NET403

Elastic Load Balancing

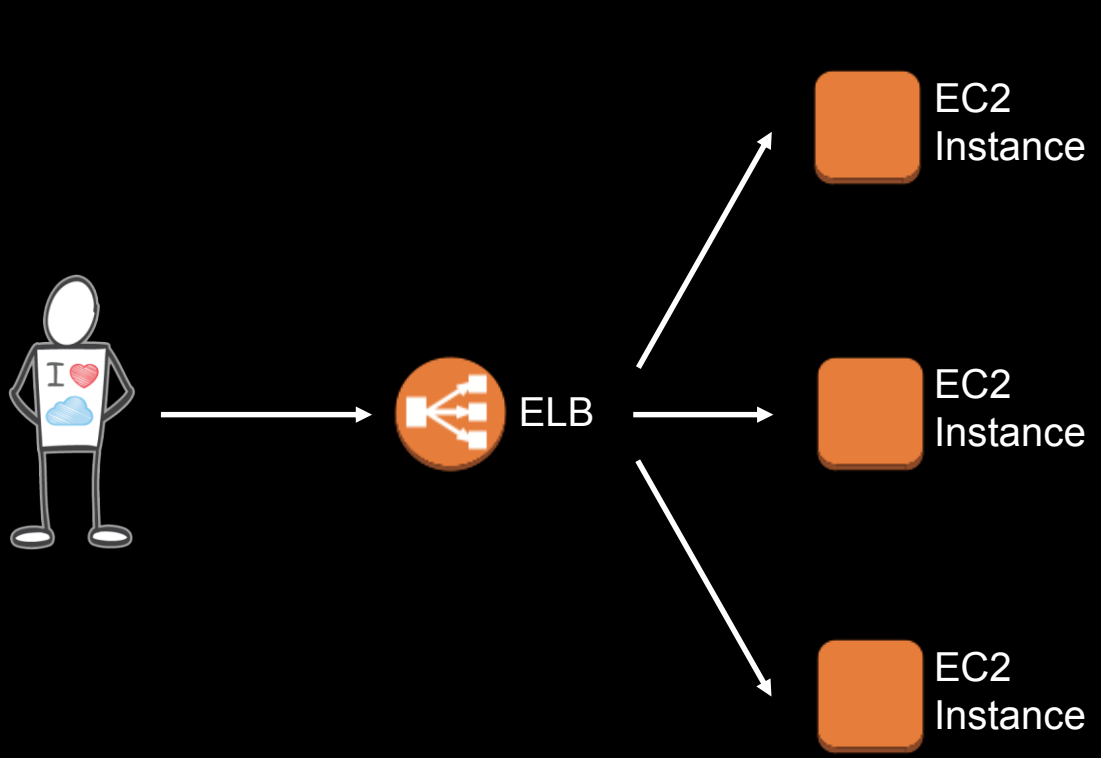
Deep Dive & Best Practices

David Brown, General Manager, Elastic Load Balancing

December 1, 2016

amazon web services

EC2
Instance

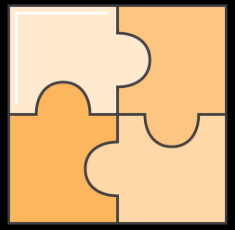


Load Balancer used to route incoming requests to multiple EC2 instances.

Elastic Load Balancing automatically distributes incoming application traffic across multiple applications, microservices and containers hosted on Amazon EC2 instances.

Elastic

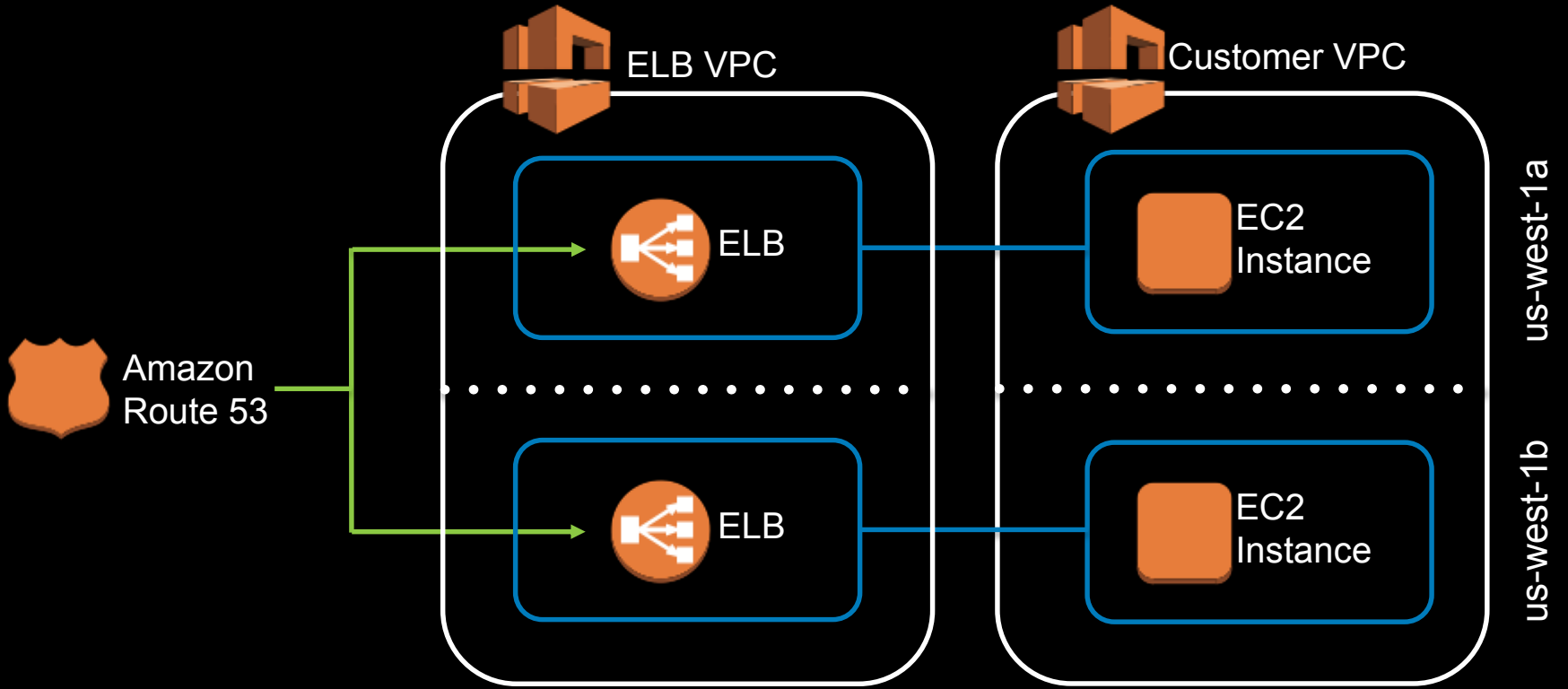
Secure



Integrated

Cost Effective

Elastic Load Balancing provides high availability by utilizing multiple Availability Zones


ELB VPC
Customer VPC
ELB
EC2
Instance
Amazon
Route 53
ELB
EC2
Instance
us-west-1a
us-west-1b

Layer 4 (network)

Supports TCP and SSL

Incoming client connection bound to server connection

No header modification

Proxy Protocol prepends source and destination IP and ports to request

Layer 7 (application)

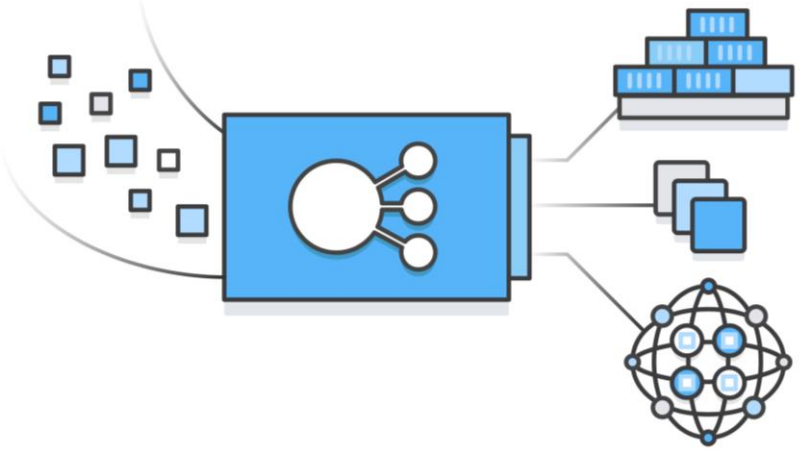
Supports HTTP and HTTPS

Connection terminated at the load balancer and pooled to the server

Headers may be modified

X-Forwarded-For header contains client IP address

New



Application Load Balancer

Advanced request routing with support for microservices and container-based applications.

	Classic	Application
Protocol	TCP, SSL, HTTP, HTTPS	HTTP, HTTPS
Platforms	EC2-Classic, EC2-VPC	EC2-VPC
Health checks	✓	Improved
CloudWatch metrics	✓	Improved
Path-based routing		✓
Container support		✓
WebSockets & HTTP/2		✓

