Elastic Load Balancing

Application Load Balancers

Elastic Load Balancing: Application Load Balancers

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What is an Application Load Balancer?

Elastic Load Balancing automatically distributes your incoming traffic across multiple targets, such as EC2 instances, containers, and IP addresses, in one or more Availability Zones. It monitors the health of its registered targets, and routes traffic only to the healthy targets. Elastic Load Balancing scales your load balancer as your incoming traffic changes over time. It can automatically scale to the vast majority of workloads.

Elastic Load Balancing supports the following load balancers: Application Load Balancers, Network Load Balancers, Gateway Load Balancers, and Classic Load Balancers. You can select the type of load balancer that best suits your needs. This guide discusses Application Load Balancers. For more information about the other load balancers, see the User Guide for Network Load Balancers, the User Guide for Gateway Load Balancers, and the User Guide for Classic Load Balancers.

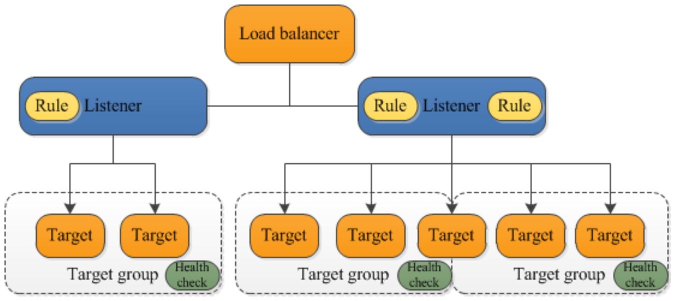
Application Load Balancer components

A *load balancer* serves as the single point of contact for clients. The load balancer distributes incoming application traffic across multiple targets, such as EC2 instances, in multiple Availability Zones. This increases the availability of your application. You add one or more listeners to your load balancer.

A *listener* checks for connection requests from clients, using the protocol and port that you configure. The rules that you define for a listener determine how the load balancer routes requests to its registered targets. Each rule consists of a priority, one or more actions, and one or more conditions. When the conditions for a rule are met, then its actions are performed. You must define a default rule for each listener, and you can optionally define additional rules.

Each *target group* routes requests to one or more registered targets, such as EC2 instances, using the protocol and port number that you specify. You can register a target with multiple target groups. You can configure health checks on a per target group basis. Health checks are performed on all targets registered to a target group that is specified in a listener rule for your load balancer.

The following diagram illustrates the basic components. Notice that each listener contains a default rule, and one listener contains another rule that routes requests to a different target group. One target is registered with two target groups.



For more information, see the following documentation:

- Load Balancers (p. 10)
- Listeners (p. 30)

- Target Groups (p. 67)

Application Load Balancer overview

An Application Load Balancer functions at the application layer, the seventh layer of the Open Systems Interconnection (OSI) model. After the load balancer receives a request, it evaluates the listener rules in priority order to determine which rule to apply, and then selects a target from the target group for the rule action. You can configure listener rules to route requests to different target groups based on the content of the application traffic. Routing is performed independently for each target group, even when a target is registered with multiple target groups. You can configure the routing algorithm used at the target group level. The default routing algorithm is round robin; alternatively, you can specify the least outstanding requests routing algorithm.

You can add and remove targets from your load balancer as your needs change, without disrupting the overall flow of requests to your application. Elastic Load Balancing scales your load balancer as traffic to your application changes over time. Elastic Load Balancing can scale to the vast majority of workloads automatically.

You can configure health checks, which are used to monitor the health of the registered targets so that the load balancer can send requests only to the healthy targets.

For more information, see How Elastic Load Balancing works in the *Elastic Load Balancing User Guide*.

Benefits of migrating from a Classic Load Balancer

Using an Application Load Balancer instead of a Classic Load Balancer has the following benefits:

- Support for Path conditions (p. 38). You can configure rules for your listener that forward requests based on the URL in the request. This enables you to structure your application as smaller services, and route requests to the correct service based on the content of the URL.
- Support for Host conditions (p. 37). You can configure rules for your listener that forward requests based on the host field in the HTTP header. This enables you to route requests to multiple domains using a single load balancer.
- Support for routing based on fields in the request, such as HTTP header conditions (p. 37) and methods, query parameters, and source IP addresses.
- Support for routing requests to multiple applications on a single EC2 instance. You can register an instance or IP address with multiple target groups, each on a different port.
- Support for redirecting requests from one URL to another.
- Support for returning a custom HTTP response.
- Support for registering targets by IP address, including targets outside the VPC for the load balancer.
- Support for registering Lambda functions as targets.
- Support for the load balancer to authenticate users of your applications through their corporate or social identities before routing requests.
- Support for containerized applications. Amazon Elastic Container Service (Amazon ECS) can select an unused port when scheduling a task and register the task with a target group using this port. This enables you to make efficient use of your clusters.
- Support for monitoring the health of each service independently, as health checks are defined at the target group level and many CloudWatch metrics are reported at the target group level. Attaching a target group to an Auto Scaling group enables you to scale each service dynamically based on demand.
- Access logs contain additional information and are stored in compressed format.

- Improved load balancer performance.

For more information about the features supported by each load balancer type, see Product comparisons for Elastic Load Balancing.

Related services

Elastic Load Balancing works with the following services to improve the availability and scalability of your applications.

- **Amazon EC2** — Virtual servers that run your applications in the cloud. You can configure your load balancer to route traffic to your EC2 instances.
- **Amazon EC2 Auto Scaling** — Ensures that you are running your desired number of instances, even if an instance fails, and enables you to automatically increase or decrease the number of instances as the demand on your instances changes. If you enable Auto Scaling with Elastic Load Balancing, instances that are launched by Auto Scaling are automatically registered with the load balancer, and instances that are terminated by Auto Scaling are automatically de-registered from the load balancer.
- **AWS Certificate Manager** — When you create an HTTPS listener, you can specify certificates provided by ACM. The load balancer uses certificates to terminate connections and decrypt requests from clients. For more information, see SSL certificates (p. 42).
- **Amazon CloudWatch** — Enables you to monitor your load balancer and take action as needed. For more information, see CloudWatch metrics for your Application Load Balancer (p. 103).
- **Amazon ECS** — Enables you to run, stop, and manage Docker containers on a cluster of EC2 instances. You can configure your load balancer to route traffic to your containers. For more information, see Service load balancing in the *Amazon Elastic Container Service Developer Guide*.
- **AWS Global Accelerator** — Improves the availability and performance of your application. Use an accelerator to distribute traffic across multiple load balancers in one or more AWS Regions. For more information, see the AWS Global Accelerator Developer Guide.
- **Route 53** — Provides a reliable and cost-effective way to route visitors to websites by translating domain names (such as `www.example.com`) into the numeric IP addresses (such as `192.0.2.1`) that computers use to connect to each other. AWS assigns URLs to your resources, such as load balancers. However, you might want a URL that is easy for users to remember. For example, you can map your domain name to a load balancer.
- **AWS WAF** — You can use AWS WAF with your Application Load Balancer to allow or block requests based on the rules in a web access control list (web ACL). For more information, see Application Load Balancers and AWS WAF (p. 18).

To view information about services that are integrated with your load balancer, select your load balancer in the AWS Management Console and choose the **Integrated services** tab.

Pricing

With your load balancer, you pay only for what you use. For more information, see Elastic Load Balancing pricing.

Getting started with Application Load Balancers

This tutorial provides a hands-on introduction to Application Load Balancers through the AWS Management Console, a web-based interface. To create your first Application Load Balancer, complete the following steps.

Tasks

For demos of common load balancer configurations, see Elastic Load Balancing demos.

Before you begin

- Decide which two Availability Zones you will use for your EC2 instances. Configure your virtual private cloud (VPC) with at least one public subnet in each of these Availability Zones. These public subnets are used to configure the load balancer. You can launch your EC2 instances in other subnets of these Availability Zones instead.
- Launch at least one EC2 instance in each Availability Zone. Be sure to install a web server, such as Apache or Internet Information Services (IIS), on each EC2 instance. Ensure that the security groups for these instances allow HTTP access on port 80.

Step 1: Configure your target group

Create a target group, which is used in request routing. The default rule for your listener routes requests to the registered targets in this target group. The load balancer checks the health of targets in this target group using the health check settings defined for the target group.

To configure your target group

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. In the navigation pane, under **Load Balancing**, choose **Target Groups**.
3. Choose **Create target group**.
4. Under **Basic configuration**, keep the **Target type** as instance.
5. For **Target group name**, enter a name for the new target group.
6. Keep the default protocol (**HTTP**) and port (**80**).
7. Select the **VPC** containing your instances. Keep the protocol version as **HTTP1**.
8. For **Health checks**, keep the default settings.

9. Choose **Next**.
10. On the **Register targets** page, complete the following steps. This is an optional step for creating the load balancer. However, you must register this target if you want to test your load balancer and ensure that it is routing traffic to this target.

    a. For **Available instances**, select one or more instances.

    b. Keep the default port 80, and choose **Include as pending below**.
11. Choose **Create target group**.

Step 2: Choose a load balancer type

Elastic Load Balancing supports different types of load balancers. For this tutorial, you create an Application Load Balancer.

To create a Application Load Balancer

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation bar, choose a Region for your load balancer. Be sure to choose the same Region that you used for your EC2 instances.
3. In the navigation pane, under **Load Balancing**, choose **Load Balancers**.
4. Choose **Create Load Balancer**.
5. For **Application Load Balancer**, choose **Create**.

Step 3: Configure your load balancer and listener

To create an Application Load Balancer, you must first provide basic configuration information for your load balancer, such as a name, scheme, and IP address type. Then, you provide information about your network, and one or more listeners. A listener is a process that checks for connection requests. It is configured with a protocol and a port for connections from clients to the load balancer. For more information about supported protocols and ports, see Listener configuration (p. 30).

To configure your load balancer and listener

1. For **Load balancer name**, enter a name for your load balancer. For example, `my-alb`.
2. For **Scheme** and **IP address type**, keep the default values.
3. For **Network mapping**, select the VPC that you used for your EC2 instances. Select at least two Availability Zones and one subnet per zone. For each Availability Zone that you used to launch your EC2 instances, select the Availability Zone and then select one public subnet for that Availability Zone.
4. For **Security groups**, keep the default. This is the default security group that the console creates for the load balancer on your behalf. It includes rules that allow it to communicate with registered targets on both the listener port and the health check port.
5. For **Listeners and routing**, keep the default protocol and port, and select your target group from the list. This configures a listener that accepts HTTP traffic on port 80 and forwards traffic to the selected target group by default. For this tutorial, you are not creating an HTTPS listener.
6. For **Default action**, select the target group that you created and registered in Step 1: Configure your target group.
7. (Optional) Add a tag to categorize your load balancer. Tag keys must be unique for each load balancer. Allowed characters are letters, spaces, numbers (in UTF-8), and the following special characters: + - = . _ : / @. Do not use leading or trailing spaces. Tag values are case-sensitive.

8. Review your configuration, and choose **Create load balancer**. A few default attributes are applied to your load balancer during creation. You can view and edit them after creating the load balancer. For more information, see Load balancer attributes (p. 12).

Step 4: Test your load balancer

After creating the load balancer, verify that it's sending traffic to your EC2 instances.

To test your load balancer

1. After you are notified that your load balancer was created successfully, choose **Close**.
2. In the navigation pane, under **Load Balancing**, choose **Target Groups**.
3. Select the newly created target group.
4. Choose **Targets** and verify that your instances are ready. If the status of an instance is `initial`, it's probably because the instance is still in the process of being registered, or it has not passed the minimum number of health checks to be considered healthy. After the status of at least one instance is `healthy`, you can test your load balancer.
5. In the navigation pane, under **Load Balancing**, choose **Load Balancers**.
6. Select the newly created load balancer.
7. Choose **Description** and copy the DNS name of the load balancer (for example, my-load-balancer-1234567890abcdef.elb.us-east-2.amazonaws.com). Paste the DNS name into the address field of an internet-connected web browser. If everything is working, the browser displays the default page of your server.
8. (Optional) To define additional listener rules, see Add a rule (p. 49).

Step 5: (Optional) Delete your load balancer

As soon as your load balancer becomes available, you are billed for each hour or partial hour that you keep it running. When you no longer need a load balancer, you can delete it. As soon as the load balancer is deleted, you stop incurring charges for it. Note that deleting a load balancer does not affect the targets registered with the load balancer. For example, your EC2 instances continue to run after deleting the load balancer created in this guide.

To delete your load balancer

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. In the navigation pane, under **Load Balancing**, choose **Load Balancers**.
3. Select the checkbox for the load balancer, choose **Actions**, then choose **Delete**.
4. When prompted for confirmation, choose **Yes, Delete**.

Tutorial: Create an Application Load Balancer using the AWS CLI

This tutorial provides a hands-on introduction to Application Load Balancers through the AWS CLI.

Before you begin

- Use the following command to verify that you are running a version of the AWS CLI that supports Application Load Balancers.

  ```
  aws elbv2 help
  ```

  If you get an error message that elbv2 is not a valid choice, update your AWS CLI. For more information, see Installing the AWS Command Line Interface in the *AWS Command Line Interface User Guide*.
- Launch your EC2 instances in a virtual private cloud (VPC). Ensure that the security groups for these instances allow access on the listener port and the health check port. For more information, see Target security groups (p. 86).
- Decide if you will create an IPv4 or dualstack load balancer. Use IPv4 if you want clients to communicate with the load balancer using IPv4 addresses only. Use dualstack if you want clients to communicate with the load balancer using IPv4 and IPv6 addresses. You can also use dualstack to communicate with backend targets, such as IPv6 applications or dualstack subnets, using IPv6.

Create your load balancer

To create your first load balancer, complete the following steps.

To create a load balancer

1. Use the create-load-balancer command to create a load balancer. You must specify two subnets that are not from the same Availability Zone.

   ```
   aws elbv2 create-load-balancer --name my-load-balancer  \
   --subnets subnet-0e3f5cac72EXAMPLE subnet-081ec835f3EXAMPLE --security-groups
    sg-07e8ffd50fEXAMPLE
   ```

   Use the create-load-balancer command to create a **dualstack** load balancer.

   ```
   aws elbv2 create-load-balancer --name my-load-balancer  \
   --subnets subnet-0e3f5cac72EXAMPLE subnet-081ec835f3EXAMPLE --security-groups
    sg-07e8ffd50fEXAMPLE --ip-address-type dualstack
   ```

   The output includes the Amazon Resource Name (ARN) of the load balancer, with the following format:

```
arn:aws:elasticloadbalancing:us-east-2:123456789012:loadbalancer/app/my-load-
balancer/1234567890123456
```

2. Use the create-target-group command to create a target group, specifying the same VPC that you used for your EC2 instances.

   You can create IPv4 and IPv6 target groups to associate with dualstack load balancers. The target group's IP address type determines the IP version that the load balancer will use to both communicate with, and check the health of, your backend targets.

   IPv4 target groups support IP and instance type targets. IPv6 targets only support IP targets.

   ```
   aws elbv2 create-target-group --name my-targets --protocol HTTP --port 80 \
   --vpc-id vpc-0598c7d356EXAMPLE --ip-address-type [ipv4 or ipv6]
   ```

   The output includes the ARN of the target group, with this format:

   ```
   arn:aws:elasticloadbalancing:us-east-2:123456789012:targetgroup/my-
   targets/1234567890123456
   ```

3. Use the register-targets command to register your instances with your target group:

   ```
   aws elbv2 register-targets --target-group-arn targetgroup-arn  \
   --targets Id=i-0abcdef1234567890 Id=i-1234567890abcdef0
   ```

4. Use the create-listener command to create a listener for your load balancer with a default rule that forwards requests to your target group:

   ```
   aws elbv2 create-listener --load-balancer-arn loadbalancer-arn \
   --protocol HTTP --port 80  \
   --default-actions Type=forward,TargetGroupArn=targetgroup-arn
   ```

   The output contains the ARN of the listener, with the following format:

   ```
   arn:aws:elasticloadbalancing:us-east-2:123456789012:listener/app/my-load-
   balancer/1234567890123456/1234567890123456
   ```

5. (Optional) You can verify the health of the registered targets for your target group using this describe-target-health command:

   ```
   aws elbv2 describe-target-health --target-group-arn targetgroup-arn
   ```

Add an HTTPS listener

If you have a load balancer with an HTTP listener, you can add an HTTPS listener as follows.

To add an HTTPS listener to your load balancer

1. Create an SSL certificate for use with your load balancer using one of the following methods:

   - Create or import the certificate using AWS Certificate Manager (ACM). For more information, see Request a certificate or Importing certificates in the *AWS Certificate Manager User Guide*.
   - Upload the certificate using AWS Identity and Access Management (IAM). For more information, see Working with server certificates in the *IAM User Guide*.

2. Use the create-listener command to create the listener with a default rule that forwards requests to your target group. You must specify an SSL certificate when you create an HTTPS listener. Note that you can specify an SSL policy other than the default using the `--ssl-policy` option.

```
aws elbv2 create-listener --load-balancer-arn loadbalancer-arn \
--protocol HTTPS --port 443  \
--certificates CertificateArn=certificate-arn \
--default-actions Type=forward,TargetGroupArn=targetgroup-arn
```

Add path-based routing

If you have a listener with a default rule that forwards requests to one target group, you can add a rule that forwards requests to another target group based on URL. For example, you can route general requests to one target group and requests to display images to another target group.

To add a rule to a listener with a path pattern

1. Use the create-target-group command to create a target group:

```
aws elbv2 create-target-group --name my-targets --protocol HTTP --port 80 \
--vpc-id vpc-0598c7d356EXAMPLE
```

2. Use the register-targets command to register your instances with your target group:

```
aws elbv2 register-targets --target-group-arn targetgroup-arn  \
--targets Id=i-0abcdef1234567890 Id=i-1234567890abcdef0
```

3. Use the create-rule command to add a rule to your listener that forwards requests to the target group if the URL contains the specified pattern:

```
aws elbv2 create-rule --listener-arn listener-arn --priority 10 \
--conditions Field=path-pattern,Values='/img/*' \
--actions Type=forward,TargetGroupArn=targetgroup-arn
```

Delete your load balancer

When you no longer need your load balancer and target group, you can delete them as follows:

```
aws elbv2 delete-load-balancer --load-balancer-arn loadbalancer-arn
aws elbv2 delete-target-group --target-group-arn targetgroup-arn
```

Application Load Balancers

A *load balancer* serves as the single point of contact for clients. Clients send requests to the load balancer, and the load balancer sends them to targets, such as EC2 instances. To configure your load balancer, you create target groups (p. 67), and then register targets with your target groups. You also create listeners (p. 30) to check for connection requests from clients, and listener rules to route requests from clients to the targets in one or more target groups.

For more information, see How Elastic Load Balancing works in the *Elastic Load Balancing User Guide*.

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Subnets for your load balancer

When you create an Application Load Balancer, you must specify one of the following types of subnets: Availability Zone, Local Zone, or Outpost.

Availability Zones

You must select at least two Availability Zone subnets. The following restrictions apply:

- Each subnet must be from a different Availability Zone.
- To ensure that your load balancer can scale properly, verify that each Availability Zone subnet for your load balancer has a CIDR block with at least a `/27` bitmask (for example, `10.0.0.0/27`) and at least 8 free IP addresses per subnet. Your load balancer uses these IP addresses to establish connections with the targets. Depending on your traffic profile, the load balancer can scale higher and consume up to a maximum of 100 IP addresses distributed across all enabled subnets.

Local Zones

You can specify one or more Local Zone subnets. The following restrictions apply:

- You cannot use AWS WAF with the load balancer.
- You cannot use a Lambda function as a target.

Outposts

You can specify a single Outpost subnet. The following restrictions apply:

- You must have installed and configured an Outpost in your on-premises data center. You must have a reliable network connection between your Outpost and its AWS Region. For more information, see the AWS Outposts User Guide.
- The load balancer requires two `large` instances on the Outpost for the load balancer nodes. The supported instance types are shown in the following table. The load balancer scales as needed, resizing the nodes one size at a time (from `large` to `xlarge`, then `xlarge` to `2xlarge`, and then `2xlarge` to `4xlarge`). After scaling the nodes to the largest instance size, if you need additional capacity, the load balancer adds `4xlarge` instances as load balancer nodes. If you do not have sufficient instance capacity or available IP addresses to scale the load balancer, the load balancer reports an event to the AWS Health Dashboard and the load balancer state is `active_impaired`.
- You can register targets by instance ID or IP address. If you register targets in the AWS Region for the Outpost, they are not used.
- The following features are not available: Lambda functions as targets, AWS WAF integration, sticky sessions, authentication support, and integration with AWS Global Accelerator.

An Application Load Balancer can be deployed on c5/c5d, m5/m5d, or r5/r5d instances on an Outpost. The following table shows the size and EBS volume per instance type that the load balancer can use on an Outpost:

Instance type and size	EBS volume (GB)	
c5/c5d		
large	50	
xlarge	50	
2xlarge	50	
4xlarge	100	
m5/m5d		
large	50	
xlarge	50	
2xlarge	100	
4xlarge	100	
r5/r5d		
large	50	
xlarge	100	
2xlarge	100	
4xlarge	100	

Load balancer security groups

A *security group* acts as a firewall that controls the traffic allowed to and from your load balancer. You can choose the ports and protocols to allow for both inbound and outbound traffic.

The rules for the security groups that are associated with your load balancer must allow traffic in both directions on both the listener and the health check ports. Whenever you add a listener to a load balancer or update the health check port for a target group, you must review your security group rules to ensure that they allow traffic on the new port in both directions. For more information, see Recommended rules (p. 23).

Load balancer state

A load balancer can be in one of the following states:

`provisioning`

The load balancer is being set up.

`active`

The load balancer is fully set up and ready to route traffic.

`active_impaired`

The load balancer is routing traffic but does not have the resources it needs to scale.

`failed`

The load balancer could not be set up.

Load balancer attributes

The following are the load balancer attributes:

`access_logs.s3.enabled`

Indicates whether access logs stored in Amazon S3 are enabled. The default is `false`.

`access_logs.s3.bucket`

The name of the Amazon S3 bucket for the access logs. This attribute is required if access logs are enabled. For more information, see Enable access logs (p. 129).

`access_logs.s3.prefix`

The prefix for the location in the Amazon S3 bucket.

`deletion_protection.enabled`

Indicates whether deletion protection is enabled. The default is `false`.

`idle_timeout.timeout_seconds`

The idle timeout value, in seconds. The default is 60 seconds.

`ipv6.deny_all_igw_traffic`

Blocks internet gateway (IGW) access to the load balancer, preventing unintended access to your internal load balancer through an internet gateway. It is set to `false` for internet-facing load balancers and `true` for internal load balancers. This attribute does not prevent non-IGW internet access (such as, through peering, Transit Gateway, AWS Direct Connect, or AWS VPN).

`routing.http.desync_mitigation_mode`

Determines how the load balancer handles requests that might pose a security risk to your application. The possible values are `monitor`, `defensive`, and `strictest`. The default is `defensive`.

`routing.http.drop_invalid_header_fields.enabled`

Indicates whether HTTP headers with header fields that are not valid are removed by the load balancer (`true`), or routed to targets (`false`). The default is `false`. Elastic Load Balancing requires that valid HTTP header names conform to the regular expression `[-A-Za-z0-9]+`, as described in the HTTP Field Name Registry. Each name consists of alphanumeric characters or hyphens. Select `true` if you want HTTP headers that do not conform to this pattern, to be removed from requests.

`routing.http.preserve_host_header.enabled`

Indicates whether the Application Load Balancer should preserve the `Host` header in the HTTP request and send it to targets without any change. The possible values are `true` and `false`. The default is `false`.

`routing.http.x_amzn_tls_version_and_cipher_suite.enabled`

Indicates whether the two headers (`x-amzn-tls-version` and `x-amzn-tls-cipher-suite`), which contain information about the negotiated TLS version and cipher suite, are added to the client request before sending it to the target. The `x-amzn-tls-version` header has information about the TLS protocol version negotiated with the client, and the `x-amzn-tls-cipher-suite` header has information about the cipher suite negotiated with the client. Both headers are in OpenSSL format. The possible values for the attribute are `true` and `false`. The default is `false`.

`routing.http.xff_client_port.enabled`

Indicates whether the `X-Forwarded-For` header should preserve the source port that the client used to connect to the load balancer. The possible values are `true` and `false`. The default is `false`.

`routing.http.xff_header_processing.mode`

Enables you to modify, preserve, or remove the `X-Forward-For` header in the HTTP request before the Application Load Balancer sends the request to the target. The possible values are `append`, `preserve`, and `remove`. The default is `append`.

- If the value is `append`, the Application Load Balancer adds the client IP address (of the last hop) to the `X-Forward-For` header in the HTTP request before it sends it to targets.
- If the value is `preserve`, the Application Load Balancer preserves the `X-Forward-For` header in the HTTP request, and sends it to targets without any change.
- If the value is `remove`, the Application Load Balancer removes the `X-Forward-For` header in the HTTP request before it sends it to targets.

`routing.http2.enabled`

Indicates whether HTTP/2 is enabled. The default is `true`.

`waf.fail_open.enabled`

Indicates whether to allow a AWS WAF-enabled load balancer to route requests to targets if it is unable to forward the request to AWS WAF. The possible values are `true` and `false`. The default is `false`.

Note
The `routing.http.drop_invalid_header_fields.enabled` attribute was introduced to offer HTTP desync protection. The `routing.http.desync_mitigation_mode` attribute was added to provide more comprehensive protection from HTTP desync for your applications. You aren't required to use both attributes and may choose either, depending on your application's requirements.

