AWS re:Invent

DAT317

Best Practices for Running Oracle Databases on Amazon RDS

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Amazon Web Services

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UK Ministry of Justice

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aws

Related breakouts

Wednesday, November 28

DAT354-R2 – Migrate your Oracle Database to Amazon RDS (Builders Session)
4:00 PM – 5:00 PM | Mirage, Grand Ballroom D, Table 9

Thursday, November 29

GPSTEC313 – Accelerate Oracle to Aurora PostgreSQL Migration
11:30 AM – 12:30 PM | MGM, Level 1, Grand Ballroom 111

Thursday, November 29

DAT307-R1 – Running Oracle Databases on Amazon RDS and Migrating to PostgreSQL
11:30 AM – 1:45 PM | Venetian, Level 2, Venetian H

Agenda

Introduction – Amazon RDS

Best Practices for Oracle DBAs

Ministry of Justice migration story

Q & A

Managed databases on AWS

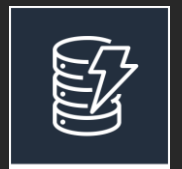
Relational Databases

Amazon RDS

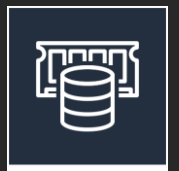
Amazon Aurora

Amazon Redshift

Non-Relational Databases



Amazon DynamoDB



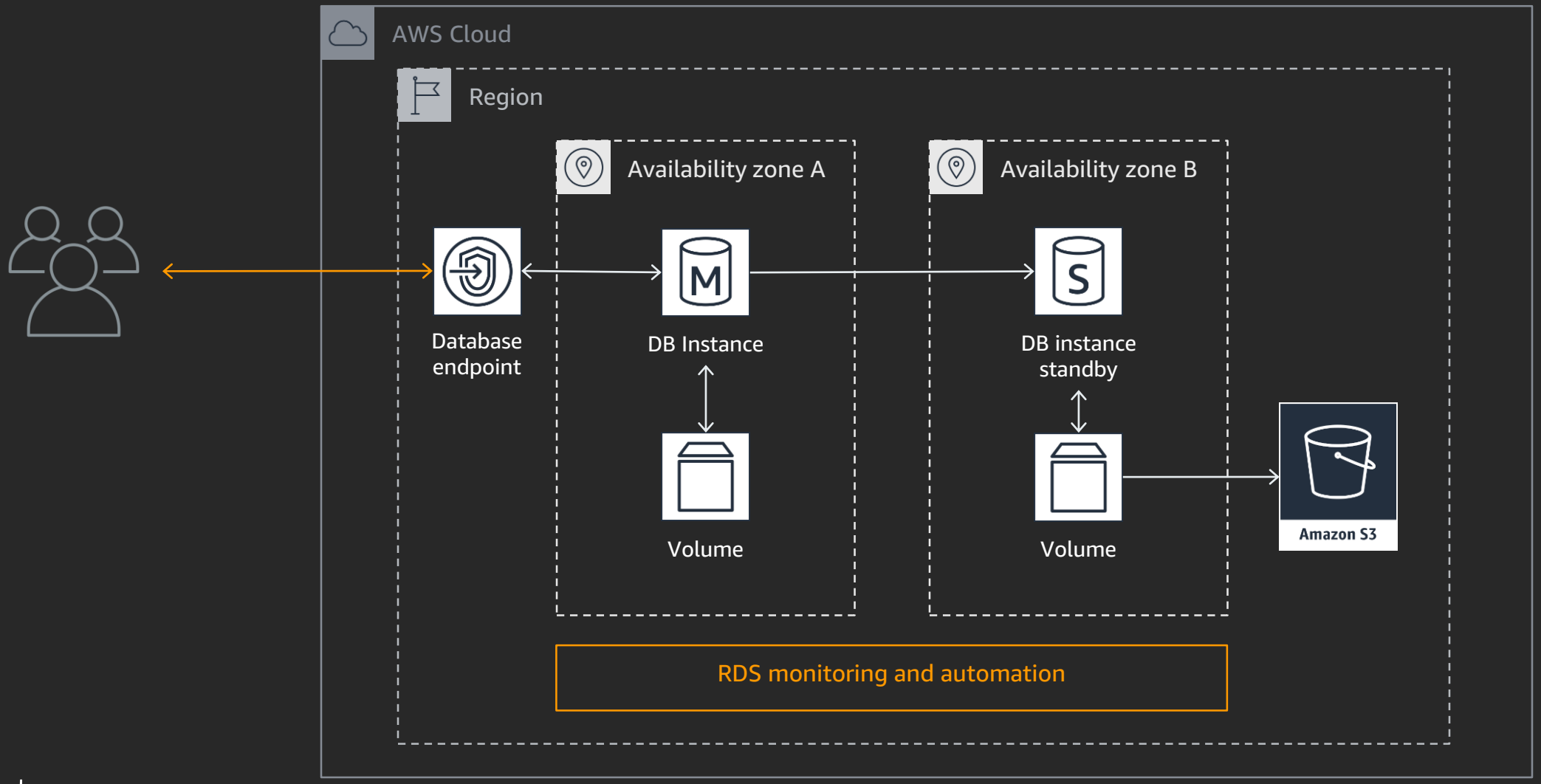
Amazon ElastiCache

Amazon ElastiCache for Memcached

Amazon ElastiCache for Redis

Amazon Neptune

Amazon Relational Database Service



Amazon Relational Database Service

Easy to Administer

Scalable and Fast

Available and Durable

Secure

Inexpensive

- Managed Infrastructure
- Available in minutes
- Manage parameters and options across instances
- Web console, CLI, SDK, AWS CloudFormation

Amazon Relational Database Service

Easy to Administer

Scalable and Fast

Available and Durable

Secure

Inexpensive

- SSD-backed storage burstable or provisioned IOPS, scalable to 32 TiB
- Easy scaling for compute, from 1 vCPU / 1 GiB to 128 vCPU / 3,904 GiB

Amazon Relational Database Service

Easy to Administer
Scalable and Fast
Available and Durable
Secure
Inexpensive

- Automatic host replacement
- Managed high availability
- Managed backups
- Durable storage – Amazon EBS and Amazon S3

Amazon Relational Database Service

Easy to Administer
Scalable and Fast
Available and Durable
Secure
Inexpensive

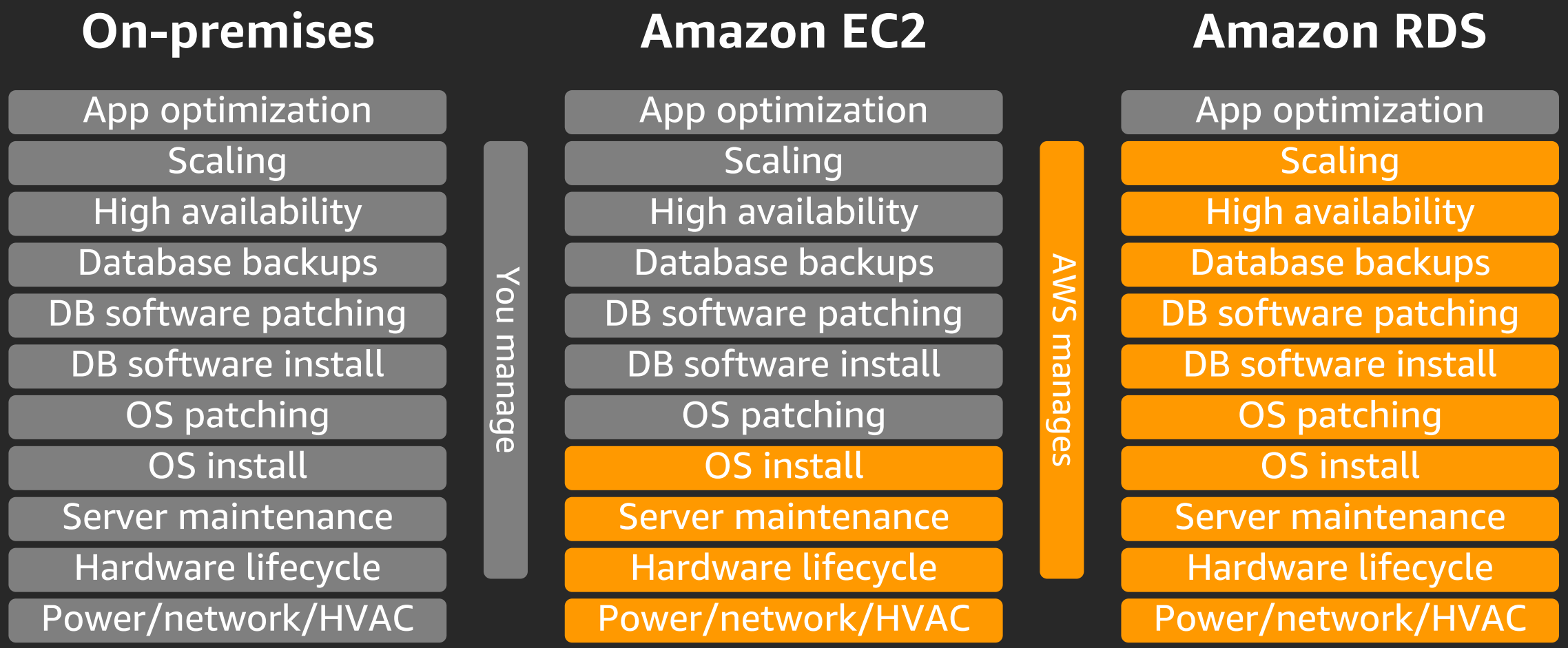
- VPC by default
- VPN/Direct Connect to on-premises
- Encryption at rest
- Encryption in transit
- Strong account controls

