



# Cloud Day Prague

O2 UNIVERSUM | 23 OCTOBER 2024

APP306

# Resilient architectures at scale: Real-life use cases from Amazon

Dragoș Mădărășan

Solutions Architect Team Lead

AWS



# Resilient architectures

## Resilience

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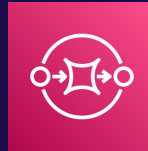
**The ability of an application to resist or recover from faults or load spikes, and remain functional.**

# Amazon got big

AMAZON PRIME DAY 2023 STATISTICS

Prime members globally  
purchased over  
**375M items**

Global Amazon Prime  
Day sales  
**\$12.7B**



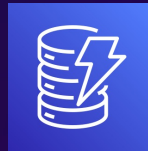
Amazon SQS

**86M peak requests per second**



Amazon Aurora

**318 billion transactions  
2,140 terabytes stored**



Amazon DynamoDB

**126M peak requests per second**



Amazon EBS

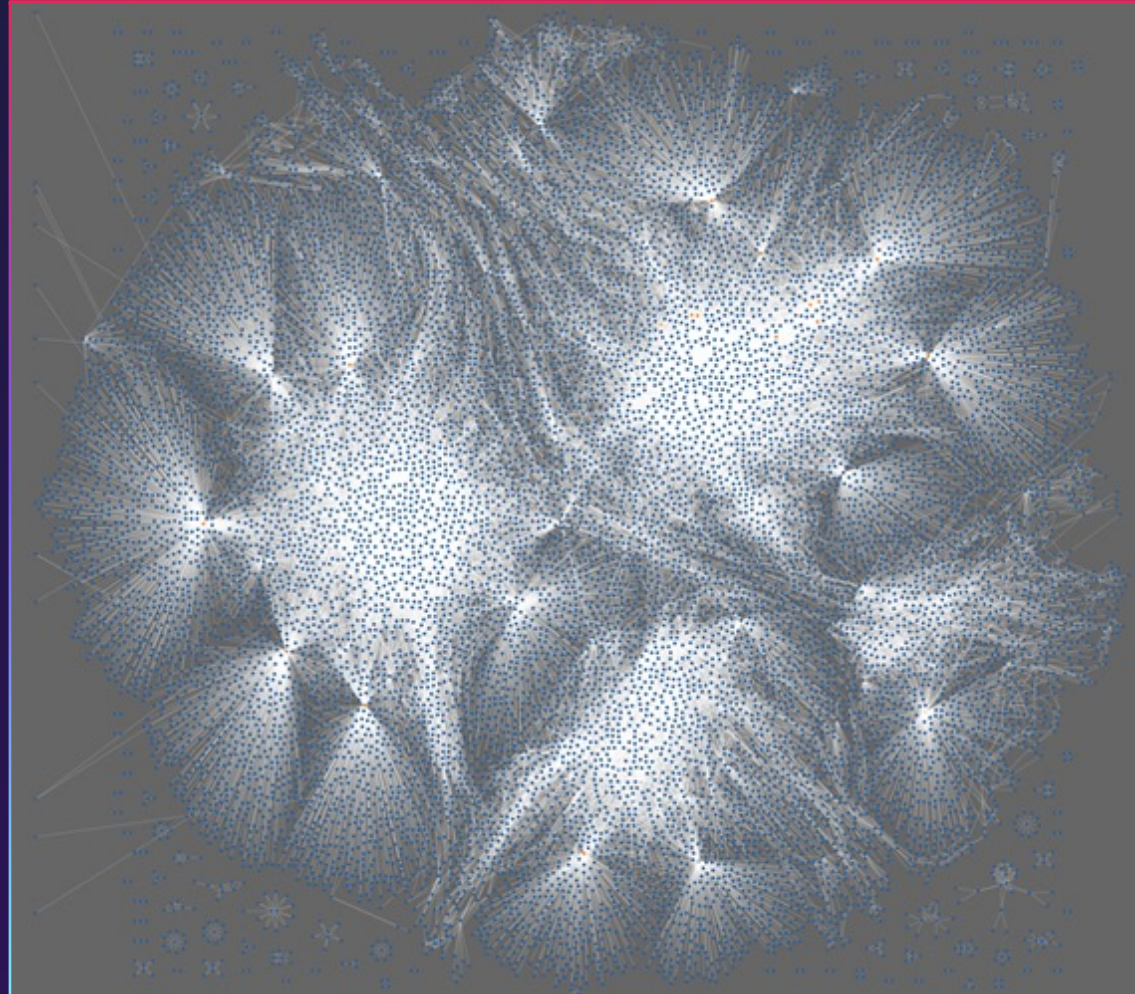
**15.4T requests per day**



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<https://bit.ly/prime-day-2023-stats>  
<https://bit.ly/prime-day-2023-record>  
<https://bit.ly/prime-day-2023-on-aws>

# Architecture 2024



# Amazon product "detail page"

Amazon product detail page for the All-new Fire HD 8 tablet. The page features a large hero image of the tablet with various app logos (Prime Video, Netflix, Disney+, Amazon Music, Spotify, Zoom, Kindle, Audible) and key specifications: 32/64 GB storage, 12-hour battery, and 2 GB RAM. The right side contains product information, including the title, price (\$89.99), availability (In Stock), and delivery date (Monday, Aug 10). Below this are options for style (Fire HD 8, Fire HD 8 Plus, Fire HD 8 Plus + Wireless Charging Dock), digital storage capacity (32 GB, 64 GB), and offer type (With Special Offers, Without Special Offers). The bottom right section includes a 'Buy Now' button, an 'Add to Cart' button, and a list of optional accessories like a case, warranty, and screen protector.

Amazon Devices | Echo & Alexa | Fire Tablets | Fire TV | Kindle | Home Security | Smart Home | Pre-Owned | Device Deals | Accessories | Device Support

## All-new fire HD 8

32/64 GB storage | 12-hour battery | 2 GB RAM

prime video | NETFLIX | Disney+ | amazon music | Spotify | zoom | kindle | audible

### All-new Fire HD 8 tablet, 8" HD display, 32 GB, designed for portable entertainment, Black

by Amazon

★★★★★ 5,055 ratings | 1000+ answered questions

Amazon's Choice for "8 inch tablet"

Price: \$89.99 & FREE Shipping. Details

In Stock.

Arrives: Monday, Aug 10 Details

Fastest delivery: Friday, Aug 7 Details

Ships from and sold by Amazon.com Services LLC.

Style: Fire HD 8

Fire HD 8 | Fire HD 8 Plus | Fire HD 8 Plus + Wireless Charging Dock

Digital Storage Capacity: 32 GB

32 GB | 64 GB

Offer Type: With Special Offers

With Special Offers | Without Special Offers

Color: Black

Special offers display on your device's lockscreen. [Learn more](#)

Share | Sign in | New customer? Start here.

Shop College Essentials

Upgrade and save with Trade-In

Qty: 1

Add to Cart

Buy Now

Secure transaction

This is a gift

Link to my Amazon account to simplify setup. Why is this important?

Select delivery location

Add Additional Items

Amazon Standing Case: Charcoal Black \$29.99

Extended Warranty: 2 year \$16.99

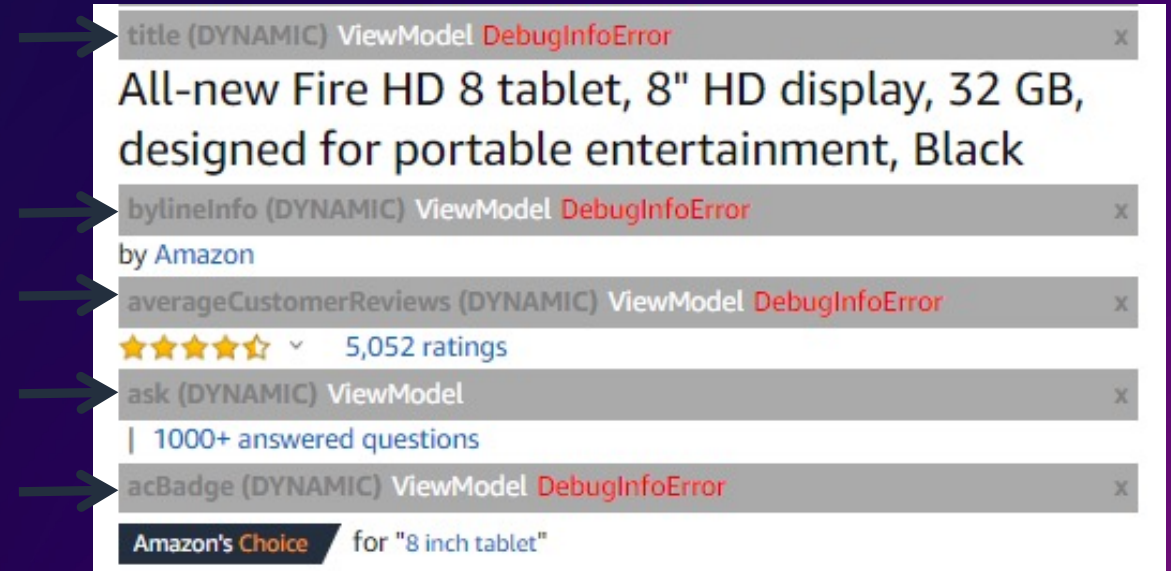
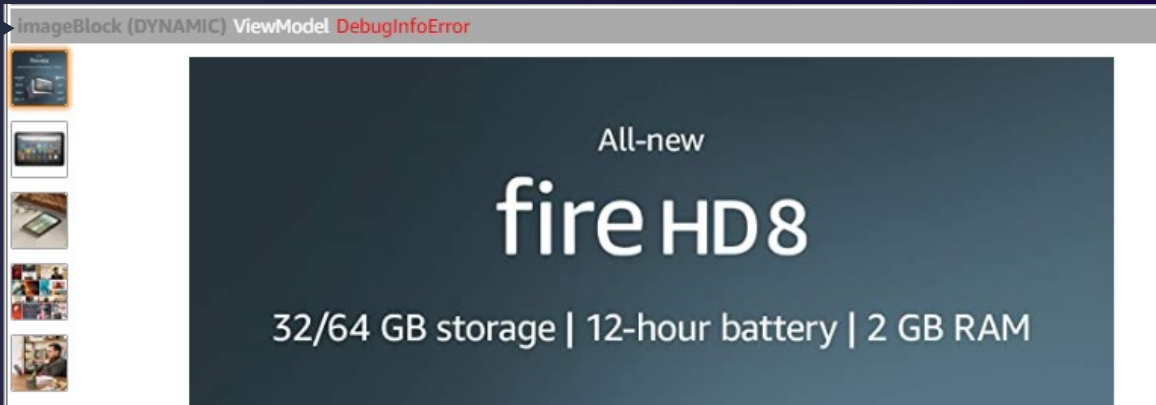
Themed cases made for Amazon: Mickey No Bad Days \$34.99

