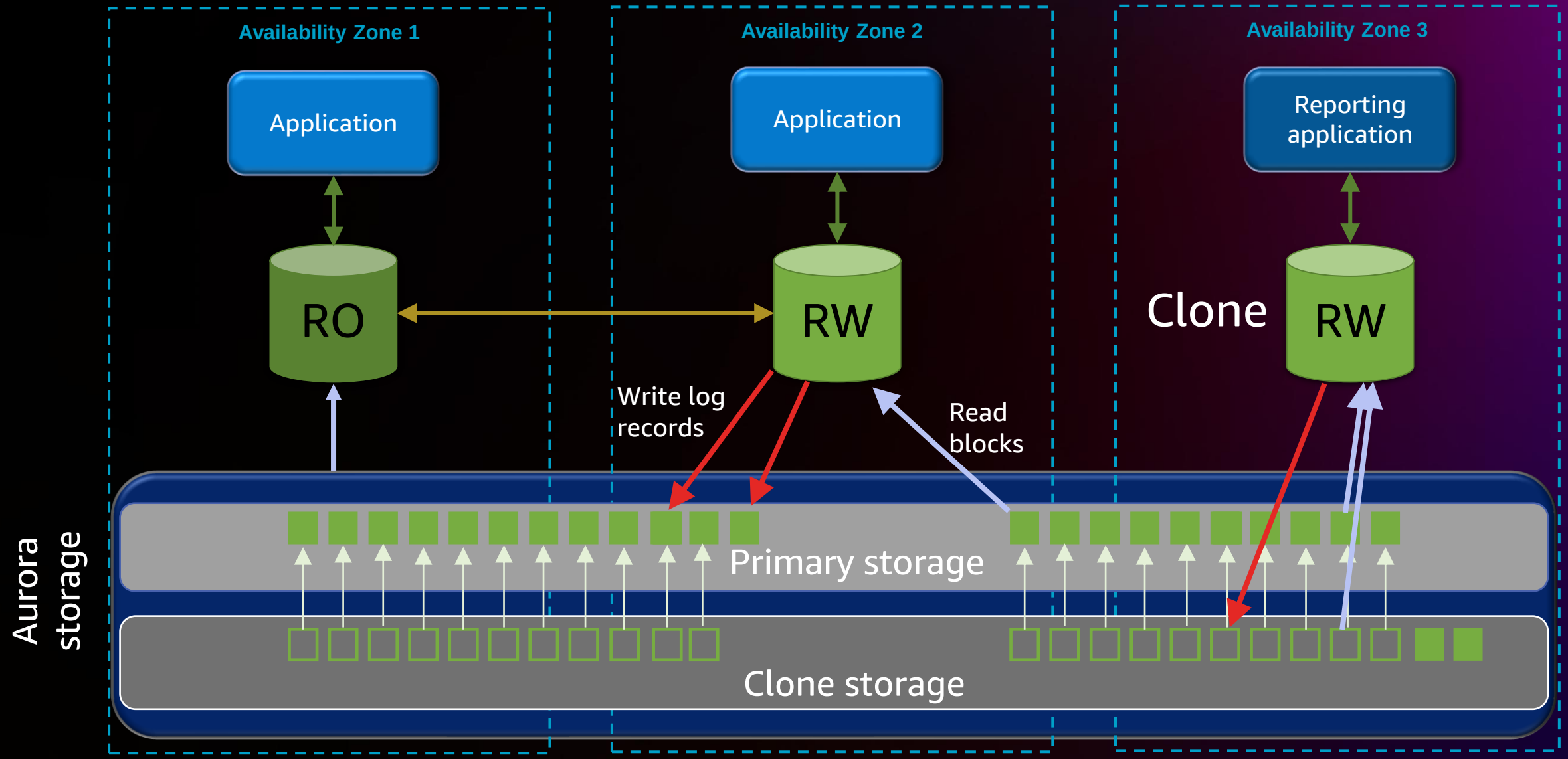


Up to 90% cost savings when compared to provisioning for peak load

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Fast clones

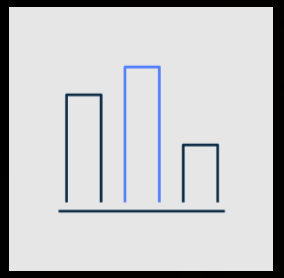


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Aurora observability at a glance