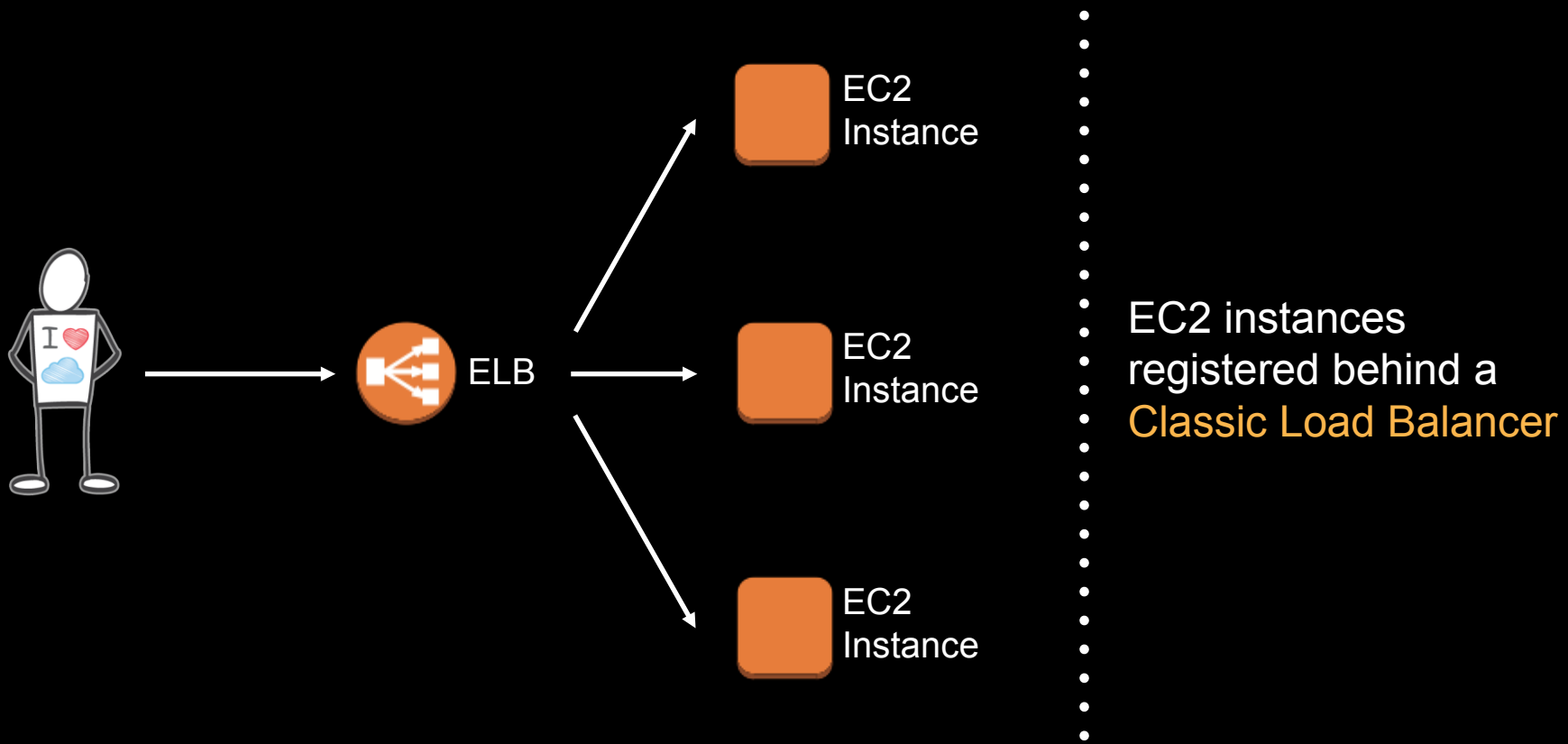
Application Load Balancer

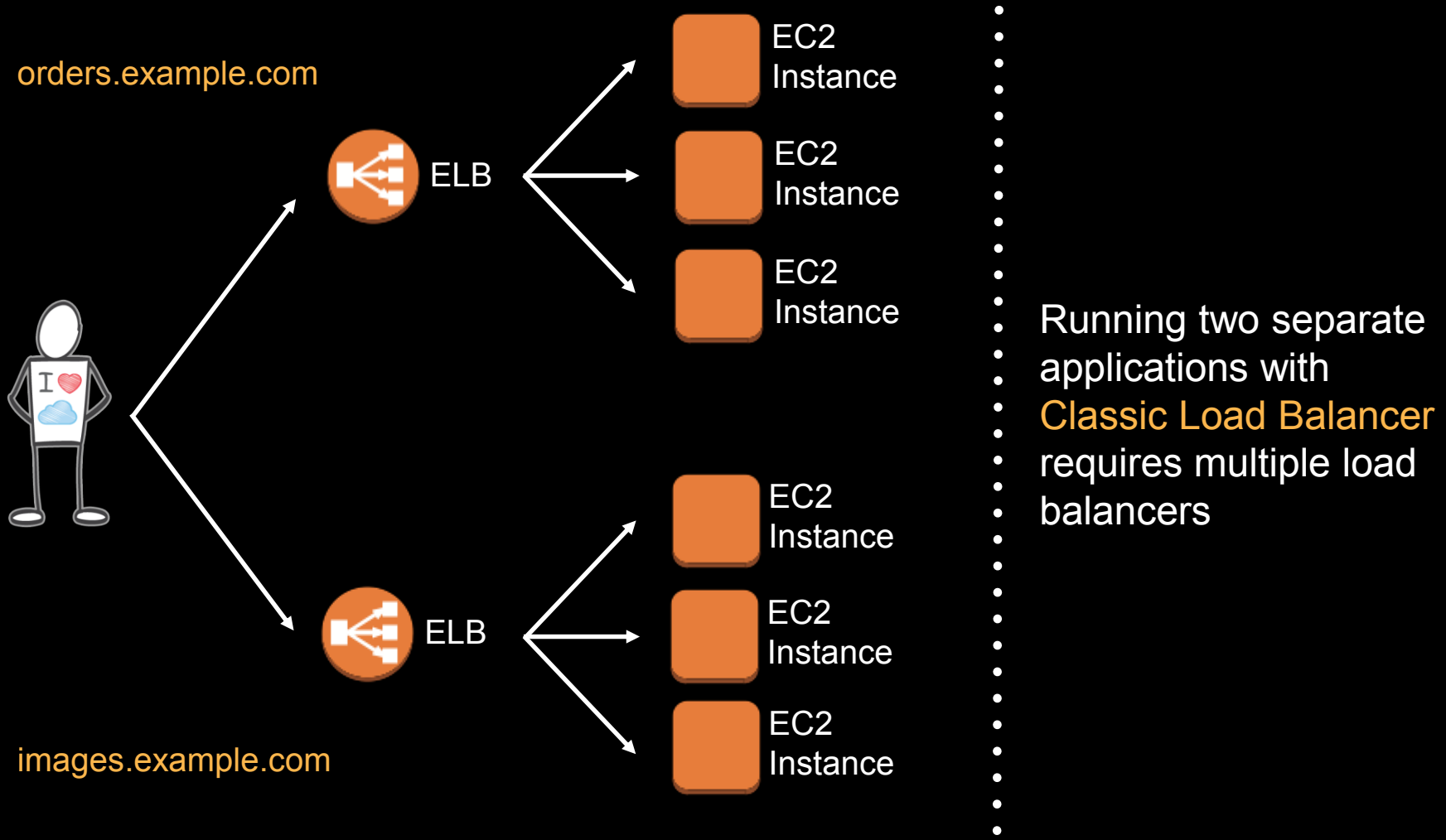
New, feature rich, layer 7 load balancing platform

Fully-managed, scalable and highly available load balancing platform

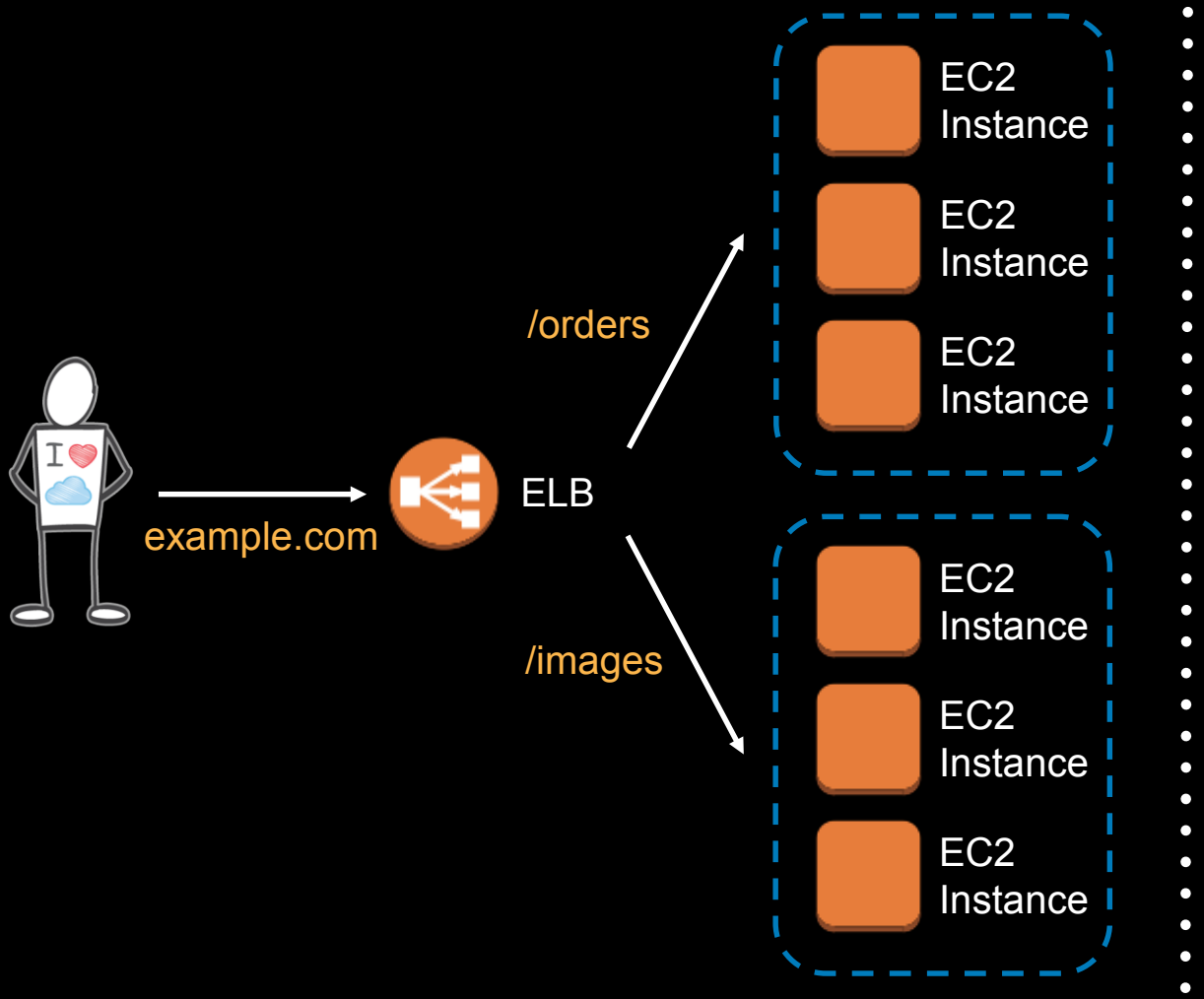
Content-based routing allows requests to be routed to different applications behind a single load balancer

Application Load Balancer allows for multiple applications to be hosted behind a single load balancer


I
ELB
EC2
Instance
EC2
Instance
EC2
Instance
EC2 instances
registered behind a
Classic Load Balancer



Running two separate applications with Classic Load Balancer requires multiple load balancers



Application Load Balancer allows for multiple applications to be hosted behind a single load balancer

Multiple applications behind a single load balancer provides a significant cost saving

Consider blast radius and isolation when grouping applications behind a single load balancer

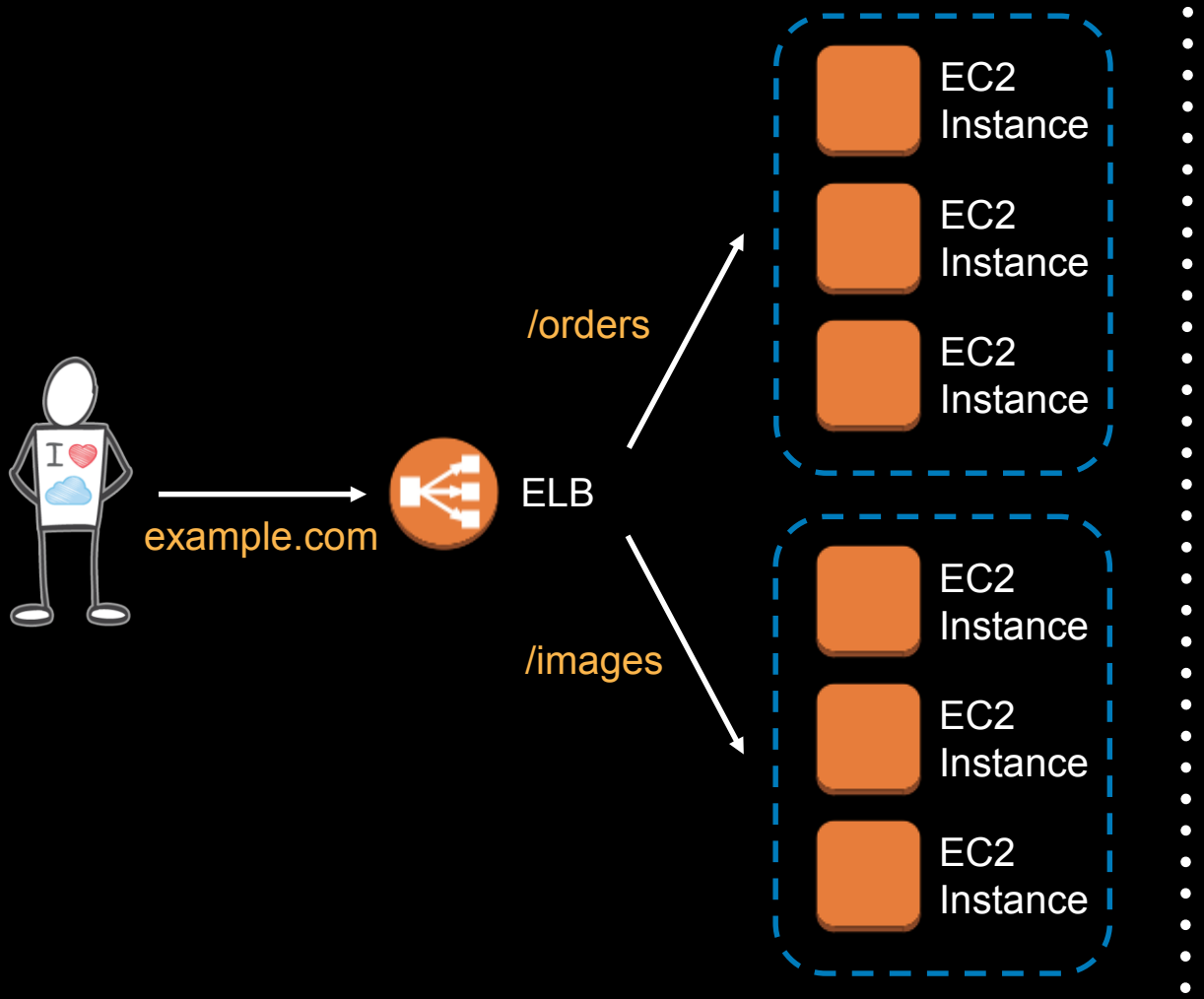
Application Load Balancer provides native support for microservice and container-based architectures

