

AWS
re:Invent

S V S 3 3 7 - R

Best practices for building multi-region, active-active serverless applications

Adrian Hornsby

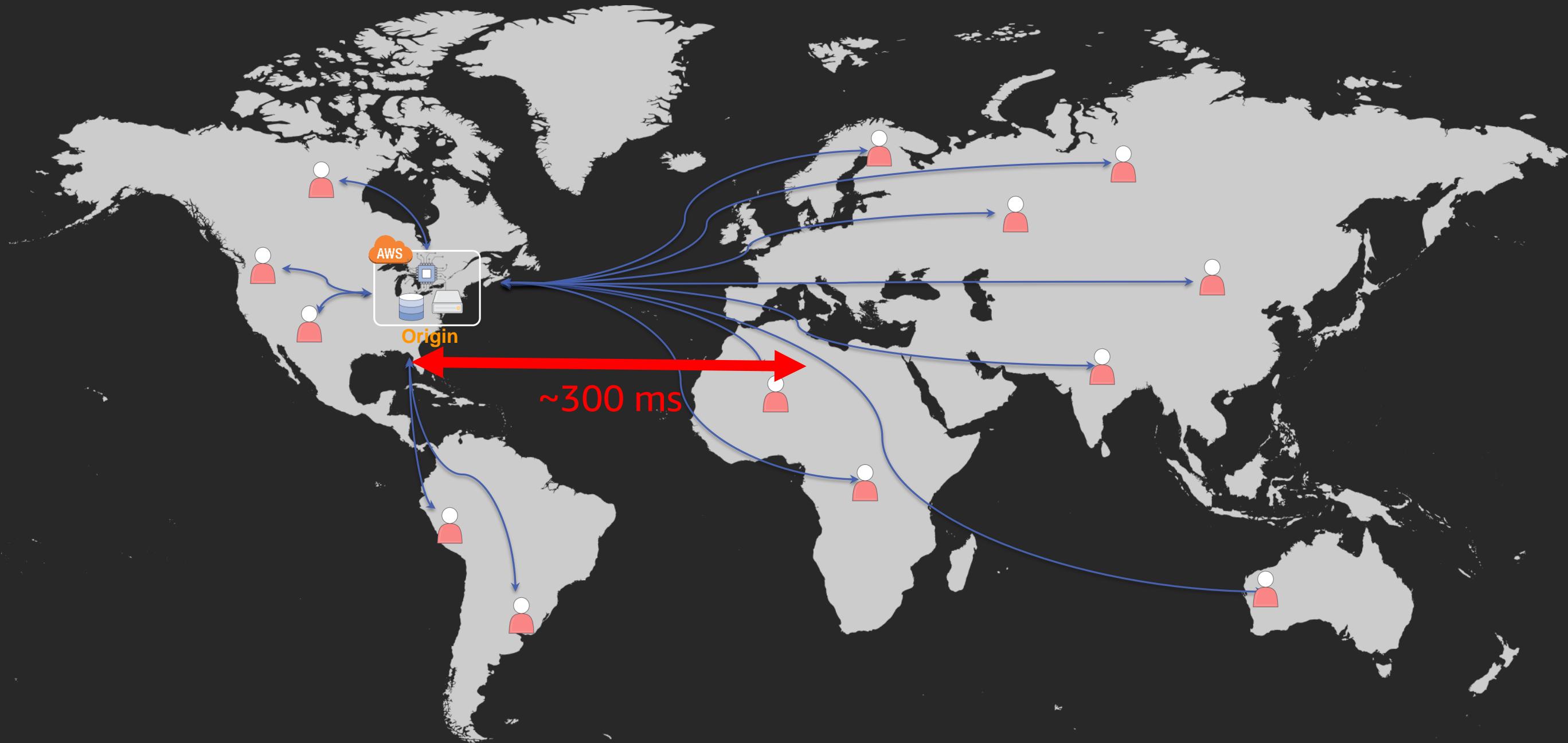
Principal Evangelist
Amazon Web Services

Why build a global architecture?

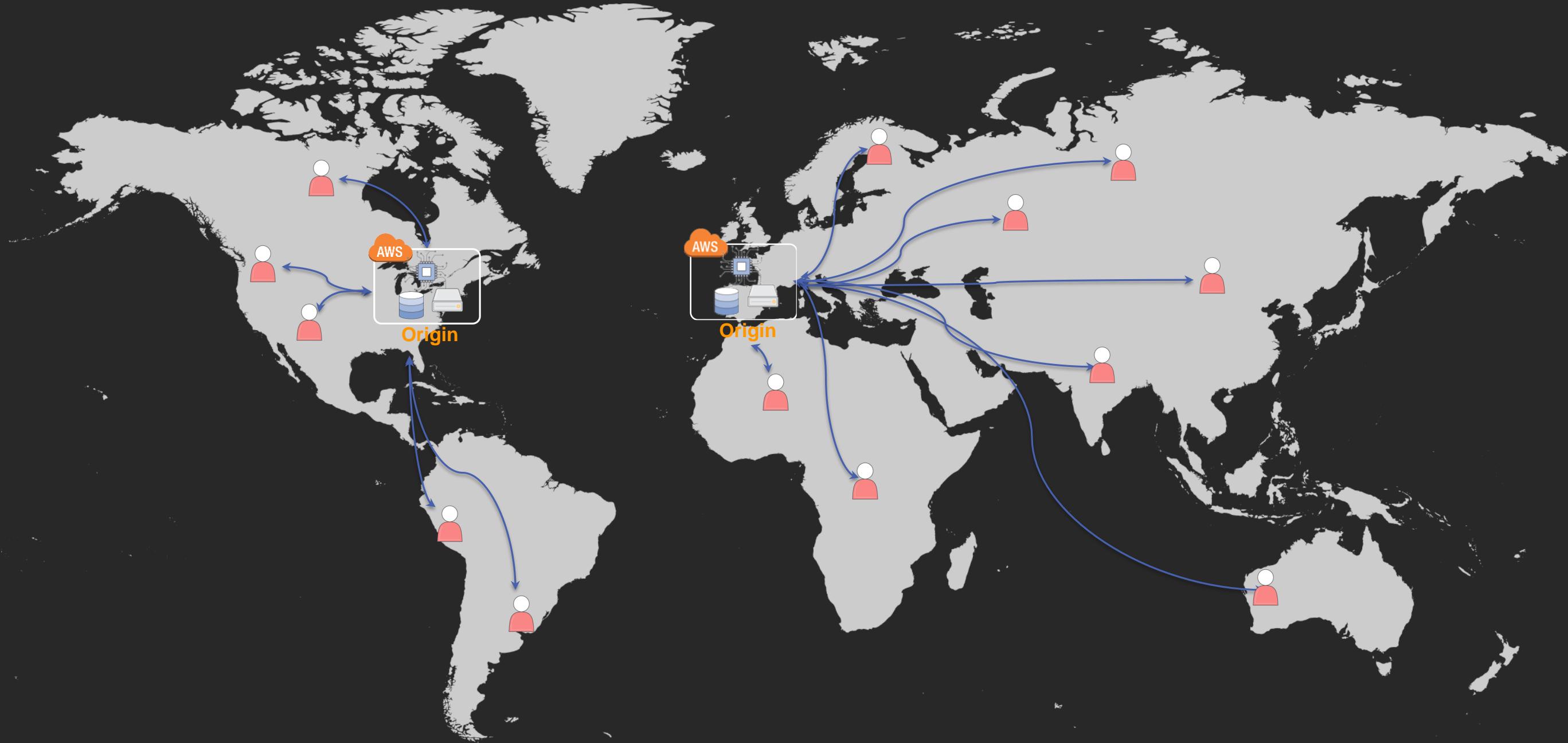
Once upon a time ...



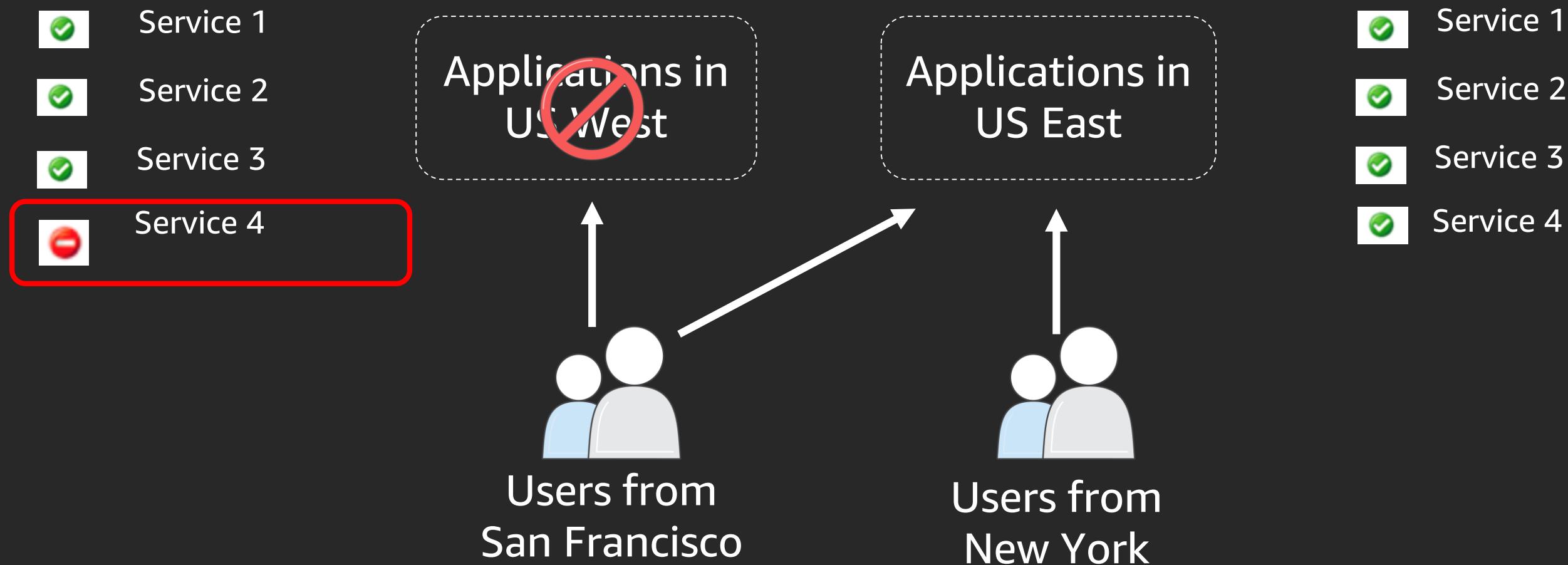
And now . . .



Improve latency for end users



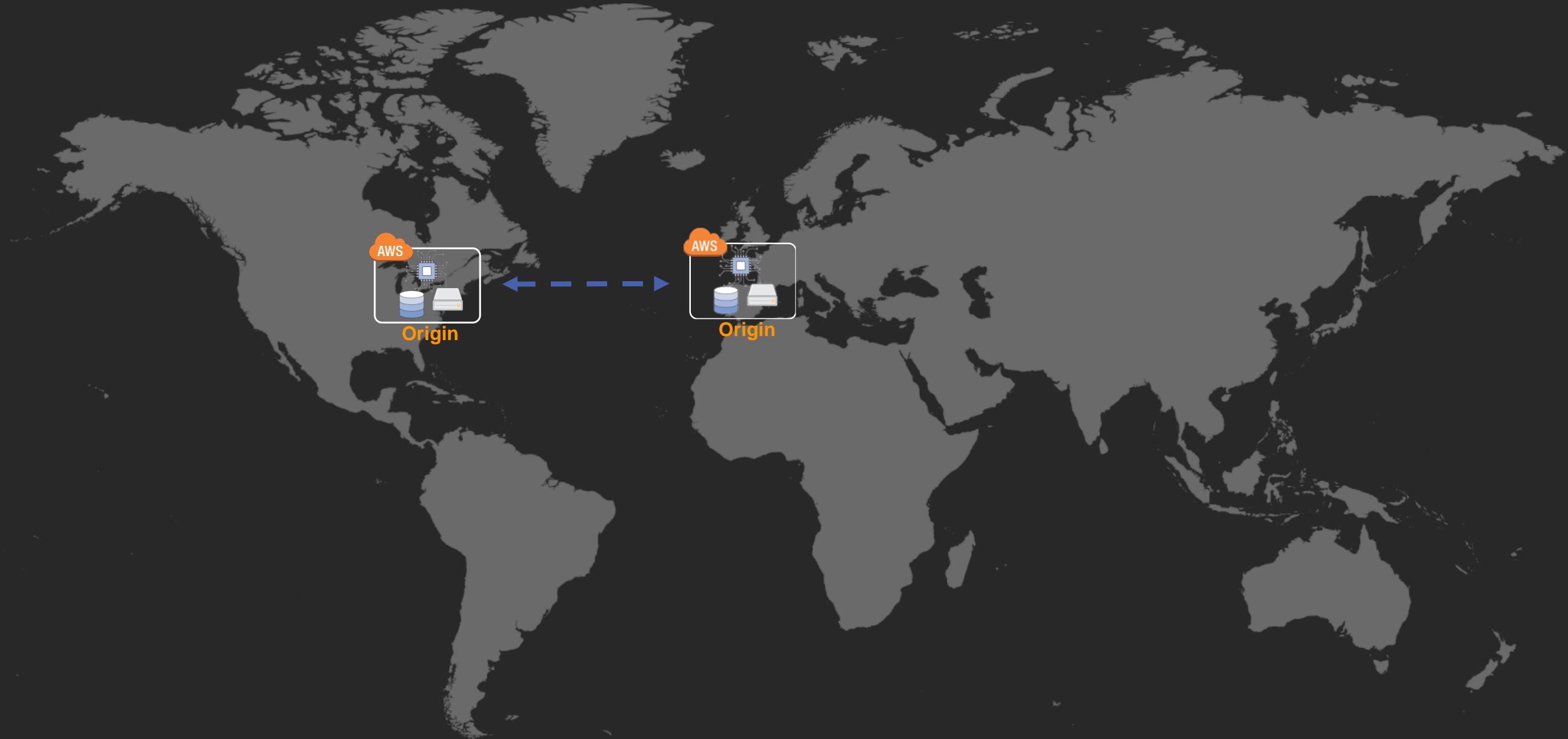
Improve availability and disaster recovery