Aurora comes with comprehensive monitoring built in

Amazon CloudWatch metrics & logs



Monitor metrics & publishing database logs

Enhanced monitoring



Additional database-specific metrics at up to 1 second granularity

Performance insights



Query- and wait-level performance data

Amazon DevOps Guru for RDS



ML-powered performance monitoring & analysis

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Aurora security at a glance

Aurora comes with comprehensive security built in



Network security

VPC
Subnet
NACL
Security group



Data protection

AWS KMS
TLS



Resource access

AWS Identity and Access Management (IAM)
Organization



Authentication

IAM
Kerberos
Native



Audit

Database Activity Streams
VPC Flow Logs
Amazon Cloudwatch Logs

Migration options at a glance

Consider all options in context of your requirements and limitations

1

Physical restore from backups

Physical migration
+ logical replication

2

Logical export and import

Using native or ecosystem tools
+ logical replication

Homogeneous only

3

AWS Database Migration Service (AWS DMS)

Using AWS DMS and AWS SCT for conversion and data migration

Heterogeneous Homogeneous

Migrate using AWS DMS and AWS SCT



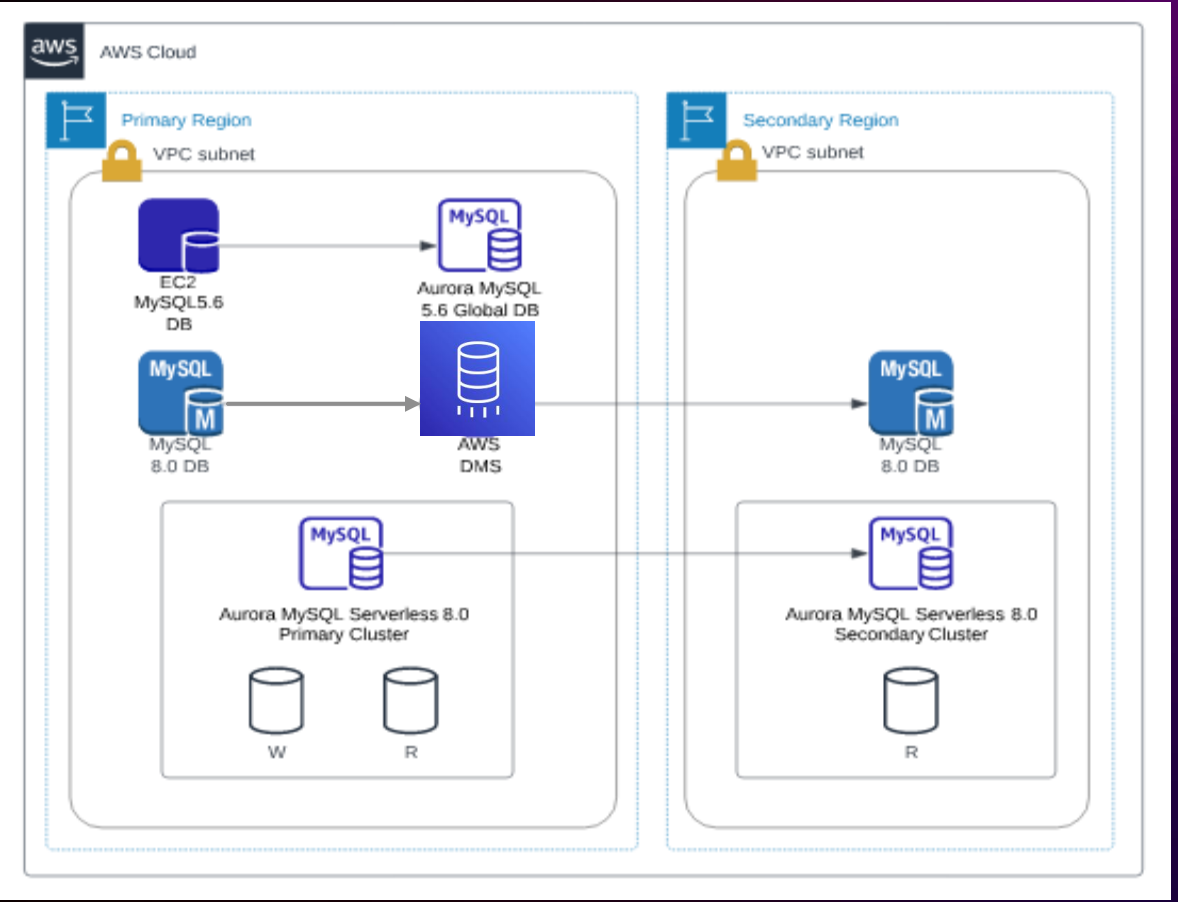
AWS Schema Conversion Tool (AWS SCT)
converts your commercial database and data warehouse schemas to open-source engines or AWS-native services, such as Amazon Aurora and Amazon Redshift