IP address type

You can set the types of IP addresses that clients can use to access your internet-facing and internal load balancers.

The following are the IP address types:

`ipv4`

Clients must connect to the load balancer using IPv4 addresses (for example, 192.0.2.1)

`dualstack`

Clients can connect to the load balancer using both IPv4 addresses (for example, 192.0.2.1) and IPv6 addresses (for example, 2001:0db8:85a3:0:0:8a2e:0370:7334).

Dualstack load balancer considerations

- The load balancer communicates with targets based on the IP address type of the target group.
- When you enable dualstack mode for the load balancer, Elastic Load Balancing provides an AAAA DNS record for the load balancer. Clients that communicate with the load balancer using IPv4 addresses resolve the A DNS record. Clients that communicate with the load balancer using IPv6 addresses resolve the AAAA DNS record.
- Access to your internal dualstack load balancers through the internet gateway is blocked to prevent unintended internet access. However, this does not prevent non-IWG internet access (such as, through peering, Transit Gateway, AWS Direct Connect, or AWS VPN).

Cross-zone load balancing

With Application Load Balancers, cross-zone load balancing is on by default and cannot be changed at the load balancer level. For more information, see the Cross-zone load balancing section in the *Elastic Load Balancing User Guide*.

Turning off cross-zone load balancing is possible at the target group level. For more information, see the section called “Turn off cross-zone load balancing” (p. 82).

Connection idle timeout

For each request that a client makes through a load balancer, the load balancer maintains two connections. The front-end connection is between a client and the load balancer. The backend connection is between the load balancer and a target. The load balancer has a configured idle timeout period that applies to its connections. If no data has been sent or received by the time that the idle timeout period elapses, the load balancer closes the connection. To ensure that lengthy operations such as file uploads have time to complete, send at least 1 byte of data before each idle timeout period elapses, and increase the length of the idle timeout period as needed.

For backend connections, we recommend that you enable the HTTP keep-alive option for your EC2 instances. You can enable HTTP keep-alive in the web server settings for your EC2 instances. If you enable HTTP keep-alive, the load balancer can reuse backend connections until the keep-alive timeout expires. We also recommend that you configure the idle timeout of your application to be larger than the idle timeout configured for the load balancer. Otherwise, if the application closes the TCP connection to the load balancer ungracefully, the load balancer might send a request to the application before it receives the packet indicating that the connection is closed. If this is the case, then the load balancer sends an HTTP 502 Bad Gateway error to the client.

By default, Elastic Load Balancing sets the idle timeout value for your load balancer to 60 seconds. Use the following procedure to set a different idle timeout value.

To update the idle timeout value using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.
3. Select the load balancer.
4. On the **Description** tab, choose **Edit attributes**.
5. On the **Edit load balancer attributes** page, enter a value for **Idle timeout**, in seconds. The valid range is from 1 through 4000.
6. Choose **Save**.

To update the idle timeout value using the AWS CLI

Use the modify-load-balancer-attributes command with the `idle_timeout.timeout_seconds` attribute.

Deletion protection

To prevent your load balancer from being deleted accidentally, you can enable deletion protection. By default, deletion protection is disabled for your load balancer.

If you enable deletion protection for your load balancer, you must disable it before you can delete the load balancer.

To enable deletion protection using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.
3. Select the load balancer.
4. On the **Description** tab, choose **Edit attributes**.
5. On the **Edit load balancer attributes** page, select **Enable** for **Delete Protection**, and then choose **Save**.
6. Choose **Save**.

To disable deletion protection using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.
3. Select the load balancer.
4. On the **Description** tab, choose **Edit attributes**.
5. On the **Edit load balancer attributes** page, clear **Enable** for **Delete Protection**, and then choose **Save**.
6. Choose **Save**.

To enable or disable deletion protection using the AWS CLI

Use the modify-load-balancer-attributes command with the `deletion_protection.enabled` attribute.

Desync mitigation mode

Desync mitigation mode protects your application from issues due to HTTP desync. The load balancer classifies each request based on its threat level, allows safe requests, and then mitigates risk as specified by the mitigation mode that you specify. The desync mitigation modes are monitor, defensive, and strictest. The default is the defensive mode, which provides durable mitigation against HTTP desync while maintaining the availability of your application. You can switch to strictest mode to ensure that your application receives only requests that comply with RFC 7230.

The http_desync_guardian library analyzes HTTP requests to prevent HTTP desync attacks. For more information, see HTTP Desync Guardian on GitHub.

Classifications

The classifications are as follows:

- Compliant — Request complies with RFC 7230 and poses no known security threats.
- Acceptable — Request does not comply with RFC 7230 but poses no known security threats.
- Ambiguous — Request does not comply with RFC 7230 but poses a risk, as various web servers and proxies could handle it differently.
- Severe — Request poses a high security risk. The load balancer blocks the request, serves a 400 response to the client, and closes the client connection.

If a request does not comply with RFC 7230, the load balancer increments the `DesyncMitigationMode_NonCompliant_Request_Count` metric. For more information, see Application Load Balancer metrics (p. 104).

The classification for each request is included in the load balancer access logs. If the request does not comply, the access logs include a classification reason code. For more information, see Classification reasons (p. 123).

Modes

The following table describes how Application Load Balancers treat requests based on mode and classification.

Classification	Monitor mode	Defensive mode	Strictest mode
Compliant	Allowed	Allowed	Allowed
Acceptable	Allowed	Allowed	Blocked
Ambiguous	Allowed	Allowed[1]	Blocked
Severe	Allowed	Blocked	Blocked

[1] Routes the requests but closes the client and target connections. You might incur additional charges if your load balancer receives a large number of Ambiguous requests in Defensive mode. This is because the increased number of new connections per second contributes to the Load Balancer Capacity Units (LCU) used per hour. You can use the `NewConnectionCount` metric to compare how your load balancer establishes new connections in Monitor mode and Defensive mode.

To update desync mitigation mode using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.

3. Select the load balancer.
4. On the **Description** tab, choose **Edit attributes**.
5. For **Desync mitigation mode**, choose **Monitor**, **Defensive**, or **Strictest**.
6. Choose **Save**.

To update desync mitigation mode using the AWS CLI

Use the modify-load-balancer-attributes command with the `routing.http.desync_mitigation_mode` attribute set to `monitor`, `defensive`, or `strictest`.

Host header preservation

When you enable the **Preserve host header** attribute, the Application Load Balancer preserves the `Host` header in the HTTP request, and sends the header to targets without any modification. If the Application Load Balancer receives multiple `Host` headers, it preserves all of them. Listener rules are applied only to the first `Host` header received.

By default, when the **Preserve host header** attribute is not enabled, the Application Load Balancer modifies the `Host` header in the following manner:

When host header preservation is not enabled, and listener port is a non-default port: When not using the default ports (ports 80 or 443) we append the port number to the host header if it isn't already appended by the client. For example, the `Host` header in the HTTP request with `Host: www.example.com` would be modified to `Host: www.example.com:8080`, if the listener port is a non-default port such as `8080`.

When host header preservation is not enabled, and the listener port is a default port (port 80 or 443): For default listener ports (either port 80 or 443), we do not append the port number to the outgoing host header. Any port number that was already in the incoming host header, is removed.

The following table shows more examples of how Application Load Balancers treat host headers in the HTTP request based on listener port.

Listener port	Example request	Host header in the request	Host header preservation is disabled (default behavior)	Host header preservation is enabled
Request is sent on default HTTP/HTTPS listener.	`GET /index.html HTTP/1.1 Host: example.com`	example.com	example.com	example.com
Request is sent on default HTTP listener and host header has a port (80 or 443).	`GET /index.html HTTP/1.1 Host: example.com:80`	example.com:80	example.com	example.com:80
Request has an absolute path.	`GET https://dns_name/index.html HTTP/1.1 Host: example.com`	example.com	dns_name	example.com

Listener port	Example request	Host header in the request	Host header preservation is disabled (default behavior)	Host header preservation is enabled
Request is sent on a non-default listener port and host header has port (for example, 8080).	`GET / index.html HTTP/1.1 Host: example.com`	example.com	example.com:8080	example.com

To enable host header preservation

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. In the navigation pane, under **Load Balancing**, choose **Load Balancers**.
3. Select the load balancer you want to use.
4. On the **Description** tab, choose **Edit attributes**.
5. For **Preserve host header** , choose **Enable**.
6. Choose **Save**.

To enable host header preservation using the AWS CLI

Use the modify-load-balancer-attributes command with the `routing.http.preserve_host_header.enabled` attribute set to `true`.

Application Load Balancers and AWS WAF

You can use AWS WAF with your Application Load Balancer to allow or block requests based on the rules in a web access control list (web ACL). For more information, see Working with web ACLs in the *AWS WAF Developer Guide*.

To check whether your load balancer integrates with AWS WAF, select your load balancer in the AWS Management Console and choose the **Integrated services** tab.

By default, if the load balancer cannot get a response from AWS WAF, it returns an HTTP 500 error and does not forward the request. If you need your load balancer to forward requests to targets even if it is unable to contact AWS WAF, you can enable the AWS WAF fail open attribute.

To enable AWS WAF fail open using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.
3. Select the load balancer.
4. On the **Description** tab, choose **Edit attributes**.
5. For **AWS WAF fail open**, choose **Enable**.
6. Choose **Save**.

To enable AWS WAF fail open using the AWS CLI

Use the modify-load-balancer-attributes command with the `waf.fail_open.enabled` attribute set to `true`.

Create an Application Load Balancer

A load balancer takes requests from clients and distributes them across targets in a target group.

Before you begin, ensure that you have a virtual private cloud (VPC) with at least one public subnet in each of the Availability Zones used by your targets.

To create a load balancer using the AWS CLI, see Tutorial: Create an Application Load Balancer using the AWS CLI (p. 7).

To create a load balancer using the AWS Management Console, complete the following tasks.

Tasks

Step 1: Configure a target group

Configuring a target group allows you to register targets such as EC2 instances. The target group that you configure in this step is used as the target group in the listener rule when you configure your load balancer. For more information, see Target groups for your Application Load Balancers (p. 67).

To configure your target group

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. In the left navigation pane, under **Load Balancing**, choose **Target Groups**.
3. Choose **Create target group**.
4. In the **Basic configuration** section, set the following parameters:

   a. For **Choose a target type**, select **Instance** to specify targets by instance ID or **IP addresses** to specify targets by IP address. If the target type is a **Lambda function**, you can enable health checks by selecting **Enable** in the **Health checks** section.

   b. For **Target group name**, enter a name for the target group.

   c. Modify the **Port** and **Protocol** as needed.

   d. If the target type is **IP addresses**, choose **IPv4** or **IPv6** as the **IP address type**, otherwise skip to the next step.

      Note that only targets that have the selected IP address type can be included in this target group. The IP address type cannot be changed after the target group is created.

   e. For VPC, select a virtual private cloud (VPC) with the targets that you want to include in your target group.

   f. For **Protocol version**, select **HTTP1** when the request protocol is HTTP/1.1 or HTTP/2; select **HTTP2**, when the request protocol is HTTP/2 or gRPC; and select **gRPC**, when the request protocol is gRPC.
5. In the **Health checks** section, modify the default settings as needed. For **Advanced health check settings**, choose the health check port, count, timeout, interval, and specify success codes. If health

checks consecutively exceed the **Unhealthy threshold** count, the load balancer takes the target out of service. If health checks consecutively exceed the **Healthy threshold** count, the load balancer puts the target back in service. For more information, see Health checks for your target groups (p. 77).

6. (Optional) Add one or more tags as follows:

    a. Expand the **Tags** section.
    b. Choose **Add tag**.
    c. Enter the tag **Key** and tag **Value**. Allowed characters are letters, spaces, numbers (in UTF-8), and the following special characters: + - = . _ : / @. Do not use leading or trailing spaces. Tag values are case-sensitive.

7. Choose **Next**.

Step 2: Register targets

You can register EC2 instances, IP addresses, or Lambda functions as targets in a target group. This is an optional step to create a load balancer. However, you must register your targets to ensure that your load balancer routes traffic to them.

1. In the **Register targets** page, add one or more targets as follows:
    - If the target type is **Instances**, select one or more instances, enter one or more ports, and then choose **Include as pending below**.
    - If the target type is **IP addresses**, do the following:

        a. Select a network **VPC** from the list, or choose **Other private IP addresses**.
        b. Enter the IP address manually, or find the IP address using instance details. You can enter up to five IP addresses at a time.
        c. Enter the ports for routing traffic to the specified IP addresses.
        d. Choose **Include as pending below**.
    - If the target type is **Lambda**, select a Lambda function, or enter a Lambda function ARN, and then choose **Include as pending below**.
2. Choose **Create target group**.

Step 3: Configure a load balancer and a listener

To create an Application Load Balancer, you must first provide basic configuration information for your load balancer, such as a name, scheme, and IP address type. Then, you provide information about your network, and one or more listeners. A listener is a process that checks for connection requests. It is configured with a protocol and a port for connections from clients to the load balancer. For more information about supported protocols and ports, see Listener configuration (p. 30).

To configure your load balancer and listener

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. In the navigation pane, under **Load Balancing**, choose **Load Balancers**.
3. Choose **Create Load Balancer**.
4. Under **Application Load Balancer**, choose **Create**.
5. **Basic configuration**

    a. For **Load balancer name**, enter a name for your load balancer. For example, **`my-alb`**. The name of your Application Load Balancer must be unique within your set of Application Load Balancers and Network Load Balancers for the Region. Names can have a maximum of 32 characters, and can contain only alphanumeric characters and hyphens. They can not begin or end with a hyphen, or with `internal-`.

   b. For **Scheme**, choose **Internet-facing** or **Internal**. An internet-facing load balancer routes requests from clients to targets over the internet. An internal load balancer routes requests to targets using private IP addresses.

   c. For **IP address type**, choose **IPv4** or **Dualstack**. Use **IPv4** if your clients use IPv4 addresses to communicate with the load balancer. Choose **Dualstack** if your clients use both IPv4 and IPv6 addresses to communicate with the load balancer.

6. **Network mapping**

   a. For **VPC**, select the VPC that you used for your EC2 instances. If you selected **Internet-facing** for **Scheme**, only VPCs with an internet gateway are available for selection.

   b. For **Mappings**, select two or more Availability Zones and corresponding subnets. Enabling multiple Availability Zones increases the fault tolerance of your applications.

      For an internal load balancer, you can assign a private IP address from the IPv4 or IPv6 range of each subnet instead of letting AWS assign one for you.

      Select one subnet per zone to enable. If you enabled **Dualstack** mode for the load balancer, select subnets with associated IPv6 CIDR blocks. You can specify one of the following:

      - Subnets from two or more Availability Zones
      - Subnets from one or more Local Zones
      - One Outpost subnet

7. For **Security groups**, select an existing security group, or create a new one.

   The security group for your load balancer must allow it to communicate with registered targets on both the listener port and the health check port. The console can create a security group for your load balancer on your behalf with rules that allow this communication. You can also create a security group and select it instead. For more information, see Recommended rules (p. 23).

   (Optional) To create a new security group for your load balancer, choose **Create a new security group**.

8. For **Listeners and routing**, the default listener accepts HTTP traffic on port 80. You can keep the default protocol and port, or choose different ones. For **Default action**, choose the target group that you created. You can optionally choose **Add listener** to add another listener (for example, an HTTPS listener).

   If you create an HTTPS listener, configure the required **Secure listener settings**. Otherwise, go to the next step.

   When you use HTTPS for your load balancer listener, you must deploy an SSL certificate on your load balancer. The load balancer uses this certificate to terminate the connection and decrypt requests from clients before sending them to the targets. For more information, see SSL certificates (p. 42). Additionally, specify the security policy that the load balancer uses to negotiate SSL connections with the clients. For more information, see Security policies (p. 43).

   For **Default SSL certificate**, do one of the following:

   - If you created or imported a certificate using AWS Certificate Manager, select **From ACM**, and then select the certificate.
   - If you uploaded a certificate using IAM, select **From IAM**, and then select the certificate.
   - If you want to import a certificate to ACM or IAM , enter a certificate name. Then, paste the PEM-encoded private key and body.

9. (Optional) You can use **Add-on services**, such as the **AWS Global Accelerator** to create an accelerator and associate the load balancer with the accelerator. The accelerator name can have

up to 64 characters. Allowed characters are a-z, A-Z, 0-9, . and - (hyphen). Once the accelerator is created, you can use the **AWS Global Accelerator** console to manage it.

10. **Tag and create**

    a. (Optional) Add a tag to categorize your load balancer. Tag keys must be unique for each load balancer. Allowed characters are letters, spaces, numbers (in UTF-8), and the following special characters: + - = . _ : / @. Do not use leading or trailing spaces. Tag values are case-sensitive.

    b. Review your configuration, and choose **Create load balancer**. A few default attributes are applied to your load balancer during creation. You can view and edit them after creating the load balancer. For more information, see Load balancer attributes (p. 12).

Step 4: Test the load balancer

After creating your load balancer, you can verify that your EC2 instances pass the initial health check. You can then check that the load balancer is sending traffic to your EC2 instance. To delete the load balancer, see Delete an Application Load Balancer (p. 26).

To test the load balancer

1. After the load balancer is created, choose **Close**.
2. In the navigation pane, under **Load Balancing**, choose **Target Groups**.
3. Select the newly created target group.
4. Choose **Targets** and verify that your instances are ready. If the status of an instance is `initial`, it's typically because the instance is still in the process of being registered. This status can also indicate that the instance has not passed the minimum number of health checks to be considered healthy. After the status of at least one instance is healthy, you can test your load balancer. For more information, see Target health status (p. 78).
5. In the navigation pane, under **Load Balancing**, choose **Load Balancers**.
6. Select the newly created load balancer.
7. Choose **Description** and copy the DNS name of the load balancer (for example, my-load-balancer-1234567890abcdef.elb.us-east-2.amazonaws.com). Paste the DNS name into the address field of an internet-connected web browser. If everything is working, the browser displays the default page of your server.

Availability Zones for your Application Load Balancer

You can enable or disable the Availability Zones for your load balancer at any time. After you enable an Availability Zone, the load balancer starts routing requests to the registered targets in that Availability Zone. Your load balancer is most effective if you ensure that each enabled Availability Zone has at least one registered target.

After you disable an Availability Zone, the targets in that Availability Zone remain registered with the load balancer, but the load balancer will not route requests to them.

To update Availability Zones using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.
3. Select the load balancer.

4. On the **Description** tab, under **Basic Configuration**, choose **Edit subnets**.
5. To enable a zone, select the check box for that zone and select one subnet. If there is only one subnet for that zone, it is selected. If there is more than one subnet for that zone, select one of the subnets.
6. To change the subnet for an enabled Availability Zone, choose **Change subnet** and select one of the other subnets.
7. To remove an Availability Zone, clear the check box for that Availability Zone.
8. Choose **Save**.

To update Availability Zones using the AWS CLI

Use the set-subnets command.

Security groups for your Application Load Balancer

You must ensure that your load balancer can communicate with registered targets on both the listener port and the health check port. Whenever you add a listener to your load balancer or update the health check port for a target group used by the load balancer to route requests, you must verify that the security groups associated with the load balancer allow traffic on the new port in both directions. If they do not, you can edit the rules for the currently associated security groups or associate different security groups with the load balancer. In a VPC, you provide the security group for your load balancer, which enables you to choose the ports and protocols to allow. For example, you can open Internet Control Message Protocol (ICMP) connections for the load balancer to respond to ping requests (however, ping requests are not forwarded to any instances).

Recommended rules

The following rules are recommended for an internet-facing load balancer.

Inbound		
Source	**Port Range**	**Comment**
0.0.0.0/0	*listener*	Allow all inbound traffic on the load balancer listener port
Outbound		
Destination	**Port Range**	**Comment**
instance security group	*instance listener*	Allow outbound traffic to instances on the instance listener port
instance security group	*health check*	Allow outbound traffic to instances on the health check port

The following rules are recommended for an internal load balancer.

Inbound

Source	Port Range	Comment
VPC CIDR	*listener*	Allow inbound traffic from the VPC CIDR on the load balancer listener port
Outbound		
Destination	**Port Range**	**Comment**
instance security group	*instance listener*	Allow outbound traffic to instances on the instance listener port
instance security group	*health check*	Allow outbound traffic to instances on the health check port

The following rules are recommended for an Application Load Balancer used as a target of a Network Load Balancer.

Inbound		
Source	**Port Range**	**Comment**
client IP addresses/CIDR	*alb listener*	Allow inbound client traffic on the load balancer listener port
VPC CIDR	*alb listener*	Allow inbound client traffic via AWS PrivateLink on the load balancer listener port
VPC CIDR	*alb listener*	Allow inbound health traffic from the Network Load Balancer
Outbound		
Destination	**Port Range**	**Comment**
instance security group	*instance listener*	Allow outbound traffic to instances on the instance listener port
instance security group	*health check*	Allow outbound traffic to instances on the health check port

Note that the security groups for your Application Load Balancer use connection tracking to track information about traffic coming from the Network Load Balancer. This happens regardless of the security group rules set for your Application Load Balancer. To learn more about Amazon EC2 connection tracking, see Security group connection tracking in the *Amazon EC2 User Guide for Linux Instances*.

We also recommend that you allow inbound ICMP traffic to support Path MTU Discovery. For more information, see Path MTU Discovery in the *Amazon EC2 User Guide for Linux Instances*.

Update the associated security groups

You can update the security groups associated with your load balancer at any time.

To update security groups using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.
3. Select the load balancer.
4. On the **Description** tab, under **Security**, choose **Edit security groups**.
5. To associate a security group with your load balancer, select it. To remove a security group from your load balancer, clear it.
6. Choose **Save**.

To update security groups using the AWS CLI

Use the set-security-groups command.

IP address types for your Application Load Balancer

You can configure your Application Load Balancer so that clients can communicate with the load balancer using IPv4 addresses only, or using both IPv4 and IPv6 addresses (dualstack). The load balancer communicates with targets based on the IP address type of the target group. For more information, see IP address type (p. 14).

Dualstack requirements

- You can set the IP address type when you create the load balancer and update it at any time.
- The virtual private cloud (VPC) and subnets that you specify for the load balancer must have associated IPv6 CIDR blocks. For more information, see IPv6 addresses in the *Amazon EC2 User Guide*.
- The route tables for the load balancer subnets must route IPv6 traffic.
- The security groups for the load balancer must allow IPv6 traffic.
- The network ACLs for the load balancer subnets must allow IPv6 traffic.

To set the IP address type at creation

Configure settings as described in Create a Load Balancer (p. 20).

To update the IP address type using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.
3. Select the load balancer.
4. Choose **Actions**, **Edit IP address type**.
5. For **IP address type**, choose **ipv4** to support IPv4 addresses only or **dualstack** to support both IPv4 and IPv6 addresses.
6. Choose **Save**.

To update the IP address type using the AWS CLI

Use the set-ip-address-type command.

Tags for your Application Load Balancer

Tags help you to categorize your load balancers in different ways, for example, by purpose, owner, or environment.

You can add multiple tags to each load balancer. If you add a tag with a key that is already associated with the load balancer, it updates the value of that tag.

When you are finished with a tag, you can remove it from your load balancer.

Restrictions

- Maximum number of tags per resource—50
- Maximum key length—127 Unicode characters
- Maximum value length—255 Unicode characters
- Tag keys and values are case sensitive. Allowed characters are letters, spaces, and numbers representable in UTF-8, plus the following special characters: + - = . _ : / @. Do not use leading or trailing spaces.
- Do not use the `aws:` prefix in your tag names or values because it is reserved for AWS use. You can't edit or delete tag names or values with this prefix. Tags with this prefix do not count against your tags per resource limit.

To update the tags for a load balancer using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.
3. Select the load balancer.
4. On the **Tags** tab, choose **Add/Edit Tags**, and then do one or more of the following:
   a. To update a tag, edit the values of **Key** and **Value**.
   b. To add a new tag, choose **Create Tag** and then enter values for **Key** and **Value**.
   c. To delete a tag, choose the delete icon (X) next to the tag.
5. When you have finished updating tags, choose **Save**.

To update the tags for a load balancer using the AWS CLI

Use the add-tags and remove-tags commands.

Delete an Application Load Balancer

As soon as your load balancer becomes available, you are billed for each hour or partial hour that you keep it running. When you no longer need the load balancer, you can delete it. As soon as the load balancer is deleted, you stop incurring charges for it.

You can't delete a load balancer if deletion protection is enabled. For more information, see Deletion protection (p. 15).

Note that deleting a load balancer does not affect its registered targets. For example, your EC2 instances continue to run and are still registered to their target groups. To delete your target groups, see Delete a target group (p. 102).

To delete a load balancer using the console

1. If you have a CNAME record for your domain that points to your load balancer, point it to a new location and wait for the DNS change to take effect before deleting your load balancer.
2. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
3. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.
4. Select the load balancer, and then choose **Actions**, **Delete**.
5. When prompted for confirmation, choose **Yes, Delete**.

To delete a load balancer using the AWS CLI

Use the delete-load-balancer command.

Zonal shift

Zonal shift is in preview release for Application Load Balancers and is subject to change.

Zonal shift is a function within the Amazon Route 53 Application Recovery Controller (Route 53 ARC). With zonal shifting, you can shift your load balancer resources away from an impaired Availability Zone with a single action. This way, you can continue operating from other healthy Availability Zones.

When you start a zonal shift, your load balancer stops sending traffic for those resources to the affected Availability Zone. Route 53 ARC creates this zonal shift immediately in Route 53 ARC. However, it can take a short time, typically up to a few minutes, to complete existing, in-progress connections in the affected Availability Zone. For more information, see How a zonal shift works: health checks and zonal IP addresses in the *Amazon Route 53 Application Recovery Controller Developer Guide*.