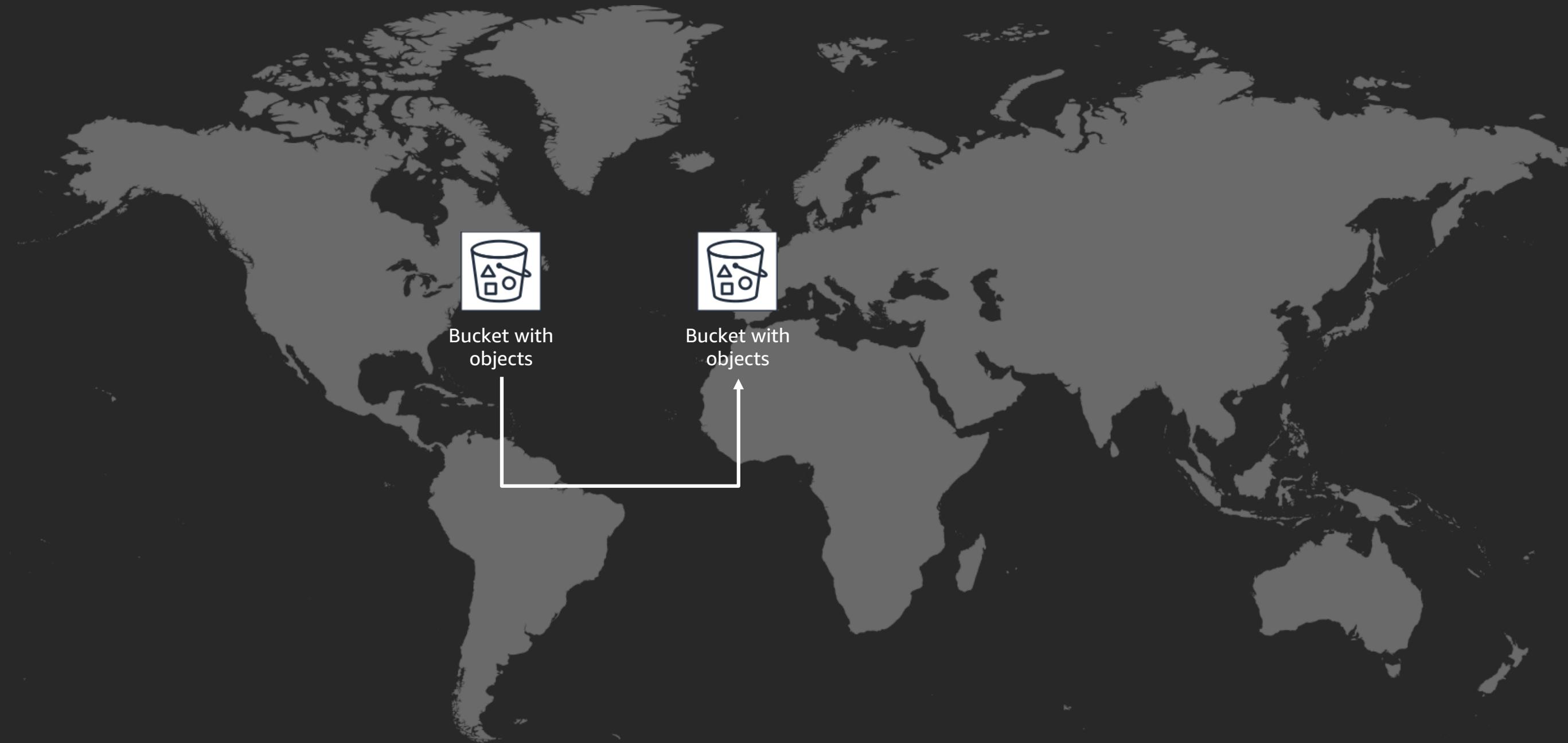
Amazon global network



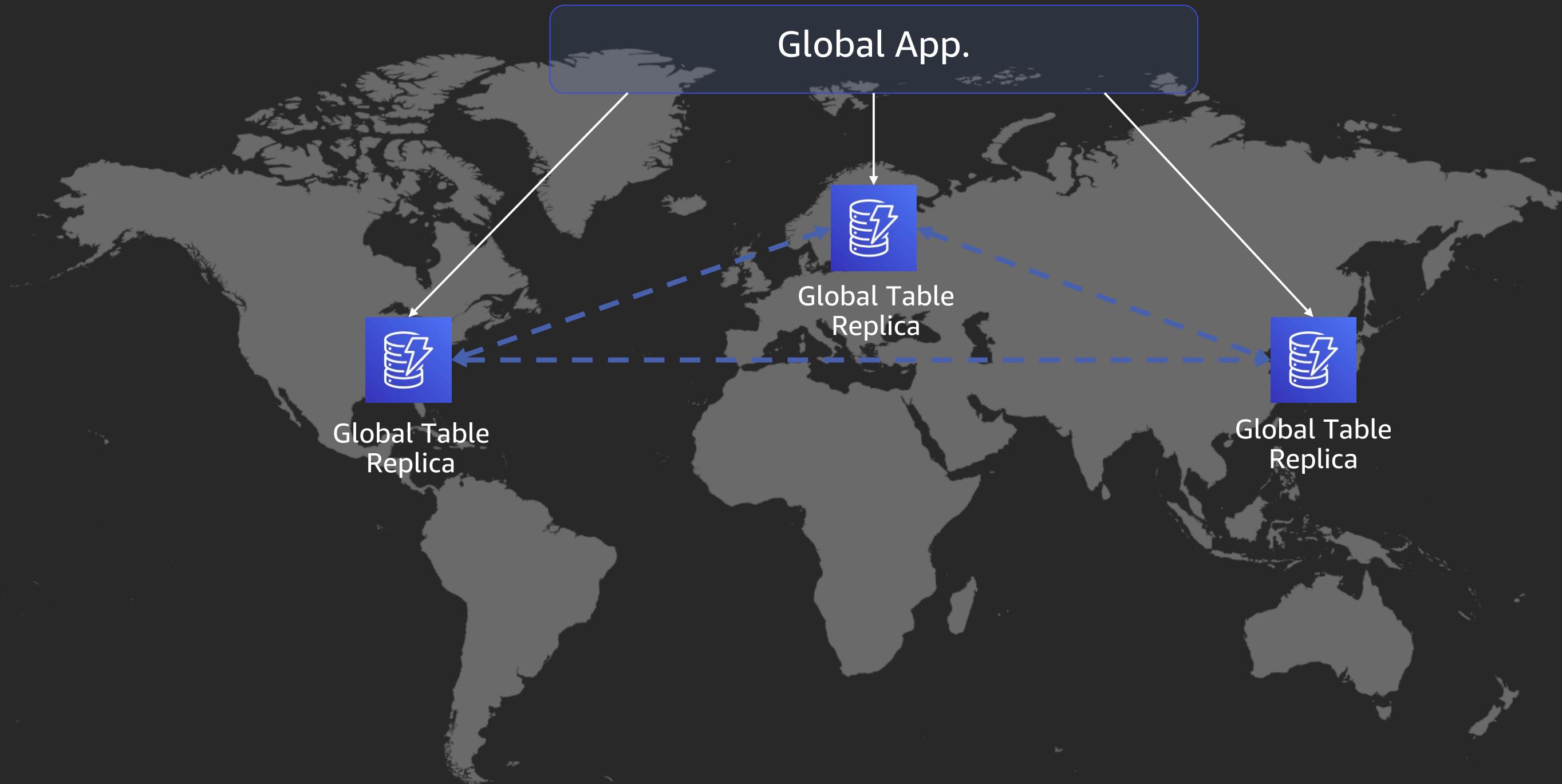
Cross-region VPC peering



Amazon S3 cross-region replication



Amazon DynamoDB global table



You now can enhance availability of your existing Amazon DynamoDB tables by adding global replicas

Posted On: Nov 21, 2019

You now can benefit from the 99.999% [DynamoDB availability SLA](#) more easily by adding global tables replicas to your existing, single-region tables with a few clicks in the DynamoDB console. Previously, you could only create new DynamoDB global tables. For existing tables, you can now easily create a hot standby for disaster recovery, or you can extend your existing tables to additional AWS Regions to support latency-sensitive applications, without taking any downtime on your table. In addition, you benefit from efficiency improvements that can reduce replicated writes consumed by up to 50 percent.

When you add an AWS Region to your table, DynamoDB begins populating a new replica by using a snapshot of your existing table. You can continue writing to the originating region while DynamoDB builds the new replica, and DynamoDB replicates all in-flight updates automatically to the new replica. You can add or delete replicas to your existing global tables at any time, providing you the flexibility to move or replicate your data as your business requires.

You now can use DynamoDB global tables in the [AWS GovCloud \(US\) Regions](#). To learn more about regional availability and pricing for this feature, see [Amazon DynamoDB pricing](#). For more information about global tables, see [DynamoDB Global Tables](#), or read more about this feature on the [AWS News Blog](#).

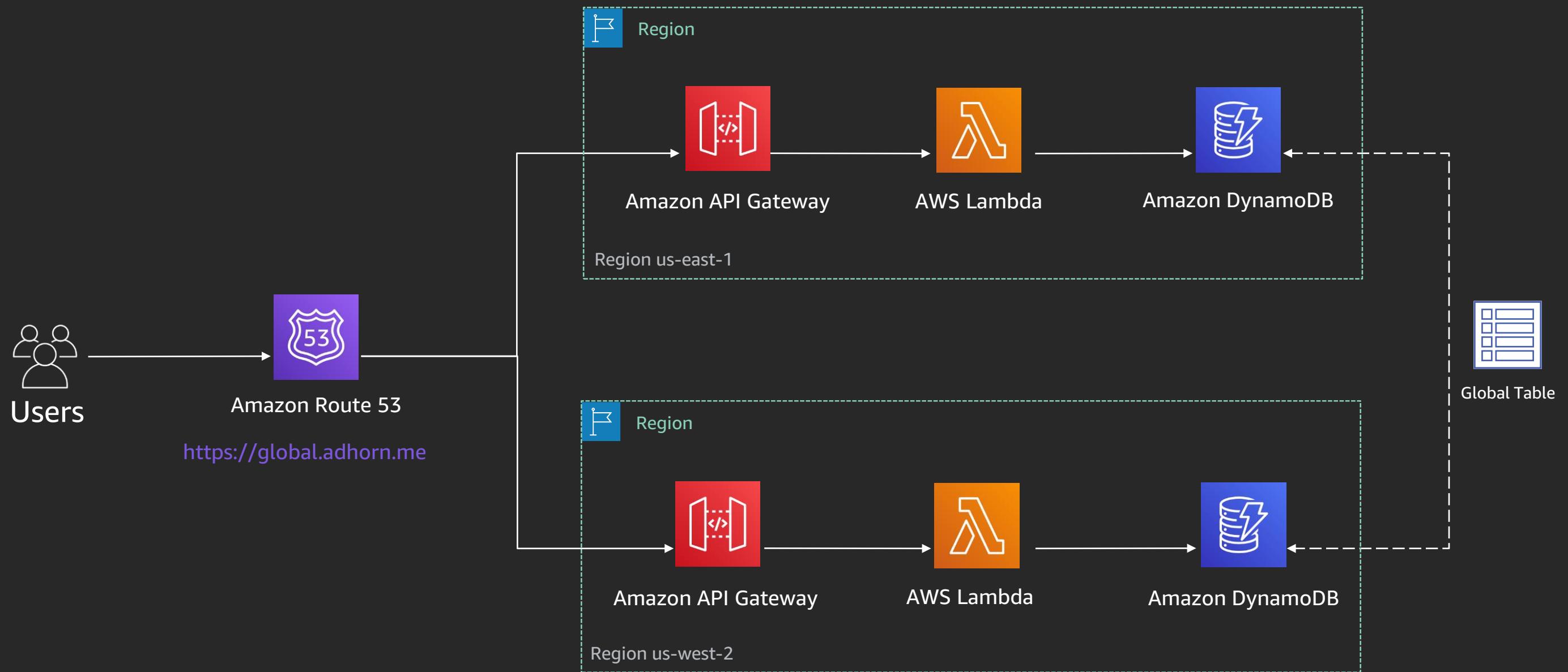
<https://aws.amazon.com/blogs/aws/new-convert-your-single-region-amazon-dynamodb-tables-to-global-tables/>

Active-Active | Active-Passive | What to do?