Amazon Relational Database Service

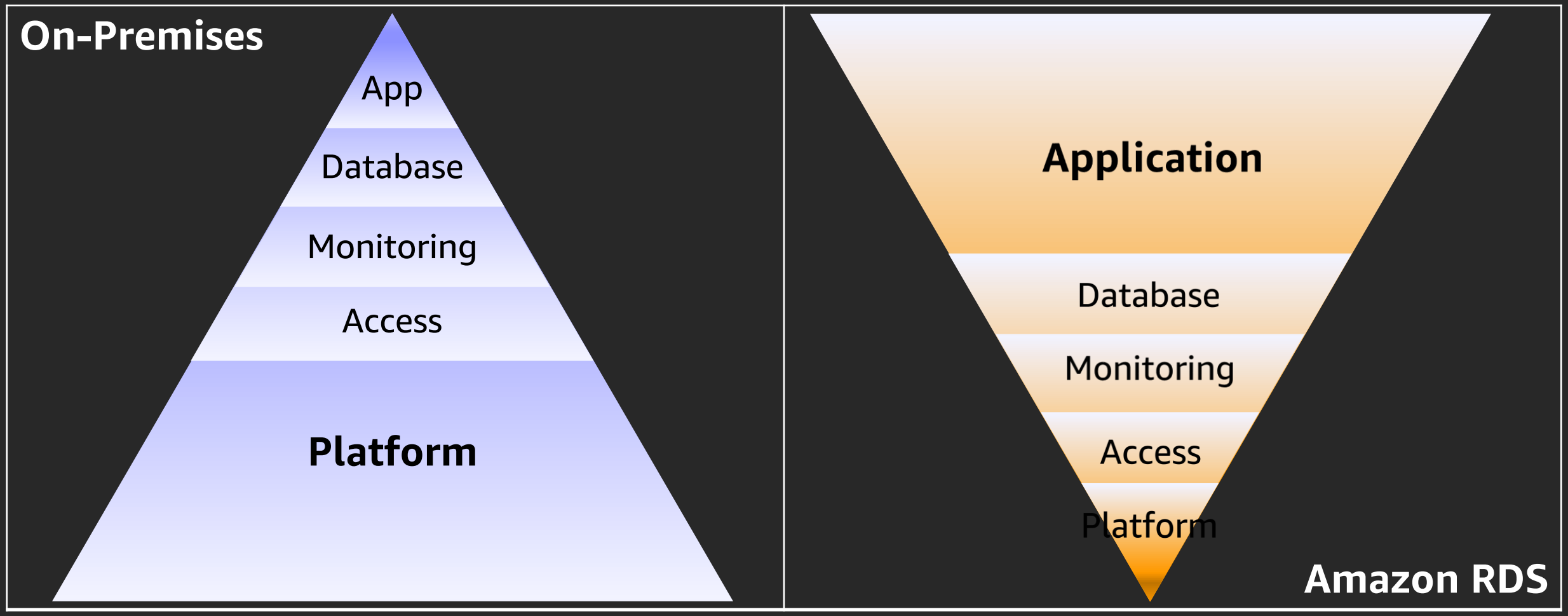
Easy to Administer
Scalable and Fast
Available and Durable
Secure
Inexpensive

- Pay for what you use
- Shift CAPEX to OPEX
- Scale down when appropriate
- Reserved Instances available
- License-included available (SE1, SE2)
- Bring-your-own license (SE, SE1, SE2, EE)

Self-managed versus managed



Oracle DBA time spent



DBA best practices

Amazon RDS for Oracle

Best practices for Oracle Database Administrators

- Security
- Performance
- Availability
- Configuration

Security

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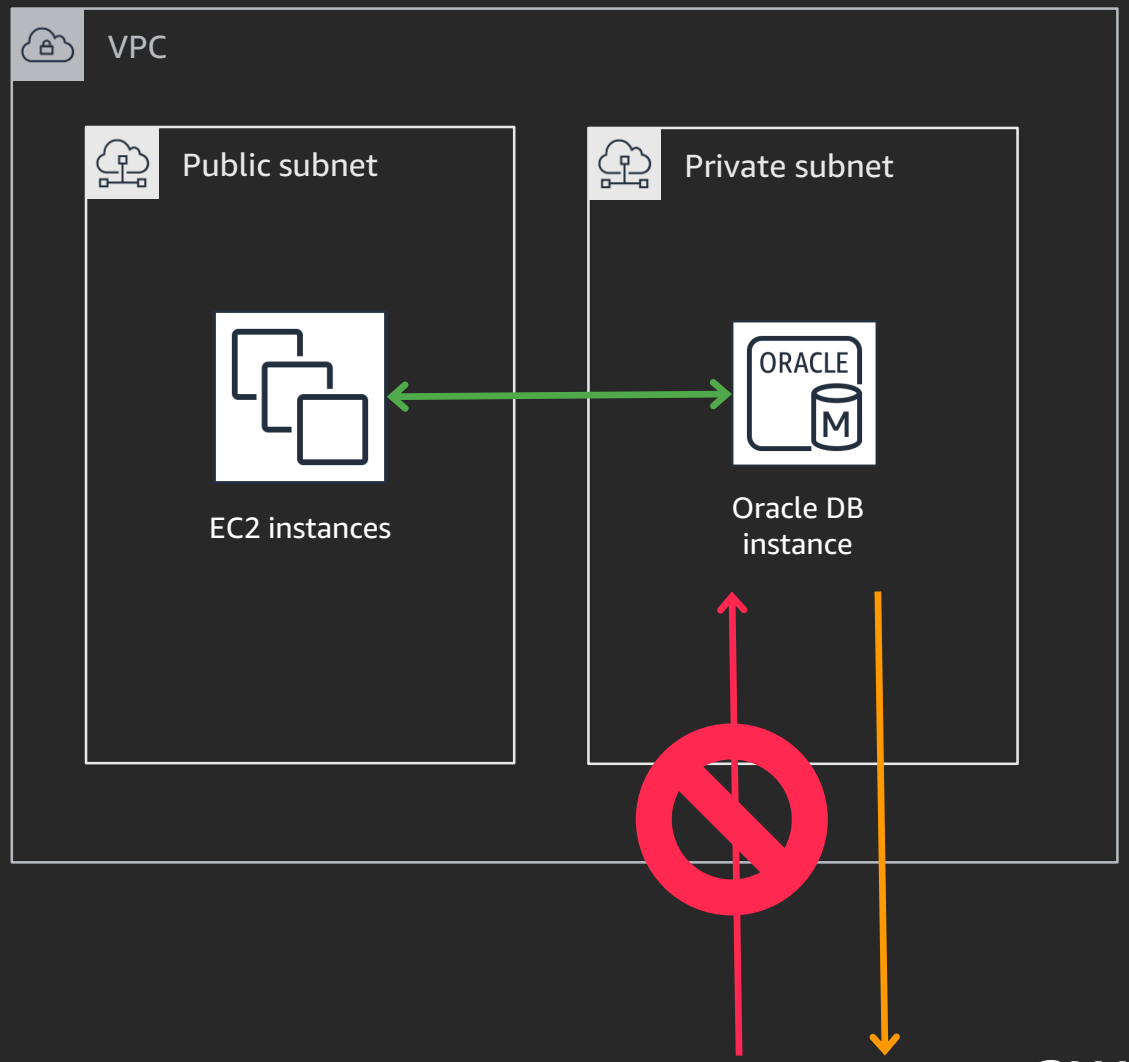
Prevent unauthorized access

Amazon Virtual Private Cloud

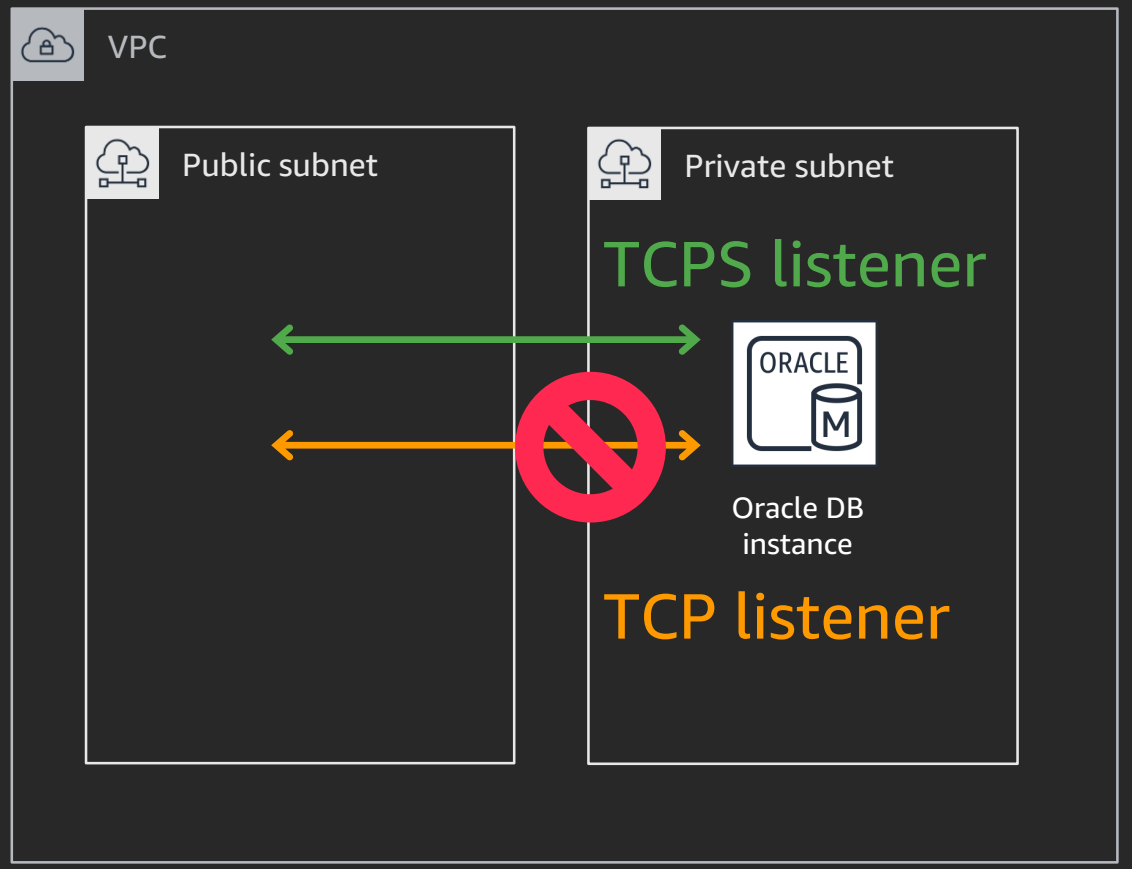
- Define VPC security group ingress/egress rules
- Keep databases in private subnets
- Control egress when using outbound network access (UTL_SMTP, UTL_HTTP, database links)



Prevent unauthorized access

SSL Network encryption

- Available with all Oracle versions and editions
- TLS 1.2 (11.2 EE and 12.1+)
- Configure client wallets with AWS root certificates



Prevent unauthorized access

RDS Storage encryption

- Amazon KMS integration
- Manage/bring your own keys
- All engines/editions
- Transparent, low overhead

- Enable when creating instance
- Encrypt existing snapshots and restore as encrypted instances

Detect misuse

Database Auditing

- Standard and fine-grained audit trails supported
- OS/XML to Amazon CloudWatch Logs
- Unified auditing in 12.2

When was table X dropped?

Where are invalid logon attempts coming from?

