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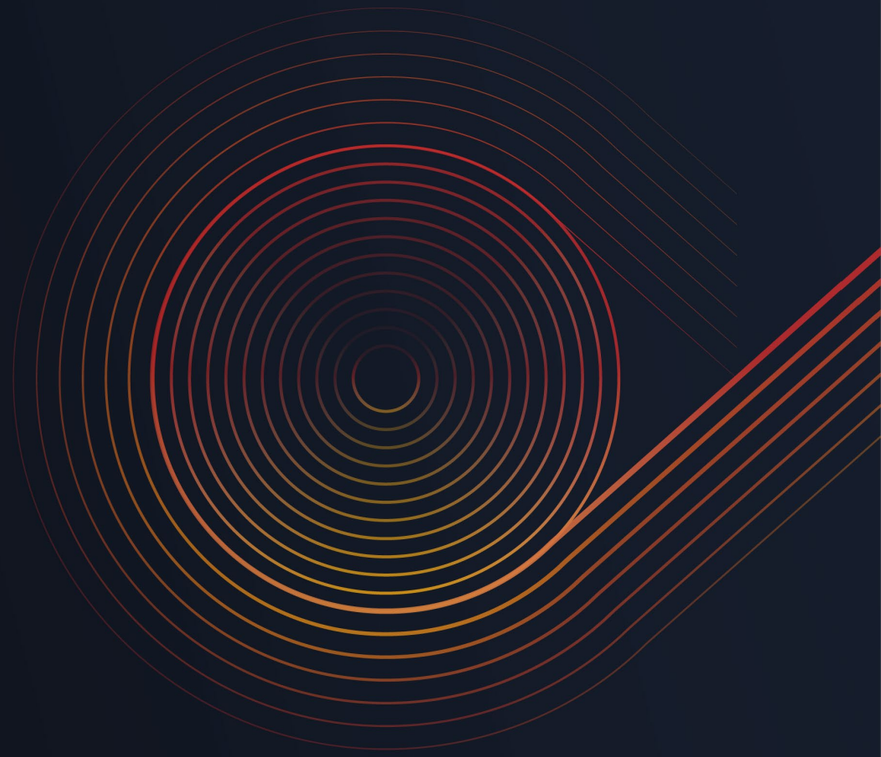
Building modern application with modern databases

Denys Dobrelya

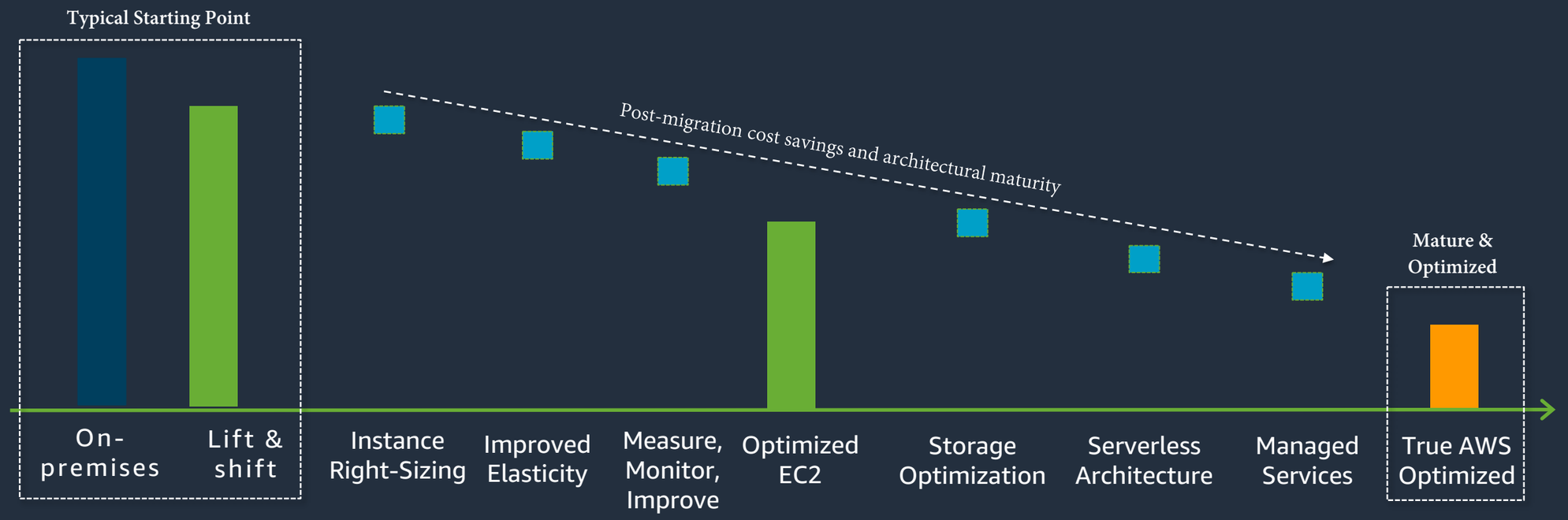
Senior Data Architect, AWS



Agenda

- Application modernization and new data requirements
- Using non-relational databases for internet-scale apps
- Running relational databases at internet scale
- Demo

Modernization and cloud maturity is a journey



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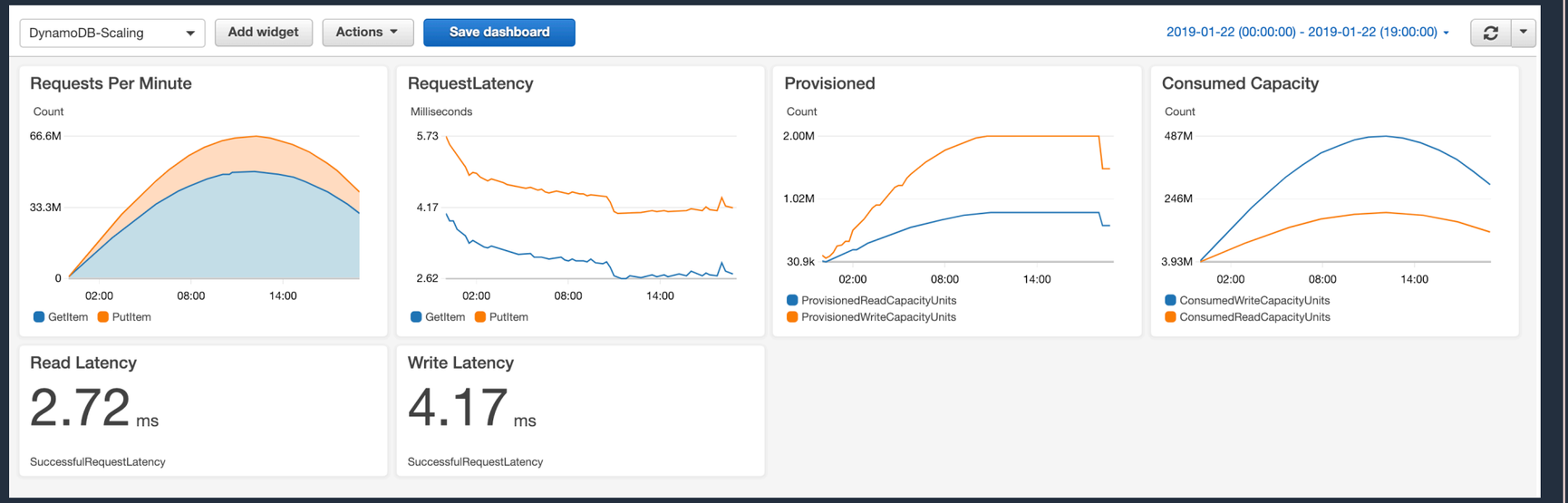
Performance at scale

Single-digit-millisecond latency at petabytes of scale



Millions of requests per second

Trillions of items

Petabytes of storage

Single-digit-millisecond read and write latencies

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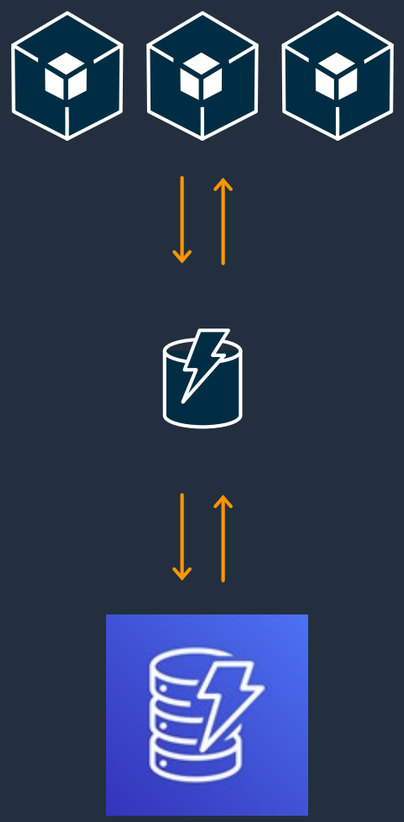
Performance at scale

Amazon DynamoDB Accelerator (DAX)



Fully managed, highly available cache for DynamoDB

Even faster—microsecond latency

Scales to millions of requests per second

API compatible

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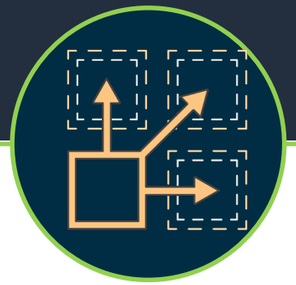
Amazon DocumentDB

Fast, scalable, and fully managed MongoDB-compatible database service

Fast

Millions of requests per second with millisecond latency

Scalable



Separation of compute and storage scales both independently; scale out to 15 read replicas in minutes

Fully managed

Managed by AWS:
no hardware provisioning; auto patching, quick setup, secure, and automatic backups

MongoDB compatible

Compatible with MongoDB 3.6; use the same SDKs, tools, and applications with Amazon DocumentDB. Migrate workloads with AWS DMS.

