11-Alta disponibilidad y elasticidad en computación clásica

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Module overview

Sections

1. Architectural need
2. Scaling your compute resources
3. Scaling your databases
4. Designing an environment that's highly available
5. Monitoring

Demonstrations

- Creating Scaling Policies for Amazon EC2 Auto Scaling
- Creating a Highly Available Web Application
- Amazon Route 53

Labs

- Guided Lab: Creating a Highly Available Environment
- Challenge Lab: Creating a Scalable and Highly Available Environment for the Café

✓ **Knowledge check**

Module objectives

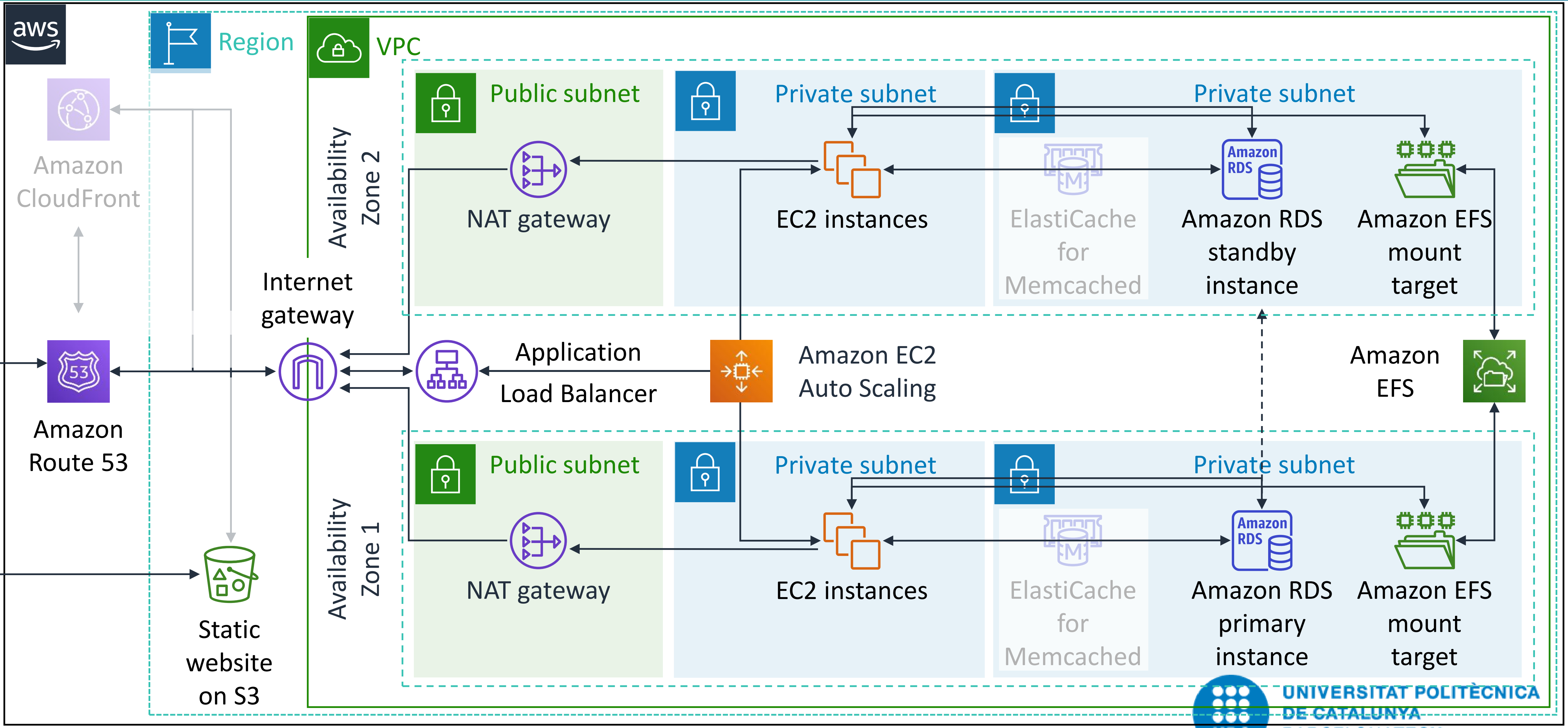
At the end of this module, you should be able to:

- Use Amazon EC2 Auto Scaling within an architecture to promote elasticity
- Explain how to scale your database resources
- Deploy an Application Load Balancer to create a highly available environment
- Use Amazon Route 53 for Domain Name System (DNS) failover
- Create a highly available environment
- Design architectures that use Amazon CloudWatch to monitor resources and react accordingly

Implementing Elasticity, High Availability, and Monitoring

Section 1: Architectural need

Implementing high availability as part of a larger architecture



Café business requirement

The café will be featured in a famous TV food show. When it airs, the architecture must handle significant increases in capacity.

Reactive architectures

Elastic
and scalable

Resilient

Responsive

Message-driven

Implementing Elasticity, High Availability, and Monitoring

Section 2: Scaling your compute resources

What is elasticity?

An elastic infrastructure can expand and contract as capacity needs change.

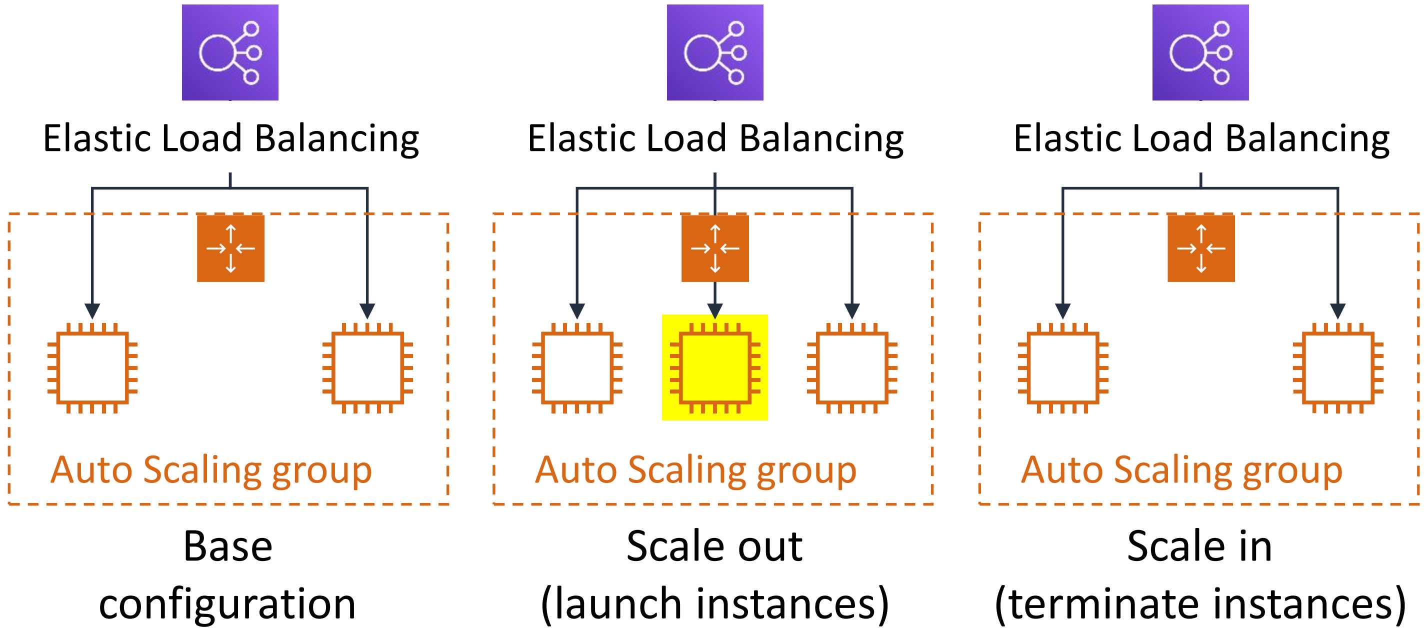
Examples:

- Increasing the number of web servers when traffic spikes
- Lowering write capacity on your database when traffic goes down
- Handling the day-to-day fluctuation of demand throughout your architecture

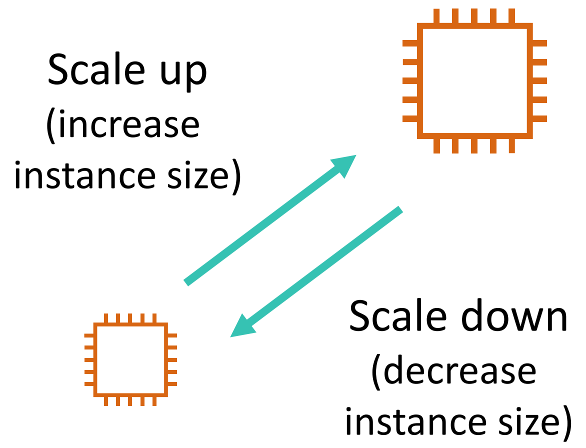
What is scaling?

A technique that is used to achieve elasticity

Horizontal scaling



Vertical scaling



Scale up (increase instance size)
Scale down (decrease instance size)

Amazon EC2 Auto Scaling

Amazon EC2
Auto Scaling

- Launches or terminates instances based on specified conditions
- Automatically registers new instances with load balancers when specified
- Can launch across Availability Zones

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Scaling options

Scheduled	Dynamic	Predictive
Good for predictable workloads	Good for changing conditions	Good for predicted demand
Scale based on date and time	Supports target tracking	Scale based on machine learning
Use case: Turning off your development and test instances at night	Use case: Scaling based on CPU utilization	Use case: Handling an increase in workload for ecommerce website during a major sales event

Dynamic scaling policy types

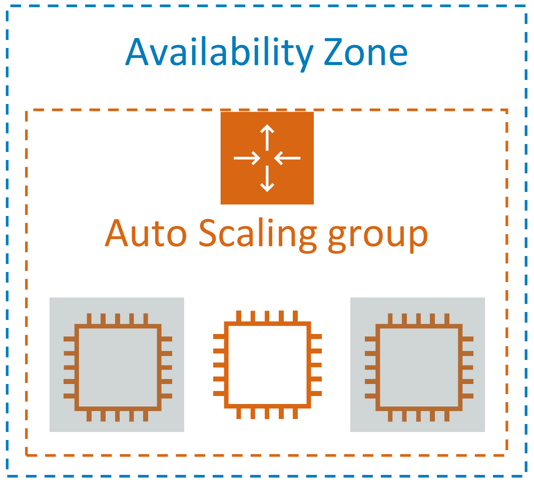
- Simple scaling – Single scaling adjustment
  - Example use cases: New workloads, spiky workloads
- Step scaling – Adjustment depends on size of alarm breach
  - Example use case: Predictable workloads
- Target tracking scaling – Target value for specific metric
  - Example use case: Horizontally scalable applications, such as load-balanced applications and batch data-processing applications

Auto Scaling groups

An Auto Scaling group defines:

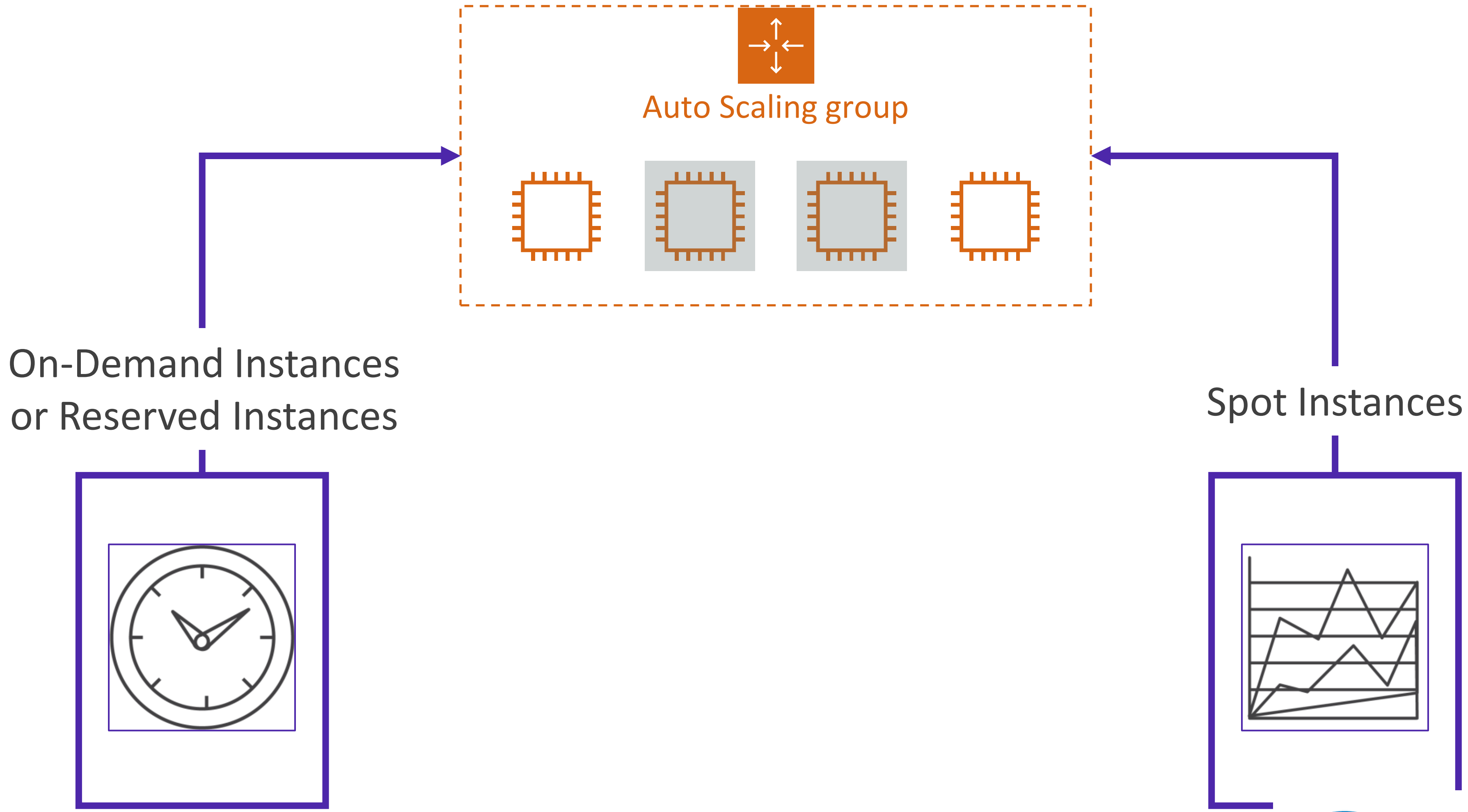
- Minimum capacity
- Maximum capacity
- Desired capacity*

Capacity?