API Auditing

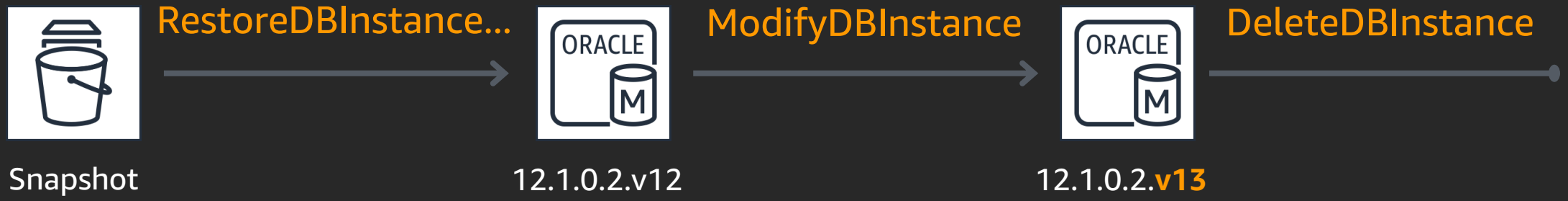
- AWS CloudTrail
- Actions on account resources
- Detect, analyze, alarm

Who created instance X?

What changes were made to parameter groups yesterday?

Stay up to date on patches

- New releases quarterly
- PSU (11.2, 12.1) or RU (12.2)
- DescribeDBEngineVersions
- Patch composition in Engine Release Notes
- No custom or one-off patches
- Test upgrades!



Upgrade best practices

Before you upgrade

- Review RDS documentation
- Pre-create parameter and option groups (major version upgrades)
- Ensure objects are valid and database links are reachable
- Ensure sufficient space is available
- Take a backup

After you upgrade

- Test your application
- Rollback via Point-in-Time Recovery

Performance

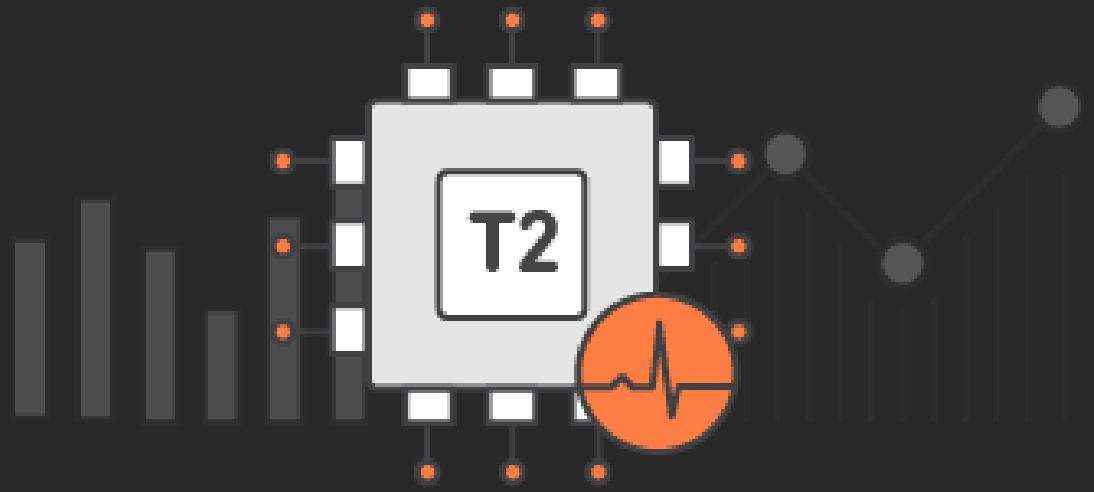
Know your workload

Burstable instance types	→	Typically steady, with periodic short spikes
Scale up and down	→	Predictable, steadily increasing, periodic peaks
Reserved Instances	→	Steady state, enterprise applications

Scale for your workload

Burstable instance types

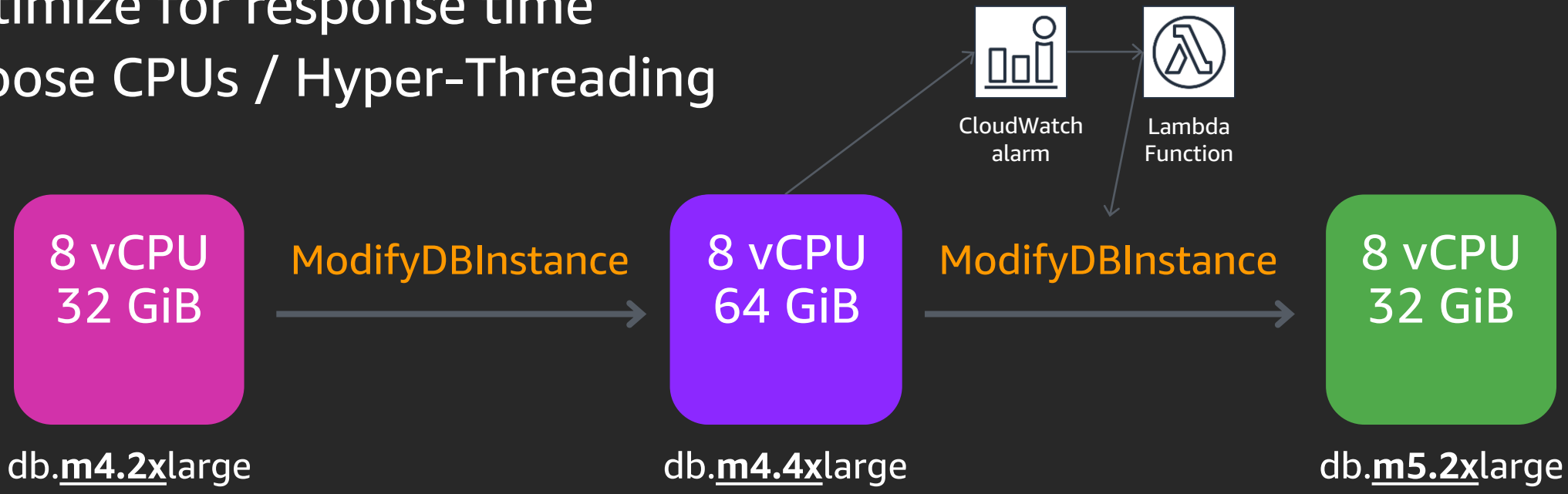
- Dev/test
- Smaller production databases
- Baseline CPU performance
- Burst performance with CPU credits



Scale for your workload

Scale up and down

- Predictable workloads with periodic peaks
- Fast failover with Multi-AZ
- Optimize for response time
- Choose CPUs / Hyper-Threading



Scale for your workload

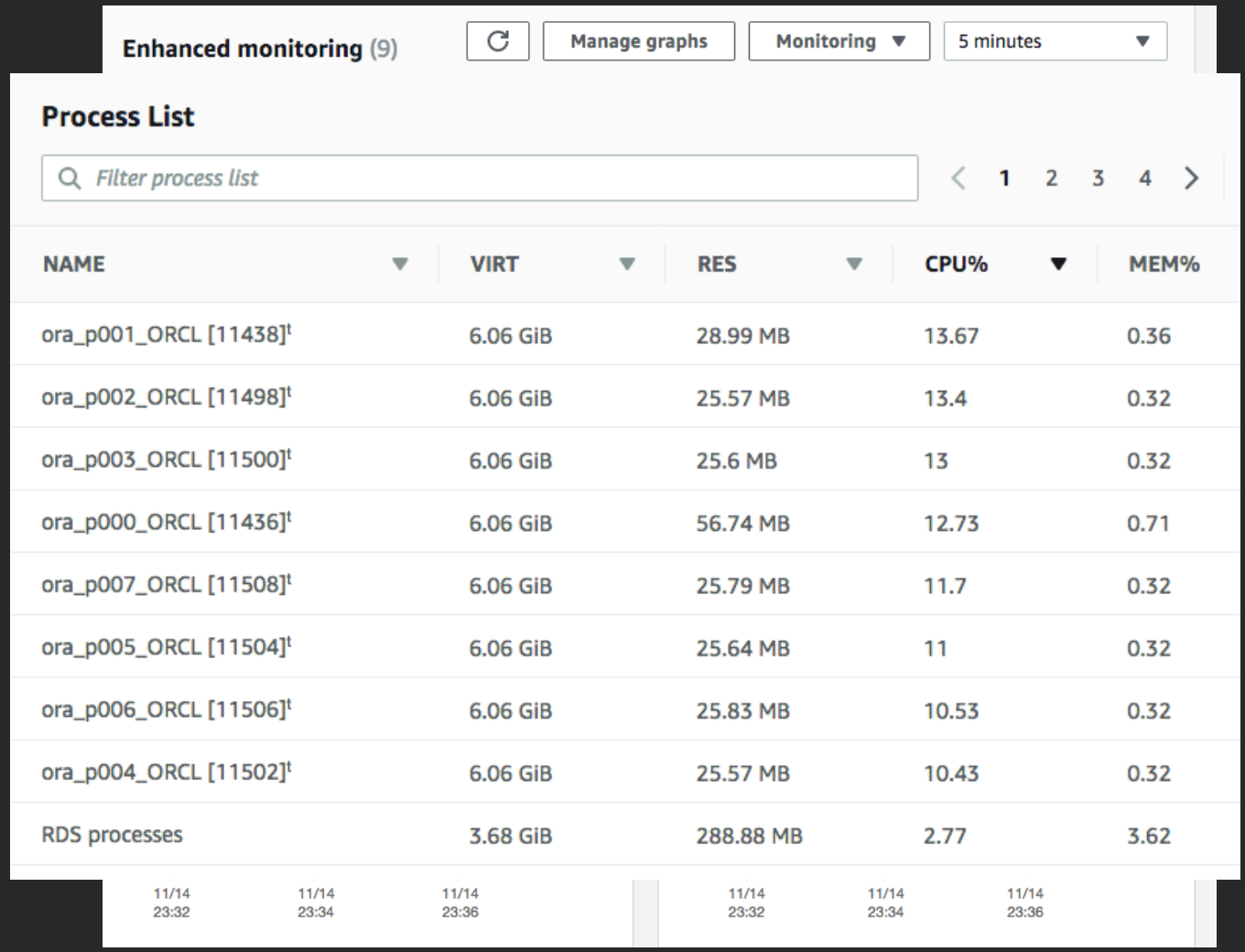
Reserved Instances

- Steady state workloads
- 1- and 3-year terms
- No upfront, partial upfront, or all upfront
- Savings up to 69%

Why is my CPU 100?

