
AWS
re:Invent
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SUP401

Building resilient multi-site workloads using AWS global services

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Agenda

AWS fault isolation boundaries and static stability

AWS service types

Global services best practices

Using AWS Health for multi-site resilience

Netflix case study

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AWS fault isolation boundaries

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AWS Regions and Availability Zones (AZs)

AWS REGIONS ARE PHYSICAL LOCATIONS AROUND THE WORLD WHERE WE CLUSTER DATA CENTERS

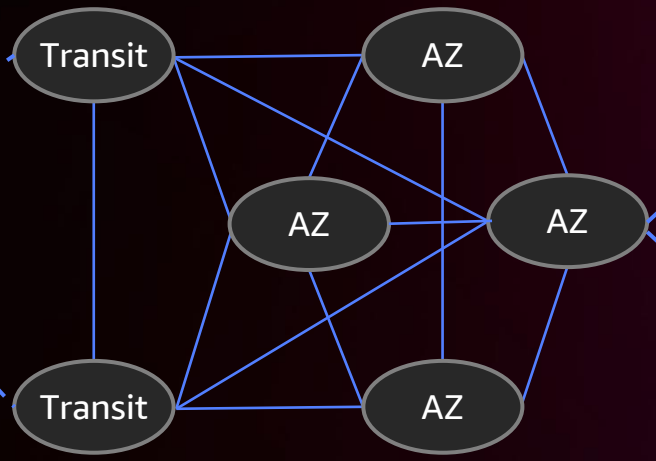
30 AWS Regions worldwide



AWS Regions

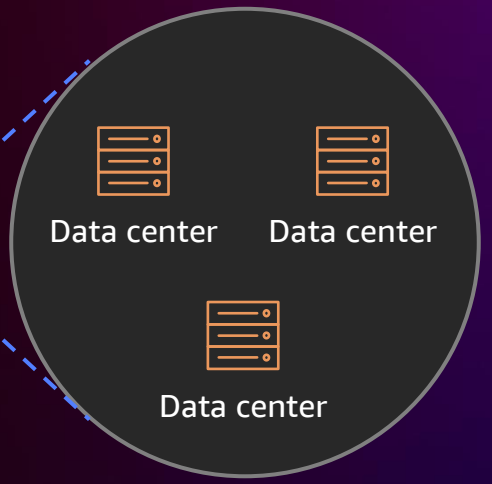
Announced Regions

Each AWS Region has multiple AZs



A **Region** is a physical location in the world

Each AZ is one or more discrete data centers

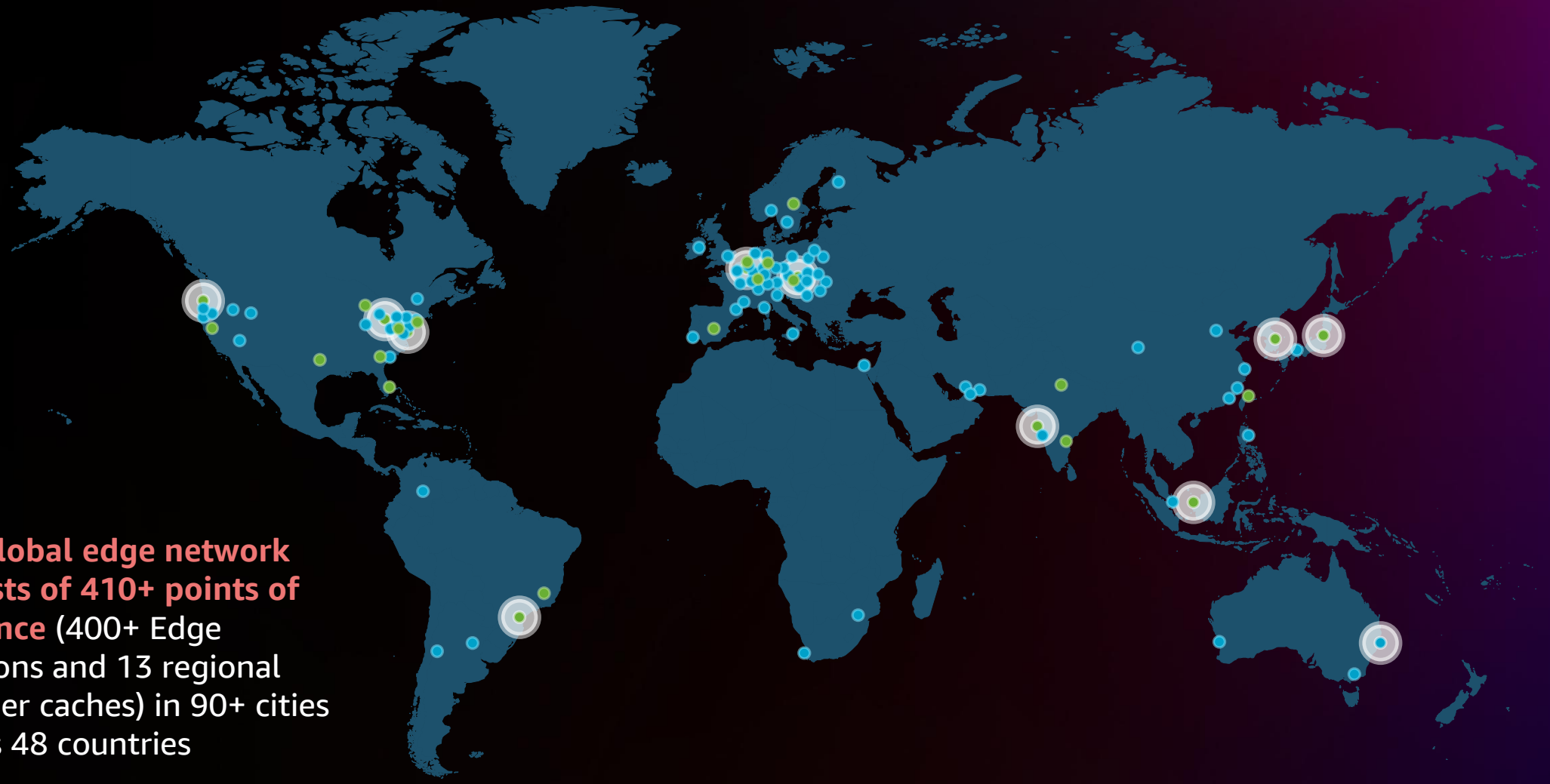


Data centers, each with redundant power, networking, and connectivity, are housed in separate facilities

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AWS global edge network

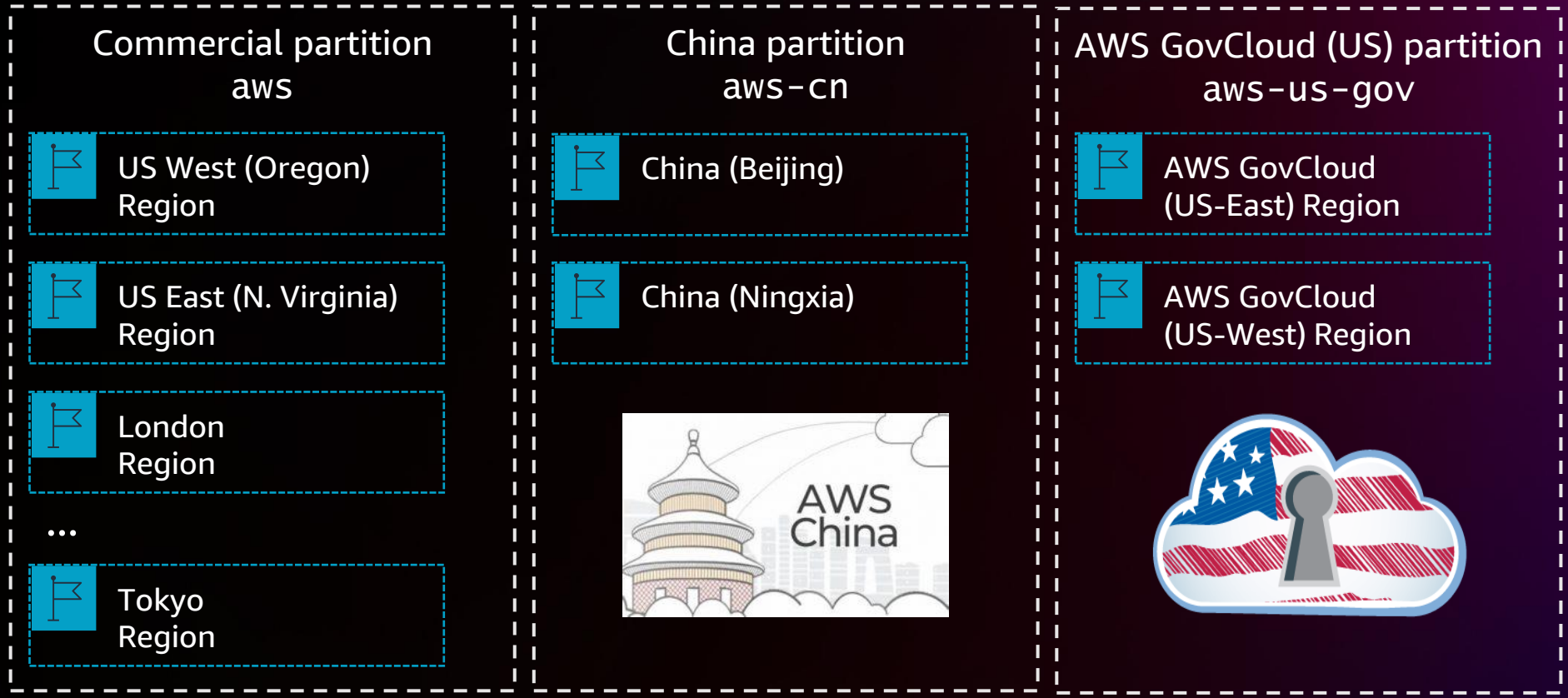


The global edge network consists of 410+ points of presence (400+ Edge locations and 13 regional mid-tier caches) in 90+ cities across 48 countries

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AWS partitions

ISOLATED INFRASTRUCTURE AND SERVICES



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Control planes and data planes

Control plane

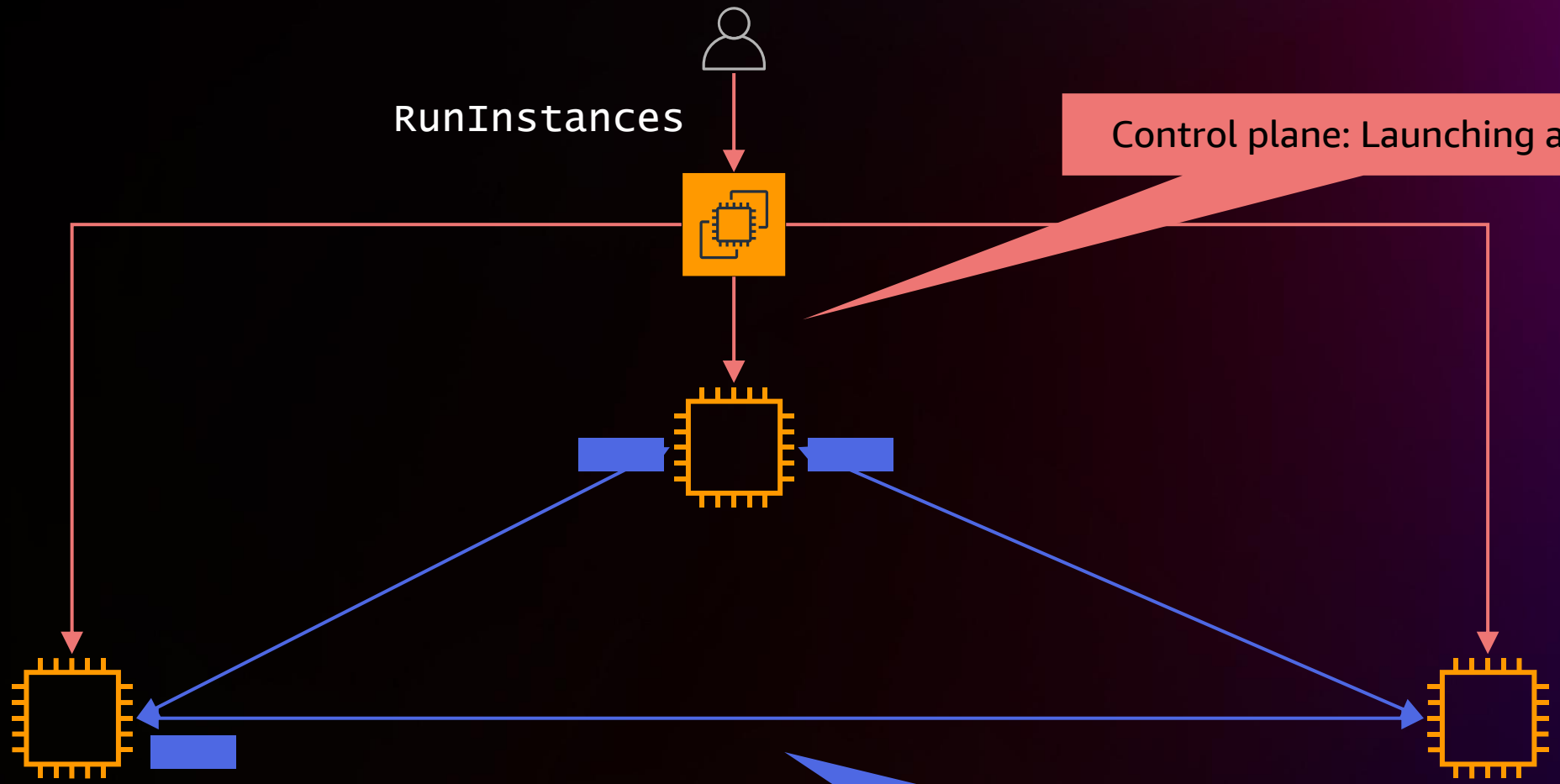
- Create, update, delete, list, and describe resources
- Complex orchestration with many dependencies
- Lower volume

Data plane

- The day-to-day business of the resource
- Simpler, fewer dependencies
- Higher volume