Purpose-built document database engineered for the cloud

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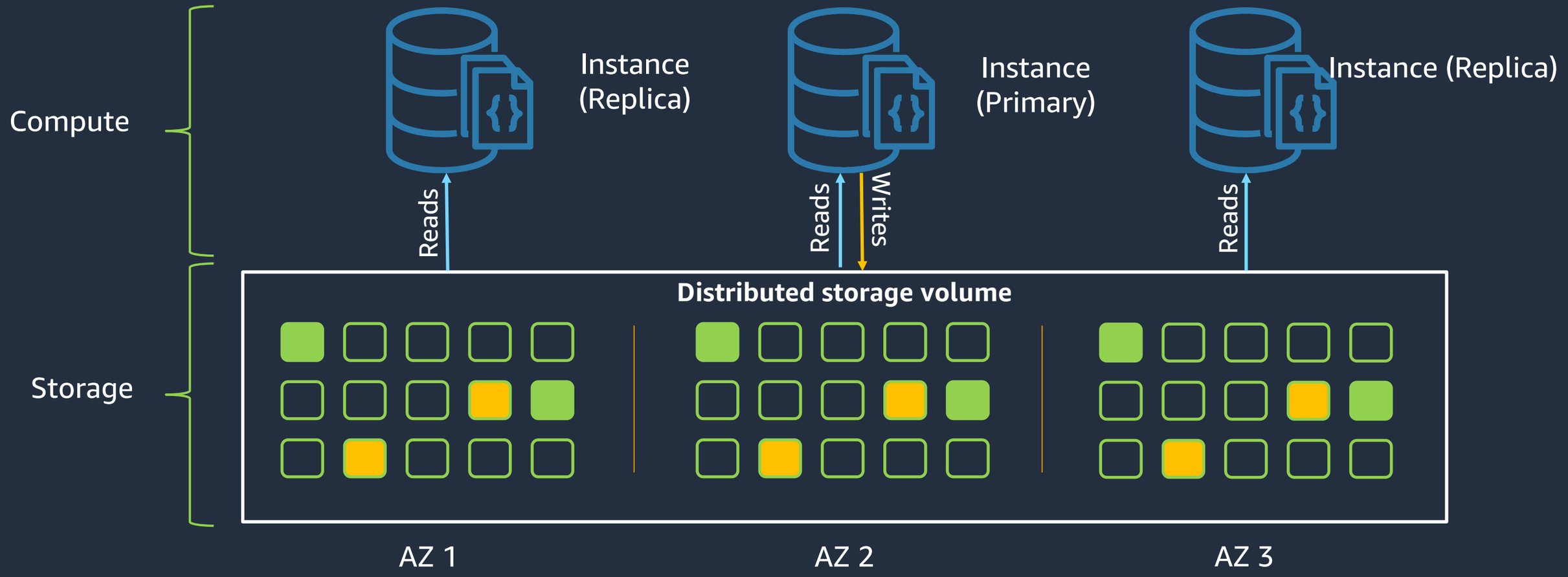
Amazon DocumentDB Architecture



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Amazon Neptune

Fast, reliable graph database built for the cloud

Open

Supports Apache TinkerPop & W3C RDF graph models

Fast

Queries billions of relationships with millisecond latency

Reliable

Six replicas of your data across three Availability Zones, with full backup and restore

Easy

Build powerful queries easily with Gremlin and SPARQL

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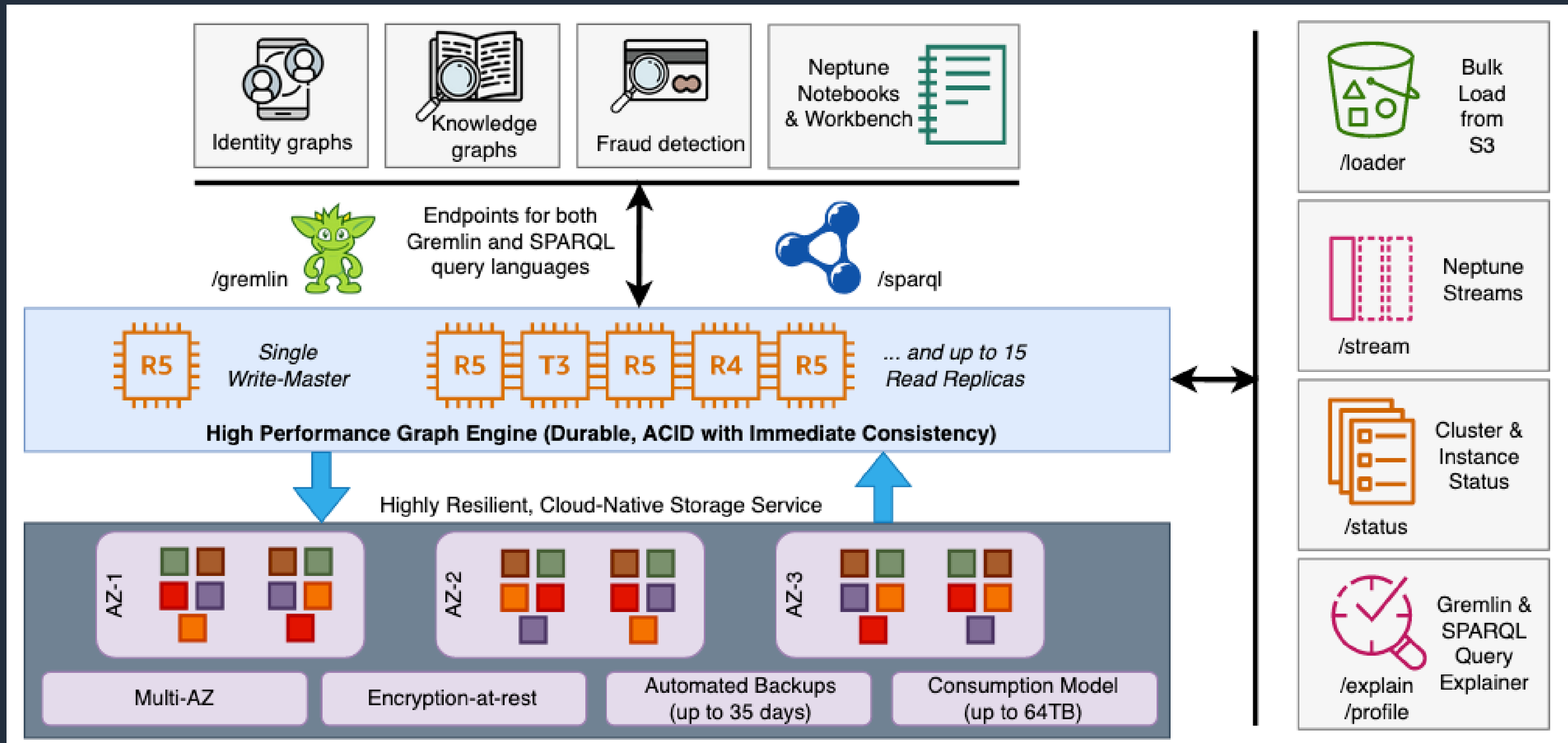
Amazon Neptune architecture



Amazon Aurora

MySQL and PostgreSQL-compatible relational database built for the cloud

Performance and availability of commercial-grade databases at 1/10th the cost

Performance and scalability

5x throughput of standard MySQL and 3x of standard PostgreSQL; scale-out up to 15 read replicas

Availability and durability

Fault-tolerant, self-healing storage; six copies of data across three Availability Zones; continuous backup to Amazon S3

Highly secure

Network isolation, encryption at rest/transit, compliance and assurance programs

Fully managed

Managed by Amazon RDS: No server provisioning, software patching, setup, configuration, or backups