Screen Protector: Clear \$12.99

Memory Card: 32 GB \$49.99 \$8.49

Made for Amazon clear case

# Microservices can enable resilience and scale

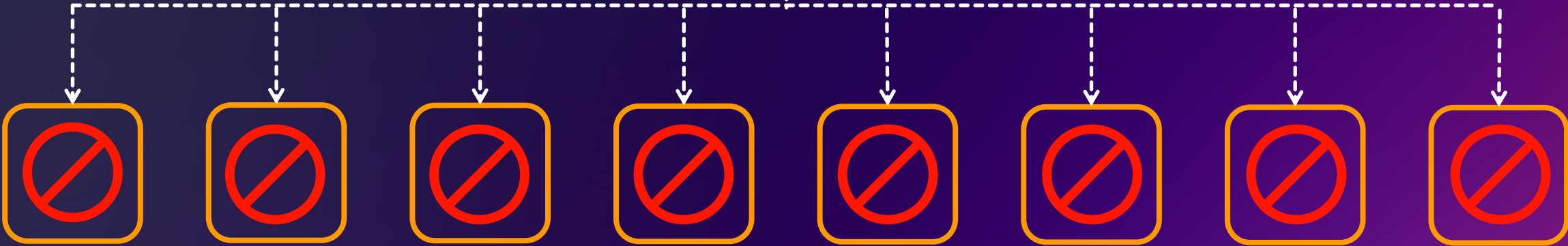


# Prime Video and Amazon Music improve availability

**Using fault isolation with cell-based architectures**

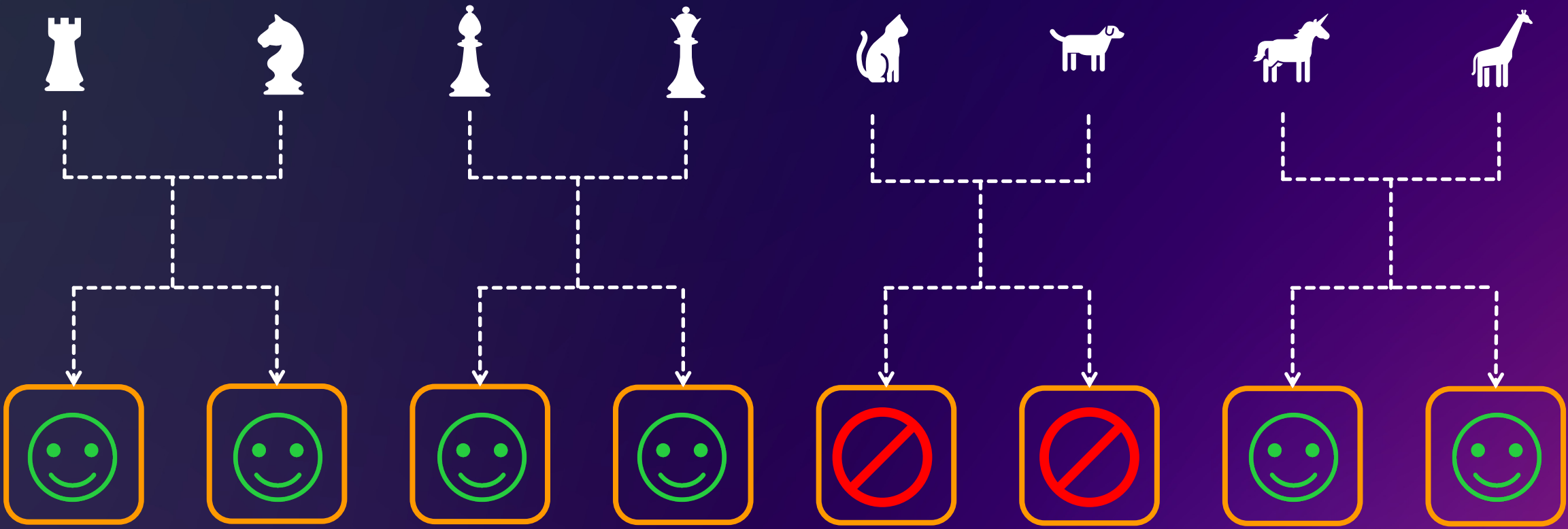


# Traditional scaling has gaps



Blast radius = |customers|

# Cell-based scaling and fault isolation



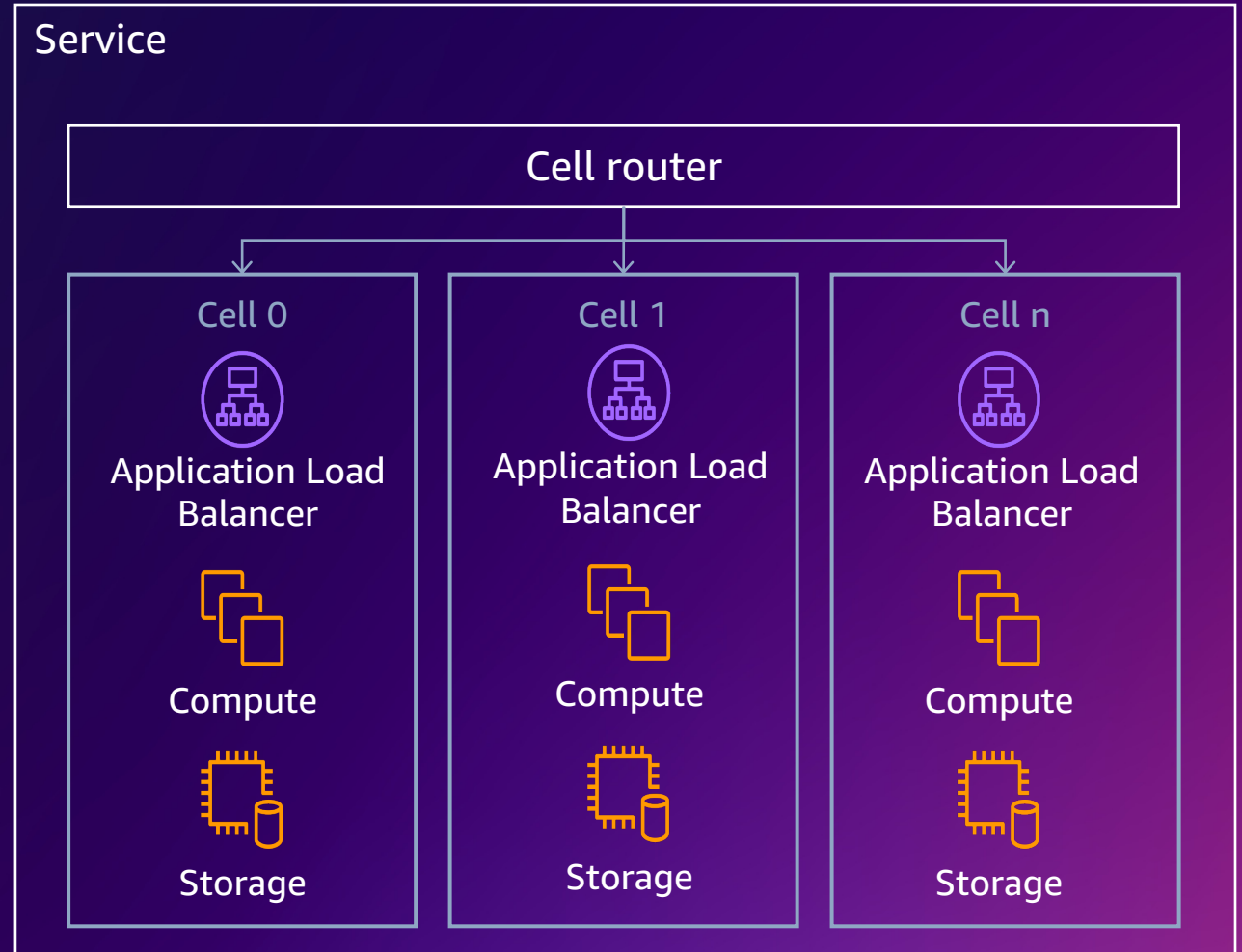
$$\text{Blast radius} = \frac{|\text{customers}|}{|\text{cells}|}$$



# Cell-based architecture

Design pattern where a service is split into multiple deployment stacks, called “cells”

- Independent instance of the service
- Independently service the full workload of customers
- Cells share nothing



# Use cases - goals

prime video



Simplifying global setups

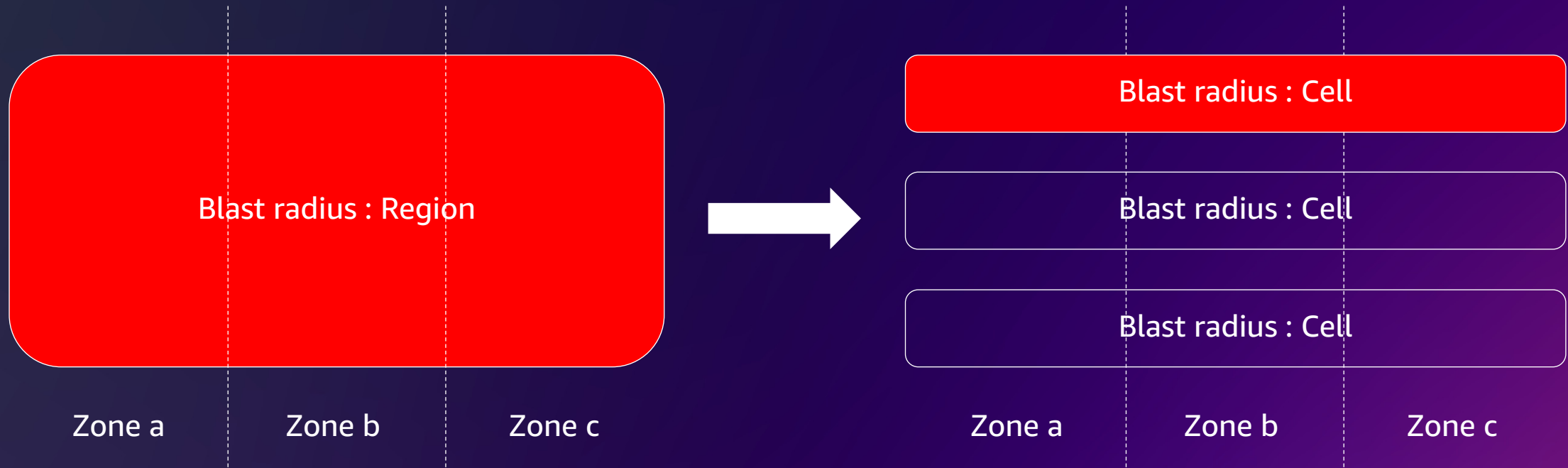
amazon music



Fault isolation

# Cells in each Region

## KEY DECISIONS



AWS Fault Isolation  
Boundaries Whitepaper:

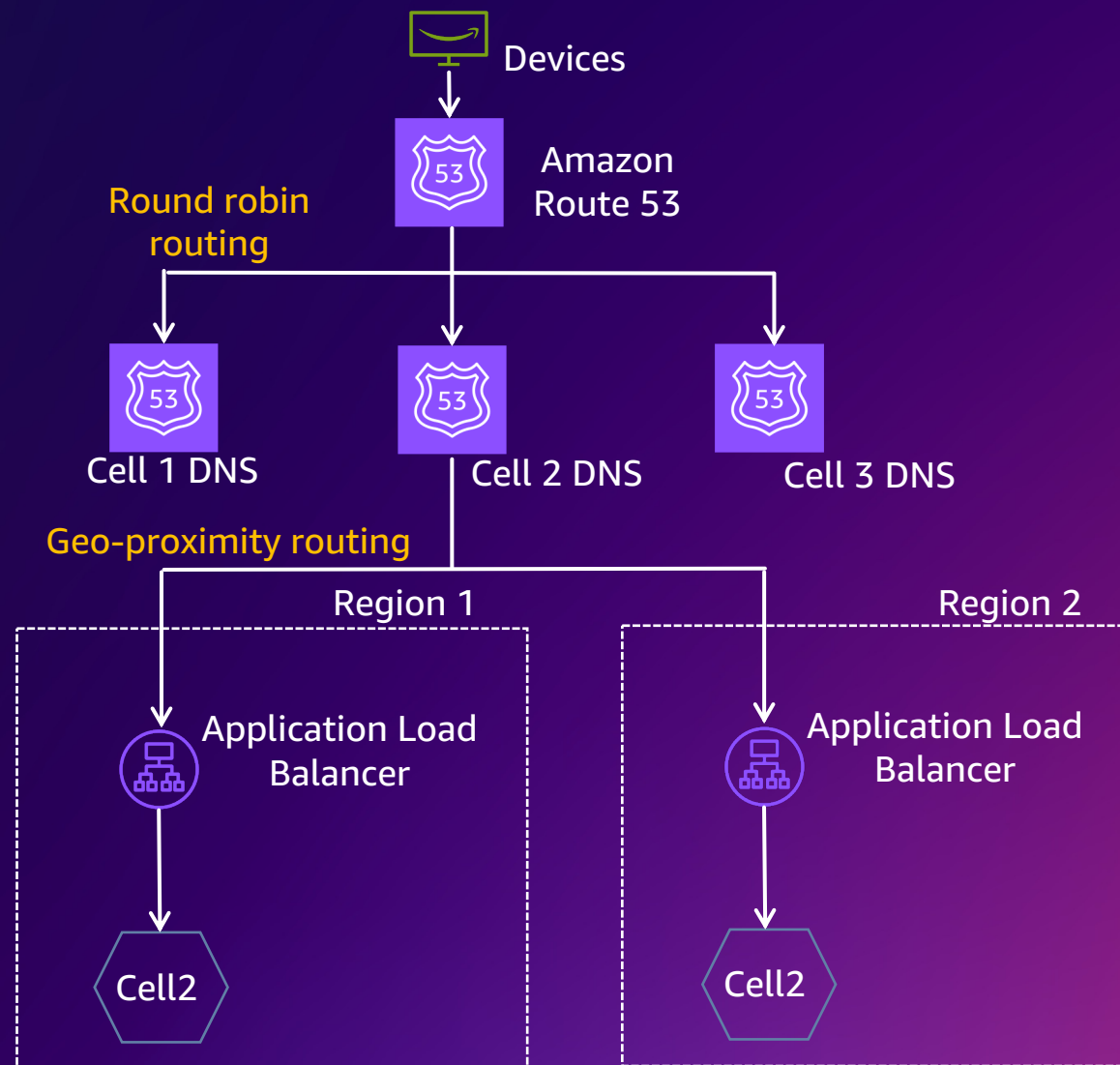


# Cellular traffic policy to isolate failures

## KEY DECISIONS

First round robin routing to a cell DNS

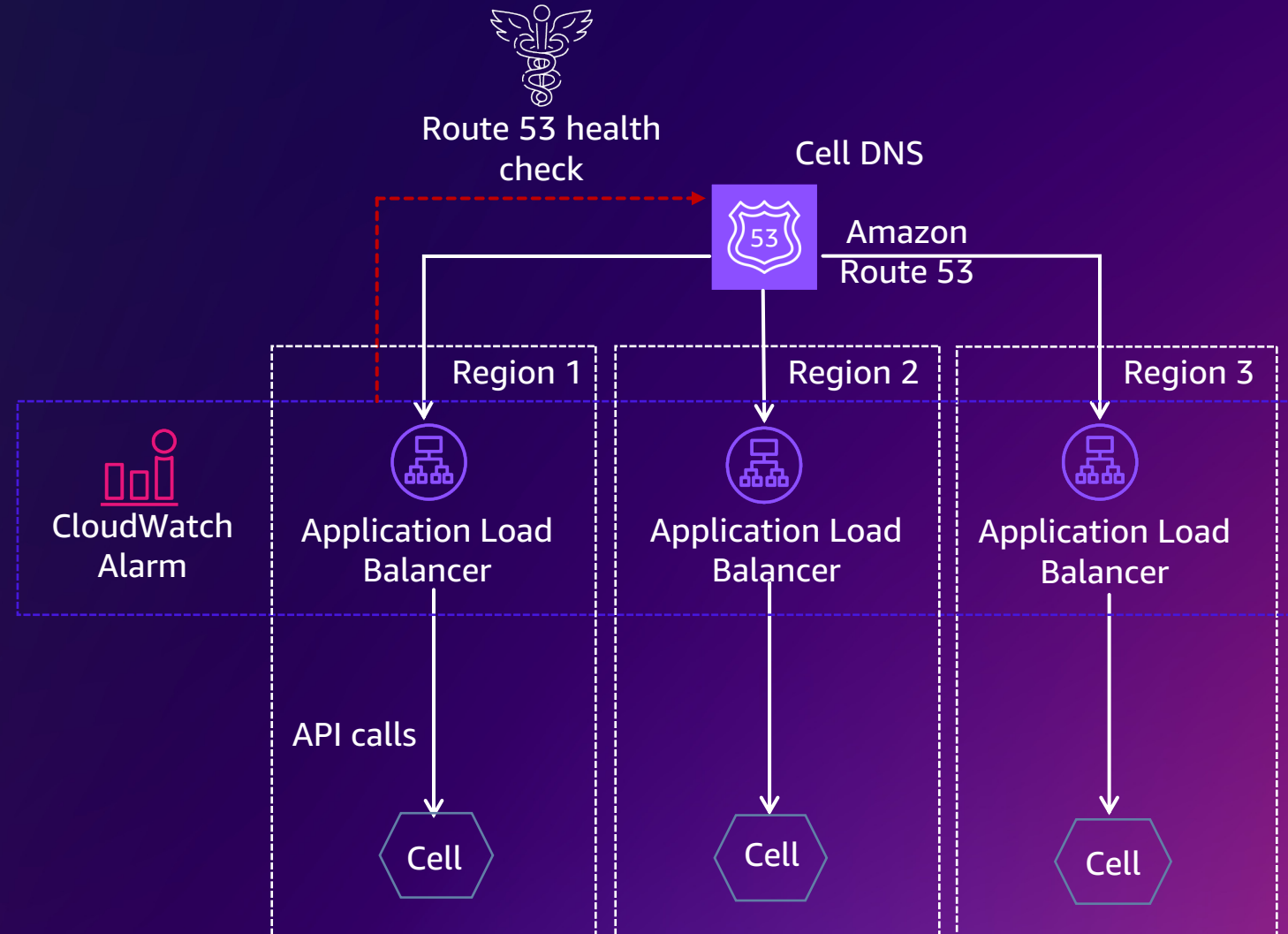
Second geo-proximity routing to the closest Region



# Calculated health check

## KEY DECISIONS

- Route 53 health check that calls bootstrap API
- CloudWatch-alarm health check based on ELB 5xx errors (>100 errors for 1 minute)



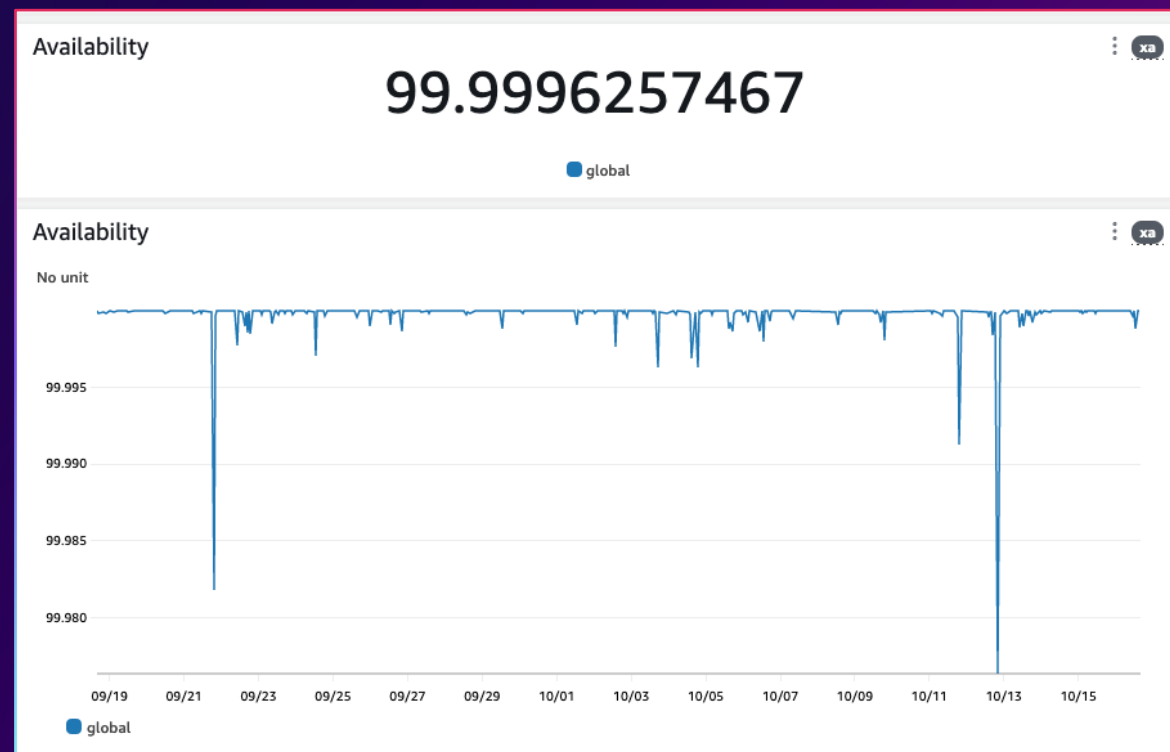
# Outcomes - Increased availability

**99.9996% availability**

Improved ability to failover that comes with cellularisation

$$\text{Availability} = \frac{(\text{Total Requests} - \text{Errors})}{\text{Total Requests}}$$

Global edge service availability (4 weeks)