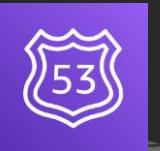
Serverless cost model is a huge advantage here!

Brace yourself, demos are coming!

**Amazon Route 53 > Amazon API Gateway >
AWS Lambda > Amazon DynamoDB**



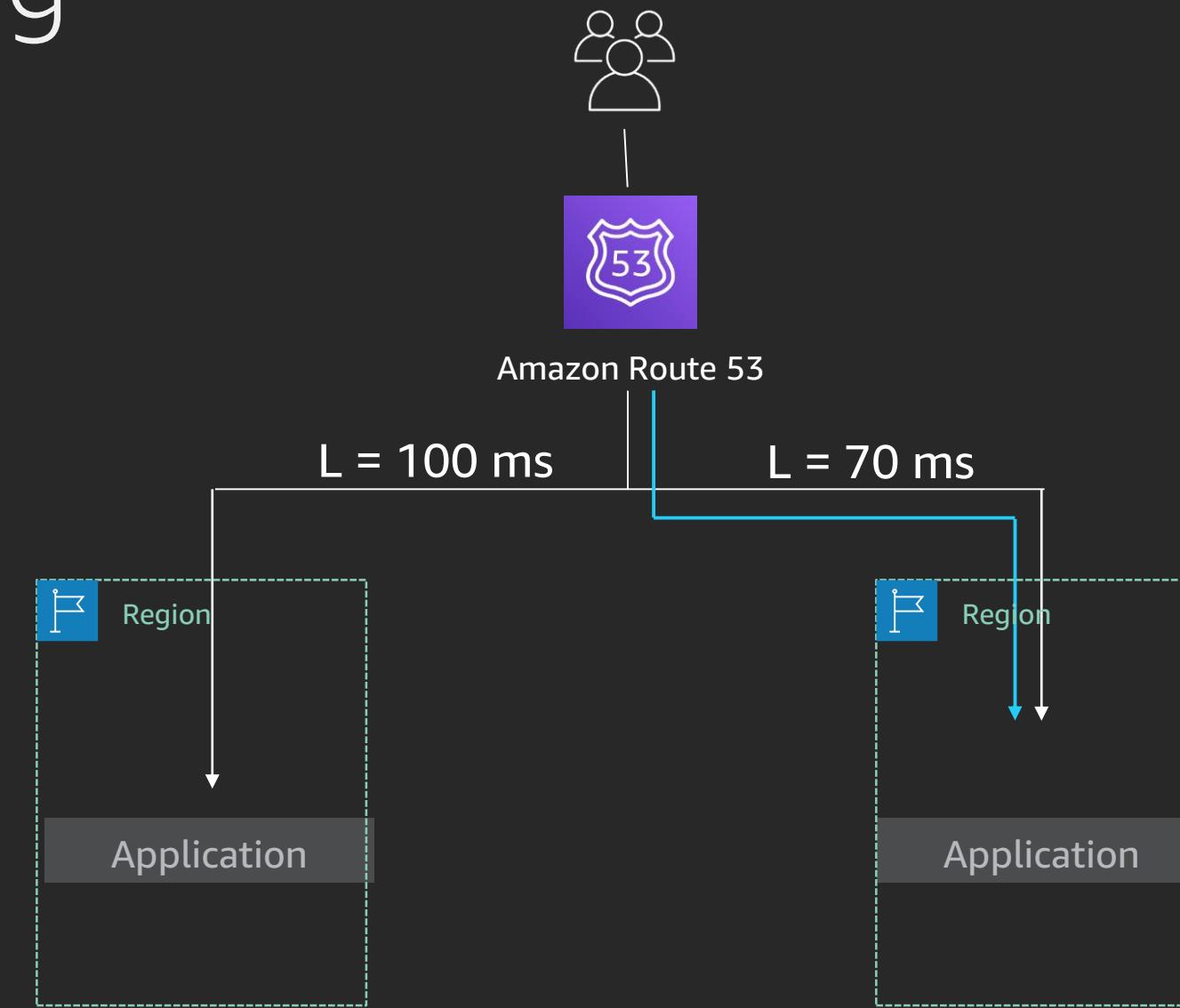
Multi-region with Route 53



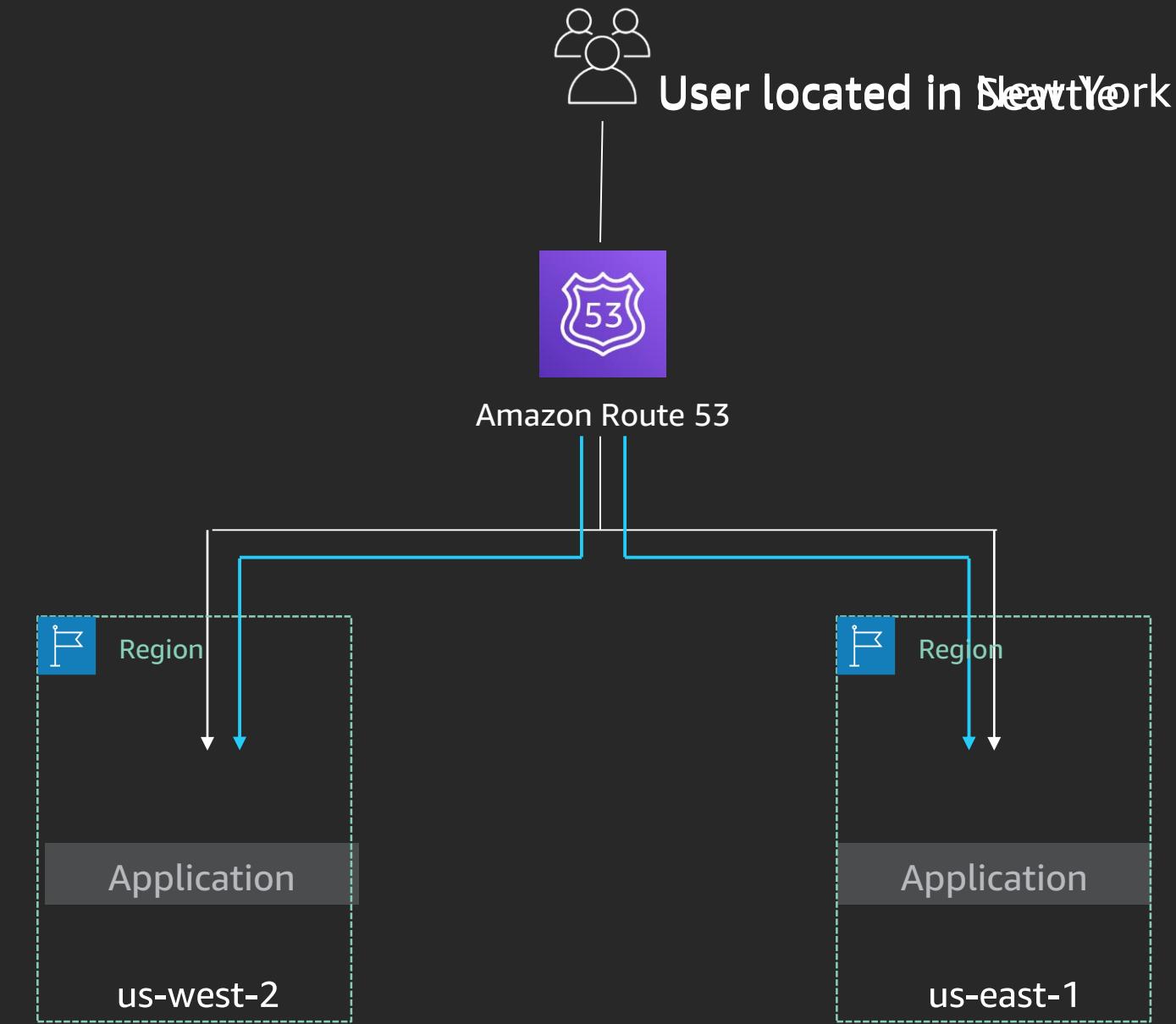
Amazon Route 53



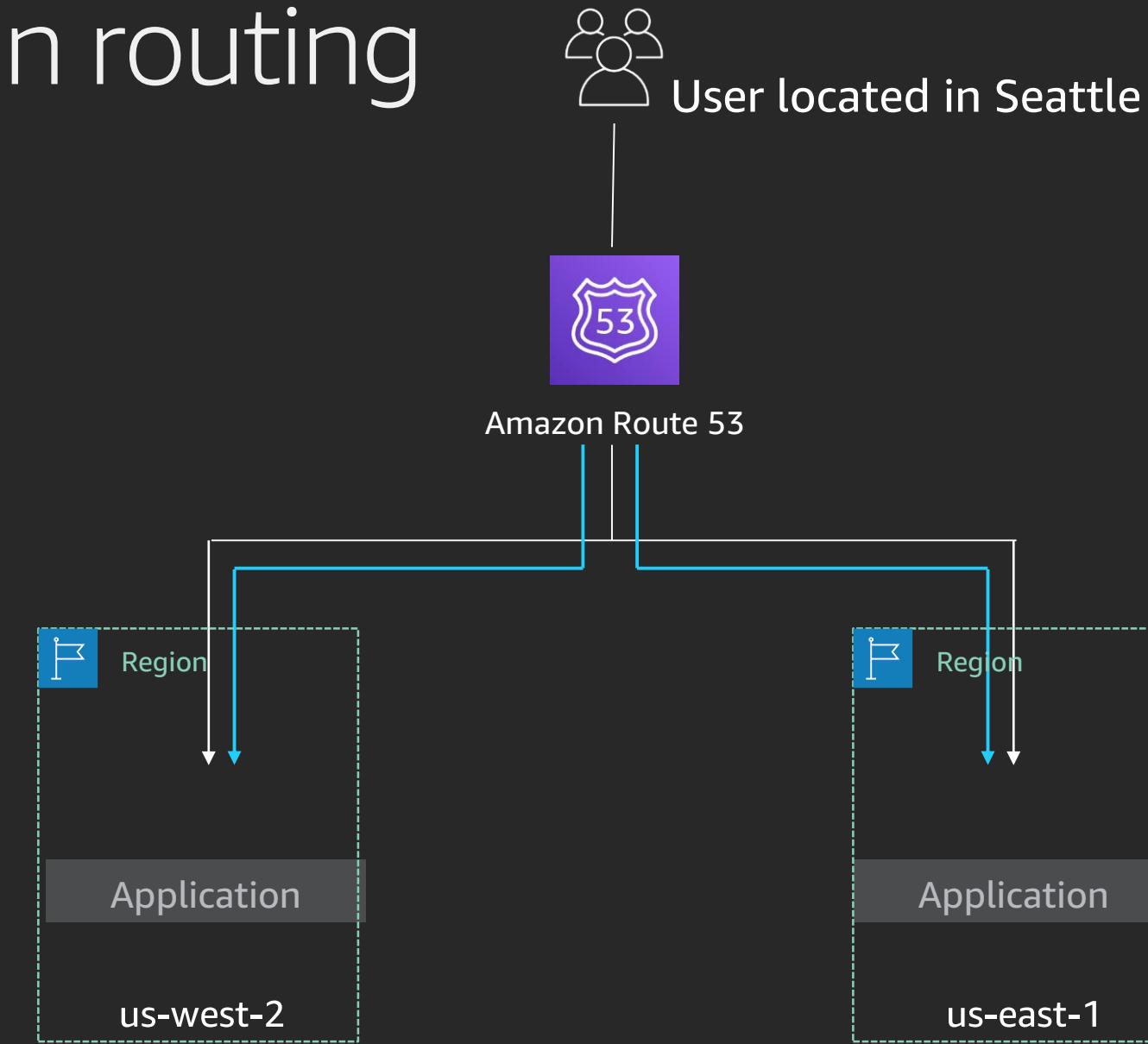
Latency-based routing



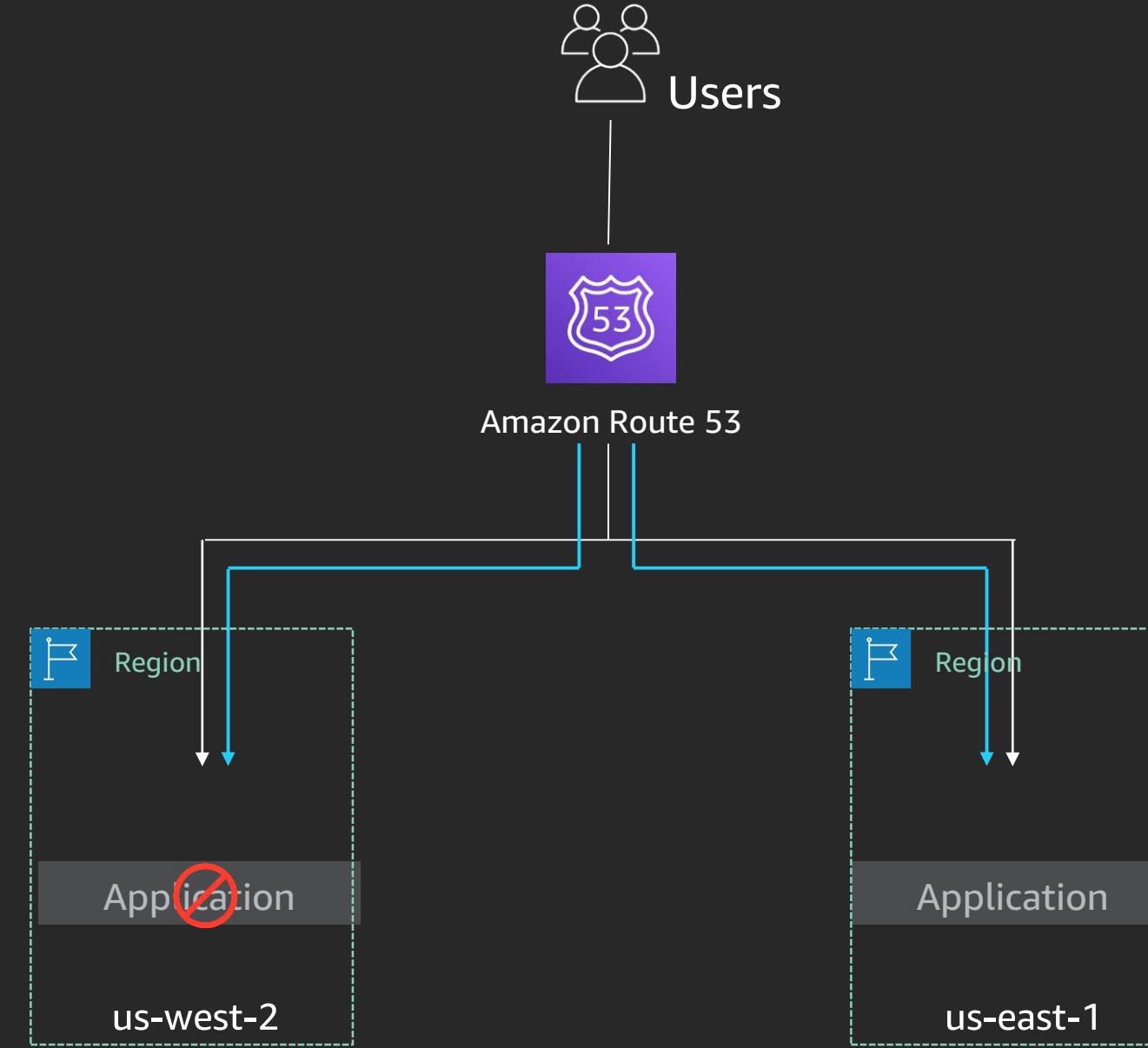
Geo-based routing

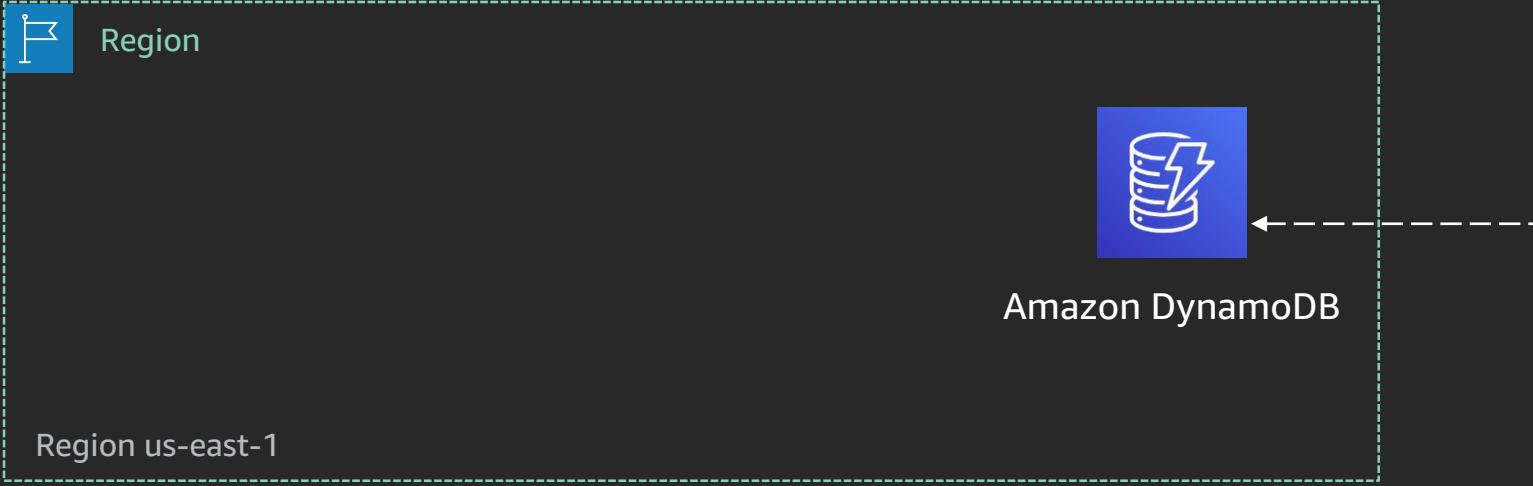


Weighted round-robin routing



DNS failover

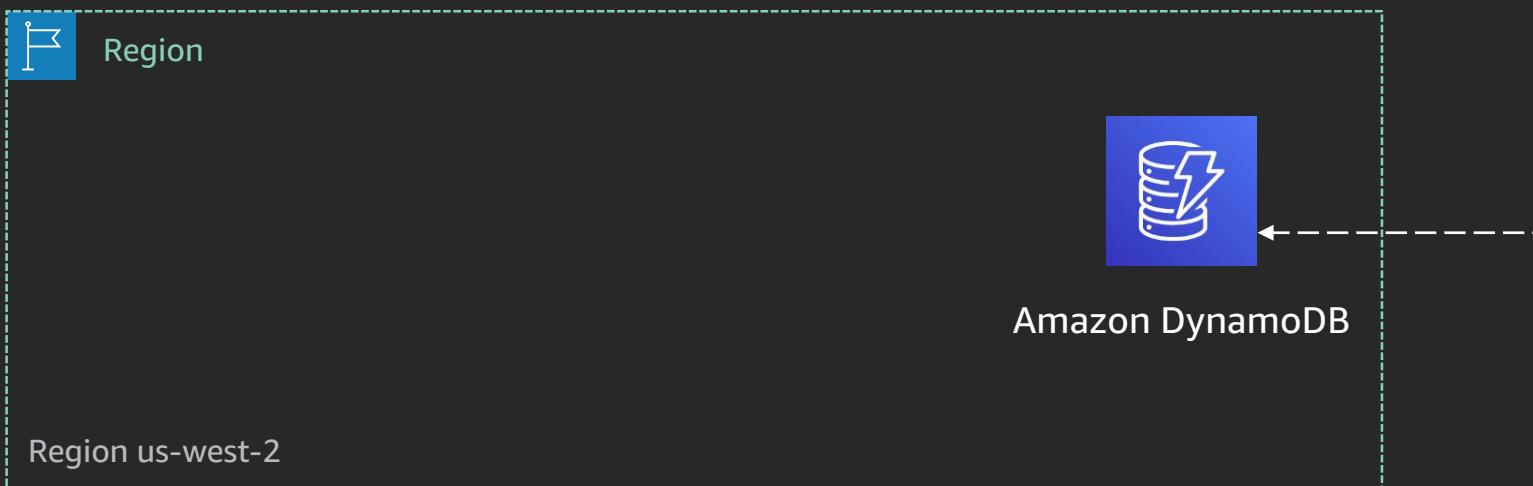




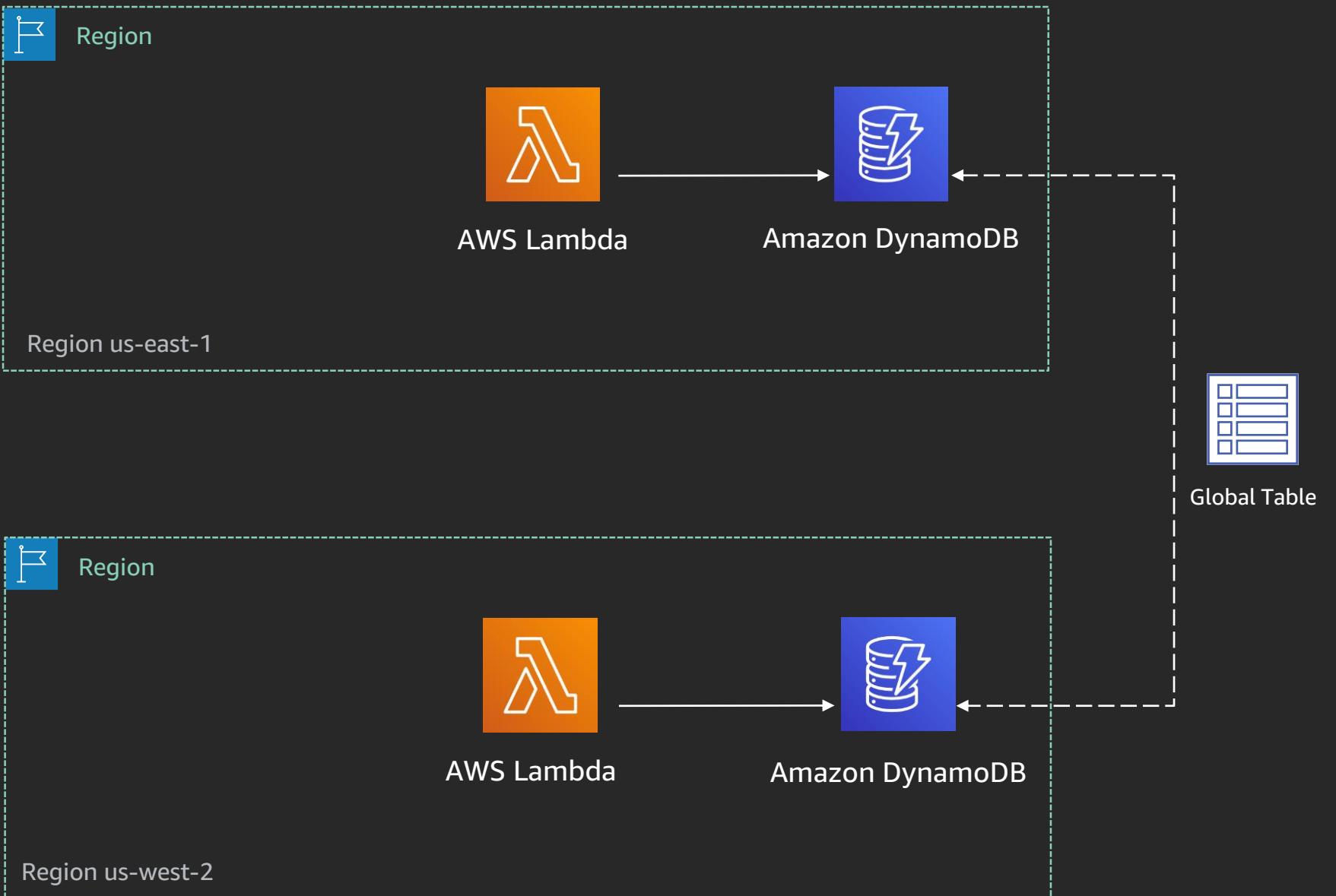
Region us-east-1



Global Table



Region us-west-2



```

import json
import logging
import boto3
import os
import uuid

log = logging.getLogger()
log.setLevel(logging.DEBUG)

region = os.environ["AWS_REGION"]

dynamodb = boto3.resource('dynamodb', region_name=region)
table = dynamodb.Table('dynamo_serverless')

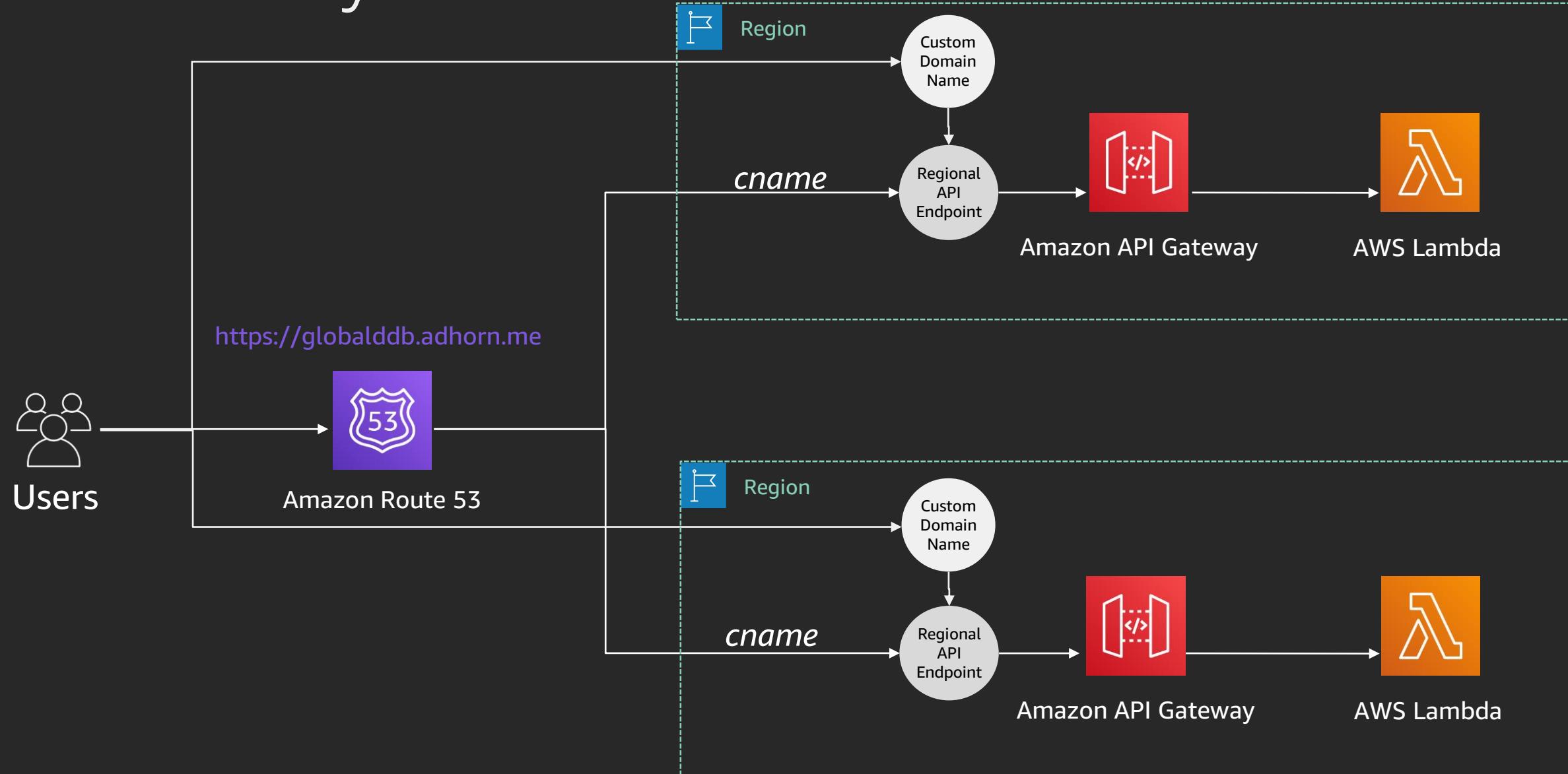
def put_to_dynamo(event):
    log.debug("Received in put_to_dynamo: {}".format(json.dumps(event)))
    feedback_id = str(uuid.uuid4())
    table.put_item(
        Item={
            'feedback_id': feedback_id,
            'value': "This item is coming from {}".format(region),