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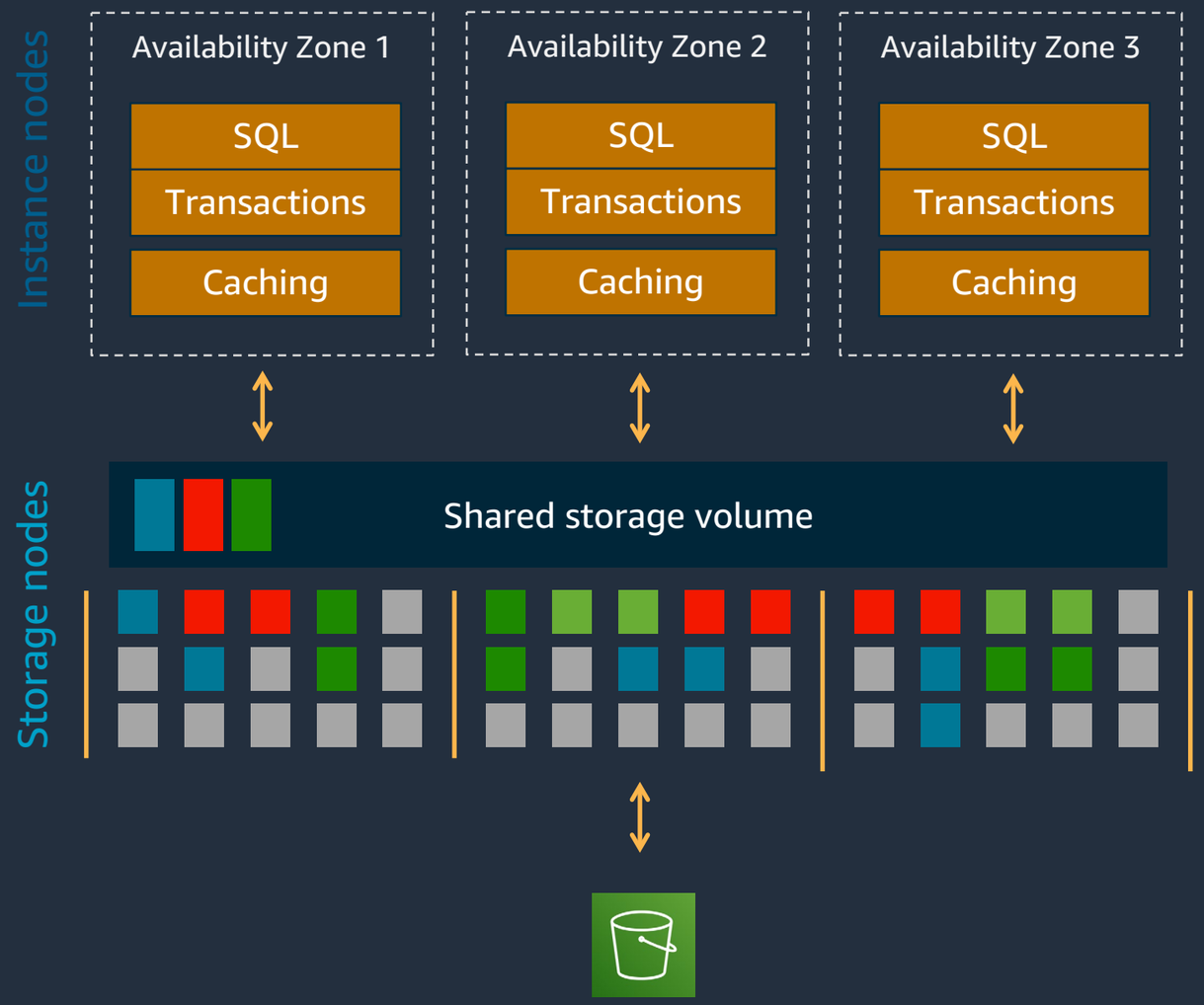
Scale-out, distributed storage processing architecture

Purpose-built log-structured distributed storage system designed for databases

Storage volume is striped across hundreds of storage nodes distributed over 3 different Availability Zones

Six copies of data, two copies in each Availability Zone to protect against AZ+1 failures

Data is written in 10 GB “protection groups”, growing automatically when needed



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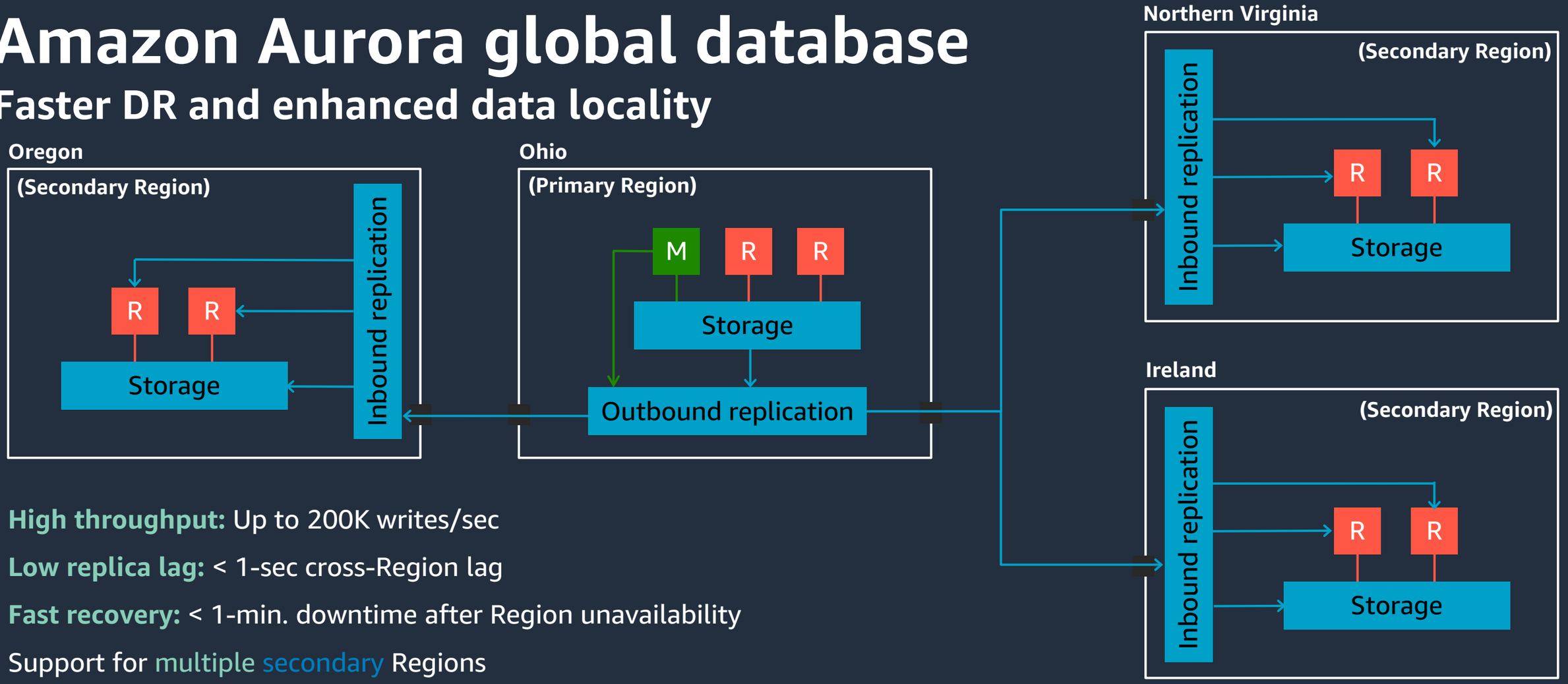
Amazon Aurora global database

Faster DR and enhanced data locality



High throughput: Up to 200K writes/sec

Low replica lag: < 1-sec cross-Region lag

Fast recovery: < 1-min. downtime after Region unavailability

Support for multiple secondary Regions

Support for in-place conversion to Global Database

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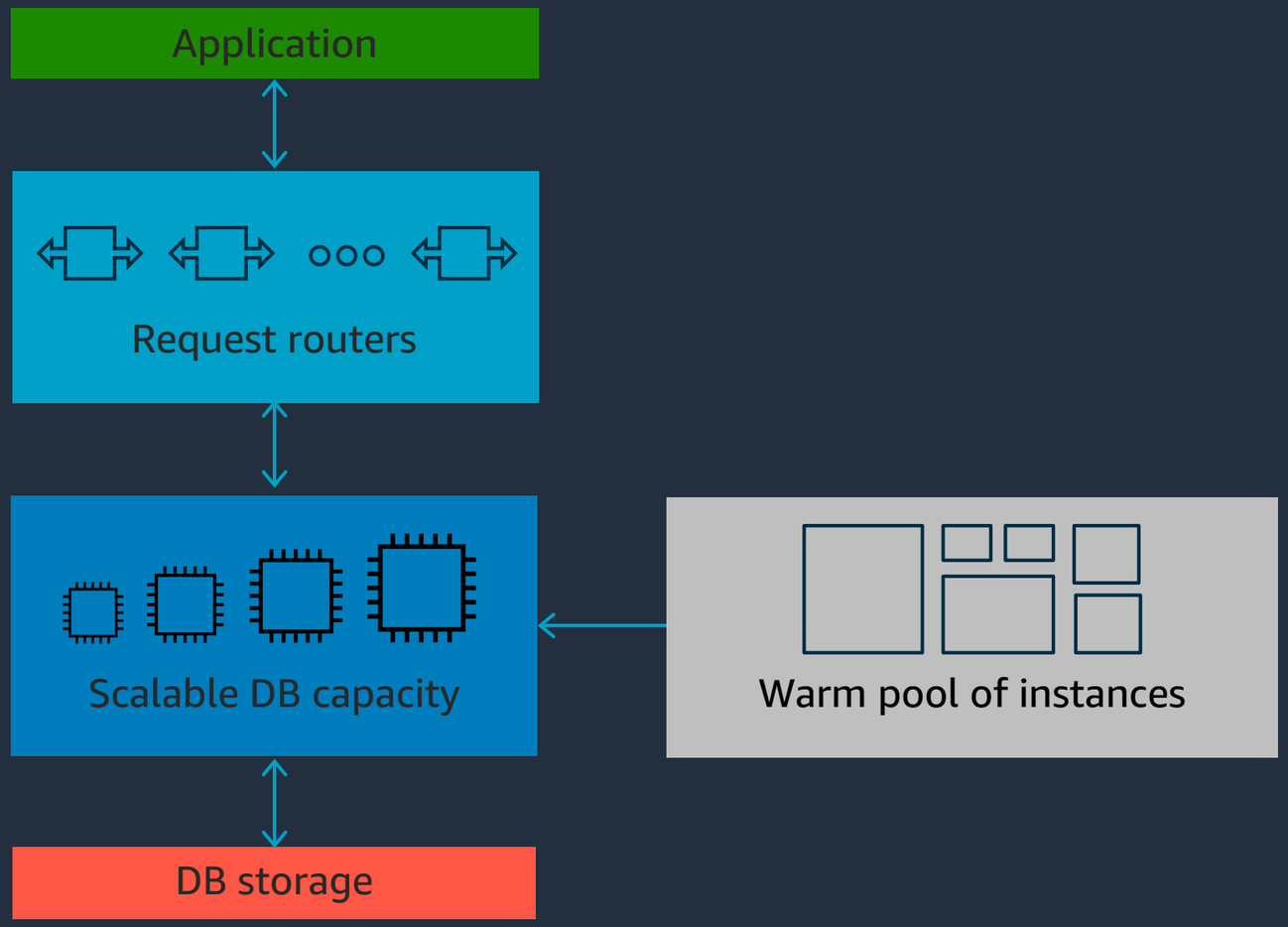
Amazon Aurora Serverless for PostgreSQL and MySQL