Before you implement zonal shifting, review the following:

- Cross-zone load balancing isn't supported with zonal shifts. You must turn off cross-zone load balancing to use this function.
- Zonal shift isn't supported when using Application Load Balancers as an AWS Global Accelerator target.
- A given load balancer can start zonal shifts for only a single Availability Zone. Load balancers reject requests to start a zonal shift for multiple Availability Zones.
- AWS proactively removes zonal load balancer IP addresses from DNS when multiple infrastructure issues impact services. For load balancers with cross-zone load balancing turned off, removal of the zonal load balancer IP address results in the loss of target capacity in that Availability Zone.
- When an Application Load Balancer is a target of a Network Load Balancer, always start the zonal shift from the Network Load Balancer. If started from the Application Load Balancer, the Network Load Balancer doesn't recognize the shift and continues to send traffic to the Application Load Balancer.

For best practices using zonal shifts, see Best practices with Route 53 ARC zonal shifts in the *Route 53 Application Recovery Controller Developer Guide*.

Start a zonal shift

The steps in this section explain how to start a zonal shift on the Amazon EC2 Load Balancing console. For steps to start a zonal shift on the Amazon Route 53 Application Recovery Controller console, see Starting zonal shifts in the *Route 53 Application Recovery Controller Developer Guide*.

To start a zonal shift using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **Load Balancing**, choose **Load Balancers**.
3. Select the load balancer name.
4. On the **Integrations** tab, under **Route 53 Application Recovery Controller**, choose **Start zonal shift**.
5. Select the Availability Zone you want to move traffic away from.
6. Choose or enter an expiration for the zonal shift. A zonal shift can initially be set from 1 minute up to three days (72 hours).

   All zonal shifts are temporary. You must set an expiration, but you can update active shifts later to extend the expiration.
7. Enter a comment. You can edit the comment later if you need.
8. Select the check box to acknowledge that starting a zonal shift will reduce capacity for your application by shifting traffic away from one of the Availability Zones in the Region.
9. Choose **Start**

To start a zonal shift using the AWS CLI

To work with zonal shift programmatically, see the Zonal Shift API Reference Guide

Update a zonal shift

The steps in this section explain how to update a zonal shift on the Amazon EC2 Load Balancing console. For steps to update a zonal shift on the Amazon Route 53 Application Recovery Controller console, see To update a zonal shift in the *Route 53 Application Recovery Controller Developer Guide*.

To update a zonal shift using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **Load Balancing**, choose **Load Balancers**.
3. Select the load balancer name which has an active zonal shift.
4. On the **Integrations** tab, under **Route 53 Application Recovery Controller**, choose **Update zonal shift**

   This will open the Route 53 ARC console to continue the update.
5. For **Set zonal shift expiration time**, optionally select or enter an expiration time.
6. For **Comment**, optionally edit the existing comment or enter a new comment.
7. Choose **Save**.

To update a zonal shift using the AWS CLI

To work with zonal shift programmatically, see the Zonal Shift API Reference Guide

Cancel a zonal shift

The steps in this section explain how to cancel a zonal shift on the Amazon EC2 Load Balancing console. For steps to cancel a zonal shift on the Amazon Route 53 Application Recovery Controller console, see To cancel a zonal shift in the *Route 53 Application Recovery Controller Developer Guide*.

To cancel a zonal shift using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.

2. On the navigation pane, under **Load Balancing**, choose **Load Balancers**.
3. Select the load balancer name which has an active zonal shift.
4. On the **Integrations** tab, under **Route 53 Application Recovery Controller**, choose **Cancel zonal shift**

   This will open the Route 53 ARC console to continue the cancellation.
5. Choose **Cancel zonal shift**.
6. On the confirmation dialog, choose **Confirm**.

To cancel a zonal shift using the AWS CLI

To work with zonal shift programmatically, see the Zonal Shift API Reference Guide

Listeners for your Application Load Balancers

Before you start using your Application Load Balancer, you must add one or more *listeners*. A listener is a process that checks for connection requests, using the protocol and port that you configure. The rules that you define for a listener determine how the load balancer routes requests to its registered targets.

Contents

Listener configuration

Listeners support the following protocols and ports:

- **Protocols**: HTTP, HTTPS
- **Ports**: 1-65535

You can use an HTTPS listener to offload the work of encryption and decryption to your load balancer so that your applications can focus on their business logic. If the listener protocol is HTTPS, you must deploy at least one SSL server certificate on the listener. For more information, see Create an HTTPS listener for your Application Load Balancer (p. 41).

If you must ensure that the targets decrypt HTTPS traffic instead of the load balancer, you can create a Network Load Balancer with a TCP listener on port 443. With a TCP listener, the load balancer passes encrypted traffic through to the targets without decrypting it. For more information, see the User Guide for Network Load Balancers.

Application Load Balancers provide native support for WebSockets. You can upgrade an existing HTTP/1.1 connection into a WebSocket (`ws` or `wss`) connection by using an HTTP connection upgrade. When you upgrade, the TCP connection used for requests (to the load balancer as well as to the target) becomes a persistent WebSocket connection between the client and the target through the load balancer. You can use WebSockets with both HTTP and HTTPS listeners. The options that you choose for your listener apply to WebSocket connections as well as to HTTP traffic. For more information, see How the WebSocket Protocol Works in the *Amazon CloudFront Developer Guide*.

Application Load Balancers provide native support for HTTP/2 with HTTPS listeners. You can send up to 128 requests in parallel using one HTTP/2 connection. You can use the protocol version to send the request to the targets using HTTP/2. For more information, see Protocol version (p. 69). Because

HTTP/2 uses front-end connections more efficiently, you might notice fewer connections between clients and the load balancer. You can't use the server-push feature of HTTP/2.

For more information, see Request routing in the *Elastic Load Balancing User Guide*.

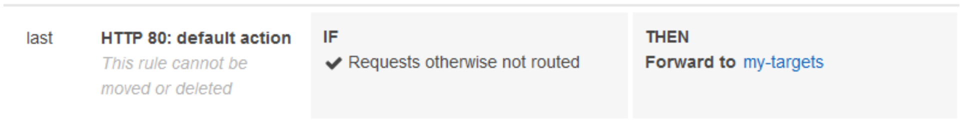
Listener rules

Each listener has a default rule, and you can optionally define additional rules. Each rule consists of a priority, one or more actions, and one or more conditions. You can add or edit rules at any time. For more information, see Edit a rule (p. 51).

Default rules

When you create a listener, you define actions for the default rule. Default rules can't have conditions. If the conditions for none of a listener's rules are met, then the action for the default rule is performed.

The following is an example of a default rule as shown in the console:



last	**HTTP 80: default action** *This rule cannot be moved or deleted*	**IF** ✓ Requests otherwise not routed	**THEN** **Forward to** my-targets

Rule priority

Each rule has a priority. Rules are evaluated in priority order, from the lowest value to the highest value. The default rule is evaluated last. You can change the priority of a nondefault rule at any time. You cannot change the priority of the default rule. For more information, see Reorder rules (p. 52).

Rule actions

Each rule action has a type, an order, and the information required to perform the action. For more information, see Rule action types (p. 31).

Rule conditions

Each rule condition has a type and configuration information. When the conditions for a rule are met, then its actions are performed. For more information, see Rule condition types (p. 36).

Rule action types

The following are the supported action types for a listener rule:

`authenticate-cognito`

[HTTPS listeners] Use Amazon Cognito to authenticate users. For more information, see Authenticate users using an Application Load Balancer (p. 55).

`authenticate-oidc`

[HTTPS listeners] Use an identity provider that is compliant with OpenID Connect (OIDC) to authenticate users.

`fixed-response`

Return a custom HTTP response. For more information, see Fixed-response actions (p. 32).

`forward`

Forward requests to the specified target groups. For more information, see Forward actions (p. 32).

`redirect`

Redirect requests from one URL to another. For more information, see Redirect actions (p. 34).

The action with the lowest order value is performed first. Each rule must include exactly one of the following actions: `forward`, `redirect`, or `fixed-response`, and it must be the last action to be performed.

If the protocol version is gRPC or HTTP/2, the only supported actions are `forward` actions.

Fixed-response actions

You can use `fixed-response` actions to drop client requests and return a custom HTTP response. You can use this action to return a 2XX, 4XX, or 5XX response code and an optional message.

When a `fixed-response` action is taken, the action and the URL of the redirect target are recorded in the access logs. For more information, see Access log entries (p. 119). The count of successful `fixed-response` actions is reported in the `HTTP_Fixed_Response_Count` metric. For more information, see Application Load Balancer metrics (p. 104).

Example Example fixed response action for the AWS CLI

You can specify an action when you create or modify a rule. For more information, see the create-rule and modify-rule commands. The following action sends a fixed response with the specified status code and message body.

```
[
  {
      "Type": "fixed-response",
      "FixedResponseConfig": {
          "StatusCode": "200",
          "ContentType": "text/plain",
          "MessageBody": "Hello world"
      }
  }
]
```

Forward actions

You can use `forward` actions to route requests to one or more target groups. If you specify multiple target groups for a `forward` action, you must specify a weight for each target group. Each target group weight is a value from 0 to 999. Requests that match a listener rule with weighted target groups are distributed to these target groups based on their weights. For example, if you specify two target groups, each with a weight of 10, each target group receives half the requests. If you specify two target groups, one with a weight of 10 and the other with a weight of 20, the target group with a weight of 20 receives twice as many requests as the other target group.

By default, configuring a rule to distribute traffic between weighted target groups does not guarantee that sticky sessions are honored. To ensure that sticky sessions are honored, enable target group stickiness for the rule. When the load balancer first routes a request to a weighted target group, it generates a cookie named AWSALBTG that encodes information about the selected target group, encrypts the cookie, and includes the cookie in the response to the client. The client should include the cookie that it receives in subsequent requests to the load balancer. When the load balancer receives a request that matches a rule with target group stickiness enabled and contains the cookie, the request is routed to the target group specified in the cookie.

Application Load Balancers do not support cookie values that are URL encoded.

With CORS (cross-origin resource sharing) requests, some browsers require `SameSite=None; Secure` to enable stickiness. In this case, Elastic Load Balancing generates a second cookie, AWSALBTGCORS, which includes the same information as the original stickiness cookie plus this `SameSite` attribute. Clients receive both cookies.

Example Example forward action with one target group

You can specify an action when you create or modify a rule. For more information, see the create-rule and modify-rule commands. The following action forwards requests to the specified target group.

```
[
  {
      "Type": "forward",
      "ForwardConfig": {
          "TargetGroups": [
              {
                  "TargetGroupArn": "arn:aws:elasticloadbalancing:us-
west-2:123456789012:targetgroup/my-targets/73e2d6bc24d8a067"
              }
          ]
      }
  }
]
```

Example Example forward action with two weighted target groups

The following action forwards requests to the two specified target groups, based on the weight of each target group.

```
[
  {
      "Type": "forward",
      "ForwardConfig": {
          "TargetGroups": [
              {
                  "TargetGroupArn": "arn:aws:elasticloadbalancing:us-
west-2:123456789012:targetgroup/blue-targets/73e2d6bc24d8a067",
                  "Weight": 10
              },
              {
                  "TargetGroupArn": "arn:aws:elasticloadbalancing:us-
west-2:123456789012:targetgroup/green-targets/09966783158cda59",
                  "Weight": 20
              }
          ]
      }
  }
]
```

Example Example forward action with stickiness enabled

If you have a forward action with multiple target groups and one or more of the target groups has sticky sessions (p. 89) enabled, you must enable target group stickiness.

The following action forwards requests to the two specified target groups, with target group stickiness enabled. Requests that do not contain the stickiness cookies are routed based on the weight of each target group.

```
[
  {
      "Type": "forward",
      "ForwardConfig": {
          "TargetGroups": [
              {
                  "TargetGroupArn": "arn:aws:elasticloadbalancing:us-
west-2:123456789012:targetgroup/blue-targets/73e2d6bc24d8a067",
                  "Weight": 10
              },
              {
                  "TargetGroupArn": "arn:aws:elasticloadbalancing:us-
west-2:123456789012:targetgroup/green-targets/09966783158cda59",
                  "Weight": 20
              }
          ],
          "TargetGroupStickinessConfig": {
              "Enabled": true,
              "DurationSeconds": 1000
          }
      }
  }
]
```

Redirect actions

You can use `redirect` actions to redirect client requests from one URL to another. You can configure redirects as either temporary (HTTP 302) or permanent (HTTP 301) based on your needs.

A URI consists of the following components:

```
protocol://hostname:port/path?query
```

You must modify at least one of the following components to avoid a redirect loop: protocol, hostname, port, or path. Any components that you do not modify retain their original values.

protocol

The protocol (HTTP or HTTPS). You can redirect HTTP to HTTP, HTTP to HTTPS, and HTTPS to HTTPS. You cannot redirect HTTPS to HTTP.

hostname

The hostname. A hostname is not case-sensitive, can be up to 128 characters in length, and consists of alpha-numeric characters, wildcards (* and ?), and hyphens (-).

port

The port (1 to 65535).

path

The absolute path, starting with the leading "/". A path is case-sensitive, can be up to 128 characters in length, and consists of alpha-numeric characters, wildcards (* and ?), & (using &amp;), and the following special characters: _-.$/~"'@:+.

query

The query parameters. The maximum length is 128 characters.

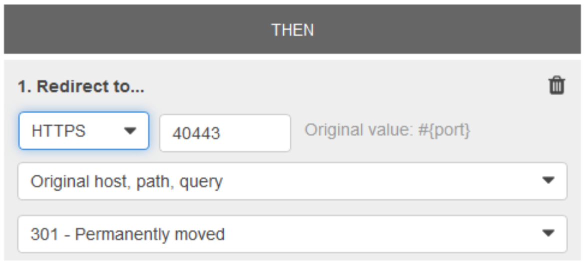
You can reuse URI components of the original URL in the target URL using the following reserved keywords:

- #{protocol} - Retains the protocol. Use in the protocol and query components.
- #{host} - Retains the domain. Use in the hostname, path, and query components.
- #{port} - Retains the port. Use in the port, path, and query components.
- #{path} - Retains the path. Use in the path and query components.
- #{query} - Retains the query parameters. Use in the query component.

When a `redirect` action is taken, the action is recorded in the access logs. For more information, see Access log entries (p. 119). The count of successful `redirect` actions is reported in the `HTTP_Redirect_Count` metric. For more information, see Application Load Balancer metrics (p. 104).

Example Example redirect actions using the console

The following rule sets up a permanent redirect to a URL that uses the HTTPS protocol and the specified port (40443), but retains the original hostname, path, and query parameters. This screen is equivalent to "https://#{host}:40443/#{path}?#{query}".



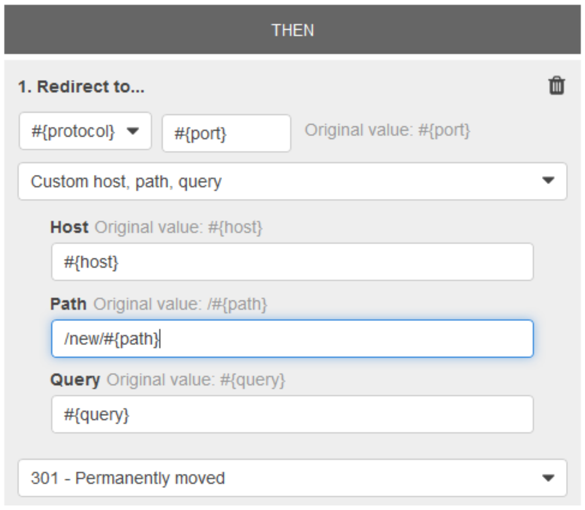
1. Redirect to...

HTTPS | 40443 | Original value: #{port}

Original host, path, query

301 - Permanently moved

The following rule sets up a permanent redirect to a URL that retains the original protocol, port, hostname, and query parameters, and uses the #{path} keyword to create a modified path. This screen is equivalent to "#{protocol}://#{host}:#{port}/new/#{path}?#{query}".



1. Redirect to...

#{protocol} | #{port} | Original value: #{port}

Custom host, path, query

Host Original value: #{host}
#{host}

Path Original value: /#{path}
/new/#{path}

Query Original value: #{query}
#{query}

301 - Permanently moved

Example Example redirect action for the AWS CLI

You can specify an action when you create or modify a rule. For more information, see the create-rule and modify-rule commands. The following action redirects an HTTP request to an HTTPS request on port 443, with the same host name, path, and query string as the HTTP request.

```
[
  {
      "Type": "redirect",
      "RedirectConfig": {
          "Protocol": "HTTPS",
          "Port": "443",
          "Host": "#{host}",
          "Path": "/#{path}",
          "Query": "#{query}",
          "StatusCode": "HTTP_301"
      }
  }
]
```

Rule condition types

The following are the supported condition types for a rule:

`host-header`

: Route based on the host name of each request. For more information, see Host conditions (p. 37).

`http-header`

: Route based on the HTTP headers for each request. For more information, see HTTP header conditions (p. 37).

`http-request-method`

: Route based on the HTTP request method of each request. For more information, see HTTP request method conditions (p. 37).

`path-pattern`

: Route based on path patterns in the request URLs. For more information, see Path conditions (p. 38).

`query-string`

: Route based on key/value pairs or values in the query strings. For more information, see Query string conditions (p. 39).

`source-ip`

: Route based on the source IP address of each request. For more information, see Source IP address conditions (p. 39).

Each rule can optionally include up to one of each of the following conditions: `host-header`, `http-request-method`, `path-pattern`, and `source-ip`. Each rule can also optionally include one or more of each of the following conditions: `http-header` and `query-string`.

You can specify up to three match evaluations per condition. For example, for each `http-header` condition, you can specify up to three strings to be compared to the value of the HTTP header in the request. The condition is satisfied if one of the strings matches the value of the HTTP header. To require that all of the strings are a match, create one condition per match evaluation.

You can specify up to five match evaluations per rule. For example, you can create a rule with five conditions where each condition has one match evaluation.

You can include wildcard characters in the match evaluations for the `http-header`, `host-header`, `path-pattern`, and `query-string` conditions. There is a limit of five wildcard characters per rule.

Rules are applied only to visible ASCII characters; control characters (0x00 to 0x1f and 0x7f) are excluded.

For demos, see Advanced request routing.

HTTP header conditions

You can use HTTP header conditions to configure rules that route requests based on the HTTP headers for the request. You can specify the names of standard or custom HTTP header fields. The header name and the match evaluation are not case-sensitive. The following wildcard characters are supported in the comparison strings: * (matches 0 or more characters) and ? (matches exactly 1 character). Wildcard characters are not supported in the header name.

Example Example HTTP header condition for the AWS CLI

You can specify conditions when you create or modify a rule. For more information, see the create-rule and modify-rule commands. The following condition is satisfied by requests with a User-Agent header that matches one of the specified strings.

```
[
  {
      "Field": "http-header",
      "HttpHeaderConfig": {
          "HttpHeaderName": "User-Agent",
          "Values": ["*Chrome*", "*Safari*"]
      }
  }
]
```

HTTP request method conditions

You can use HTTP request method conditions to configure rules that route requests based on the HTTP request method of the request. You can specify standard or custom HTTP methods. The match evaluation is case-sensitive. Wildcard characters are not supported; therefore, the method name must be an exact match.

We recommend that you route GET and HEAD requests in the same way, because the response to a HEAD request may be cached.

Example Example HTTP method condition for the AWS CLI

You can specify conditions when you create or modify a rule. For more information, see the create-rule and modify-rule commands. The following condition is satisfied by requests that use the specified method.

```
[
  {
      "Field": "http-request-method",
      "HttpRequestMethodConfig": {
          "Values": ["CUSTOM-METHOD"]
      }
  }
]
```

Host conditions

You can use host conditions to define rules that route requests based on the host name in the host header (also known as *host-based routing*). This enables you to support multiple subdomains and different top-level domains using a single load balancer.

A hostname is not case-sensitive, can be up to 128 characters in length, and can contain any of the following characters:

- A–Z, a–z, 0–9
- - .
- * (matches 0 or more characters)
- ? (matches exactly 1 character)

You must include at least one "." character. You can include only alphabetical characters after the final "." character.

Example hostnames

- `example.com`
- `test.example.com`
- `*.example.com`

The rule `*.example.com` matches `test.example.com` but doesn't match `example.com`.

Example Example host header condition for the AWS CLI

You can specify conditions when you create or modify a rule. For more information, see the create-rule and modify-rule commands. The following condition is satisfied by requests with a host header that matches the specified string.

```
[
  {
      "Field": "host-header",
      "HostHeaderConfig": {
          "Values": ["*.example.com"]
      }
  }
]
```

Path conditions

You can use path conditions to define rules that route requests based on the URL in the request (also known as *path-based routing*).

The path pattern is applied only to the path of the URL, not to its query parameters. It is applied only to visible ASCII characters; control characters (0x00 to 0x1f and 0x7f) are excluded.

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 &amp;)
- * (matches 0 or more characters)
- ? (matches exactly 1 character)

If the protocol version is gRPC, conditions can be specific to a package, service, or method.

Example HTTP path patterns

- `/img/*`
- `/img/*/pics`

Example gRPC path patterns

- /package
- /package.service
- /package.service/method

The path pattern is used to route requests but does not alter them. For example, if a rule has a path pattern of `/img/*`, the rule forwards a request for `/img/picture.jpg` to the specified target group as a request for `/img/picture.jpg`.

Example Example path pattern condition for the AWS CLI

You can specify conditions when you create or modify a rule. For more information, see the create-rule and modify-rule commands. The following condition is satisfied by requests with a URL that contains the specified string.

```
[
  {
      "Field": "path-pattern",
      "PathPatternConfig": {
          "Values": ["/img/*"]
      }
  }
]
```

Query string conditions

You can use query string conditions to configure rules that route requests based on key/value pairs or values in the query string. The match evaluation is not case-sensitive. The following wildcard characters are supported: * (matches 0 or more characters) and ? (matches exactly 1 character).

Example Example query string condition for the AWS CLI

You can specify conditions when you create or modify a rule. For more information, see the create-rule and modify-rule commands. The following condition is satisfied by requests with a query string that includes either a key/value pair of "version=v1" or any key set to "example".

```
[
  {
      "Field": "query-string",
      "QueryStringConfig": {
          "Values": [
            {
                "Key": "version",
                "Value": "v1"
            },
            {
                "Value": "*example*"
            }
          ]
      }
  }
]
```

Source IP address conditions

You can use source IP address conditions to configure rules that route requests based on the source IP address of the request. The IP address must be specified in CIDR format. You can use both IPv4 and IPv6 addresses. Wildcard characters are not supported. You cannot specify the `255.255.255.255/32` CIDR for the source IP rule condition.

If a client is behind a proxy, this is the IP address of the proxy, not the IP address of the client.

This condition is not satisfied by the addresses in the X-Forwarded-For header. To search for addresses in the X-Forwarded-For header, use an `http-header` condition.

Example Example source IP condition for the AWS CLI

You can specify conditions when you create or modify a rule. For more information, see the create-rule and modify-rule commands. The following condition is satisfied by requests with a source IP address in one of the specified CIDR blocks.

```
[
  {
      "Field": "source-ip",
      "SourceIpConfig": {
          "Values": ["192.0.2.0/24", "198.51.100.10/32"]
      }
  }
]
```

Create an HTTP listener for your Application Load Balancer

A listener is a process that checks for connection requests. You define a listener when you create your load balancer, and you can add listeners to your load balancer at any time.

The information on this page helps you create an HTTP listener for your load balancer. To add an HTTPS listener to your load balancer, see Create an HTTPS listener for your Application Load Balancer (p. 41).

Prerequisites

- To add a forward action to the default listener rule, you must specify an available target group. For more information, see Create a target group (p. 75).
- You can specify the same target group in multiple listeners, but these listeners must belong to the same load balancer. To use a target group with a load balancer, you must verify that it is not used by a listener for any other load balancer.

Add an HTTP listener

You configure a listener with a protocol and a port for connections from clients to the load balancer, and a target group for the default listener rule. For more information, see Listener configuration (p. 30).

To add an HTTP listener using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.
3. Select a load balancer, and choose **Listeners**, **Add listener**.
4. For **Protocol : port**, choose **HTTP** and keep the default port or enter a different port.

5. For **Default actions**, do one of the following:
   - Choose **Add action**, **Forward to** and choose a target group.
   - Choose **Add action**, **Redirect to** and provide the URL for the redirect. For more information, see Redirect actions (p. 34).
   - Choose **Add action**, **Return fixed response** and provide a response code and optional response body. For more information, see Fixed-response actions (p. 32).

   To save the action, choose the checkmark icon.
6. Choose **Save**.
7. (Optional) To define additional listener rules that forward requests based on a path pattern or a hostname, see Add a rule (p. 49).

To add an HTTP listener using the AWS CLI

Use the create-listener command to create the listener and default rule, and the create-rule command to define additional listener rules.

Create an HTTPS listener for your Application Load Balancer

A listener is a process that checks for connection requests. You define a listener when you create your load balancer, and you can add listeners to your load balancer at any time.

You can create an HTTPS listener, which uses encrypted connections (also known as *SSL offload*). This feature enables traffic encryption between your load balancer and the clients that initiate SSL or TLS sessions.

If you need to pass encrypted traffic to targets without the load balancer decrypting it, you can create a Network Load Balancer or Classic Load Balancer with a TCP listener on port 443. With a TCP listener, the load balancer passes encrypted traffic through to the targets without decrypting it.

Application Load Balancers do not support mutual TLS authentication (mTLS). For mTLS support, create a TCP listener using a Network Load Balancer or a Classic Load Balancer and implement mTLS on the target.