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Example: Amazon EC2



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Additional examples

Service	Control plane	Data plane
Amazon S3	CreateBucket, PutBucketPolicy	GetObject, PutObject
Amazon DynamoDB	CreateTable, UpdateTable	GetItem, PutItem, Scan, Query
Elastic Load Balancing (ELB)	CreateLoadBalancer, CreateTargetGroup	The load balancer itself
Amazon Route 53	CreateHostedZone, UpdateResourceRecordSet	DNS resolution, health checks
AWS Identity and Access Management (IAM)	CreateRole, CreateManagedPolicy	AuthN/AuthZ
Amazon RDS	CreateDatabaseInstance	The database itself

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Fault isolation takeaways

- AWS provides **multiple fault containers**: partitions, AZs, Regions, control planes, data planes, and more
- **Physical and logical separation** of Regions and AZs helps **prevent correlated failures**
- **Control planes are more complex** and have more dependencies than data planes and thus are **statistically more likely to fail**

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Static stability

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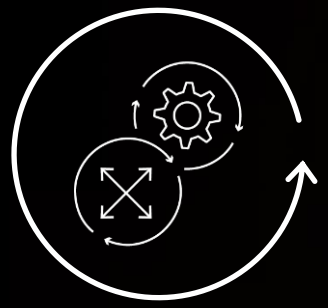
Static stability

Static stability means a system can operate in a static state and continue to operate as normal without the need to make changes during the failure or unavailability of a dependency

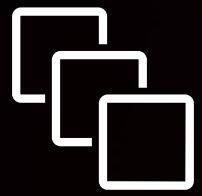
Dependency != Destiny

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Static stability approaches



Prevent circular dependencies



Pre-provision capacity



Maintain the existing state

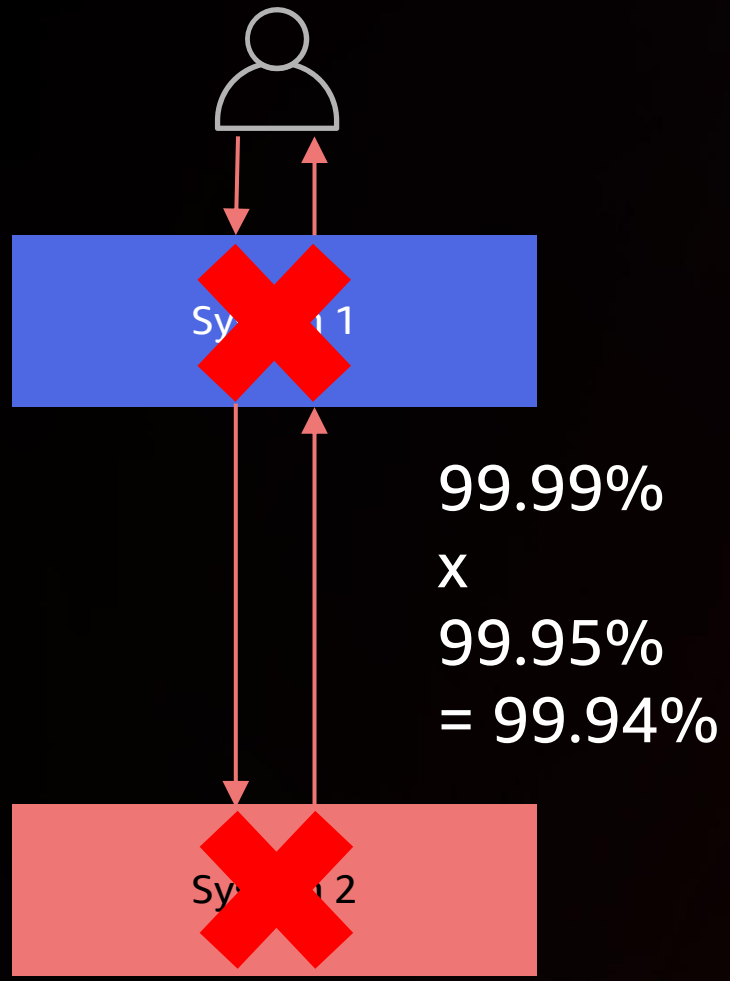


Eliminate synchronous interaction

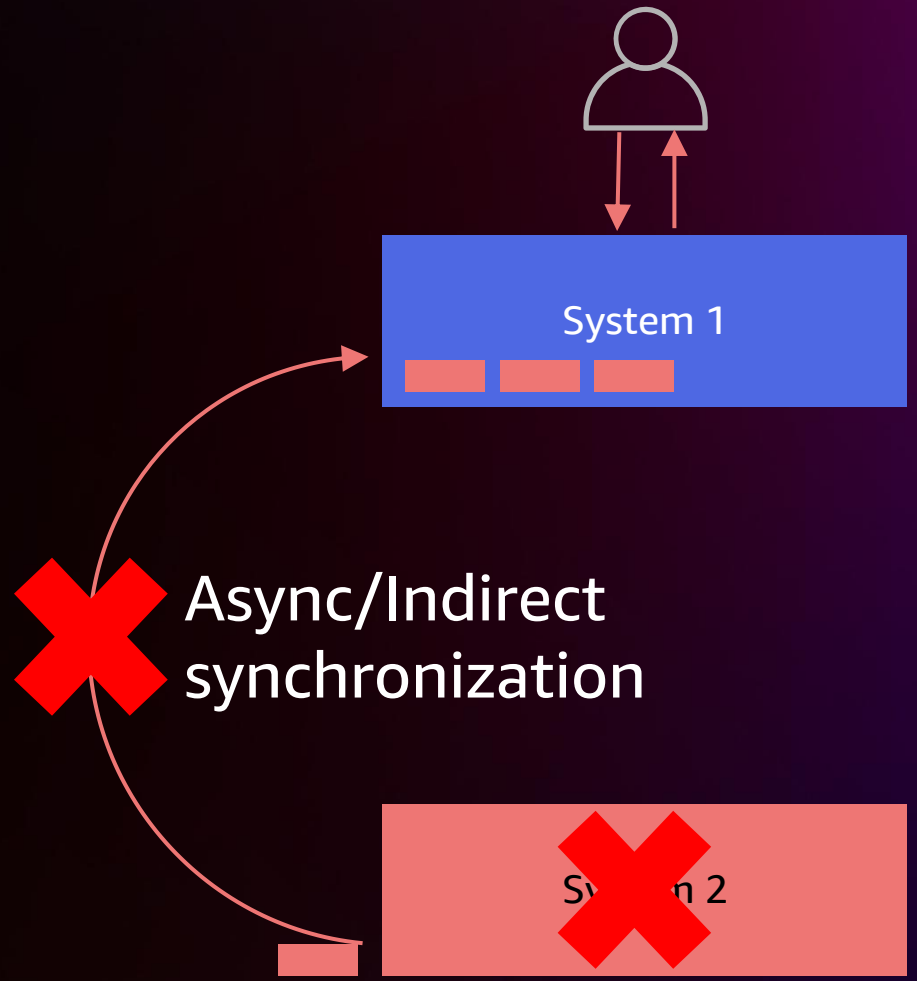
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Static stability example

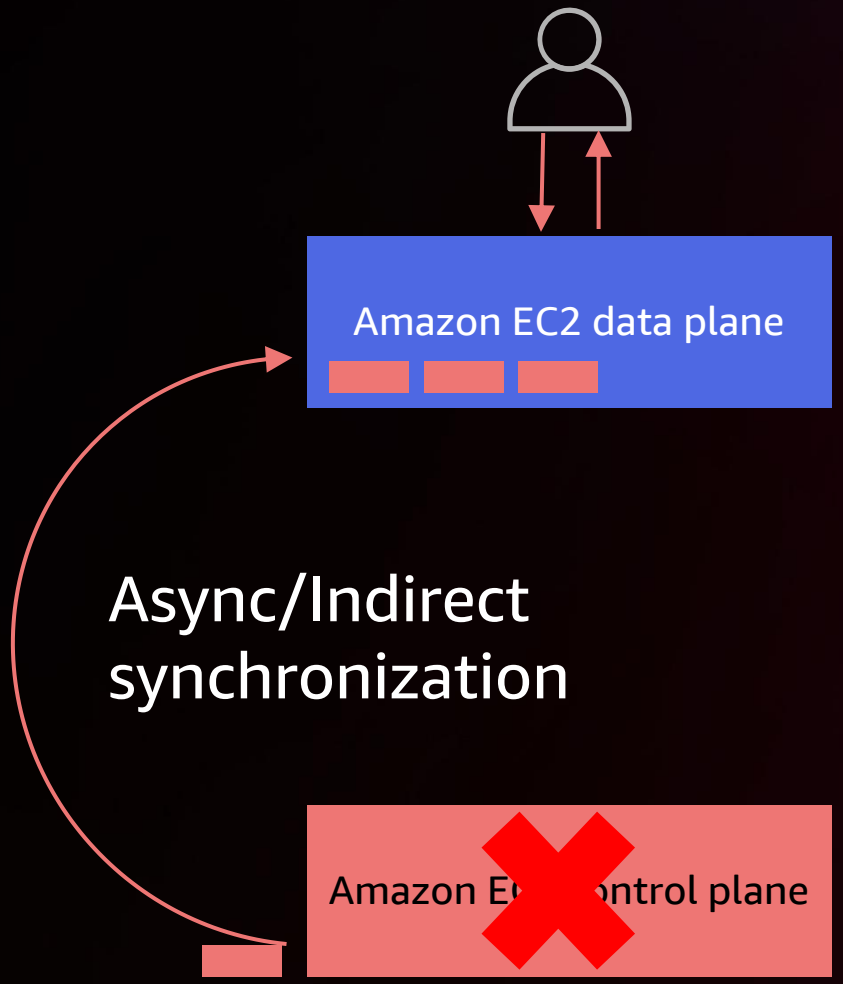


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= 99.94%



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Static stability with Amazon EC2 infrastructure



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Static stability takeaways

- Static stability means a system can **operate in a static state** and continue to operate as normal **without the need to make changes** during the failure or unavailability of a dependency
- One way AWS achieves static stability is by **removing control plane dependencies from the data plane** in AWS services
- A **dependency on a data plane is better** than a dependency on a control plane
- **Relying on data plane operations for recovery** can help make your system more statically stable; this may include **pre-provisioning resources** or capacity or just relying on data plane operations

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AWS service types

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AWS service types

UNDERSTANDING THE DIFFERENCES

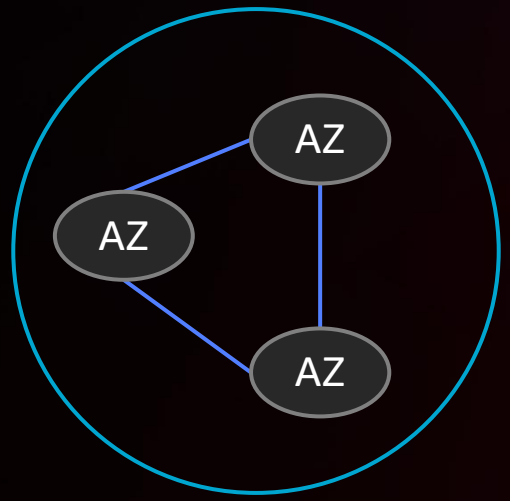
Zonal services



Amazon RDS | Amazon EC2 | Amazon EBS

Control plane: Regional
Data plane: Zonal

Regional services



Amazon S3 | Amazon SQS | Amazon DynamoDB

Control plane: Regional
Data plane: Regional

Global services



IAM | Amazon CloudFront | Amazon Route 53 | AWS Global Accelerator

Control plane: Single Region
Data plane: Global

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Global service categories

Partitional

IAM

AWS Network Manager

Organizations

Route 53 Application Recovery Controller (ARC)

Route 53 private DNS

Edge

Route 53 public DNS

CloudFront

Global Accelerator

AWS Shield Advanced

Globally-scoped operations

Resource creation/update/deletion that creates/updates/deletes Route 53 resources

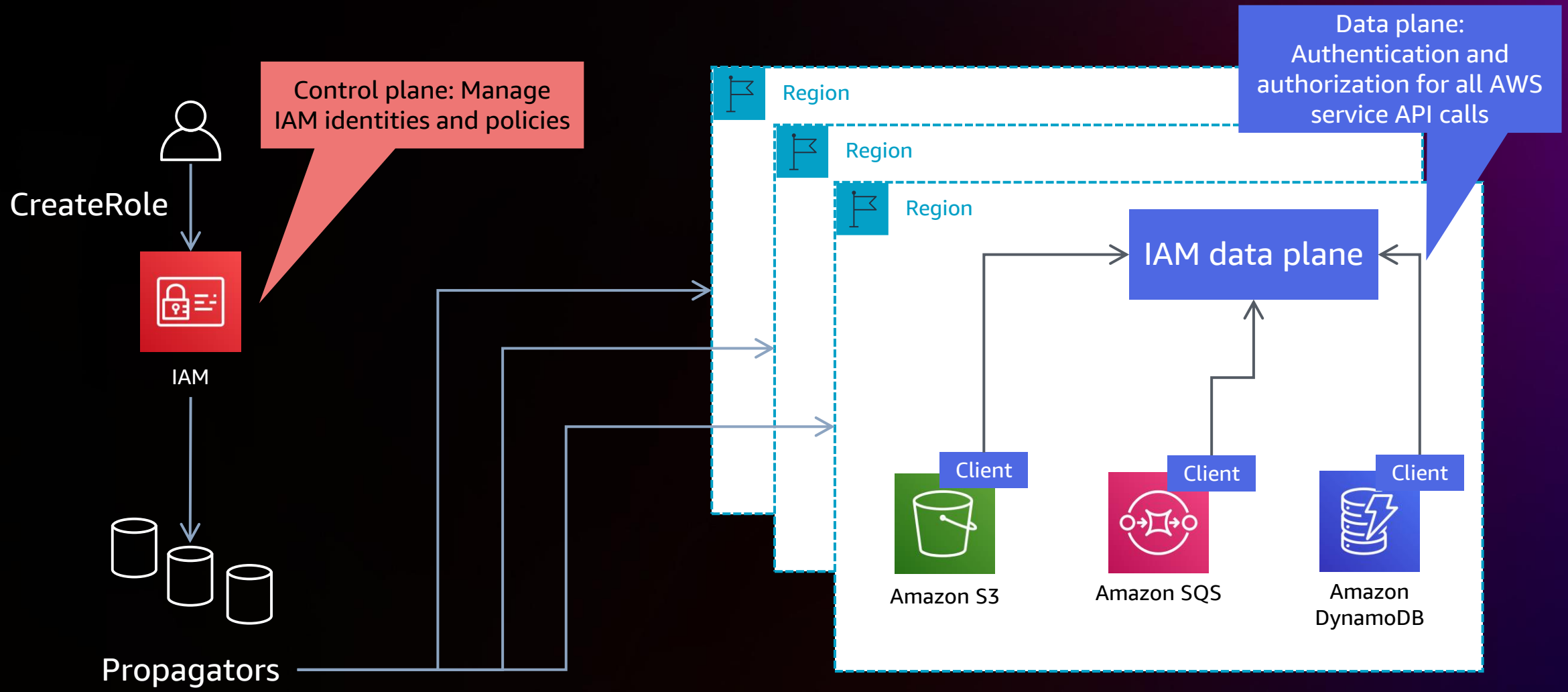
Amazon S3 Put/Delete control plane actions, Create/Delete Bucket actions, and Multi-Region Access Points (MRAPs)