        }
    )
    return feedback_id

```

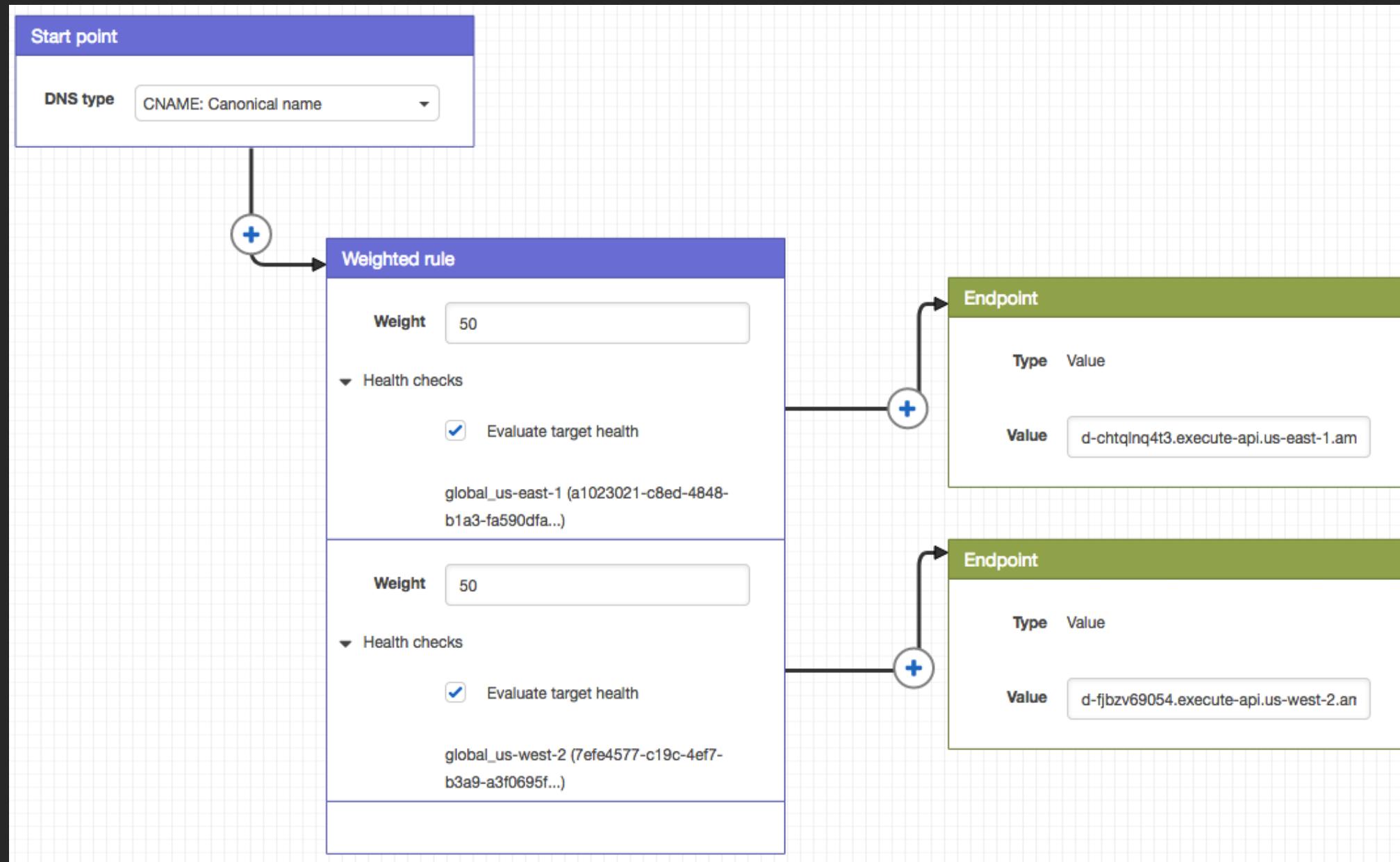
Scan: [Table] dynamo_serverless: feedback_id ▲

	feedback_id	value
<input checked="" type="checkbox"/>	f04e4753-034c-4926-b22c-ab32eb5a2	This item is coming from eu-west-
<input type="checkbox"/>	5ad7c308-67eb-4f93-a4a0-0de25c98e	This item is coming from us-east-
<input type="checkbox"/>	0d840eed-0063-458f-8bb4-9007b91a:	This item is coming from us-east-
<input type="checkbox"/>	0f5f844e-ce8c-4678-969d-963c1db9a	This item is coming from us-east-
<input type="checkbox"/>	968e4545-80a9-4981-b50b-fd60ab19l	This item is coming from us-east-
<input type="checkbox"/>	6bb6f5f41c7945c794c5abd2a0f1abca	This item is coming from us-east-
<input type="checkbox"/>	a288feed-11e6-446e-955f-34c13d61e	This item is coming from us-east-
<input type="checkbox"/>	018029a3-9542-45bd-9db8-fb377b1f3	This item is coming from eu-west-
<input type="checkbox"/>	51bd6619-37a4-42fd-8312-d94f4d984	This item is coming from us-east-
<input type="checkbox"/>	39f1fb90-da48-4b8f-a7ab-ce1dde105:	This item is coming from us-east-
<input type="checkbox"/>	882abaa9-d883-4e28-b0dd-112502d6	This item is coming from eu-west-