RDS Enhanced Monitoring

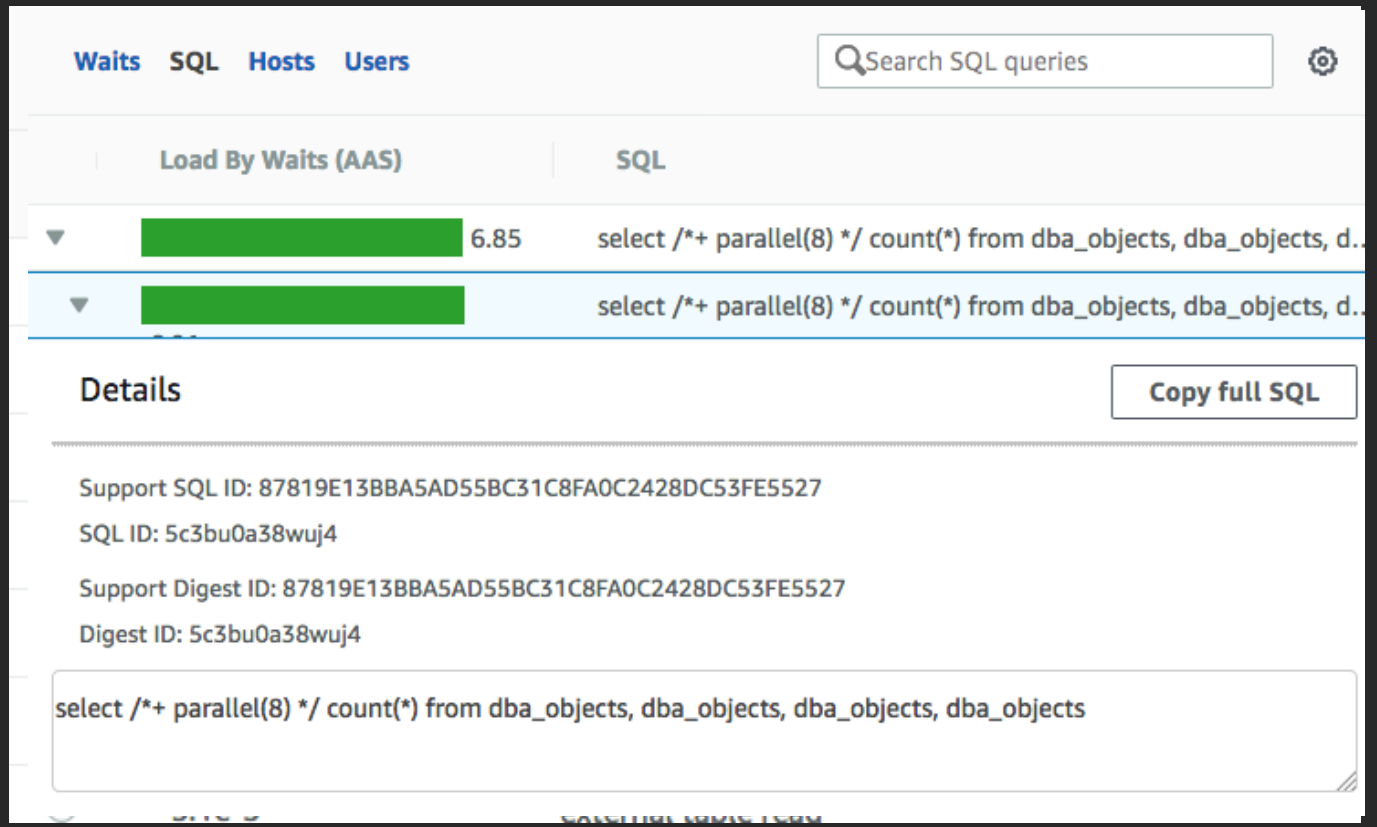
- Per-process host metrics
- View in AWS Console or push to monitoring systems
- 1-60 second granularity
  - Start with 15s
  - Dial down to 1s when troubleshooting



Why is my CPU 100?!

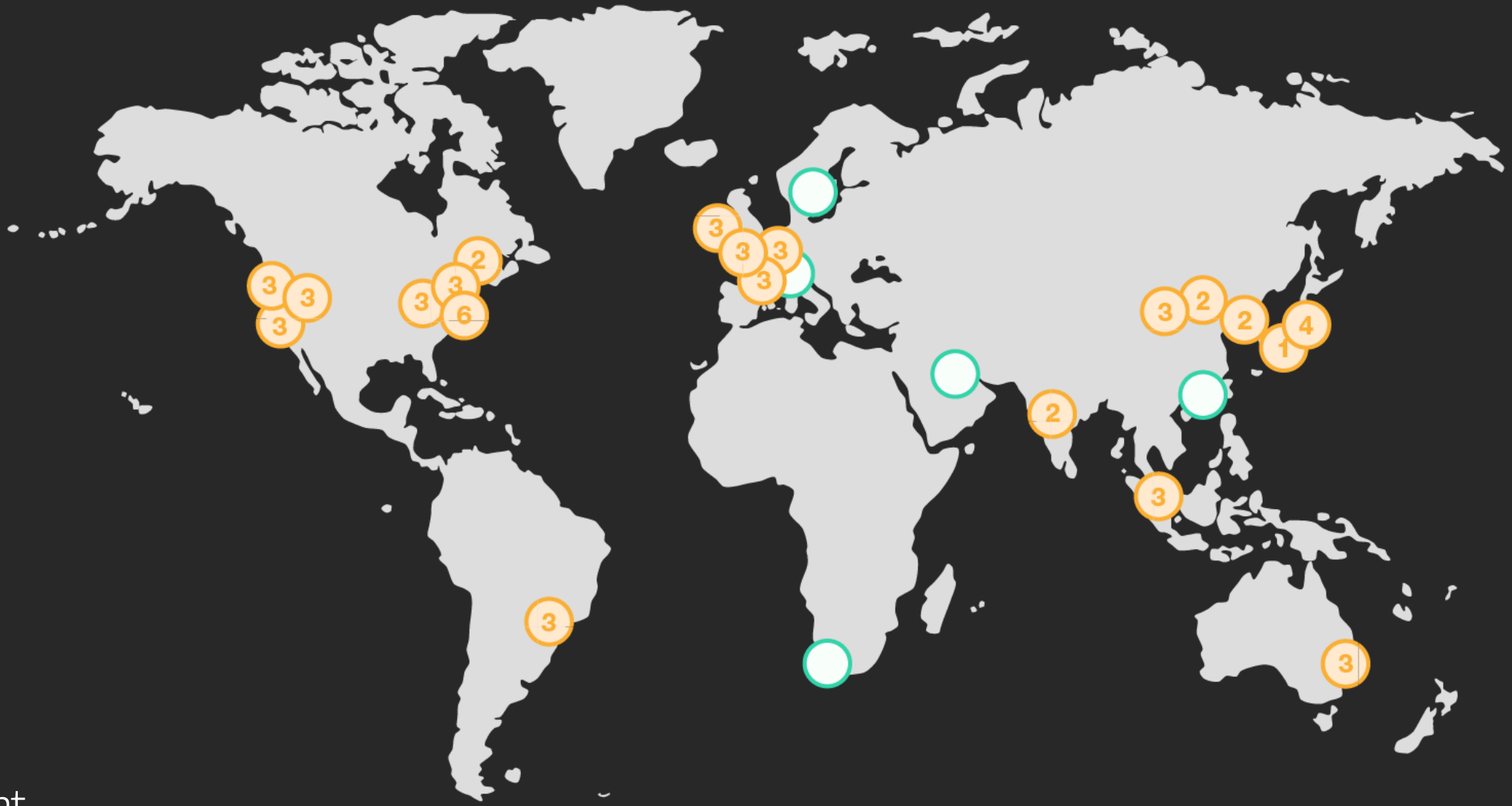
RDS Performance Insights

- Measure database load, average active sessions
- All RDS engines
- No licensing requirements
- View in AWS Console or push to monitoring systems



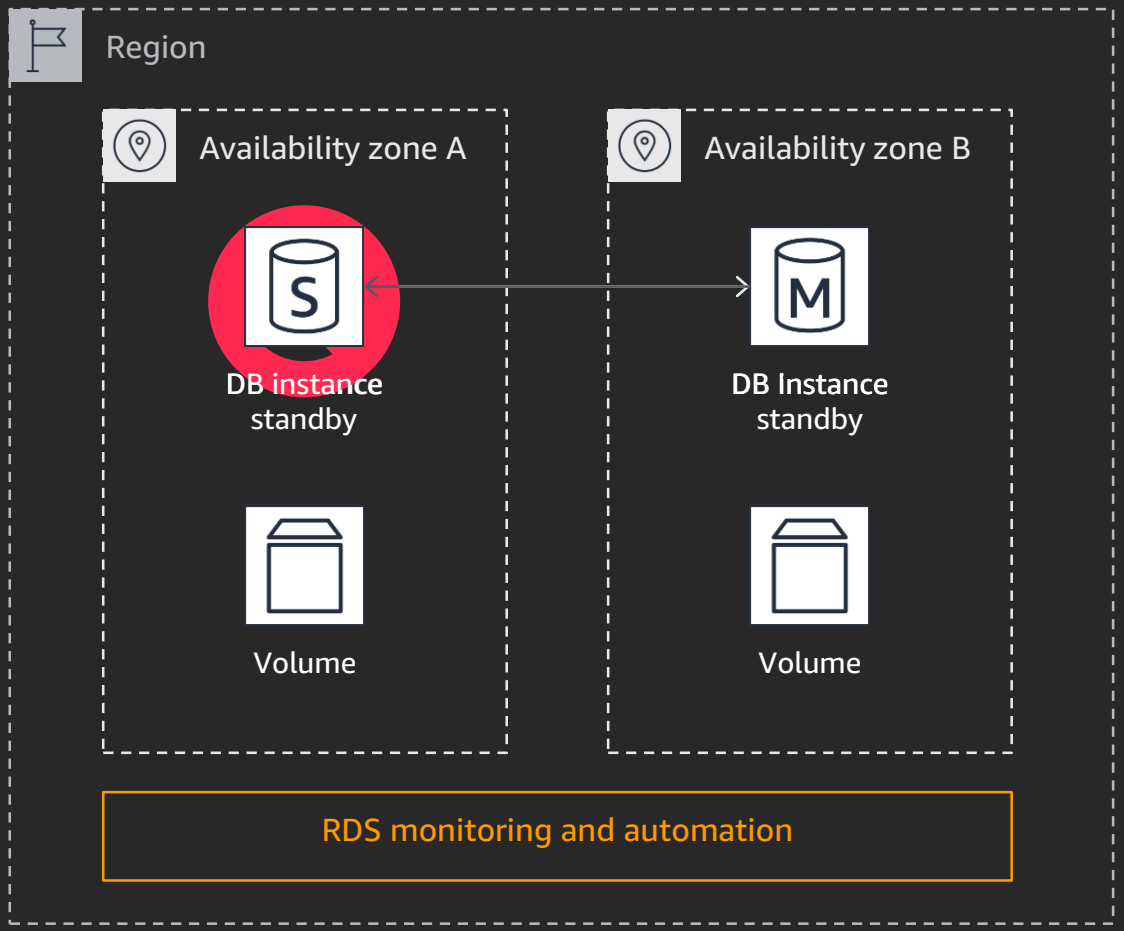
Availability

Choosing regions



RDS Multi-AZ

- Fully managed secondary in-region
- Distinct EC2/EBS resources
- Synchronous storage replication
- Failover in 1-2 minutes
  - Crash recovery
  - CNAME propagation
- 99.95% monthly uptime SLA