- Starts up on demand; shuts down when not in use
- Scales up/down automatically
- No application impact when scaling
- Pay per second, one-minute minimum
- Great for infrequently used, unpredictable or cyclical workloads



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AWS purpose-built databases

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Contact us at:

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Demo:

Django App migration to AWS Fargate and Amazon Aurora Serverless

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Agenda for demo

Database migration to *Amazon Aurora Serverless* and Application *Docker* Image deployment on *AWS Fargate*

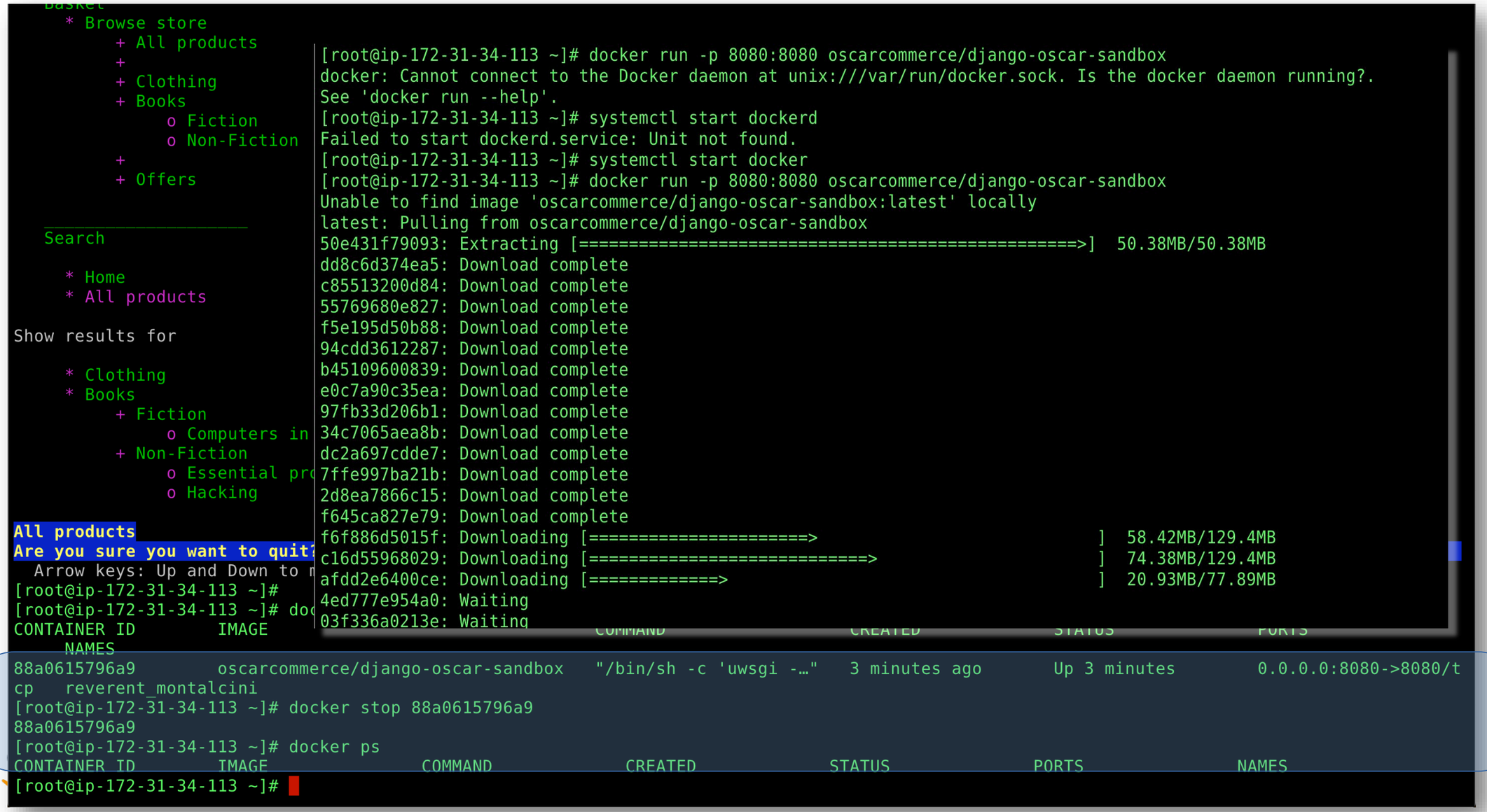
- Sample Application: Oscar
  - *oscarcommerce.com*
  - *hub.docker.com/r/oscarcommerce/django-oscar-sandbox/*
- ISV Application's architecture review
- Database re-platforming
- Running Application in AWS Fargate
- Verifying final application

Sample application: Oscar

Deploying as your own Docker Container

- Login to your AWS Account
- Provision Amazon Linux 2 EC2 instance (i.e. *t2.medium*):
  - Refer to *docs.aws.amazon.com/cli/latest/reference/ec2/*
  - $> ***aws ec2 run-instances*** *--image-id ami-0e38b48473ea5777 *
    > --count 1 --instance-type ***t2.medium*** *--key-name* ***denys.dobrelya*****
    > --security-group-ids sg-817a2cea --subnet-id subnet-81764fcc
- Deploy Oscar Docker image to new EC2 host:
  - *#>* ***docker run*** *-p 8080:8080 oscarcommerce/django-oscar-sandbox*
- Check Oscar application availability on EC2 host:
  - *#>* ***lynx*** *localhost:8080*

Sample application: Oscar



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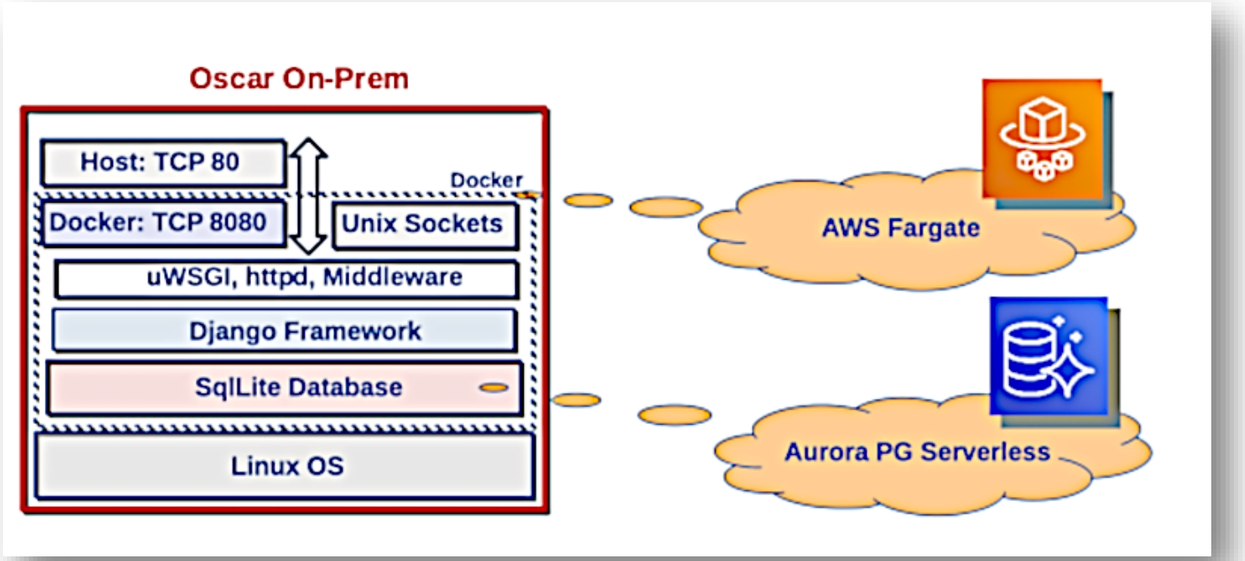
Application's architecture review

Considering previous paragraphs, the new architecture, mapped to AWS Cloud, would look like the following:



- The "remapping" of ISV Application's on-prem architecture to AWS Cloud is quite easy and it brings side benefits of *serverless elasticity* and fully *managed services*.