<input type="checkbox"/>	36deeb95-4863-4ceb-9046-66284054	This item is coming from us-east-
<input type="checkbox"/>	58912e49-e74f-4837-8598-a9d2d6ecc	This item is coming from us-east-
<input type="checkbox"/>	a845320f-f9d6-41b6-ae0f-2cbcd08d6!	This item is coming from us-east-

API Gateway



Route 53: Traffic policy



Health checks with Route 53

Configure health check

Route 53 health checks let you track the health status of your resources, such as web servers or mail servers, and take action when an outage occurs.

Name: global_us-west-2

What to monitor: Endpoint

Monitor an endpoint

Multiple Route 53 health checkers will try to establish a TCP connection with the following resource to determine whether it's healthy. [Learn more](#)

Specify endpoint by: Domain name

Protocol: HTTPS

Domain name *: rsp6crl0i.execute-api.us-west-2.amazonaws.com

Port *: 443

Path: /dev/health

URL: https://rsp6crl0i.execute-api.us-west-2.amazonaws.com:443/dev/health

Advanced configuration

Create health check Delete health check Edit health check

Filter by keyword

	Name	Status	Description
<input type="checkbox"/>	global_us-west-2	A day ago 15 minutes ago Unhealthy	https://rsp6crl...
<input type="checkbox"/>	global_us-east-1	A day ago 15 minutes ago Unhealthy	https://3vox0rc...