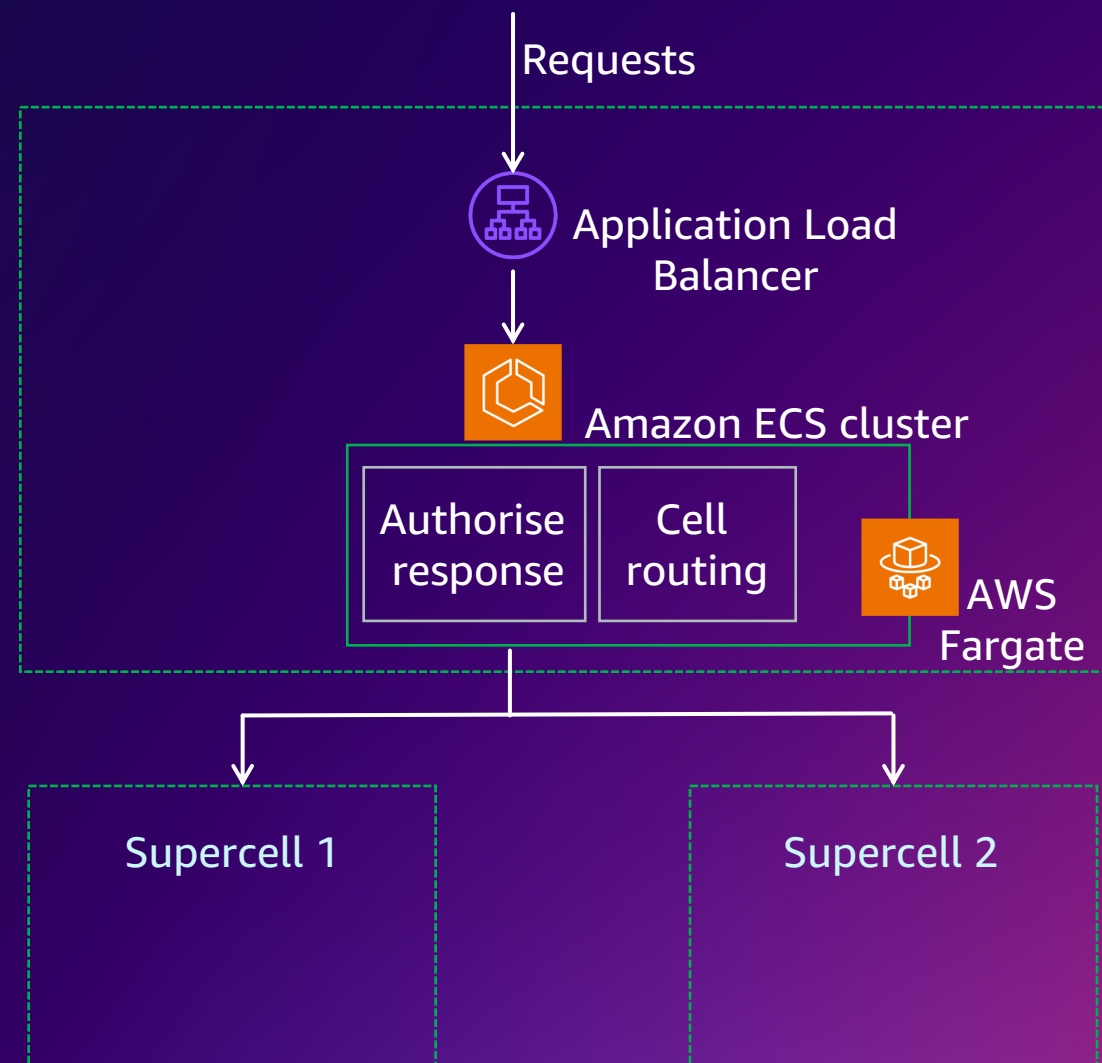


# Cell routing and authentication logic

## KEY DECISIONS

AWS Fargate service hosts both cell-routing logic and authentication logic

Static routing configuration stored as config as code



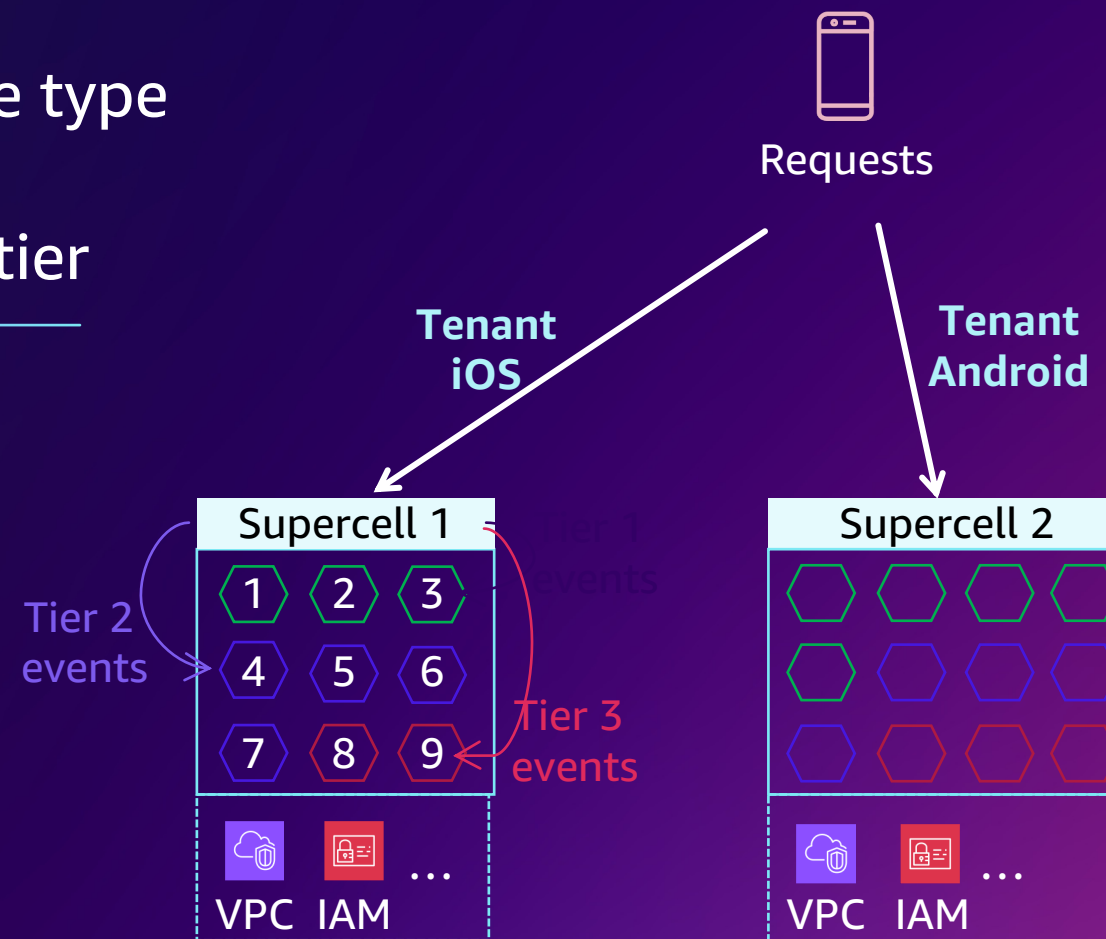
# Cell mapping strategy

## KEY DECISIONS

**First layer:** manual assignment using device type

**Second layer:** route to cells base on event tier

- Event based mapping - event mapped to different tiers
- Partition key of device type



# Cell size management model

## KEY DECISIONS

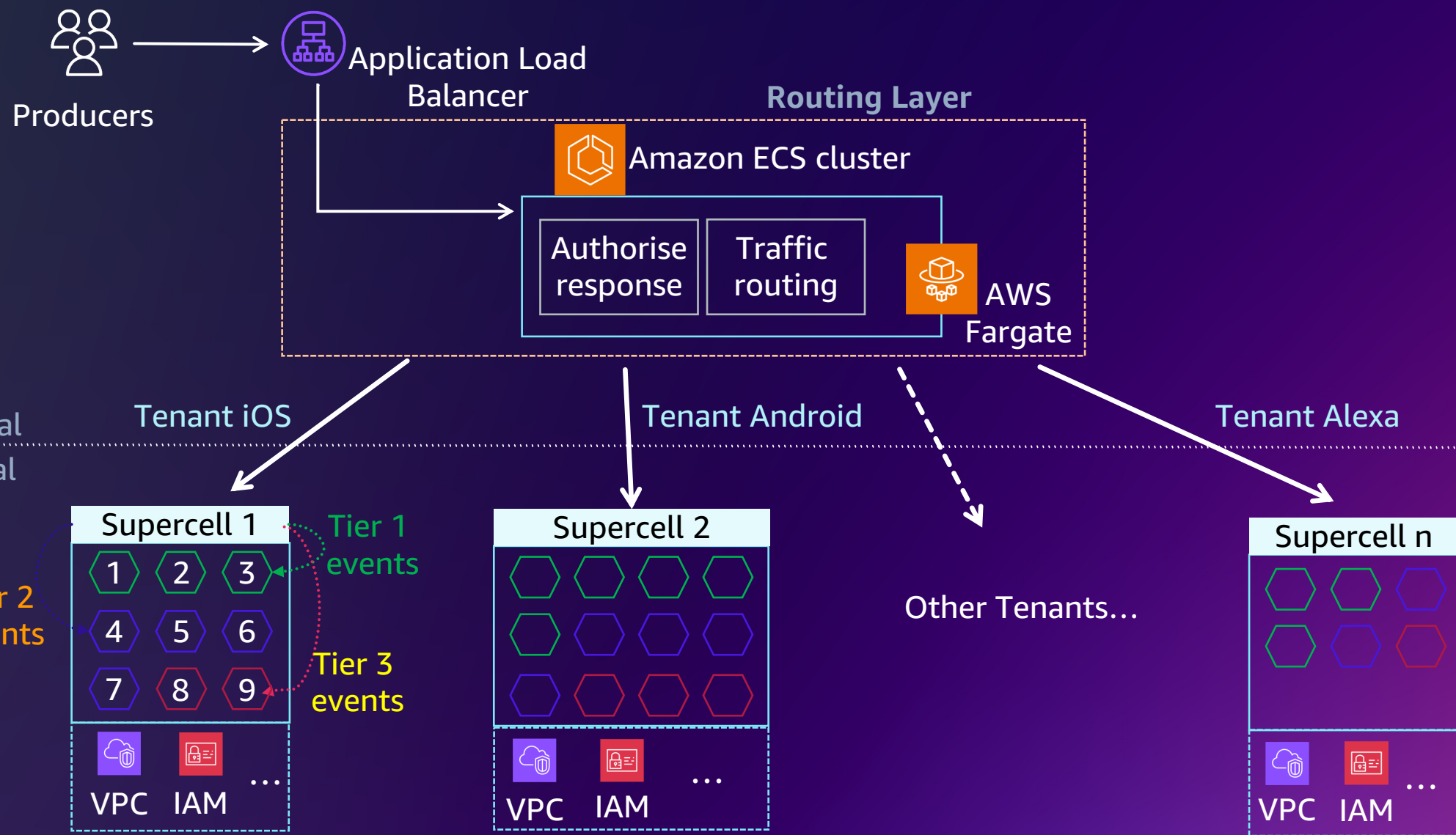
**Atomic Cells** = add more identical cells

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**Non-atomic Cells** = scale existing cells up