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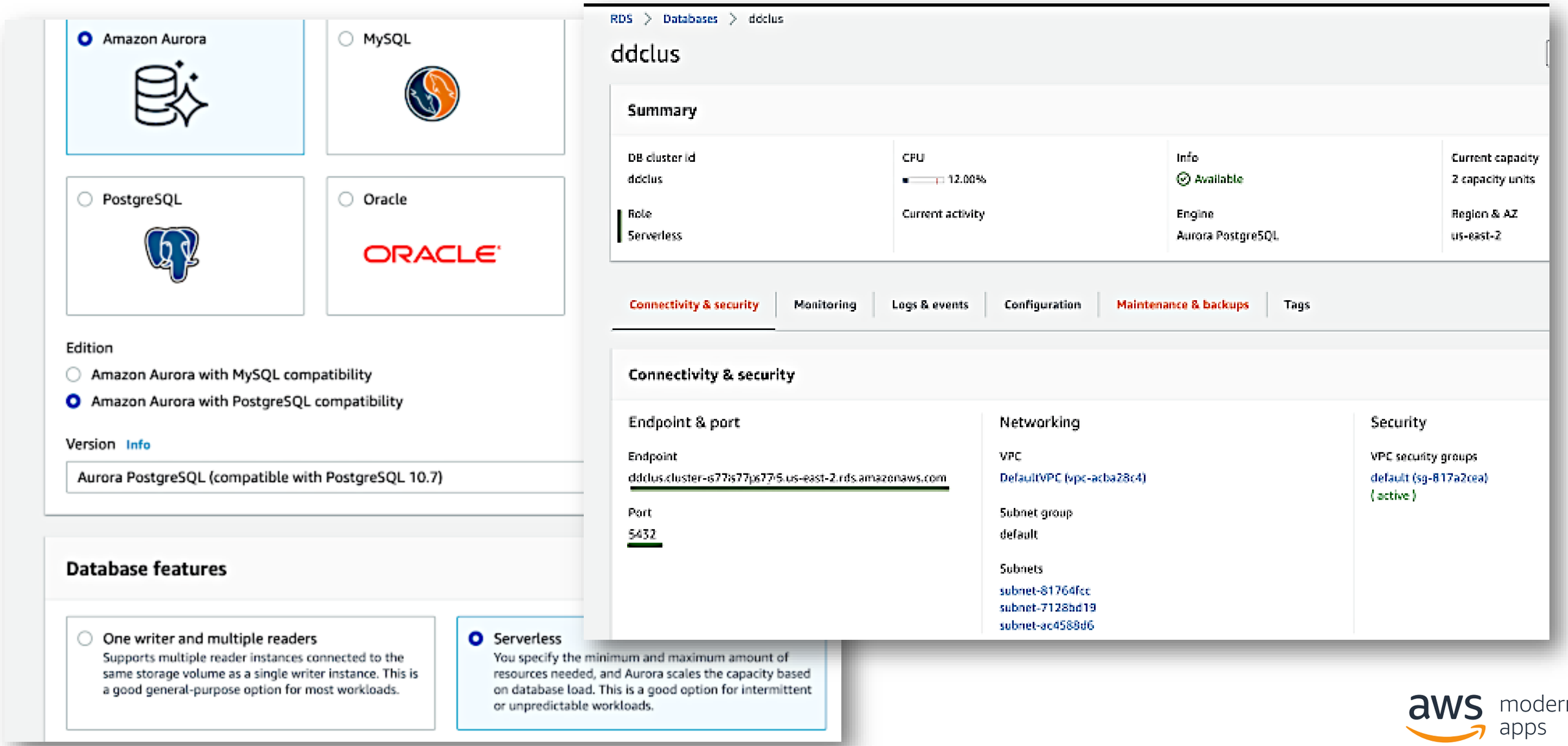
Serverless database provisioning



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Application schema migration

The usual approach is to create empty application schema with AWS Schema Conversion Tool (SCT) and then to migrate the actual data with AWS Data Migration Service (DMS).

- With *Django* these steps can be avoided - the framework does understand different database "dialects" and can literally re-create empty database schema "*from scratch*"
- This can be done only from the "inside" of *Docker container*, so let's connect to it first

Application schema migration

Check that new APG database …

```
oscar_travis=> \conninfo
You are connected to database "oscar_travis" as user "travis" on host
"ddclus.cluster-c77.us-east-2.rds.amazonaws.com" at port "5432".
oscar_travis=> \l
                                  List of databases
     Name      |  Owner   | Encoding |   Collate   |    Ctype    |   Access privileges
---------------+----------+----------+-------------+-------------+-----------------------
 oscar_travis  | travis   | UTF8     | en_US.UTF-8 | en_US.UTF-8 |
 postgres      | postgres | UTF8     | en_US.UTF-8 | en_US.UTF-8 |
 rdsadmin      | rdsadmin | UTF8     | en_US.UTF-8 | en_US.UTF-8 | rdsadmin=CTc/rdsadmin
 template0     | rdsadmin | UTF8     | en_US.UTF-8 | en_US.UTF-8 | =c/rdsadmin          +
               |          |          |             |             | rdsadmin=CTc/rdsadmin
 template1     | postgres | UTF8     | en_US.UTF-8 | en_US.UTF-8 | =c/postgres          +
               |          |          |             |             | postgres=CTc/postgres
```


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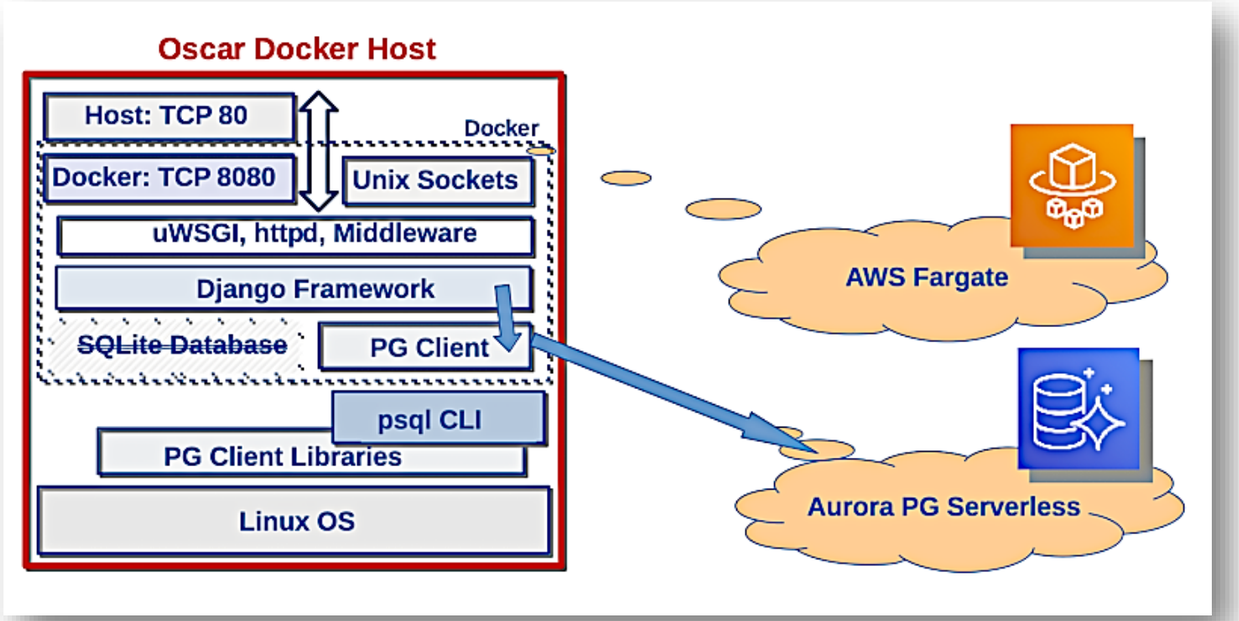
Application schema migration

We moved data from SQLite to APG and
re-pointed Oscar Django application to use Amazon Aurora



- The *schema migration* may become very *complex* quickly and application re-platforming does require thorough and deep *understanding* of *database* schemas and *application* layout