Application Load Balancer

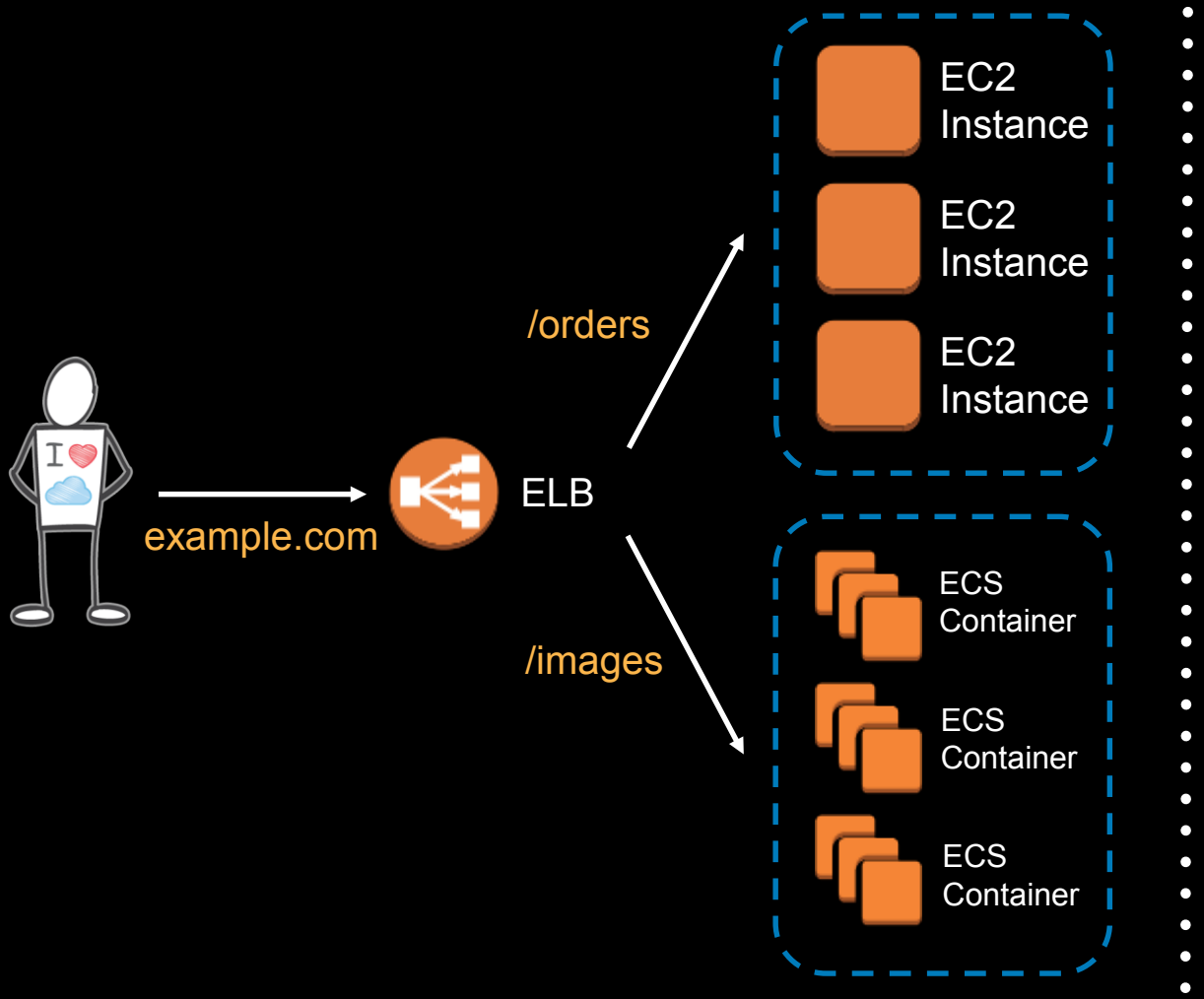
Instances can be registered with multiple ports, allowing for requests to be routed to multiple containers on a single instance

Amazon ECS will automatically register tasks with the load balancer using a dynamic port mapping

Can also be used with other container technologies



Application Load Balancer allows for multiple applications to be hosted behind a single load balancer



Application Load Balancer allows containers to be registered with the load balancer

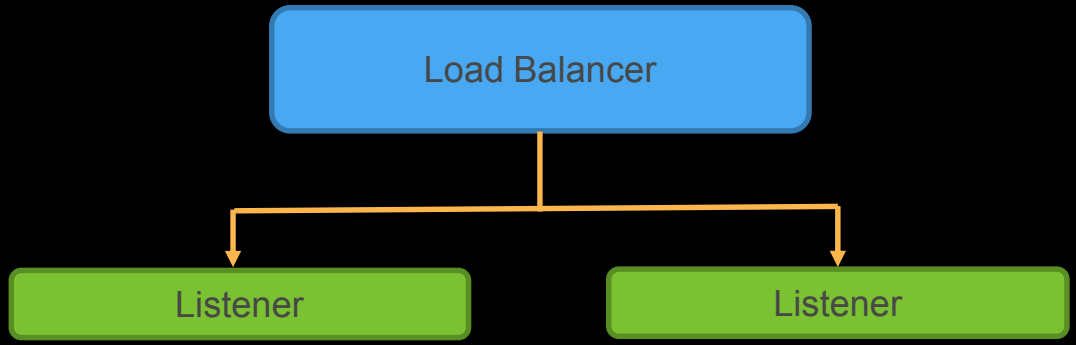
Microservice and container-based architectures provide further cost savings by improving resource utilization

Application Load Balancer

New API version provided for creating, configuring and managing Application Load Balancers

Follows latest AWS best practices for resource identifiers and API design

Provides several new resource types, including target groups, targets and rules

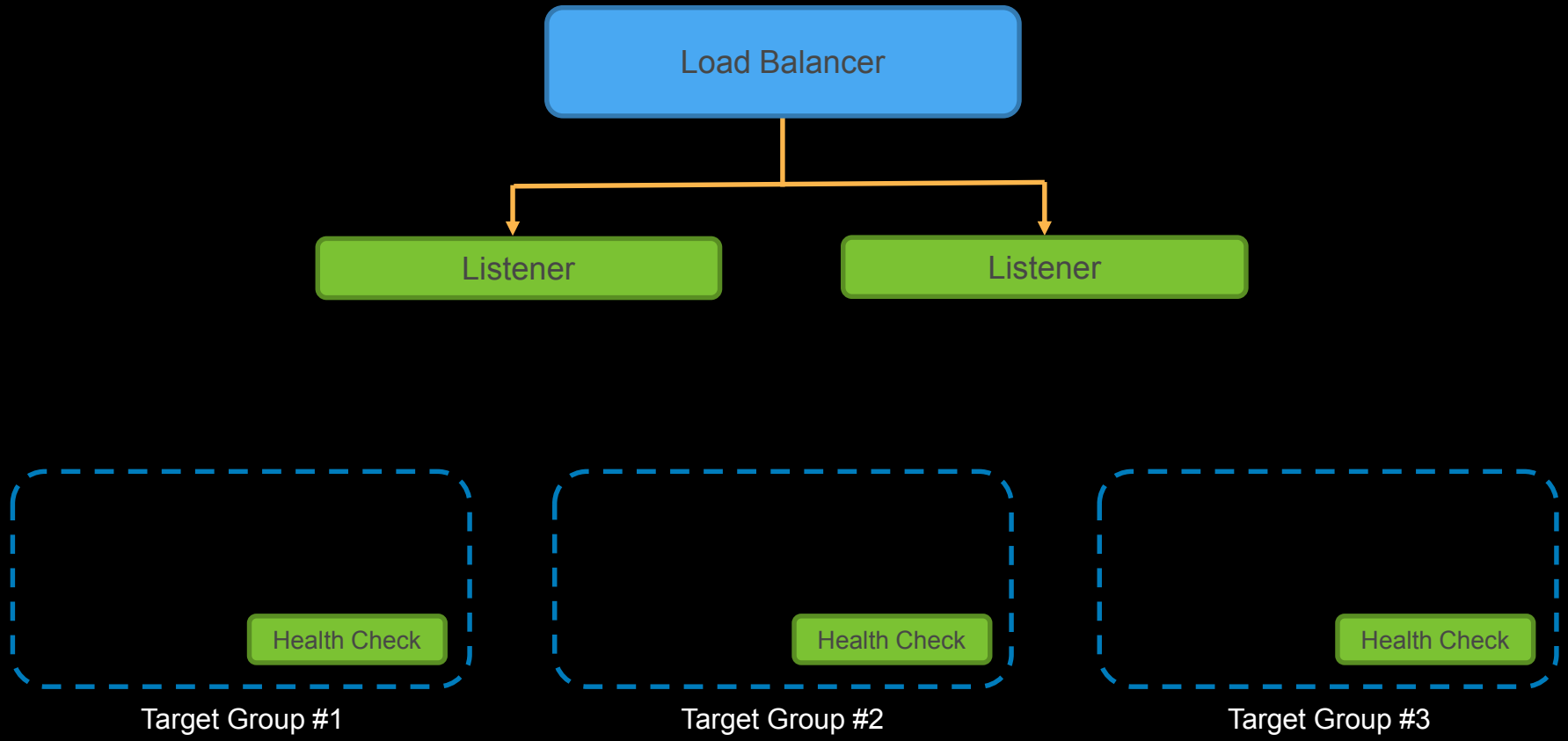

Load Balancer
Listener
Listener

Listeners

Define the protocol and port on which the load balancer listens for incoming connections

Each load balancer needs at least one listener to accept incoming traffic, and can support up to 10 listeners