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



Aurora MySQL adoption

- Migrated MySQL on EC2 to Aurora MySQL 5.7
- MySQL 8.1 RDS Active/Active
- Leverage AWS DMS CDC
- Aurora MySQL global database
- Enabled write forwarding



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Oracle 19c to Aurora Postgres migration

Schema Conversion Tool : AWS SCT to convert schema & data; focuses on the differences, incompatibilities, and similarities between Oracle and Aurora PostgreSQL-Compatible

Tables of Feature Compatibility

Feature Compatibility Legend

Compatibility Score Symbol	Description
	**Very high compatibility:** None or minimal low-risk and low-effort rewrites needed
	**High compatibility:** Some low-risk rewrites needed, easy workarounds exist for incompatible features
	**Medium compatibility:** More involved low-medium risk rewrites needed, some redesign may be needed for incompatible features
	**Low compatibility:** Medium to high risk rewrites needed, some incompatible features require redesign and reasonable-effort workarounds exist
	**Very low compatibility:** High risk and/or high-effort rewrites needed, some features require redesign and workarounds are challenging
	**Not compatible:** No practical workarounds yet, may require an application level architectural solution to work around incompatibilities

SCT Automation Level Legend

SCT Automation Level Symbol	Description
	**Full Automation** SCT performs fully automatic conversion, no manual conversion needed.
	**High Automation:** Minor, simple manual conversions may be needed.
	**Medium Automation:** Low-medium complexity manual conversions may be needed.
	**Low Automation:** Medium-high complexity manual conversions may be needed.
	**Very Low Automation:** High risk or complex manual conversions may be needed.
	**No Automation:** Not currently supported by SCT, manual conversion is required for this feature.

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Schema conversion challenges

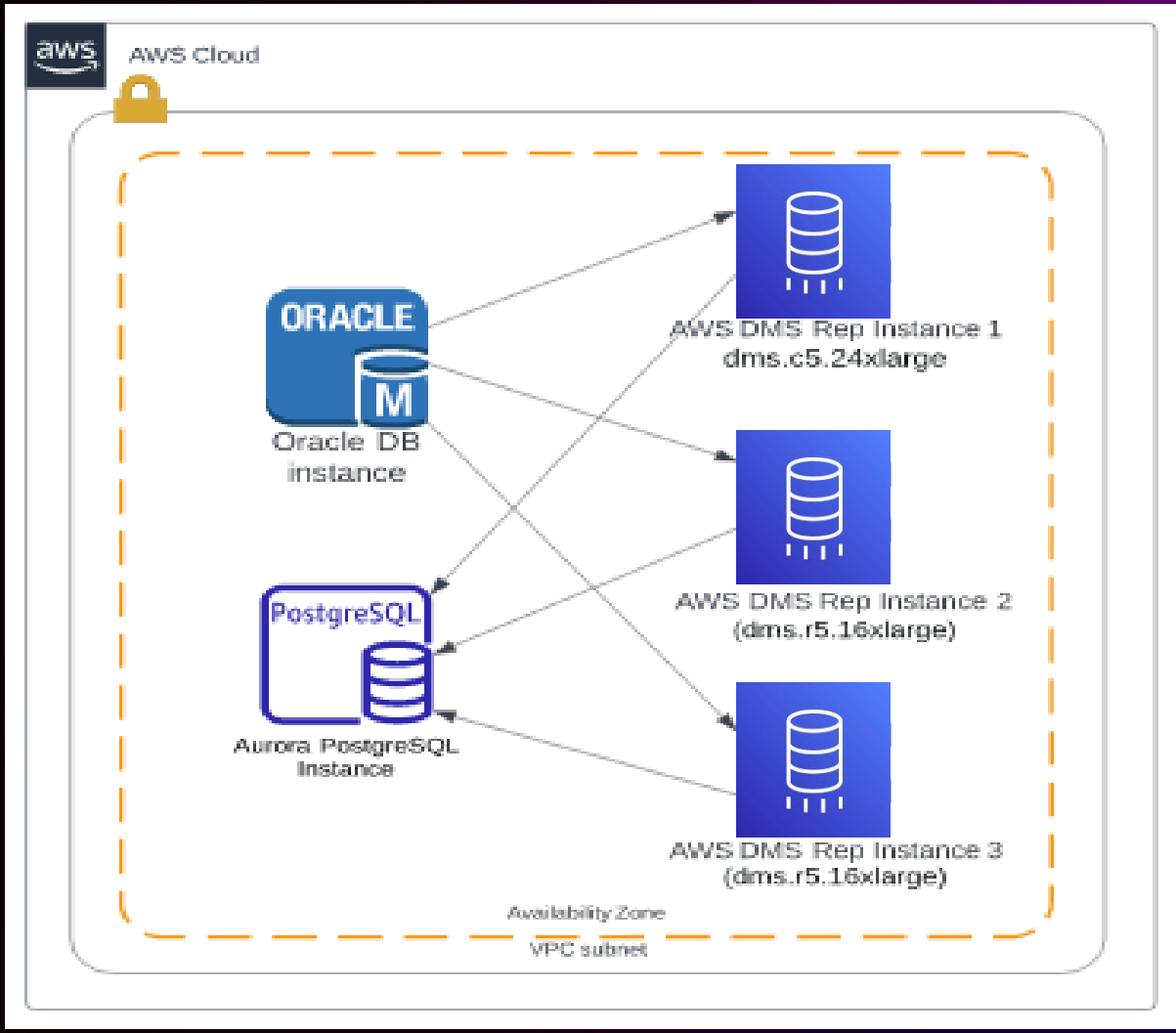
- Int & BigInt vs. Numeric; Issues in Joins
- Refactoring Oracle Partitioned tables
- Refactoring some Database Stored Procedures, Packages, & Functions
- Oracle native features not available in Postgres
  - Custom Password Verify function
- pgcrypto in lieu of dbms_crypto
- Performance regression with prepared statements
- Postgres does not allow transaction control inside of PL/pgSQL
- Run-time exceptions in transactions; recoding effort