Application Load Balancers do not support ED25519 keys.

The information on this page helps you create an HTTPS listener for your load balancer. To add an HTTP listener to your load balancer, see Create an HTTP listener for your Application Load Balancer (p. 40).

Contents

SSL certificates

To use an HTTPS listener, you must deploy at least one SSL/TLS server certificate on your load balancer. The load balancer uses a server certificate to terminate the front-end connection and then decrypt requests from clients before sending them to the targets.

The load balancer requires X.509 certificates (SSL/TLS server certificates). Certificates are a digital form of identification issued by a certificate authority (CA). A certificate contains identification information, a validity period, a public key, a serial number, and the digital signature of the issuer.

When you create a certificate for use with your load balancer, you must specify a domain name.

We recommend that you create certificates for your load balancer using AWS Certificate Manager (ACM). ACM supports RSA certificates with 2048, 3072, and 4096-bit key lengths, and all ECDSA certificates. ACM integrates with Elastic Load Balancing so that you can deploy the certificate on your load balancer. For more information, see the AWS Certificate Manager User Guide.

Alternatively, you can use SSL/TLS tools to create a certificate signing request (CSR), then get the CSR signed by a CA to produce a certificate, then import the certificate into ACM or upload the certificate to AWS Identity and Access Management (IAM). For more information about importing certificates into ACM, see Importing certificates in the *AWS Certificate Manager User Guide*. For more information about uploading certificates to IAM, see Working with server certificates in the *IAM User Guide*.

Default certificate

When you create an HTTPS listener, you must specify exactly one certificate. This certificate is known as the *default certificate*. You can replace the default certificate after you create the HTTPS listener. For more information, see Replace the default certificate (p. 53).

If you specify additional certificates in a certificate list (p. 42), the default certificate is used only if a client connects without using the Server Name Indication (SNI) protocol to specify a hostname or if there are no matching certificates in the certificate list.

If you do not specify additional certificates but need to host multiple secure applications through a single load balancer, you can use a wildcard certificate or add a Subject Alternative Name (SAN) for each additional domain to your certificate.

Certificate list

After you create an HTTPS listener, it has a default certificate and an empty certificate list. You can optionally add certificates to the certificate list for the listener. Using a certificate list enables the load balancer to support multiple domains on the same port and provide a different certificate for each domain. For more information, see Add certificates to the certificate list (p. 54).

The load balancer uses a smart certificate selection algorithm with support for SNI. If the hostname provided by a client matches a single certificate in the certificate list, the load balancer selects this certificate. If a hostname provided by a client matches multiple certificates in the certificate list, the load balancer selects the best certificate that the client can support. Certificate selection is based on the following criteria in the following order:

- Public key algorithm (prefer ECDSA over RSA)
- Hashing algorithm (prefer SHA over MD5)
- Key length (prefer the largest)
- Validity period

The load balancer access log entries indicate the hostname specified by the client and the certificate presented to the client. For more information, see Access log entries (p. 119).

Certificate renewal

Each certificate comes with a validity period. You must ensure that you renew or replace each certificate for your load balancer before its validity period ends. This includes the default certificate and certificates in a certificate list. Renewing or replacing a certificate does not affect in-flight requests that were received by the load balancer node and are pending routing to a healthy target. After a certificate is renewed, new requests use the renewed certificate. After a certificate is replaced, new requests use the new certificate.

You can manage certificate renewal and replacement as follows:

- Certificates provided by AWS Certificate Manager and deployed on your load balancer can be renewed automatically. ACM attempts to renew certificates before they expire. For more information, see Managed renewal in the *AWS Certificate Manager User Guide*.
- If you imported a certificate into ACM, you must monitor the expiration date of the certificate and renew it before it expires. For more information, see Importing certificates in the *AWS Certificate Manager User Guide*.
- If you imported a certificate into IAM, you must create a new certificate, import the new certificate to ACM or IAM, add the new certificate to your load balancer, and remove the expired certificate from your load balancer.

Security policies

Elastic Load Balancing uses a Secure Socket Layer (SSL) negotiation configuration, known as a security policy, to negotiate SSL connections between a client and the load balancer. A security policy is a combination of protocols and ciphers. The protocol establishes a secure connection between a client and a server and ensures that all data passed between the client and your load balancer is private. A cipher is an encryption algorithm that uses encryption keys to create a coded message. Protocols use several ciphers to encrypt data over the internet. During the connection negotiation process, the client and the load balancer present a list of ciphers and protocols that they each support, in order of preference. By default, the first cipher on the server's list that matches any one of the client's ciphers is selected for the secure connection.

Application Load Balancers do not support SSL renegotiation for client or target connections.

When you create an HTTPS listener, you must select a security policy. You can update the security policy as needed. For more information, see Update the security policy (p. 55).

You can choose the security policy that is used for front-end connections. The `ELBSecurityPolicy-2016-08` security policy is always used for backend connections. Application Load Balancers do not support custom security policies.

Elastic Load Balancing provides the following security policies for Application Load Balancers:

- `ELBSecurityPolicy-2016-08` (default)
- `ELBSecurityPolicy-TLS-1-0-2015-04`
- `ELBSecurityPolicy-TLS-1-1-2017-01`
- `ELBSecurityPolicy-TLS-1-2-2017-01`
- `ELBSecurityPolicy-TLS-1-2-Ext-2018-06`
- `ELBSecurityPolicy-FS-2018-06`
- `ELBSecurityPolicy-FS-1-1-2019-08`
- `ELBSecurityPolicy-FS-1-2-2019-08`

- `ELBSecurityPolicy-FS-1-2-Res-2019-08`
- `ELBSecurityPolicy-2015-05` (identical to `ELBSecurityPolicy-2016-08`)
- `ELBSecurityPolicy-FS-1-2-Res-2020-10`

We recommend the `ELBSecurityPolicy-2016-08` policy for compatibility. You can use one of the `ELBSecurityPolicy-FS` policies if you require Forward Secrecy (FS). You can use one of the `ELBSecurityPolicy-TLS` policies to meet compliance and security standards that require disabling certain TLS protocol versions, or to support legacy clients that require deprecated ciphers. Only a small percentage of internet clients require TLS version 1.0. To view the TLS protocol version for requests to your load balancer, enable access logging for your load balancer and examine the access logs. For more information, see Access Logs (p. 118).

FS supported policies

The following table describes the default policy, `ELBSecurityPolicy-2016-08`, and the `ELBSecurityPolicy-FS` policies. The `ELBSecurityPolicy-` has been removed from policy names in the heading row so that they fit.

Security policies	Default	FS-1-2-Res-2020-10	FS-1-2-Res-2019-08	FS-1-2-2019-08	FS-1-1-2019-08	FS-2018-06
TLS Protocols						
Protocol-TLSv1	✓					✓
Protocol-TLSv1.1	✓				✓	✓
Protocol-TLSv1.2	✓	✓	✓	✓	✓	✓
TLS Ciphers						
ECDHE-ECDSA-AES128-GCM-SHA256	✓	✓	✓	✓	✓	✓
ECDHE-RSA-AES128-GCM-SHA256	✓	✓	✓	✓	✓	✓
ECDHE-ECDSA-AES128-SHA256	✓		✓	✓	✓	✓

Security policies	Default	FS-1-2-Res-2020-10	FS-1-2-Res-2019-08	FS-1-2-2019-08	FS-1-1-2019-08	FS-2018-06
ECDHE-RSA-AES128-SHA256	✓		✓	✓	✓	✓
ECDHE-ECDSA-AES128-SHA	✓			✓	✓	✓
ECDHE-RSA-AES128-SHA	✓			✓	✓	✓
ECDHE-ECDSA-AES256-GCM-SHA384	✓	✓	✓	✓	✓	✓
ECDHE-RSA-AES256-GCM-SHA384	✓	✓	✓	✓	✓	✓
ECDHE-ECDSA-AES256-SHA384	✓		✓	✓	✓	✓
ECDHE-RSA-AES256-SHA384	✓		✓	✓	✓	✓
ECDHE-RSA-AES256-SHA	✓			✓	✓	✓
ECDHE-ECDSA-AES256-SHA	✓			✓	✓	✓
AES128-GCM-SHA256	✓					
AES128-SHA256	✓					
AES128-SHA	✓					

Security policies	Default	FS-1-2-Res-2020-10	FS-1-2-Res-2019-08	FS-1-2-2019-08	FS-1-1-2019-08	FS-2018-06
AES256-GCM-SHA384	✓					
AES256-SHA256	✓					
AES256-SHA	✓					

TLS security policies

The following table describes the default policy, `ELBSecurityPolicy-2016-08`, and the `ELBSecurityPolicy-TLS` policies. The `ELBSecurityPolicy-` has been removed from policy names in the heading row so that they fit.

Security policies	Default	TLS-1-2-Ext-2018-06	TLS-1-2-2017-01	TLS-1-1-2017-01	TLS-1-0-2015-04*
TLS Protocols					
Protocol-TLSv1	✓				✓
Protocol-TLSv1.1	✓			✓	✓
Protocol-TLSv1.2	✓	✓	✓	✓	✓
TLS Ciphers					
ECDHE-ECDSA-AES128-GCM-SHA256	✓	✓	✓	✓	✓
ECDHE-RSA-AES128-GCM-SHA256	✓	✓	✓	✓	✓

Security policies	Default	TLS-1-2-Ext-2018-06	TLS-1-2-2017-01	TLS-1-1-2017-01	TLS-1-0-2015-04*
ECDHE-ECDSA-AES128-SHA256	✓	✓	✓	✓	✓
ECDHE-RSA-AES128-SHA256	✓	✓	✓	✓	✓
ECDHE-ECDSA-AES128-SHA	✓	✓		✓	✓
ECDHE-RSA-AES128-SHA	✓	✓		✓	✓
ECDHE-ECDSA-AES256-GCM-SHA384	✓	✓	✓	✓	✓
ECDHE-RSA-AES256-GCM-SHA384	✓	✓	✓	✓	✓
ECDHE-ECDSA-AES256-SHA384	✓	✓	✓	✓	✓
ECDHE-RSA-AES256-SHA384	✓	✓	✓	✓	✓
ECDHE-RSA-AES256-SHA	✓	✓		✓	✓
ECDHE-ECDSA-AES256-SHA	✓	✓		✓	✓
AES128-GCM-SHA256	✓	✓	✓	✓	✓
AES128-SHA256	✓	✓	✓	✓	✓
AES128-SHA	✓	✓		✓	✓
AES256-GCM-SHA384	✓	✓	✓	✓	✓
AES256-SHA256	✓	✓	✓	✓	✓

Security policies	Default	TLS-1-2-Ext-2018-06	TLS-1-2-2017-01	TLS-1-1-2017-01	TLS-1-0-2015-04*
AES256-SHA	✓	✓		✓	✓
DES-CBC3-SHA					✓

* Do not use this policy unless you must support a legacy client that requires the DES-CBC3-SHA cipher, which is a weak cipher.

To view the configuration of a security policy for Application Load Balancers using the AWS CLI, use the describe-ssl-policies command.

Add an HTTPS listener

You configure a listener with a protocol and a port for connections from clients to the load balancer, and a target group for the default listener rule. For more information, see Listener configuration (p. 30).

Prerequisites

- To create an HTTPS listener, you must specify a certificate and a security policy. The load balancer uses the certificate to terminate the connection and decrypt requests from clients before routing them to targets. The load balancer uses the security policy when negotiating SSL connections with the clients.
- To add a forward action to the default listener rule, you must specify an available target group. For more information, see Create a target group (p. 75).
- You can specify the same target group in multiple listeners, but these listeners must belong to the same load balancer. To use a target group with a load balancer, you must verify that it is not used by a listener for any other load balancer.

To add an HTTPS listener using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.
3. Select a load balancer, and choose **Listeners**, **Add listener**.
4. For **Protocol : port**, choose **HTTPS** and keep the default port or enter a different port.
5. (Optional) To authenticate users, for **Default actions**, choose **Add action**, **Authenticate** and provide the requested information. To save the action, choose the checkmark icon. For more information, see Authenticate users using an Application Load Balancer (p. 55).
6. For **Default actions**, do one of the following:
    - Choose **Add action**, **Forward to** and choose a target group.
    - Choose **Add action**, **Redirect to** and provide the URL for the redirect. For more information, see Redirect actions (p. 34).
    - Choose **Add action**, **Return fixed response** and provide a response code and optional response body. For more information, see Fixed-response actions (p. 32).

    To save the action, choose the checkmark icon.

7. For **Security policy**, we recommend that you keep the default security policy.
8. For **Default SSL certificate**, do one of the following:
   - If you created or imported a certificate using AWS Certificate Manager, choose **From ACM** and choose the certificate.
   - If you uploaded a certificate using IAM, choose **From IAM** and choose the certificate.
9. Choose **Save**.
10. (Optional) To define additional listener rules that forward requests based on a path pattern or a hostname, see Add a rule (p. 49).
11. (Optional) To add a certificate list for use with the SNI protocol, see Add certificates to the certificate list (p. 54).

To add an HTTPS listener using the AWS CLI

Use the create-listener command to create the listener and default rule, and the create-rule command to define additional listener rules.

Update an HTTPS listener

After you create an HTTPS listener, you can replace the default certificate, update the certificate list, or replace the security policy. For more information, see Update an HTTPS listener for your Application Load Balancer (p. 53).

Listener rules for your Application Load Balancer

The rules that you define for your listener determine how the load balancer routes requests to the targets in one or more target groups.

Each rule consists of a priority, one or more actions, and one or more conditions. For more information, see Listener rules (p. 31).

> **Note**
> The console displays the rules in priority order. However, the console displays a sequence number for each rule, which might differ from the rule priority displayed by the AWS CLI or the Elastic Load Balancing API.

Requirements

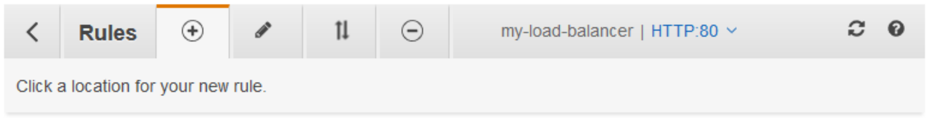
- Each rule must include exactly one of the following actions: `forward`, `redirect`, or `fixed-response`, and it must be the last action to be performed.
- Each rule can include zero or one of the following conditions: `host-header`, `http-request-method`, `path-pattern`, and `source-ip`, and zero or more of the following conditions: `http-header` and `query-string`.
- You can specify up to three comparison strings per condition and up to five per rule.
- A `forward` action routes requests to its target group. Before you add a `forward` action, create the target group and add targets to it. For more information, see Create a target group (p. 75).

Add a rule

You define a default rule when you create a listener, and you can define additional nondefault rules at any time.

To add a rule using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.
3. Select the load balancer and choose **Listeners**.
4. For the listener to update, choose **View/edit rules**.
5. Choose the **Add rules** icon (the plus sign) in the menu bar, which adds **Insert Rule** icons at the locations where you can insert a rule in the priority order.



Click a location for your new rule.

6. Choose one of the **Insert Rule** icons added in the previous step.
7. Add one or more conditions as follows:

    a. To add a host header condition, choose **Add condition**, **Host header** and enter the hostname (for example, `*.example.com`). To save the condition, choose the checkmark icon.

       The maximum size of each string is 128 characters. The comparison is not case-sensitive. The following wildcard characters are supported: * and ?.

    b. To add a path condition, choose **Add condition**, **Path** and enter the path pattern (for example, `/img/*`). To save the condition, choose the checkmark icon.

       The maximum size of each string is 128 characters. The comparison is case-sensitive. The following wildcard characters are supported: * and ?.

    c. To add an HTTP header condition, choose **Add condition**, **Http header**. Enter the name of the header and add one or more comparison strings. To save the condition, choose the checkmark icon.

       The maximum size of each header name is 40 characters, the header name is not case-sensitive, and wildcards are not supported. The maximum size of each comparison string is 128 characters and the following wildcard characters are supported: * and ?. The comparison is not case-sensitive.

    d. To add an HTTP request method condition, choose **Add condition**, **Http request method** and add one or more method names. To save the condition, choose the checkmark icon.

       The maximum size of each name is 40 characters. The allowed characters are A-Z, hyphen (-), and underscore (_). The comparison is case sensitive. Wildcards are not supported.

    e. To add a query string condition, choose **Add condition**, **Query string** and add one or more key/value pairs. For each key/value pair, you can omit the key and specify only the value. To save the condition, choose the checkmark icon.

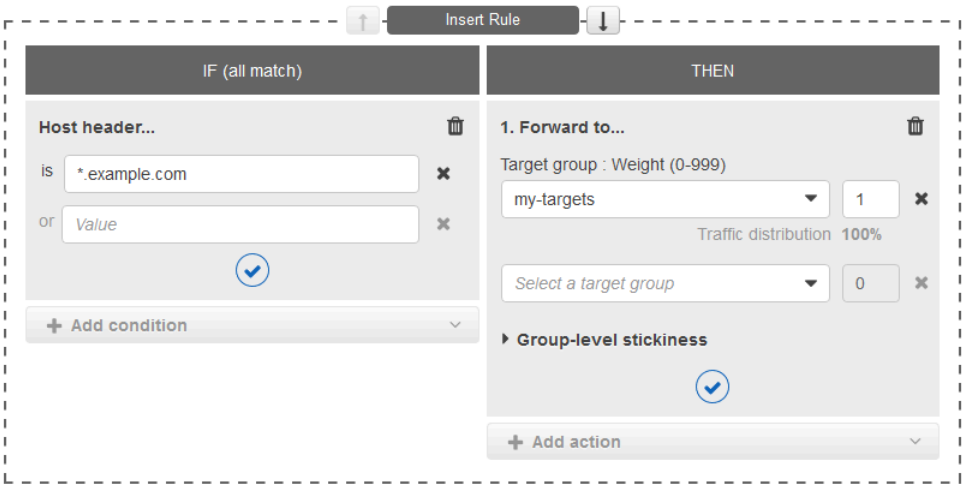
       The maximum size of each string is 128 characters. The comparison is not case-sensitive. The following wildcard characters are supported: * and ?.

    f. To add a source IP condition, choose **Add condition**, **Source IP** and add one or more CIDR blocks. To save the condition, choose the checkmark icon.

       You can use both IPv4 and IPv6 addresses. Wildcards are not supported.
8. (Optional, HTTPS listener) To authenticate users, choose **Add action**, **Authenticate** and provide the requested information. To save the action, choose the checkmark icon. For more information, see Authenticate users using an Application Load Balancer (p. 55).
9. Add one of the following actions:
    - To add a forward action, choose **Add action**, **Forward to** and choose one or more target groups. If you use more than one target group, select a weight for each target group and optionally

enable target group stickiness. If you enable target group stickiness and there is more than one target group, you must also enable sticky sessions on the target groups. To save the action, choose the checkmark icon. For more information, see Forward actions (p. 32).

- To add a redirect action, choose **Add action**, **Redirect to** and provide the URL for the redirect. To save the action, choose the checkmark icon. For more information, see Redirect actions (p. 34).
- To add a fixed-response action, choose **Add action**, **Return fixed response** and provide a response code and optional response body. To save the action, choose the checkmark icon. For more information, see Fixed-response actions (p. 32).



10. Choose **Save**.
11. (Optional) To change the order of the rule, use the arrows and then choose **Save**. The default rule always has the **last** priority.
12. To leave this screen, choose the **Back to the load balancer** icon (the back button) in the menu bar.

To add a rule using the AWS CLI

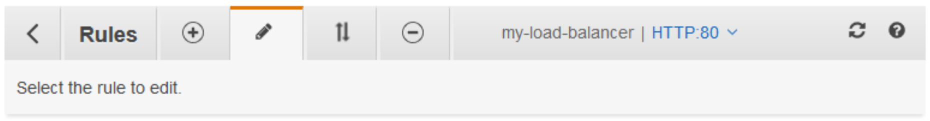
Use the create-rule command to create the rule. Use the describe-rules command to view information about the rule.

Edit a rule

You can edit the action and conditions for a rule at any time. Rule updates do not take effect immediately, so requests could be routed using the previous rule configuration for a short time after you update a rule. Any in-flight requests are completed.

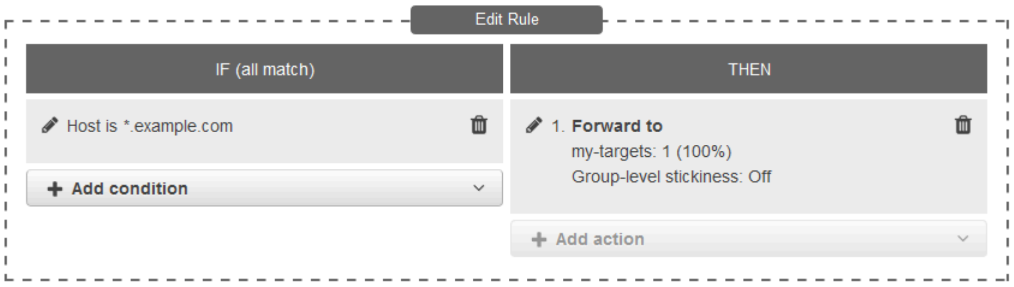
To edit a rule using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.
3. Select the load balancer and choose **Listeners**.
4. For the listener to update, choose **View/edit rules**.
5. Choose the **Edit rules** icon (the pencil) in the menu bar.



Select the rule to edit.

6. For the rule to edit, choose the **Edit rules** icon (the pencil).
7. (Optional) Modify the conditions and actions as needed. For example, you can edit a condition or action (pencil icon), add a condition, add an authenticate action to a rule for an HTTPS listener, or delete a condition or action (trash can icon). You can't add conditions to the default rule.



8. Choose **Update**.
9. To leave this screen, choose the **Back to the load balancer** icon (the back button) in the menu bar.

To edit a rule using the AWS CLI

Use the modify-rule command.

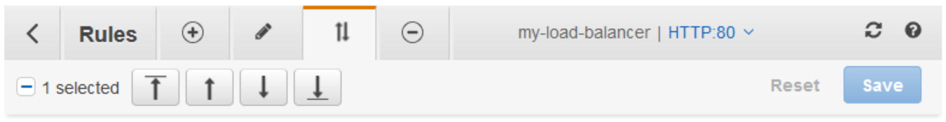
Reorder rules

Rules are evaluated in priority order, from the lowest value to the highest value. The default rule is evaluated last. You can change the priority of a nondefault rule at any time. You cannot change the priority of the default rule.

> **Note**
> The console displays a relative sequence number for each rule, not the rule priority. When you reorder rules using the console, they get new rule priorities based on the existing rule priorities. To set the priority of a rule to a specific value, use the AWS CLI or the Elastic Load Balancing API.

To reorder rules using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.
3. Select the load balancer and choose **Listeners**.
4. For the listener to update, choose **View/edit rules**.
5. Choose the **Reorder rules** icon (the arrows) in the menu bar.



6. Select the check box next to a rule, and then use the arrows to give the rule a new priority. The default rule always has the last priority.
7. When you have finished reordering rules, choose **Save**.
8. To leave this screen, choose the **Back to the load balancer** icon (the back button) in the menu bar.

To update rule priorities using the AWS CLI

Use the set-rule-priorities command.

Delete a rule

You can delete the nondefault rules for a listener at any time. You cannot delete the default rule for a listener. When you delete a listener, all its rules are deleted.

To delete a rule using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.
3. Select the load balancer and choose **Listeners**.
4. For the listener to update, choose **View/edit rules**.
5. Choose the **Delete rules** icon (the minus sign) in the menu bar.
6. Select the check box for the rule and choose **Delete**. You can't delete the default rule for the listener.
7. To leave this screen, choose the **Back to the load balancer** icon (the back button) in the menu bar.

To delete a rule using the AWS CLI

Use the delete-rule command.

Update an HTTPS listener for your Application Load Balancer

After you create an HTTPS listener, you can replace the default certificate, update the certificate list, or replace the security policy.

Tasks

Replace the default certificate

You can replace the default certificate for your listener using the following procedure. For more information, see SSL certificates (p. 42).

To change the default certificate using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.
3. Select the load balancer and choose **Listeners**.
4. Select the check box for the listener and choose **Edit**.
5. For **Default SSL certificate**, do one of the following:
   - If you created or imported a certificate using AWS Certificate Manager, choose **From ACM** and choose the certificate.
   - If you uploaded a certificate using IAM, choose **From IAM** and choose the certificate.

6. Choose **Update**.

To change the default certificate using the AWS CLI

Use the modify-listener command.

Add certificates to the certificate list

You can add certificates to the certificate list for your listener using the following procedure. When you first create an HTTPS listener, the certificate list is empty. You can add one or more certificates. You can optionally add the default certificate to ensure that this certificate is used with the SNI protocol even if it is replaced as the default certificate. For more information, see SSL certificates (p. 42).

To add certificates to the certificate list using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.
3. Select the load balancer and choose **Listeners**.
4. For the HTTPS listener to update, choose **View/edit certificates**, which displays the default certificate followed by any other certificates that you've added to the listener.
5. Choose the **Add certificates** icon (the plus sign) in the menu bar, which displays the default certificate followed by any other certificates managed by ACM and IAM. If you've already added a certificate to the listener, its check box is selected and disabled.
6. To add certificates that are already managed by ACM or IAM, select the check boxes for the certificates and choose **Add**.
7. If you have a certificate that isn't managed by ACM or IAM, import it to ACM and add it to your listener as follows:

   a. Choose **Import certificate**.
   b. For **Certificate private key**, paste the PEM-encoded, unencrypted private key for the certificate.
   c. For **Certificate body**, paste the PEM-encoded certificate.
   d. (Optional) For **Certificate chain**, paste the PEM-encoded certificate chain.
   e. Choose **Import**. The newly imported certificate appears in the list of available certificates and is selected.
   f. Choose **Add**.
8. To leave this screen, choose the **Back to the load balancer** icon (the back button) in the menu bar.