Multi-AZ best practices

- Single-AZ – non-critical workloads
- Multi-AZ – critical workloads
- Symmetric configuration – no “fail back”
- Connection pools need to reconnect, not cache DNS
- Test performance
- Test application resilience → `RebootDBInstance` + `ForceFailover`
- Customer-managed logical replication for cross-region/DR

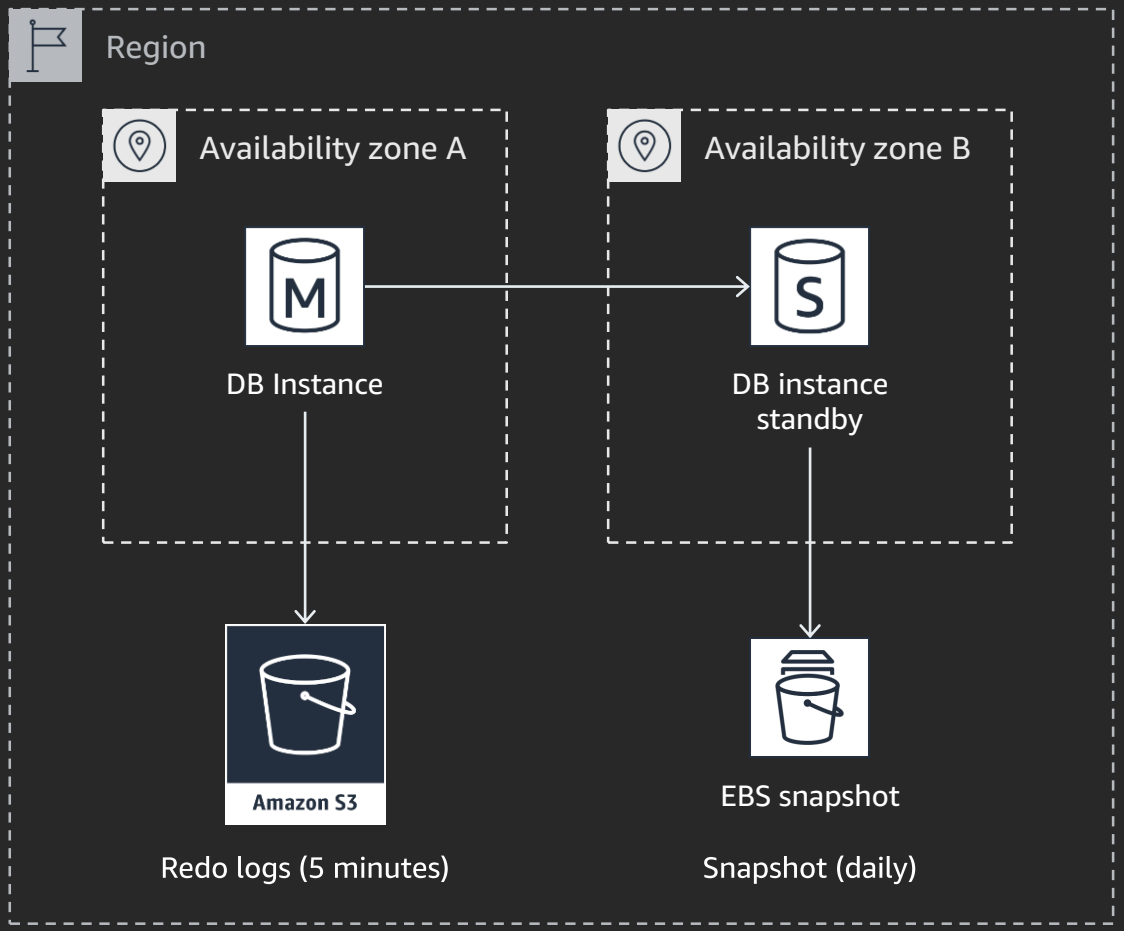
RDS backups

Automated backups

- Daily snapshot during backup window
- Redo logs to S3 every 5 minutes
- Retained 1-35 days

Manual backups

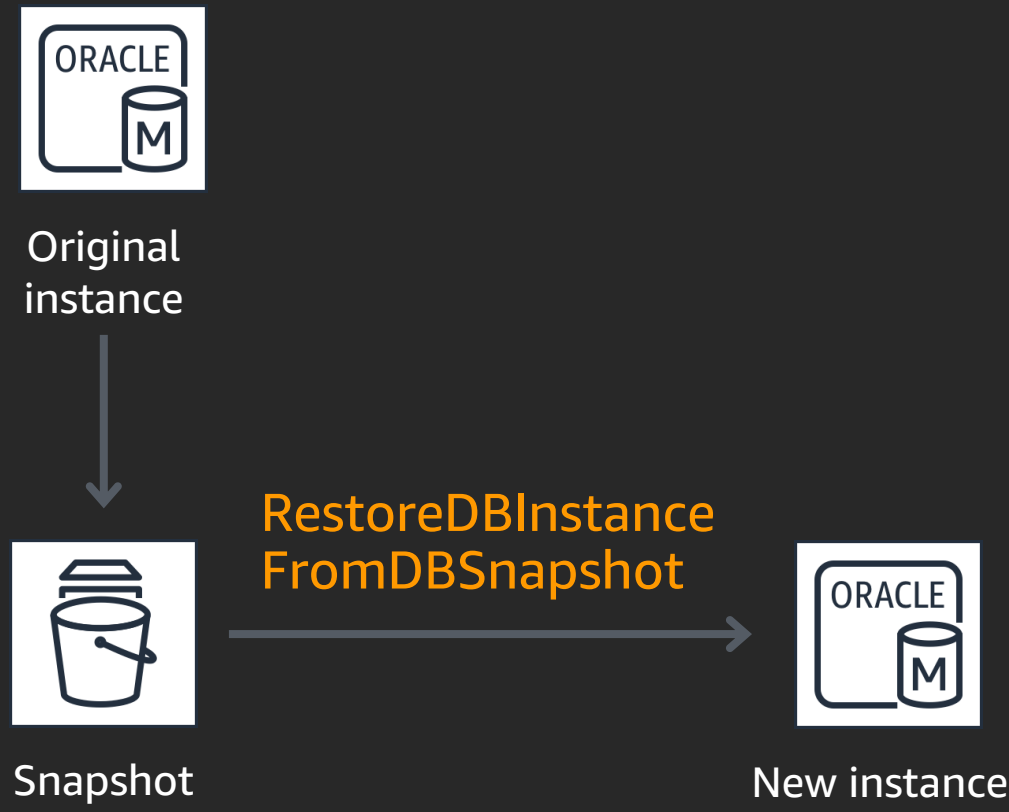
- Take a snapshot any time
- Kept until you delete



Restore from snapshot

- Restore from any snapshot
- Copy snapshots to other regions or accounts

Refresh test environments
Test upgrades
Instantiate logical replicas

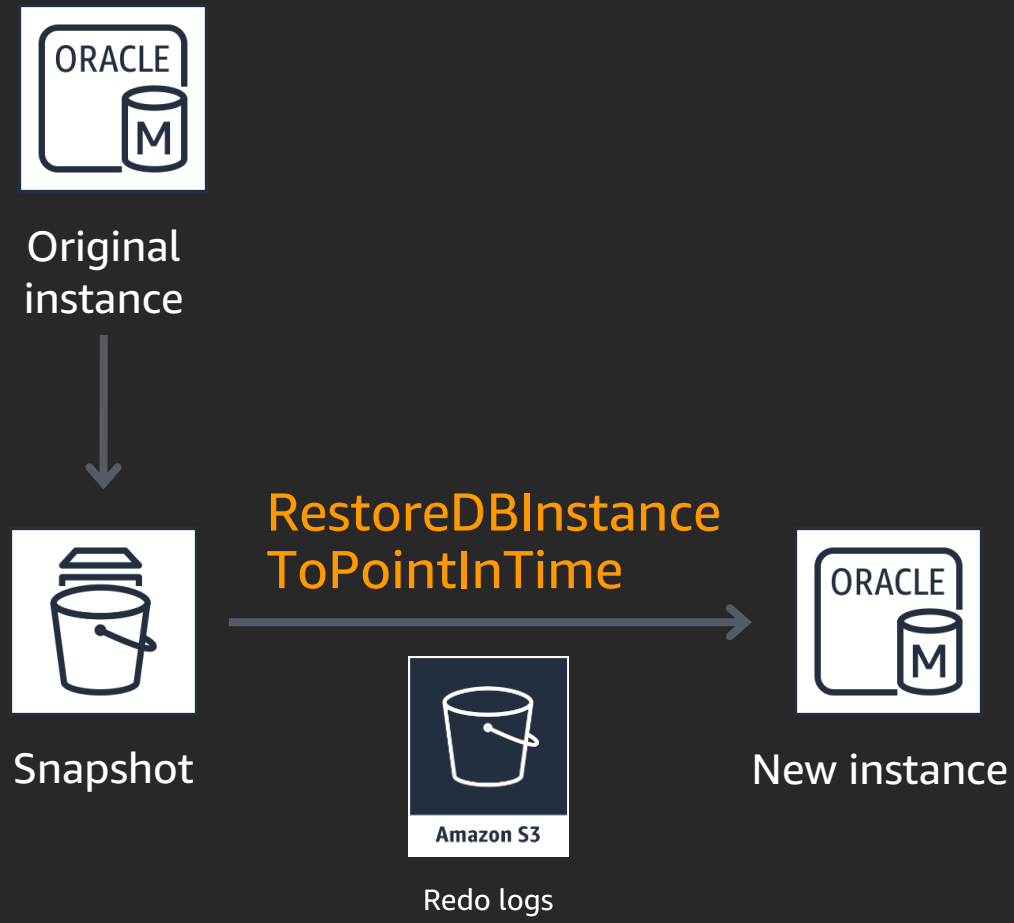


Restore to a point in time

- Restore to any second in backup retention
- Available in-region/account
- Latest restorable time typically <5 minutes

Oops… I dropped a table

Recover from application errors or logical corruption



Backup and restore best practices

- Disable backups for data load (NOARCHIVELOG mode)
  - WARNING: deletes existing automated backups
- Enable backups for critical workloads (ARCHIVELOG mode)
- Set backup window to low-usage time
- Take manual snapshots to reduce PiTR replay window
- Use restores to test upgrades/parameters/app changes
- Copy snapshots to other accounts/regions

Configuration

Rethinking Standard Edition

High availability with RDS Multi-AZ

- Synchronous replication and automated failover → 99.95% uptime SLA
- Independent infrastructure