*The desired capacity reflects the number of instances that are running and can fluctuate in response to events.

Amazon EC2 Auto Scaling: Purchasing options



Automatic scaling considerations

- Multiple types of automatic scaling
- Simple, step, or target tracking scaling
- Multiple metrics (not just CPU)
- When to scale out and scale in
- Use of lifecycle hooks

Demonstration: Creating Scaling Policies for Amazon EC2 Auto Scaling

Section 2 key takeaways

- An elastic infrastructure can expand and contract as capacity needs change
- Amazon EC2 Auto Scaling automatically adds or removes EC2 instances according to policies that you define, schedules, and health checks
- Amazon EC2 Auto Scaling provides several scaling options to best meet the needs of your applications
- When you configure an Auto Scaling group, you can specify the EC2 instance types and the combination of pricing models that it uses

Implementing Elasticity, High Availability, and Monitoring

Section 3: Scaling your databases

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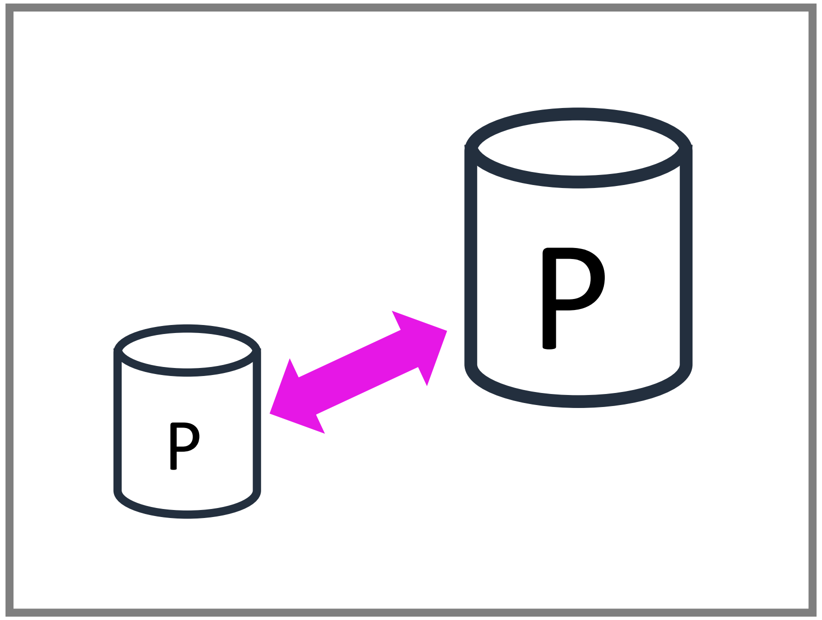
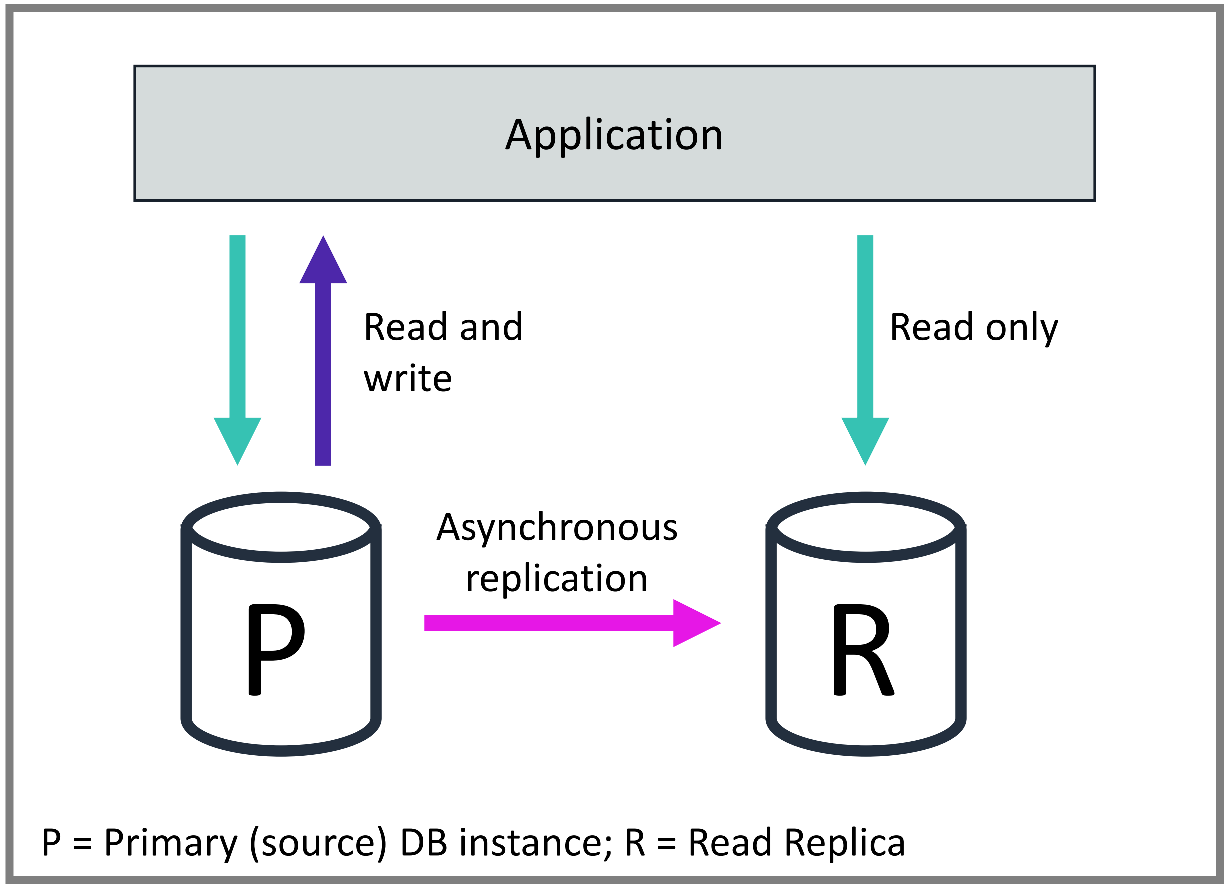
Vertical scaling with Amazon RDS: Push-button scaling

- Scale DB instances vertically up or down
- From micro to 24xlarge and everything in between
- Scale vertically with minimal downtime



Horizontal scaling with Amazon RDS: Read replicas

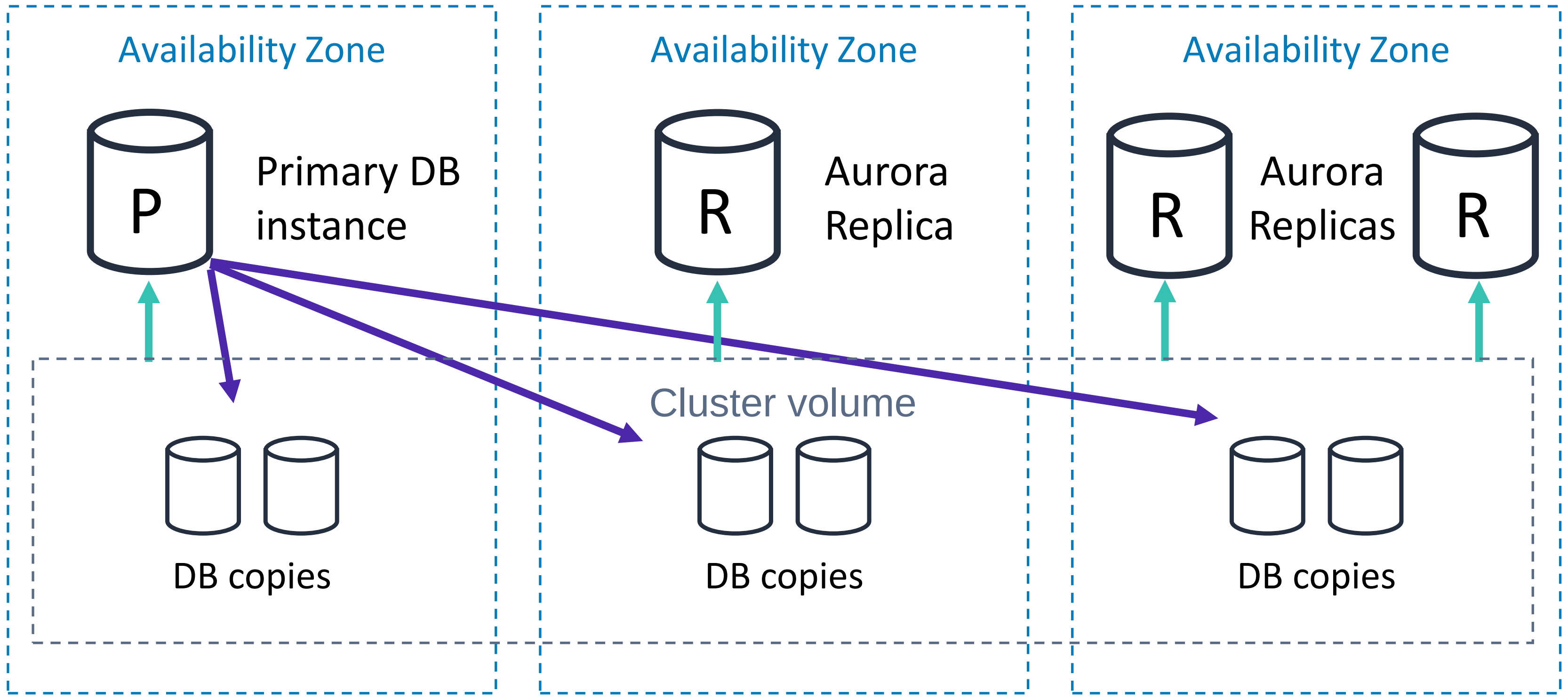


P = Primary (source) DB instance; R = Read Replica

- Horizontally scale for read-heavy workloads
- Up to five read replicas and up to 15 Aurora replicas
- Replication is asynchronous
- Available for Amazon RDS for MySQL, MariaDB, PostgreSQL, and Oracle

Scaling with Amazon Aurora

Each Aurora DB cluster can have up to 15 Aurora replicas



Amazon Aurora Serverless

Responds to your application automatically:

- Scales capacity
- Starts up
- Shuts down

Pay for the number of Aurora capacity units (ACUs) that are used

Good for intermittent and unpredictable workloads

Horizontal scaling: Database sharding

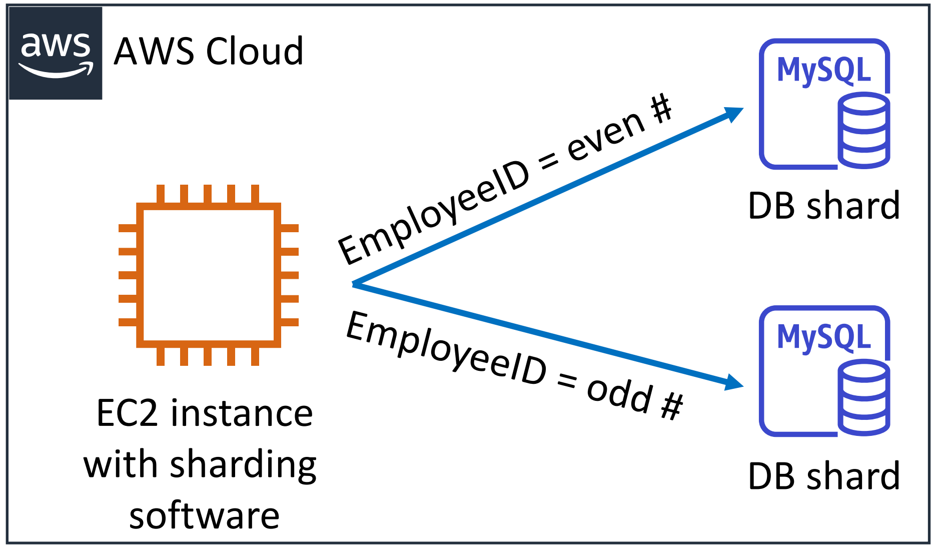
Without shards, all data resides in one partition.

- Example: Employee IDs in one database

With sharding, data is split into large chunks (shards).

- Example: Even-numbered employee IDs in one database, and odd-numbered employee IDs in another database

In many circumstances, sharding improves write performance.



Scaling with Amazon DynamoDB: On-Demand

On-Demand

Pay per request

No more provisioning

Use case: Spiky, unpredictable workloads. Rapidly accommodates to need.

Scaling with Amazon DynamoDB: Auto scaling

On-Demand

Pay per request

No more provisioning

Use case: Spiky, unpredictable workloads. Rapidly accommodates to need.

Auto scaling

Default for all new tables

Specify upper and lower bounds

Use case: General scaling, good solution for most applications.