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AWS DMS for database migration

- Source Oracle database nearly 15TB
- 3 AWS DMS replication instances
- Multiple AWS DMS tasks
- Tasks executed using APIs



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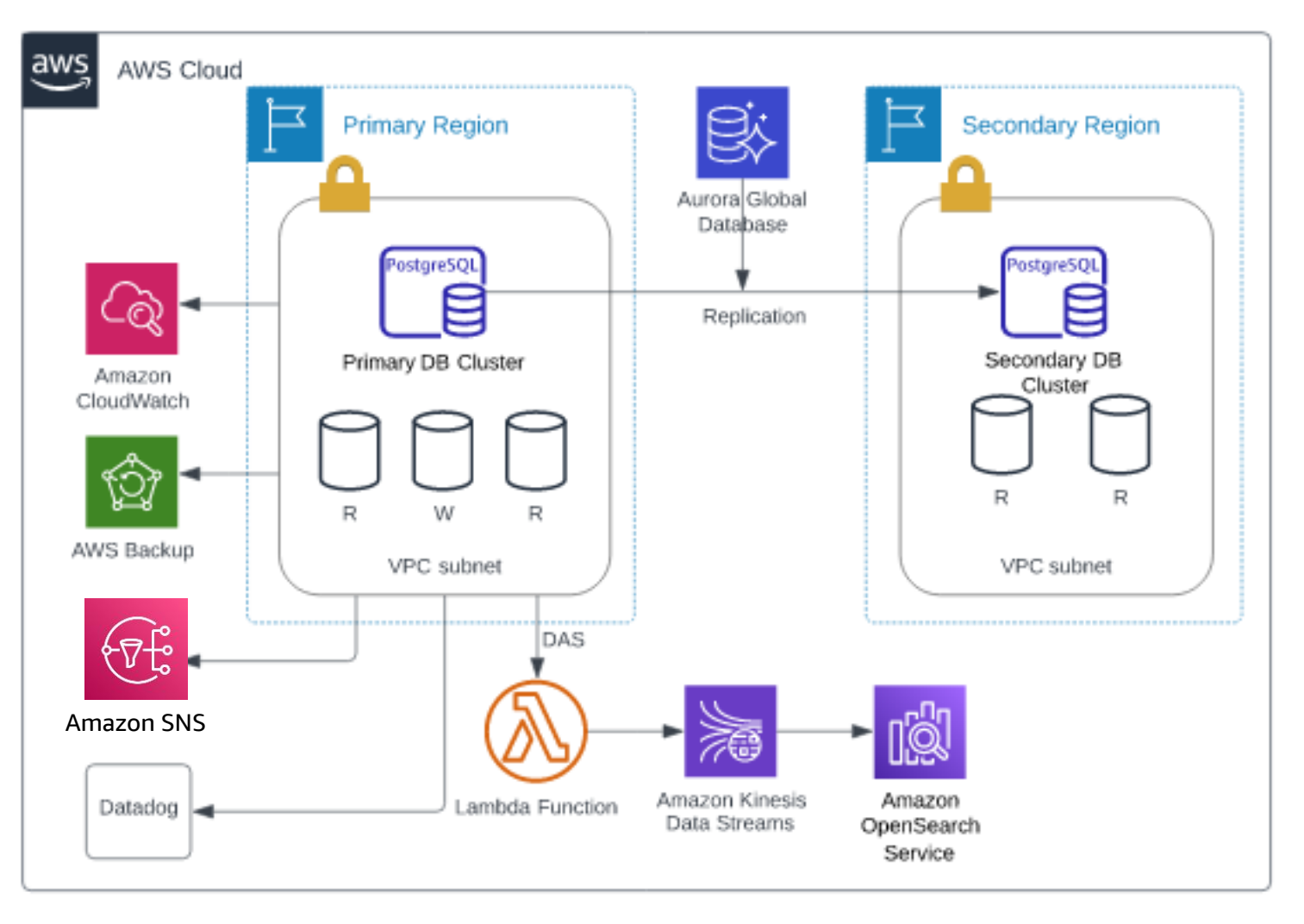
Database migration challenges & resolution