RDS Storage encryption with Amazon KMS

- AES-256 encryption at rest
- Bring your own keys

Tuning with RDS Enhanced Monitoring and Performance Insights

- Per-process host metrics, granularity down to 1 second
- Analyze database load and active sessions

Rethinking versions

Stay current

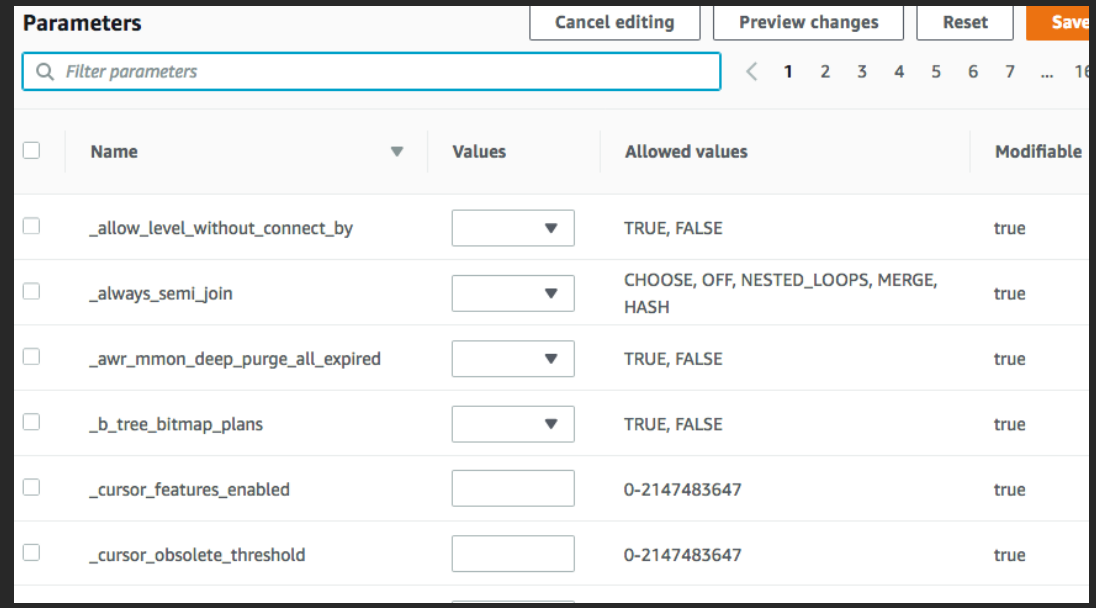
- 12.2.0.1 now available!
- Older releases deprecated when Extended Support ends
- Upgrade with 30-60 minutes of outage

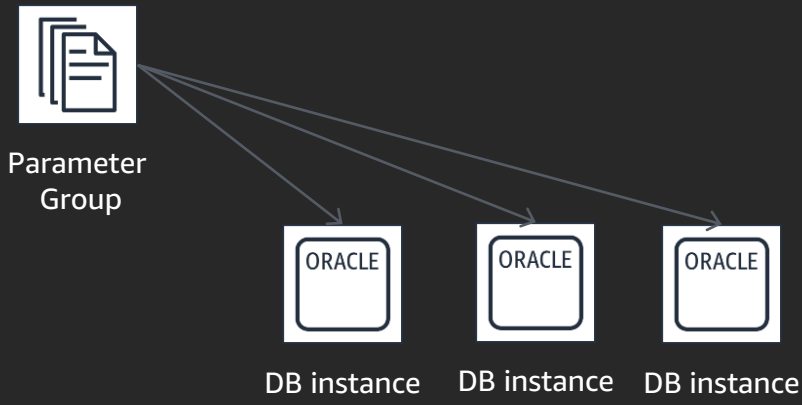
Stay secure

- Latest PSU/RU quarterly
- Updates typically required for JVM / Spatial / Locator / Multimedia
- Upgrade with 5-10 minutes of outage

Manage parameters across instances

- Use a single group to manage configuration across similar instances
- Formula expression support
- Test parameter changes!
- Reboot *without* failover to modify static memory-related parameters