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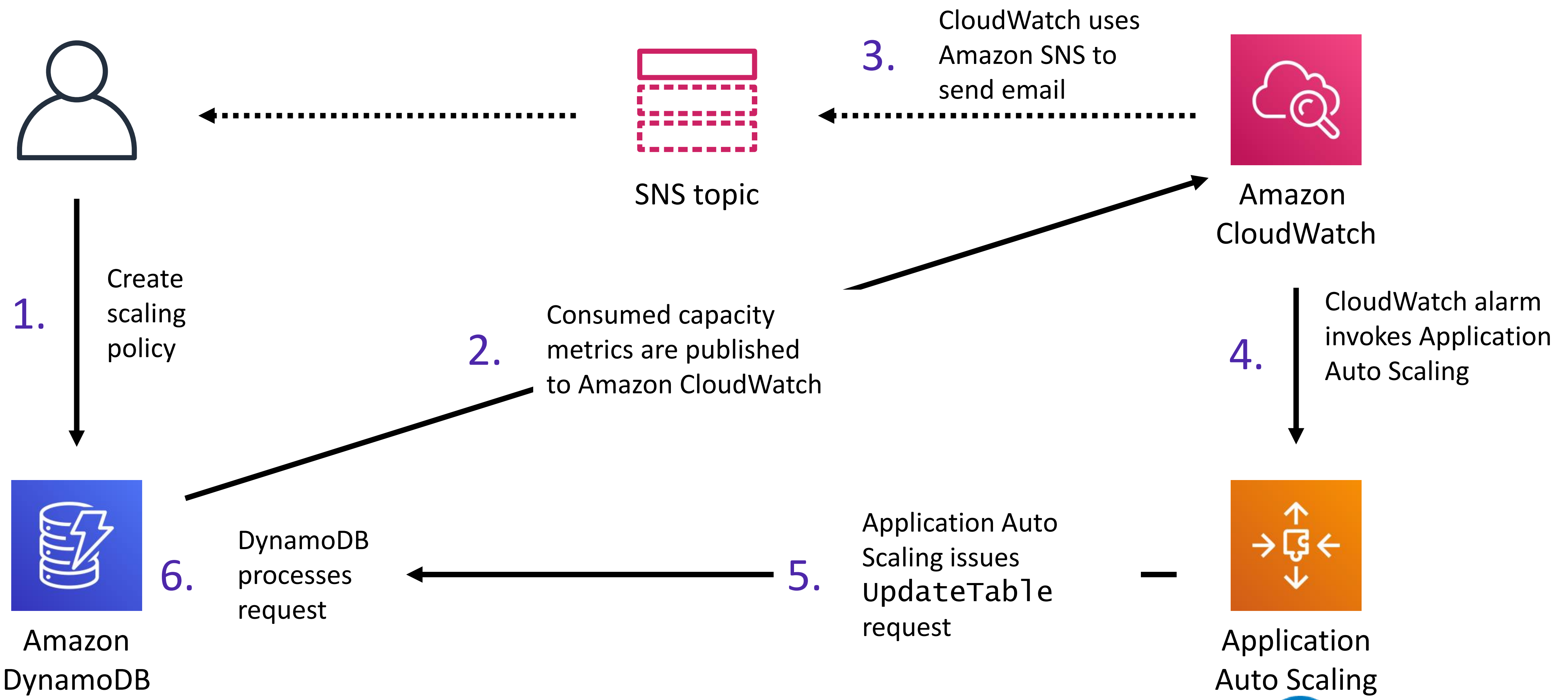
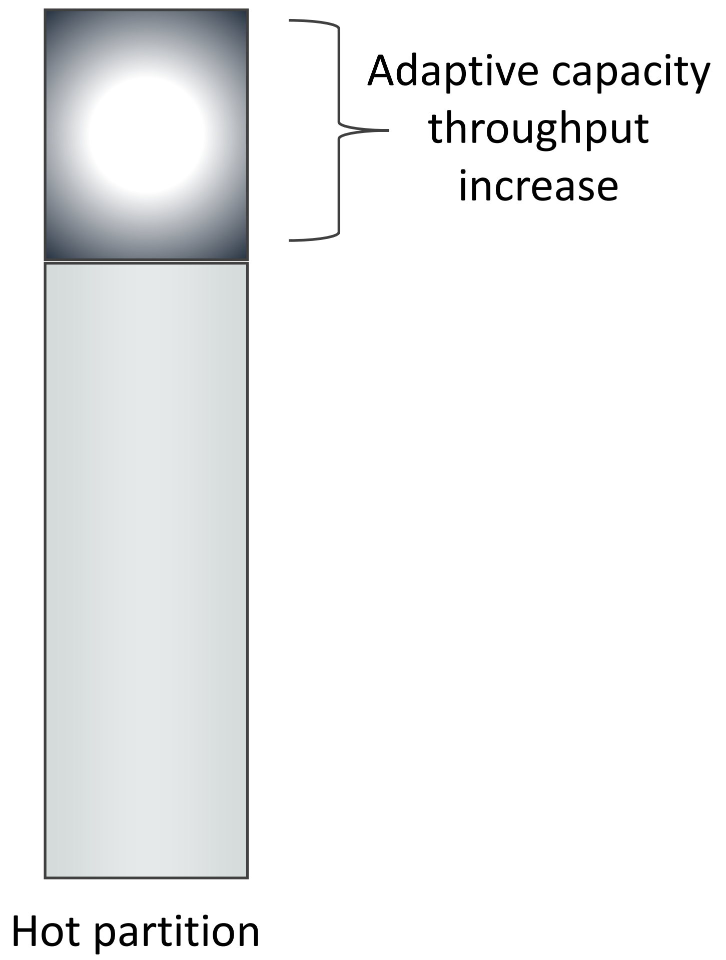
How to implement DynamoDB auto scaling


3.
CloudWatch uses Amazon SNS to send email
SNS topic
Amazon CloudWatch
1.
Create scaling policy
2.
Consumed capacity metrics are published to Amazon CloudWatch
4.
CloudWatch alarm invokes Application Auto Scaling
Amazon DynamoDB
6.
DynamoDB processes request
5.
Application Auto Scaling issues UpdateTable request
Application Auto Scaling

Scaling throughput capacity: DynamoDB adaptive capacity

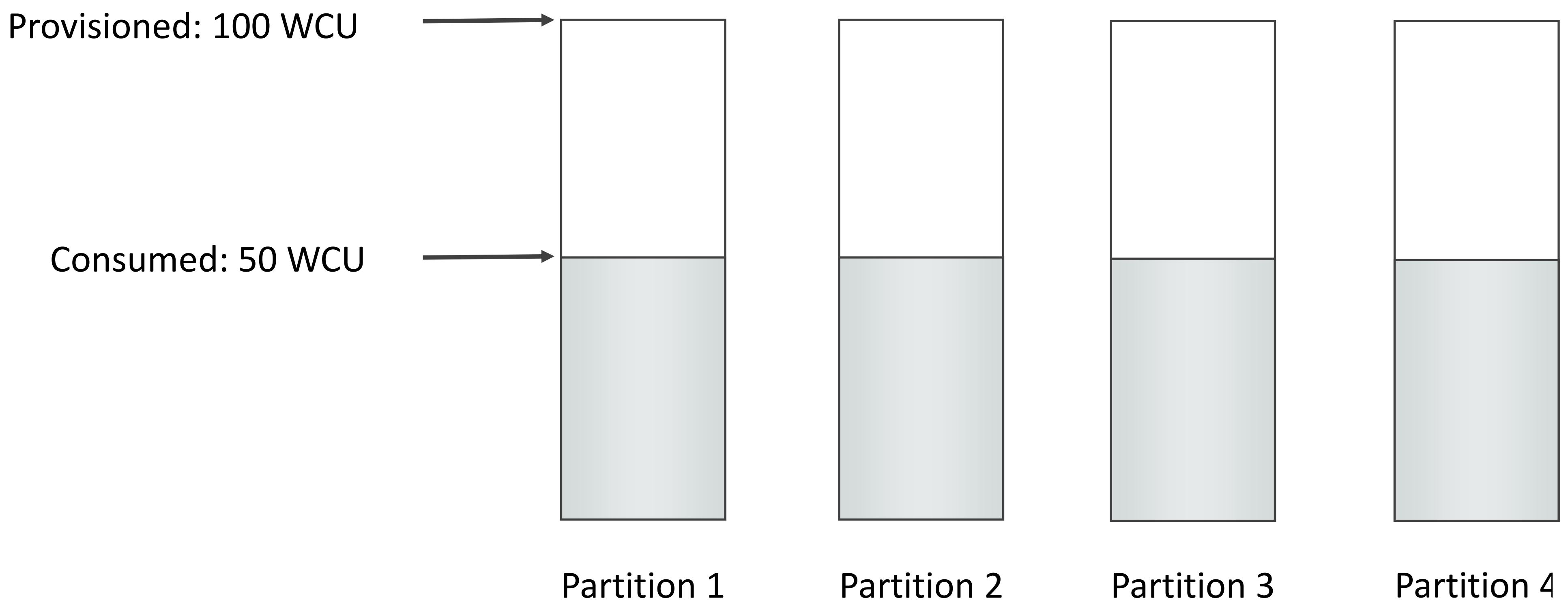
- Enables reading and writing to hot partitions without throttling
- Automatically increases throughput capacity for partitions that receive more traffic*
- Is enabled automatically for every DynamoDB table

*Traffic cannot exceed the table's total provisioned capacity or the partition's maximum capacity.



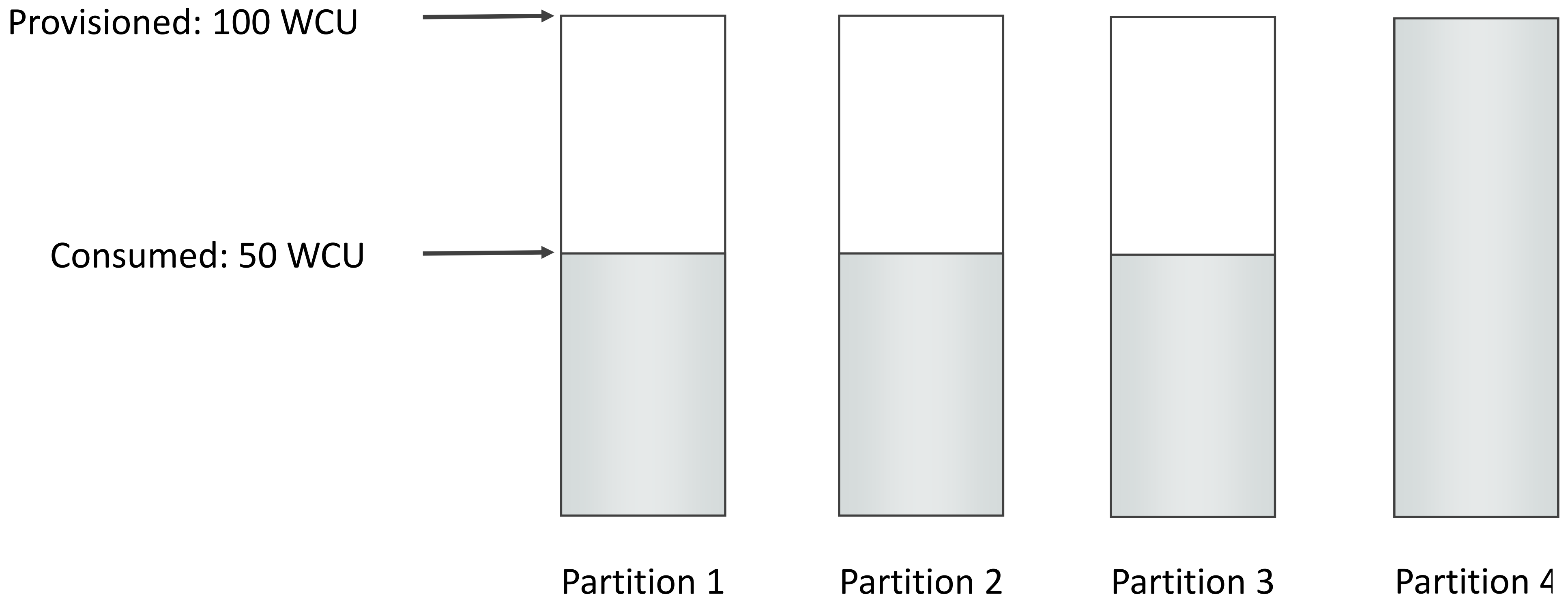
Adaptive capacity example (1 of 3)

Example table with adaptive capacity
Total provisioned capacity = 400 WCUs
Total consumed capacity = 200 WCUs



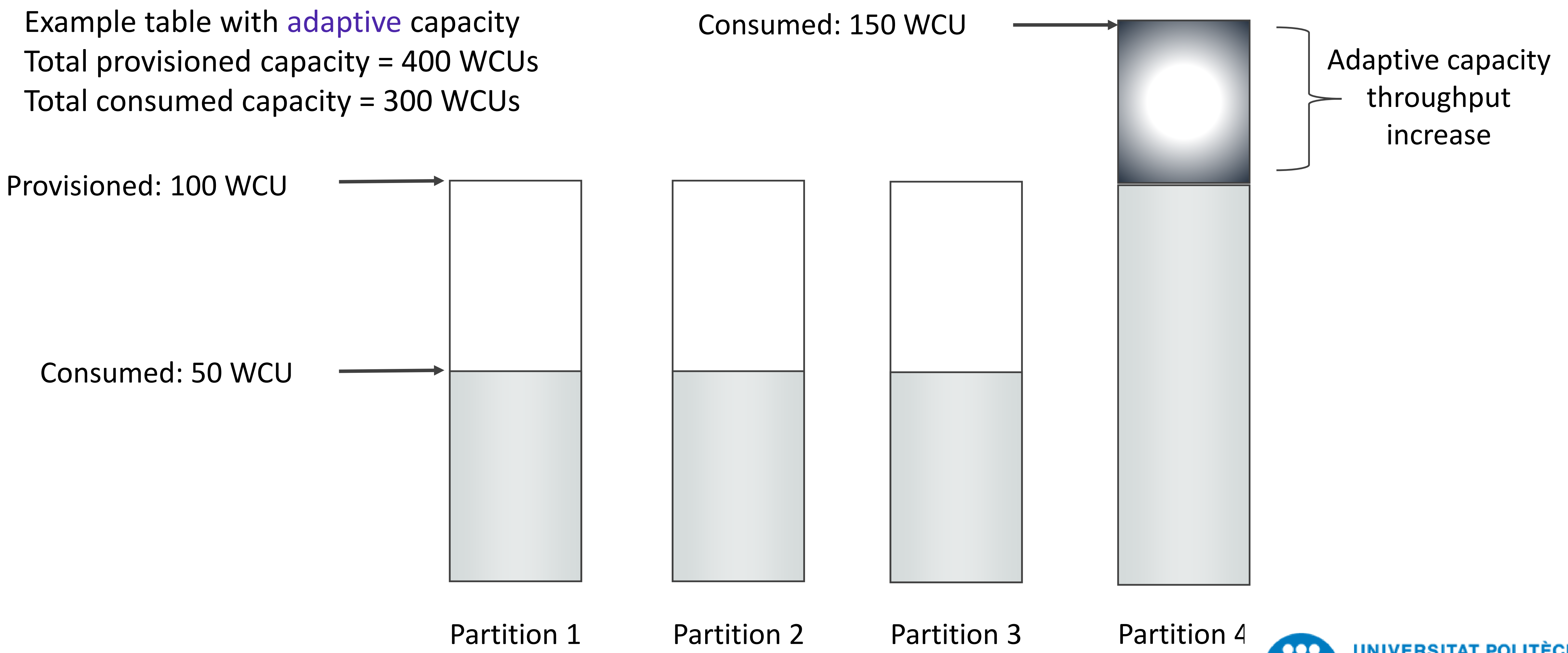
Adaptive capacity example (2 of 3)