Advanced configuration

Request interval: Standard (30 seconds) Fast (10 seconds)

Failure threshold *: 3

String matching: No Yes

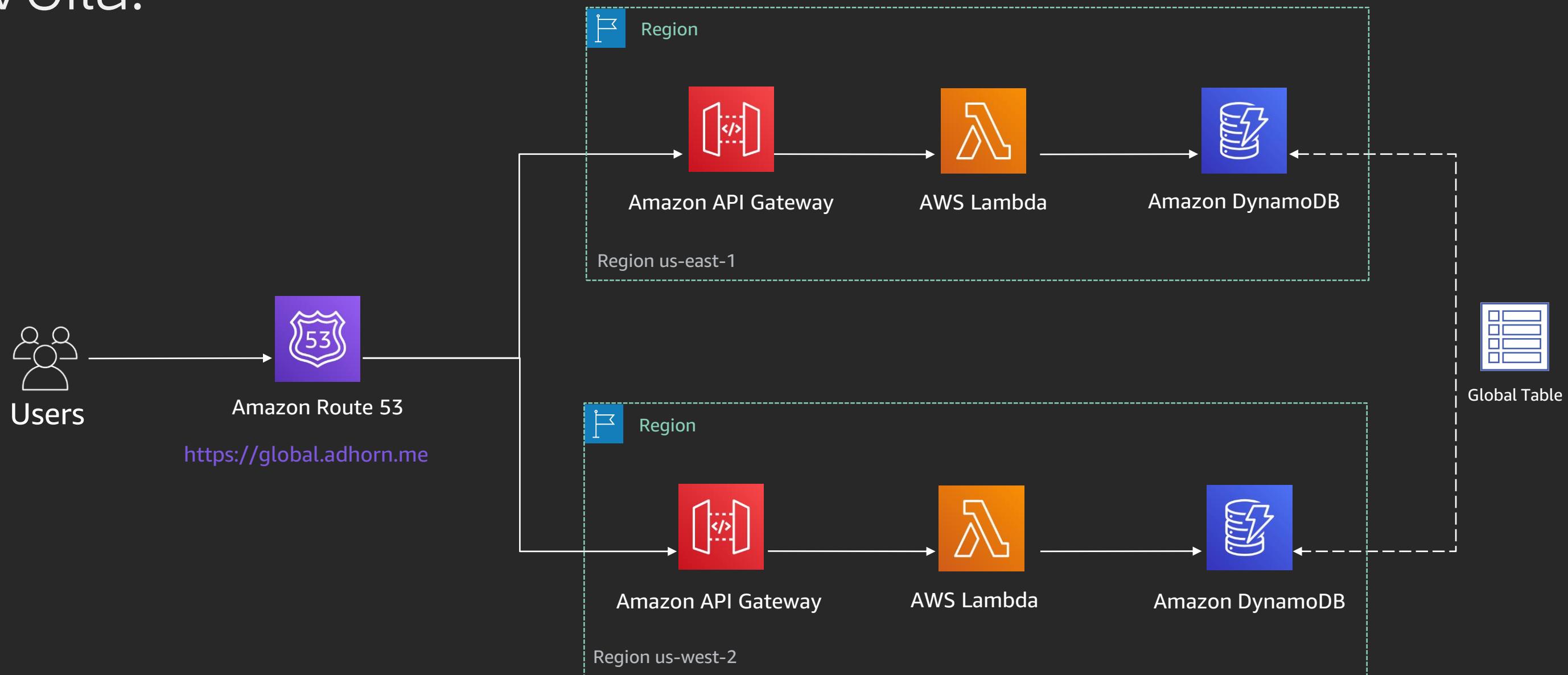
Latency graphs:

Invert health check status:

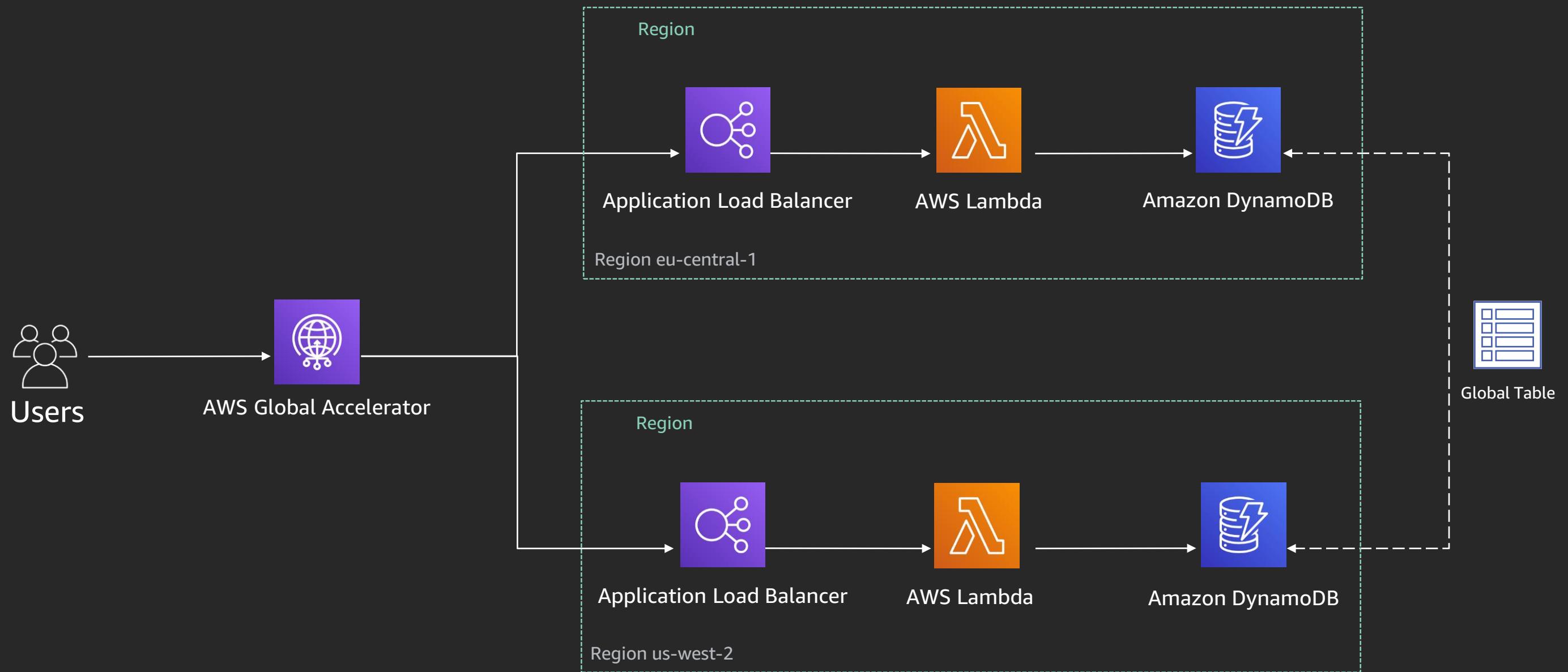
Health checker regions: Customize Use recommended [i](#)

- US East (N. Virginia)
- US West (N. California)
- US West (Oregon)
- EU (Ireland)
- Asia Pacific (Singapore)
- Asia Pacific (Sydney)
- Asia Pacific (Tokyo)
- South America (São Paulo)

Voilà!