# Cellularisation as a requirement



# Summary

prime video

Stateless systems –

- ALB + Lambda + SQS

Routing policy –

- round robin and geo proximity

amazon music

Stateless systems –

- ALB + Lambda + Kinesis

Routing policy –

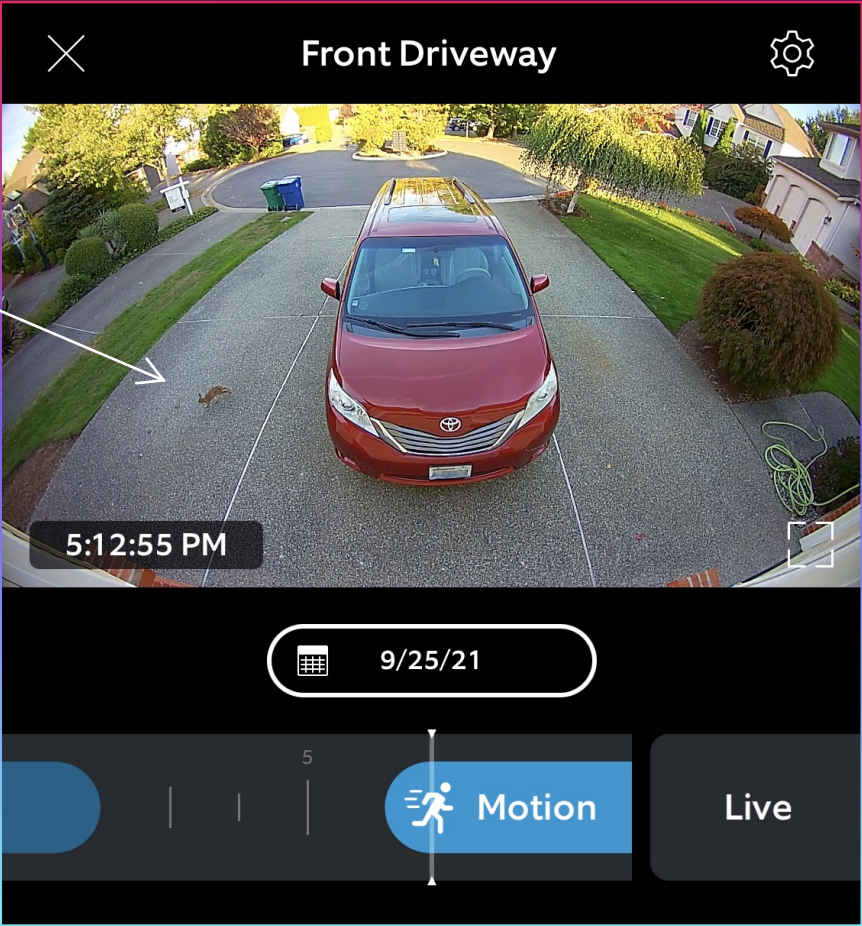
- device type and event based

**Outcome – Increased Availability and Resilience**

# Ring's massive-scale event-driven architecture

**Over 129K RPS with 99.9999% availability**

# Ring doorbells, camera, home security

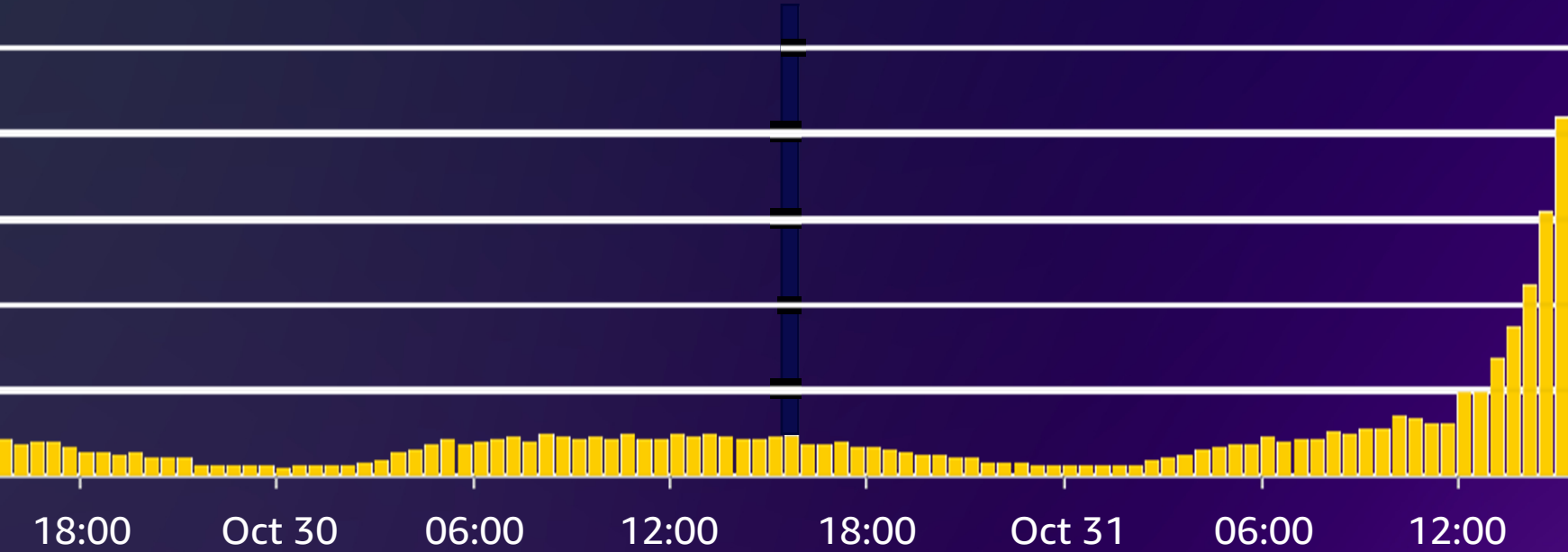


# Ring video processing

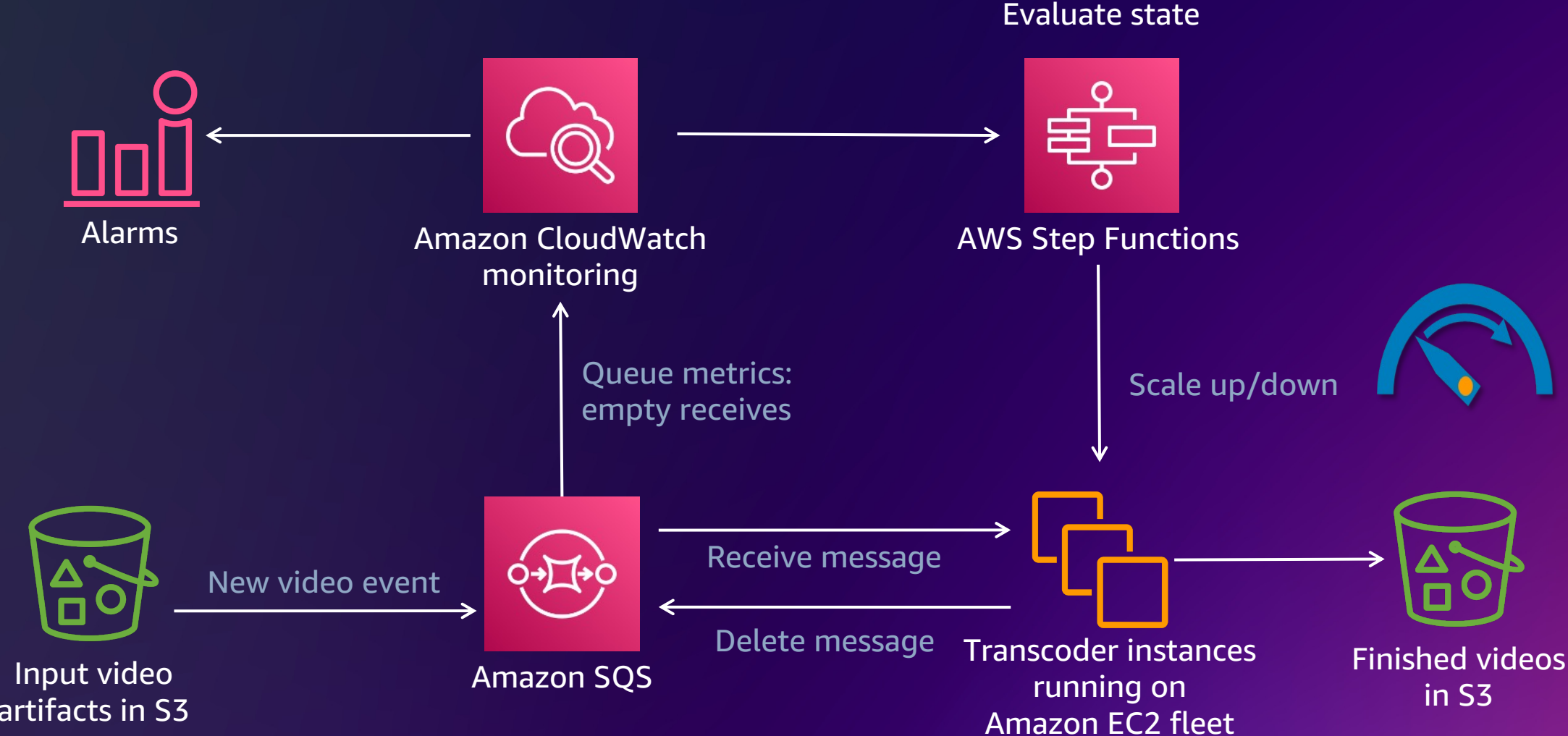


# Ring's "Prime Day" Halloween!

PREPARING FOR HIGH DEMAND



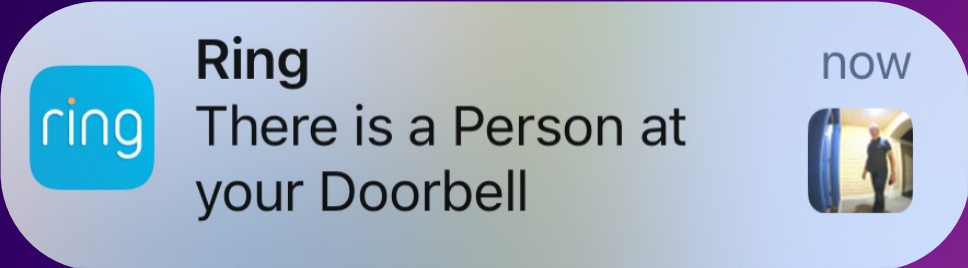
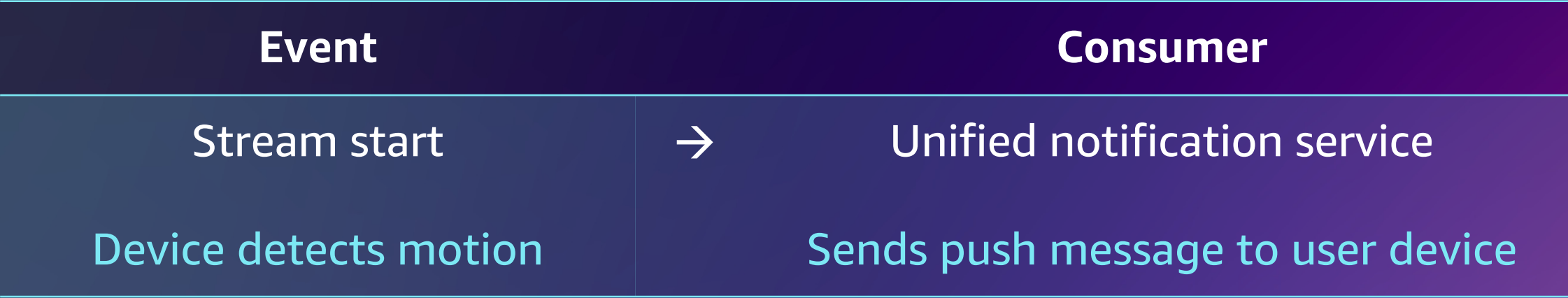
# Auto scaling for Ring



# The quest for low latency

Previous story was about reducing latency to see video

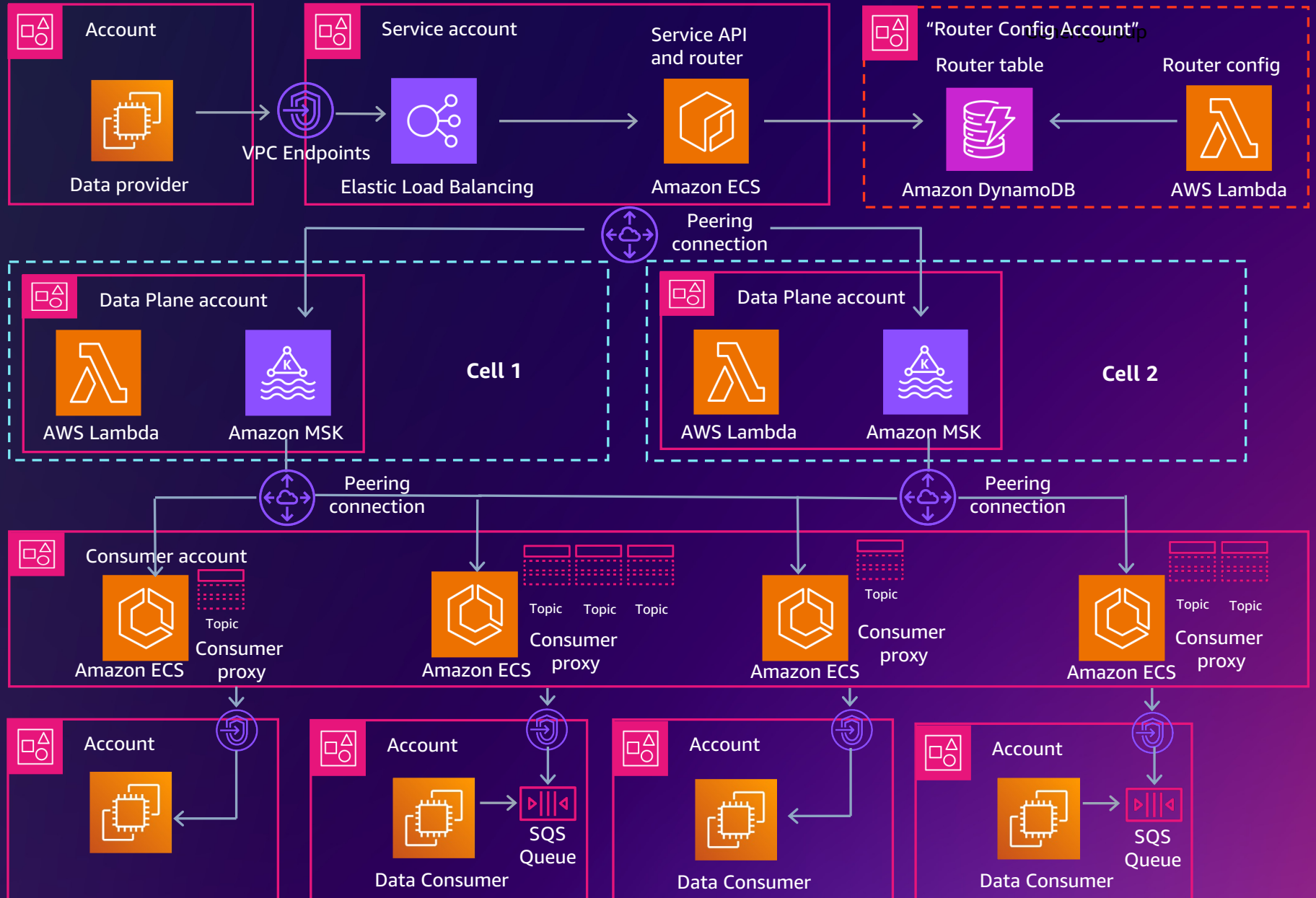
Next is a story about reducing latency between all events and actions



# SEB

- Tiers:
  - Service: API/Router
  - Data Plane
  - Consumer proxy

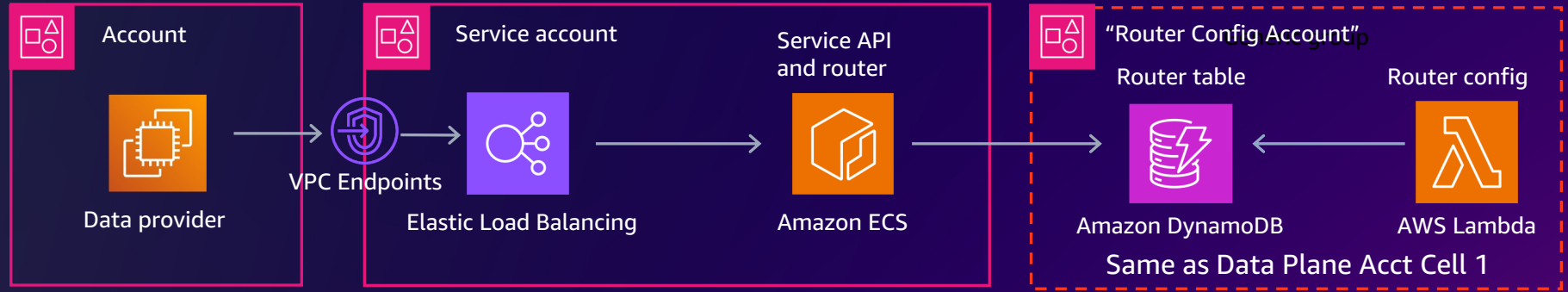
- Multi-cell
- Separate AWS Accounts



# SEB

- Tiers:

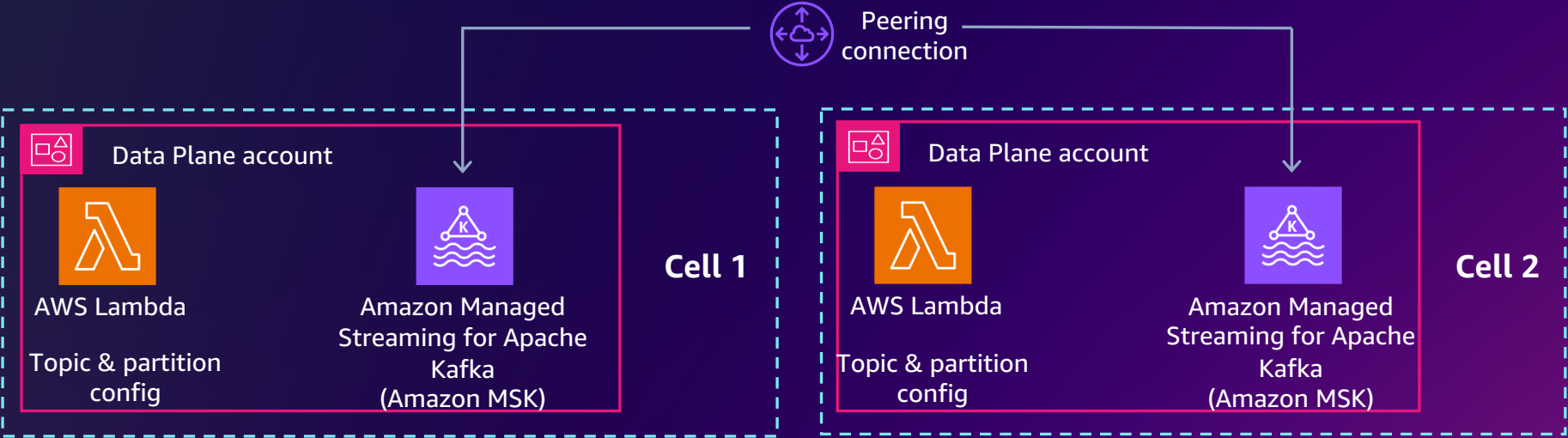
Service:  
API/Router



# Streaming Event Bus (SEB)

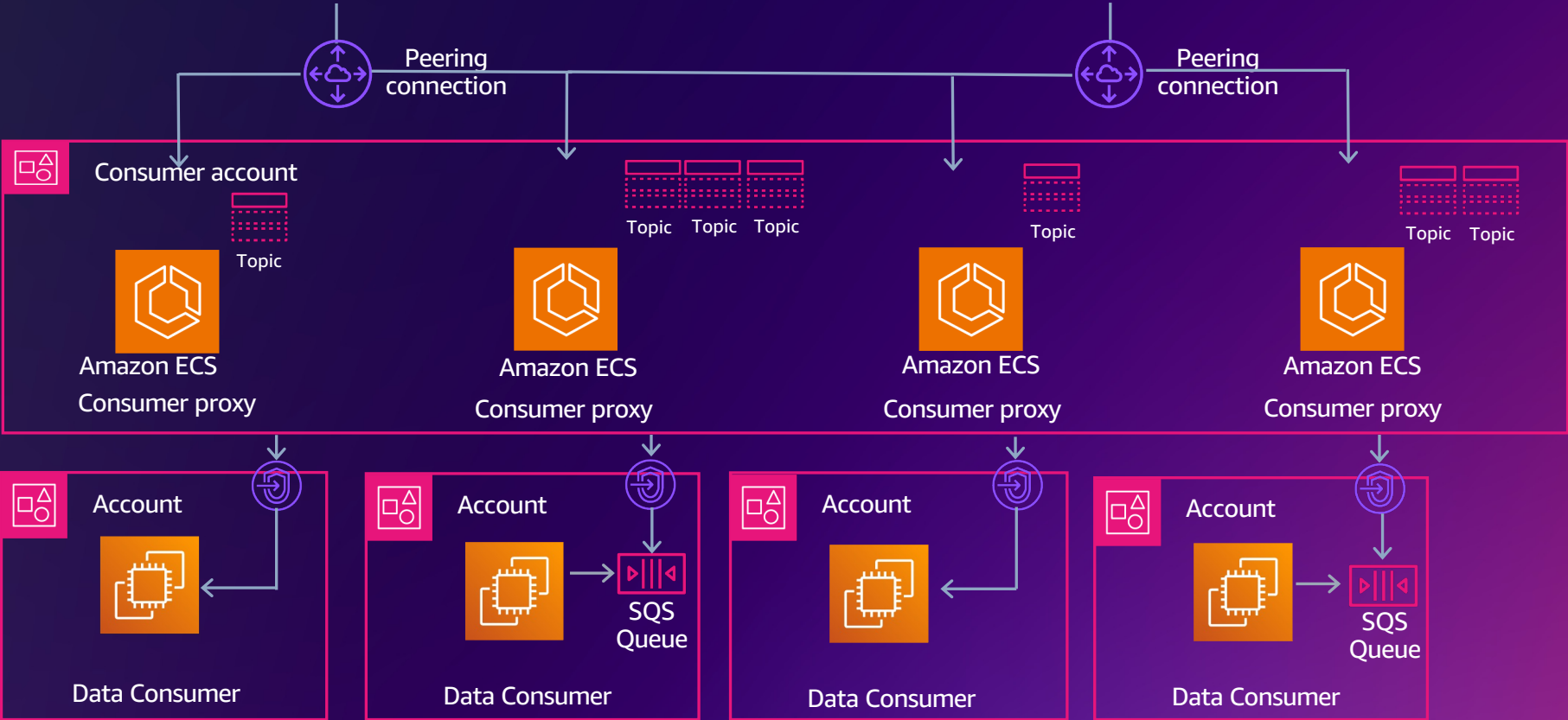
- Tiers:

Data Plane



# Streaming Event Bus (SEB)

- Tiers:
  - Consumer proxy

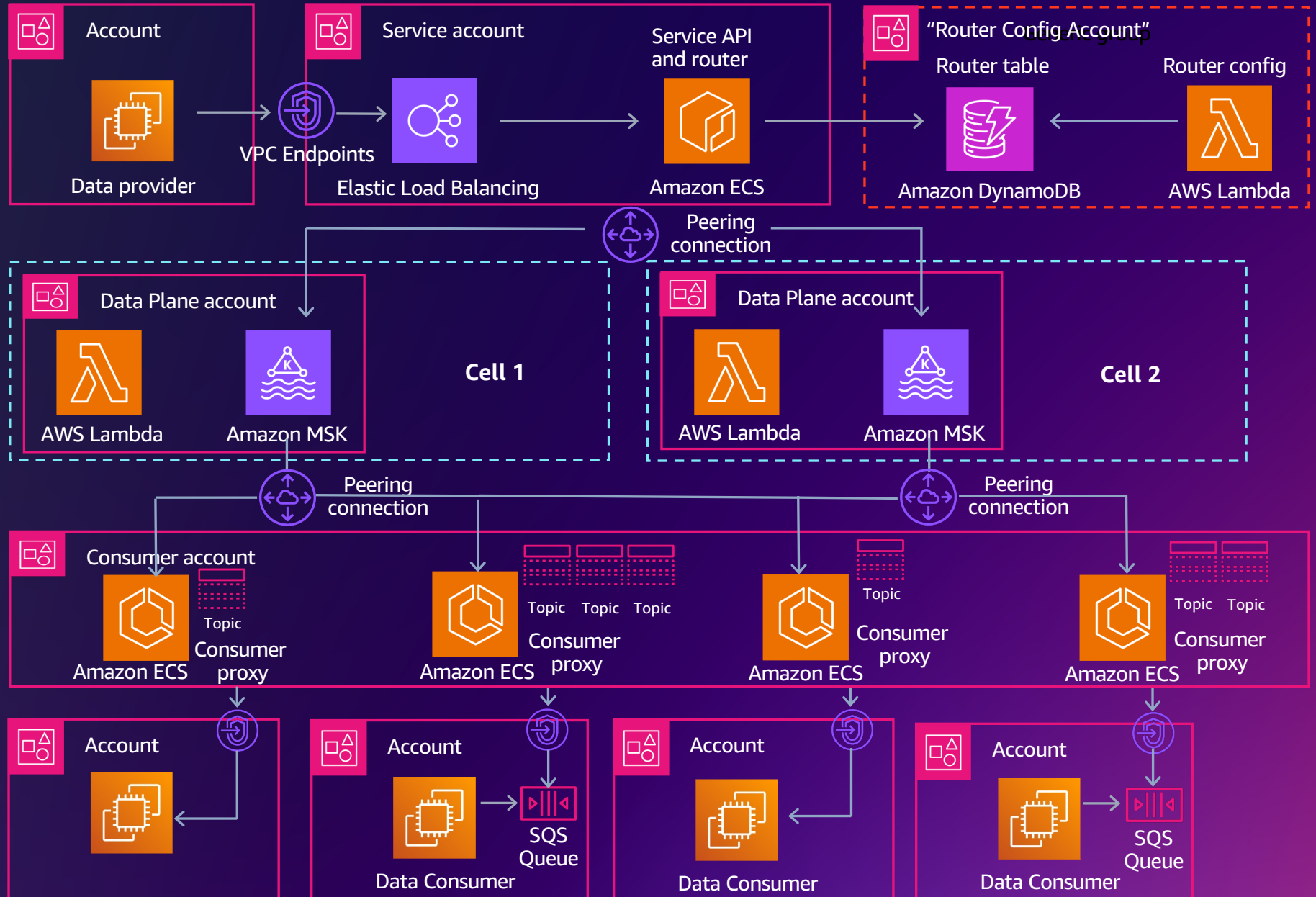


# SEB

- Tiers:
  - Service: API/Router
  - Data Plane
  - Consumer proxy

- Multi-cell

- Separate AWS Accounts



# SEB – Active/active architecture

## Cell-based architecture

**Scaling:** Topics mapped to a cell

**Resilience:** Impact: limited (to blast radius)



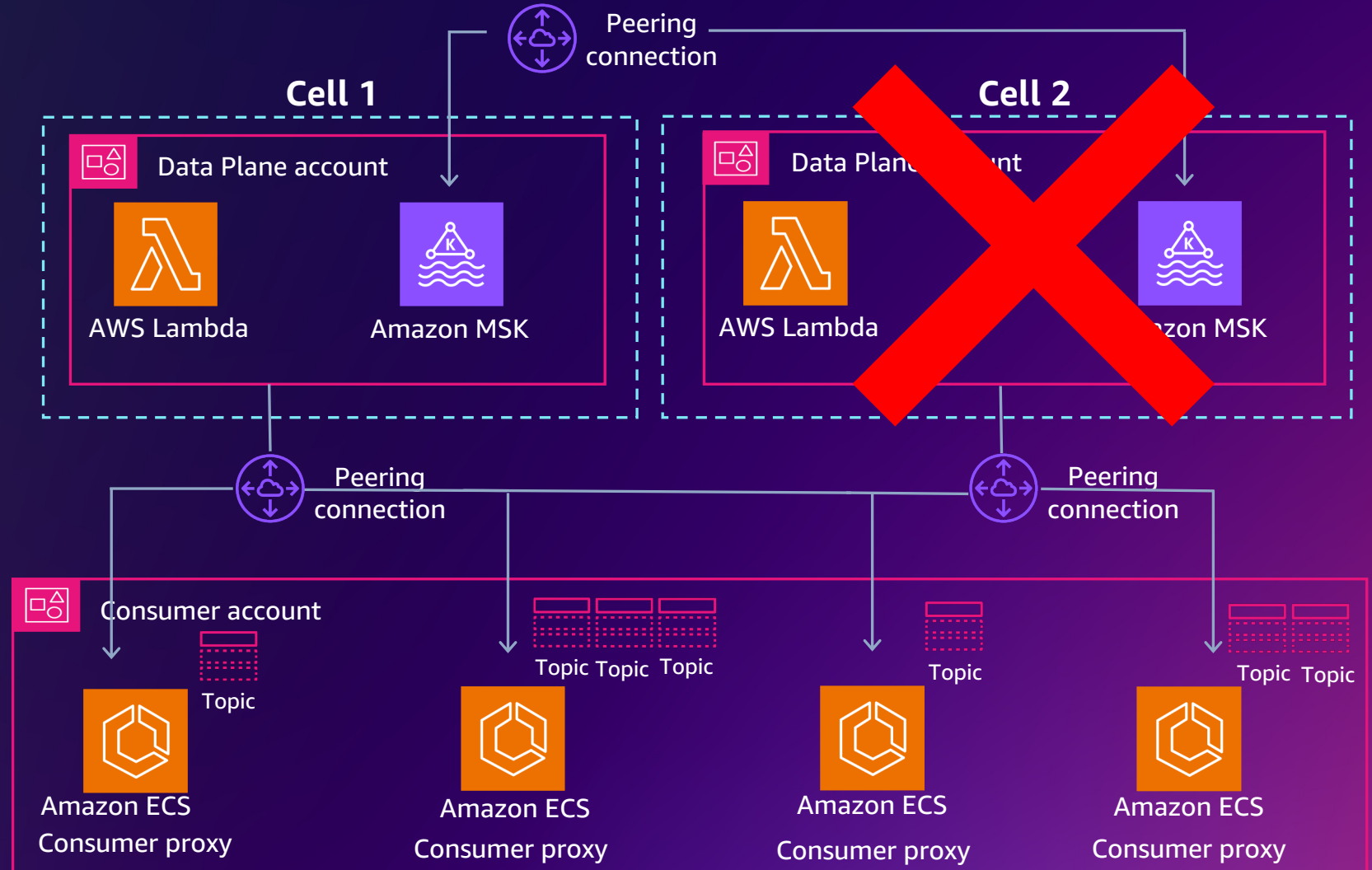
## Active/active architecture

Any cell can handle all topics

Can failover

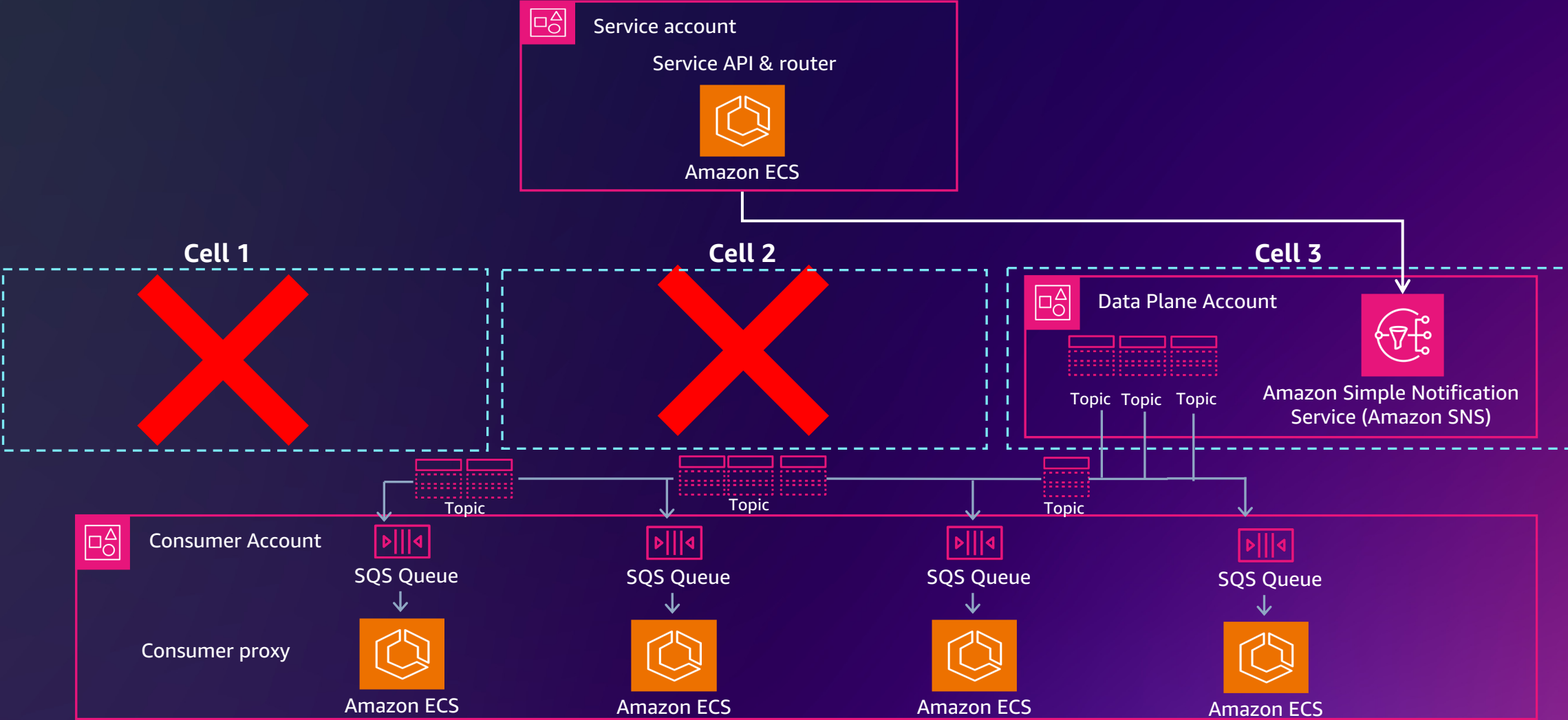
**Resilience:** Impact: none

**Scaling:** Still map topics to cell



# SEB – Add an additional layer of resilience

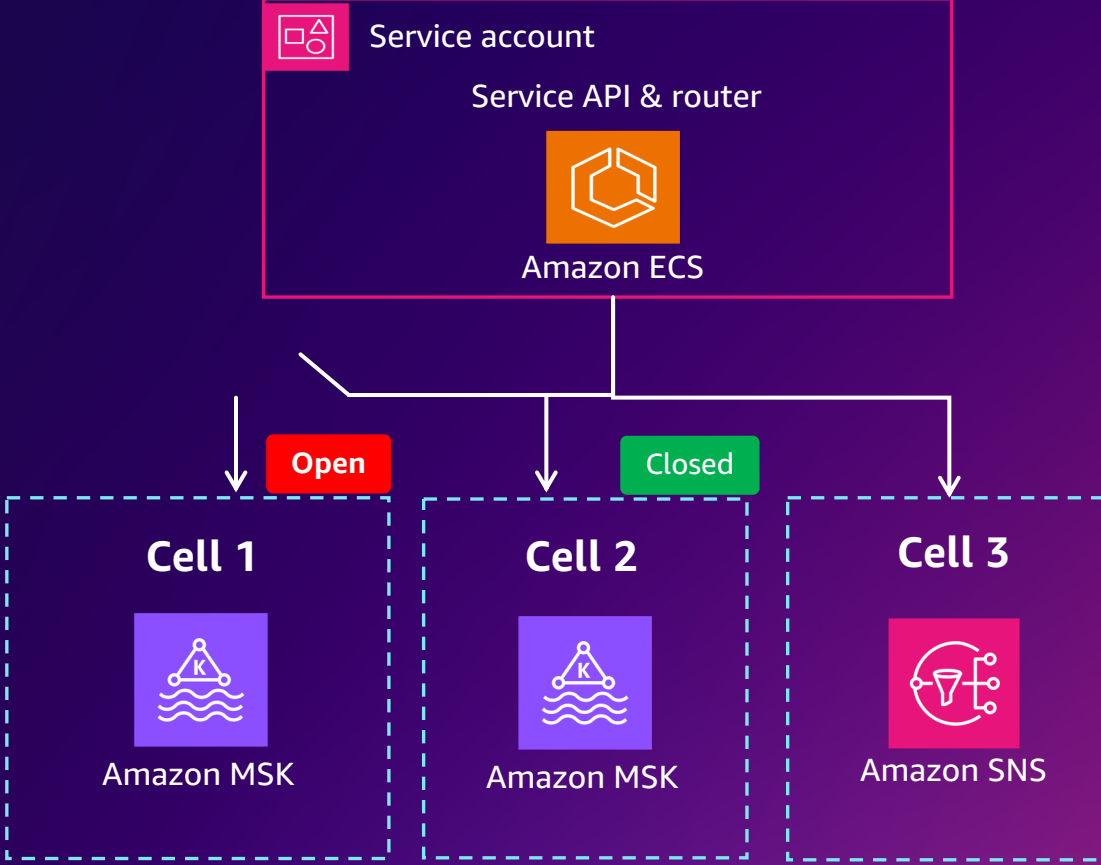
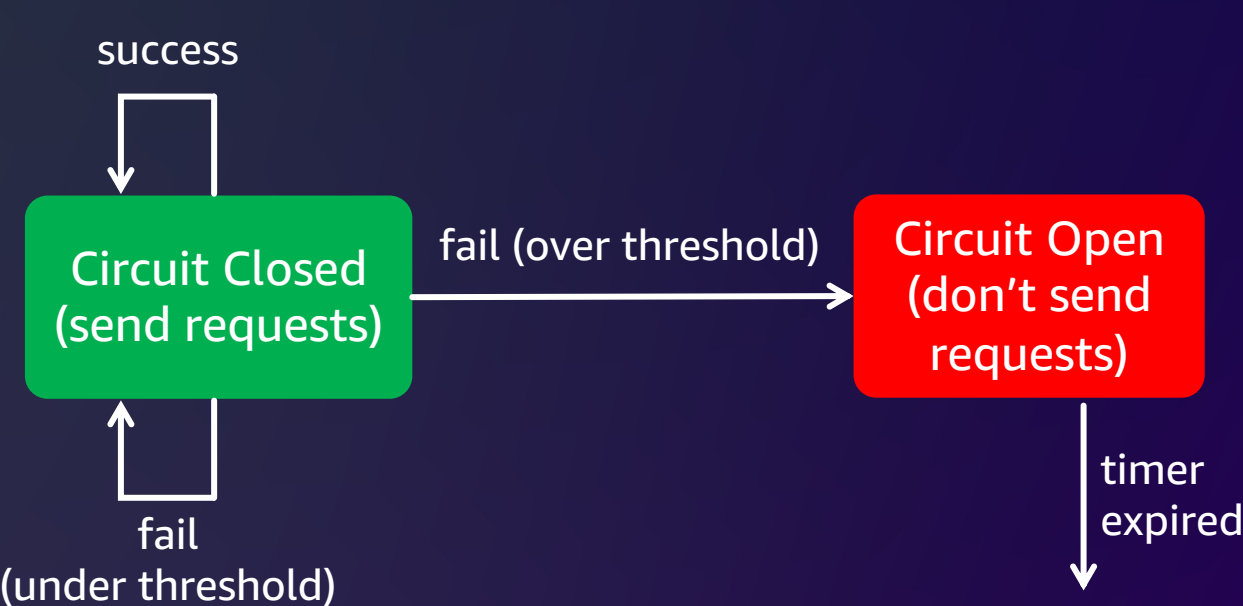
## FALLBACK CELL