CloudFront – Amazon API Gateway

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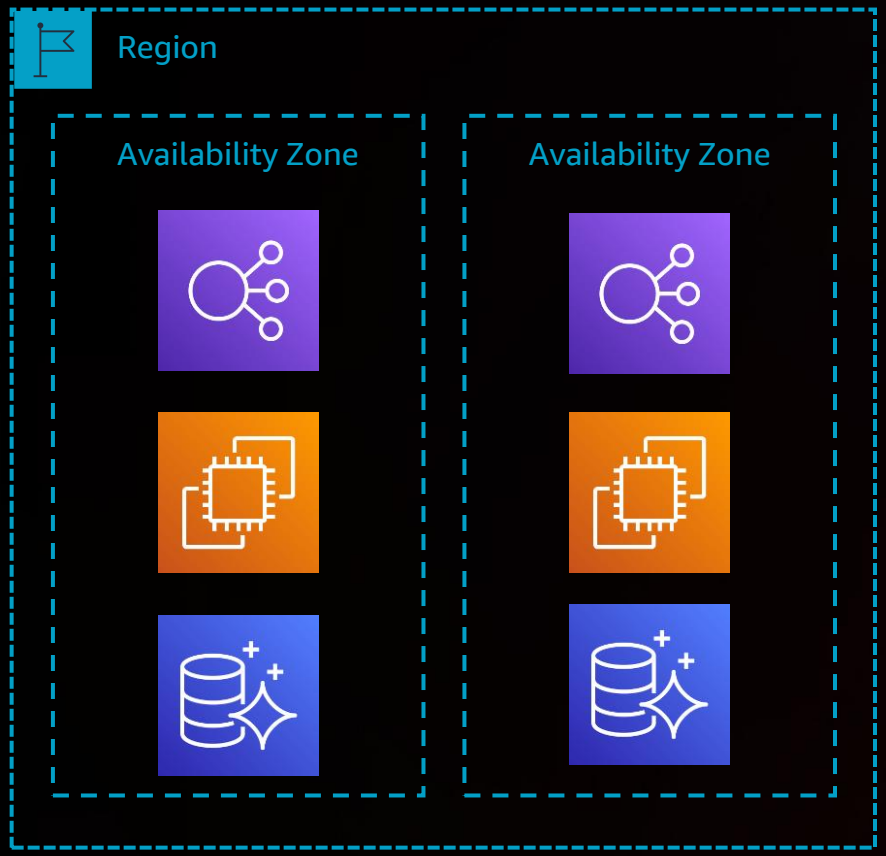
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IAM control plane and data plane

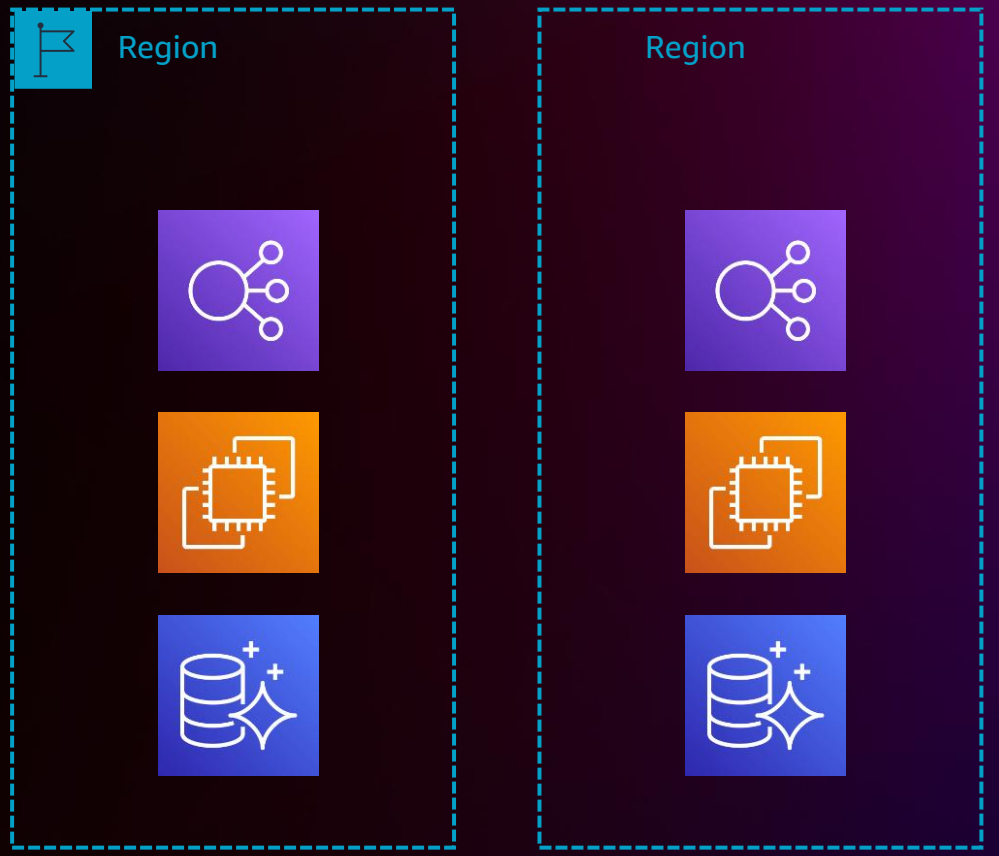


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Multi-site workloads



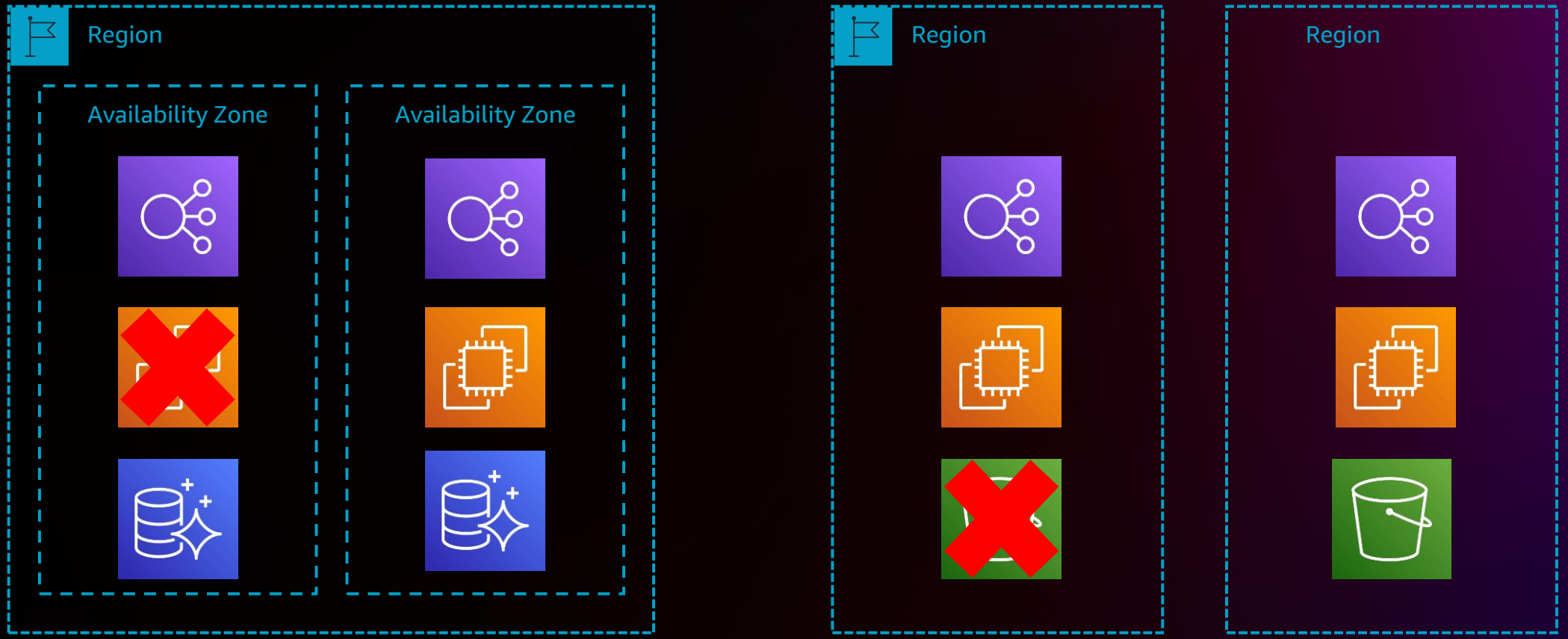
Multi-AZ



Multi-Region

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Site evacuation



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Global services best practices

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Avoid control plane actions for recovery

GLOBAL SERVICES



IAM

What will work	What may not work
AuthN/AuthZ of signed AWS requests	CRUD-L IAM policies, roles, users



Route 53

DNS resolution and health checks	Updates to routing policies and records, creating health checks



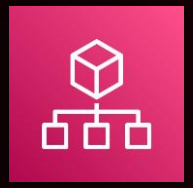
Route 53 ARC

Listing and updating routing controls	CRUD-L cluster endpoints



CloudFront

What will work	What may not work
Will continue to cache and serve content, perform origin failover	CRUD-L CloudFront distributions



Organizations

Service control policy (SCP) evaluation	View or update organization structure, modify SCPs



Global Accelerator

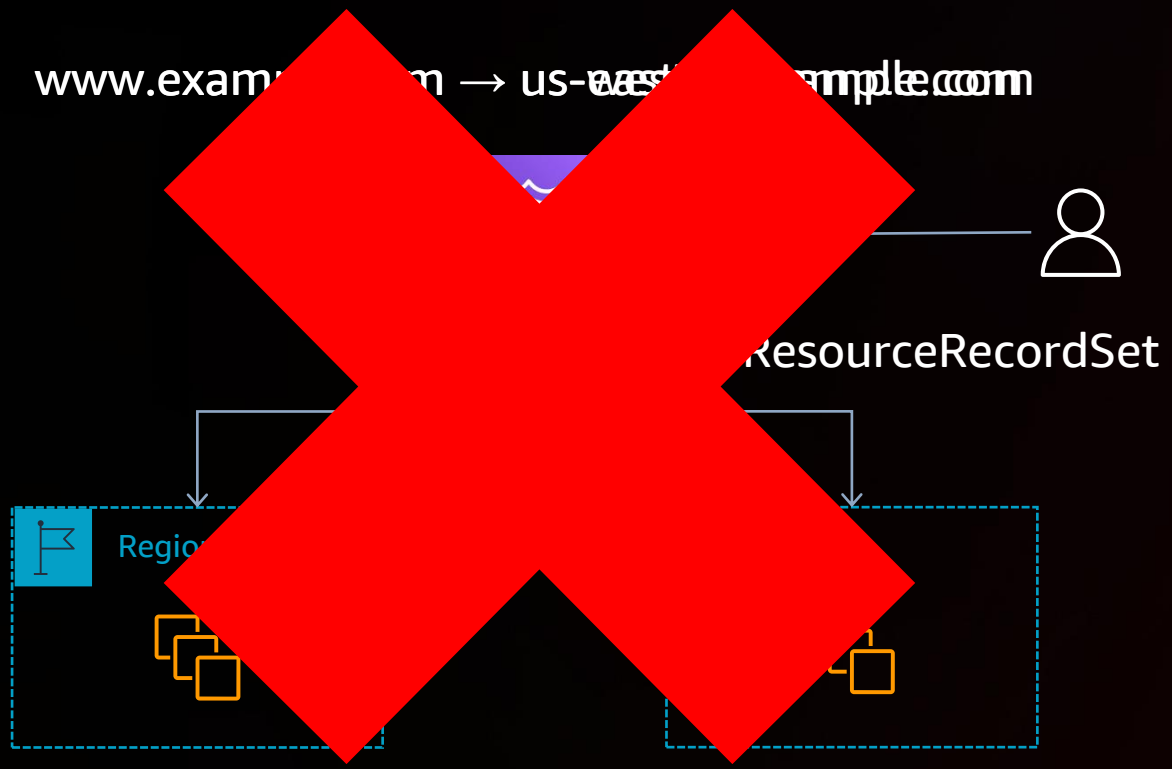
Edge routing will continue to function, existing traffic dials and endpoint weights	Add/modify endpoints, change traffic dials