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Committing Docker container

To preserve our DB configuration changes, we need to produce final version of Oscar Docker container, which will be using our Amazon Aurora Serverless database connect string every time it starts

```
[root@docker ~]# docker ps
CONTAINER ID   IMAGE          COMMAND                  STATUS       PORTS                    NAMES
ead933288976   3bf9e4ede2a5   "/bin/sh -c 'uwsgi -…"   Up 8 hours   0.0.0.0:8080->8080/tcp   pensive_hertz
[root@docker ~]#
[root@docker ~]# docker commit pensive_hertz denys-dobrelya:django-oscar-sandbox
sha256:1cafee50dce5e1fcafada5478844529c16adeb91154a2fe0514879e34959ffb1
[root@docker ~]# docker images
REPOSITORY                          TAG                 IMAGE ID            CREATED              SIZE
denys-dobrelya                      django-oscar-sandbox 1cafee50dce5        10 seconds ago       1.68GB
oscarcommerce/django-oscar-sandbox  latest              ae22dc366d80        5 days ago           1.68GB
hello-world                         latest              fce289e99eb9        13 months ago        1.84kB
[root@docker ~]#
```

This *finalized* container is *still* on my *EC2 Docker host*

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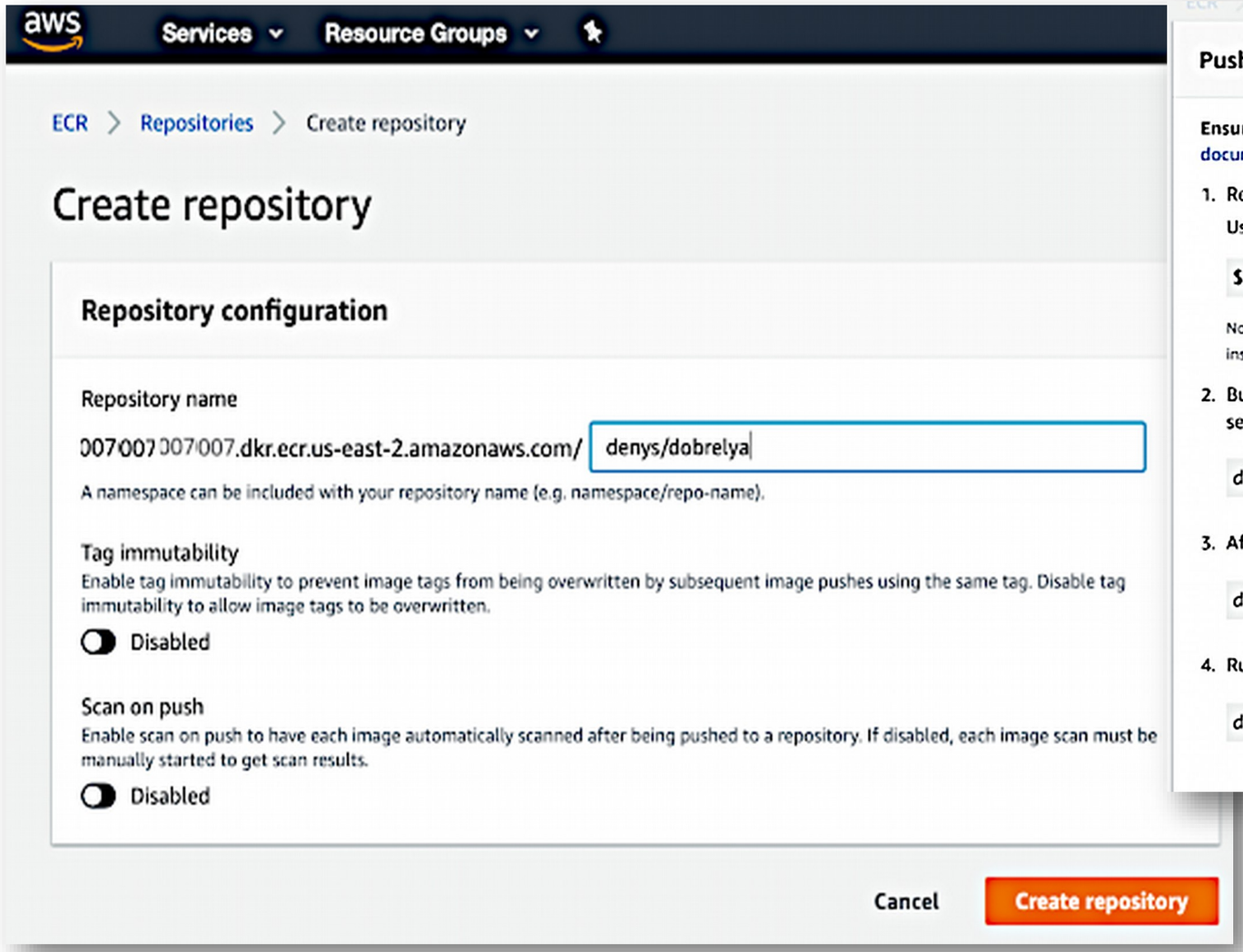
Running application in AWS Fargate

For developers, AWS Fargate provides ability to run containers without managing servers or scaling clusters

- Creating a Docker image repository
- Creating a Docker cluster
- Preparing a task
- Running a task

Create a Docker image repository



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Push a Docker image to repository

These push commands need to be used on my EC2 Docker host where Oscar Django "final" container is currently located

```
[root@docker ~]# $(aws ecr get-login --no-include-email --region us-east-2)
Login Succeeded

[root@docker ~]# docker tag denys-dobrelya:django-oscar-sandbox \
                            007.dkr.ecr.us-east-2.amazonaws.com/denys/dobrelya:latest

[root@docker ~]# docker images
REPOSITORY                                                  TAG                 IMAGE ID      CREATED
007.dkr.ecr.us-east-2.amazonaws.com/denys/dobrelya          latest              1cafee50dce5  18 hours ago
denys-dobrelya                                              django-oscar-sandbox 1cafee50dce5 18 hours ago
oscarcommerce/django-oscar-sandbox                          latest              ae22dc366d80  6 days ago
hello-world                                                 latest              fce289e99eb9  13 months ago

[root@docker ~]# docker push 007.dkr.ecr.us-east-2.amazonaws.com/denys/dobrelya:latest
The push refers to repository [007.dkr.ecr.us-east-2.amazonaws.com/denys/dobrelya]
17ecaffa93e4: Pushed
...
2256db4119b7: Pushing [==================================================>]  24.82MB
247b58ddb788: Pushing [==>                                                ]  10.13MB/174.6MB
```


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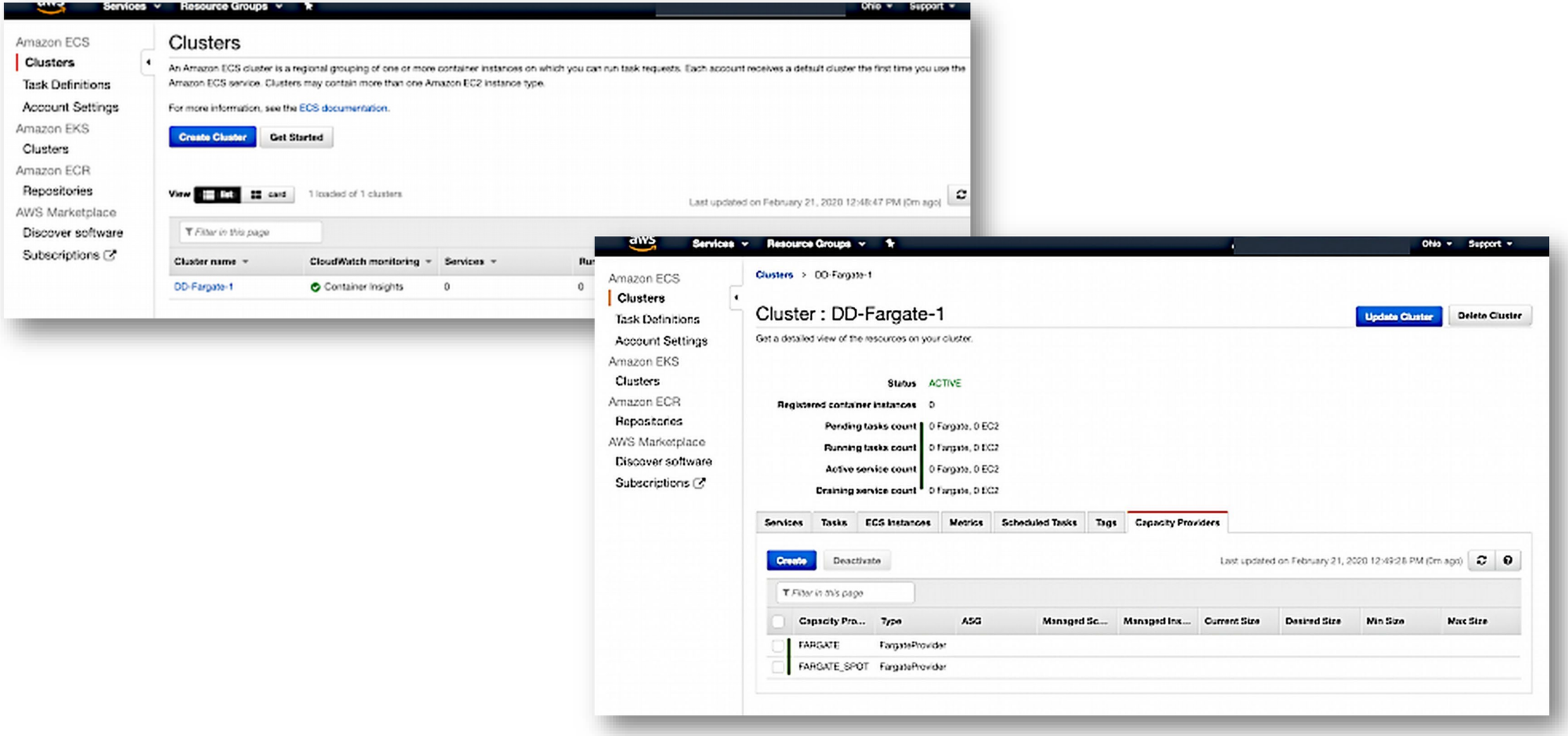
Creating a Docker cluster