Routing rules are defined on listeners

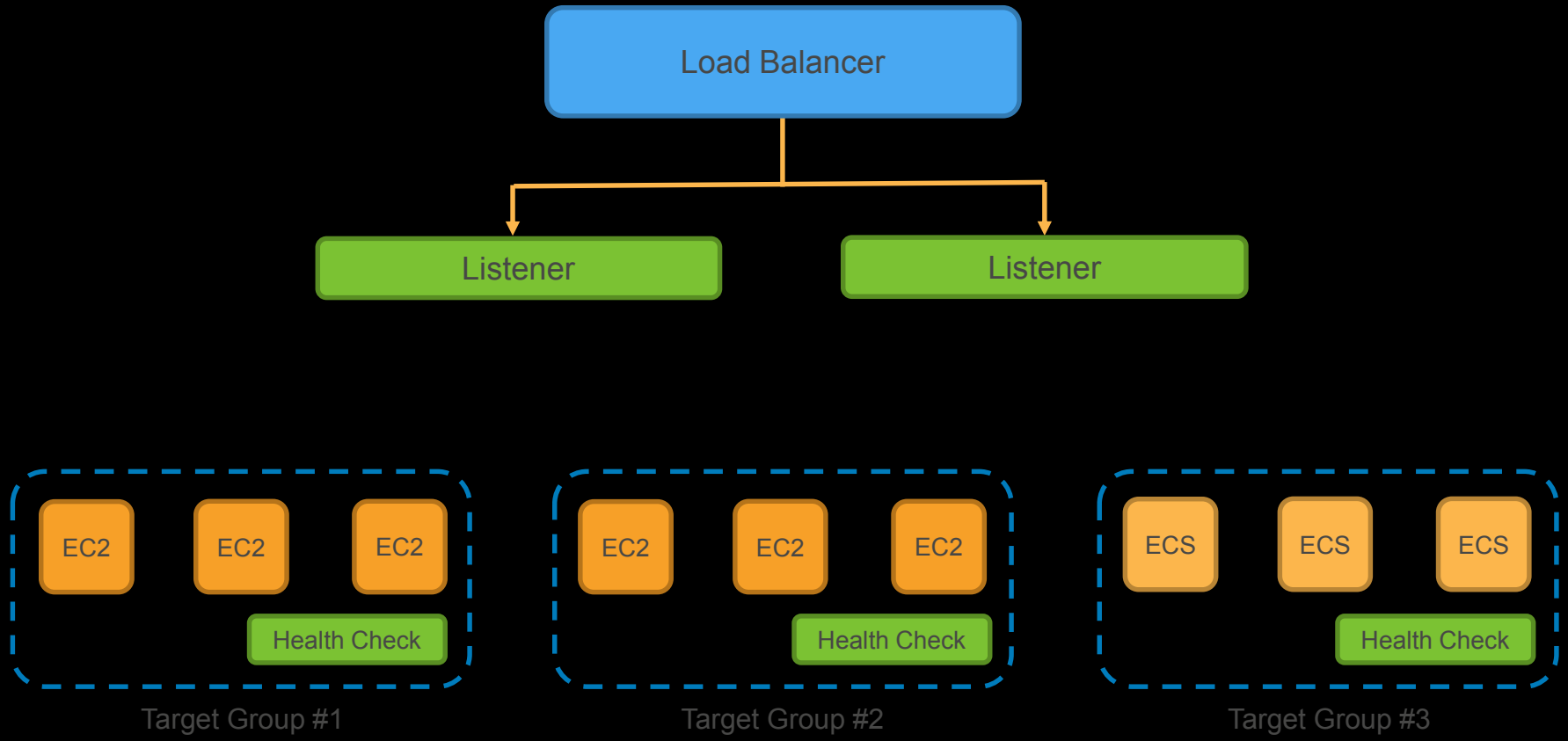

Load Balancer
Listener
Listener
Health Check
Health Check
Health Check
Target Group #1
Target Group #2
Target Group #3

Target Groups

Logical grouping of targets
behind a load balancer

Target groups can be exist independently
from the load balancer, and be associated
with a load balancer when needed

Regional construct that can be associated
with Auto Scaling group

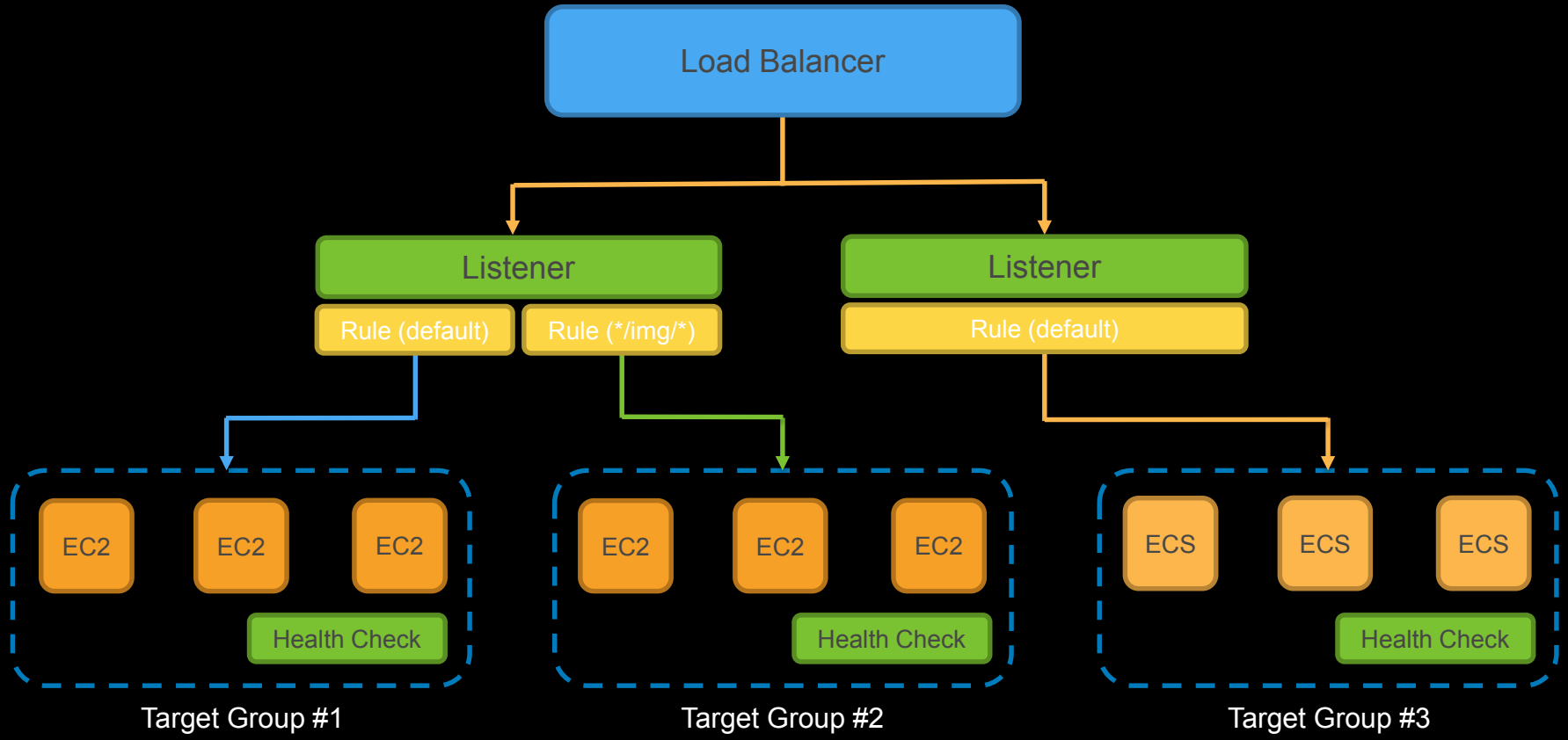

Load Balancer
Listener
Listener
EC2
EC2
EC2
Health Check
Target Group #1
EC2
EC2
EC2
Health Check
Target Group #2
ECS
ECS
ECS
Health Check
Target Group #3

Targets

Logical load balancing target, which can be an EC2 instance, microservice, or container-based application

EC2 instances can be registered with the same target group using multiple ports

A single target can be registered with multiple target groups


Load Balancer
Listener
Rule (default)
Rule (*/img/*)
Listener
Rule (default)
EC2
EC2
EC2
Health Check
Target Group #1
EC2
EC2
EC2
Health Check
Target Group #2
ECS
ECS
ECS
Health Check
Target Group #3

Rules

Provide the link between listeners and target groups and consist of conditions and actions

When a request meets the condition of the rule, the associated action is taken

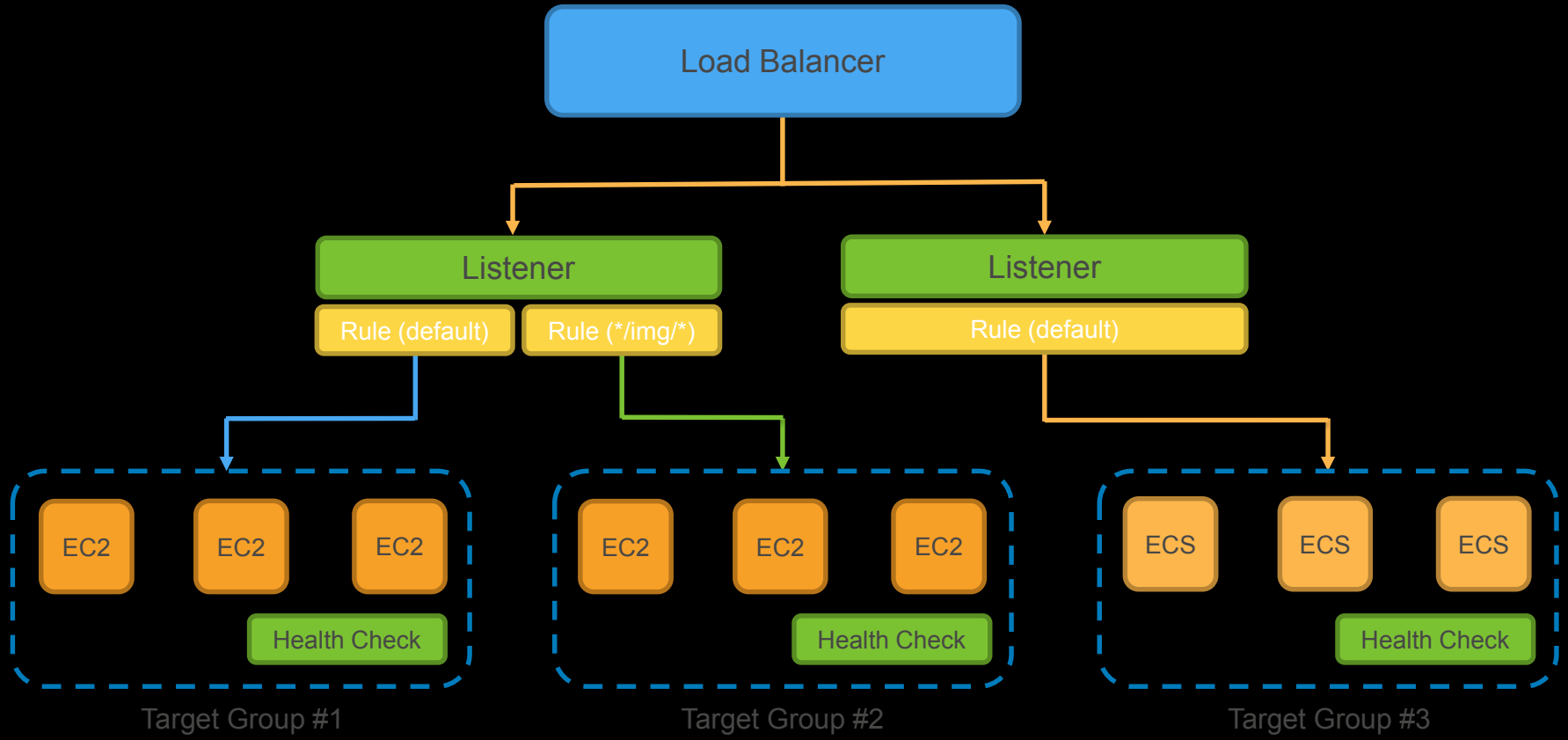
Today, rules can forward requests to a specified target group