To add a certificate to the certificate list using the AWS CLI

Use the add-listener-certificates command.

Remove certificates from the certificate list

You can remove certificates from the certificate list for an HTTPS listener using the following procedure. To remove the default certificate for an HTTPS listener, see Replace the default certificate (p. 53).

To remove certificates from the certificate list using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.
3. Select the load balancer and choose **Listeners**.

4. For the listener to update, choose **View/edit certificates**, which displays the default certificate followed by any other certificates that you've added to the listener.
5. Choose the **Remove certificates** icon (the minus sign) in the menu bar.
6. Select the check boxes for the certificates and choose **Remove**.
7. To leave this screen, choose the **Back to the load balancer** icon (the back button) in the menu bar.

To remove a certificate from the certificate list using the AWS CLI

Use the remove-listener-certificates command.

Update the security policy

When you create an HTTPS listener, you can select the security policy that meets your needs. When a new security policy is added, you can update your HTTPS listener to use the new security policy. Application Load Balancers do not support custom security policies. For more information, see Security policies (p. 43).

To update the security policy using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.
3. Select the load balancer and choose **Listeners**.
4. Select the check box for the HTTPS listener and choose **Edit**.
5. For **Security policy**, choose a security policy.
6. Choose **Update**.

To update the security policy using the AWS CLI

Use the modify-listener command.

Authenticate users using an Application Load Balancer

You can configure an Application Load Balancer to securely authenticate users as they access your applications. This enables you to offload the work of authenticating users to your load balancer so that your applications can focus on their business logic.

The following use cases are supported:

- Authenticate users through an identity provider (IdP) that is OpenID Connect (OIDC) compliant.
- Authenticate users through social IdPs, such as Amazon, Facebook, or Google, through the user pools supported by Amazon Cognito.
- Authenticate users through corporate identities, using SAML, LDAP, or Microsoft AD, through the user pools supported by Amazon Cognito.

Prepare to use an OIDC-compliant IdP

Do the following if you are using an OIDC-compliant IdP with your Application Load Balancer:

- Create a new OIDC app in your IdP. The IdP's DNS must be publicly resolvable.

- You must configure a client ID and a client secret.
- Get the following endpoints published by the IdP: authorization, token, and user info. You can locate this information in the config.
- The DNS entries for the endpoints must be publicly resolvable, even if they resolve to private IP addresses.
- Allow one of the following redirect URLs in your IdP app, whichever your users will use, where DNS is the domain name of your load balancer and CNAME is the DNS alias for your application:
  - https://*DNS*/oauth2/idpresponse
  - https://*CNAME*/oauth2/idpresponse

Prepare to use Amazon Cognito

Do the following if you are using Amazon Cognito user pools with your Application Load Balancer:

- Create a user pool. For more information, see Amazon Cognito user pools in the *Amazon Cognito Developer Guide*.
- Create a user pool client. You must configure the client to generate a client secret, use code grant flow, and support the same OAuth scopes that the load balancer uses. For more information, see Configuring a user pool app client in the *Amazon Cognito Developer Guide*.
- Create a user pool domain. For more information, see Adding a Domain name for your user pool in the *Amazon Cognito Developer Guide*.
- Verify that the requested scope returns an ID token. For example, the default scope, `openid` returns an ID token but the `aws.cognito.signin.user.admin` scope does not.
- To federate with a social or corporate IdP, enable the IdP in the federation section. For more information, see Add social sign-in to a user pool or Add sign-in with a SAML IdP to a user pool in the *Amazon Cognito Developer Guide*.
- Allow the following redirect URLs in the callback URL field for Amazon Cognito, where DNS is the domain name of your load balancer, and CNAME is the DNS alias for your application (if you are using one):
  - https://*DNS*/oauth2/idpresponse
  - https://*CNAME*/oauth2/idpresponse
- Allow your user pool domain on your IdP app's callback URL. Use the format for your IdP. For example:
  - https://*`domain-prefix`*.auth.*`region`*.amazoncognito.com/saml2/idpresponse
  - https://*`user-pool-domain`*/oauth2/idpresponse

The callback URL in the app client settings must use all lowercase letters.

To enable an IAM user to configure a load balancer to use Amazon Cognito to authenticate users, you must grant the user permission to call the `cognito-idp:DescribeUserPoolClient` action.

Prepare to use Amazon CloudFront

Enable the following settings if you are using a CloudFront distribution in front of your Application Load Balancer:

- Forward request headers (all) — Ensures that CloudFront does not cache responses for authenticated requests. This prevents them from being served from the cache after the authentication session expires. Alternatively, to reduce this risk while caching is enabled, owners of a CloudFront distribution can set the time-to-live (TTL) value to expire before the authentication cookie expires.
- Query string forwarding and caching (all) — Ensures that the load balancer has access to the query string parameters required to authenticate the user with the IdP.

- Cookie forwarding (all) — Ensures that CloudFront forwards all authentication cookies to the load balancer.

Configure user authentication

You configure user authentication by creating an authenticate action for one or more listener rules. The `authenticate-cognito` and `authenticate-oidc` action types are supported only with HTTPS listeners. For descriptions of the corresponding fields, see AuthenticateCognitoActionConfig and AuthenticateOidcActionConfig in the *Elastic Load Balancing API Reference version 2015-12-01*.

The load balancer sends a session cookie to the client to maintain authentication status. This cookie always contains the `secure` attribute, because user authentication requires an HTTPS listener. This cookie contains the `SameSite=None` attribute with CORS (cross-origin resource sharing) requests.

For a load balancer supporting multiple applications that require independent client authentication, each listener rule with an authenticate action should have a unique cookie name. This ensures that clients are always authenticated with the IdP before being routed to the target group specified in the rule.

Application Load Balancers do not support cookie values that are URL encoded.

By default, the `SessionTimeout` field is set to 7 days. If you want shorter sessions, you can configure a session timeout as short as 1 second. For more information, see Session timeout (p. 62).

Set the `OnUnauthenticatedRequest` field as appropriate for your application. For example:

- **Applications that require the user to log in using a social or corporate identity**—This is supported by the default option, `authenticate`. If the user is not logged in, the load balancer redirects the request to the IdP authorization endpoint and the IdP prompts the user to log in using its user interface.
- **Applications that provide a personalized view to a user that is logged in or a general view to a user that is not logged in**—To support this type of application, use the `allow` option. If the user is logged in, the load balancer provides the user claims and the application can provide a personalized view. If the user is not logged in, the load balancer forwards the request without the user claims and the application can provide the general view.
- **Single-page applications with JavaScript that loads every few seconds**—If you use the `deny` option, the load balancer returns an HTTP 401 Unauthorized error to AJAX calls that have no authentication information. But if the user has expired authentication information, it redirects the client to the IdP authorization endpoint.

The load balancer must be able to communicate with the IdP token endpoint (`TokenEndpoint`) and the IdP user info endpoint (`UserInfoEndpoint`). Verify that the security groups for your load balancer and the network ACLs for your VPC allow outbound access to these endpoints. Verify that your VPC has internet access. If you have an internal-facing load balancer, use a NAT gateway to enable the load balancer to access these endpoints. For more information, see NAT gateway basics in the *Amazon VPC User Guide*.

Use the following create-rule command to configure user authentication.

```
aws elbv2 create-rule --listener-arn listener-arn --priority 10 \
--conditions Field=path-pattern,Values="/login" --actions file://actions.json
```

The following is an example of the `actions.json` file that specifies an `authenticate-oidc` action and a `forward` action. `AuthenticationRequestExtraParams` allows you to pass extra parameters to an IdP during authentication. Please follow documentation provided by your identity provider to determine the fields that are supported

```
[{
    "Type": "authenticate-oidc",
    "AuthenticateOidcConfig": {
        "Issuer": "https://idp-issuer.com",
        "AuthorizationEndpoint": "https://authorization-endpoint.com",
        "TokenEndpoint": "https://token-endpoint.com",
        "UserInfoEndpoint": "https://user-info-endpoint.com",
        "ClientId": "abcdefghijklmnopqrstuvwxyz123456789",
        "ClientSecret": "123456789012345678901234567890",
        "SessionCookieName": "my-cookie",
        "SessionTimeout": 3600,
        "Scope": "email",
        "AuthenticationRequestExtraParams": {
            "display": "page",
            "prompt": "login"
        },
        "OnUnauthenticatedRequest": "deny"
    },
    "Order": 1
},
{
    "Type": "forward",
    "TargetGroupArn": "arn:aws:elasticloadbalancing:region-code:account-
id:targetgroup/target-group-name/target-group-id",
    "Order": 2
}]
```

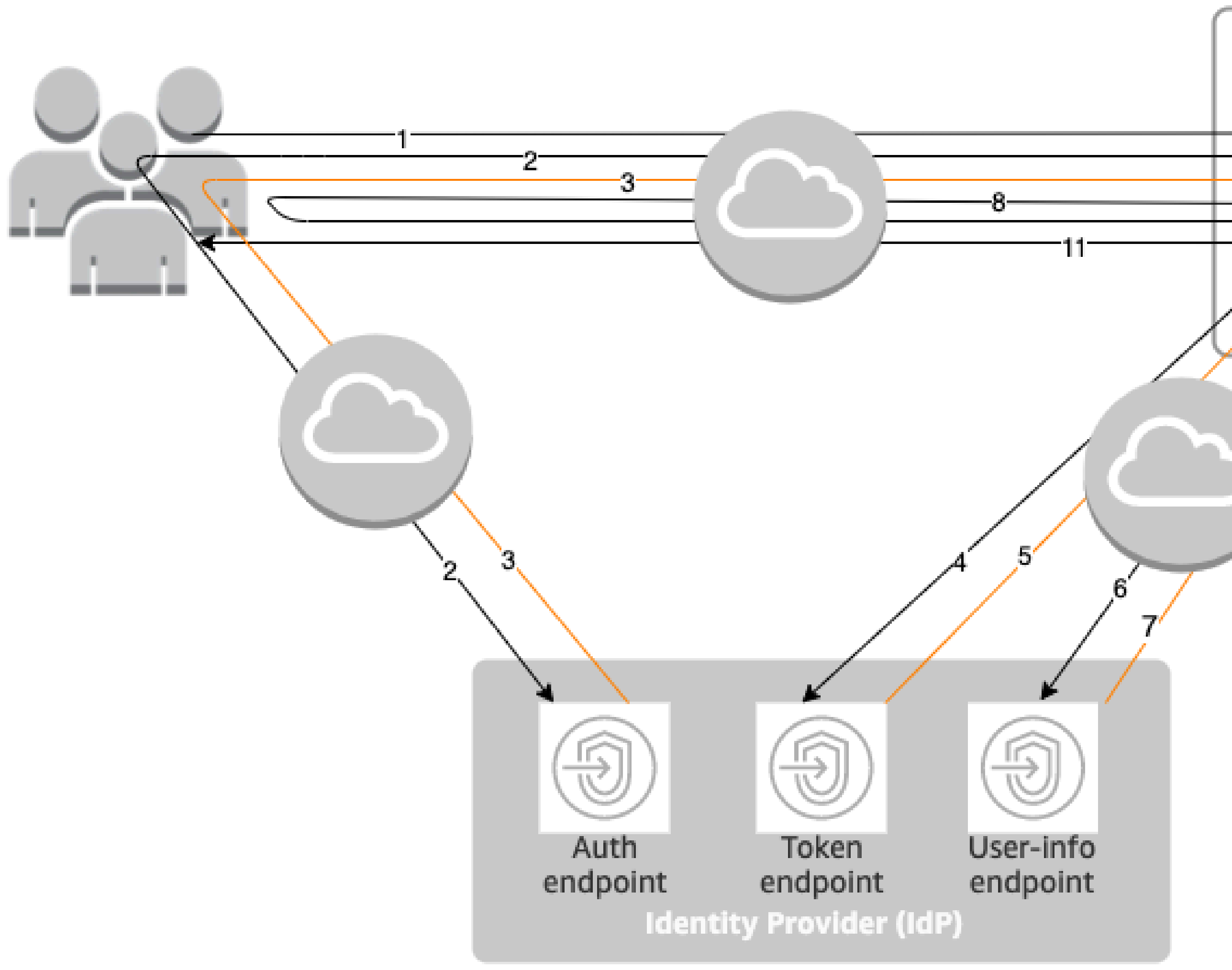
The following is an example of the `actions.json` file that specifies an `authenticate-cognito` action and a `forward` action.

```
[{
    "Type": "authenticate-cognito",
    "AuthenticateCognitoConfig": {
        "UserPoolArn": "arn:aws:cognito-idp:region-code:account-id:userpool/user-pool-id",
        "UserPoolClientId": "abcdefghijklmnopqrstuvwxyz123456789",
        "UserPoolDomain": "userPoolDomain1",
        "SessionCookieName": "my-cookie",
        "SessionTimeout": 3600,
        "Scope": "email",
        "AuthenticationRequestExtraParams": {
            "display": "page",
            "prompt": "login"
        },
        "OnUnauthenticatedRequest": "deny"
    },
    "Order": 1
},
{
    "Type": "forward",
    "TargetGroupArn": "arn:aws:elasticloadbalancing:region-code:account-
id:targetgroup/target-group-name/target-group-id",
    "Order": 2
}]
```

For more information, see Listener rules (p. 31).

Authentication flow

The following network diagram is a visual representation of how an Application Load Balancer uses OIDC to authenticate users.



The numbered items below, highlight and explain elements shown in the preceding network diagram.

1. User sends an HTTPS request to a website hosted behind an Application Load Balancer. When the conditions for a rule with an authenticate action are met, the load balancer checks for an authentication session cookie in the request headers.
2. If the cookie is not present, the load balancer redirects the user to the IdP authorization endpoint so that the IdP can authenticate the user.
3. After the user is authenticated, the IdP sends the user back to the load balancer with an authorization grant code.
4. The load balancer presents the authorization grant code to the IdP token endpoint.
5. Upon receiving a valid authorization grant code, the IdP provides the ID token and access token to the Application Load Balancer.
6. The Application Load Balancer then sends the access token to the user info endpoint.
7. The user info endpoint exchanges the access token for user claims.
8. The Application Load Balancer redirects the user with the `AWSELB` authentication session cookie to the original URI. Because most browsers limit the cookie size to 4K, the load balancer shards a cookie that is greater than 4K in size into multiple cookies. If the total size of the user claims and access token received from the IdP is greater than 11K bytes in size, the load balancer returns an HTTP 500 error to the client and increments the `ELBAuthUserClaimsSizeExceeded` metric.

9. The Application Load Balancer validates the cookie and forwards the user info to targets in the `X-AMZN-OIDC-*` HTTP headers set. For more information, see User claims encoding and signature verification (p. 60).
10. The target sends a response back to the Application Load Balancer.
11. The Application Load Balancer sends the final response to the user.

Every new request goes through steps 1 through 11, while subsequent requests go through steps 9 through 11. That is, every subsequent request starts at step 9 as long as the cookie has not expired.

If the IdP provides a valid refresh token in the ID token, the load balancer saves the refresh token and uses it to refresh the user claims each time the access token expires, until the session times out or the IdP refresh fails. If the user logs out, the refresh fails and the load balancer redirects the user to the IdP authorization endpoint. This enables the load balancer to drop sessions after the user logs out. For more information, see Session timeout (p. 62).

Note
The cookie expiry is different from the authentication session expiry. The cookie expiry is an attribute of the cookie, which is set to 7 days. The actual length of the authentication session is determined by the session timeout configured on the Application Load Balancer for the authentication feature. This session timeout is included in the Auth cookie value, which is also encrypted.

User claims encoding and signature verification

After your load balancer authenticates a user successfully, it sends the user claims received from the IdP to the target. The load balancer signs the user claim so that applications can verify the signature and verify that the claims were sent by the load balancer.

The load balancer adds the following HTTP headers:

`x-amzn-oidc-accesstoken`

The access token from the token endpoint, in plain text.

`x-amzn-oidc-identity`

The subject field (`sub`) from the user info endpoint, in plain text.

`x-amzn-oidc-data`

The user claims, in JSON web tokens (JWT) format.

Access tokens and user claims are different from ID tokens. Access tokens and user claims only allow access to server resources, while ID tokens carry additional information to authenticate a user. The Application Load Balancer authenticates the user and only passes access tokens and claims to the backend but does not pass the ID token information.

These tokens follow the JWT format but are not ID tokens. The JWT format includes a header, payload, and signature that are base64 URL encoded, and includes padding characters at the end. An Application Load Balancer uses ES256 (ECDSA using P-256 and SHA256) to generate the JWT signature.

The JWT header is a JSON object with the following fields:

```
{
   "alg": "algorithm",
   "kid": "12345678-1234-1234-1234-123456789012",
   "signer": "arn:aws:elasticloadbalancing:region-code:account-id:loadbalancer/app/load-
balancer-name/load-balancer-id",
   "iss": "url",
   "client": "client-id",
   "exp": "expiration"
}
```

The JWT payload is a JSON object that contains the user claims received from the IdP user info endpoint.

```
{
   "sub": "1234567890",
   "name": "name",
   "email": "alias@example.com",
   ...
}
```

Because the load balancer does not encrypt the user claims, we recommend that you configure the target group to use HTTPS. If you configure your target group to use HTTP, be sure to restrict the traffic to your load balancer using security groups. We also recommend that you verify the signature before doing any authorization based on the claims. To get the public key, get the key ID from the JWT header and use it to look up the public key from the endpoint. The endpoint for each AWS Region is as follows:

```
https://public-keys.auth.elb.region.amazonaws.com/key-id
```

For AWS GovCloud (US), the endpoints are as follows:

```
https://s3-us-gov-west-1.amazonaws.com/aws-elb-public-keys-prod-us-gov-west-1/key-id
https://s3-us-gov-east-1.amazonaws.com/aws-elb-public-keys-prod-us-gov-east-1/key-id
```

The following example shows how to get the key ID, public key, and payload in Python 3.x:

```
import jwt
import requests
import base64
import json

# Step 1: Get the key id from JWT headers (the kid field)
encoded_jwt = headers.dict['x-amzn-oidc-data']
jwt_headers = encoded_jwt.split('.')[0]
decoded_jwt_headers = base64.b64decode(jwt_headers)
decoded_jwt_headers = decoded_jwt_headers.decode("utf-8")
decoded_json = json.loads(decoded_jwt_headers)
kid = decoded_json['kid']

# Step 2: Get the public key from regional endpoint
url = 'https://public-keys.auth.elb.' + region + '.amazonaws.com/' + kid
req = requests.get(url)
pub_key = req.text

# Step 3: Get the payload
payload = jwt.decode(encoded_jwt, pub_key, algorithms=['ES256'])
```

The following example shows how to get the key ID, public key, and payload in Python 2.7:

```
import jwt
import requests
import base64
import json
```

```
# Step 1: Get the key id from JWT headers (the kid field)
encoded_jwt = headers.dict['x-amzn-oidc-data']
jwt_headers = encoded_jwt.split('.')[0]
decoded_jwt_headers = base64.b64decode(jwt_headers)
decoded_json = json.loads(decoded_jwt_headers)
kid = decoded_json['kid']

# Step 2: Get the public key from regional endpoint
url = 'https://public-keys.auth.elb.' + region + '.amazonaws.com/' + kid
req = requests.get(url)
pub_key = req.text

# Step 3: Get the payload
payload = jwt.decode(encoded_jwt, pub_key, algorithms=['ES256'])
```

Considerations

- These examples do not cover how to validate the signature of the issuer with the signature in the token.
- Standard libraries are not compatible with the padding that is included in the Application Load Balancer authentication token in JWT format.

Timeout

Session timeout

The refresh token and the session timeout work together as follows:

- If the session timeout is shorter than the access token expiration, the load balancer honors the session timeout. If the user has an active session with the IdP, the user might not be prompted to log in again. Otherwise, the user is redirected to log in.
  - If the IdP session timeout is longer than the Application Load Balancer session timeout, the user does not have to supply credentials to log in again. Instead, the IdP redirects back to the Application Load Balancer with a new authorization grant code. Authorization codes are single use, even if there is no re-login.
  - If the IdP session timeout is equal to or shorter than the Application Load Balancer session timeout, the user is asked to supply credentials to log in again. After the user logs in, IdP redirects back to the Application Load Balancer with a new authorization grant code, and the rest of the authentication flow continues until the request reaches the backend.
- If the session timeout is longer than the access token expiration and the IdP does not support refresh tokens, the load balancer keeps the authentication session until it times out. Then, it has the user log in again.
- If the session timeout is longer than the access token expiration and the IdP supports refresh tokens, the load balancer refreshes the user session each time the access token expires. The load balancer has the user log in again only after the authentication session times out or the refresh flow fails.

Client login timeout

A client must initiate and complete the authentication process within 15 minutes. If a client fails to complete authentication within the 15-minute limit, it receives an HTTP 401 error from the load balancer. This timeout can't be changed or removed.

For example, if a user loads the login page through the Application Load Balancer, they must complete the login process within 15 minutes. If the user waits and then attempts to log in after the 15-minute timeout has expired, the load balancer returns an HTTP 401 error. The user will have to refresh the page and attempt logging in again.

Authentication logout

When an application needs to log out an authenticated user, it should set the expiration time of the authentication session cookie to -1 and redirect the client to the IdP logout endpoint (if the IdP supports one). To prevent users from reusing a deleted cookie, we recommend that you configure as short an expiration time for the access token as is reasonable. If a client provides a load balancer with a session cookie that has an expired access token with a non-NULL refresh token, the load balancer contacts the IdP to determine whether the user is still logged in.

The client logout landing page is an unauthenticated page. This means that it cannot be behind an Application Load Balancer rule that requires authentication.

- When a request is sent to the target, the application must set the expiry to -1 for all authentication cookies. Application Load Balancers support cookies up to 16K in size and can therefore create up to 4 shards to send to the client.
  - If the IdP has a logout endpoint, it should issue a redirect to the IdP logout endpoint, for example, the LOGOUT Endpoint documented in the *Amazon Cognito Developer Guide*.
  - If the IdP does not have a logout endpoint, the request goes back to the client logout landing page, and the login process is restarted.
- Assuming that the IdP has a logout endpoint, the IdP must expire access tokens and refresh tokens, and redirect the user back to the client logout landing page.
- Subsequent requests follow the original authentication flow.

HTTP headers and Application Load Balancers

HTTP requests and HTTP responses use header fields to send information about the HTTP messages. HTTP headers are added automatically. Header fields are colon-separated name-value pairs that are separated by a carriage return (CR) and a line feed (LF). A standard set of HTTP header fields is defined in RFC 2616, Message Headers. There are also non-standard HTTP headers available that are automatically added and widely used by the applications. Some of the non-standard HTTP headers have an `X-Forwarded` prefix. Application Load Balancers support the following `X-Forwarded` headers.

For more information about HTTP connections, see Request routing in the *Elastic Load Balancing User Guide*.

X-Forwarded headers

X-Forwarded-For

The `X-Forwarded-For` request header helps you identify the IP address of a client when you use an HTTP or HTTPS load balancer. Because load balancers intercept traffic between clients and servers, your server access logs only contain the IP address of the load balancer. To see the IP address of the client, use the `routing.http.xff_header_processing.mode` attribute. This attribute enables you to modify, preserve, or remove the `X-Forwarded-For` header in the HTTP request before the Application Load Balancer sends the request to the target. The possible values for this attribute are `append`, `preserve`, and `remove`. The default value for this attribute is `append`.

Append

By default, the Application Load Balancer stores the IP address of the client in the X-Forwarded-For request header and passes the header to your server. If the X-Forwarded-For request header is not included in the original request, the load balancer creates one with the client IP address as the request value. Otherwise, the load balancer adds the client IP address to the existing header and then passes the header to your server. The X-Forwarded-For request header may contain multiple IP addresses that are comma separated. The left-most address is the client IP address where the request was first made. This is followed by any subsequent proxy identifiers in a chain.

The X-Forwarded-For request header takes the following form:

```
X-Forwarded-For: client-ip-address
```

The following is an example X-Forwarded-For request header for a client with an IP address of 203.0.113.7.

```
X-Forwarded-For: 203.0.113.7
```

The following is an example X-Forwarded-For request header for a client with an IPv6 address of 2001:DB8::21f:5bff:febf:ce22:8a2e.

```
X-Forwarded-For: 2001:DB8::21f:5bff:febf:ce22:8a2e
```

When the client port preservation attribute (routing.http.xff_client_port.enabled) is enabled on the load balancer, the X-Forwarded-For request header includes the client-port-number appended to the client-ip-address, separated by a colon. The header then takes the following form:

```
IPv4 -- X-Forwarded-For: client-ip-address:client-port-number
```

```
IPv6 -- X-Forwarded-For: [client-ip-address]:client-port-number
```

For IPv6, note that when the load balancer appends the client-ip-address to the existing header, it encloses the address in square brackets.

The following is an example X-Forwarded-For request header for a client with an IPv4 address of 12.34.56.78 and a port number of 8080.

```
X-Forwarded-For: 12.34.56.78:8080
```

The following is an example X-Forwarded-For request header for a client with an IPv6 address of 2001:db8:85a3:8d3:1319:8a2e:370:7348 and a port number of 8080.

```
X-Forwarded-For: [2001:db8:85a3:8d3:1319:8a2e:370:7348]:8080
```

Preserve

The preserve mode in the attribute ensures that the X-Forwarded-For header in the HTTP request is not modified in any way before it is sent to targets.