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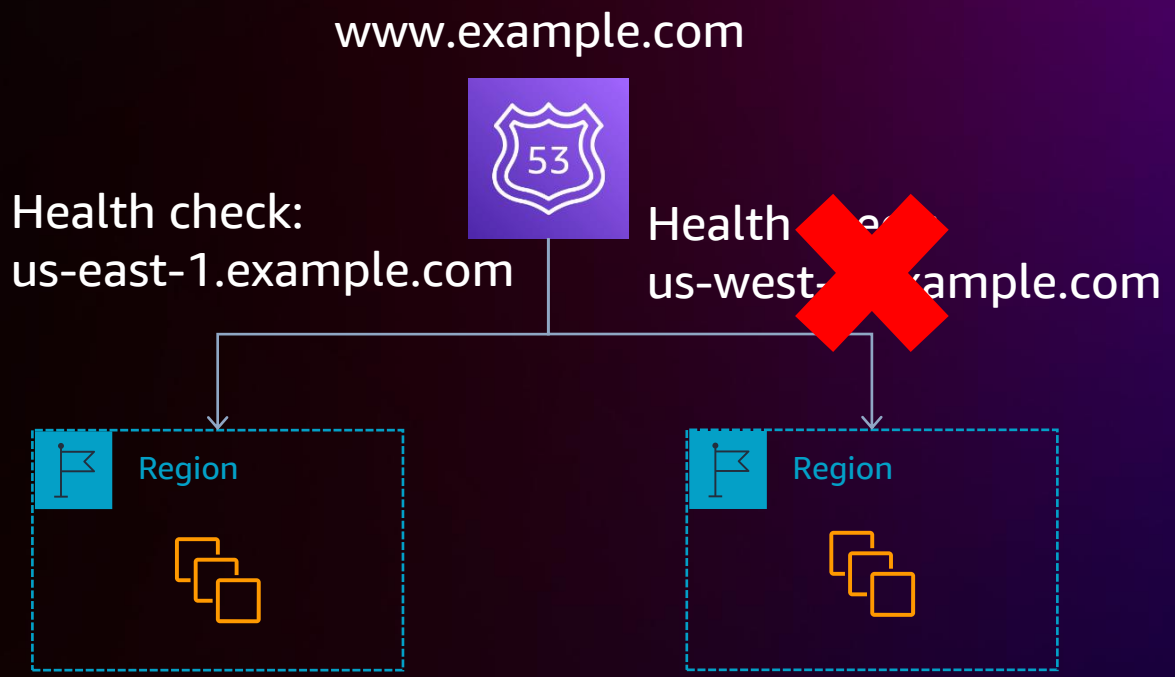
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Amazon Route 53 best practices

Don’t do this



Do this!



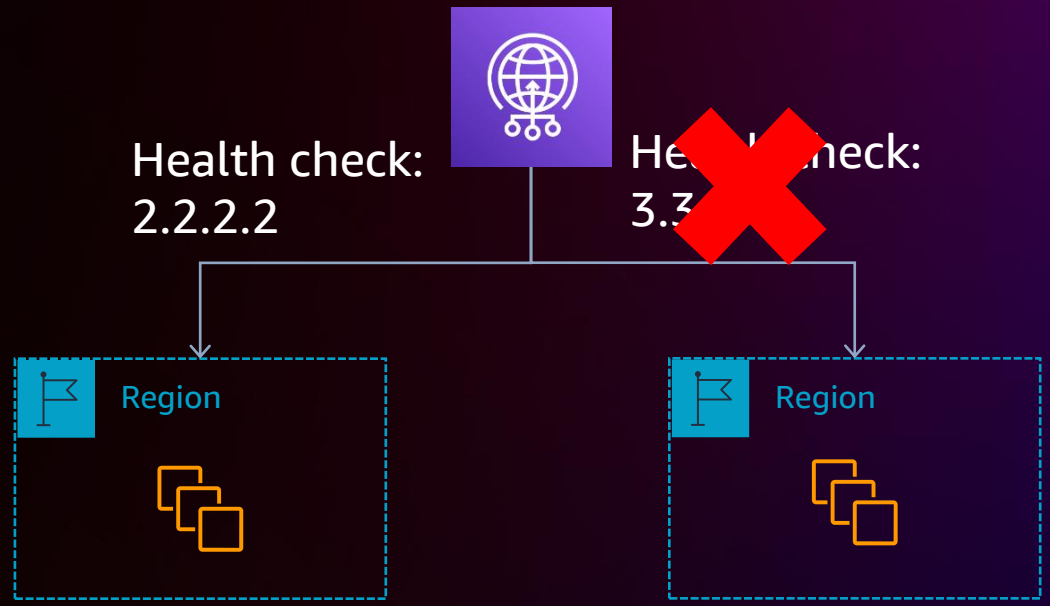
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AWS Global Accelerator best practices

Don’t do this



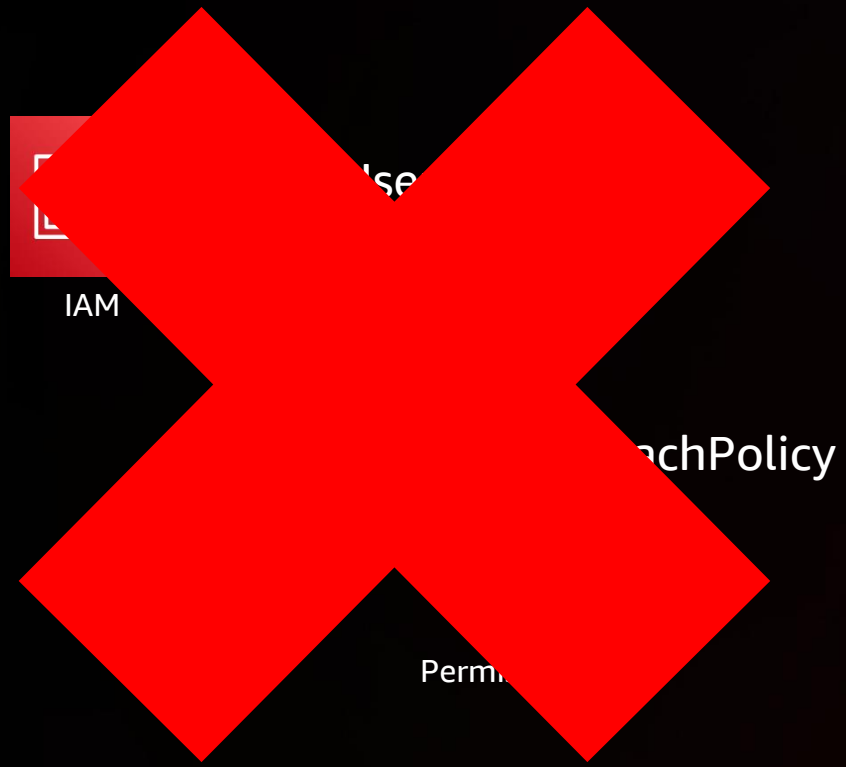
Do this!



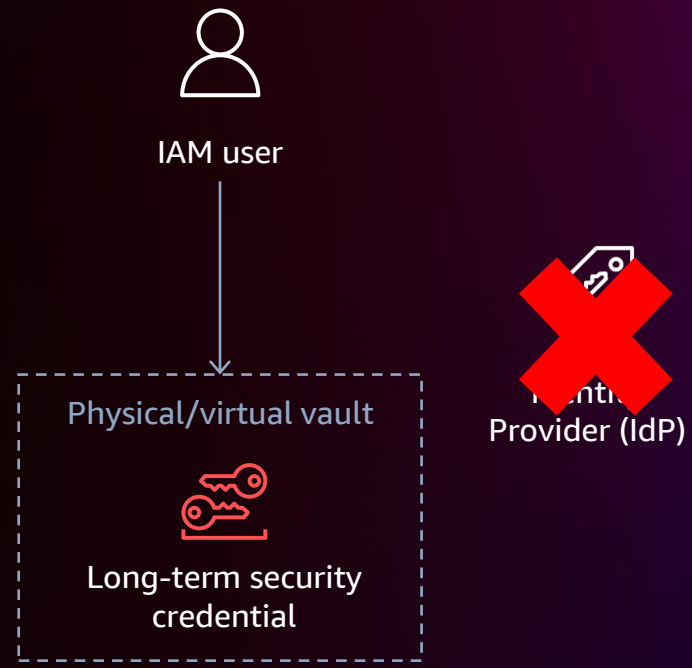
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IAM best practices

Don’t do this



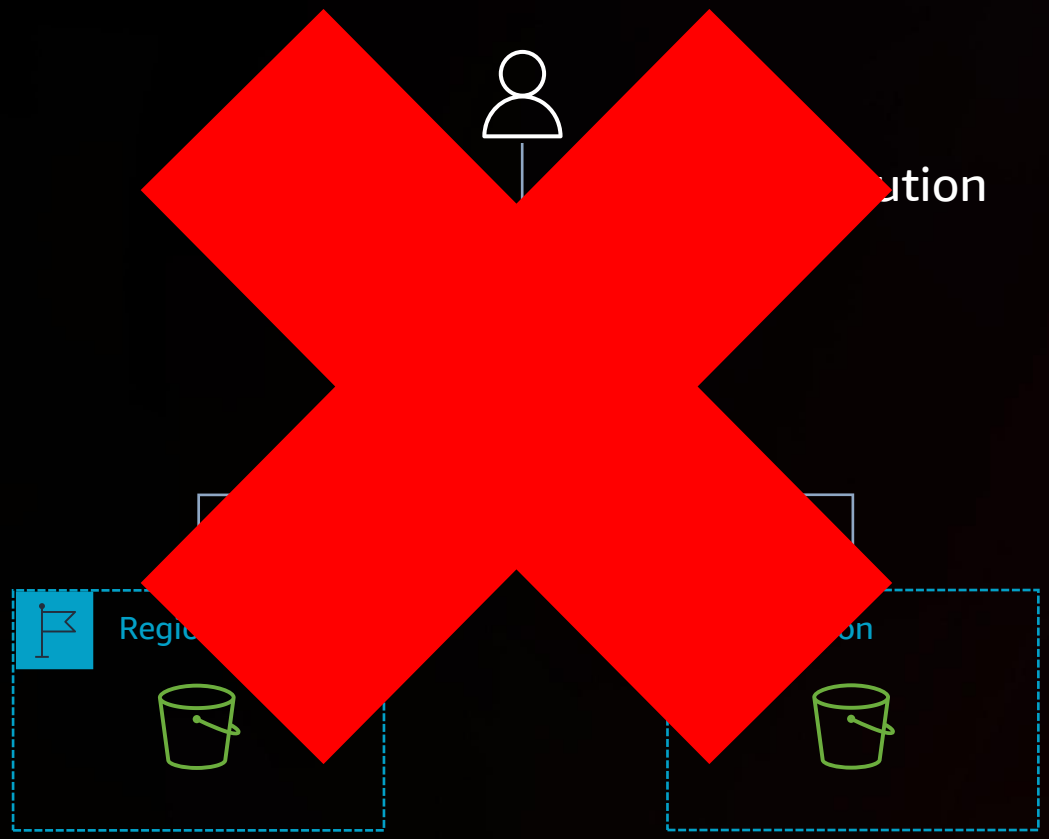
Do this!



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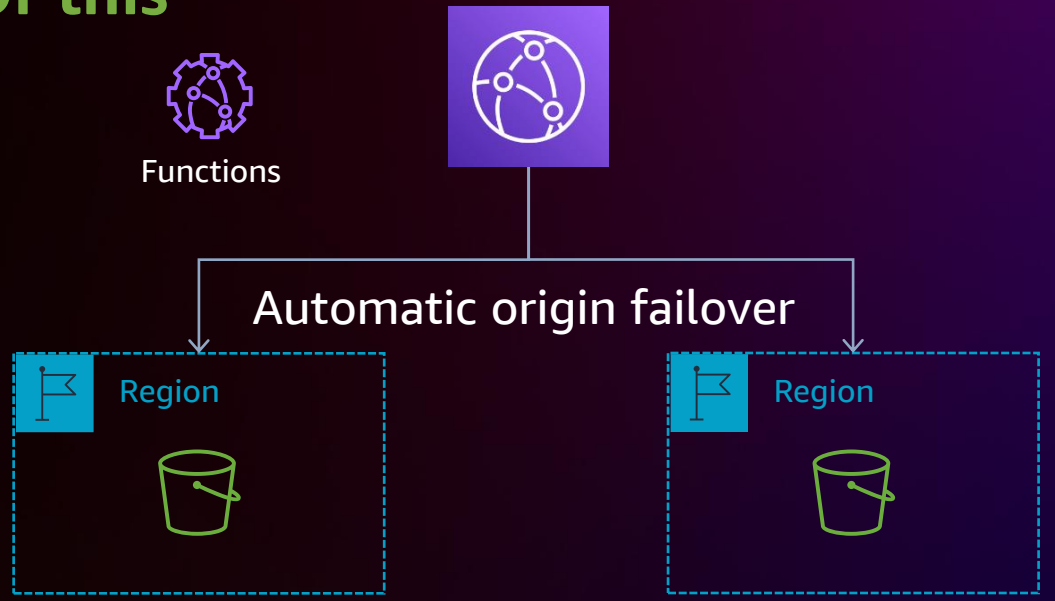
Amazon CloudFront best practices

Don’t do this



Do this!