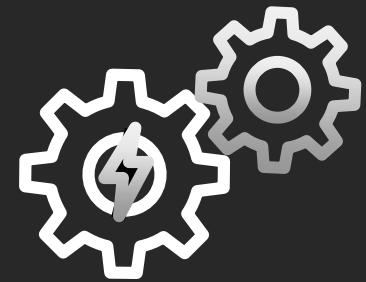


**AWS Global Accelerator > Application Load
Balancer > Lambda > DynamoDB**



AWS Global Accelerator

Improves global application availability and performance



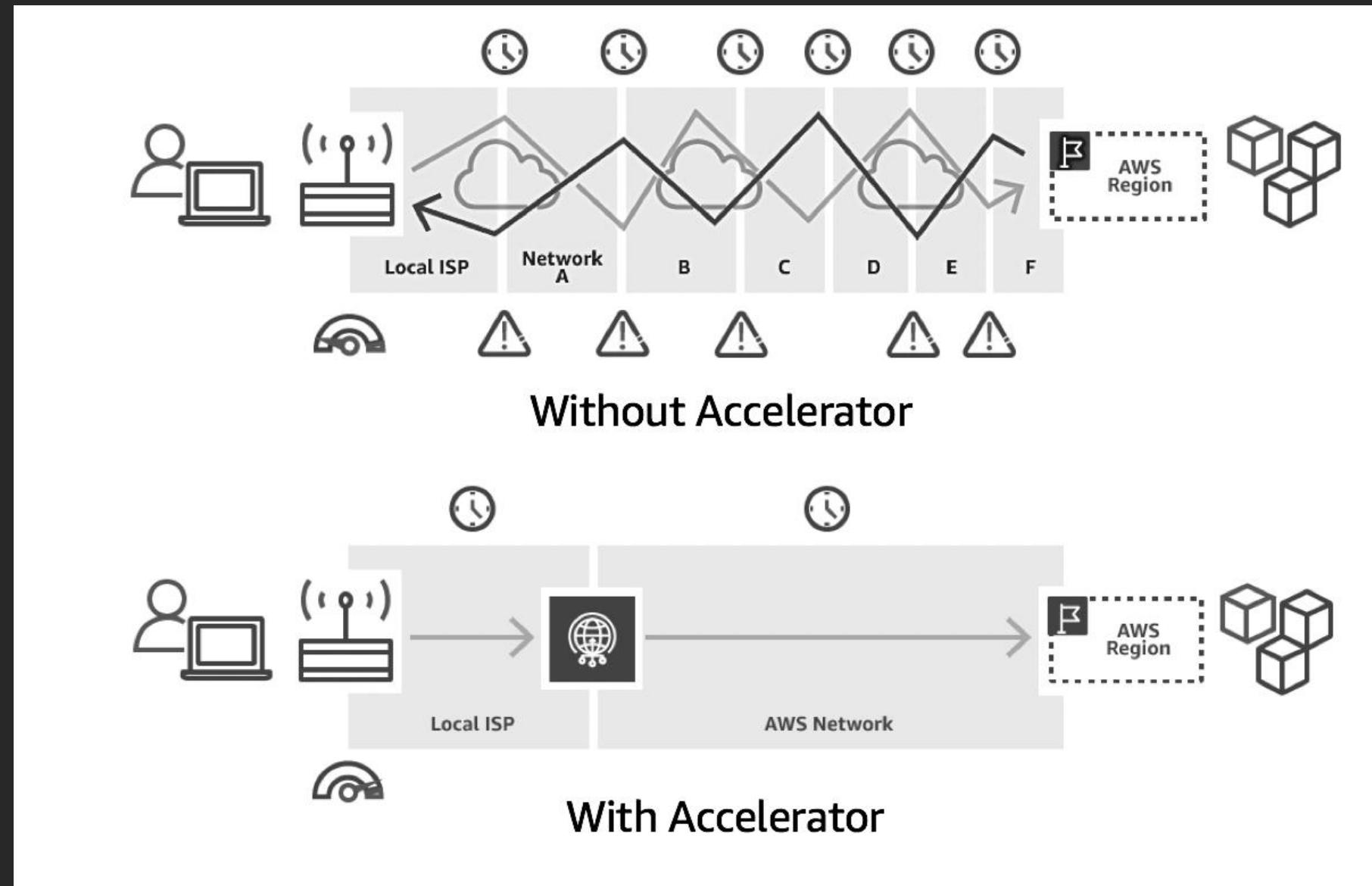
Improved
performance



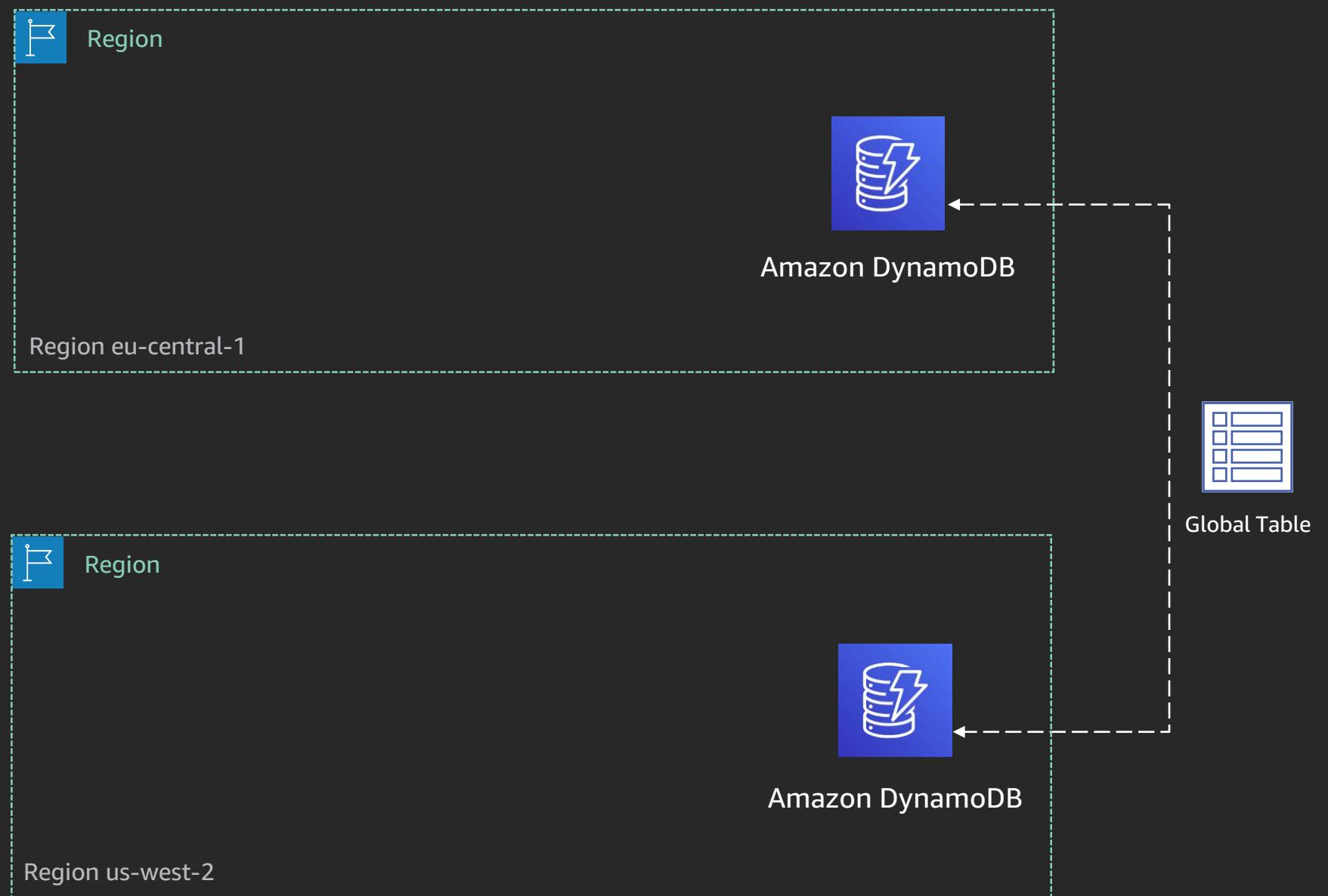
Built-in fault
isolation



Control for
multi-region applications

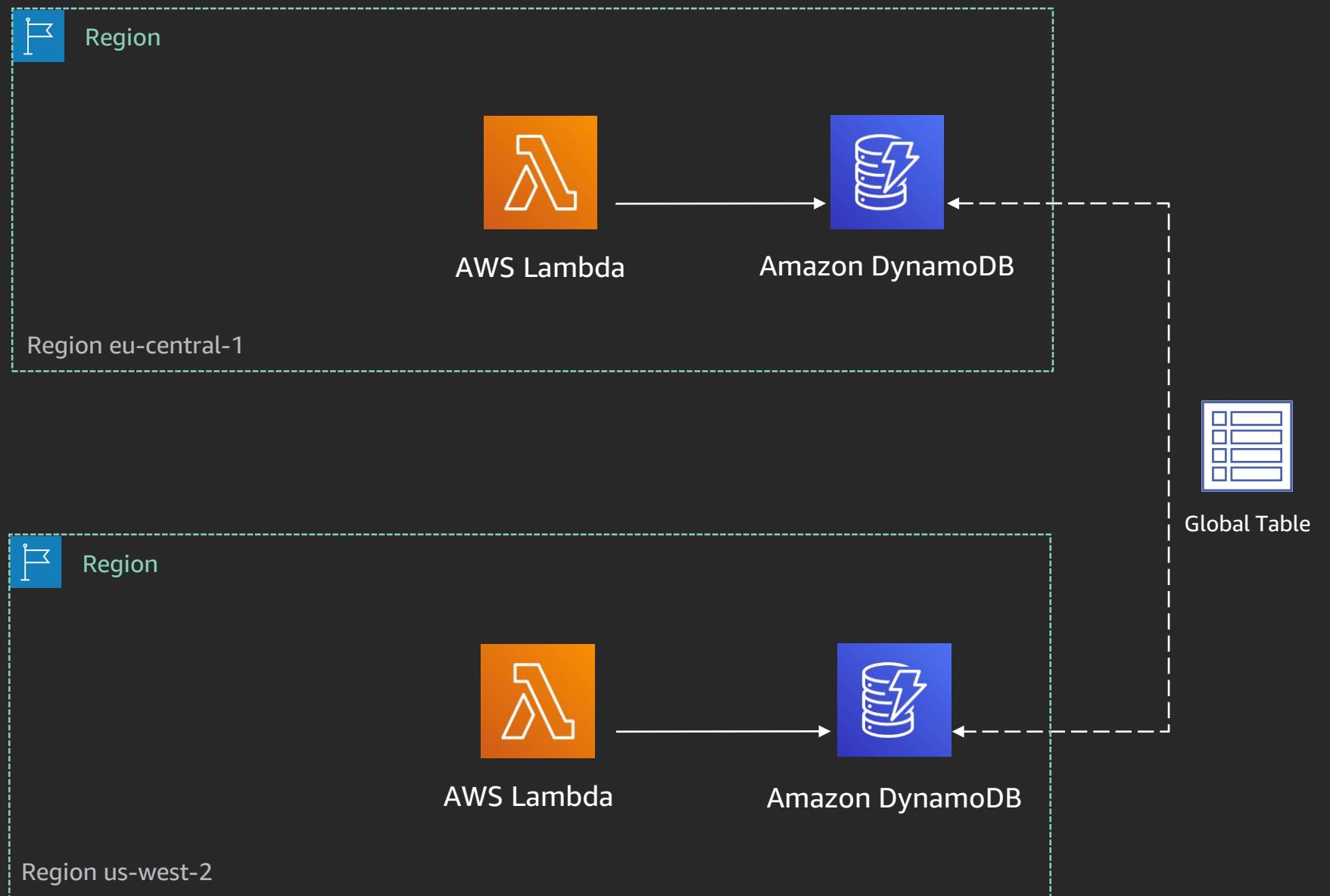


Same as previous!



```
def get_from_dynamo(event):
    log.debug("Received in get_from_dynamo: {}".format(json.dumps(event)))
    item_id = event
    log.debug("item_id: {}".format(item_id))
    item = table.get_item(
        Key={
            'item_id': item_id,
        }
    )
    return item['Item']['item_id']

def get_item(event, context):
    log.debug("Received event in get_item: {}".format(json.dumps(event)))
    basepath = event["path"].split('/')
    print(basepath)
    if basepath[1] == "get":
        body = {
            "item_id": get_from_dynamo(basepath[2]),
        }
        response = {
            "statusCode": 200,
            "isBase64Encoded": False, ←
            "headers": {
                "Content-Type": "text/html; charset=utf-8" ←
            },
            "body": "<html><body><h1> \
                Returned {0} from {1} \
                </h1></body></html>".format(
                    json.dumps(body), region
                )
        }
    elif basepath[1] == "health":
        response = {
            "statusCode": makehealthcheckcalls(),
            "isBase64Encoded": False, ←
            "headers": {
                "Content-Type": "text/html; charset=utf-8" ←
            },
            "body": "<html><body><h1> \
                health: {0} {1} \
                </h1></body></html>".format(
                    makehealthcheckcalls(), region
                )
        }
    return response
```



Load balancer

Name GlobalApp
Scheme internet-facing
Listeners Port:80 - Protocol:HTTP
IP address type ipv4
VPC vpc-d75555b2
Subnets subnet-55c1e922, subnet-e81a0d8d, subnet-78f6b721
Tags

Security groups

Security groups globalappHTTPOnly

Routing

Target group New target group
Target group name GlobalApp
Target type lambda
Healthy threshold 5
Unhealthy threshold 2
Timeout 30
Interval 35
Health check Enabled

Targets

Lambda function arn:aws:lambda:us-west-2:322549714802:function:GlobalApp

 Cancel Previous Create

Create Load Balancer Actions ▾

Filter by tags and attributes or search by keyword

Name	DNS name	State	VPC ID	Availability Zones	Type	Created At
[REDACTED]	[REDACTED]	active	vpc-d75555b2	us-west-2a, us-west-2c...	application	December 10, 2018 at 3:24:...
GlobalApp	GlobalApp-166433126.us-w...	active	vpc-d75555b2	us-west-2a, us-west-2c...	application	January 28, 2019 at 8:29:28 ...

Load balancer: GlobalApp

Description Listeners Monitoring Integrated services Tags

Basic Configuration

Name	GlobalApp	Creation time	January 28, 2019 at 8:29:28 PM UTC+2
ARN	arn:aws:elasticloadbalancing:us-west-2:322549714802:loadbalancer/app/GlobalApp/11f88cb6e2a0f02e	Hosted zone	Z1H1FL5HABSF5
DNS name	GlobalApp-166433126.us-west-2.elb.amazonaws.com (A Record)	State	active
Scheme	internet-facing	VPC	vpc-d75555b2
Type	application	IP address type	ipv4
Availability Zones	subnet-55c1e922 - us-west-2a, subnet-78f6b721 - us-west-2c, subnet-e81a0d8d - us-west-2b		

Edit availability zones

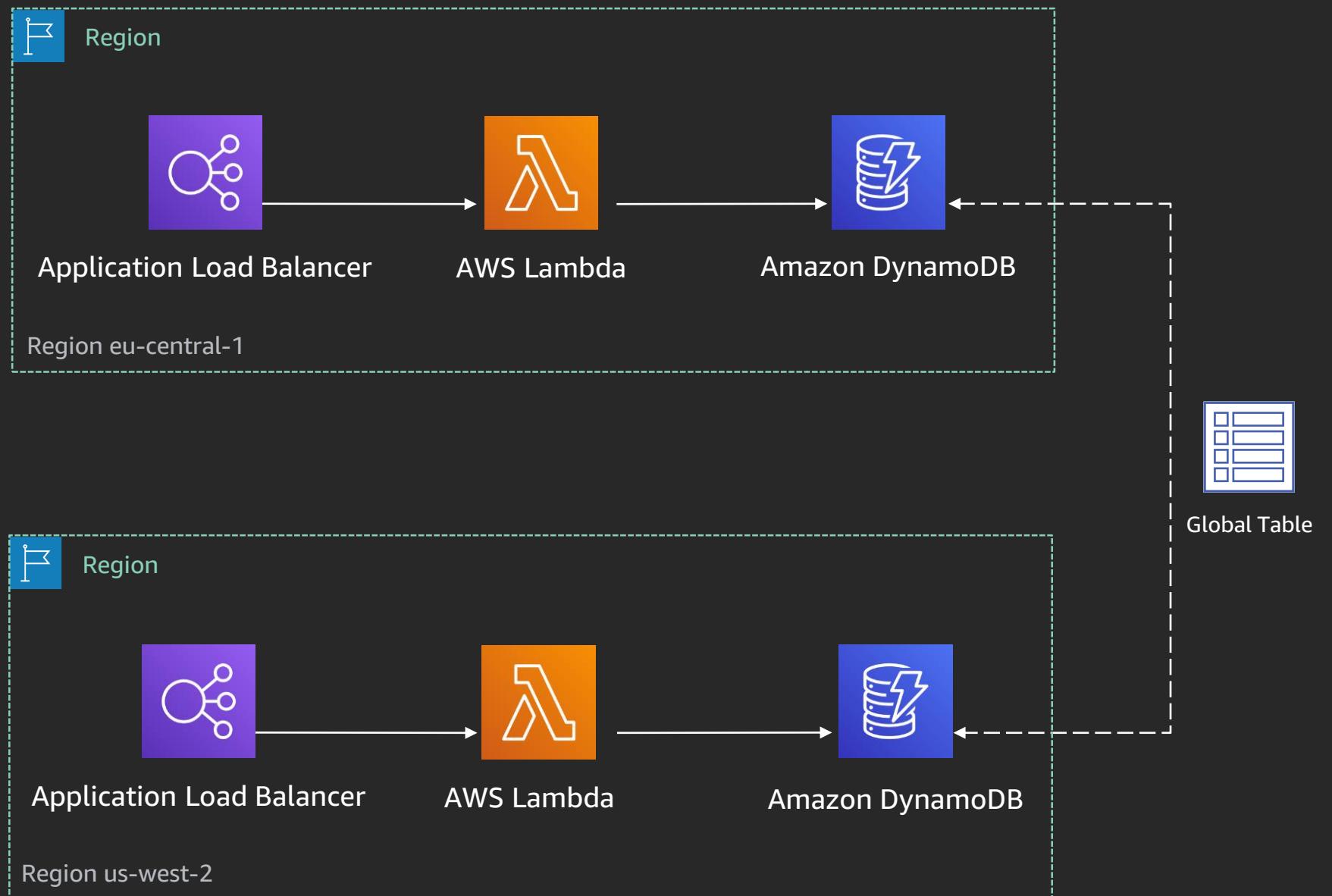
```
(globalappdemo) ➔ lambdaALB http GlobalApp-166433126.us-west-2.elb.amazonaws.com/health
HTTP/1.1 200 OK
Connection: keep-alive
Content-Length: 57
Content-Type: text/html; charset=utf-8
Date: Mon, 28 Jan 2019 18:37:00 GMT
Server: awselb/2.0
```

```
<html><body><h1>health: 200 us-west-2 </h1></body></html>
```

```
(globalappdemo) ➔ lambdaALB http GlobalApp-166433126.us-west-2.elb.amazonaws.com/get/foobar
HTTP/1.1 200 OK
Connection: keep-alive
Content-Length: 80
Content-Type: text/html; charset=utf-8
Date: Mon, 28 Jan 2019 18:38:07 GMT
Server: awselb/2.0
```

```
<html><body><h1>Returned {"item_id": "foobar"} from us-west-2</h1></body></html>
```

```
(globalappdemo) ➔ lambdaALB █
```



Step 1

Enter name

Step 2

Add listeners

Step 3

Add endpoint groups

Step 4

Add endpoints

Enter name

An accelerator includes one or more listeners that direct traffic to one or more endpoint groups. An endpoint group includes endpoints, such as load balancers.