Remove

The remove mode in the attribute removes the X-Forwarded-For header in the HTTP request before it is sent to targets.

Note

If you enable the client port preservation attribute (`routing.http.xff_client_port.enabled`), and also select `preserve` or `remove` for the `routing.http.xff_header_processing.mode` attribute, the Application Load Balancer overrides the client port preservation attribute. It keeps the `X-Forwarded-For` header unchanged, or removes it depending on the mode you select, before it sends it to the targets.

The following table shows examples of the `X-Forwarded-For` header that the target receives when you select either the `append`, `preserve` or the `remove` mode. In this example, the IP address of the last hop is `127.0.0.1`.

Request description	Example request	XFF in append mode	XFF in `preserve` mode	XFF in `remove` mode
Request is sent with no XFF header	`GET / index.html HTTP/1.1 Host: example.com`	`X-Forwarded-For: 127.0.0.1`	Not present	Not present
Request is sent with an XFF header and a client IP address.	`GET / index.html HTTP/1.1 Host: example.com X-Forwarded-For: 127.0.0.4`	`X-Forwarded-For: 127.0.0.4, 127.0.0.1`	`X-Forwarded-For: 127.0.0.4`	Not present
Request is sent with an XFF header with multiple client IP addresses.	`GET / index.html HTTP/1.1 Host: example.com X-Forwarded-For: 127.0.0.4, 127.0.0.8`	`X-Forwarded-For: 127.0.0.4, 127.0.0.8, 127.0.0.1`	`X-Forwarded-For: 127.0.0.4, 127.0.0.8`	Not present

To modify, preserve, or remove the `X-Forwarded-For` header using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.
3. Select the load balancer.
4. On the **Description** tab, choose **Edit attributes**.
5. On the **Edit load balancer attributes** page, select **Append** (default), **Preserve**, or **Remove**.
6. Choose **Save**.

To modify, preserve, or remove the `X-Forwarded-For` header using the AWS CLI

Use the modify-load-balancer-attributes command with the `routing.http.xff_header_processing.mode` attribute.

X-Forwarded-Proto

The `X-Forwarded-Proto` request header helps you identify the protocol (HTTP or HTTPS) that a client used to connect to your load balancer. Your server access logs contain only the protocol used between the server and the load balancer; they contain no information about the protocol used between the client and the load balancer. To determine the protocol used between the client and the load balancer, use the `X-Forwarded-Proto` request header. Elastic Load Balancing stores the protocol used between the client and the load balancer in the `X-Forwarded-Proto` request header and passes the header along to your server.

Your application or website can use the protocol stored in the `X-Forwarded-Proto` request header to render a response that redirects to the appropriate URL.

The `X-Forwarded-Proto` request header takes the following form:

```
X-Forwarded-Proto: originatingProtocol
```

The following example contains an `X-Forwarded-Proto` request header for a request that originated from the client as an HTTPS request:

```
X-Forwarded-Proto: https
```

X-Forwarded-Port

The `X-Forwarded-Port` request header helps you identify the destination port that the client used to connect to the load balancer.

Delete a listener for your Application Load Balancer

You can delete a listener at any time. When you delete a load balancer, all its listeners are deleted.

To delete a listener using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Load Balancers**.
3. Select the load balancer and choose **Listeners**.
4. Select the check box for the HTTPS listener and choose **Delete**.
5. When prompted for confirmation, choose **Yes, Delete**.

To delete a listener using the AWS CLI

Use the delete-listener command.

Target groups for your Application Load Balancers

Each *target group* is used to route requests to one or more registered targets. When you create each listener rule, you specify a target group and conditions. When a rule condition is met, traffic is forwarded to the corresponding target group. You can create different target groups for different types of requests. For example, create one target group for general requests and other target groups for requests to the microservices for your application. For more information, see Application Load Balancer components (p. 1).

You define health check settings for your load balancer on a per target group basis. Each target group uses the default health check settings, unless you override them when you create the target group or modify them later on. After you specify a target group in a rule for a listener, the load balancer continually monitors the health of all targets registered with the target group that are in an Availability Zone enabled for the load balancer. The load balancer routes requests to the registered targets that are healthy.

Contents

Routing configuration

By default, a load balancer routes requests to its targets using the protocol and port number that you specified when you created the target group. Alternatively, you can override the port used for routing traffic to a target when you register it with the target group.

Target groups support the following protocols and ports:

- **Protocols**: HTTP, HTTPS
- **Ports**: 1-65535

If a target group is configured with the HTTPS protocol or uses HTTPS health checks, the TLS connections to the targets use the security settings from the `ELBSecurityPolicy-2016-08` policy. The load balancer establishes TLS connections with the targets using certificates that you install on the targets. The load balancer does not validate these certificates. Therefore, you can use self-signed certificates or certificates that have expired. Because the load balancer is in a virtual private cloud (VPC), traffic between the load balancer and the targets is authenticated at the packet level, so it is not at risk of man-in-the-middle attacks or spoofing even if the certificates on the targets are not valid.

Target type

When you create a target group, you specify its target type, which determines the type of target you specify when registering targets with this target group. After you create a target group, you cannot change its target type.

The following are the possible target types:

`instance`

    The targets are specified by instance ID.

`ip`

    The targets are IP addresses.

`lambda`

    The target is a Lambda function.

When the target type is `ip`, you can specify IP addresses from one of the following CIDR blocks:

- The subnets of the VPC for the target group
- 10.0.0.0/8 (RFC 1918)
- 100.64.0.0/10 (RFC 6598)
- 172.16.0.0/12 (RFC 1918)
- 192.168.0.0/16 (RFC 1918)

These supported CIDR blocks enable you to register the following with a target group: ClassicLink instances, instances in a VPC that is peered to the load balancer VPC (same Region or different Region), AWS resources that are addressable by IP address and port (for example, databases), and on-premises resources linked to AWS through AWS Direct Connect or a Site-to-Site VPN connection.

Important
You can't specify publicly routable IP addresses.

If you specify targets using an instance ID, traffic is routed to instances using the primary private IP address specified in the primary network interface for the instance. If you specify targets using IP addresses, you can route traffic to an instance using any private IP address from one or more network interfaces. This enables multiple applications on an instance to use the same port. Each network interface can have its own security group.

If the target type of your target group is `lambda`, you can register a single Lambda function. When the load balancer receives a request for the Lambda function, it invokes the Lambda function. For more information, see Lambda functions as targets (p. 93).

IP address type

When creating a new target group, you can select the IP address type of your target group. This controls the IP version used to communicate with targets and check their health status.

Application Load Balancers support both IPv4 and IPv6 target groups. The default selection is IPv4.

Considerations

- All IP addresses within a target group must have the same IP address type. For example, you can't register an IPv4 target with an IPv6 target group.
- IPv6 target groups can only be used with `dualstack` load balancers.
- IPv6 target groups only support IP type targets.

Protocol version

By default, Application Load Balancers send requests to targets using HTTP/1.1. You can use the protocol version to send requests to targets using HTTP/2 or gRPC.

The following table summarizes the result for the combinations of request protocol and target group protocol version.

Request protocol	Protocol version	Result
HTTP/1.1	HTTP/1.1	Success
HTTP/2	HTTP/1.1	Success
gRPC	HTTP/1.1	Error
HTTP/1.1	HTTP/2	Error
HTTP/2	HTTP/2	Success
gRPC	HTTP/2	Success if targets support gRPC
HTTP/1.1	gRPC	Error
HTTP/2	gRPC	Success if a POST request
gRPC	gRPC	Success

Considerations for the gRPC protocol version

- The only supported listener protocol is HTTPS.
- The only supported action type for listener rules is `forward`.
- The only supported target types are `instance` and `ip`.

- The load balancer parses gRPC requests and routes the gRPC calls to the appropriate target groups based on the package, service, and method.
- The load balancer supports unary, client-side streaming, server-side streaming, and bi-directional streaming.
- You must provide a custom health check method with the format `/package.service/method`.
- You must specify the gRPC status codes to use when checking for a successful response from a target.
- You cannot use Lambda functions as targets.

Considerations for the HTTP/2 protocol version

- The only supported listener protocol is HTTPS.
- The only supported action type for listener rules is `forward`.
- The only supported target types are `instance` and `ip`.
- The load balancer supports streaming from clients. The load balancer does not support streaming to the targets.

Registered targets

Your load balancer serves as a single point of contact for clients and distributes incoming traffic across its healthy registered targets. You can register each target with one or more target groups.

If demand on your application increases, you can register additional targets with one or more target groups in order to handle the demand. The load balancer starts routing requests to a newly registered target as soon as the registration process completes and the target passes the initial health checks.

If demand on your application decreases, or you need to service your targets, you can deregister targets from your target groups. Deregistering a target removes it from your target group, but does not affect the target otherwise. The load balancer stops routing requests to a target as soon as it is deregistered. The target enters the `draining` state until in-flight requests have completed. You can register the target with the target group again when you are ready for it to resume receiving requests.

If you are registering targets by instance ID, you can use your load balancer with an Auto Scaling group. After you attach a target group to an Auto Scaling group, Auto Scaling registers your targets with the target group for you when it launches them. For more information, see Attaching a load balancer to your Auto Scaling group in the *Amazon EC2 Auto Scaling User Guide*.

Limits

- You cannot register the IP addresses of another Application Load Balancer in the same VPC. If the other Application Load Balancer is in a VPC that is peered to the load balancer VPC, you can register its IP addresses.

Target group attributes

The following target group attributes are supported if the target group type is `instance` or `ip`:

`deregistration_delay.timeout_seconds`

The amount of time for Elastic Load Balancing to wait before deregistering a target. The range is 0–3600 seconds. The default value is 300 seconds.

`load_balancing.algorithm.type`

The load balancing algorithm determines how the load balancer selects targets when routing requests. The value is `round_robin` or `least_outstanding_requests`. The default is `round_robin`.

`load_balancing.cross_zone.enabled`

Indicates whether cross zone load balancing is enabled. The value is `true`, `false` or `use_load_balancer_configuration`. The default is `use_load_balancer_configuration`.

`slow_start.duration_seconds`

The time period, in seconds, during which the load balancer sends a newly registered target a linearly increasing share of the traffic to the target group. The range is 30–900 seconds (15 minutes). The default is 0 seconds (disabled).

`stickiness.enabled`

Indicates whether sticky sessions are enabled. The value is `true` or `false`. The default is `false`.

`stickiness.app_cookie.cookie_name`

The name of the application cookie. The application cookie name cannot have the following prefixes: `AWSALB`, `AWSALBAPP`, or `AWSALBTG`; they're reserved for use by the load balancer.

`stickiness.app_cookie.duration_seconds`

The application-based cookie expiration period, in seconds. After this period, the cookie is considered stale. The minimum value is 1 second and the maximum value is 7 days (604800 seconds). The default value is 1 day (86400 seconds).

`stickiness.lb_cookie.duration_seconds`

The duration-based cookie expiration period, in seconds. After this period, the cookie is considered stale. The minimum value is 1 second and the maximum value is 7 days (604800 seconds). The default value is 1 day (86400 seconds).

`stickiness.type`

The type of stickiness. The possible values are `lb_cookie` and `app_cookie`.

`target_group_health.dns_failover.minimum_healthy_targets.count`

The minimum number of targets that must be healthy. If the number of healthy targets is below this value, mark the zone as unhealthy in DNS, so that traffic is routed only to healthy zones. The possible values are `off` or an integer from 1 to the maximum number of targets. The default is `off`.

`target_group_health.dns_failover.minimum_healthy_targets.percentage`

The minimum percentage of targets that must be healthy. If the percentage of healthy targets is below this value, mark the zone as unhealthy in DNS, so that traffic is routed only to healthy zones. The possible values are `off` or an integer from 1 to 100. The default is `off`.

`target_group_health.unhealthy_state_routing.minimum_healthy_targets.count`

The minimum number of targets that must be healthy. If the number of healthy targets is below this value, send traffic to all targets, including unhealthy targets. The range is 1 to the maximum number of targets. The default is 1.

`target_group_health.unhealthy_state_routing.minimum_healthy_targets.percentage`

The minimum percentage of targets that must be healthy. If the percentage of healthy targets is below this value, send traffic to all targets, including unhealthy targets. The possible values are `off` or an integer from 1 to 100. The default is `off`.

The following target group attribute is supported if the target group type is `lambda`:

`lambda.multi_value_headers.enabled`

Indicates whether the request and response headers exchanged between the load balancer and the Lambda function include arrays of values or strings. The possible values are `true` or `false`. The default value is `false`. For more information, see Multi-value headers (p. 97).

Routing algorithm

By default, the round robin routing algorithm is used to route requests at the target group level. You can specify the least outstanding requests routing algorithm instead.

Consider using least outstanding requests when the requests for your application vary in complexity or your targets vary in processing capability. Round robin is a good choice when the requests and targets are similar, or if you need to distribute requests equally among targets. You can compare the effect of round robin versus least outstanding requests using the following CloudWatch metrics: **RequestCount**, **TargetConnectionErrorCount**, and **TargetResponseTime**.

Considerations

- You cannot enable both least outstanding requests and slow start mode.
- If you enable sticky sessions, the routing algorithm of the target group is overridden after the initial target selection.
- With HTTP/2, the load balancer converts the request to multiple HTTP/1.1 requests, so least outstanding request treats each HTTP/2 request as multiple requests.
- When you use least outstanding requests with WebSockets, the target is selected using least outstanding requests. The load balancer creates a connection to this target and sends all messages over this connection.

New console

To modify the routing algorithm using the new console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Choose the name of the target group to open its details page.
4. On the **Group details** tab, in the **Attributes** section, choose **Edit**.
5. On the **Edit attributes** page, for **Load balancing algorithm**, choose **Round robin** or **Least outstanding requests**.
6. Choose **Save changes**.

Old console

To modify the routing algorithm using the old console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Select the target group.
4. On the **Description** tab, choose **Edit attributes**.

5. On the **Edit attributes** page, for **Load balancing algorithm**, choose **Round robin** or **Least outstanding requests**, and then choose **Save**.

To modify the routing algorithm using the AWS CLI

Use the modify-target-group-attributes command with the `load_balancing.algorithm.type` attribute.

Deregistration delay

Elastic Load Balancing stops sending requests to targets that are deregistering. By default, Elastic Load Balancing waits 300 seconds before completing the deregistration process, which can help in-flight requests to the target to complete. To change the amount of time that Elastic Load Balancing waits, update the deregistration delay value.

The initial state of a deregistering target is `draining`. After the deregistration delay elapses, the deregistration process completes and the state of the target is `unused`. If the target is part of an Auto Scaling group, it can be terminated and replaced.

If a deregistering target has no in-flight requests and no active connections, Elastic Load Balancing immediately completes the deregistration process, without waiting for the deregistration delay to elapse. However, even though target deregistration is complete, the status of the target is displayed as `draining` until the deregistration delay timeout expires. After the timeout expires, the target transitions to an `unused` state.

If a deregistering target terminates the connection before the deregistration delay elapses, the client receives a 500-level error response.

New console

To update the deregistration delay value using the new console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Choose the name of the target group to open its details page.
4. On the **Group details** tab, in the **Attributes** section, choose **Edit**.
5. On the **Edit attributes** page, change the value of **Deregistration delay** as needed.
6. Choose **Save changes**.

Old console

To update the deregistration delay value using the old console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Select the target group.
4. On the **Description** tab, choose **Edit attributes**.
5. On the **Edit attributes** page, change the value of **Deregistration delay** as needed, and then choose **Save**.

To update the deregistration delay value using the AWS CLI

Use the modify-target-group-attributes command with the `deregistration_delay.timeout_seconds` attribute.

Slow start mode

By default, a target starts to receive its full share of requests as soon as it is registered with a target group and passes an initial health check. Using slow start mode gives targets time to warm up before the load balancer sends them a full share of requests.

After you enable slow start for a target group, its targets enter slow start mode when they are considered healthy by the target group. A target in slow start mode exits slow start mode when the configured slow start duration period elapses or the target becomes unhealthy. The load balancer linearly increases the number of requests that it can send to a target in slow start mode. After a healthy target exits slow start mode, the load balancer can send it a full share of requests.

Considerations

- When you enable slow start for a target group, the healthy targets registered with the target group do not enter slow start mode.
- When you enable slow start for an empty target group and then register targets using a single registration operation, these targets do not enter slow start mode. Newly registered targets enter slow start mode only when there is at least one healthy target that is not in slow start mode.
- If you deregister a target in slow start mode, the target exits slow start mode. If you register the same target again, it enters slow start mode when it is considered healthy by the target group.
- If a target in slow start mode becomes unhealthy, the target exits slow start mode. When the target becomes healthy, it enters slow start mode again.
- You cannot enable both slow start mode and least outstanding requests.

New console

To update the slow start duration value using the new console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Choose the name of the target group to open its details page.
4. On the **Group details** tab, in the **Attributes** section, choose **Edit**.
5. On the **Edit attributes** page, change the value of **Slow start duration** as needed. To disable slow start mode, set the duration to 0.
6. Choose **Save changes**.

Old console

To update the slow start duration value using the old console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Select the target group.
4. On the **Description** tab, choose **Edit attributes**.
5. On the **Edit attributes** page, change the value of **Slow start duration** as needed, and then choose **Save**. To disable slow start mode, set the duration to 0.

To update the slow start duration value using the AWS CLI

Use the modify-target-group-attributes command with the `slow_start.duration_seconds` attribute.

Create a target group

You register your targets with a target group. By default, the load balancer sends requests to registered targets using the port and protocol that you specified for the target group. You can override this port when you register each target with the target group.

After you create a target group, you can add tags.

To route traffic to the targets in a target group, specify the target group in an action when you create a listener or create a rule for your listener. For more information, see Listener rules (p. 31). You can specify the same target group in multiple listeners, but these listeners must belong to the same Application Load Balancer. To use a target group with a load balancer, you must verify that the target group is not in use by a listener for any other load balancer.

You can add or remove targets from your target group at any time. For more information, see Register targets with your target group (p. 86). You can also modify the health check settings for your target group. For more information, see Modify the health check settings of a target group (p. 81).

New console

To create a target group using the new console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Choose **Create target group**.
4. For **Choose a target type**, select **Instances** to register targets by instance ID, **IP addresses** to register targets by IP address, or **Lambda function** to register a Lambda function as a target.
5. For **Target group name**, type a name for the target group. This name must be unique per region per account, can have a maximum of 32 characters, must contain only alphanumeric characters or hyphens, and must not begin or end with a hyphen.
6. (Optional) For **Protocol** and **Port**, modify the default values as needed.
7. If the target type is **IP addresses**, choose **IPv4** or **IPv6** as the **IP address type**, otherwise skip to the next step.

   Note that only targets that have the selected IP address type can be included in this target group. The IP address type cannot be changed after the target group is created.
8. For **VPC**, select a virtual private cloud (VPC). Note that for **IP addresses** target types, the VPCs available for selection are those that support the **IP address type** that you chose in the previous step.
9. (Optional) For **Protocol version**, modify the default value as needed.
10. (Optional) In the **Health checks** section, modify the default settings as needed.
11. If the target type is **Lambda function**, you can enable health checks by selecting **Enable** in the **Health checks** section.
12. (Optional) Add one or more tags as follows:

    a. Expand the **Tags** section.

   b. Choose **Add tag**.
   c. Enter the tag key and the tag value.
13. Choose **Next**.
14. (Optional) Add one or more targets as follows:
   - If the target type is **Instances**, select one or more instances, enter one or more ports, and then choose **Include as pending below**.
   - If the target type is **IP addresses**, do the following:
     a. Select a network **VPC** from the list, or choose **Other private IP addresses**.
     b. Enter the IP address manually, or find the IP address using instance details. You can enter up to five IP addresses at a time.
     c. Enter the ports for routing traffic to the specified IP addresses.
     d. Choose **Include as pending below**.
   - If the target type is a **Lambda function**, specify a single Lambda function or omit this step and specify a Lambda function later.
15. Choose **Create target group**.
16. (Optional) You can specify the target group in a listener rule. For more information, see Listener Rules (p. 49).

Old console

To create a target group using the old console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Choose **Create target group**.
4. For **Target group name**, type a name for the target group. This name must be unique per region per account, can have a maximum of 32 characters, must contain only alphanumeric characters or hyphens, and must not begin or end with a hyphen.
5. For **Target type**, select **Instance** to register targets by instance ID, **IP** to register IP addresses, and **Lambda function** to register a Lambda function.
6. If the target type is **Instance** or **IP**, do the following:
   a. (Optional) For **Protocol** and **Port**, modify the default values as needed.
   b. (Optional) For **Protocol version**, modify the default value as needed.
   c. For **VPC**, select a virtual private cloud (VPC).
7. If the target type is **Lambda function**, do the following:
   a. For **Lambda function**, do one of the following:
      - Select the Lambda function
      - Create a new Lambda function and select it
      - Register the Lambda function after you create the target group
   b. (Optional) To enable health checks, choose **Health check**, **Enable**.
8. (Optional) For **Health check settings** and **Advanced health check settings**, modify the default settings as needed.
9. Choose **Create**.
10. (Optional) Add one or more tags as follows:
   a. Select the newly created target group.

   b. On the **Tags** tab, choose **Add/Edit Tags**.
   c. On the **Add/Edit Tags** page, for each tag you add, choose **Create Tag** and then specify the tag key and tag value. When you have finished adding tags, choose **Save**.
11. (Optional) To add targets to the target group, see Register targets with your target group (p. 86).
12. (Optional) You can specify the target group in a listener rule. For more information, see Listener Rules (p. 49).

To create a target group using the AWS CLI

Use the create-target-group command to create the target group, the add-tags command to tag your target group, and the register-targets command to add targets.

Health checks for your target groups

Your Application Load Balancer periodically sends requests to its registered targets to test their status. These tests are called *health checks*.

Each load balancer node routes requests only to the healthy targets in the enabled Availability Zones for the load balancer. Each load balancer node checks the health of each target, using the health check settings for the target groups with which the target is registered. After your target is registered, it must pass one health check to be considered healthy. After each health check is completed, the load balancer node closes the connection that was established for the health check.

If a target group contains only unhealthy registered targets, the load balancer routes requests to all those targets, regardless of their health status. This means that if all targets fail health checks at the same time in all enabled Availability Zones, the load balancer fails open. The effect of the fail-open is to allow traffic to all targets in all enabled Availability Zones, regardless of their health status, based on the load balancing algorithm.

Health checks do not support WebSockets.

Health check settings

You configure health checks for the targets in a target group as described in the following table. The setting names used in the table are the names used in the API. The load balancer sends a health check request to each registered target every **HealthCheckIntervalSeconds** seconds, using the specified port, protocol, and ping path. Each health check request is independent and the result lasts for the entire interval. The time that it takes for the target to respond does not affect the interval for the next health check request. If the health checks exceed **UnhealthyThresholdCount** consecutive failures, the load balancer takes the target out of service. When the health checks exceed **HealthyThresholdCount** consecutive successes, the load balancer puts the target back in service.

Setting	Description
HealthCheckProtocol	The protocol the load balancer uses when performing health checks on targets. The possible protocols are HTTP and HTTPS. The default is the HTTP protocol.
HealthCheckPort	The port the load balancer uses when performing health checks on targets. The default is to use the

Setting	Description
	port on which each target receives traffic from the load balancer.
HealthCheckPath	The destination for health checks on the targets. If the protocol version is HTTP/1.1 or HTTP/2, specify a valid URI (/*path*?*query*). The default is /. If the protocol version is gRPC, specify the path of a custom health check method with the format `/package.service/method`. The default is `/AWS.ALB/healthcheck`.
HealthCheckTimeoutSeconds	The amount of time, in seconds, during which no response from a target means a failed health check. The range is 2–120 seconds. The default is 5 seconds if the target type is `instance` or `ip` and 30 seconds if the target type is `lambda`.
HealthCheckIntervalSeconds	The approximate amount of time, in seconds, between health checks of an individual target. The range is 5–300 seconds. The default is 30 seconds if the target type is `instance` or `ip` and 35 seconds if the target type is `lambda`.
HealthyThresholdCount	The number of consecutive successful health checks required before considering an unhealthy target healthy. The range is 2–10. The default is 5.
UnhealthyThresholdCount	The number of consecutive failed health checks required before considering a target unhealthy. The range is 2–10. The default is 2.
Matcher	The codes to use when checking for a successful response from a target. These are called **Success codes** in the console. If the protocol version is HTTP/1.1 or HTTP/2, the possible values are from 200 to 499. You can specify multiple values (for example, "200,202") or a range of values (for example, "200-299"). The default value is 200. If the protocol version is gRPC, the possible values are from 0 to 99. You can specify multiple values (for example, "0,1") or a range of values (for example, "0-5"). The default value is 12.

Target health status

Before the load balancer sends a health check request to a target, you must register it with a target group, specify its target group in a listener rule, and ensure that the Availability Zone of the target is enabled for the load balancer. Before a target can receive requests from the load balancer, it must pass the initial health checks. After a target passes the initial health checks, its status is `Healthy`.

The following table describes the possible values for the health status of a registered target.