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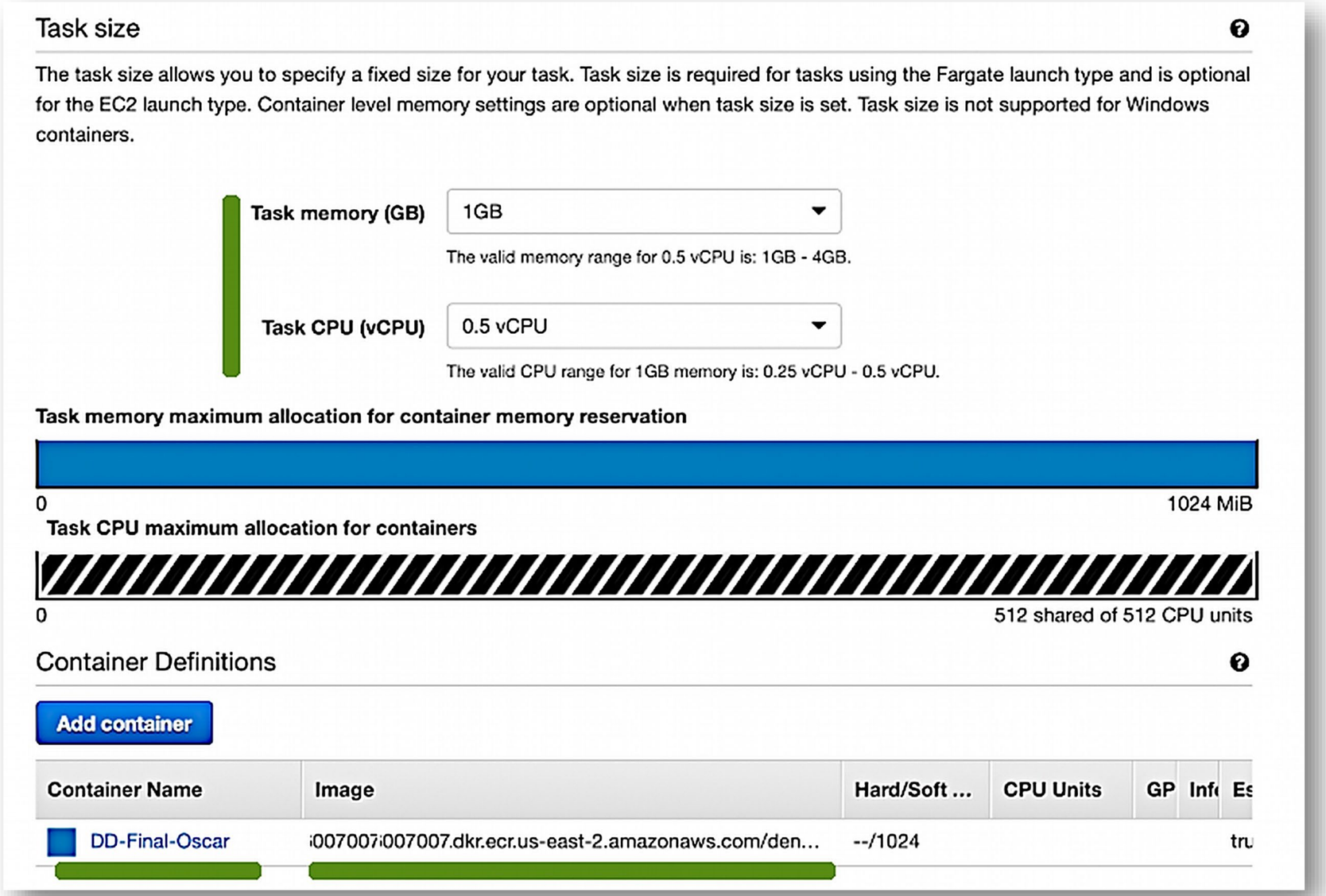
Preparing a task



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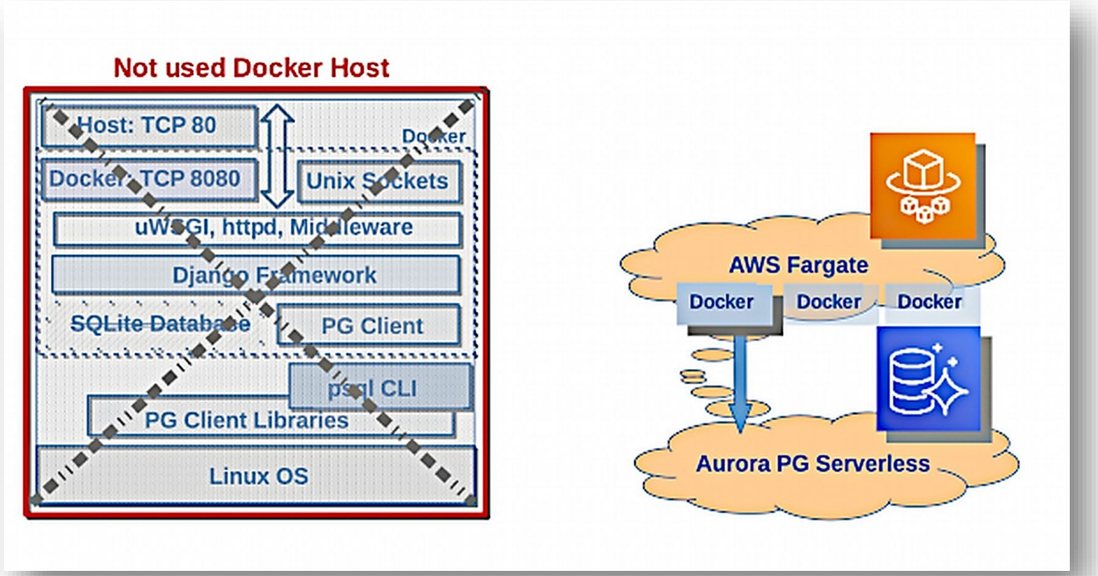
Running a task

JUST TO SUMMARIZE:

- Application database migrated to Amazon Aurora Serverless
- Application Docker Image finalised
- Private Docker repository created in AWS account
- Final Docker Image "pushed" into AWS Repository
- Fargate Docker cluster set up
- Execution task defined to use Final Docker image