Rules (continued)

Conditions can be specified in path pattern format

A path pattern is case sensitive, can be up to 128 characters in length, and can contain any of the following characters:

- A-Z, a-z, 0-9
- _ - . $ / ~ " ' @ : +
- & (using &)
- * (matches 0 or more characters)
- ? (matches exactly 1 character)


Load Balancer
Listener
Rule (default)
Rule (*/img/*)
Listener
Rule (default)
EC2
EC2
EC2
Health Check
EC2
EC2
EC2
Health Check
ECS
ECS
ECS
Health Check
Target Group #1
Target Group #2
Target Group #3

Today, load balancers support

up to 10 rules

New

Support for up to 100 rules coming soon to Application Load Balancers

Use API deletion protection to prevent a load balancer from being erroneously deleted

Application Load Balancer provides improved performance for Internet applications

Application Load Balancer

Native support for WebSockets, supporting full-duplex communication channels over a single TCP connection

Support for HTTP/2 provides improved page load times from most of today's browsers

Improved performance for real-time and streaming applications

No additional configuration is required to enable WebSockets or HTTP/2

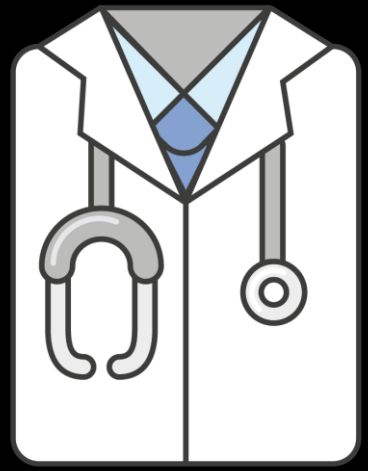
Classic Load Balancers have offered IPv6 support for some time

New

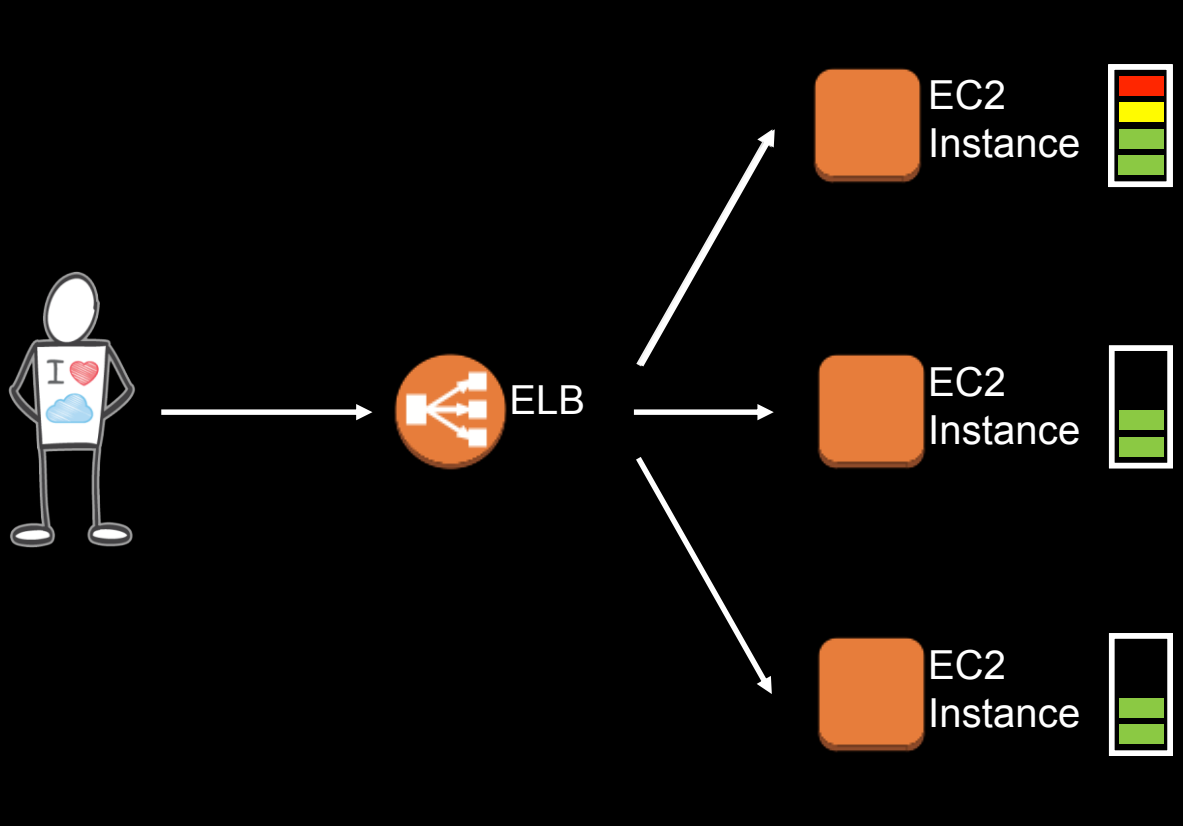
Native support for IPv6 coming soon to Application Load Balancers

Improvements to application availability and scalability

EC2
Instance

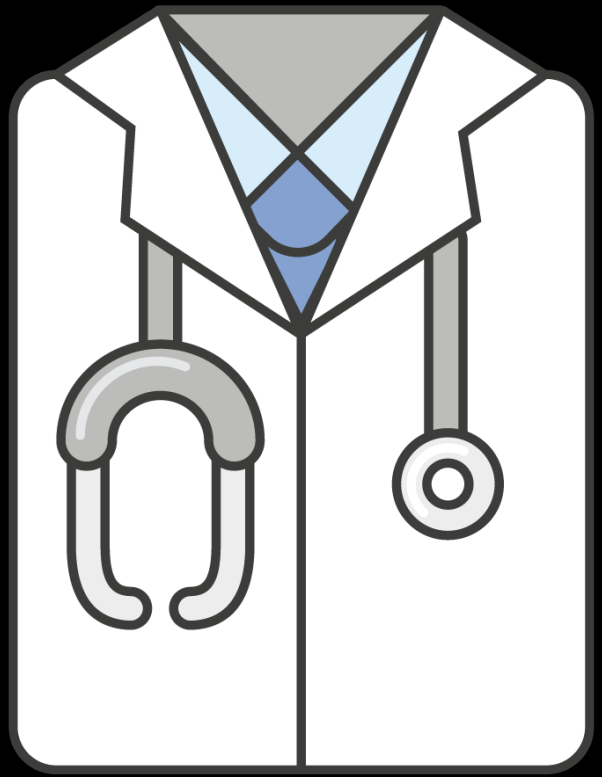


Health checks allow for traffic to be shifted away from **impaired** or **failed** instances



Health checks ensure that request traffic is shifted away from a failed instance.

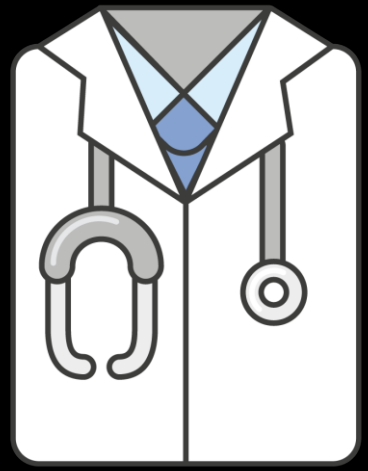
Health Checks



HTTP and HTTPS health checks

Customize the frequency, failure thresholds, and list of successful response codes

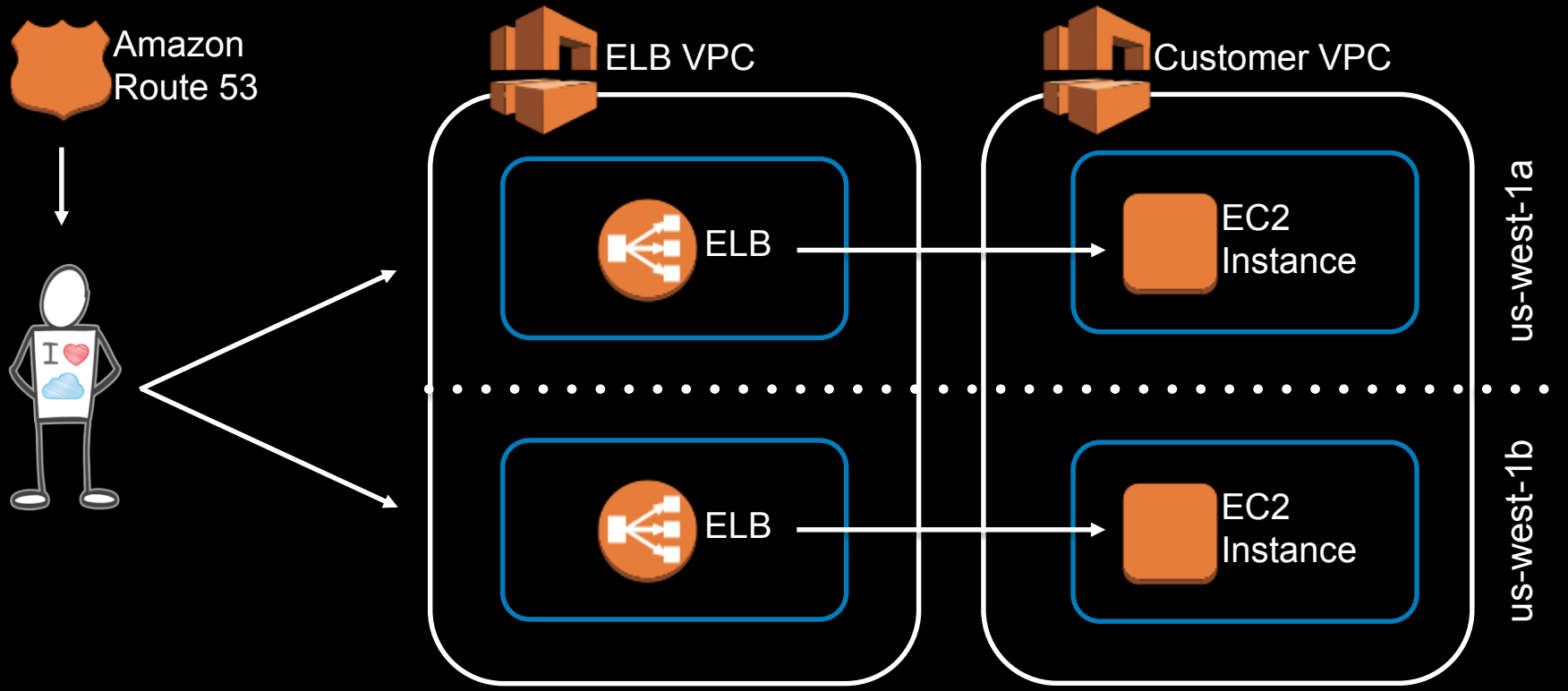
Detailed reasons for health check failures are now returned via the API and displayed in the AWS Management Console