Basic configuration

To get started with creating your accelerator, provide a name for it.

Accelerator name

Provide a name to associate with your accelerator.

GlobalApp

Use only letters or numbers, with no spaces.

IP address type

IPv4

Cancel

Next

Step 1
Enter name

Add listeners

A listener is a process that checks for connection requests that arrive to an assigned set of static IP addresses on a port or port range that you specify.

Step 2
Add listeners

Step 3
Add endpoint groups

Step 4
Add endpoints

Listeners

You designate a listener by choosing a specific port or port range to listen on

Ports Info

80

Protocol Info

TCP

Client affinity Info

None

Remove

Use commas to separate port numbers or ranges.

Add listener

Cancel

Previous

Next

Step 1
Enter name

Add endpoint groups

An accelerator includes one or more listeners that direct traffic to one or more endpoint groups. An endpoint group includes endpoints, such as load balancers.

Step 2
Add listeners

Step 3
Add endpoint groups

Step 4
Add endpoints

Listener: 80 TCP

Each listener can have multiple endpoint groups. Each endpoint group can only include endpoints that are in one Region. You aren't required to add an endpoint group, but until you do, traffic to this listener won't reach any endpoints.

Region Info

eu-central-1

Traffic dial Info

100

Remove

Configure health checks

us-west-2

100

Remove

A number from 0 to 100.

Configure health checks

Add endpoint group

Cancel

Previous

Next

Step 1
Enter nameStep 2
Add listenersStep 3
Add endpoint groupsStep 4
Add endpoints

Add endpoints

Now that you've added one or more endpoint groups, you can add endpoints to each one. If you don't have any endpoints yet, create one in the Elastic Load Balancing (ELB) console or create an Elastic IP address. Endpoints must be in the same Region as the endpoint group.



Global accelerator does not preserve client IP addresses when routing traffic to endpoints.

[View details](#)

Listener: 80 TCP

AWS Global Accelerator routes traffic that arrives on these ports to endpoints in regional endpoint groups. All endpoints for an endpoint group must be in the same Region.

▼ Endpoint group: eu-central-1 ←

Traffic dial: 100%

Endpoint type

[Info](#)
Application load balancer

Endpoint Info

[arn:aws:elasticloadbalancing:eu-central...](#)

Weight Info

100

[Remove](#)

A number from 0 to 255.

[Add endpoint](#)

▼ Endpoint group: us-west-2 ←

Traffic dial: 100%

Endpoint type

[Info](#)
Application load balancer

Endpoint Info

[arn:aws:elasticloadbalancing:us-west-2...](#)

Weight Info

100

[Remove](#)

A number from 0 to 255.

[Add endpoint](#)

[Cancel](#)

[Previous](#)

Create accelerator

Your accelerator was created successfully.

[View details](#)

AWS Global Accelerator > Accelerators > GlobalApp

GlobalApp

[Delete](#)

GlobalApp configuration

[Edit](#)

Name

GlobalApp

Static IP address set

13.248.149.110

76.223.19.244

Enabled

On

Provisioning status

Deployed

ARN

arn:aws:globalaccelerator::322549714802:accelerator/84f8f2fd-72cf-4060-a52f-70cb06ac7d21

Created

Monday, January 28, 2019 6:58 PM GMT

Edited

Monday, January 28, 2019 6:58 PM GMT

Listeners (1)

[View details](#)

[Edit](#)

[Remove](#)

[Add listener](#)

Find listeners

< 1 >

①

Listener ID	Ports and protocol	Endpoint groups	Status
arn...5c8a09ac	Listener: 80 TCP	eu-central-1, us-west-2	All healthy

```
(globalappdemo) ➔ lambdaALB http GET 13.248.149.110/health
HTTP/1.1 200 OK
Connection: keep-alive
Content-Length: 60
Content-Type: text/html; charset=utf-8
Date: Mon, 28 Jan 2019 19:02:36 GMT
Server: awselb/2.0
```

```
<html><body><h1>health: 200 eu-central-1 </h1></body></html>
```

```
(globalappdemo) ➔ lambdaALB http GET 13.248.149.110/get/foobar
HTTP/1.1 200 OK
Connection: keep-alive
Content-Length: 83
Content-Type: text/html; charset=utf-8
Date: Mon, 28 Jan 2019 19:02:43 GMT
Server: awselb/2.0
```

```
<html><body><h1>Returned {"item_id": "foobar"} from eu-central-1</h1></body></html>
```

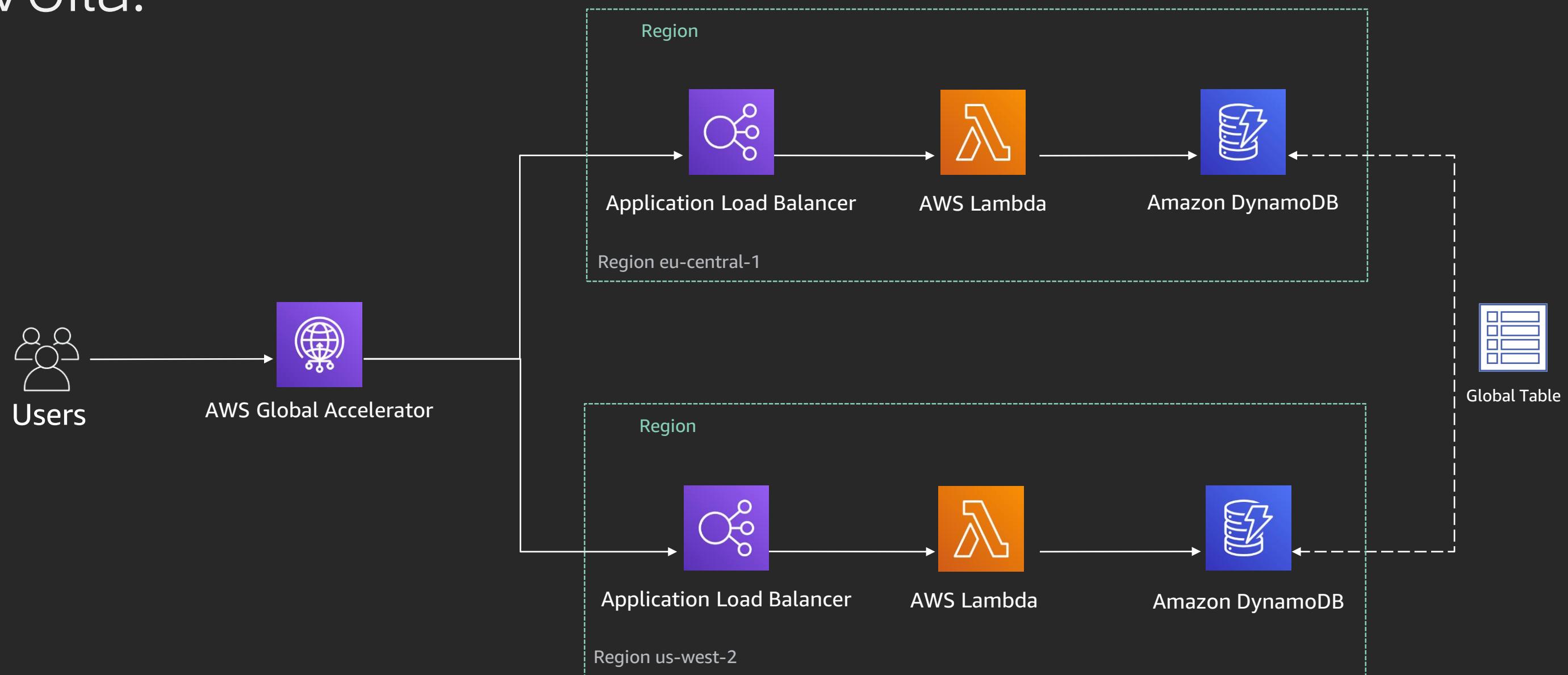
```
(globalappdemo) ➔ lambdaALB http GET 76.223.19.244/health
HTTP/1.1 200 OK
Connection: keep-alive
Content-Length: 60
Content-Type: text/html; charset=utf-8
Date: Mon, 28 Jan 2019 19:03:55 GMT
Server: awselb/2.0
```

```
<html><body><h1>health: 200 eu-central-1 </h1></body></html>
```

```
(globalappdemo) ➔ lambdaALB http GET 76.223.19.244/get/foobar
HTTP/1.1 200 OK
Connection: keep-alive
Content-Length: 83
Content-Type: text/html; charset=utf-8
Date: Mon, 28 Jan 2019 19:06:57 GMT
Server: awselb/2.0
```

```
<html><body><h1>Returned {"item_id": "foobar"} from eu-central-1</h1></body></html>
```

Voilà!



Discussion: DNS vs. IP Anycast

I could tell you a joke about DNS

SERVERLESS

LIFE INSIDE AN AMAZON VPC

Build a serverless multi-region, active-active backend solution — within a VPC

A VPC improves privacy...

387



Adrian Hornsby in A Cloud Guru
Apr 26 · 8 min

serverless backend

multi-region active-active

Build a serverless multi-region, active-active backend solution in an hour

The solution is built using...

1K

5 responses



Adrian Hornsby in A Cloud Guru
Feb 25 · 11 min

RESILIENT ARCHITECTURE

Multi-Region and Active-Active

How to build a multi-region active-active architecture on AWS

Everything fails all the time — build...

1.2K

1 response



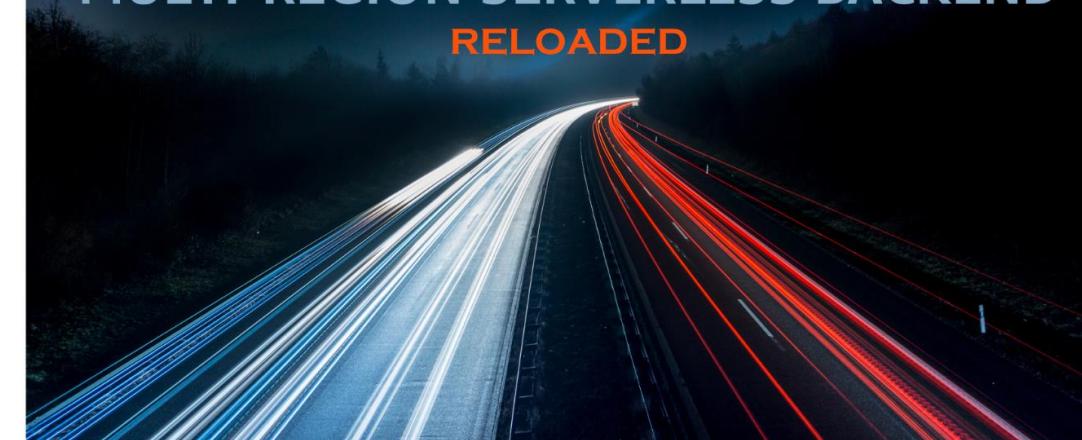
<https://medium.com/@adhorn>

Multi-region serverless backend — reloaded

Accelerating Serverless Applications with Global Accelerator and Application Load Balancer *

Adrian Hornsby
Feb 1 · 16 min read

MULTI-REGION SERVERLESS BACKEND RELOADED

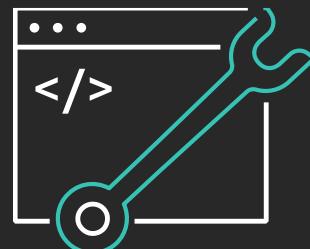


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application development and computing

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Thank you!

Adrian Hornsby

adhorn@amazon.com

Twitter: @adhorn



Please complete the session
survey in the mobile app.