Or this



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Global service takeaways

- There are three categories of global services: **partitional**, **edge**, and **globally-scoped operations**
- Global services have a **single control plane** and a **distributed, highly available data plane**
- **Avoid control plane dependencies** in global services in your recovery path; implement **static stability**
- Understand **what does** and **might not work** during a control plane impairment for global services
- **Pre-provision resources** that have single-Region control plane dependencies on services like Route 53, Amazon S3, and CloudFront

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Using AWS Health for multi-site resilience

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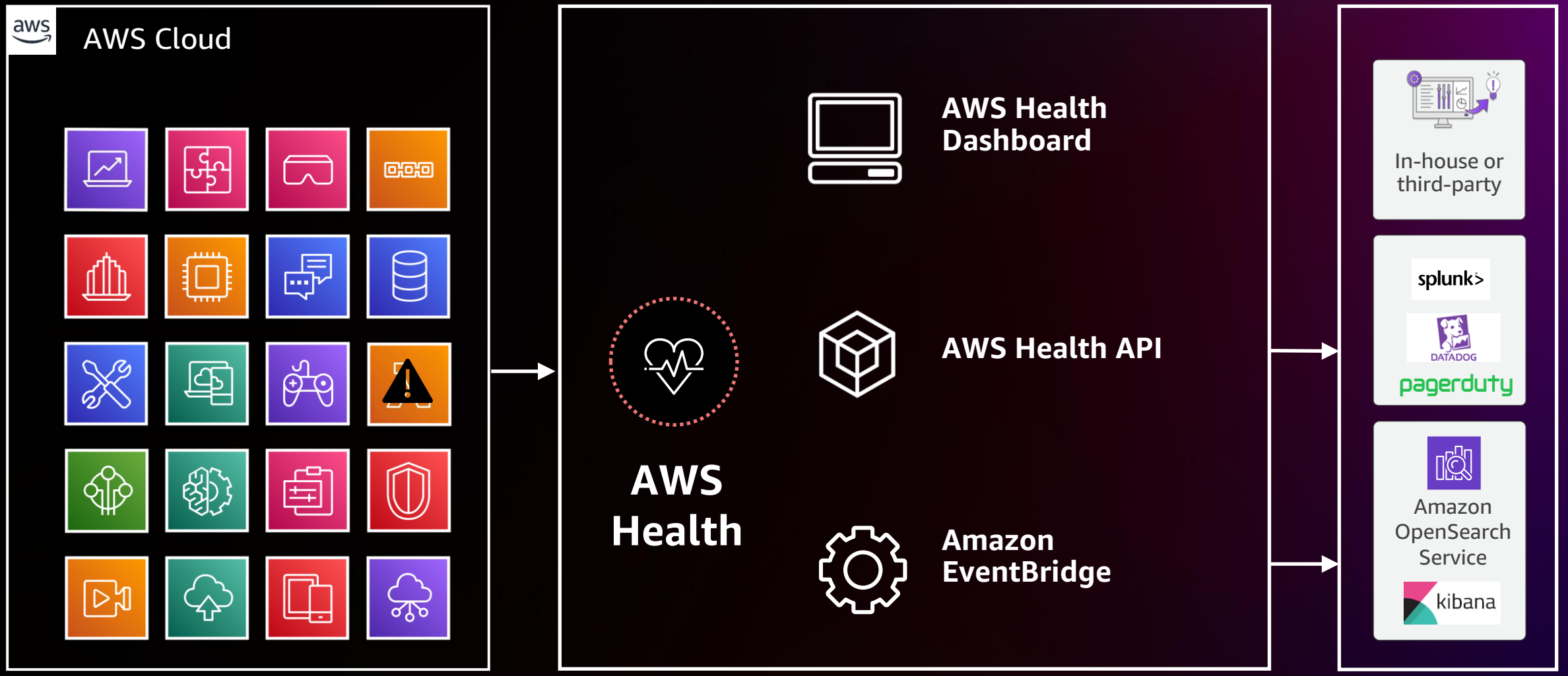
Why use AWS Health?



"When an application alarm breaches, we need to **quickly determine whether the issue is caused by an AWS service disruption or a problem with our own code**."

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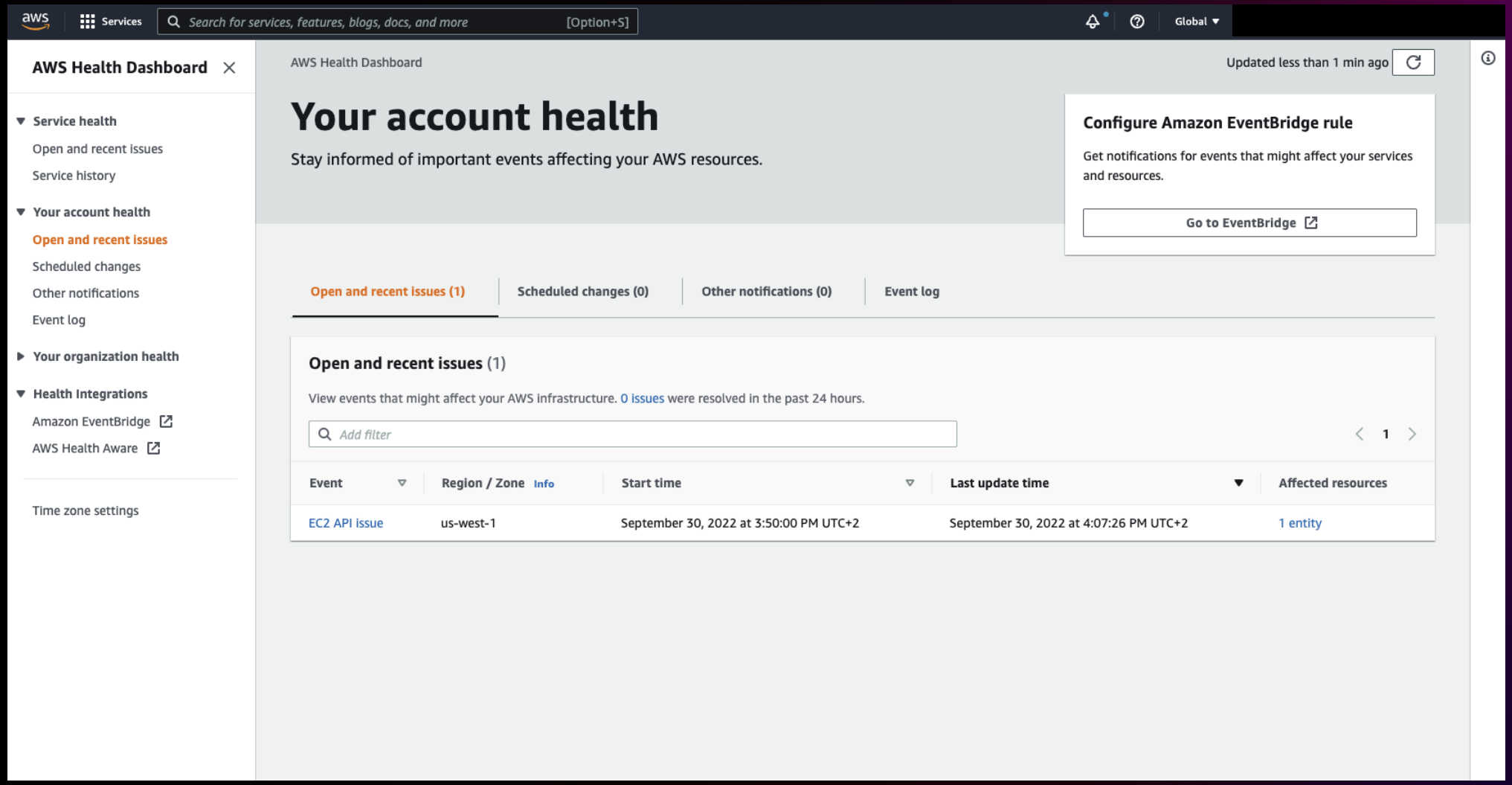
AWS Health



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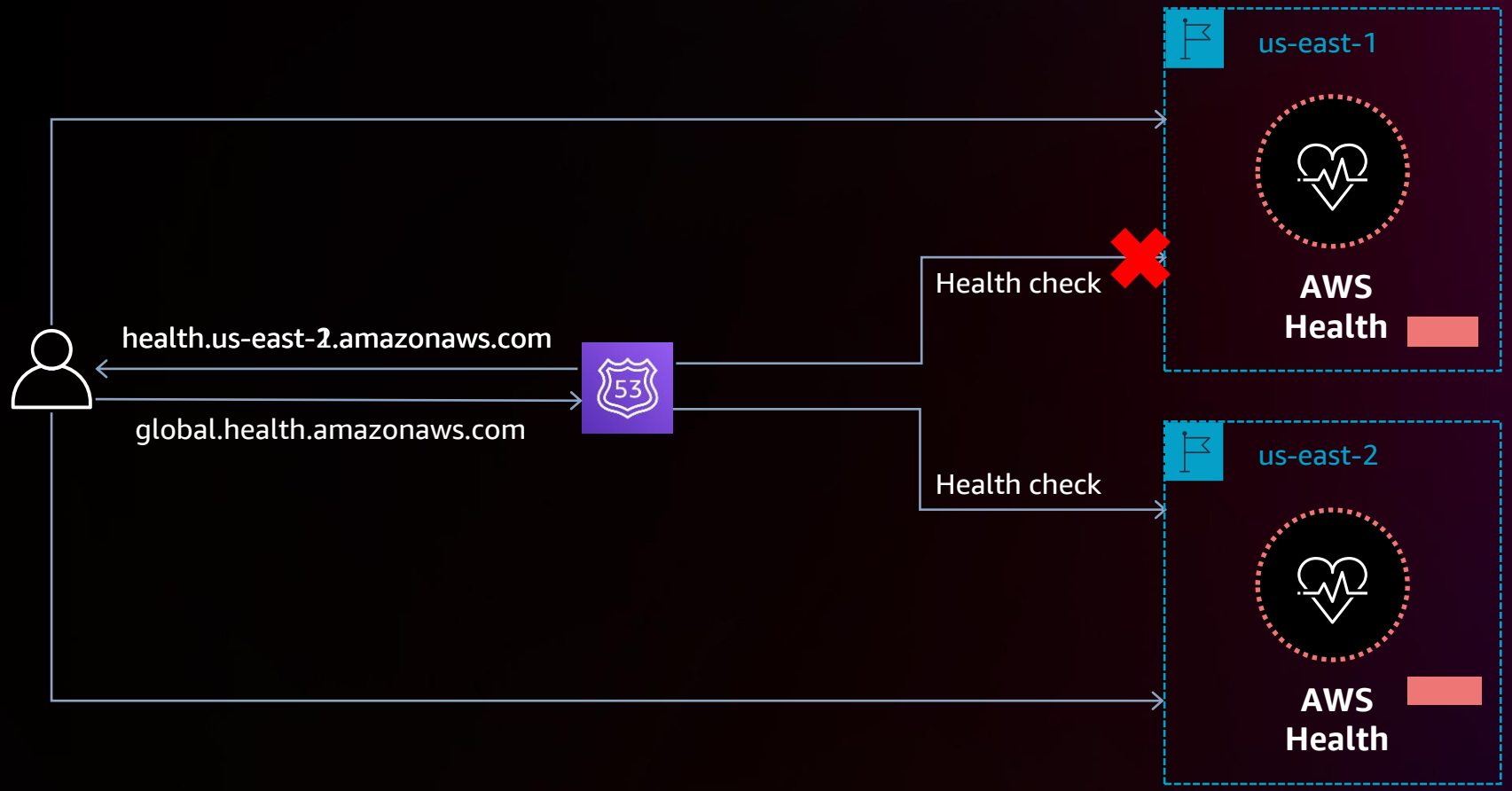
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AWS Health issues category



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How to use the AWS Health global endpoint



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AWS Health takeaways

- **Integrate with AWS Health** to implement observability best practices as part of your resiliency plan
- AWS provides customers with **notifications** about **planned or unplanned events** that may impact their workloads
- The AWS Health **operational issue category** identifies ongoing unplanned events
- Enable **AWS Organizations** for AWS Health to get an **aggregated view** of operational issues across all of your accounts
- Ensure you can always receive health events by **using the global AWS Health endpoint**