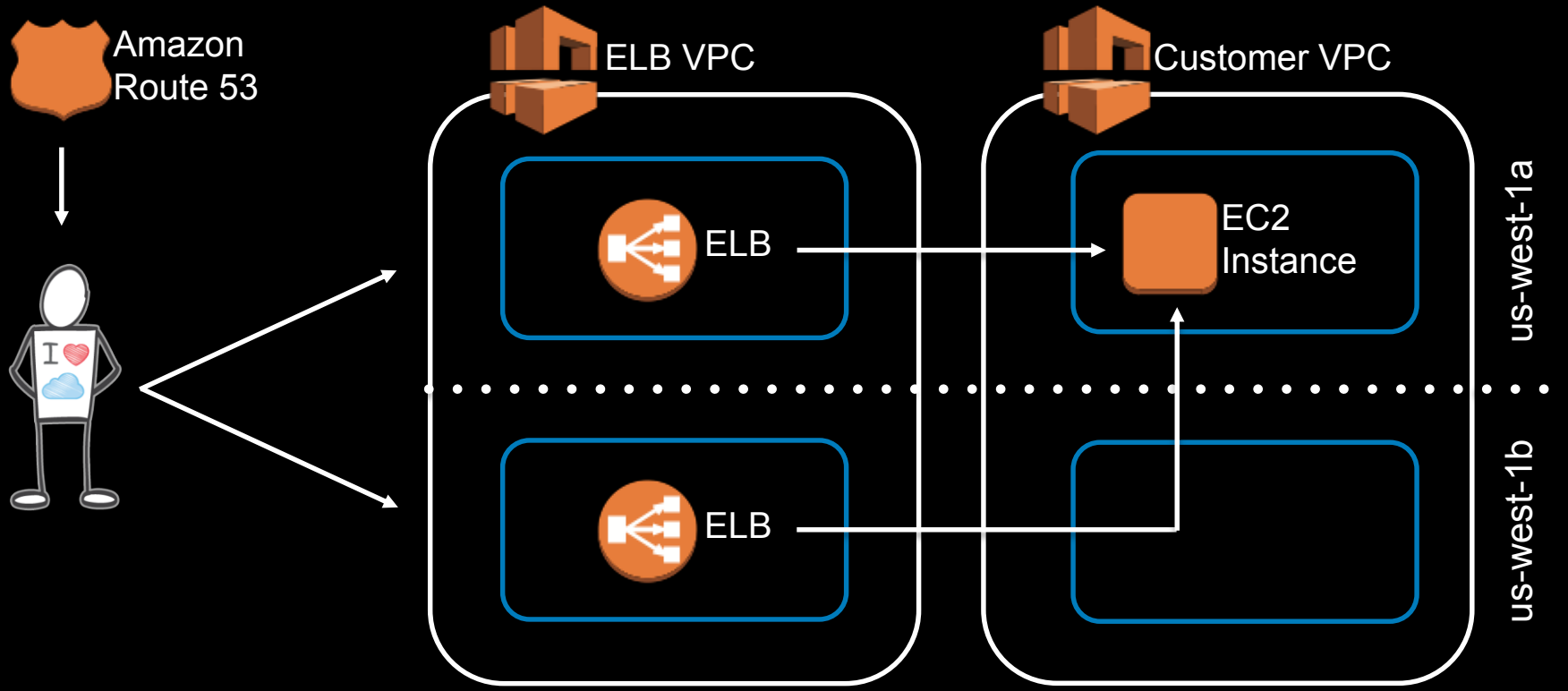


Application Load Balancer will fail open should all back-ends fail the health check

Always use

multiple Availability Zones


Amazon
Route 53
ELB VPC
Customer VPC
ELB
EC2
Instance
ELB
EC2
Instance
us-west-1a
us-west-1b


Amazon
Route 53
ELB VPC
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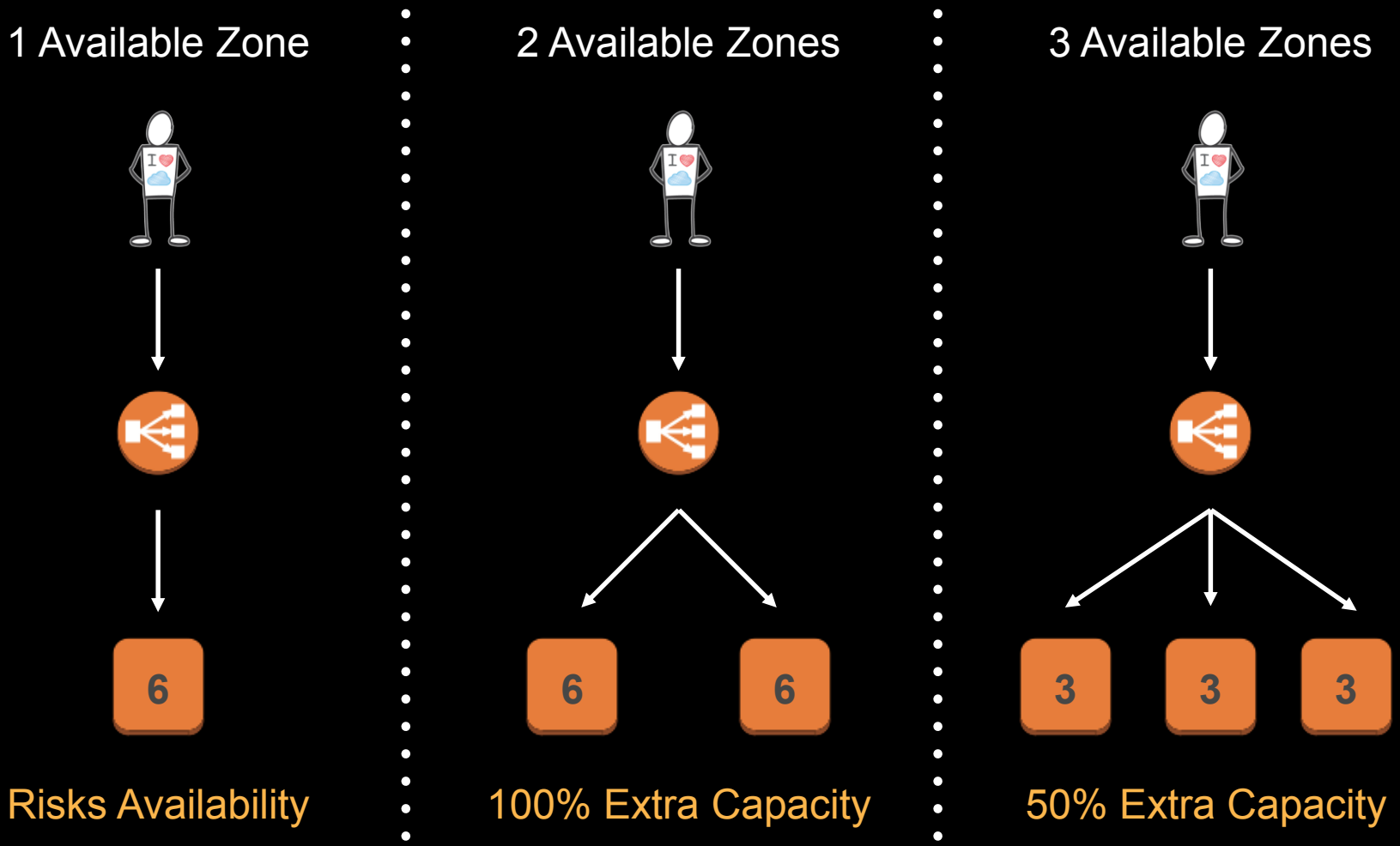
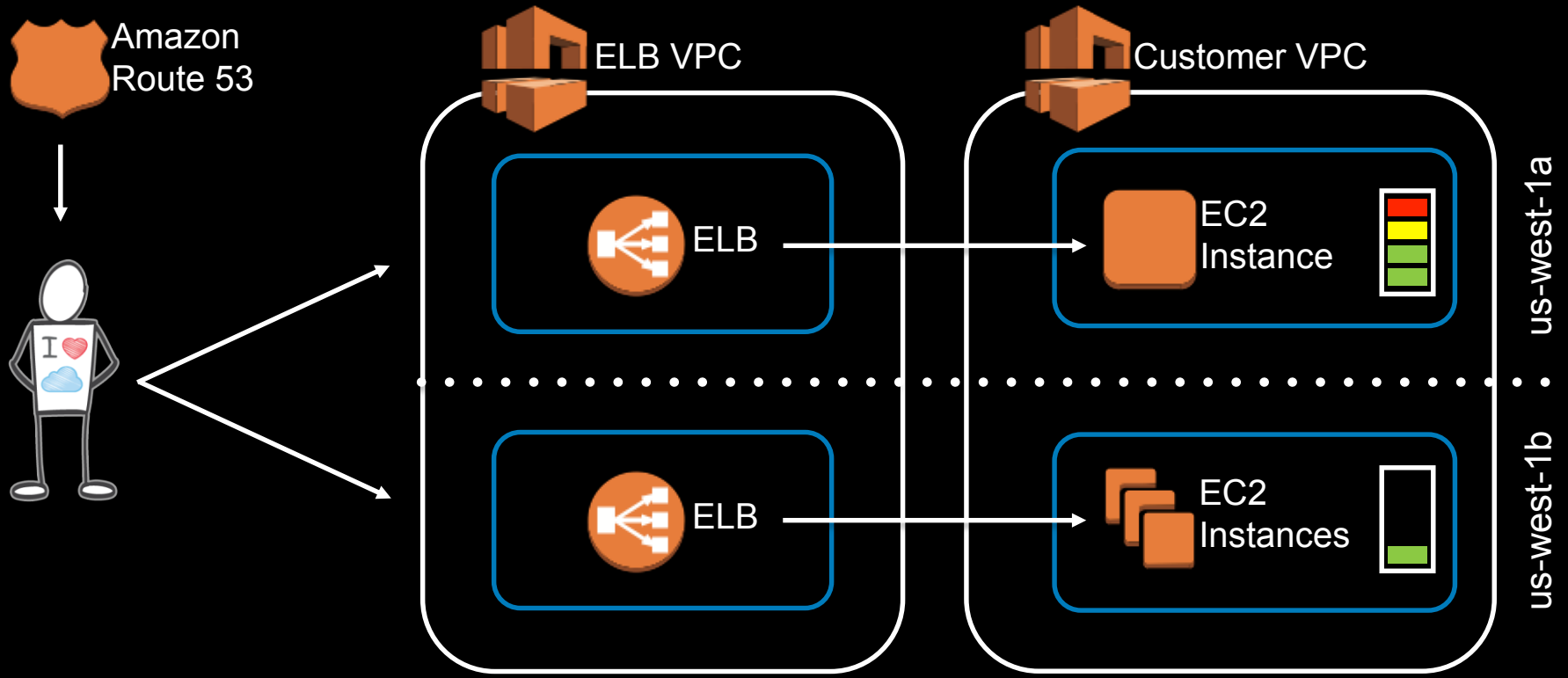
EC2
Instance
ELB
us-west-1a
us-west-1b