Example table with adaptive capacity
Total provisioned capacity = 400 WCUs
Total consumed capacity = 250 WCUs



Adaptive capacity example (3 of 3)

Example table with adaptive capacity
Total provisioned capacity = 400 WCUs
Total consumed capacity = 300 WCUs



Adaptive capacity does not fix hot keys and hot partitions

Partition key value	Uniformity
User ID, where the application has many users	Good
Status code, where there are only a few possible status codes	Bad
Item creation date, rounded to the nearest time period (for example, day, hour, or minute)	Bad
Device ID, where each device accesses data at relatively similar intervals	Good
Device ID, where even if many devices are tracked, one is much more popular than all the others	Bad

Section 3 key takeaways

- You can use push-button scaling to vertically scale compute capacity for your RDS DB instance
- You can use read replicas or shards to horizontally scale your RDS DB instance
- With Amazon Aurora, you can choose the DB instance class size and number of Aurora replicas (up to 15)
- Aurora Serverless scales resources automatically based on the minimum and maximum capacity specifications
- Amazon DynamoDB On-Demand offers a pay-per-request pricing model
- DynamoDB auto scaling uses Amazon Application Auto Scaling to dynamically adjust provisioned throughput capacity
- DynamoDB adaptive capacity works by automatically increasing throughput capacity for partitions that receive more traffic

Section 4: Designing an environment that’s highly available

Highly available systems

- Can withstand some measure of degradation while remaining available
- Have minimized downtime
- Require minimal human intervention
- Recover from failure or roll over to secondary source in an acceptable amount of degraded performance time

Percentage of Uptime	Maximum Downtime Per Year	Equivalent Downtime Per Day
90%	36.5 days	2.4 hours
99%	3.65 days	14 minutes
99.9%	8.76 hours	86 seconds
99.99%	52.6 minutes	8.6 seconds
99.999%	5.25 minutes	0.86 seconds

Elastic Load Balancing

Elastic Load Balancing

A managed load balancing service that distributes incoming application traffic across multiple EC2 instances, containers, IP addresses, and Lambda functions.

- Can be external-facing or internal-facing
- Each load balancer receives a DNS name
- Recognizes and responds to unhealthy instances

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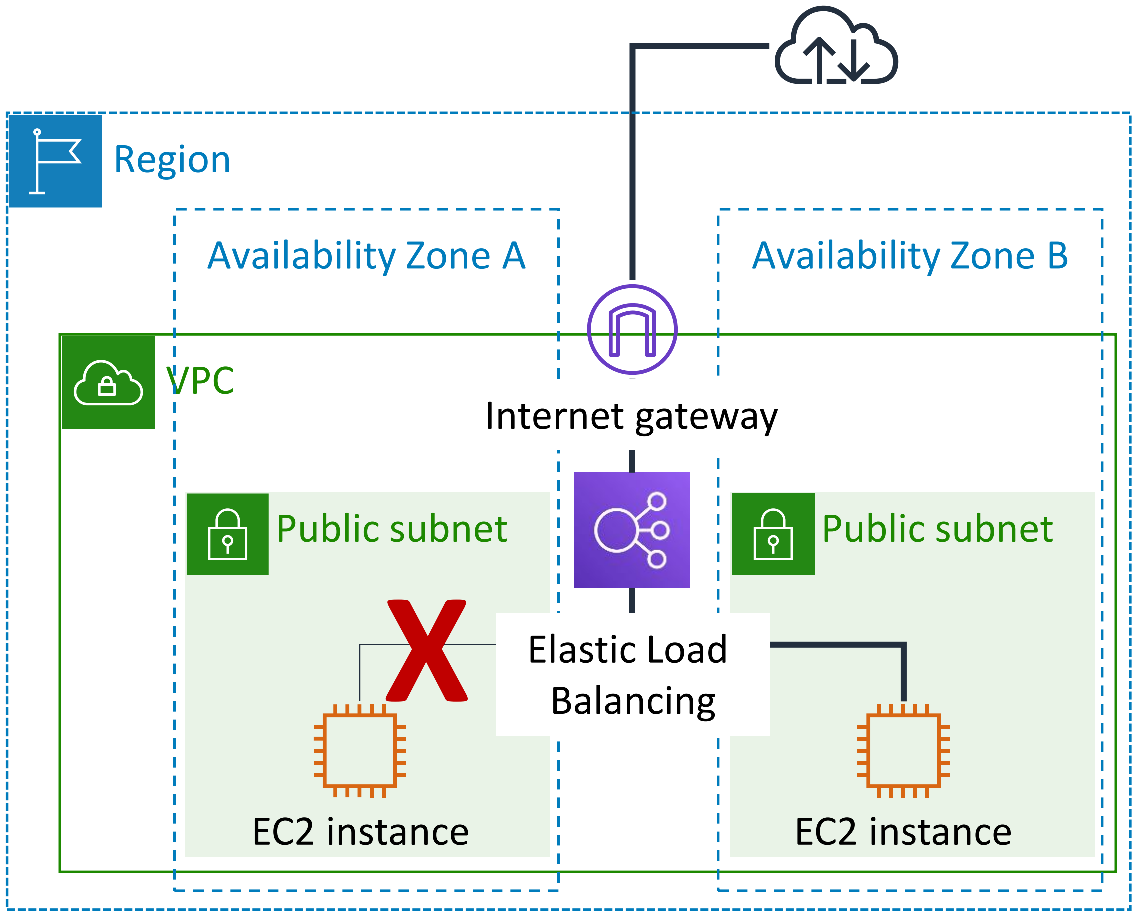
Types of load balancers

Application Load Balancer	Network Load Balancer	**Classic** Load Balancer
HTTP HTTPS	TCP, UDP, TLS	PREVIOUS GENERATION for HTTP, HTTPS, TCP, and SSL
• Flexible application management • Advanced load balancing of HTTP and HTTPS traffic • Operates at the request level (Layer 7)	• Ultra-high performance and static IP address for your application • Load balancing of TCP, UDP, and TLS traffic • Operates at the connection level (Layer 4)	• Load balancing across multiple EC2 instances • Operates at both the request level and connection level

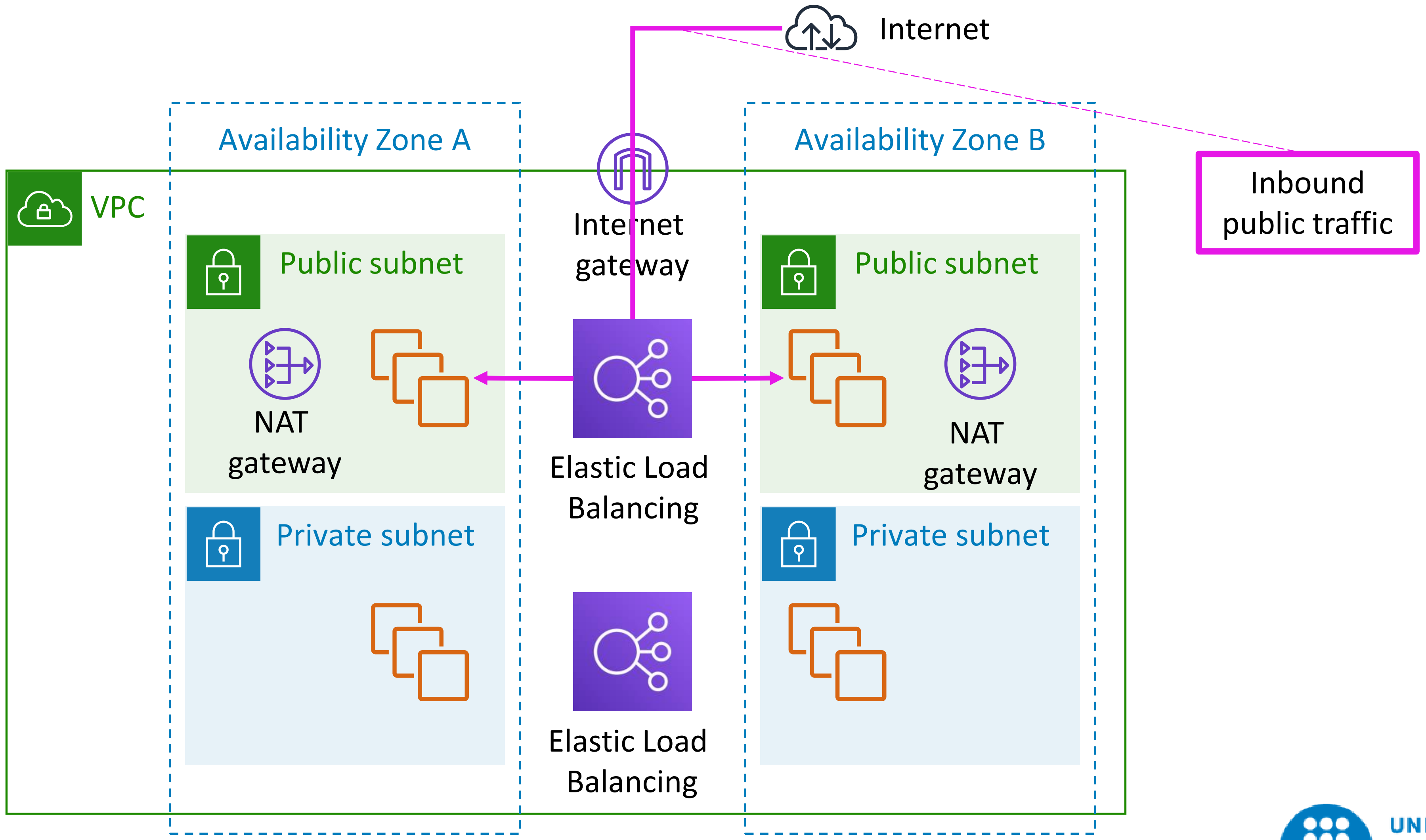
Implementing high availability

Start with two Availability Zones per AWS Region.

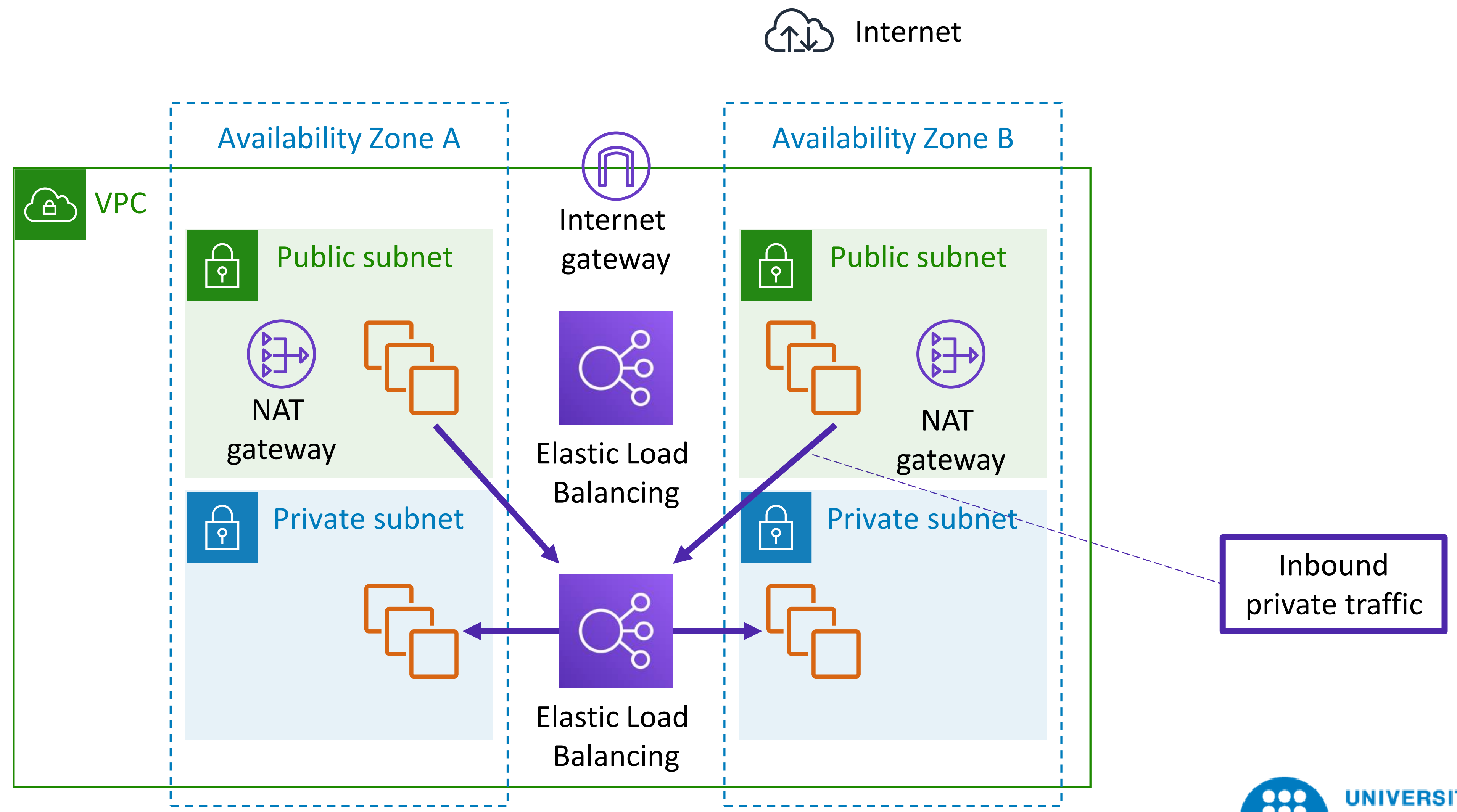
If resources in one Availability Zone are unreachable, your application shouldn't fail.