Value	Description
`initial`	The load balancer is in the process of registering the target or performing the initial health checks on the target. Related reason codes: `Elb.RegistrationInProgress` | `Elb.InitialHealthChecking`
`healthy`	The target is healthy. Related reason codes: None
`unhealthy`	The target did not respond to a health check or failed the health check. Related reason codes: `Target.ResponseCodeMismatch` | `Target.Timeout` | `Target.FailedHealthChecks` | `Elb.InternalError`
`unused`	The target is not registered with a target group, the target group is not used in a listener rule, the target is in an Availability Zone that is not enabled, or the target is in the stopped or terminated state. Related reason codes: `Target.NotRegistered` | `Target.NotInUse` | `Target.InvalidState` | `Target.IpUnusable`
`draining`	The target is deregistering and connection draining is in process. Related reason code: `Target.DeregistrationInProgress`
`unavailable`	Health checks are disabled for the target group. Related reason code: `Target.HealthCheckDisabled`

Health check reason codes

If the status of a target is any value other than `Healthy`, the API returns a reason code and a description of the issue, and the console displays the same description in a tooltip. Reason codes that begin with `Elb` originate on the load balancer side and reason codes that begin with `Target` originate on the target side.

Reason code	Description
`Elb.InitialHealthChecking`	Initial health checks in progress
`Elb.InternalError`	Health checks failed due to an internal error
`Elb.RegistrationInProgress`	Target registration is in progress
`Target.DeregistrationInProgress`	Target deregistration is in progress
`Target.FailedHealthChecks`	Health checks failed

Reason code	Description
`Target.HealthCheckDisabled`	Health checks are disabled
`Target.InvalidState`	Target is in the stopped state Target is in the terminated state Target is in the terminated or stopped state Target is in an invalid state
`Target.IpUnusable`	The IP address cannot be used as a target, as it is in use by a load balancer
`Target.NotInUse`	Target group is not configured to receive traffic from the load balancer Target is in an Availability Zone that is not enabled for the load balancer
`Target.NotRegistered`	Target is not registered to the target group
`Target.ResponseCodeMismatch`	Health checks failed with these codes: [*code*]
`Target.Timeout`	Request timed out

Check the health of your targets

You can check the health status of the targets registered with your target groups.

New console

To check the health of your targets using the new console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Choose the name of the target group to open its details page.
4. On the **Targets** tab, the **Status** column indicates the status of each target.
5. If the status is any value other than `Healthy`, the **Status details** column contains more information.

Old console

To check the health of your targets using the old console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Select the target group.
4. On the **Targets** tab, the **Status** column indicates the status of each target.
5. If the status is any value other than `Healthy`, view the tooltip for more information.

To check the health of your targets using the AWS CLI

Use the describe-target-health command. The output of this command contains the target health state. If the status is any value other than `Healthy`, the output also includes a reason code.

To receive email notifications about unhealthy targets

Use CloudWatch alarms to trigger a Lambda function to send details about unhealthy targets. For step-by-step instructions, see the following blog post: Identifying unhealthy targets of your load balancer.

Modify the health check settings of a target group

You can modify the health check settings for your target group at any time.

New console

To modify the health check settings of a target group using the new console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Choose the name of the target group to open its details page.
4. On the **Group details** tab, in the **Health check settings** section, choose **Edit**.
5. On the **Edit health check settings** page, modify the settings as needed, and then choose **Save changes**.

Old console

To modify the health check settings of a target group using the old console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Select the target group.
4. On the **Health checks** tab, choose **Edit**.
5. On the **Edit target group** page, modify the settings as needed, and then choose **Save**.

To modify the health check settings of a target group using the AWS CLI

Use the modify-target-group command.

Cross-zone load balancing for target groups

The nodes for your load balancer distribute requests from clients to registered targets. When cross-zone load balancing is on, each load balancer node distributes traffic across the registered targets in all registered Availability Zones. When cross-zone load balancing is off, each load balancer node distributes traffic only across the registered targets in its Availability Zone. This could be if zonal failure domains are preferred over regional, ensuring that a healthy zone isn't impacted by an unhealthy zone, or for overall latency improvements.

With Application Load Balancers, cross-zone load balancing is always turned on at the load balancer level, and cannot be turned off. For target groups, the default is to use the load balancer setting, but you can override the default by explicitly turning cross-zone load balancing off at the target group level.

Considerations

- Target stickiness is not supported when cross-zone load balancing is off.

- Lambda functions as targets are not supported when cross-zone load balancing is off.
- Attempting to turn off cross-zone load balancing through the `ModifyTargetGroupAttributes` API if any targets have parameter `AvailabilityZone` set to `all` results in an error.
- When registering targets, the `AvailabilityZone` parameter is required. Specific Availability Zone values are only allowed when cross-zone load balancing is off. Otherwise, the parameter is ignored and treated as `all`.

Best practices

- Plan for enough target capacity across all Availability Zones that you expect to utilize, per target group. If you can't plan for enough capacity across all participating Availability Zones, we recommend that you keep cross-zone load balancing on.
- When configuring your Application Load Balancer with multiple target groups, ensure all target groups are participating in the same Availability Zones, within the configured Region. This is to avoid an Availability Zone being empty while cross-zone load balancing is off, as this triggers a 503 error for all HTTP requests that enter the empty Availability Zone.
- Avoid creating empty subnets. Application Load Balancers expose zonal IP addresses through DNS for the empty subnets, which triggers 503 errors for HTTP requests.
- There can be occurrences where a target group with cross-zone load balancing turned off has enough planned target capacity per Availability Zone, but all targets in an Availability Zone become unhealthy. When there is at least one target group with all unhealthy targets, the IP addresses of the load balancer nodes are removed from DNS. After the target group has at least one healthy target, the IP addresses are restored to DNS.

Turn off cross-zone load balancing

You can turn off cross-zone load balancing for your Application Load Balancer target groups at any time.

To turn off cross-zone load balancing using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **Load Balancing**, select **Target Groups**.
3. Select the name of the target group to open its details page.
4. On the **Attributes** tab, select **Edit**.
5. On the **Edit target group attributes** page, select **Off** for **Cross-zone load balancing**.
6. Choose **Save changes**.

To turn off cross-zone load balancing using the AWS CLI

Use the modify-target-group-attributes command and set the `load_balancing.cross_zone.enabled` attribute to `false`.

```
aws elbv2 modify-target-group-attributes --target-group-arn my-targetgroup-arn --attributes
 Key=load_balancing.cross_zone.enabled,Value=false
```

The following is an example response:

```
{
    "Attributes": [
        {
            "Key": "load_balancing.cross_zone.enabled",
            "Value": "false"
        },
    ]
}
```

Turn on cross-zone load balancing

You can turn on cross-zone load balancing for your Application Load Balancer target groups at any time. The cross-zone load balancing setting at the target group level overrides the setting at the load balancer level.

To turn on cross-zone load balancing using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **Load Balancing**, select **Target Groups**.
3. Select the name of the target group to open its details page.
4. On the **Attributes** tab, select **Edit**.
5. On the **Edit target group attributes** page, select **On** for **Cross-zone load balancing**.
6. Choose **Save changes**.

To turn on cross-zone load balancing using the AWS CLI

Use the modify-target-group-attributes command and set the `load_balancing.cross_zone.enabled` attribute to `true`.

```
aws elbv2 modify-target-group-attributes --target-group-arn my-targetgroup-arn --attributes
 Key=load_balancing.cross_zone.enabled,Value=true
```

The following is an example response:

```
{
    "Attributes": [
        {
            "Key": "load_balancing.cross_zone.enabled",
            "Value": "true"
        },
    ]
}
```

Target group health

By default, a target group is considered healthy as long as it has at least one healthy target. If you have a large fleet, having only one healthy target serving traffic is not sufficient. Instead, you can specify a minimum count or percentage of targets that must be healthy, and what actions the load balancer takes when the healthy targets fall below the specified threshold. This improves availability.

Unhealthy state actions

You can configure healthy thresholds for the following actions:

- DNS failover – When the healthy targets in a zone fall below the threshold, we mark the IP addresses of the load balancer node for the zone as unhealthy in DNS. Therefore, when clients resolve the load balancer DNS name, the traffic is routed only to healthy zones.
- Routing failover – When the healthy targets in a zone fall below the threshold, the load balancer sends traffic to all targets that are available to the load balancer node, including unhealthy targets. This increases the chances that a client connection succeeds, especially when targets temporarily fail to pass health checks, and reduces the risk of overloading the healthy targets.

Requirements and considerations

- You can't use this feature with target groups where the target is a Lambda function. If the Application Load Balancer is the target of a Network Load Balancer or Global Accelerator, do not configure a threshold for DNS failover.
- If you specify both types of thresholds for an action (count and percentage), the load balancer takes the action when either threshold is breached.
- If you specify thresholds for both actions, the threshold for DNS failover must be greater than or equal to the threshold for routing failover, so that DNS failover occurs either with or before routing failover.
- If you specify the threshold as a percentage, we calculate the value dynamically, based on the total number of targets that are registered with the target groups.
- The total number of targets is based on whether cross-zone load balancing is off or on. If cross-zone load balancing is off, each node sends traffic only to the targets in its own zone, which means that the thresholds apply to the number of targets in each enabled zone separately. If cross-zone load balancing is on, each node sends traffic to all targets in all enabled zones, which means that the specified thresholds apply to the total number targets in all enabled zones.
- With DNS failover, we remove the IP addresses for the unhealthy zones from the DNS hostname for the load balancer. However, the local client DNS cache might contain these IP addresses until the time-to-live (TTL) in the DNS record expires (60 seconds).
- When DNS failover occurs, this impacts all target groups associated with the load balancer. Ensure that you have enough capacity in your remaining zones to handle this additional traffic, especially if cross-zone load balancing is off.
- With DNS failover, if all load balancer zones are considered unhealthy, the load balancer sends traffic to all zones, including the unhealthy zones.
- There are factors other than whether there are enough healthy targets that might lead to DNS failover, such as the health of the zone.

Monitoring

To monitor the health of your target groups, see CloudWatch metrics for target group health (p. 112).

Example

The following example demonstrates how target group health settings are applied.

Scenario

- A load balancer that supports two Availability Zones, A and B
- Each Availability Zone contains 10 registered targets
- The target group has the following target group health settings:
  - DNS failover - 50%
  - Routing failover - 50%
- Six targets fail in Availability Zone B

If cross-zone load balancing is off

- The load balancer node in each Availability Zone can send traffic only to the 10 targets in its Availability Zone.
- There are 10 healthy targets in Availability Zone A, which meets the required percentage of healthy targets. The load balancer continues to distribute traffic between the 10 healthy targets.
- There are only 4 healthy targets in Availability Zone B, which is 40% of the targets for the load balancer node in Availability Zone B. Because this is less than the required percentage of healthy targets, the load balancer takes the following actions:
  - DNS failover - Availability Zone B is marked as unhealthy in DNS. Because clients can't resolve the load balancer name to the load balancer node in Availability Zone B, and Availability Zone A is healthy, clients send new connections to Availability Zone A.
  - Routing failover - When new connections are sent explicitly to Availability Zone B, the load balancer distributes traffic to all targets in Availability Zone B, including the unhealthy targets. This prevents outages among the remaining healthy targets.

If cross-zone load balancing is on

- Each load balancer node can send traffic to all 20 registered targets across both Availability Zones.
- There are 10 healthy targets in Availability Zone A and 4 healthy targets in Availability Zone B, for a total of 14 healthy targets. This is 70% of the targets for the load balancer nodes in both Availability Zones, which meets the required percentage of healthy targets.
- The load balancer distributes traffic between the 14 healthy targets in both Availability Zones.

Modify target group health settings

You can modify the target group health settings for your target group as follows.

To modify target group health settings using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. In the navigation pane, under **Load Balancing**, choose **Target Groups**.
3. Choose the name of the target group to open its details page.
4. On the **Attributes** tab, choose **Edit**.
5. Check whether cross-zone load balancing is turned on or turned off. Update this setting as needed to ensure that you have enough capacity to handle the additional traffic if a zone fails.
6. Expand **Target group health requirements**.
7. For **Configuration type**, we recommend that you choose **Unified configuration**, which sets the same threshold for both actions.
8. For **Healthy state requirements**, do one of the following:
   - Choose **Minimum healthy target count**, and then enter a number from 1 to the maximum number of targets for your target group.
   - Choose **Minimum healthy target percentage**, and then enter a number from 1 to 100.
9. Choose **Save changes**.

To modify target group health settings using the AWS CLI

Use the modify-target-group-attributes command. The following example sets the healthy threshold for both unhealthy state actions to 50%.

```
aws elbv2 modify-target-group-attributes \
--target-group-arn arn:aws:elasticloadbalancing:region:123456789012:targetgroup/my-
targets/73e2d6bc24d8a067 \
--attributes
 Key=target_group_health.dns_failover.minimum_healthy_targets.percentage,Value=50 \

 Key=target_group_health.unhealthy_state_routing.minimum_healthy_targets.percentage,Value=50
```

Register targets with your target group

You register your targets with a target group. When you create a target group, you specify its target type, which determines how you register its targets. For example, you can register instance IDs, IP addresses, or Lambda functions. For more information, see Target groups for your Application Load Balancers (p. 67).

If demand on your currently registered targets increases, you can register additional targets in order to handle the demand. When your target is ready to handle requests, register it with your target group. The load balancer starts routing requests to the target as soon as the registration process completes and the target passes the initial health checks.

If demand on your registered targets decreases, or you need to service a target, you can deregister it from your target group. The load balancer stops routing requests to a target as soon as you deregister it. When the target is ready to receive requests, you can register it with the target group again.

When you deregister a target, the load balancer waits until in-flight requests have completed. This is known as *connection draining*. The status of a target is `draining` while connection draining is in progress.

When you deregister a target that was registered by IP address, you must wait for the deregistration delay to complete before you can register the same IP address again.

If you are registering targets by instance ID, you can use your load balancer with an Auto Scaling group. After you attach a target group to an Auto Scaling group and the group scales out, the instances launched by the Auto Scaling group are automatically registered with the target group. If you detach the target group from the Auto Scaling group, the instances are automatically deregistered from the target group. For more information, see Attaching a load balancer to your Auto Scaling group in the *Amazon EC2 Auto Scaling User Guide*.

Target security groups

When you register EC2 instances as targets, you must ensure that the security groups for your instances allow the load balancer to communicate with your instances on both the listener port and the health check port.

Recommended rules

Inbound		
Source	**Port Range**	**Comment**
load balancer security group	*instance listener*	Allow traffic from the load balancer on the instance listener port
load balancer security group	*health check*	Allow traffic from the load balancer on the health check port

We also recommend that you allow inbound ICMP traffic to support Path MTU Discovery. For more information, see Path MTU Discovery in the *Amazon EC2 User Guide for Linux Instances*.

Register or deregister targets

The target type of your target group determines how you register targets with that target group. For more information, see Target type (p. 68).

Contents

Register or deregister targets by instance ID

The instance must be in the virtual private cloud (VPC) that you specified for the target group. The instance must also be in the `running` state when you register it.

New console

To register or deregister targets by instance ID using the new console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Choose the name of the target group to open its details page.
4. Choose the **Targets** tab.
5. To register instances, choose **Register targets**. Select one or more instances, enter the default instance port as needed, and then choose **Include as pending below**. When you are finished adding instances, choose **Register pending targets**.
6. To deregister instances, select the instances and then choose **Deregister**.

Old console

To register or deregister targets by instance ID using the old console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Select your target group.
4. On the **Targets** tab, choose **Edit**.
5. To register instances, select them from **Instances**, modify the default instance port as needed, and choose **Add to registered**.
6. To deregister instances, select them from **Registered instances** and choose **Remove**.
7. Choose **Save**.

Register or deregister targets by IP address

IPv4 targets

The IP addresses that you register must be from one of the following CIDR blocks:

- The subnets of the VPC for the target group
- 10.0.0.0/8 (RFC 1918)
- 100.64.0.0/10 (RFC 6598)
- 172.16.0.0/12 (RFC 1918)
- 192.168.0.0/16 (RFC 1918)

You cannot register the IP addresses of another Application Load Balancer in the same VPC. If the other Application Load Balancer is in a VPC that is peered to the load balancer VPC, you can register its IP addresses.

IPv6 targets

- The IP addresses that you register must be within the VPC CIDR block or within a peered VPC CIDR block.

New console

To register or deregister targets by IP address using the new console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Choose the name of the target group to open its details page.
4. Choose the **Targets** tab.
5. To register IP addresses, choose **Register targets**. For each IP address, select the network, enter the IP address and port, and choose **Include as pending below**. When you are finished specifying addresses, choose **Register pending targets**.
6. To deregister IP addresses, select the IP addresses and then choose **Deregister**. If you have many registered IP addresses, you might find it helpful to add a filter or change the sort order.

Old console

To register or deregister targets by IP address

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Select your target group.
4. On the **Targets** tab, choose **Edit**.
5. To register IP addresses, choose the **Register targets** icon (the plus sign) in the menu bar. For each IP address, select the network, type the IP address and port, and choose **Add to list**. When you are finished specifying addresses, choose **Register**.
6. To deregister IP addresses, choose the **Deregister targets** icon (the minus sign) in the menu bar. If you have many registered IP addresses, you might find it helpful to add a filter or change the sort order. Select the IP addresses and then choose **Deregister**.
7. To leave this screen, choose the **Back to target group** icon (the back button) in the menu bar.

Register or deregister a Lambda function

You can register a single Lambda function with each target group. Elastic Load Balancing must have permissions to invoke the Lambda function. If you no longer need to send traffic to your Lambda function, you can deregister it. After you deregister a Lambda function, in-flight requests fail with HTTP

5XX errors. To replace a Lambda function, it is better to create a new target group instead. For more information, see Lambda functions as targets (p. 93).

New console

To register or deregister a Lambda function using the new console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Choose the name of the target group to open its details page.
4. Choose the **Targets** tab.
5. If there is no Lambda function registered, choose **Register**. Select the Lambda function and choose **Register**.
6. To deregister a Lambda function, choose **Deregister**. When prompted for confirmation, choose **Deregister**.

Old console

To register or deregister a Lambda function using the old console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Select your target group and choose the **Targets** tab.
4. If there is no Lambda function registered, choose **Register**. Select the Lambda function and choose **Register**.
5. To deregister a Lambda function, choose **Deregister**. When prompted for confirmation, choose **Deregister**.

Register or deregister targets using the AWS CLI

Use the register-targets command to add targets and the deregister-targets command to remove targets.

Sticky sessions for your Application Load Balancer

By default, an Application Load Balancer routes each request independently to a registered target based on the chosen load-balancing algorithm. However, you can use the sticky session feature (also known as session affinity) to enable the load balancer to bind a user's session to a specific target. This ensures that all requests from the user during the session are sent to the same target. This feature is useful for servers that maintain state information in order to provide a continuous experience to clients. To use sticky sessions, the client must support cookies.

Application Load Balancers support both duration-based cookies and application-based cookies. Sticky sessions are enabled at the target group level. You can use a combination of duration-based stickiness, application-based stickiness, and no stickiness across your target groups.

The key to managing sticky sessions is determining how long your load balancer should consistently route the user's request to the same target. If your application has its own session cookie, then you can use application-based stickiness and the load balancer session cookie follows the duration specified by the application's session cookie. If your application does not have its own session cookie, then you can use duration-based stickiness to generate a load balancer session cookie with a duration that you specify.

The content of load balancer generated cookies are encrypted using a rotating key. You cannot decrypt or modify load balancer generated cookies.

For both stickiness types, the Application Load Balancer resets the expiry of the cookies it generates after every request. If a cookie expires, the session is no longer sticky and the client should remove the cookie from its cookie store.

Requirements

- An HTTP/HTTPS load balancer.
- At least one healthy instance in each Availability Zone.

Considerations

- Sticky sessions are not supported if cross-zone load balancing is disabled (p. 81). Attempting to enable sticky sessions while cross-zone load balancing is disabled will fail.
- For application-based cookies, cookie names have to be specified individually for each target group. However, for duration-based cookies, `AWSALB` is the only name used across all target groups.
- If you are using multiple layers of Application Load Balancers, you can enable sticky sessions across all layers with application-based cookies. However, with duration-based cookies, you can enable sticky sessions only on one layer, because `AWSALB` is the only name available.
- Application-based stickiness does not work with weighted target groups.
- If you have a forward action (p. 32) with multiple target groups, and sticky sessions are enabled for one or more of the target groups, you must enable stickiness at the target group level.
- WebSocket connections are inherently sticky. If the client requests a connection upgrade to WebSockets, the target that returns an HTTP 101 status code to accept the connection upgrade is the target used in the WebSockets connection. After the WebSockets upgrade is complete, cookie-based stickiness is not used.
- Application Load Balancers use the `Expires` attribute in the cookie header instead of the `Max-Age` attribute.
- Application Load Balancers do not support cookie values that are URL encoded.

Duration-based stickiness

Duration-based stickiness routes requests to the same target in a target group using a load balancer generated cookie (`AWSALB`). The cookie is used to map the session to the target. If your application does not have its own session cookie, you can specify your own stickiness duration and manage how long your load balancer should consistently route the user's request to the same target.

When a load balancer first receives a request from a client, it routes the request to a target (based on the chosen algorithm), and generates a cookie named `AWSALB`. It encodes information about the selected target, encrypts the cookie, and includes the cookie in the response to the client. The load balancer generated cookie has its own expiry of 7 days which is non-configurable.

In subsequent requests, the client should include the `AWSALB` cookie. When the load balancer receives a request from a client that contains the cookie, it detects it and routes the request to the same target. If the cookie is present but cannot be decoded, or if it refers to a target that was deregistered or is unhealthy, the load balancer selects a new target and updates the cookie with information about the new target.

With cross-origin resource sharing (CORS) requests, some browsers require `SameSite=None; Secure` to enable stickiness. In this case, the load balancer generates a second stickiness cookie, `AWSALBCORS`, which includes the same information as the original stickiness cookie plus the `SameSite` attribute. Clients receive both cookies.

To enable duration-based stickiness using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **Load Balancing**, choose **Target Groups**.
3. Choose the name of the target group to open its details page.
4. On the **Group details** tab, in the **Attributes** section, choose **Edit**.
5. On the **Edit attributes** page, do the following:

    a. Select **Stickiness**.
    b. For **Stickiness type**, select **Load balancer generated cookie**.
    c. For **Stickiness duration**, specify a value between 1 second and 7 days.
    d. Choose **Save changes**.

To enable duration-based stickiness using the AWS CLI

Use the modify-target-group-attributes command with the `stickiness.enabled` and `stickiness.lb_cookie.duration_seconds` attributes.

Use the following command to enable duration-based stickiness.

```
aws elbv2 modify-target-group-attributes --target-group-arn ARN --attributes
 Key=stickiness.enabled,Value=true Key=stickiness.lb_cookie.duration_seconds,Value=time-in-
seconds
```

Your output should be similar to the following example.

```
     {
        "Attributes": [
           ...
            {
                 "Key": "stickiness.enabled",
                 "Value": "true"
              },
              {
                  "Key": "stickiness.lb_cookie.duration_seconds",
                  "Value": "86500"

              },
           ...
         ]
      }
```

Application-based stickiness

Application-based stickiness gives you the flexibility to set your own criteria for client-target stickiness. When you enable application-based stickiness, the load balancer routes the first request to a target within the target group based on the chosen algorithm. The target is expected to set a custom application cookie that matches the cookie configured on the load balancer to enable stickiness. This custom cookie can include any of the cookie attributes required by the application.

When the Application Load Balancer receives the custom application cookie from the target, it automatically generates a new encrypted application cookie to capture stickiness information. This load balancer generated application cookie captures stickiness information for each target group that has application-based stickiness enabled.

The load balancer generated application cookie does not copy the attributes of the custom cookie set by the target. It has its own expiry of 7 days which is non-configurable. In the response to the client, the

Application Load Balancer only validates the name with which the custom cookie was configured at the target group level and not the value or the expiry attribute of the custom cookie. As long as the name matches, the load balancer sends both cookies, the custom cookie set by the target, and the application cookie generated by the load balancer, in the response to the client.

In subsequent requests, clients have to send back both cookies to maintain stickiness. The load balancer decrypts the application cookie, and checks whether the configured duration of stickiness is still valid. It then uses the information in the cookie to send the request to the same target within the target group to maintain stickiness. The load balancer also proxies the custom application cookie to the target without inspecting or modifying it. In subsequent responses, the expiry of the load balancer generated application cookie and the duration of stickiness configured on the load balancer are reset. To maintain stickiness between client and target, the expiry of the cookie, and the duration of stickiness should not elapse.

If a target fails or becomes unhealthy, the load balancer stops routing requests to that target, and chooses a new healthy target based on the chosen load balancing algorithm. The load balancer treats the session as now being "stuck" to the new healthy target, and continues routing requests to the new healthy target even if the failed target comes back.

With cross-origin resource sharing (CORS) requests, to enable stickiness, the load balancer adds the `SameSite=None; Secure` attributes to the load balancer generated application cookie only if the user-agent version is Chromium80 or above.

Since most browsers limit cookies to 4K in size, the load balancer shards application cookies greater than 4K into multiple cookies. Application Load Balancers support cookies up to 16K in size and can therefore create up to 4 shards that it sends to the client. The application cookie name that the client sees begins with “AWSALBAPP-" and includes a fragment number. For example, if the cookie size is 0-4K, the client sees AWSALBAPP-0. If the cookie size is 4-8k, the client sees AWSALBAPP-0 and AWSALBAPP-1, and so on.

To enable application-based stickiness using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **Load Balancing**, choose **Target Groups**.
3. Choose the name of the target group to open its details page.
4. On the **Group details** tab, in the **Attributes** section, choose **Edit**.
5. On the **Edit attributes** page, do the following:

    a. Select **Stickiness**.
    b. For **Stickiness type**, select **Application-based cookie**.
    c. For **Stickiness duration**, specify a value between 1 second and 7 days.
    d. For **App cookie name**, enter a name for your application-based cookie.

       Do not use `AWSALB`, `AWSALBAPP`, or `AWSALBTG` for the cookie name; they're reserved for use by the load balancer.
    e. Choose **Save changes**.