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Netflix case study

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A brief history

2011



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A brief history

2011

2012



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A brief history

2011

2012

2013



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A brief history

2011

2012

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2016



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A brief history

2011

2012

2013

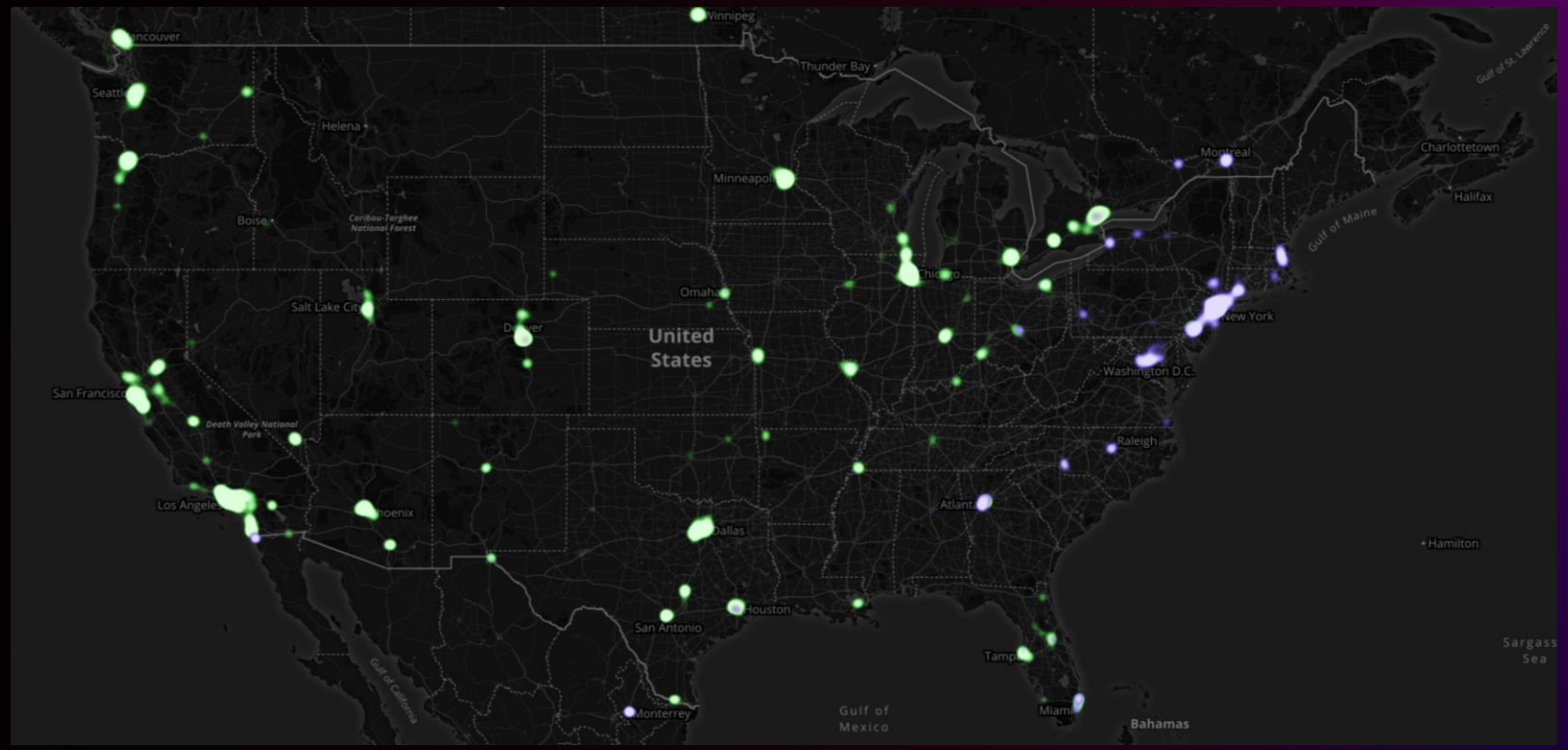
2016

2022



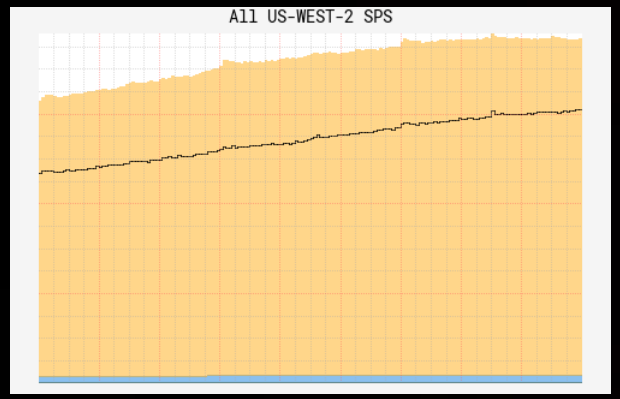
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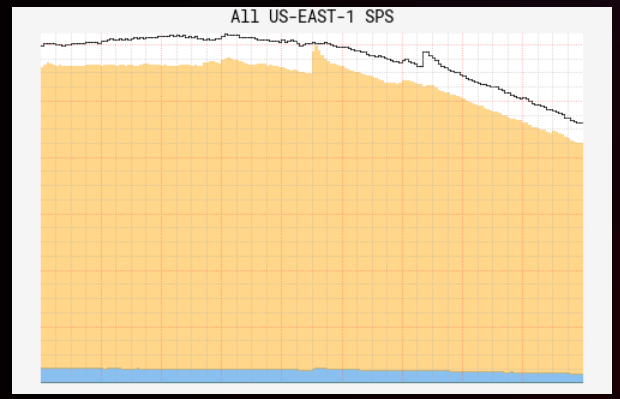


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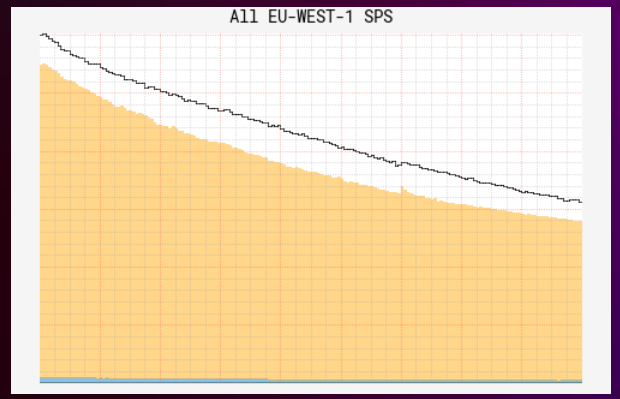
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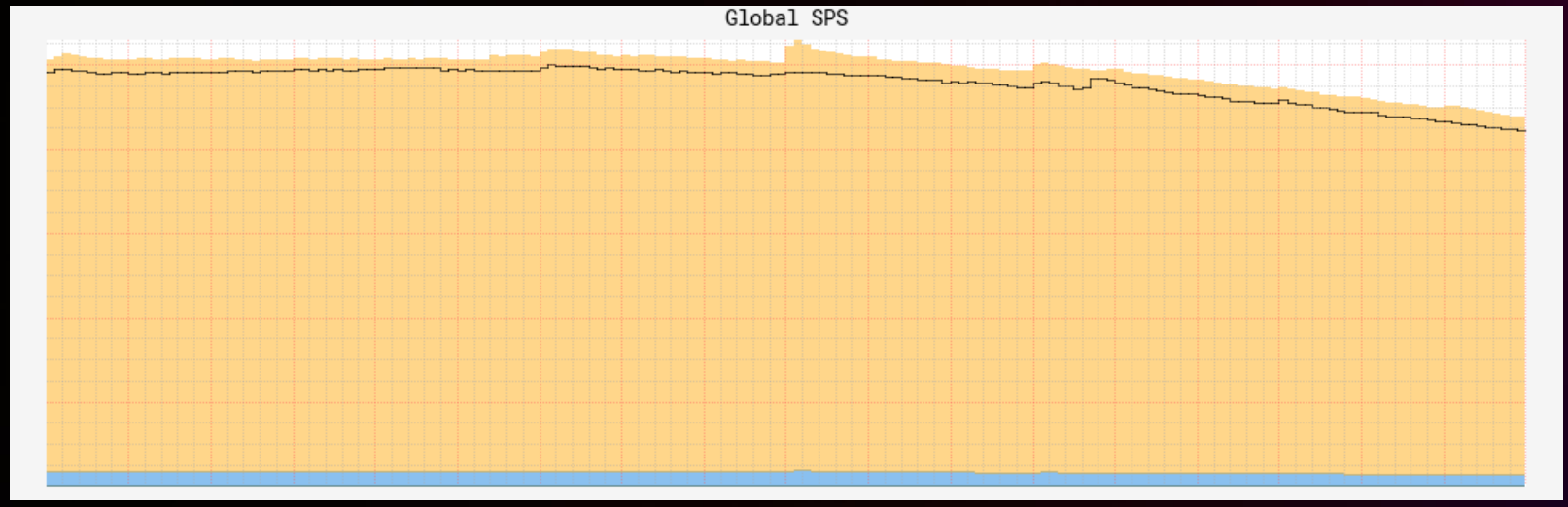
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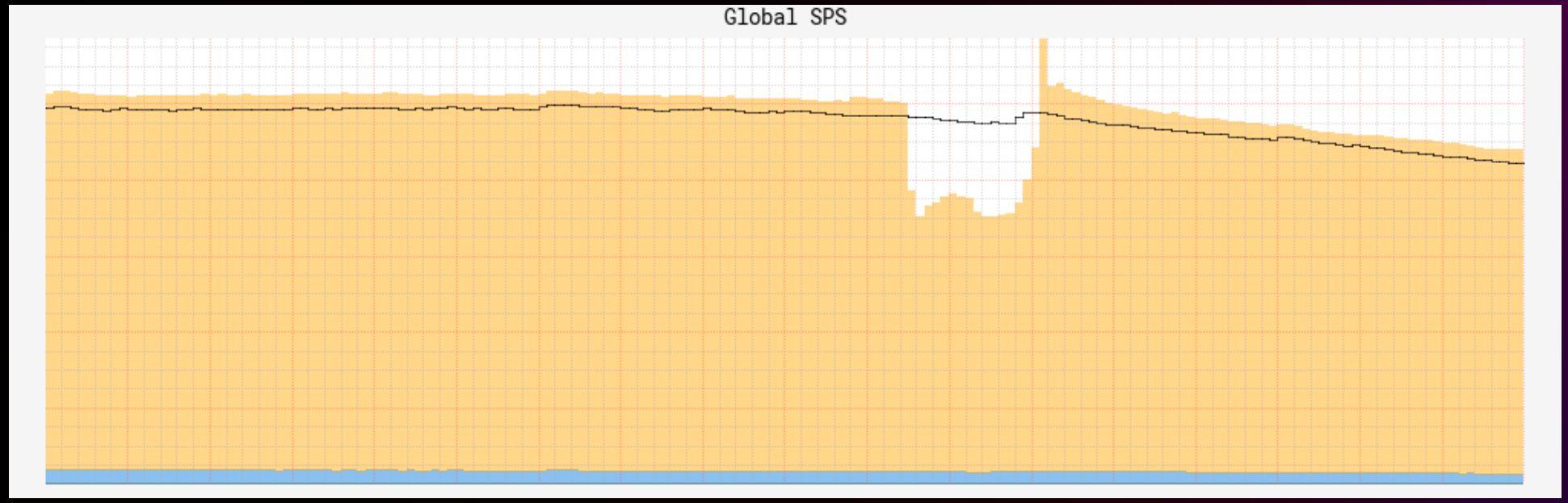


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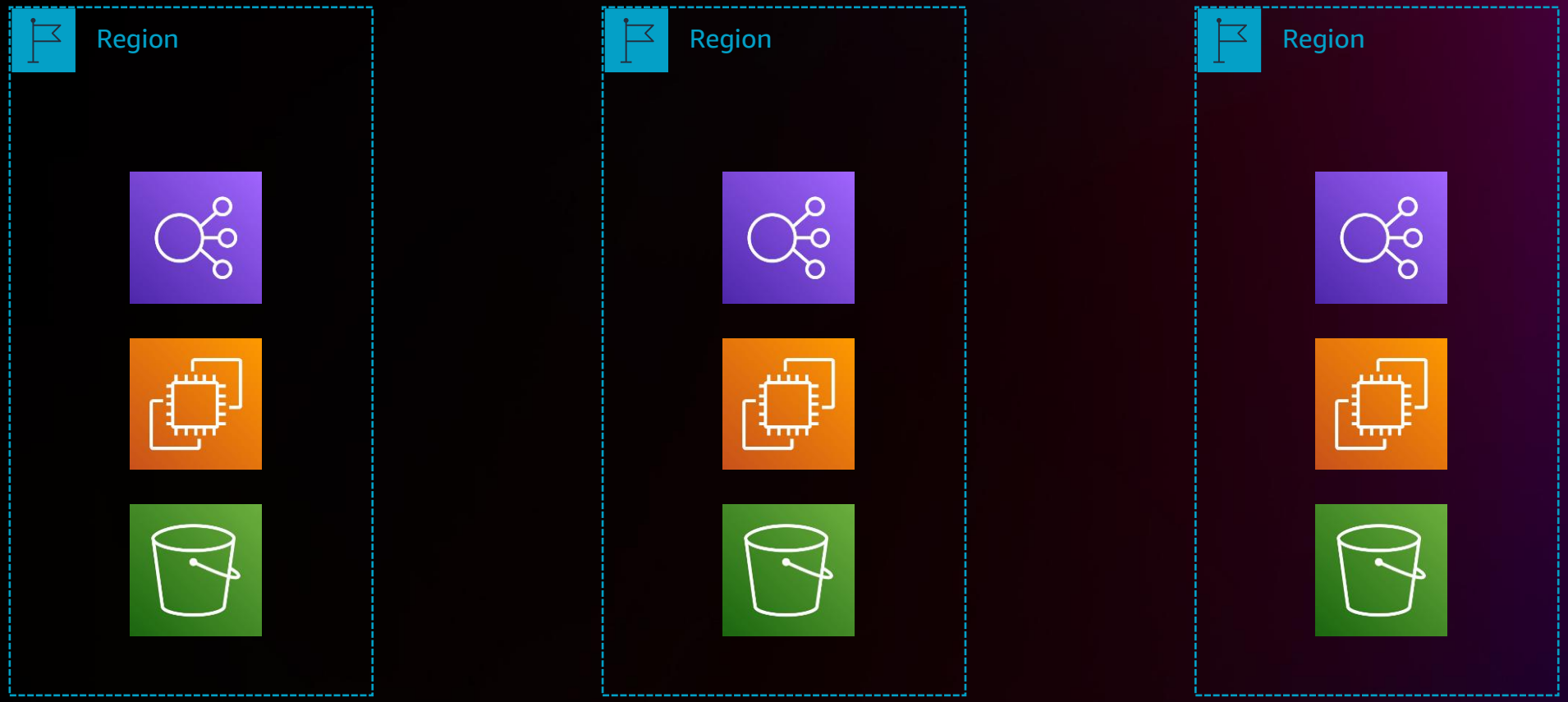
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Impact



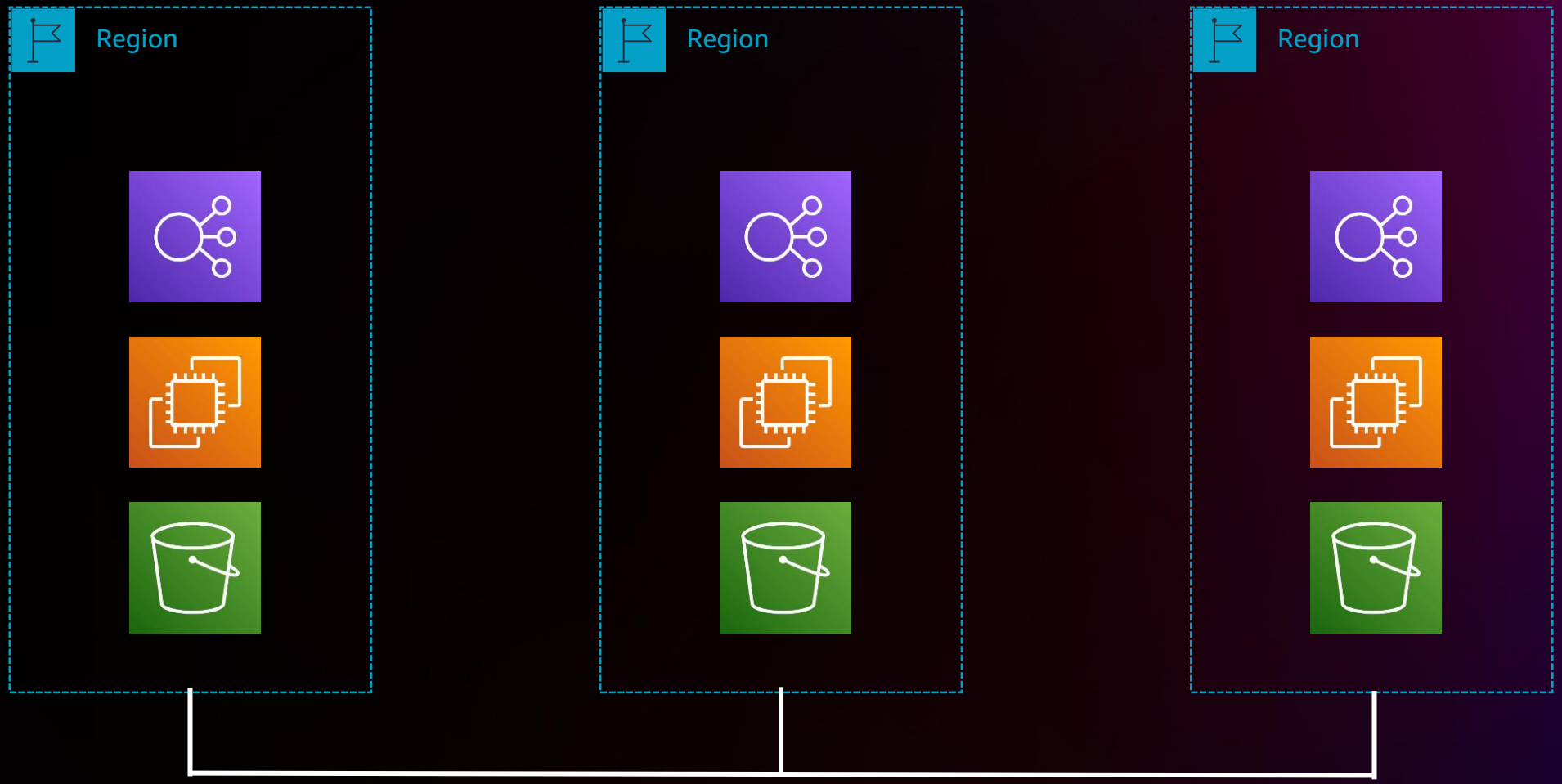
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Active-active-active