- Use the latest version of AWS DMS
- Drop secondary cluster to reduce WAN traffic during initial load
- Create the Target Postgres Aurora database in the same AZ as the Source Oracle Database. Create the AWS DMS instances in the same zone as well
- Upgrade one AWS DMS replication instance to r6i.16xlarge
- Create one AWS DMS replication instance with C class to accommodate network bandwidth for large table replication
- Defer AutoVacuum on the database during initial load
- Connection attributes modified SET session_replication_role='replica';maxFileSize=52428800;
  - executeTimeout=600;mapUnboundedNumericAsString=true;
  - truncateTrailingZerosForPlainNumeric=true;
  - writeBufferSize=2000; executeTimeout=3600

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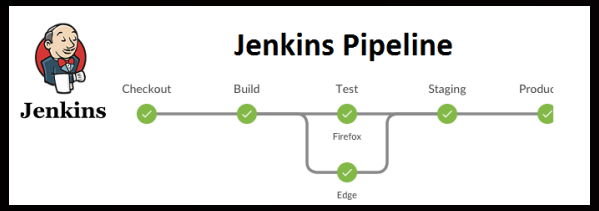
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S&P DJI Aurora architecture



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Achieving efficiency through automation

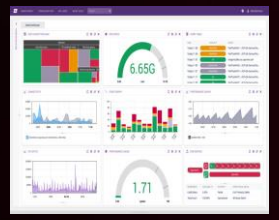


RDS/Aurora Provisioning
Automate Failover/Failback

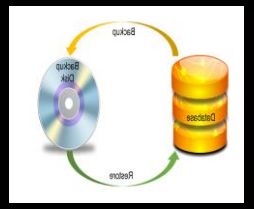


Integrate Sailpoint service for database user management

Integrate Cyberark for privileged account management



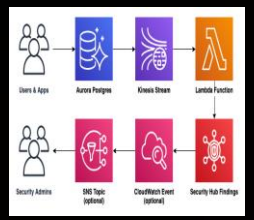
Datadog
OEM, CloudWatch
Performance Insights



AWS Backup; local & cross-Region
Separate backup for protection against cyberthreat and ransomware