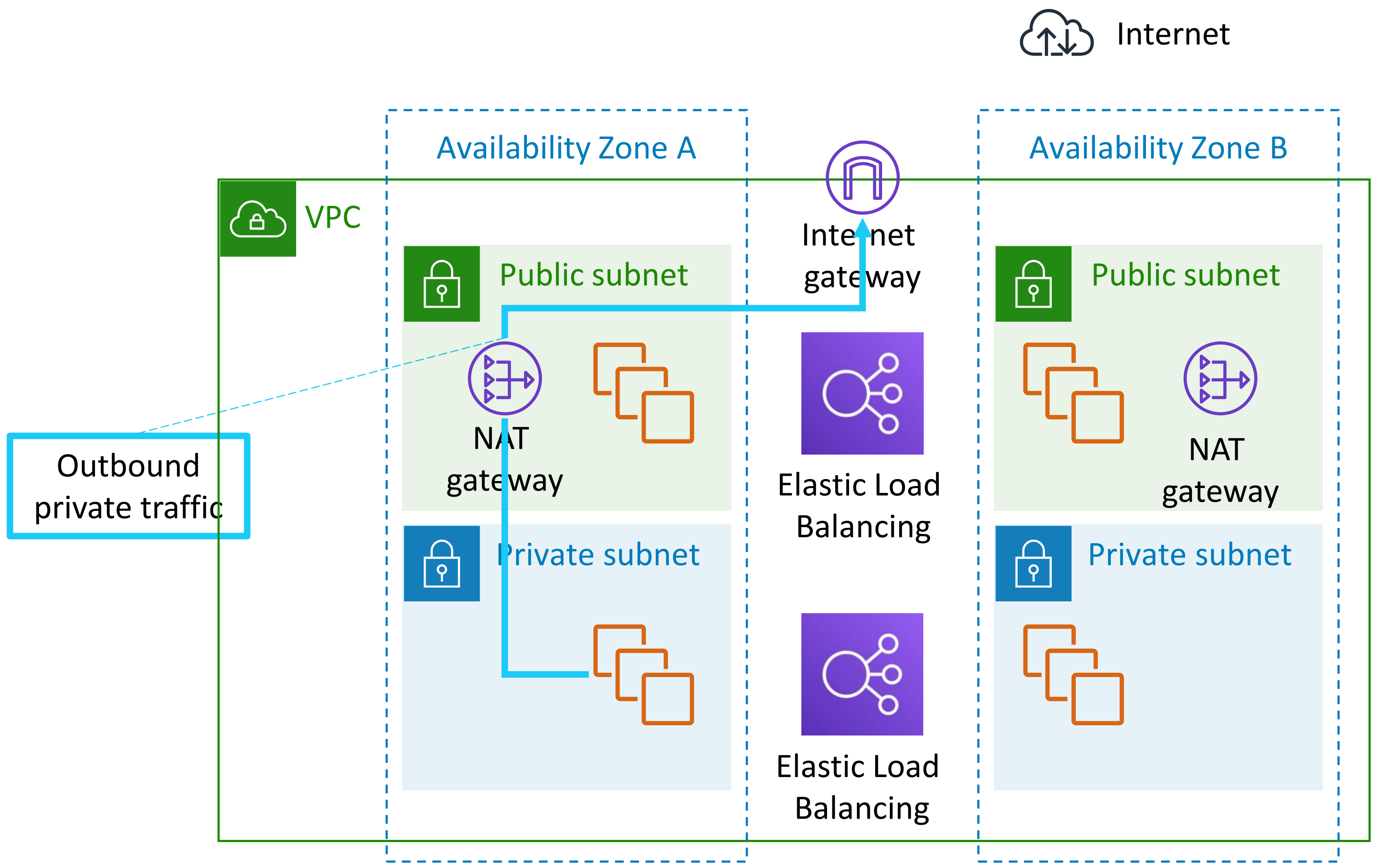
Example of a highly available architecture (1 of 3)



Example of a highly available architecture (2 of 3)



Example of a highly available architecture (3 of 3)



Demonstration: Creating a Highly Available Web Application

Amazon Route 53

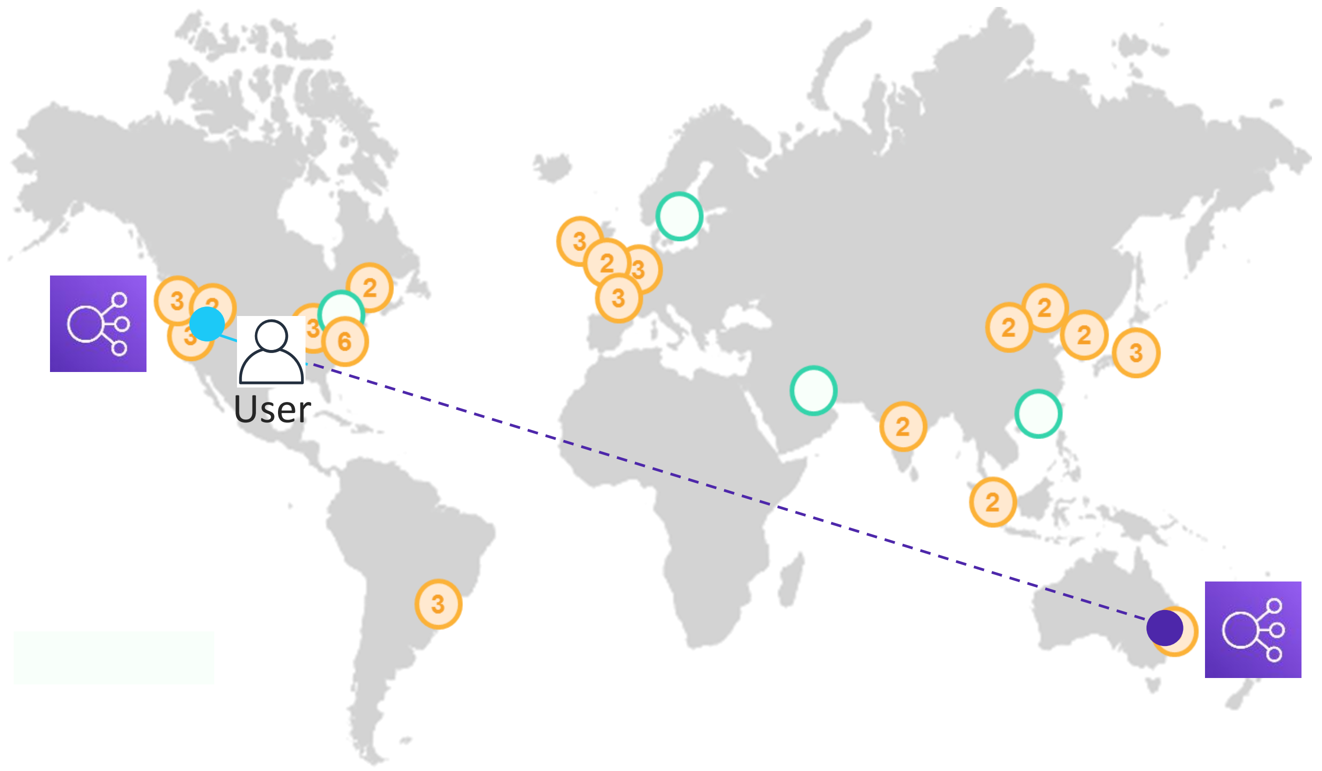
Amazon Route 53

Amazon Route 53 is a highly available and scalable cloud DNS service.

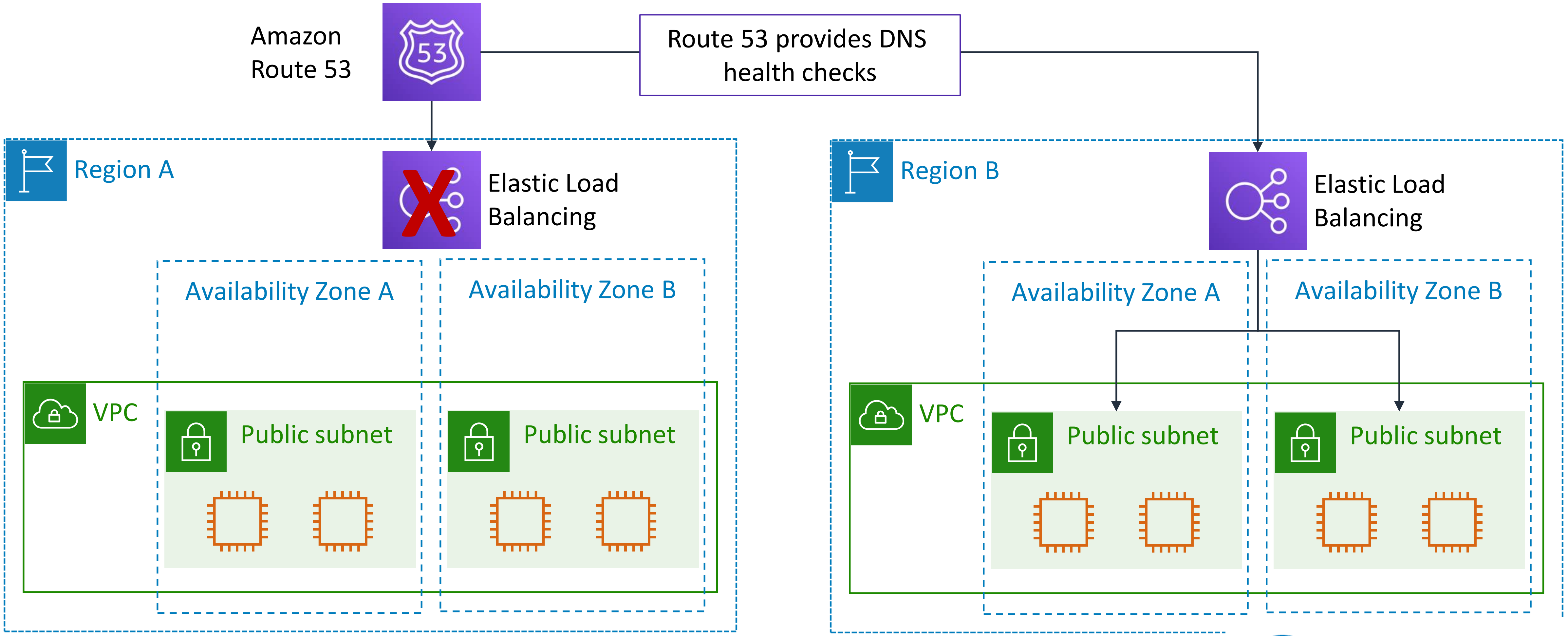
- Translates domain names into IP addresses
- Connects user requests to infrastructure that runs inside and outside of AWS
- Can be configured to route traffic to healthy endpoints, or to monitor the health of your application and its endpoints
- Offers registration for domain names
- Has multiple routing options

Amazon Route 53 supported routing

- Simple routing
- Weighted round robin routing
- Latency-based routing
- Geolocation routing
- Geoproximity routing
- Failover routing
- Multivalue answer routing



Multi-Region high availability and DNS

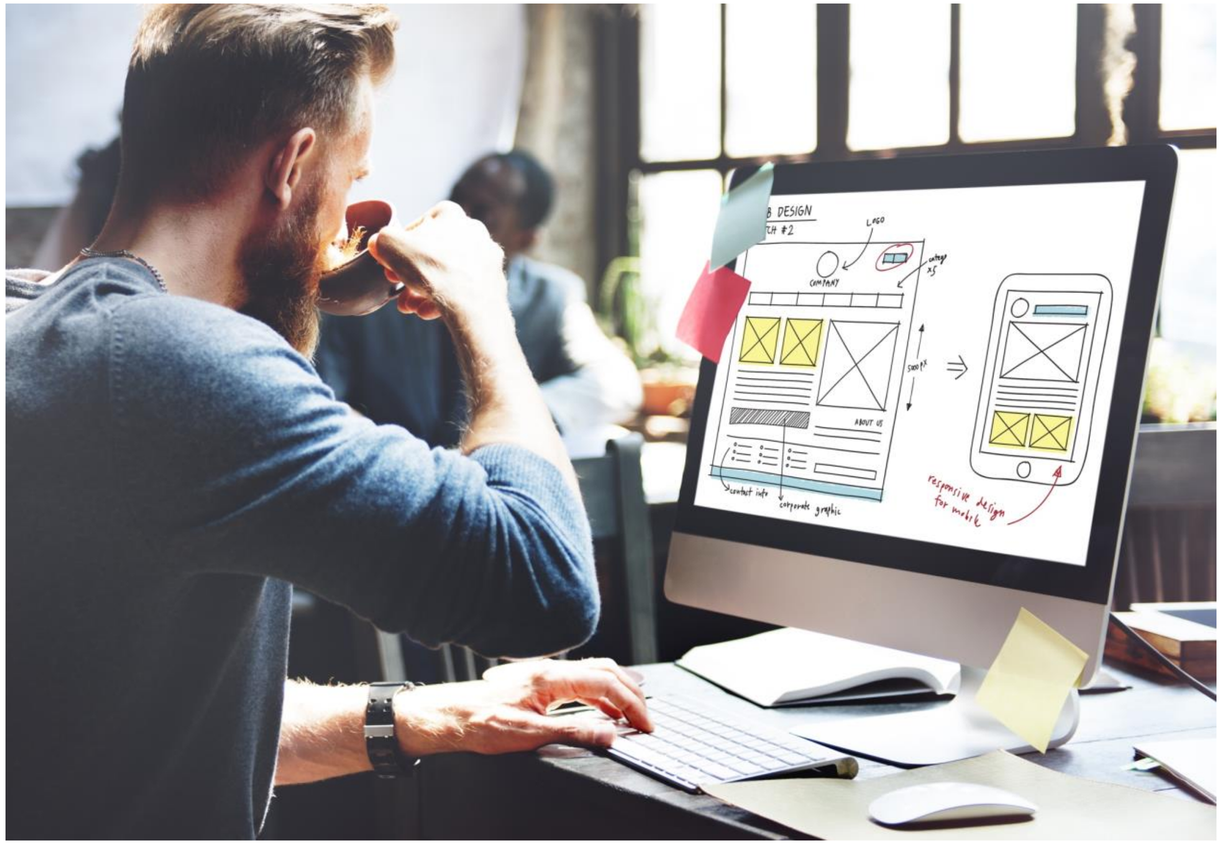


Demonstration: Amazon Route 53

Section 4 key takeaways

- You can design your network architectures to be highly available and avoid single points of failure
- Route 53 offers various routing options that can be combined with DNS failover to enable low-latency, fault-tolerant architectures