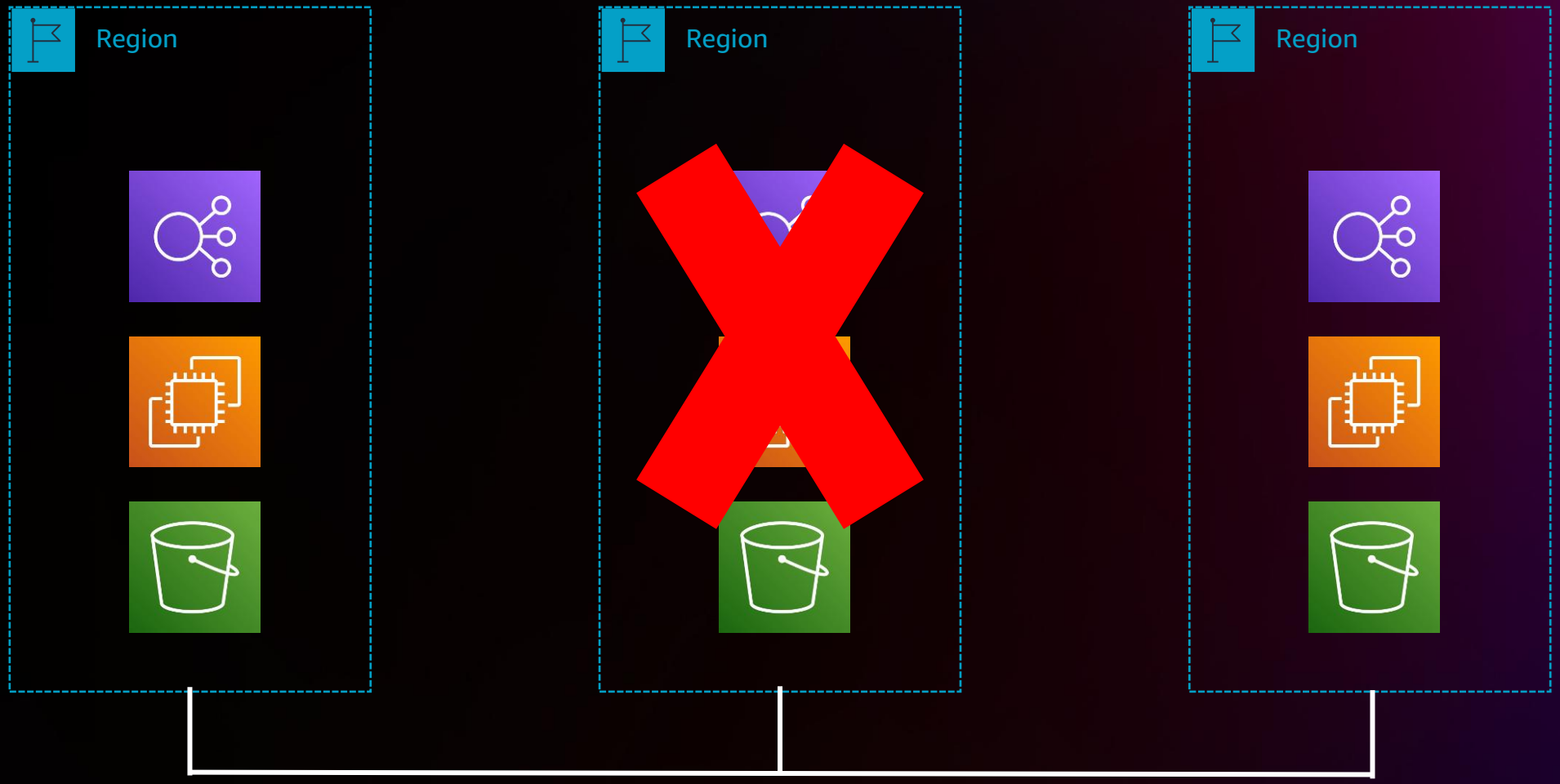
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Active-active-active



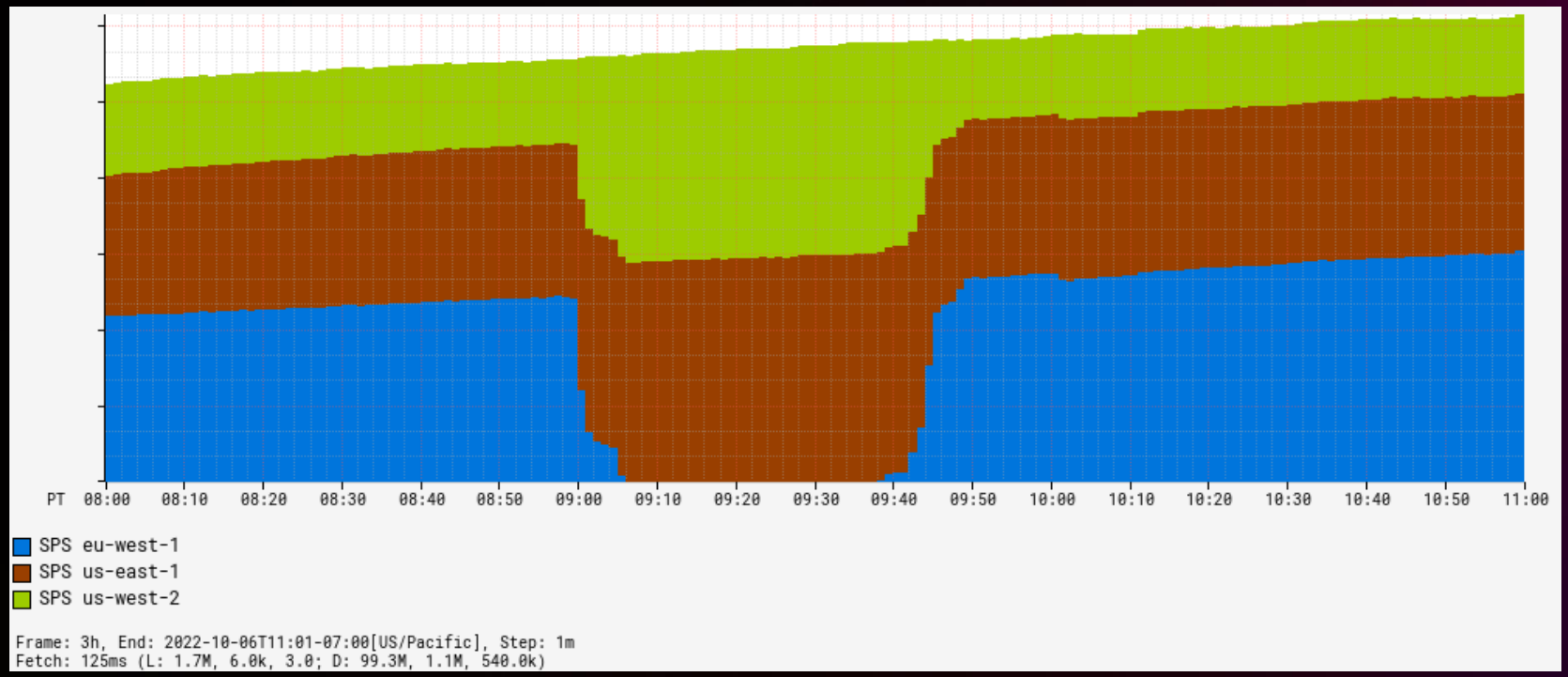
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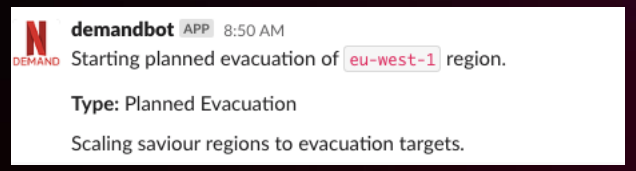
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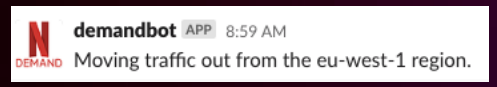
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Easy as 1, 2, 3