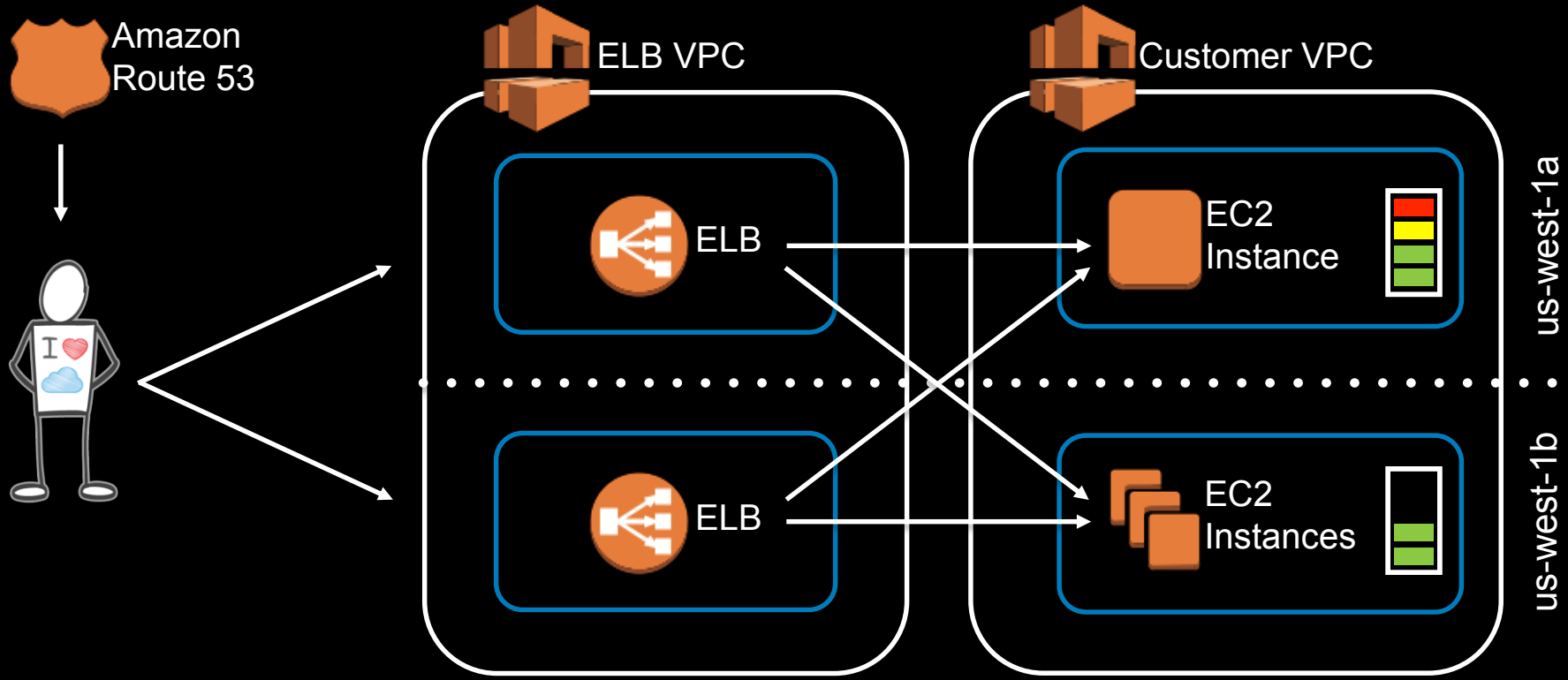

1 Available Zone
2 Available Zones
3 Available Zones
6
6
6
3
3
3
Risks Availability
100% Extra Capacity
50% Extra Capacity

Using multiple Availability Zones can bring a few challenges …

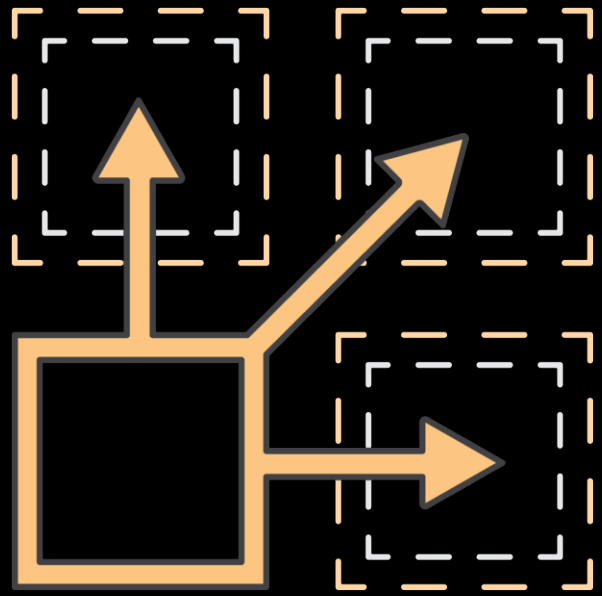
Imbalanced Instance Capacity



Cross-Zone Load Balancing



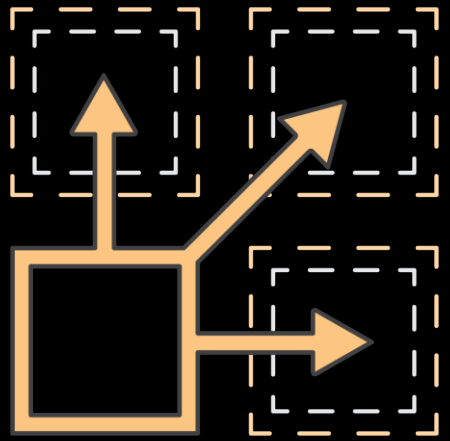
Cross-Zone Load Balancing



Distributes requests evenly across multiple Availability Zones

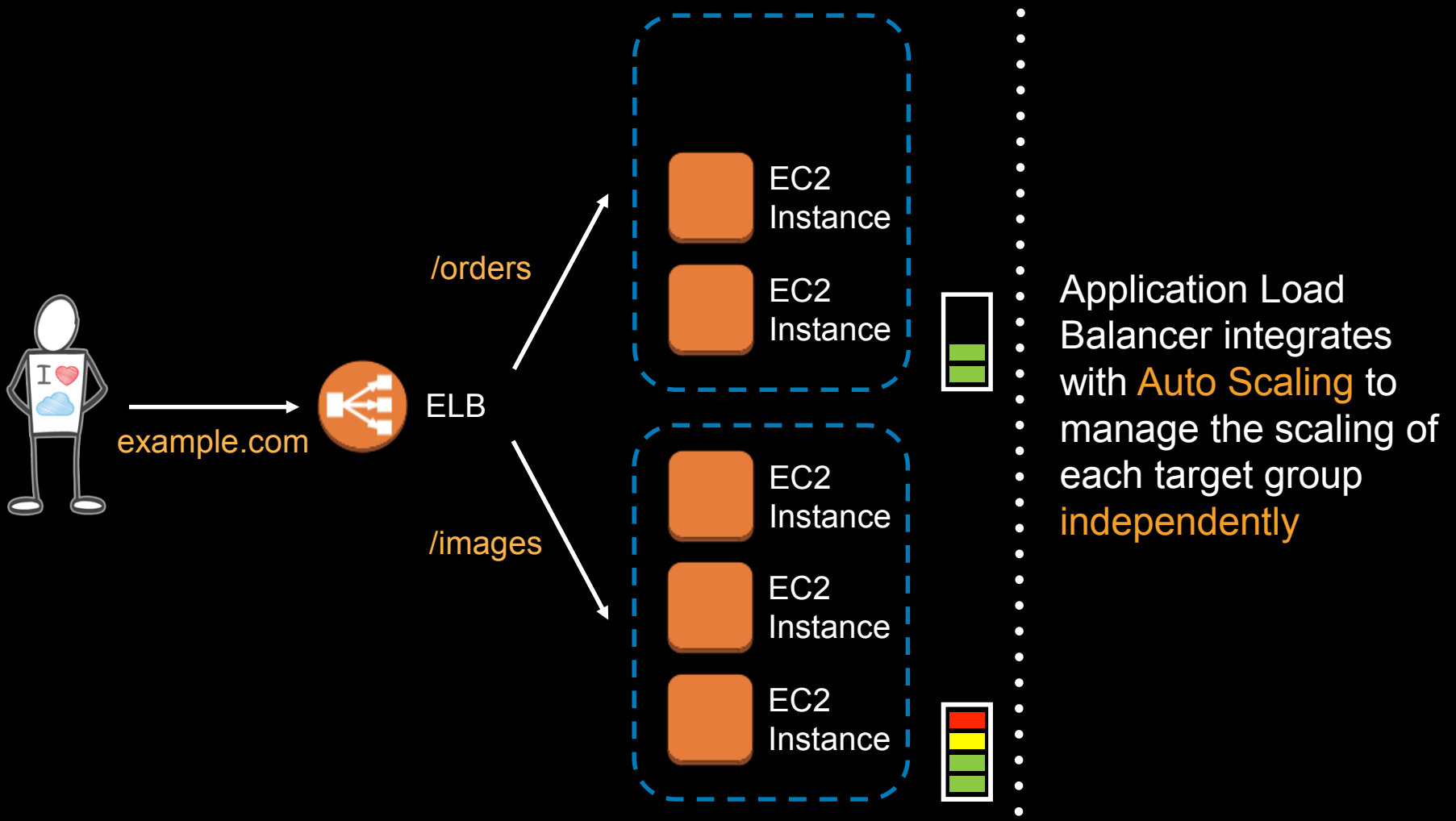
Absorbs impact of DNS caching and eliminates imbalances in backend instance utilization

No additional bandwidth charge for cross-zone traffic



Cross Zone Load Balancing **enabled by default** on all Application Load Balancers

Auto Scaling now supports the scaling of applications at the target group level

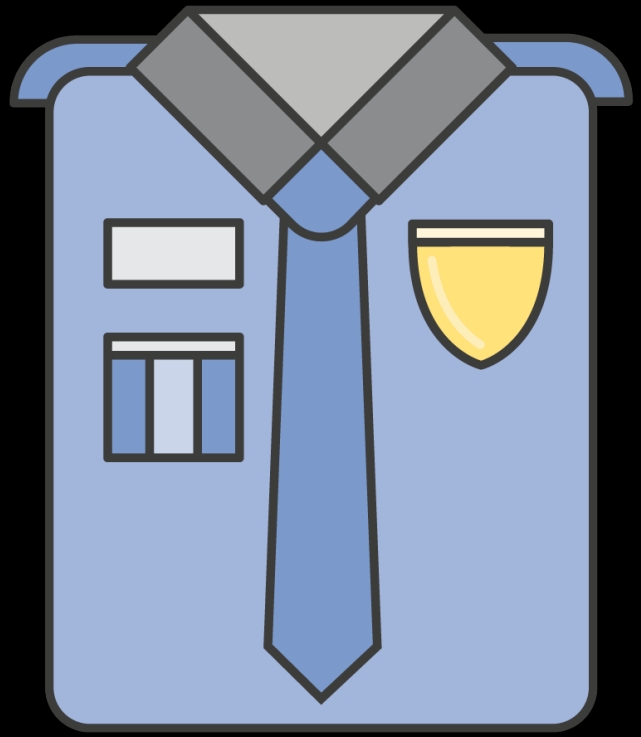


Application Load Balancer integrates with Auto Scaling to manage the scaling of each target group independently

When using Auto Scaling, keep in mind that your application may be under load during quiet times

Continued support for advanced application security features

SSL Offloading



SSL Negotiation Policies provide selection of ciphers and protocols that adhere to the latest industry best practices

Optimized for balance between security and client connectivity, as tested with Amazon.com traffic

Application Load Balancer supports security groups to limit access to specified ranges

New

Web Application Firewall support coming soon to Application Load Balancers

Website Application Firewall

New

Monitors requests and protects web applications from malicious activities at the load balancer level

Block, allow, or count web requests based on WAF rules and conditions

Preconfigured rules available for common protections: SQL-injection, cross-site scripting, bad-actor IPs, bad bots, and HTTP flood attacks

Improved load balancer and application monitoring

Amazon CloudWatch Metrics

CloudWatch metrics provided for each load balancer

Provide detailed insight into the health of the load balancer and application stack