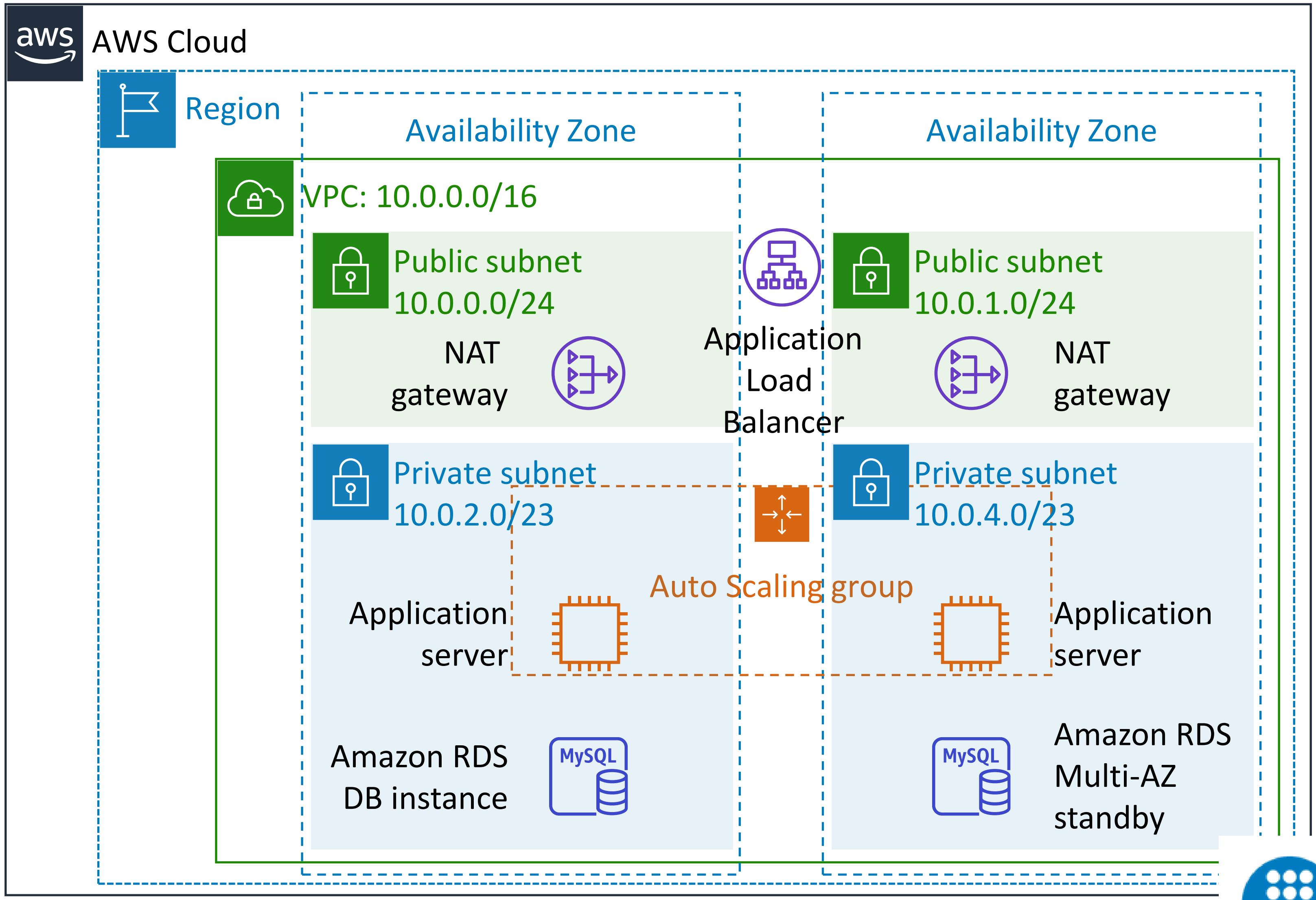
Module 9 – Guided Lab: Creating a Highly Available Environment



Guided lab: Tasks

1. Inspect a provided VPC
2. Create an Application Load Balancer
3. Create an Auto Scaling group
4. Test the application for high availability

Guided lab: Final product



~ 40 minutes

Begin Module 9 – Guided Lab: Creating a Highly Available Environment

Guided lab debrief: Key takeaways

Implementing Elasticity, High Availability, and Monitoring

Section 5: Monitoring

Monitoring usage, operations, and performance

Operational Health

Resource Utilization

Application Performance

Security Auditing

Monitoring your costs

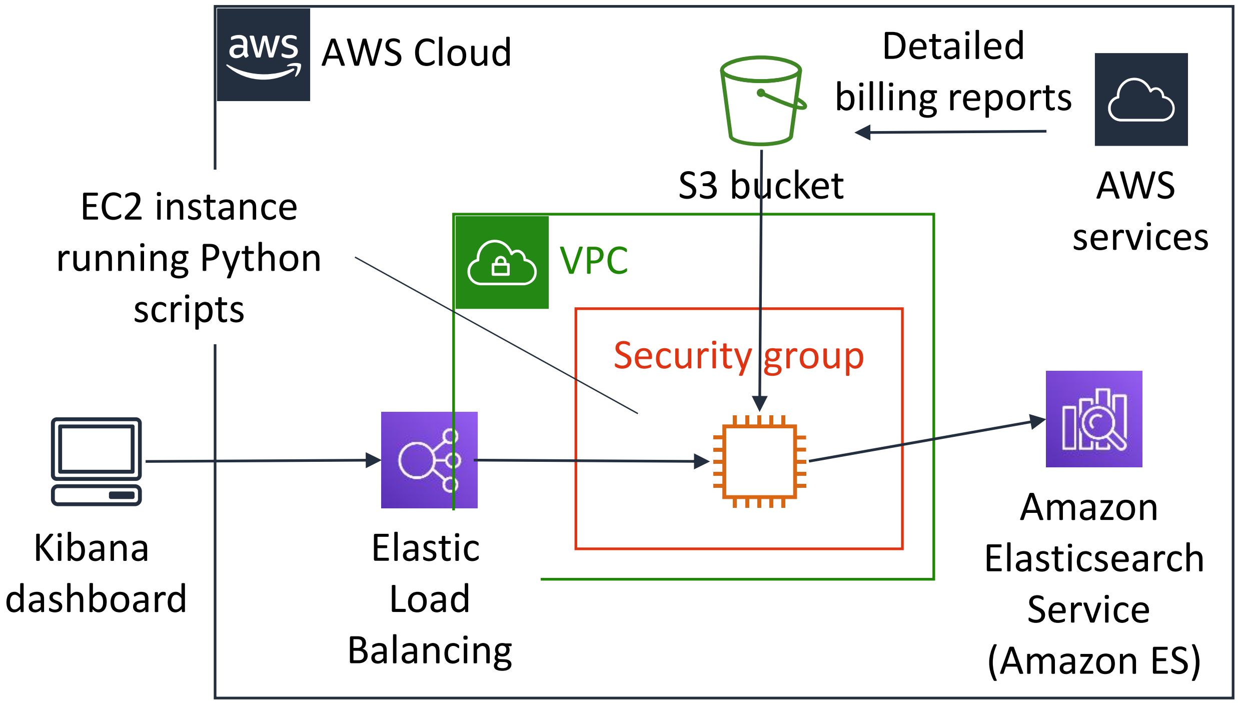
To create a more flexible and elastic architecture, you should know where you are spending money.

AWS Cost Explorer

AWS Budgets

AWS Cost and Usage Report

Cost Optimization Monitor



Amazon CloudWatch

Amazon CloudWatch

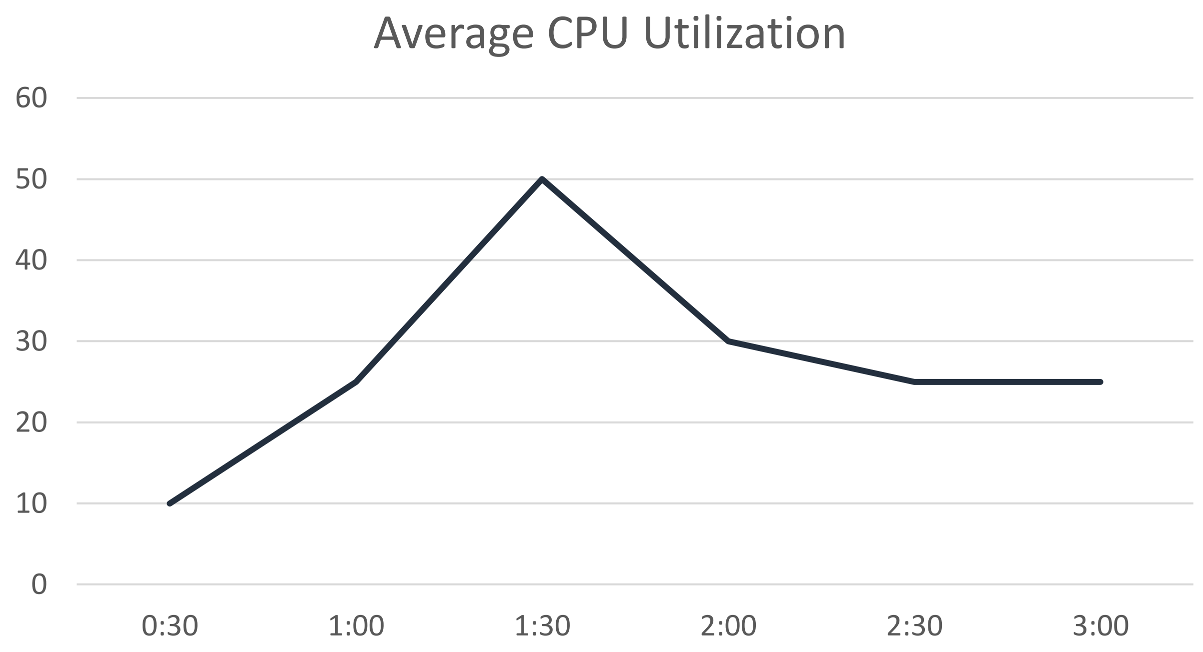
- Collects and tracks metrics for your resources and applications
- Helps you correlate, visualize, and analyze metrics and logs
- Enables you to create alarms and detect anomalous behavior
- Can send notifications or make changes to resources that you are monitoring

How CloudWatch responds

- Metrics
- Logs
- Alarms
- Events
- Rules
- Targets

CloudWatch metrics

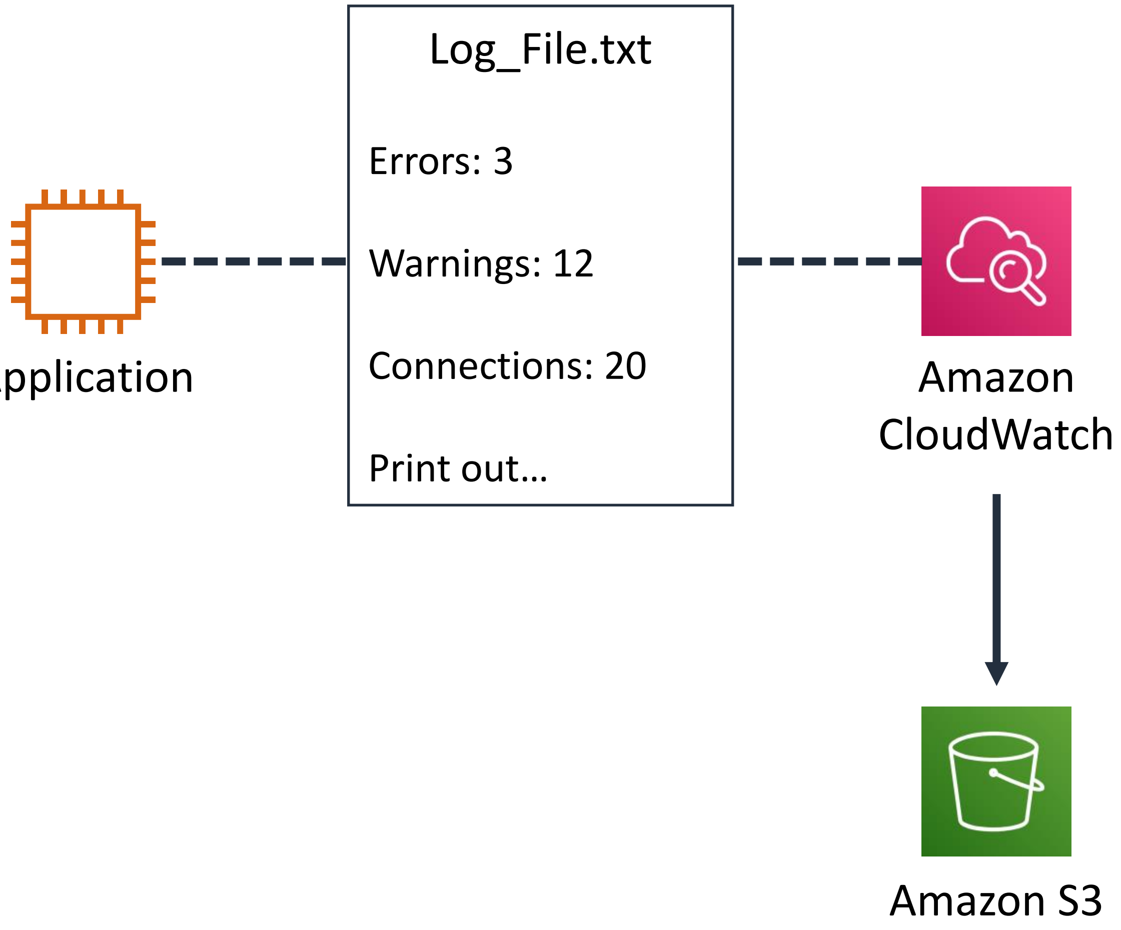
- Metrics
- Logs
- Alarms
- Events
- Rules
- Targets