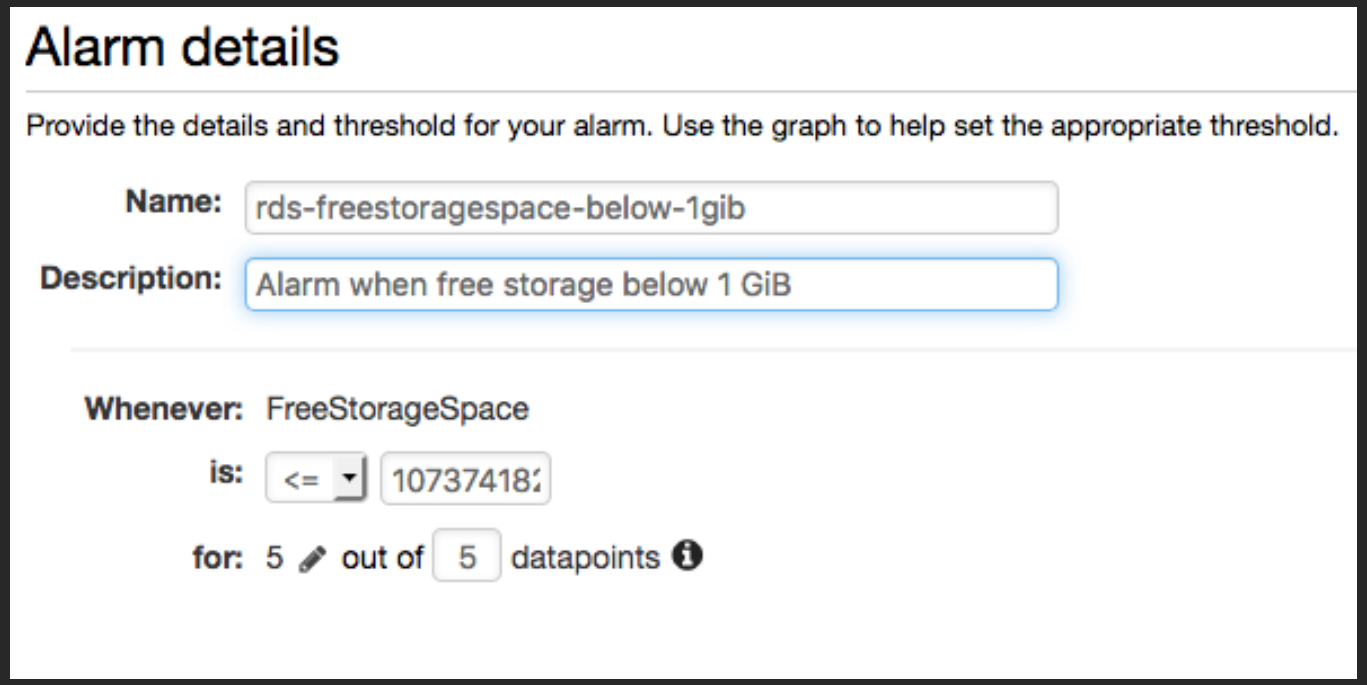


Stay in the know

CloudWatch Alarms

RDS Event Notification

RDS Recommendations

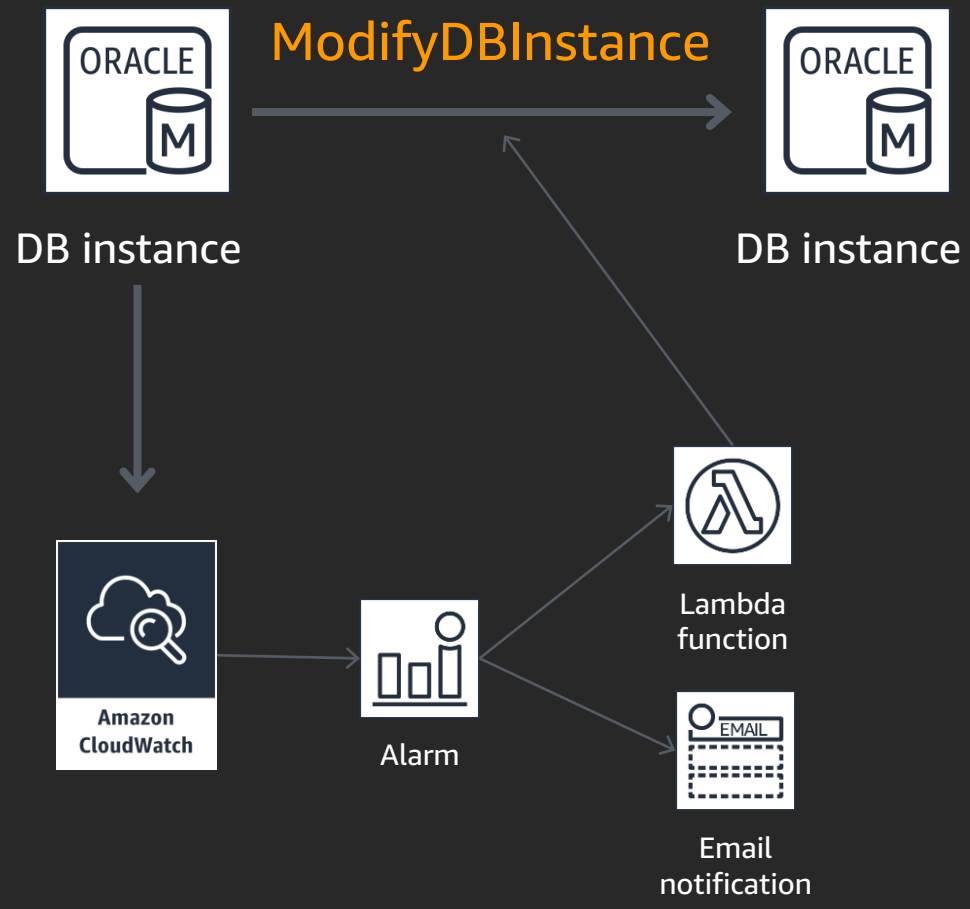


Stay in the know

CloudWatch Alarms

RDS Event Notification

RDS Recommendations



Stay in the know

CloudWatch Alarms

RDS Event Notification

RDS Recommendations

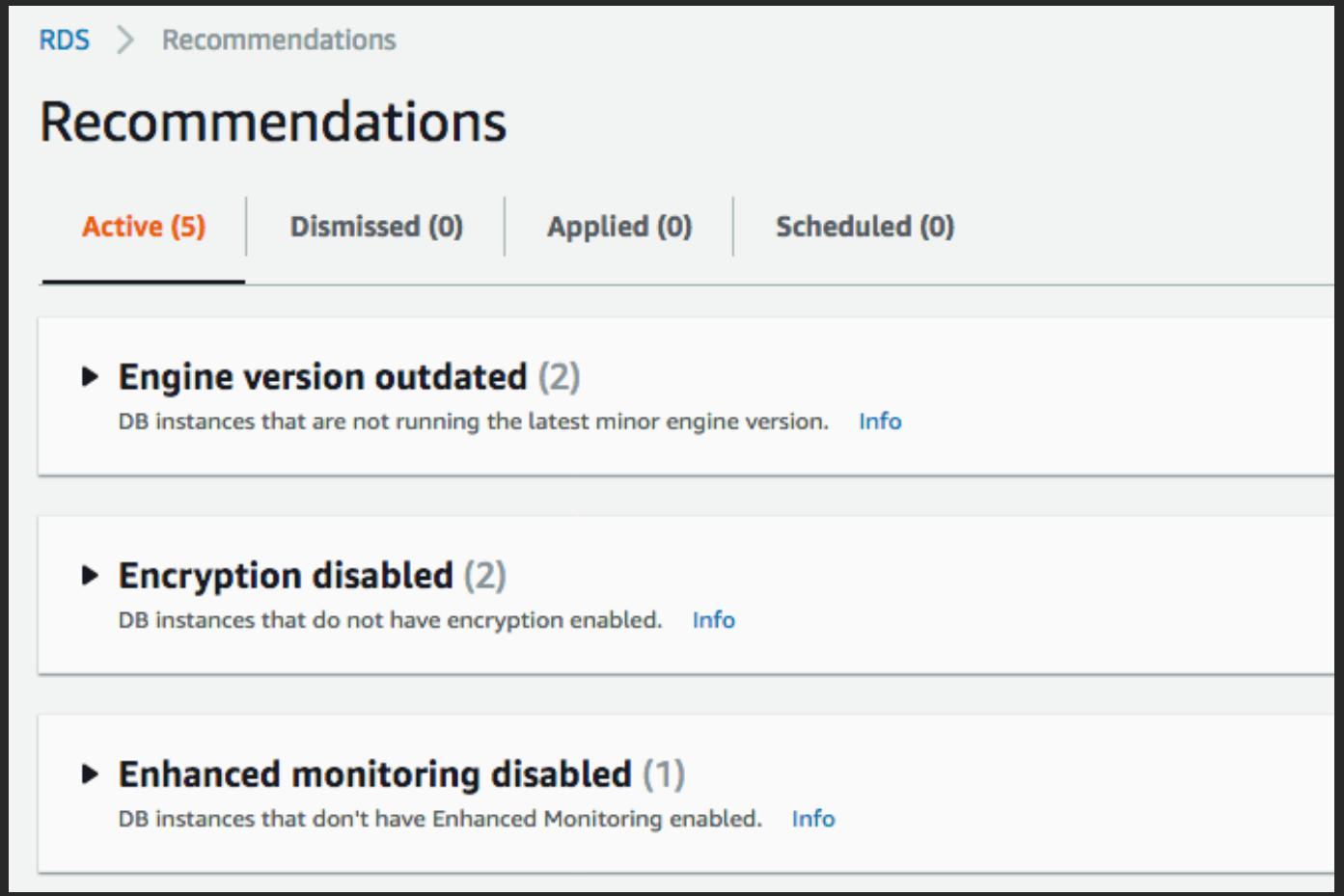
- Know when things happen to your instance
- Events for failures, maintenance, storage, event states
- View in the console or subscribe to Amazon SNS topics (email, pager, text)

Stay in the know

CloudWatch Alarms

RDS Event Notification

RDS Recommendations



Script all the things

```
$ aws rds describe-db-instances --region us-west-2 \
--query 'DBInstances[].[DBInstanceIdentifier, DBInstanceStatus, Engine, EngineVersion]' \
--output table
```

```
-------------------------------------------------------------------------
|                          DescribeDBInstances                          |
+-----------------------------+-------------+-------------+-------------+
|  mydbinstance-usw2-ora-abc  |  available  |  oracle-se1 |  11.2.0.4.v8  |
|  mydbinstance-usw2-ora-def  |  available  |  oracle-se1 |  11.2.0.4.v16 |
|  mydbinstance-usw2-ora-ghi  |  upgrading  |  oracle-ee  |  11.2.0.4.v16 |
|  mydbinstance-usw2-ora-jkl  |  available  |  oracle-ee  |  12.1.0.2.v11 |
|  mydbinstance-usw2-ora-mno  |  available  |  oracle-ee  |  12.1.0.2.v9  |
|  mydbinstance-usw2-ora-pqr  |  available  |  oracle-ee  |  11.2.0.4.v16 |
|  mydbinstance-usw2-ora-stu  |  available  |  oracle-ee  |  11.2.0.4.v17 |
|  mydbinstance-usw2-ora-vwx  |  maintenance |  oracle-se2 |  12.1.0.2.v8  |
+-----------------------------+-------------+-------------+---------------+
```

Phil Eedes, UK Ministry of Justice

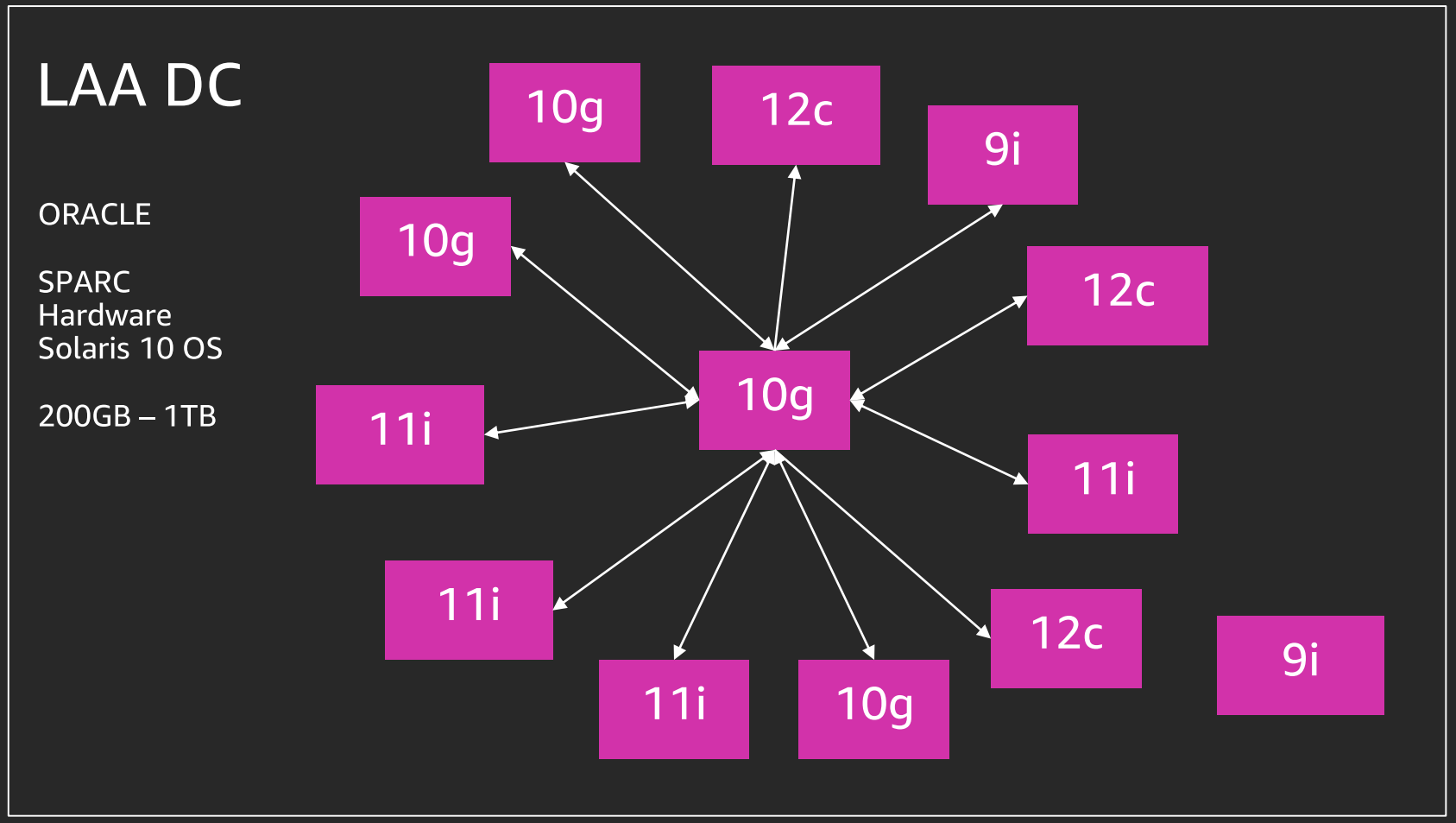
MOJ – Legal Aid Agency

UK Government Agency providing Criminal and Civil Legal Aid to the UK Public

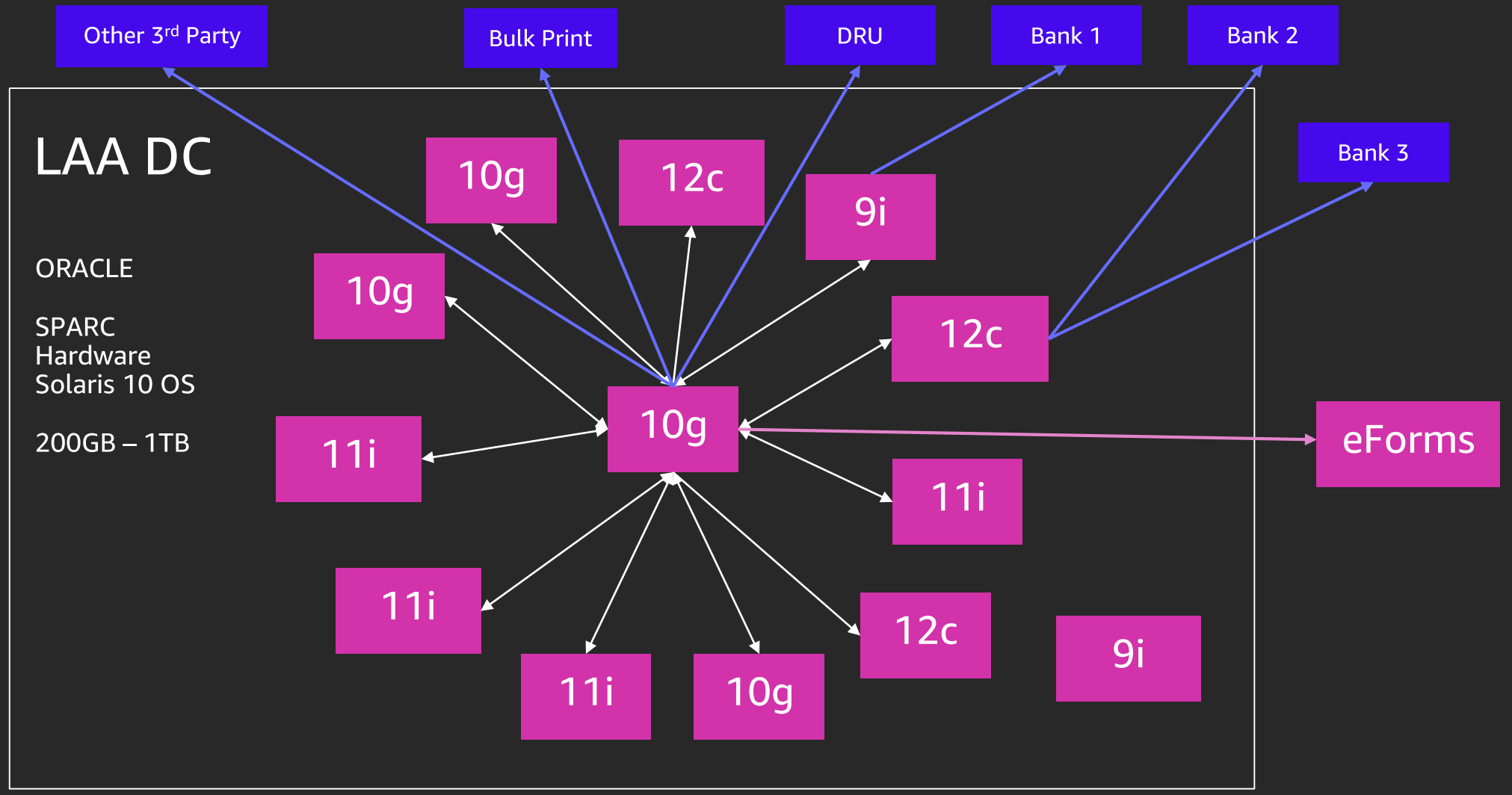
What were we moving?