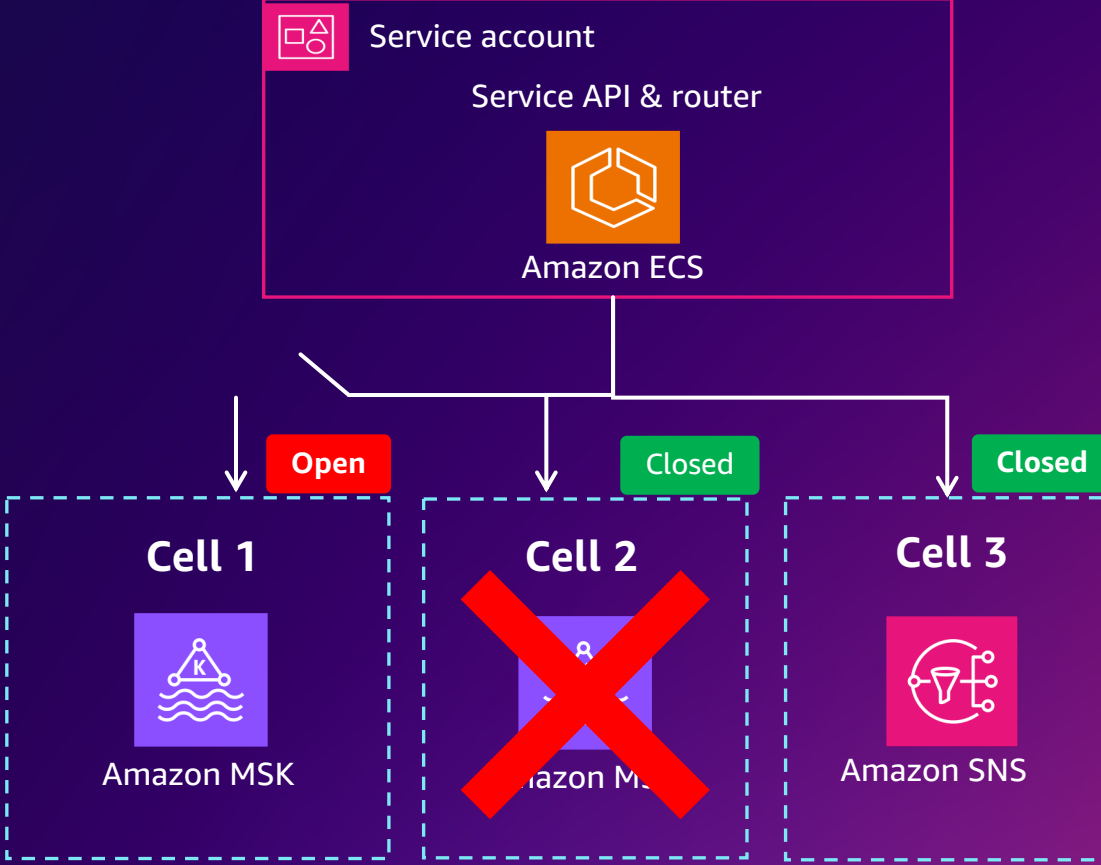
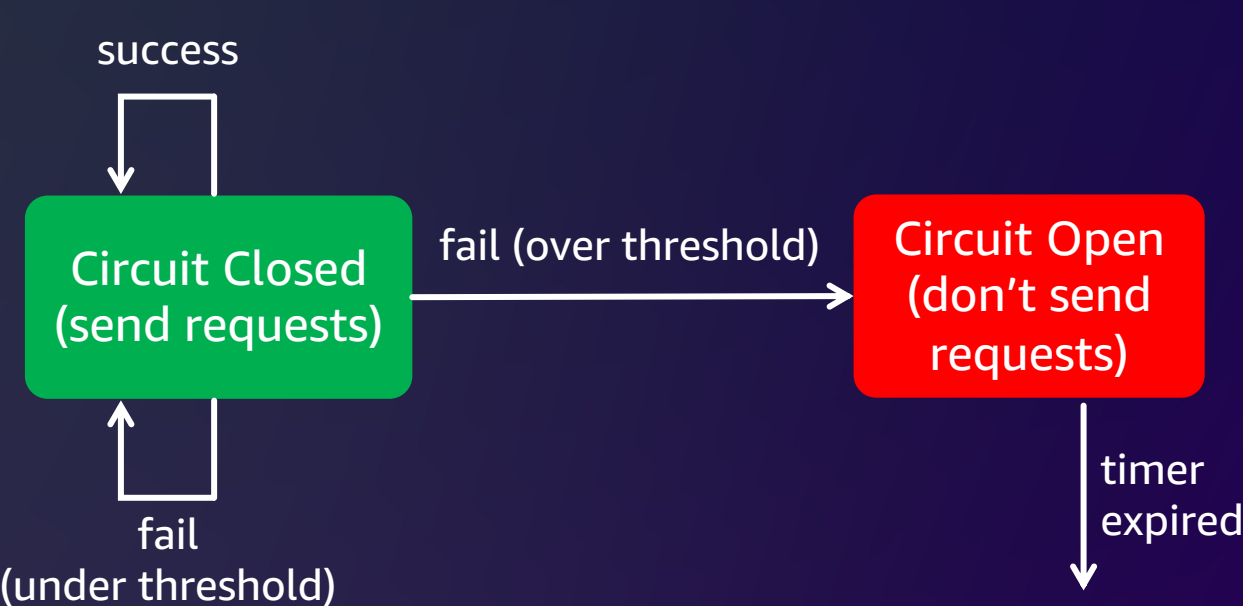
# Circuit breaker pattern used by SEB



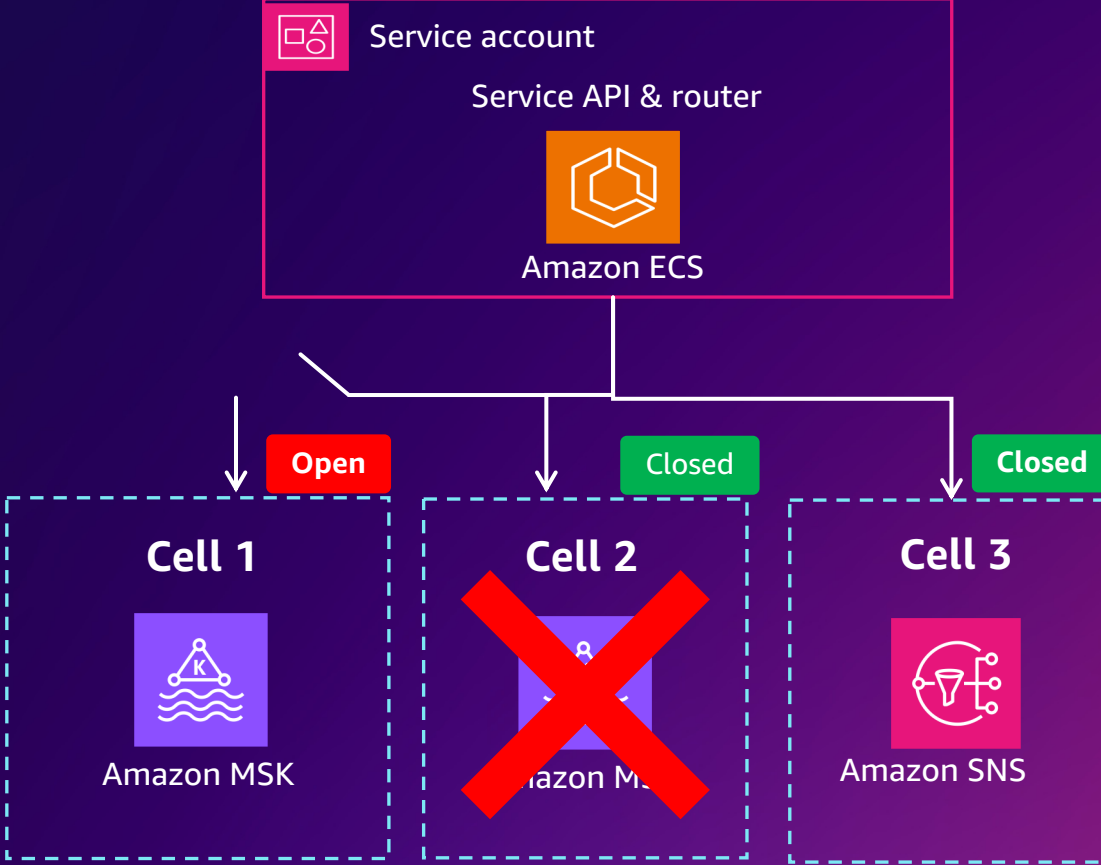
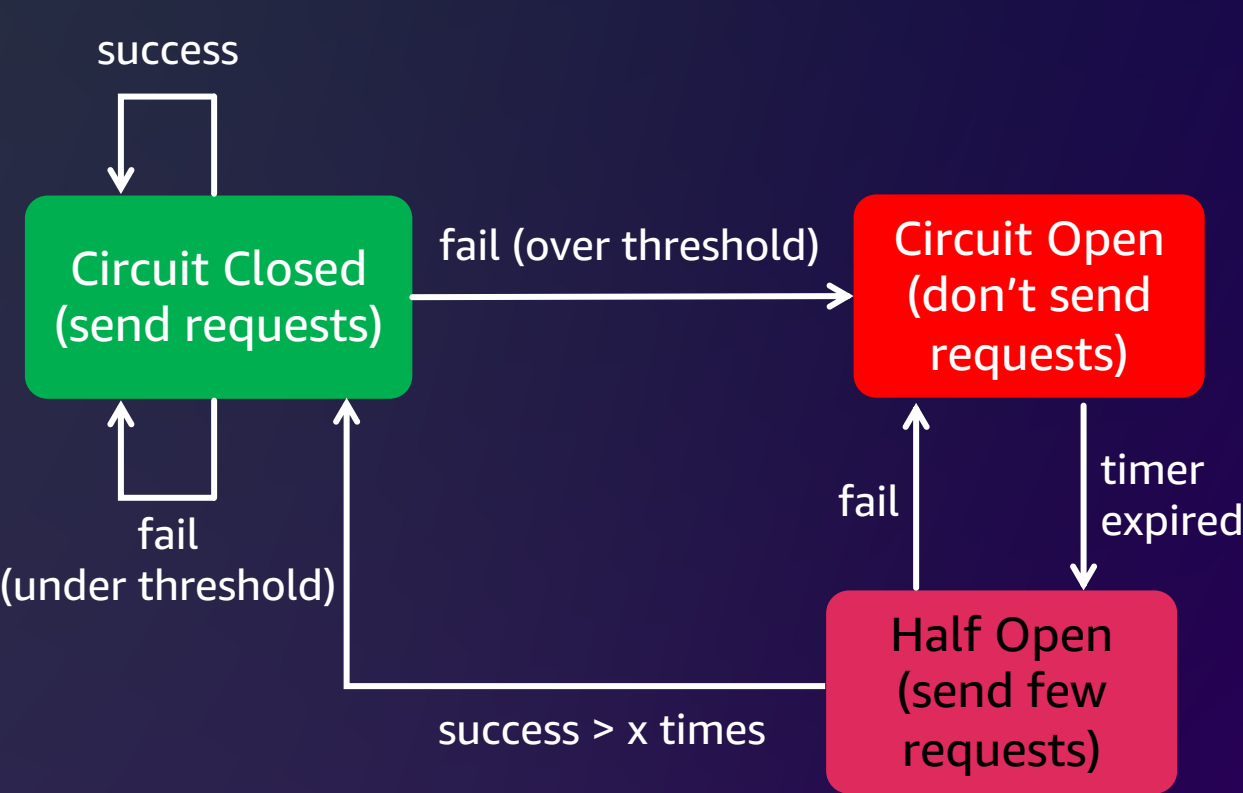
# Circuit breaker pattern used by SEB



# Circuit breaker pattern used by SEB



# Circuit breaker pattern used by SEB



# Actual availability, as measured

ACTIVE/ACTIVE STRATEGY WITH MULTI-LAYER FALLBACK

SEBServiceGlobalDashboard ▾

1h 3h 12h 1d 3d 1w Custom UTC Actions

### Global Overview

Global service metrics across all regions.

<b>Total Messages</b> 46.3 G Messages 3 days	<b>Peak Messages per Second</b> 299 k Peak Messages per Second	<b>Total Requests</b> 46.4 G Requests 3 days	<b>Average Availability</b> 99.9999 Percent
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# Actual availability, as measured

ACTIVE/ACTIVE STRATEGY WITH MULTI-LAYER FALLBACK

SEBServiceGlobalDashboard ▾

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### Availability

Service availability measured by application load balancers (External and VPC Endpoint). The load balancer with the lowest availability is shown. Calculation:

$$100 * (\text{RequestCount} - \text{Target\_5xx} - \text{ELB\_5XX}) / \text{RequestCount}$$

<b>ap-southeast-1 Availability</b> 99.9999 ap-southeast-1	<b>ap-southeast-2 Availability</b> 100 ap-southeast-2	<b>eu-west-1 Availability</b> 99.9999 eu-west-1	<b>us-east-2 Availability</b> 99.9999 us-east-2
<b>us-west-2 Availability</b> 99.9999 us-west-2	<b>us-east-1 Availability</b> 100 us-east-1	<b>ap-south-1 Availability</b> 99.9999 ap-south-1	<b>ap-northeast-1 Availability</b> 100 ap-northeast-1



# Conclusion

- Resilience at scale on the cloud is a design decision
- Real-life examples...
  - Are a great way to learn
  - Can inspire better architectures



# Purpose-built AWS resilience offerings

BUILD RESILIENT, HIGHLY AVAILABLE APPLICATIONS IN THE AWS CLOUD

## AWS Resilience Hub

Analyse the components of your application to uncover potential resilience weaknesses

## AWS Fault Injection Service

Improve application performance, observability, and resilience through controlled fault injection experiments

[aws.com/fis](https://aws.com/fis)

## AWS Elastic Disaster Recovery

Minimise downtime and data loss with fast, reliable recovery of on-premises and cloud-based applications

## AWS Backup

Protect data at scale using this cost-effective, fully managed, policy-based service

## Amazon Route53 Application Recovery Controller

Automate management and coordination of recovery for your applications across AWS AZs or Regions

## Resilience lifecycle framework

Strategies, services & mechanisms you can weave into your existing processes



# Thank you!

Dragoș Mădărășan



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App Store



Google Play Store