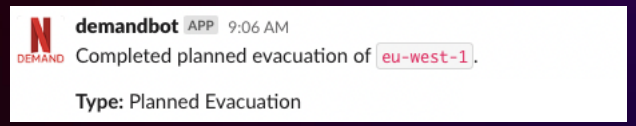
Scale up



Shift traffic

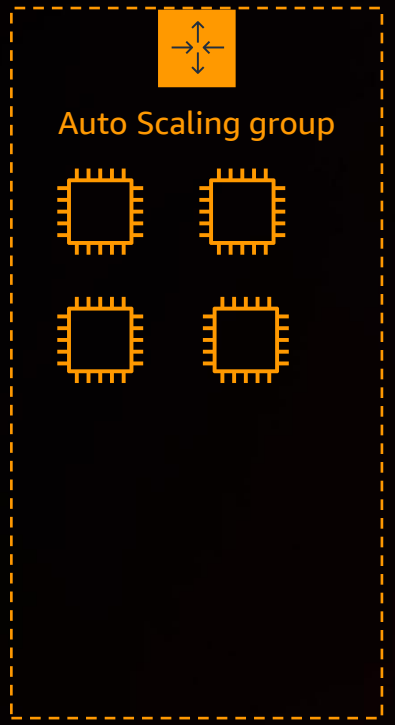


Recovery

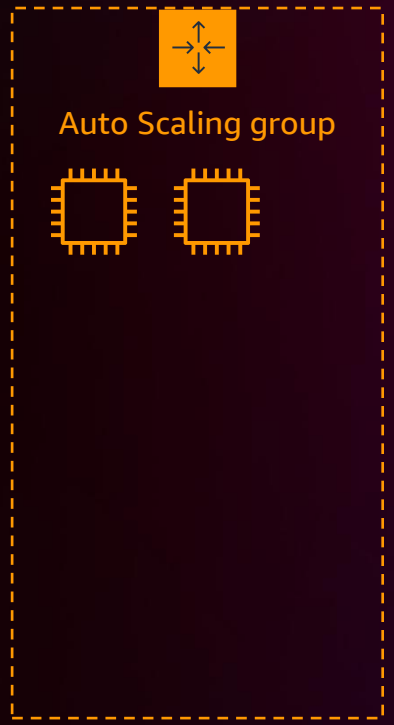


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Scale up – Nimble



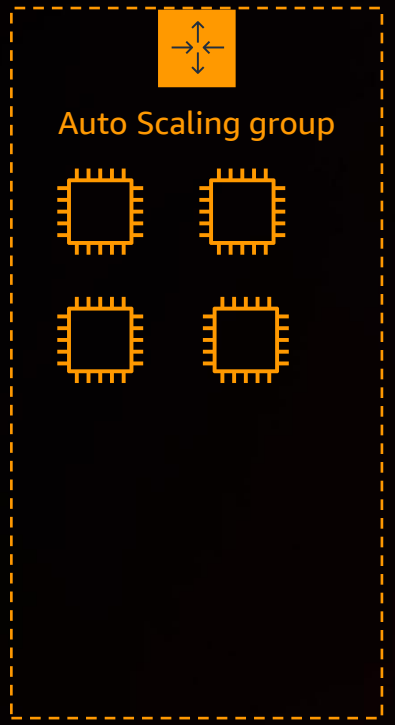
Active



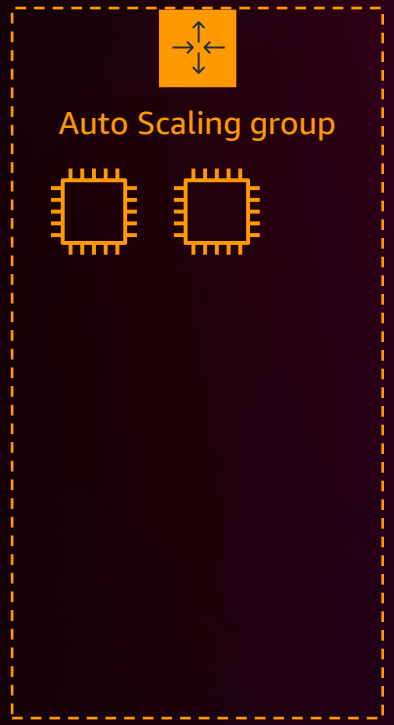
Nimble

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Scale up – Nimble



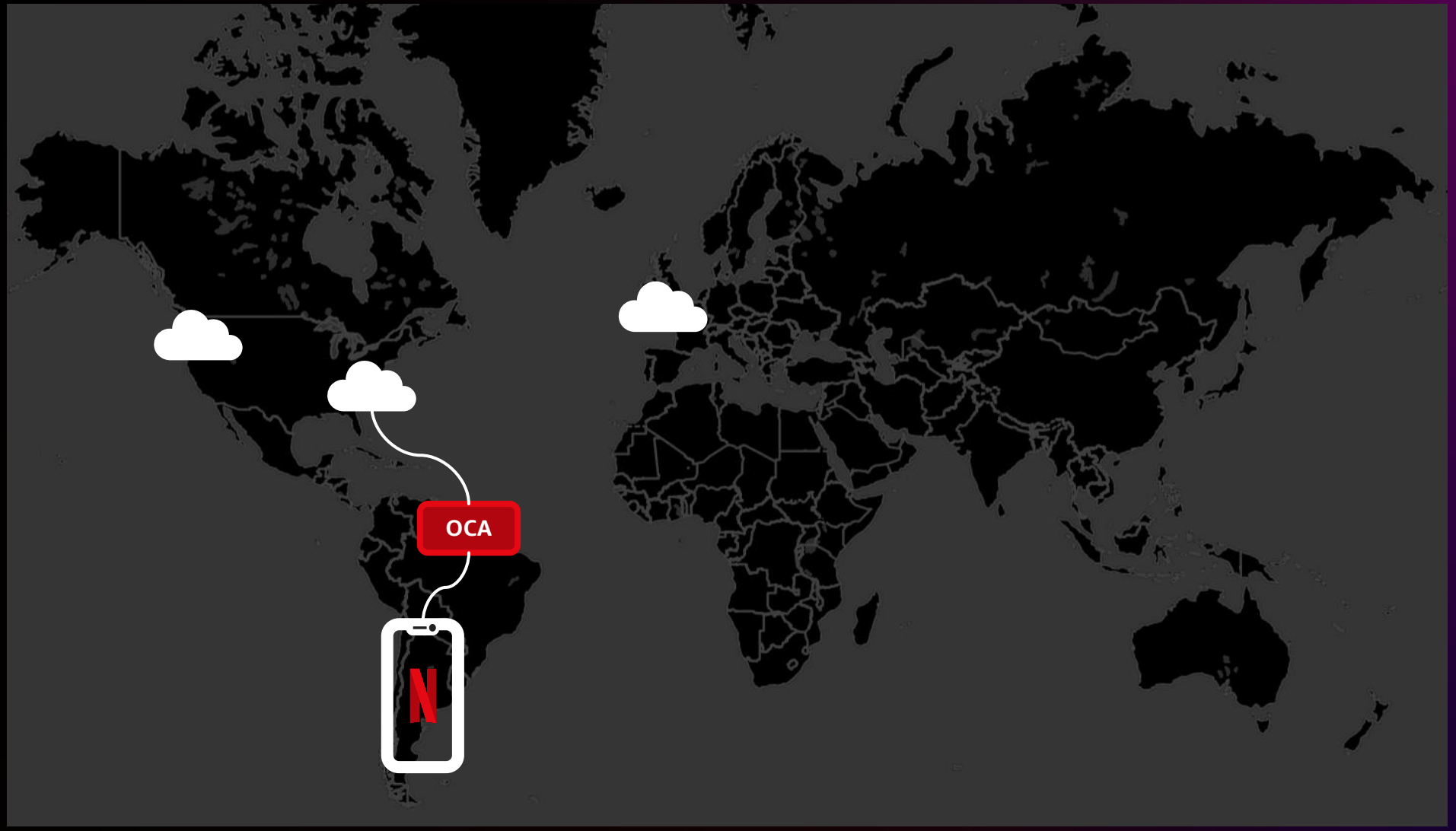
Active



Nimble

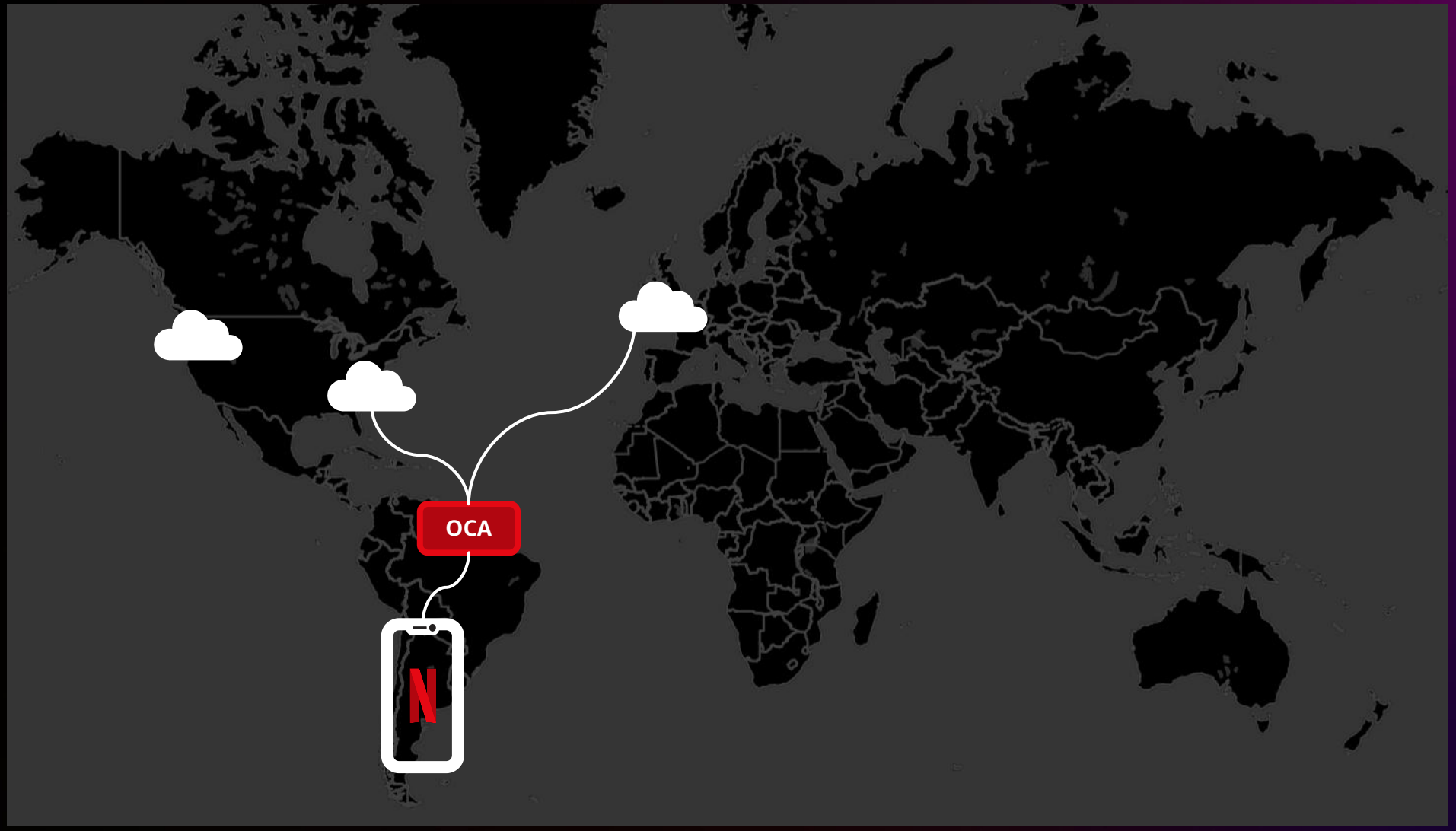
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Shift traffic



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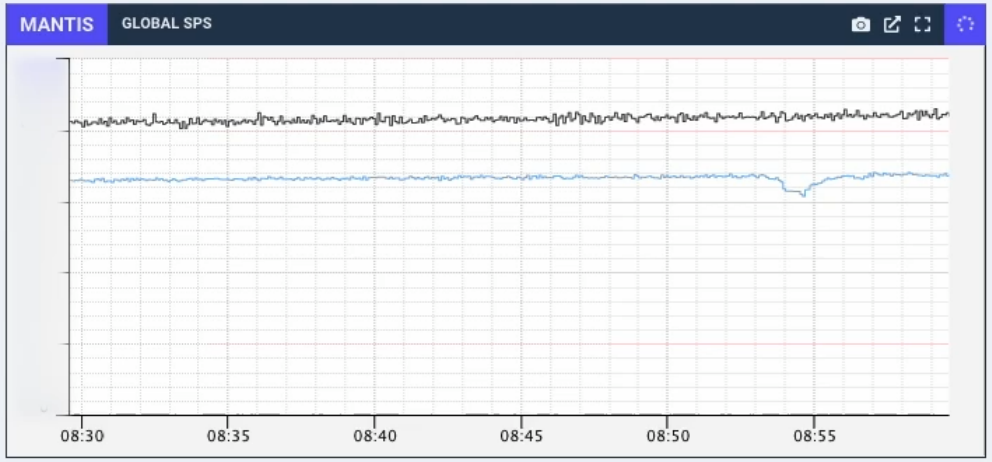
Shift traffic



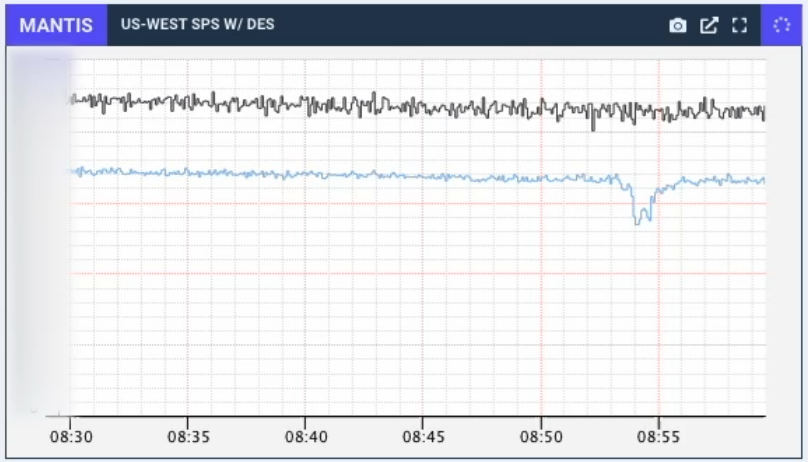
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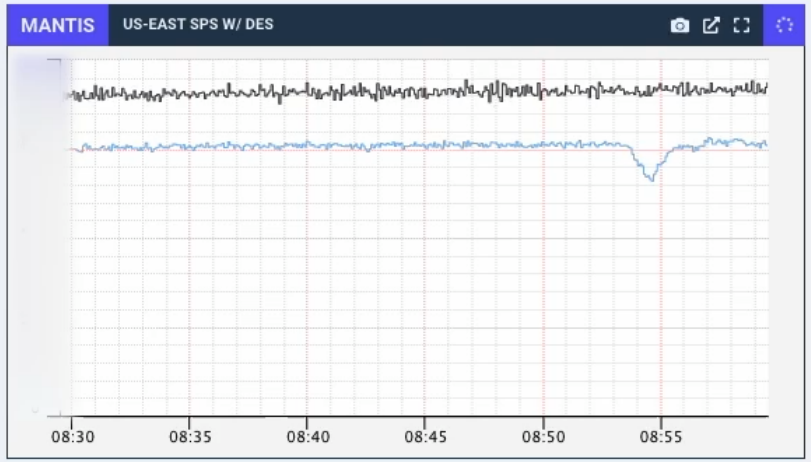
Failover in action

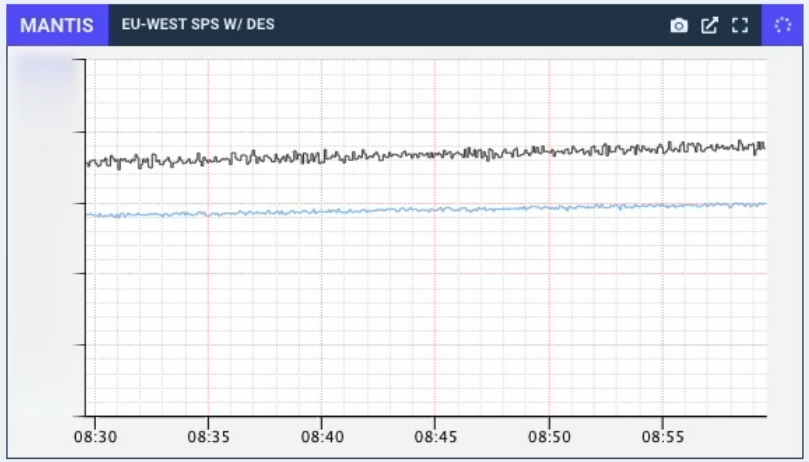
Global SPS



Regional SPS







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Netflix takeaways

- Always active
  - Pre-provisioned – less reliance on control planes
  - Architect according to fault isolation boundaries

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  - Quickly assess the scope of impact
- Exercise regularly
  - Practice, practice, practice
- Adapt operations
  - Maintain regional failover capability

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Additional resources



AWS Fault Isolation Boundaries
https://docs.aws.amazon.com/whitepapers/latest/aws-fault-isolation-boundaries/abstract-and-introduction.html



Creating disaster recovery mechanisms using Amazon Route 53
https://aws.amazon.com/blogs/networking-and-content-delivery/creating-disaster-recovery-mechanisms-using-amazon-route-53/



Advanced multi-AZ resilience patterns
https://docs.aws.amazon.com/whitepapers/latest/advanced-multi-az-resilience-patterns/advanced-multi-az-resilience-patterns.html



Deploying multi-Region applications in AWS using AWS Global Accelerator
https://aws.amazon.com/blogs/networking-and-content-delivery/deploying-multi-region-applications-in-aws-using-aws-global-accelerator/



Static stability using Availability Zones
https://aws.amazon.com/builders-library/static-stability-using-availability-zones/

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Thank you!

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