Metric data is kept for 15 months

Amazon CloudWatch Logs

- Metrics
- Logs
- Alarms
- Events
- Rules
- Targets

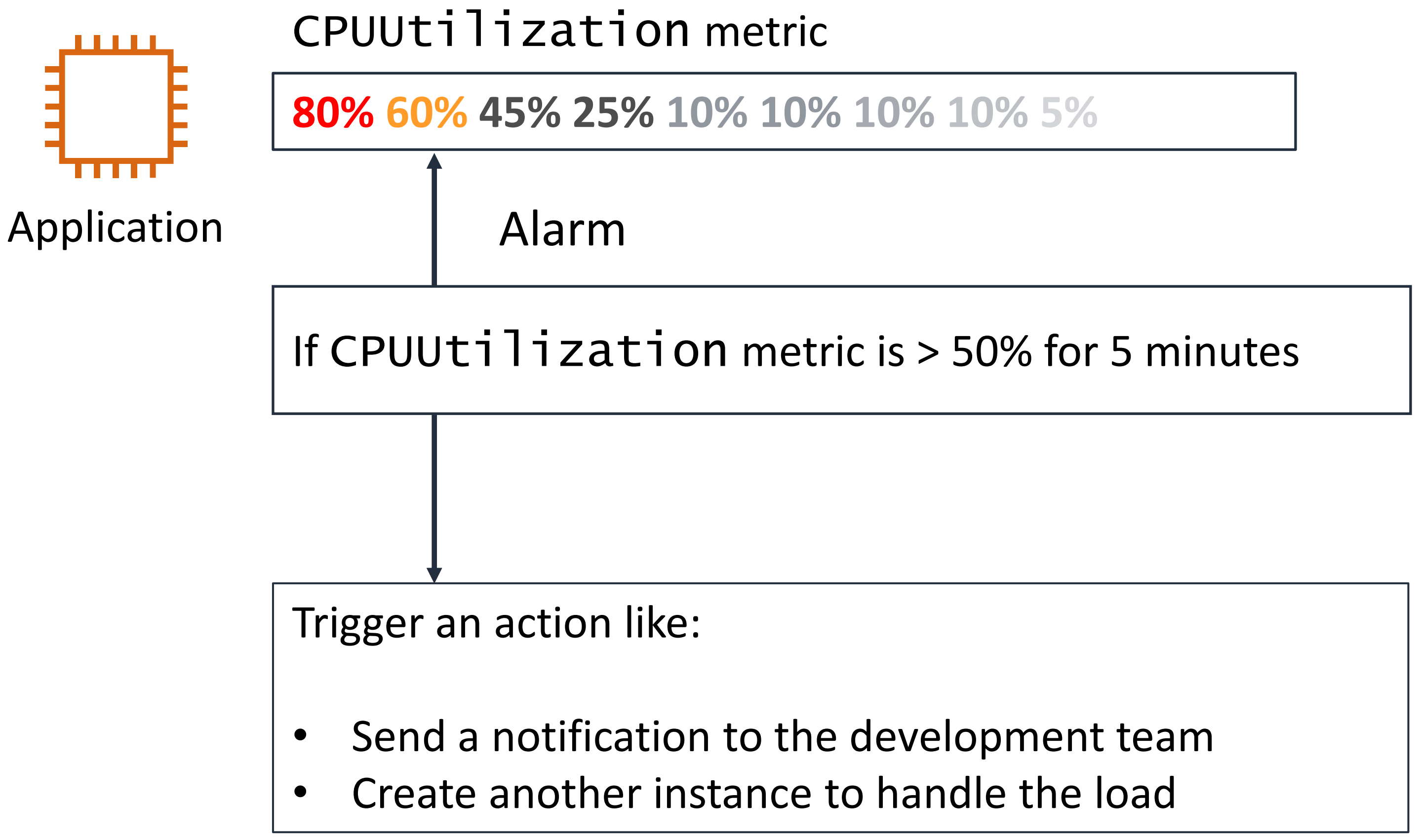


Source examples

- VPC Flow Logs
- Amazon Route 53
- Elastic Load Balancing access logs

CloudWatch alarms

- Metrics
- Logs
- Alarms
- Events
- Rules
- Targets



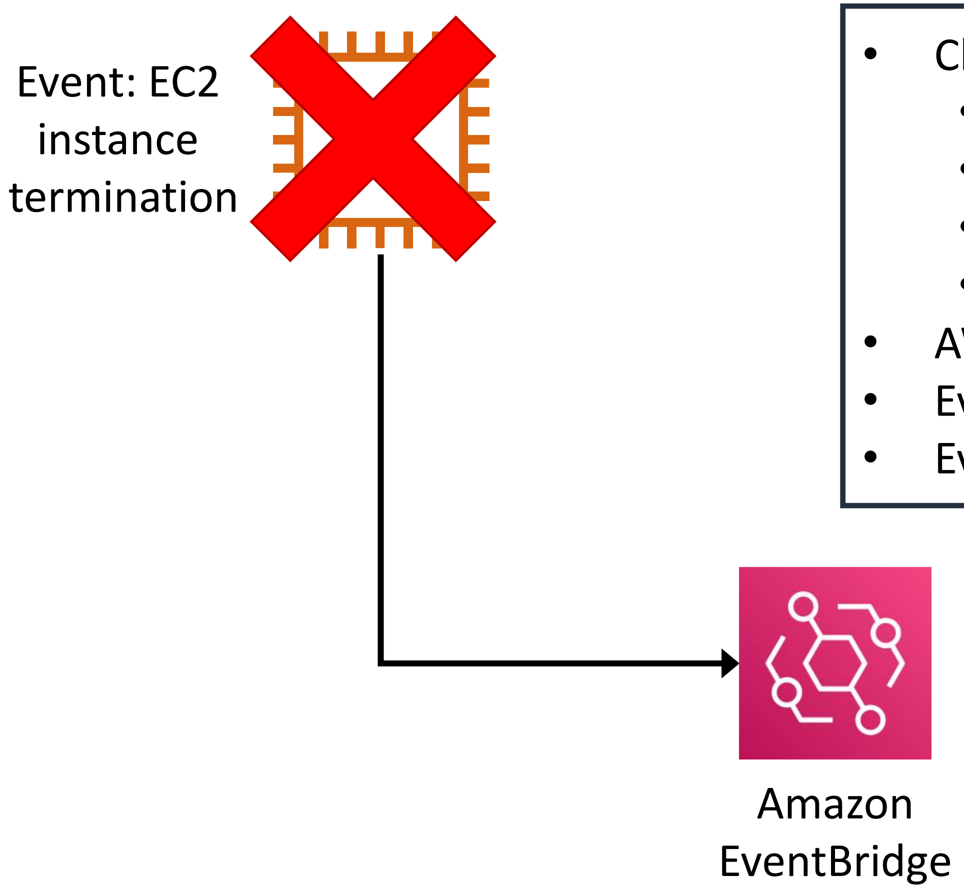
If `CPUUtilization` metric is > 50% for 5 minutes

Trigger an action like:

- Send a notification to the development team
- Create another instance to handle the load

Amazon EventBridge events

- Metrics
- Logs
- Alarms
- Events
- Rules
- Targets

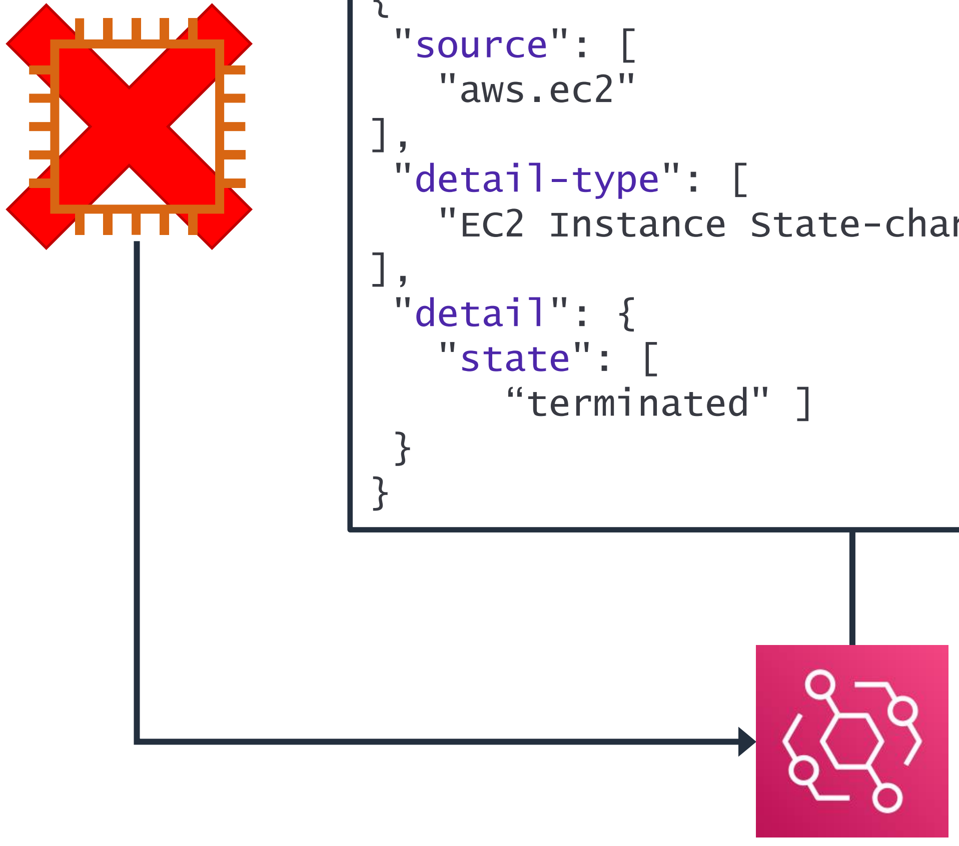


Event examples

- Change in AWS resource, such as –
  - Console sign-in
  - EC2 instance state change
  - EC2 Auto Scaling state change
  - EBS volume creation
- AWS API call
- Events from SaaS partners
- Events from your own applications

Amazon EventBridge rules

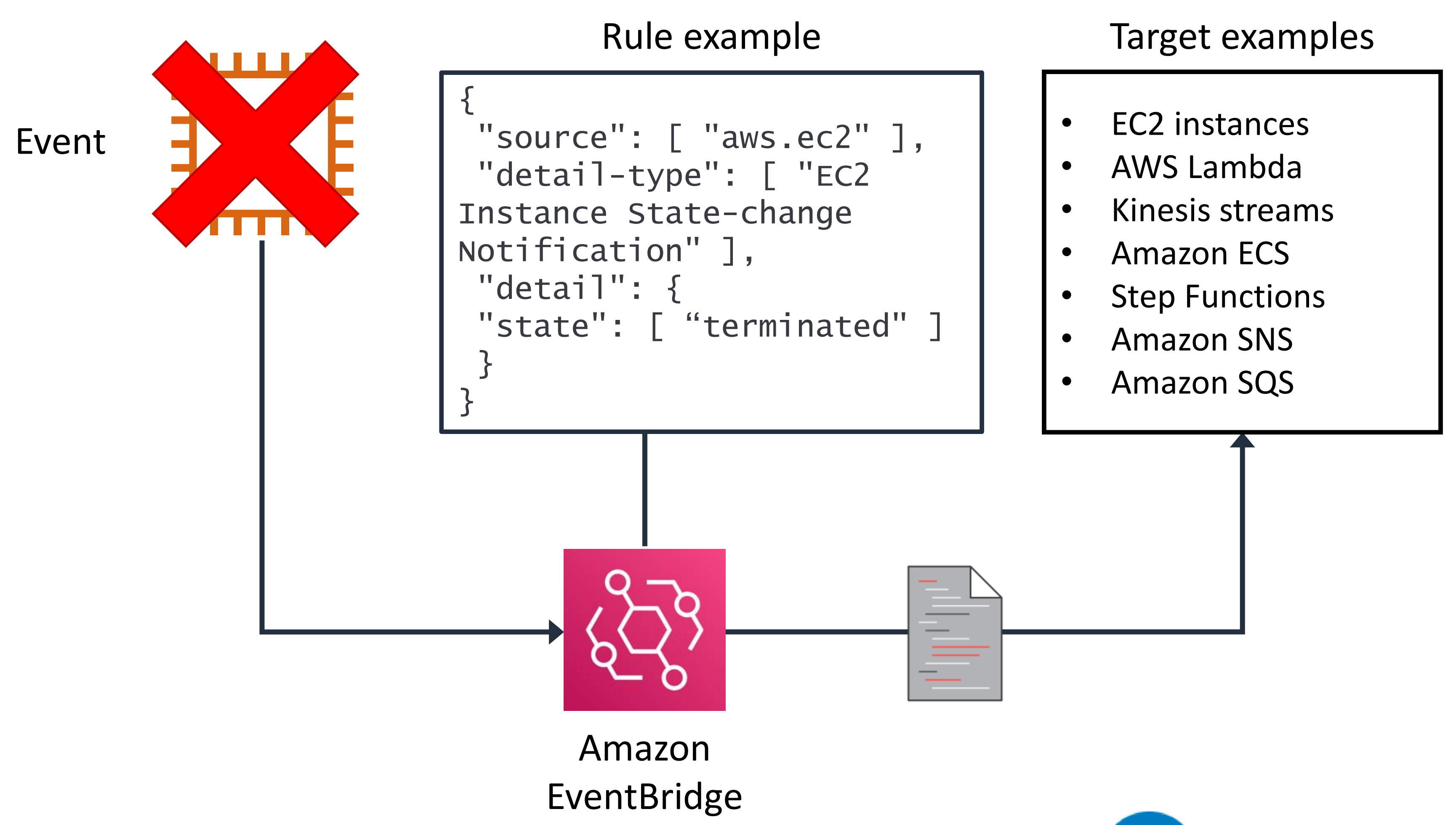
- Metrics
- Logs
- Alarms
- Events
- Rules
- Targets



```
{
 "source": [
   "aws.ec2"
],
 "detail-type": [
   "EC2 Instance State-change Notification”
],
 "detail": {
   "state": [
      “terminated" ]
 }
}
```