All metrics provided at 1-minute granularity

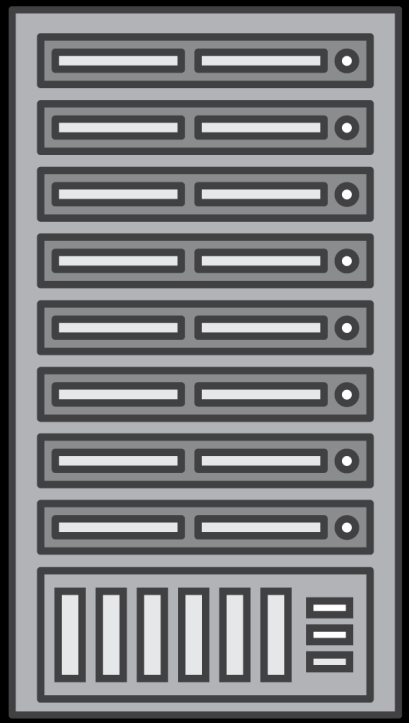
Amazon CloudWatch Metrics

Metrics provided at both the load balancer and target group level

CloudWatch alarms can be configured to notify or take action should any metric go outside of the acceptable range

Auto Scaling can use these metrics for scaling of the back-end fleet

HealthyHostCount



The count of the number of healthy instances in each Availability Zone

Most common cause of unhealthy hosts is health check exceeding the allocated timeout

Test by making repeated requests to the backend instance from another EC2 instance

View at the zonal dimension

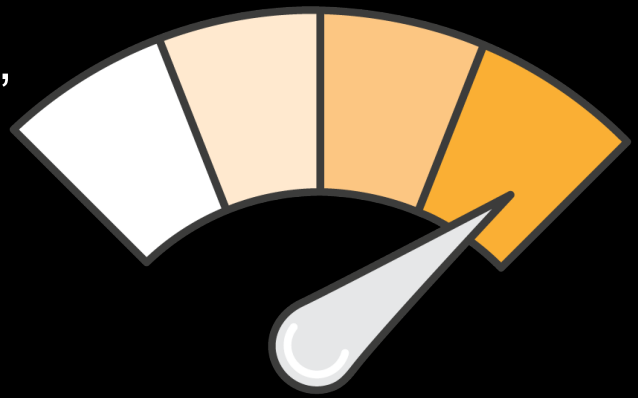
Latency

Measures the elapsed time, in seconds, from when the request leaves the load balancer until the response is received

Test by sending requests to the backend instance from another instance

Using min, average, and max CloudWatch stats, provide upper and lower bounds for latency

Debug individual requests using access logs



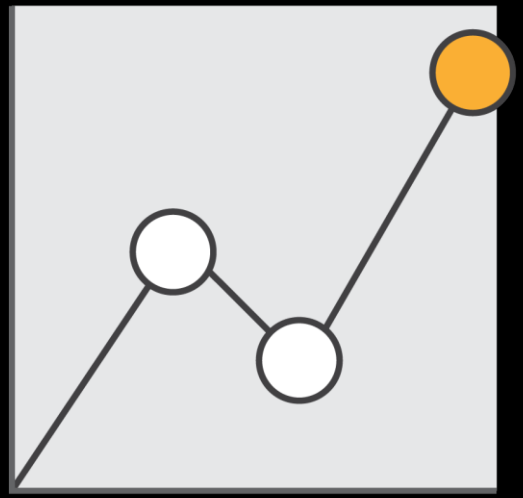
Rejected Connection Count

The number of connections that were rejected because the load balancer could not establish a connection with a healthy target in order to route the request

This replaces surge queue metrics which are used by the Classic Load Balancer

Surge queues often impact client applications, which fast request rejection improves

Normally a sign of an under-scaled application



Target Group Metrics

The following metrics are now provided at the target group level, allowing for individual applications to be closely monitored:

- RequestCount
- HTTPCode_Target_2XX_Count
- HTTPCode_Target_3XX_Count
- HTTPCode_Target_4XX_Count
- HTTPCode_Target_5XX_Count
- TargetResponseTime (Latency)
- UnHealthyHostCount
- HealthyHostCount

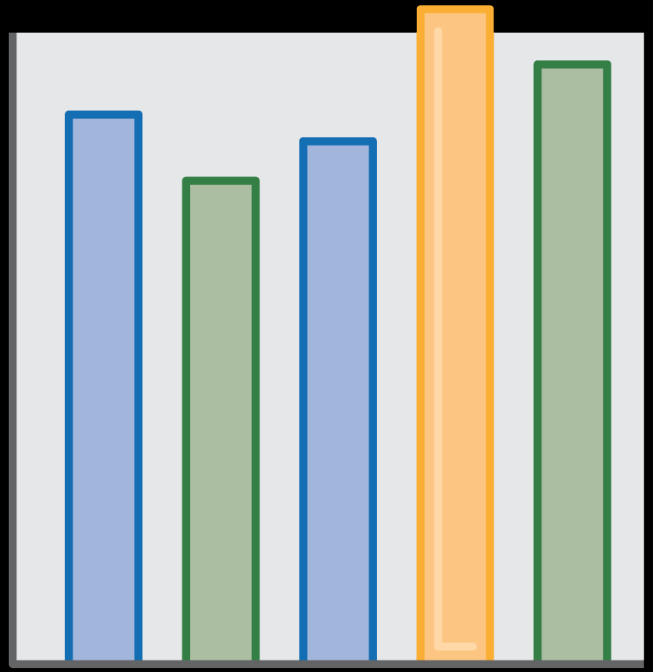
CloudWatch Percentiles

New

Load balancer request response times are now provided with percentile dimensions

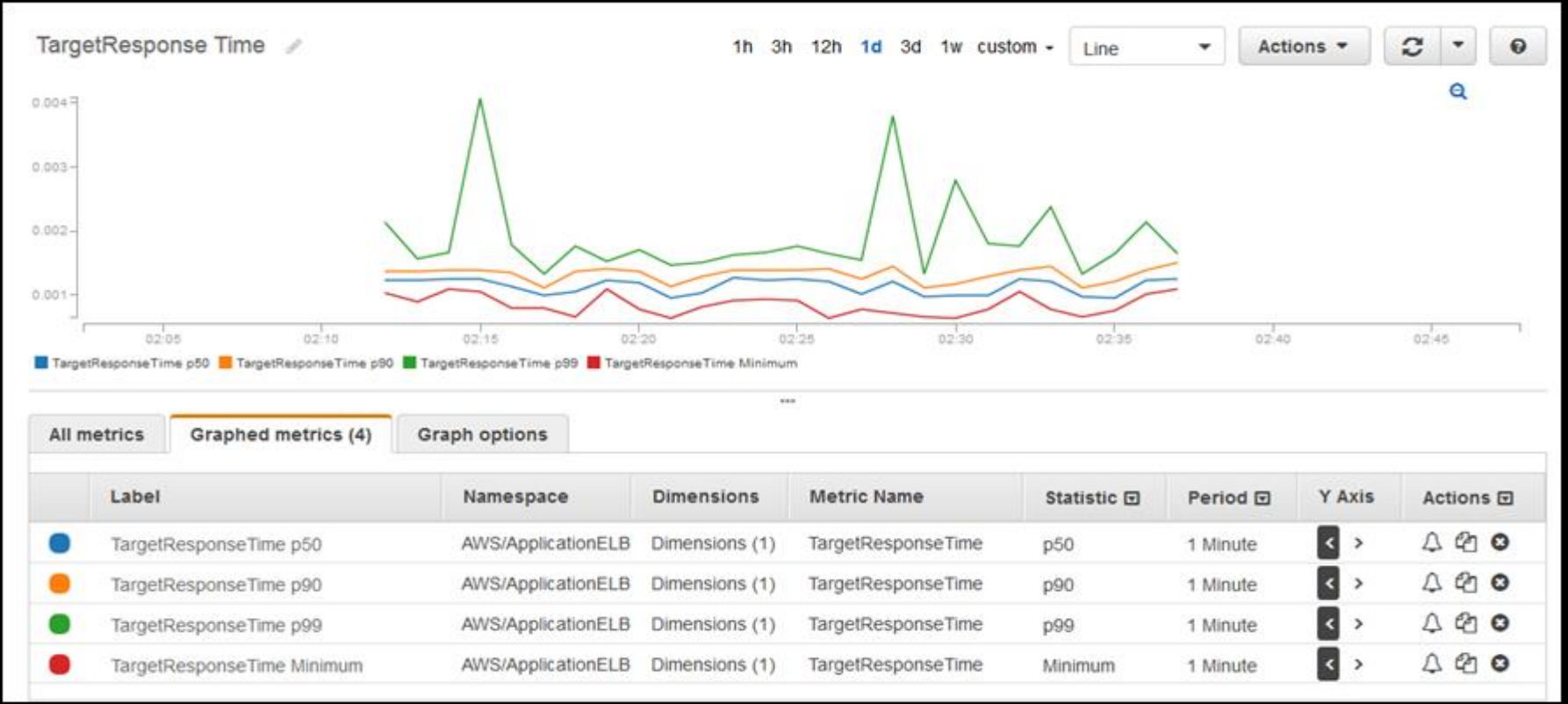
Provides visibility into the 90th, 95th, 99th, or 99.9th percentile of response times

Allows for more meaningful, and aggressive, performance targets for applications

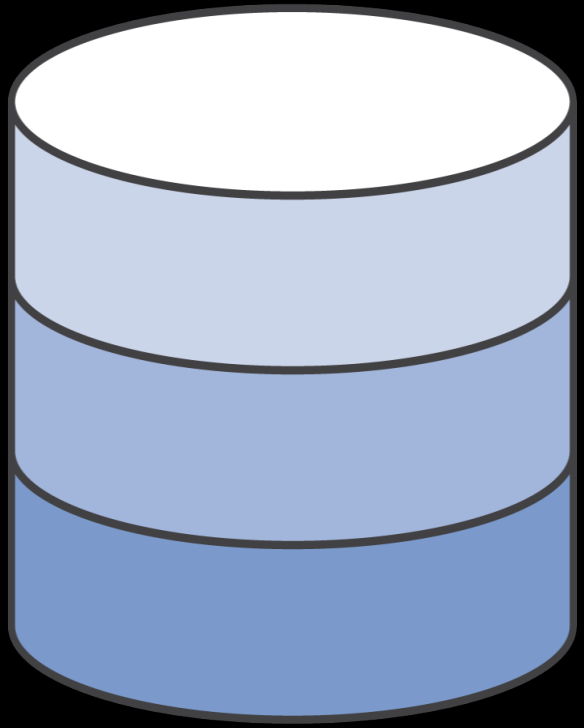


CloudWatch Percentiles

New



Access Logs



Provide detailed information on each request processed by the load balancer

Includes request time, client IP address, latencies, request path, server responses, ciphers and protocols, and user-agents

Delivered to an Amazon S3 bucket every 5 or 60 minutes

Request Tracing

New

Application Load Balancers insert a unique trace identifier into each request using a custom header: X-Amzn-Trace-ID

Trace identifiers are preserved through the request chain to allow for request tracing

Trace identifiers are included in access logs and can also be logged by applications themselves

When should I use Application Load Balancer?

	Classic	Application
Protocol	TCP, SSL, HTTP, HTTPS	HTTP, HTTPS
Platforms	EC2-Classic, EC2-VPC	EC2-VPC
Health checks	✓	Improved
CloudWatch metrics	✓	Improved
Path-based routing		✓
Container support		✓
WebSockets & HTTP/2		✓

For TCP/SSL or EC2-Classic,
use Classic Load Balancer

For all other use-cases,
use Application Load Balancer

Thank you!

Remember to complete your evaluations!