- 13 Applications
  - Databases & Interactions

Databases



Databases



Database migration considerations

Target : RDS SE vs EE vs EC2

- Licensing
- Features Used
- Backup and Recovery
- Performance and Monitoring

Method

- Capture As-Is (Size, Version, connectivity)
- Healthcheck and Remediation
- Endian Conversion
- Outage tolerance
- Route to Live

Database migration method

- EC2 Migration Server on AWS (Oracle clients)
- Create Target DB Instance on RDS (AWS CloudFormation)
- DataPump Export on Source DB
- SCP files to EC2 server
- Transfer files to RDS instance (PERL script)
- DataPump Import on RDS
- Re-establish connectivity

Challenges

Email – UTL_SMTP

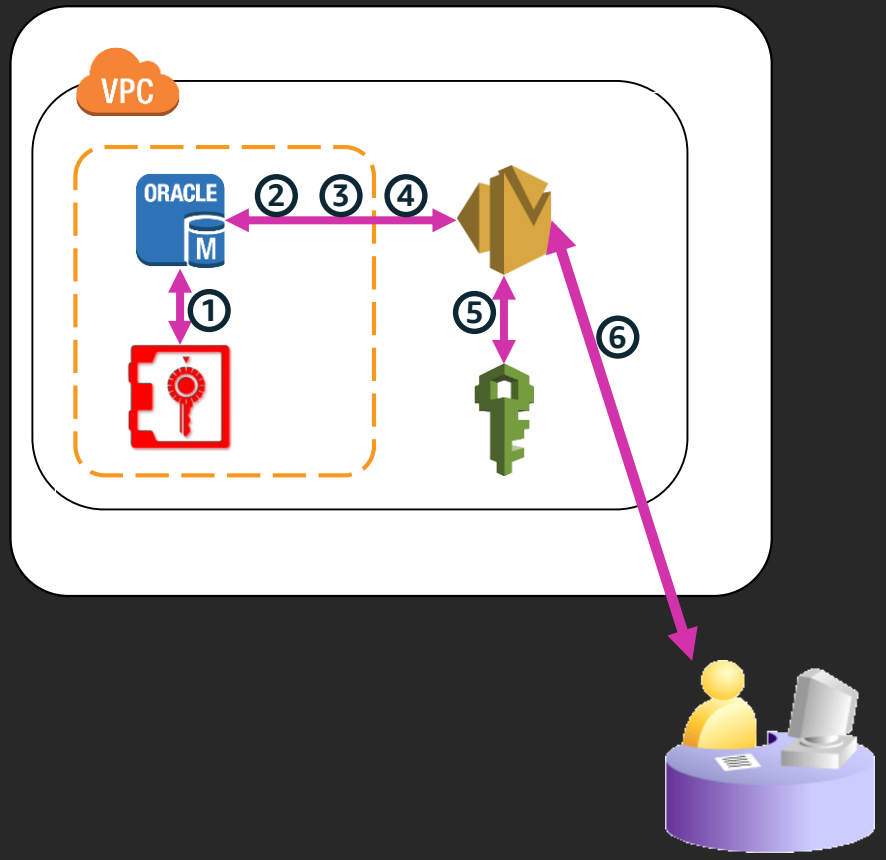
Amazon SES

FTP – UTL_FILE

Filesystem interaction

12c to 9i Links

Amazon Simple Email Service (SES) – SMTP



SES Work Flow

1. Get Certificates from Wallet
2. Open SMTP Connection
3. Establish Handshake with EHLO
4. Initiate TLS connection
5. Log on to SES with User Credentials
6. Send eMail to end user

The UTL_FILE challenge (for FTP)

The challenge

- File transfer in/out of DB filesystem
- UTL_FILE & Oracle Directories work perfectly in RDS
- The directory location is not exposed.
- AWS deprecated SHA-1

The solution

- Upgrade to Oracle 12c
- Install APEX
- Use SHA-2 (SHA-256) hash
- Use perl to upload wallet
- Create PL/SQL wrapper for S3
  - Delete
  - Get
  - List
  - Put

12c to 9i DB links

The challenge

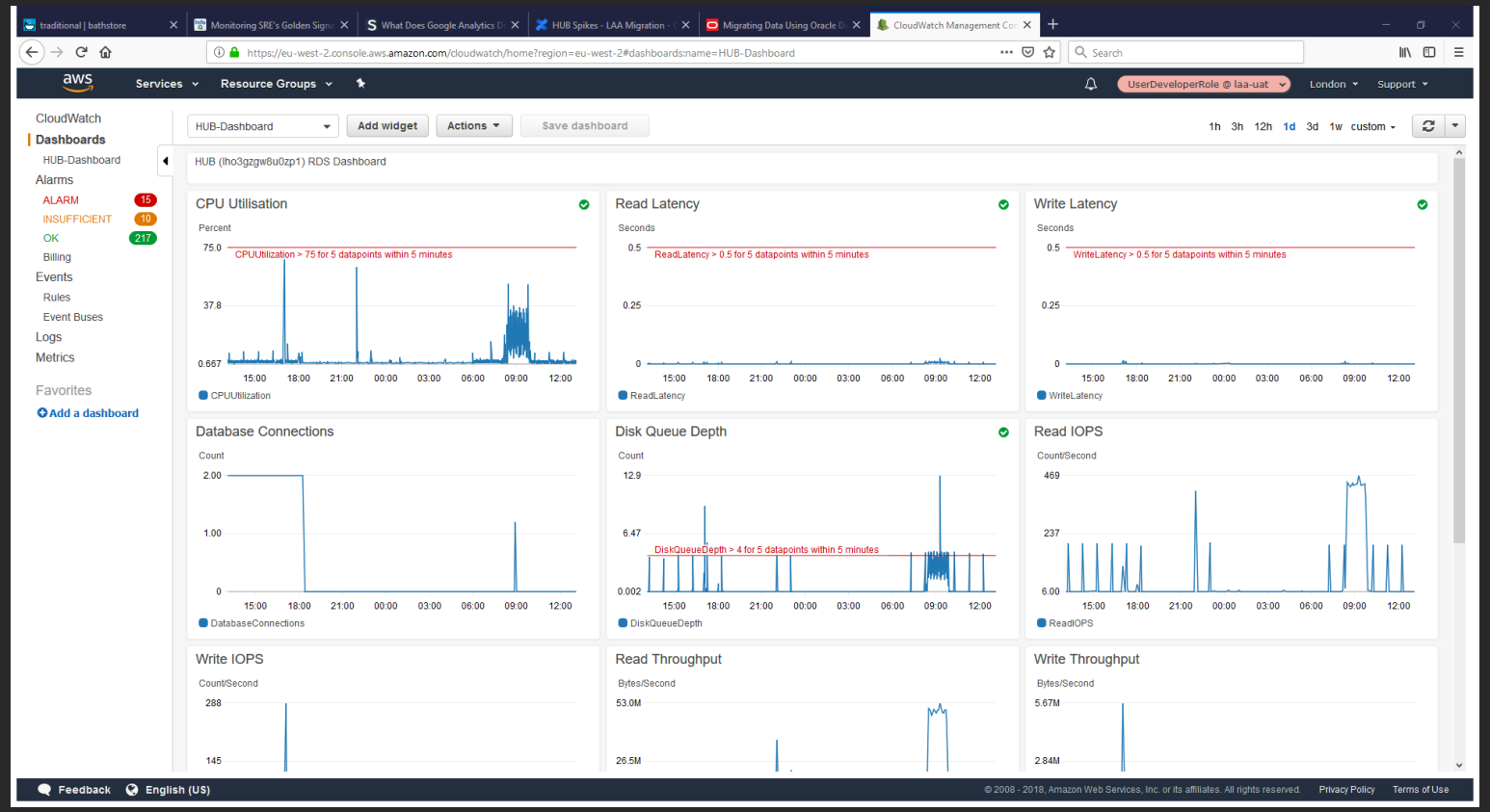
- For SHA-2 Upgrade required to 12c
- DB still required DB links to legacy 9i
- Oracle DBs tolerate links with 2 vers

The solution

- Introduce Interim “HOP” db (v11g)
- Replicate APIs on HOP db

Performance and monitoring

Configurable dashboards & alerting



Verdict

Planning pays off – understand the As-Is

Prove and improve your methodology

RDS support is both responsive and effective

Performance improvements of around 50% on AWS

Thank you!

Michael Barras
Senior Database Engineer
Amazon Web Services

Phil Eedes
Technical Architect
UK Ministry of Justice

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But wait, there's more…

- Amazon RDS for Oracle
  https://aws.amazon.com/rds/oracle/
- Documentation and white papers
  https://aws.amazon.com/rds/oracle/developer-resources/
- re:Invent 2017 DAT313
  https://www.youtube.com/watch?v=GMVKBjXjp20
- Oracle on AWS
  https://aws.amazon.com/oracle/resources/
- DBA responsibilities in RDS
  https://aws.amazon.com/blogs/database/part-1-role-of-the-dba-when-moving-to-amazon-rds-responsibilities/

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