Amazon EventBridge targets

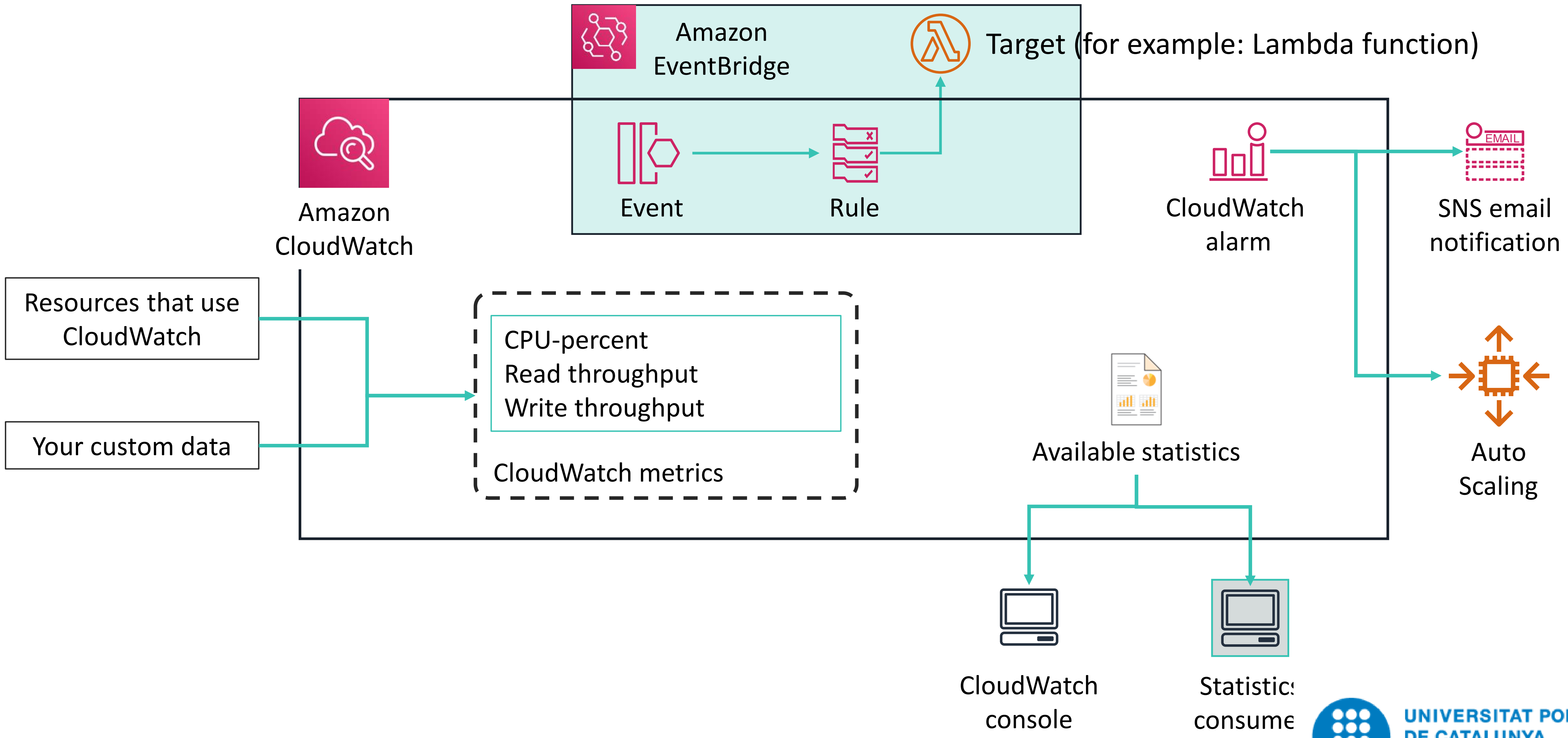
- Metrics
- Logs
- Alarms
- Events
- Rules
- Targets



```
{
 "source": [ "aws.ec2" ],
 "detail-type": [ "EC2
Instance State-change
Notification" ],
 "detail": {
 "state": [ “terminated" ]
 }
}
```

- EC2 instances
- AWS Lambda
- Kinesis streams
- Amazon ECS
- Step Functions
- Amazon SNS
- Amazon SQS

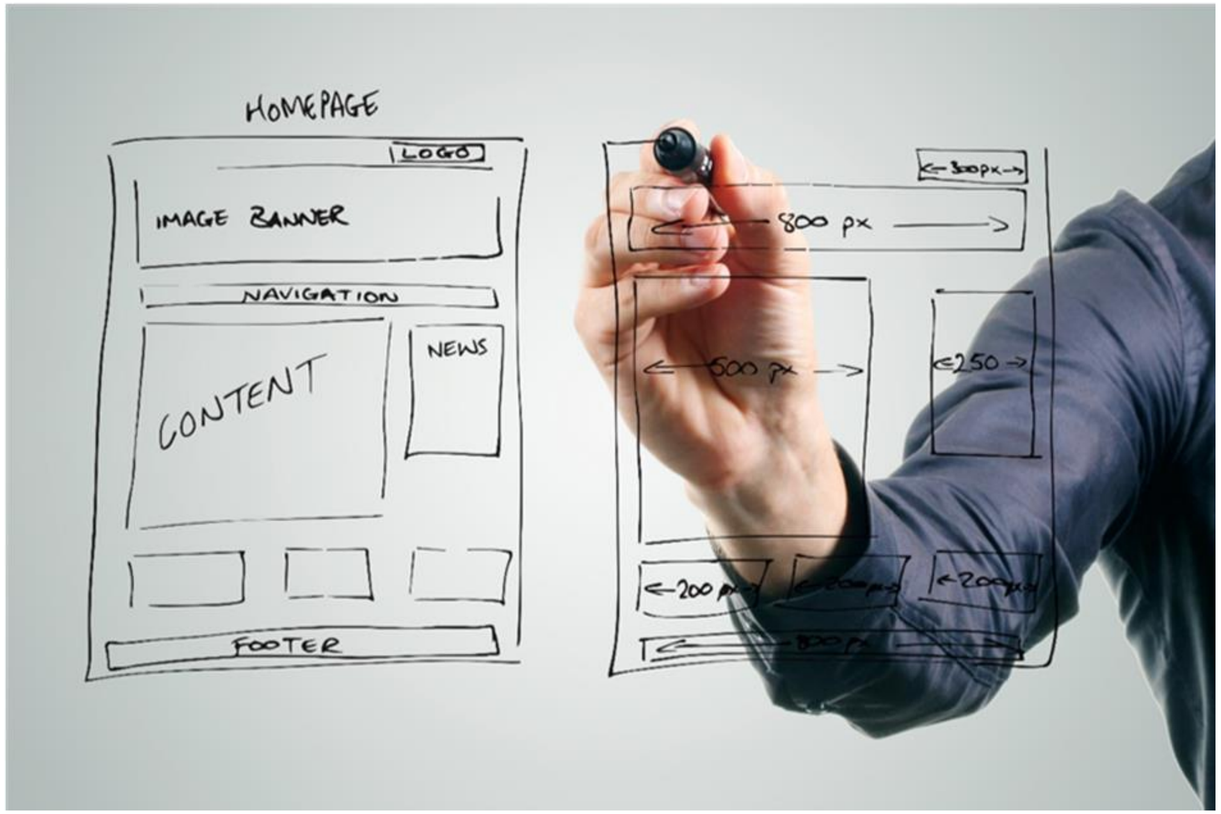
How CloudWatch and EventBridge work



Section 5 key takeaways

- AWS Cost Explorer, AWS Budgets, AWS Cost and Usage Report, and the Cost Optimization Monitor can help you understand and manage the cost of your AWS infrastructure.
- CloudWatch collects monitoring and operational data in the form of logs, metrics, and events. It visualizes the data by using automated dashboards so you can get a unified view of your AWS resources, applications, and services that run in AWS and on-premises.
- EventBridge is a serverless event bus service that connects your applications with data from various sources. EventBridge delivers a stream of real-time data from your own applications, SaaS applications, and AWS services. It then routes that data to targets.

Module 9 – Challenge Lab: Creating a Scalable and Highly Available Environment for the Café



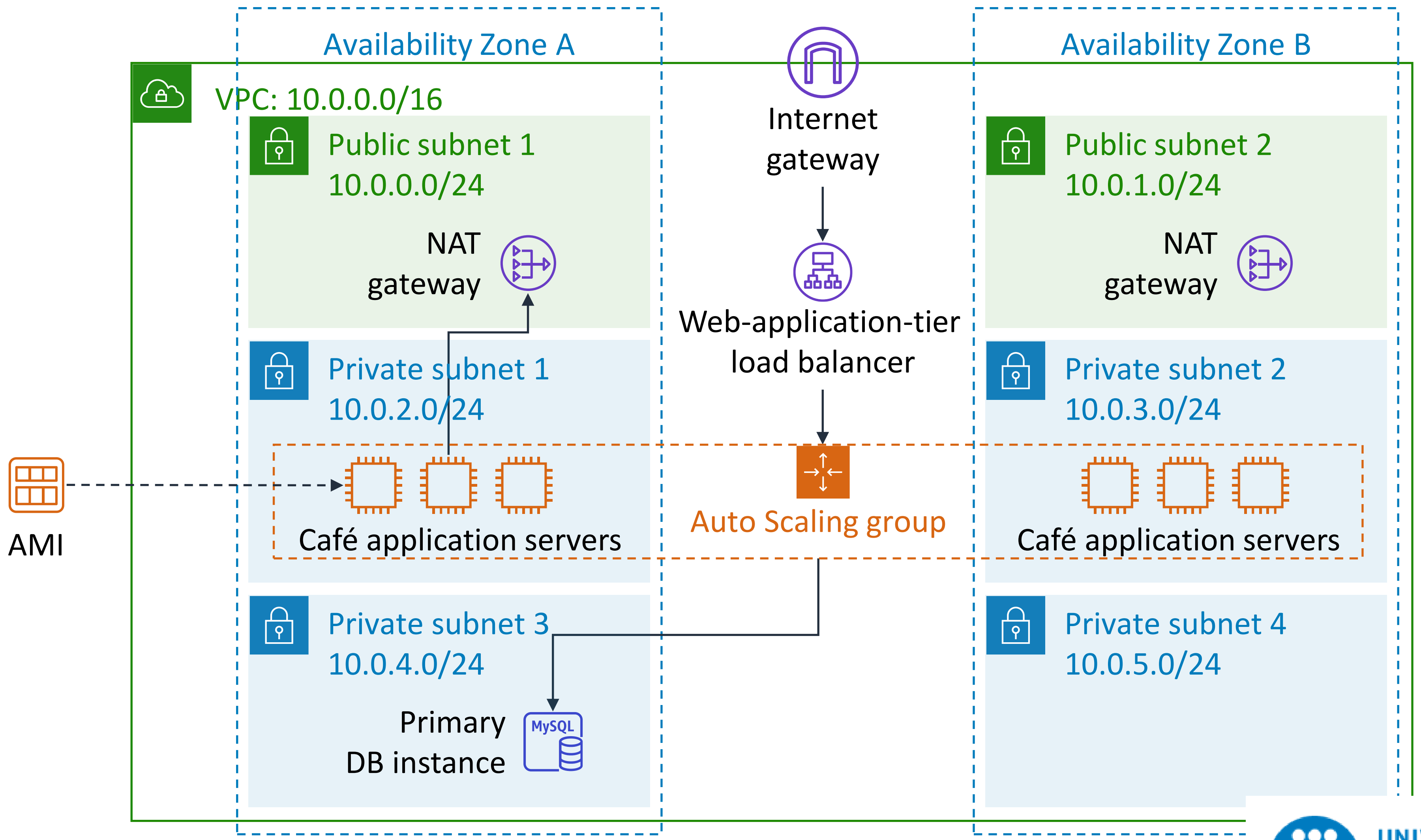
The business need: A scalable and highly available environment

- The café will soon be featured in a famous TV food show.
- Sofía and Nikhil want to make sure that the café's website can handle the expected increase in traffic.

Challenge lab: Tasks

1. Creating a NAT gateway for the second Availability Zone
2. Creating a bastion host instance in a public subnet
3. Creating a launch template
4. Creating an Auto Scaling group
5. Creating a load balancer
6. Testing the web application
7. Testing automatic scaling under load

Challenge lab: Final product



~ 90 minutes

Begin Module 9 – Challenge Lab: Creating a Scalable and Highly Available Environment for the Café

Challenge lab debrief: Key takeaways

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Implementing Elasticity, High Availability, and Monitoring

Module wrap-up

Module summary

In summary, in this module, you learned how to:

- Use Amazon EC2 Auto Scaling within an architecture to promote elasticity
- Explain how to scale your database resources
- Deploy an Application Load Balancer to create a highly available environment
- Use Amazon Route 53 for DNS failover
- Create a highly available environment
- Design architectures that use Amazon CloudWatch to monitor resources and react accordingly

Complete the knowledge check

```
<div id="content">
  <header id="topnav">
    <nav>
      <ul>
        <li class="active"><a class="scroll" href=
          Home                </a></li>
        <li><a class="scroll" href="#service">
          Service             </a></li>
        <li><a class="scroll" href="#product">
          Products            </a></li>
        <li><a class="scroll" href="#portfolio">
          Portfolio           </a></li>
        <li><a class="scroll" href="#team">
          Team                </a></li>
        <li><a class="scroll" href="#contact">
          Contact             </a></li>
        <div class="clear"></div>
      </ul>
    </nav>
    <div class="logo">
      <a href="./">
        <img src="web/images/logo3.png" id="logo_l
```

Sample exam question

A web application enables customers to upload orders to an S3 bucket. The resulting Amazon S3 events trigger a Lambda function that inserts a message into an SQS queue. A single EC2 instance reads the messages from the queue, processes them, and stores them in a DynamoDB table partitioned by unique order ID. Next month, traffic is expected to increase by a factor of 10 and a Solutions Architect is reviewing the architecture for possible scaling problems.

Which component is MOST likely to need re-architecting to be able to scale to accommodate the new traffic?

A. Lambda function

B. SQS queue

[✓ C. EC2 instance]

D. DynamoDB table

Additional resources

- Set it and Forget it: Auto Scaling Target Tracking Policies
- Introduction to Amazon Elastic Load Balancer – Application
- Configuring Auto Scaling Group with ELB Elastic Load Balancer
- What Is an Application Load Balancer?

Thank you

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