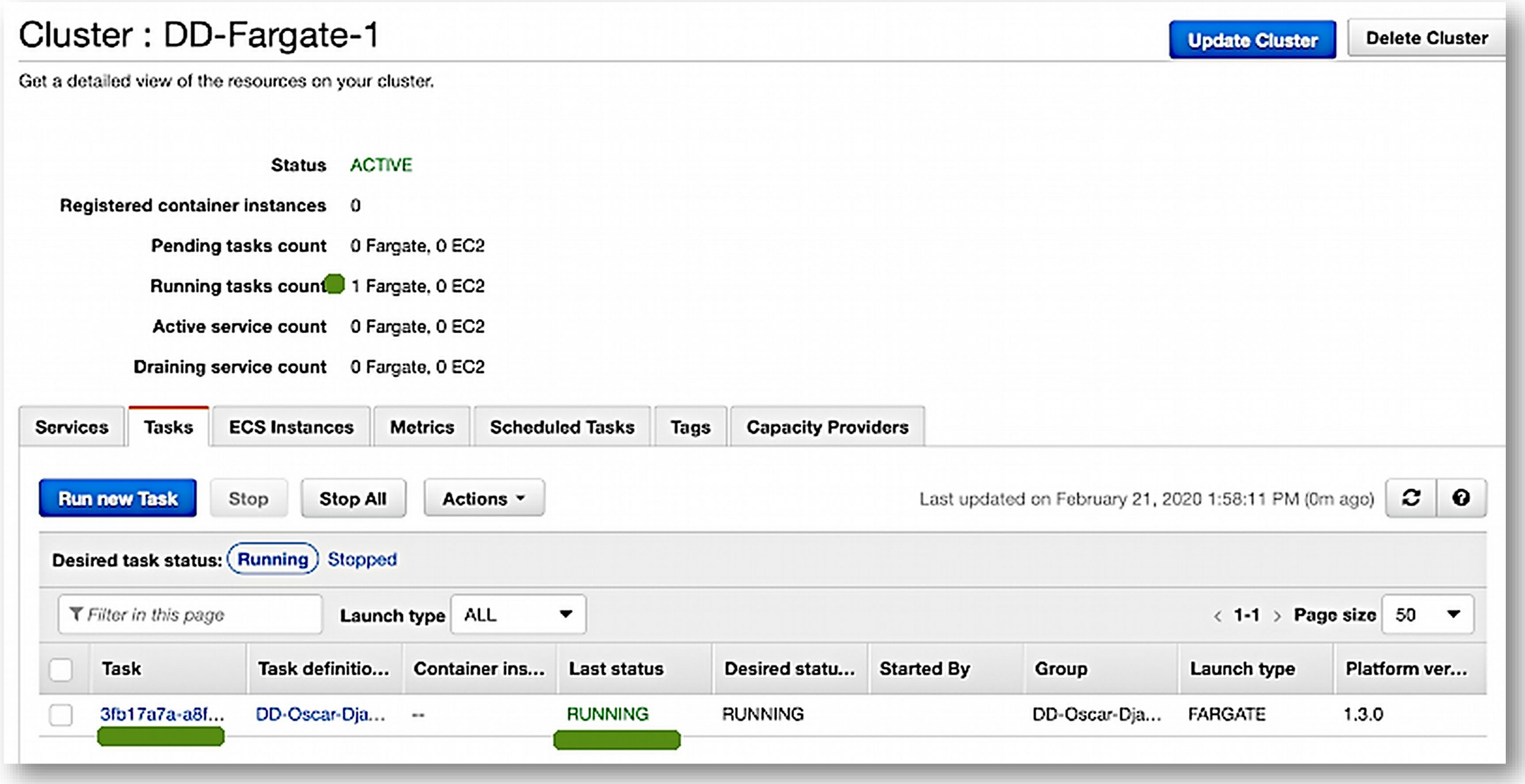
Running application in AWS Fargate

As result of all these efforts, our application's architecture had changed to the following:



There usually a fine tuning effort at the end of Docker Container deployment, where you would try to cut down the amount of RAM and CPU units allocated. But always start with reasonable values

Running a task



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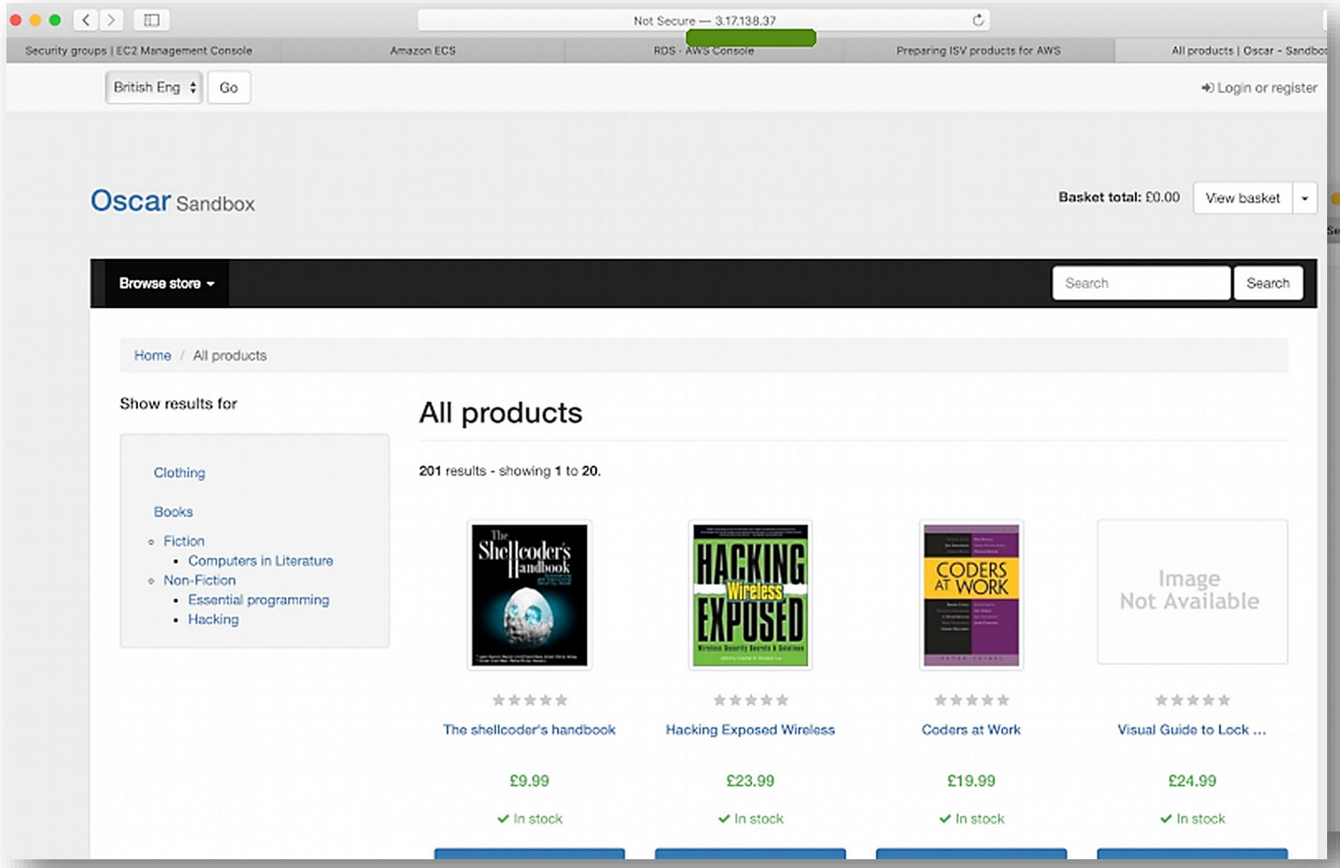
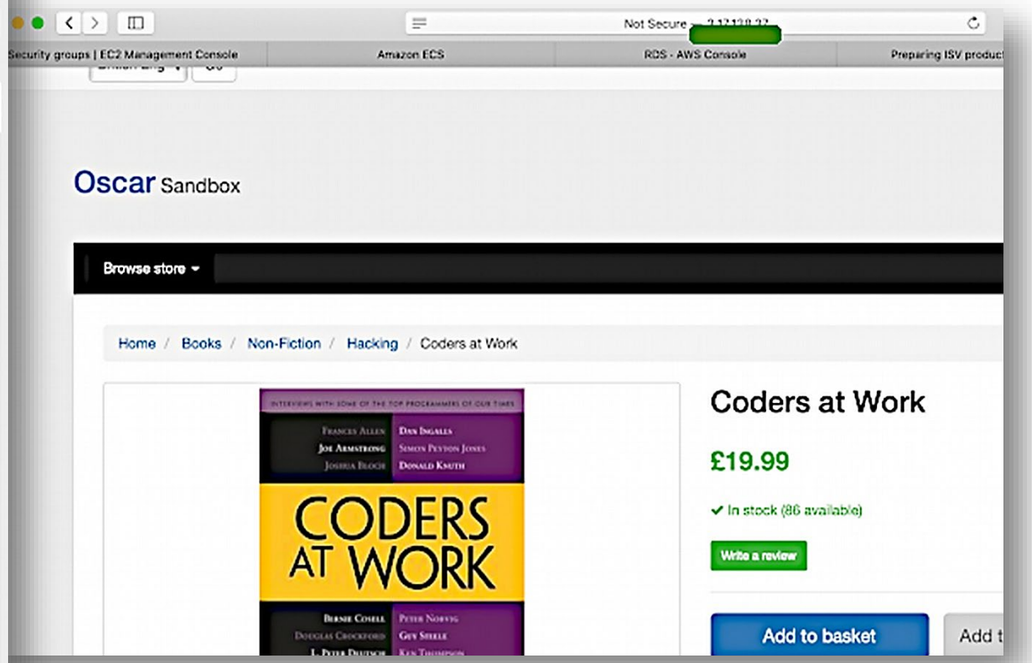
Verifying final application

Connect Browser to Task's Public IP with predefined port 8080





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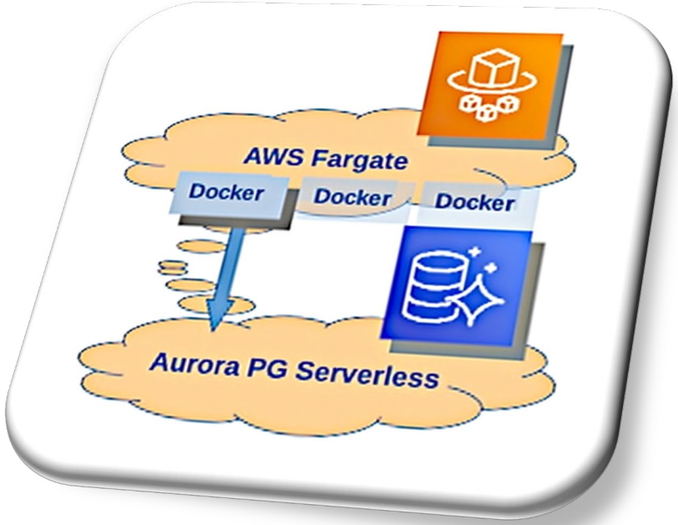
Summary

Database migration to *Amazon Aurora Serverless* and
Application *Docker* Image deployment on *AWS Fargate*

- *AWS managed services* provide *value* for ISV and Developers
- ISV can "*rewire*" their applications to run on AWS
- *Automatically* and without code changes enables:
  - Elasticity for *Database*
  - Elasticity for *Application* tier



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[1] 451 Research, *Demystifying Cloud Transformation: Where Enterprises Should Start,* September 2019.

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