AMVU
System updates
Database refreshes

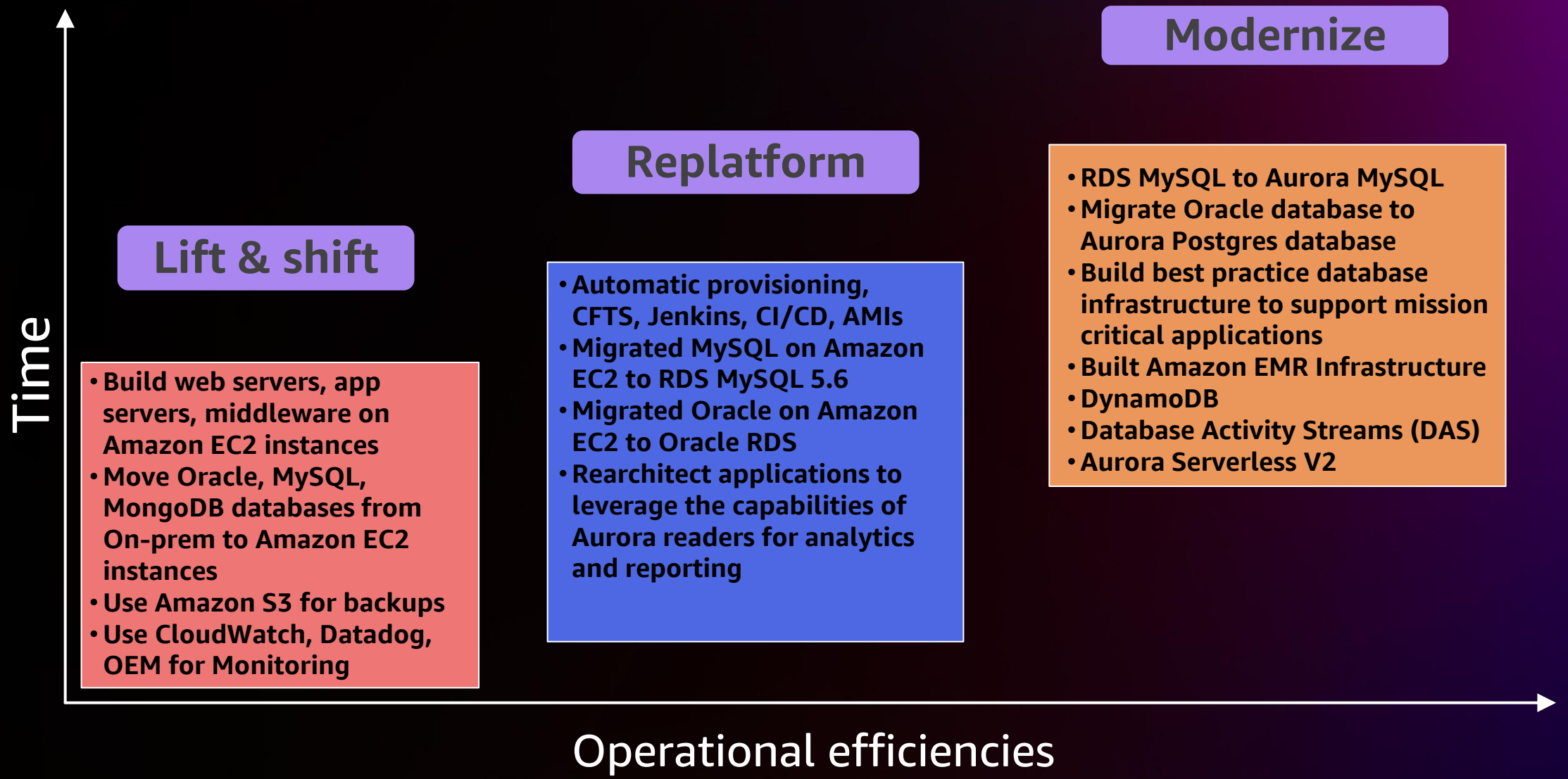


Use Database Activity Streams for capturing Select & DML activity for audit, compliance, and regulatory needs



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S&P DJI journey to AWS Cloud



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Thank you

- Index Infrastructure Team
- Database Engineering Team
- Index Technology Team
- AWS IEM Team
- Datavail DB Support Team

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Continue your data journey



Swami Sivasubramanian
VP Database, Analytics & ML

Swami Sivasubramanian Keynote (KEY003)

Venetian Theatre

November 30
8:30 AM - 10:30 AM



Jeff Carter
VP Relational Databases and Migrations

Your data: How you need it, where you need it, when you need it (DAT224-L)

Venetian Theatre

November 30
4:00 PM - 5:00 PM

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Thank you!

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