To enable application-based stickiness using the AWS CLI

Use the modify-target-group-attributes command with the following attributes:

- `stickiness.enabled`
- `stickiness.type`
- `stickiness.app_cookie.cookie_name`
- `stickiness.app_cookie.duration_seconds`

Use the following command to enable application-based stickiness.

```
aws elbv2 modify-target-group-attributes --target-group-arn ARN --attributes
 Key=stickiness.enabled,Value=true Key=stickiness.type,Value=app_cookie
 Key=stickiness.app_cookie.cookie_name,Value=my-cookie-name
 Key=stickiness.app_cookie.duration_seconds,Value=time-in-seconds
```

Your output should be similar to the following example.

```
       {
            "Attributes": [
                ...
                {
                    "Key": "stickiness.enabled",
                    "Value": "true"
                },
                {
                    "Key": "stickiness.app_cookie.cookie_name",
                    "Value": "MyCookie"
                },
                {
                    "Key": "stickiness.type",
                    "Value": "app_cookie"
                },
                {
                    "Key": "stickiness.app_cookie.duration_seconds",
                    "Value": "86500"
                },
                ...
            ]
        }
```

Manual rebalancing

When scaling up, if the number of targets increase considerably, there is potential for unequal distribution of load due to stickiness. In this scenario, you can rebalance the load on your targets using the following two options:

- Set an expiry on the cookie generated by the application that is prior to the current date and time. This will prevent clients from sending the cookie to the Application Load Balancer, which will restart the process of establishing stickiness.
- Set a very short duration on the load balancer's application-based stickiness configuration, for example, 1 second. This forces the Application Load Balancer to reestablish stickiness even if the cookie set by the target has not expired.

Lambda functions as targets

You can register your Lambda functions as targets and configure a listener rule to forward requests to the target group for your Lambda function. When the load balancer forwards the request to a target group with a Lambda function as a target, it invokes your Lambda function and passes the content of the request to the Lambda function, in JSON format.

Limits

- The Lambda function and target group must be in the same account and in the same Region.

- The maximum size of the request body that you can send to a Lambda function is 1 MB. For related size limits, see HTTP header limits.
- The maximum size of the response JSON that the Lambda function can send is 1 MB.
- WebSockets are not supported. Upgrade requests are rejected with an HTTP 400 code.
- Local Zones are not supported.

Contents

For a demo, see Lambda target on Application Load Balancer.

Prepare the Lambda function

The following recommendations apply if you are using your Lambda function with an Application Load Balancer.

Permissions to invoke the Lambda function

If you create the target group and register the Lambda function using the AWS Management Console, the console adds the required permissions to your Lambda function policy on your behalf. Otherwise, after you create the target group and register the function using the AWS CLI, you must use the add-permission command to grant Elastic Load Balancing permission to invoke your Lambda function. We recommend that you use the `aws:SourceAccount` and `aws:SourceArn` condition keys to restrict function invocation to the specified target group. For more information, see The confused deputy problem in the *IAM User Guide*,

```
aws lambda add-permission \
--function-name lambda-function-arn-with-alias-name \
--statement-id elb1 \
--principal elasticloadbalancing.amazonaws.com \
--action lambda:InvokeFunction \
--source-arn target-group-arn \
--source-account target-group-account-id
```

Lambda function versioning

You can register one Lambda function per target group. To ensure that you can change your Lambda function and that the load balancer always invokes the current version of the Lambda function, create a function alias and include the alias in the function ARN when you register the Lambda function with the load balancer. For more information, see AWS Lambda function versioning and aliases and Traffic shifting using aliases in the *AWS Lambda Developer Guide*.

Function Timeout

The load balancer waits until your Lambda function responds or times out. We recommend that you configure the timeout of the Lambda function based on your expected run time. For information about the default timeout value and how to change it, see Basic AWS Lambda function configuration. For information about the maximum timeout value you can configure, see AWS Lambda limits.

Create a target group for the Lambda function

Create a target group, which is used in request routing. If the request content matches a listener rule with an action to forward it to this target group, the load balancer invokes the registered Lambda function.

New console

To create a target group and register the Lambda function using the new console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Choose **Create target group**.
4. For **Choose a target type**, select **Lambda function**.
5. For **Target group name**, type a name for the target group.
6. (Optional) To enable health checks, choose **Enable** in the **Health checks** section.
7. (Optional) Add one or more tags as follows:
   a. Expand the **Tags** section.
   b. Choose **Add tag**.
   c. Enter the tag key and the tag value.
8. Choose **Next**.
9. Specify a single Lambda function or omit this step and specify a Lambda function later.
10. Choose **Create target group**.

Old console

To create a target group and register the Lambda function using the old console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Choose **Create target group**.
4. For **Target group name**, type a name for the target group.
5. For **Target type**, select **Lambda function**.
6. For **Lambda function**, do one of the following:
   - Select the Lambda function
   - Create a new Lambda function and select it
   - Register the Lambda function after you create the target group
7. (Optional) To enable health checks, choose **Health check**, **Enable**.
8. Choose **Create**.

To create a target group and register the Lambda function using the AWS CLI

Use the create-target-group and register-targets commands.

Receive events from the load balancer

The load balancer supports Lambda invocation for requests over both HTTP and HTTPS. The load balancer sends an event in JSON format. The load balancer adds the following headers to every request: `X-Amzn-Trace-Id`, `X-Forwarded-For`, `X-Forwarded-Port`, and `X-Forwarded-Proto`.

If the `content-encoding` header is present, the load balancer Base64 encodes the body and sets `isBase64Encoded` to `true`.

If the `content-encoding` header is not present, Base64 encoding depends on the content type. For the following types, the load balancer sends the body as is and sets `isBase64Encoded` to `false`: text/*, application/json, application/javascript, and application/xml. Otherwise, the load balancer Base64 encodes the body and sets `isBase64Encoded` to `true`.

The following is an example event.

```
{
    "requestContext": {
        "elb": {
            "targetGroupArn":
 "arn:aws:elasticloadbalancing:region:123456789012:targetgroup/my-target-
group/6d0ecf831eec9f09"
        }
    },
    "httpMethod": "GET",
    "path": "/",
    "queryStringParameters": {parameters},
    "headers": {
        "accept": "text/html,application/xhtml+xml",
        "accept-language": "en-US,en;q=0.8",
        "content-type": "text/plain",
        "cookie": "cookies",
        "host": "lambda-846800462-us-east-2.elb.amazonaws.com",
        "user-agent": "Mozilla/5.0 (Macintosh; Intel Mac OS X 10_11_6)",
        "x-amzn-trace-id": "Root=1-5bdb40ca-556d8b0c50dc66f0511bf520",
        "x-forwarded-for": "72.21.198.66",
        "x-forwarded-port": "443",
        "x-forwarded-proto": "https"
    },
    "isBase64Encoded": false,
    "body": "request_body"
}
```

Respond to the load balancer

The response from your Lambda function must include the Base64 encoding status, status code, and headers. You can omit the body.

To include a binary content in the body of the response, you must Base64 encode the content and set `isBase64Encoded` to `true`. The load balancer decodes the content to retrieve the binary content and sends it to the client in the body of the HTTP response.

The load balancer does not honor hop-by-hop headers, such as `Connection` or `Transfer-Encoding`. You can omit the `Content-Length` header because the load balancer computes it before sending responses to clients.

The following is an example response from a Lambda function.

```
{
    "isBase64Encoded": false,
    "statusCode": 200,
    "statusDescription": "200 OK",
    "headers": {
        "Set-cookie": "cookies",
        "Content-Type": "application/json"
    },
    "body": "Hello from Lambda (optional)"
}
```

For Lambda function templates that work with Application Load Balancers, see application-load-balancer-serverless-app on github. Alternatively, open the Lambda console, create a function, and select one of the following from the AWS Serverless Application Repository:

- ALB-Lambda-Target-HelloWorld
- ALB-Lambda-Target-UploadFiletoS3
- ALB-Lambda-Target-BinaryResponse
- ALB-Lambda-Target-WhatisMyIP

Multi-value headers

If requests from a client or responses from a Lambda function contain headers with multiple values or contains the same header multiple times, or query parameters with multiple values for the same key, you can enable support for multi-value header syntax. After you enable multi-value headers, the headers and query parameters exchanged between the load balancer and the Lambda function use arrays instead of strings. If you do not enable multi-value header syntax and a header or query parameter has multiple values, the load balancer uses the last value that it receives.

Contents

Requests with multi-value headers

The names of the fields used for headers and query string parameters differ depending on whether you enable multi-value headers for the target group.

The following example request has two query parameters with the same key:

```
http://www.example.com?&myKey=val1&myKey=val2
```

With the default format, the load balancer uses the last value sent by the client and sends you an event that includes query string parameters using `queryStringParameters`. For example:

```
"queryStringParameters": { "myKey": "val2"},
```

If you enable multi-value headers, the load balancer uses both key values sent by the client and sends you an event that includes query string parameters using `multiValueQueryStringParameters`. For example:

```
"multiValueQueryStringParameters": { "myKey": ["val1", "val2"] },
```

Similarly, suppose that the client sends a request with two cookies in the header:

```
"cookie": "name1=value1",
"cookie": "name2=value2",
```

With the default format, the load balancer uses the last cookie sent by the client and sends you an event that includes headers using `headers`. For example:

```
"headers": {
    "cookie": "name2=value2",
    ...
},
```

If you enable multi-value headers, the load balancer uses both cookies sent by the client and sends you an event that includes headers using `multiValueHeaders`. For example:

```
"multiValueHeaders": {
    "cookie": ["name1=value1", "name2=value2"],
    ...
},
```

If the query parameters are URL-encoded, the load balancer does not decode them. You must decode them in your Lambda function.

Responses with multi-value headers

The names of the fields used for headers differ depending on whether you enable multi-value headers for the target group. You must use `multiValueHeaders` if you have enabled multi-value headers and `headers` otherwise.

With the default format, you can specify a single cookie:

```
{
  "headers": {
      "Set-cookie": "cookie-name=cookie-value;Domain=myweb.com;Secure;HttpOnly",
      "Content-Type": "application/json"
  },
}
```

If you enable multi-value headers, you must specify multiple cookies as follows:

```
{
  "multiValueHeaders": {
      "Set-cookie": ["cookie-name=cookie-value;Domain=myweb.com;Secure;HttpOnly","cookie-
name=cookie-value;Expires=May 8, 2019"],
      "Content-Type": ["application/json"]
  },
}
```

Enable multi-value headers

You can enable or disable multi-value headers for a target group with the target type `lambda`.

New console

To enable multi-value headers using the new console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Choose the name of the target group to open its details page.
4. On the **Group details** tab, in the **Attributes** section, choose **Edit**.

5. Select or clear **Multi value headers**.
6. Choose **Save changes**.

Old console

To enable multi-value headers using the old console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Select your target group.
4. On the **Description** tab, choose **Edit attributes**.
5. For **Multi value headers**, select **Enable**.
6. Choose **Save**.

To enable multi-value headers using the AWS CLI

Use the modify-target-group-attributes command with the `lambda.multi_value_headers.enabled` attribute.

Enable health checks

By default, health checks are disabled for target groups of type `lambda`. You can enable health checks in order to implement DNS failover with Amazon Route 53. The Lambda function can check the health of a downstream service before responding to the health check request. If the response from the Lambda function indicates a health check failure, the health check failure is passed to Route 53. You can configure Route 53 to fail over to a backup application stack.

You are charged for health checks as you are for any Lambda function invocation.

The following is the format of the health check event sent to your Lambda function. To check whether an event is a health check event, check the value of the user-agent field. The user agent for health checks is `ELB-HealthChecker/2.0`.

```
{
    "requestContext": {
        "elb": {
            "targetGroupArn":
 "arn:aws:elasticloadbalancing:region:123456789012:targetgroup/my-target-
group/6d0ecf831eec9f09"
        }
    },
    "httpMethod": "GET",
    "path": "/",
    "queryStringParameters": {},
    "headers": {
        "user-agent": "ELB-HealthChecker/2.0"
    },
    "body": "",
    "isBase64Encoded": false
}
```

New console

To enable health checks for a target group using the new console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.

2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Choose the name of the target group to open its details page.
4. On the **Group details** tab, in the **Health check settings** section, choose **Edit**.
5. For **Health checks**, select **Enable**.
6. Choose **Save changes**.

Old console

To enable health checks for a target group using the old console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Select your target group.
4. On the **Health checks** tab, choose **Edit health check**.
5. For **Health check**, select **Enable**.
6. Choose **Save**.

To enable health checks for a target group using the AWS CLI

Use the modify-target-group command with the `--health-check-enabled` option.

Deregister the Lambda function

If you no longer need to send traffic to your Lambda function, you can deregister it. After you deregister a Lambda function, in-flight requests fail with HTTP 5XX errors.

To replace a Lambda function, we recommend that you create a new target group, register the new function with the new target group, and update the listener rules to use the new target group instead of the existing one.

New console

To deregister the Lambda function using the new console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Choose the name of the target group to open its details page.
4. On the **Targets** tab, choose **Deregister**.
5. When prompted for confirmation, choose **Deregister**.

Old console

To deregister the Lambda function using the old console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Select your target group.
4. On the **Targets** tab, choose **Deregister**.
5. When prompted for confirmation, choose **Deregister**.

To deregister the Lambda function using the AWS CLI

Use the deregister-targets command.

Tags for your target group

Tags help you to categorize your target groups in different ways, for example, by purpose, owner, or environment.

You can add multiple tags to each target group. Tag keys must be unique for each target group. If you add a tag with a key that is already associated with the target group, it updates the value of that tag.

When you are finished with a tag, you can remove it.

Restrictions

- Maximum number of tags per resource—50
- Maximum key length—127 Unicode characters
- Maximum value length—255 Unicode characters
- Tag keys and values are case-sensitive. Allowed characters are letters, spaces, and numbers representable in UTF-8, plus the following special characters: + - = . _ : / @. Do not use leading or trailing spaces.
- Do not use the `aws:` prefix in your tag names or values because it is reserved for AWS use. You can't edit or delete tag names or values with this prefix. Tags with this prefix do not count against your tags per resource limit.

New console

To update the tags for a target group using the new console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Choose the name of the target group to open its details page.
4. On the **Tags** tab, choose **Manage tags** and do one or more of the following:
   a. To update a tag, enter new values for **Key** and **Value**.
   b. To add a tag, choose **Add tag** and enter values for **Key** and **Value**.
   c. To delete a tag, choose **Remove** next to the tag.
5. When you have finished updating tags, choose **Save changes**.

Old console

To update the tags for a target group using the old console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Select the target group.
4. On the **Tags** tab, choose **Add/Edit Tags** and do one or more of the following:
   a. To update a tag, edit the values of **Key** and **Value**.
   b. To add a new tag, choose **Create Tag** and type values for **Key** and **Value**.
   c. To delete a tag, choose the delete icon (X) next to the tag.
5. When you have finished updating tags, choose **Save**.

To update the tags for a target group using the AWS CLI

Use the add-tags and remove-tags commands.

Delete a target group

You can delete a target group if it is not referenced by the forward actions of any listener rules. Deleting a target group does not affect the targets registered with the target group. If you no longer need a registered EC2 instance, you can stop or terminate it.

New console

To delete a target group using the new console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Select the target group and choose **Actions**, **Delete**.
4. When prompted for confirmation, choose **Yes, delete**.

Old console

To delete a target group using the old console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. On the navigation pane, under **LOAD BALANCING**, choose **Target Groups**.
3. Select the target group and choose **Actions**, **Delete**.
4. When prompted for confirmation, choose **Yes**.

To delete a target group using the AWS CLI

Use the delete-target-group command.

Monitor your Application Load Balancers

You can use the following features to monitor your load balancers, analyze traffic patterns, and troubleshoot issues with your load balancers and targets.

CloudWatch metrics

You can use Amazon CloudWatch to retrieve statistics about data points for your load balancers and targets as an ordered set of time-series data, known as *metrics*. You can use these metrics to verify that your system is performing as expected. For more information, see CloudWatch metrics for your Application Load Balancer (p. 103).

Access logs

You can use access logs to capture detailed information about the requests made to your load balancer and store them as log files in Amazon S3. You can use these access logs to analyze traffic patterns and to troubleshoot issues with your targets. For more information, see Access logs for your Application Load Balancer (p. 118).

Request tracing

You can use request tracing to track HTTP requests. The load balancer adds a header with a trace identifier to each request it receives. For more information, see Request tracing for your Application Load Balancer (p. 133).

CloudTrail logs

You can use AWS CloudTrail to capture detailed information about the calls made to the Elastic Load Balancing API and store them as log files in Amazon S3. You can use these CloudTrail logs to determine which calls were made, the source IP address where the call came from, who made the call, when the call was made, and so on. For more information, see Logging API calls for your Application Load Balancer using AWS CloudTrail (p. 134).

CloudWatch metrics for your Application Load Balancer

Elastic Load Balancing publishes data points to Amazon CloudWatch for your load balancers and your targets. CloudWatch enables you to retrieve statistics about those data points as an ordered set of time-series data, known as *metrics*. Think of a metric as a variable to monitor, and the data points as the values of that variable over time. For example, you can monitor the total number of healthy targets for a load balancer over a specified time period. Each data point has an associated time stamp and an optional unit of measurement.

You can use metrics to verify that your system is performing as expected. For example, you can create a CloudWatch alarm to monitor a specified metric and initiate an action (such as sending a notification to an email address) if the metric goes outside what you consider an acceptable range.

Elastic Load Balancing reports metrics to CloudWatch only when requests are flowing through the load balancer. If there are requests flowing through the load balancer, Elastic Load Balancing measures and sends its metrics in 60-second intervals. If there are no requests flowing through the load balancer or no data for a metric, the metric is not reported.

For more information, see the Amazon CloudWatch User Guide.

Contents

Application Load Balancer metrics

The `AWS/ApplicationELB` namespace includes the following metrics for load balancers.

Metric	Description
`ActiveConnectionCount`	The total number of concurrent TCP connections active from clients to the load balancer and from the load balancer to targets. **Reporting criteria**: There is a nonzero value **Statistics**: The most useful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`
`ClientTLSNegotiationErrorCount`	The number of TLS connections initiated by the client that did not establish a session with the load balancer due to a TLS error. Possible causes include a mismatch of ciphers or protocols or the client failing to verify the server certificate and closing the connection. **Reporting criteria**: There is a nonzero value **Statistics**: The most useful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`
`ConsumedLCUs`	The number of load balancer capacity units (LCU) used by your load balancer. You pay for the number of LCUs that you use per hour. For more information, see Elastic Load Balancing pricing. **Reporting criteria**: Always reported **Statistics**: All

Metric	Description
	Dimensions • `LoadBalancer`
`DesyncMitigationMode_NonCompliant_Request_Count`	The number of requests that do not comply with RFC 7230. **Reporting criteria**: There is a nonzero value **Statistics**: The most useful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`
`DroppedInvalidHeaderRequestCount`	The number of requests where the load balancer removed HTTP headers with header fields that are not valid before routing the request. The load balancer removes these headers only if the `routing.http.drop_invalid_header_fields.enabled` attribute is set to `true`. **Reporting criteria**: There is a nonzero value **Statistics**: All **Dimensions** • `AvailabilityZone`, `LoadBalancer`
`ForwardedInvalidHeaderRequestCount`	The number of requests routed by the load balancer that had HTTP headers with header fields that are not valid. The load balancer forwards requests with these headers only if the `routing.http.drop_invalid_header_fields.enabled` attribute is set to `false`. **Reporting criteria**: Always reported **Statistics**: All **Dimensions** • `AvailabilityZone`, `LoadBalancer`
`GrpcRequestCount`	The number of gRPC requests processed over IPv4 and IPv6. **Reporting criteria**: There is a nonzero value **Statistics**: The most useful statistic is `Sum`. `Minimum`, `Maximum`, and `Average` all return 1. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`

Metric	Description
`HTTP_Fixed_Response_Count`	The number of fixed-response actions that were successful. **Reporting criteria**: There is a nonzero value **Statistics**: The only meaningful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`
`HTTP_Redirect_Count`	The number of redirect actions that were successful. **Reporting criteria**: There is a nonzero value **Statistics**: The only meaningful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`
`HTTP_Redirect_Url_Limit_Exceeded_Count`	The number of redirect actions that couldn't be completed because the URL in the response location header is larger than 8K. **Reporting criteria**: There is a nonzero value **Statistics**: The only meaningful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`
`HTTPCode_ELB_3XX_Count`	The number of HTTP 3XX redirection codes that originate from the load balancer. This count does not include response codes generated by targets. **Reporting criteria**: There is a nonzero value **Statistics**: The only meaningful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`

Metric	Description
`HTTPCode_ELB_4XX_Count`	The number of HTTP 4XX client error codes that originate from the load balancer. This count does not include response codes generated by targets. Client errors are generated when requests are malformed or incomplete. These requests were not received by the target, other than in the case where the load balancer returns an HTTP 460 error code (p. 141). This count does not include any response codes generated by the targets. **Reporting criteria**: There is a nonzero value **Statistics**: The most useful statistic is `Sum`. `Minimum`, `Maximum`, and `Average` all return 1. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`
`HTTPCode_ELB_5XX_Count`	The number of HTTP 5XX server error codes that originate from the load balancer. This count does not include any response codes generated by the targets. **Reporting criteria**: There is a nonzero value **Statistics**: The most useful statistic is `Sum`. `Minimum`, `Maximum`, and `Average` all return 1. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`
`HTTPCode_ELB_500_Count`	The number of HTTP 500 error codes that originate from the load balancer. **Reporting criteria**: There is a nonzero value **Statistics**: The only meaningful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`
`HTTPCode_ELB_502_Count`	The number of HTTP 502 error codes that originate from the load balancer. **Reporting criteria**: There is a nonzero value **Statistics**: The only meaningful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`

Metric	Description
`HTTPCode_ELB_503_Count`	The number of HTTP 503 error codes that originate from the load balancer. **Reporting criteria**: There is a nonzero value **Statistics**: The only meaningful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`
`HTTPCode_ELB_504_Count`	The number of HTTP 504 error codes that originate from the load balancer. **Reporting criteria**: There is a nonzero value **Statistics**: The only meaningful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`
`IPv6ProcessedBytes`	The total number of bytes processed by the load balancer over IPv6. This count is included in `ProcessedBytes`. **Reporting criteria**: There is a nonzero value **Statistics**: The most useful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`
`IPv6RequestCount`	The number of IPv6 requests received by the load balancer. **Reporting criteria**: There is a nonzero value **Statistics**: The most useful statistic is `Sum`. `Minimum`, `Maximum`, and `Average` all return 1. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`

Metric	Description
`NewConnectionCount`	The total number of new TCP connections established from clients to the load balancer and from the load balancer to targets. **Reporting criteria**: There is a nonzero value **Statistics**: The most useful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`
`NonStickyRequestCount`	The number of requests where the load balancer chose a new target because it couldn't use an existing sticky session. For example, the request was the first request from a new client and no stickiness cookie was presented, a stickiness cookie was presented but it did not specify a target that was registered with this target group, the stickiness cookie was malformed or expired, or an internal error prevented the load balancer from reading the stickiness cookie. **Reporting criteria**: Stickiness is enabled on the target group. **Statistics**: The only meaningful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`
`ProcessedBytes`	The total number of bytes processed by the load balancer over IPv4 and IPv6 (HTTP header and HTTP payload). This count includes traffic to and from clients and Lambda functions, and traffic from an Identity Provider (IdP) if user authentication is enabled. **Reporting criteria**: There is a nonzero value **Statistics**: The most useful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`
`RejectedConnectionCount`	The number of connections that were rejected because the load balancer had reached its maximum number of connections. **Reporting criteria**: There is a nonzero value **Statistics**: The most useful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`

Metric	Description
`RequestCount`	The number of requests processed over IPv4 and IPv6. This metric is only incremented for requests where the load balancer node was able to choose a target. Requests that are rejected before a target is chosen are not reflected in this metric. **Reporting criteria**: Always reported **Statistics**: The most useful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `TargetGroup`, `LoadBalancer`
`RuleEvaluations`	The number of rules processed by the load balancer given a request rate averaged over an hour. **Reporting criteria**: There is a nonzero value **Statistics**: The most useful statistic is `Sum`. **Dimensions** • `LoadBalancer`

The `AWS/ApplicationELB` namespace includes the following metrics for targets.

Metric	Description
`HealthyHostCount`	The number of targets that are considered healthy. **Reporting criteria**: Reported if health checks are enabled **Statistics**: The most useful statistics are `Average`, `Minimum`, and `Maximum`. **Dimensions** • `TargetGroup`, `LoadBalancer` • `TargetGroup`, `AvailabilityZone`, `LoadBalancer` • `AvailabilityZone`, `TargetGroup`, `LoadBalancer`
`HTTPCode_Target_2XX_Count`, `HTTPCode_Target_3XX_Count`, `HTTPCode_Target_4XX_Count`, `HTTPCode_Target_5XX_Count`	The number of HTTP response codes generated by the targets. This does not include any response codes generated by the load balancer. **Reporting criteria**: There is a nonzero value **Statistics**: The most useful statistic is `Sum`. `Minimum`, `Maximum`, and `Average` all return 1. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`

Metric	Description
	• `TargetGroup`, `LoadBalancer` • `TargetGroup`, `AvailabilityZone`, `LoadBalancer`
`RequestCountPerTarget`	The average number of requests received by each target in a target group. You must specify the target group using the `TargetGroup` dimension. This metric does not apply if the target is a Lambda function. **Reporting criteria**: Always reported **Statistics**: The only valid statistic is `Sum`. This represents the average not the sum. **Dimensions** • `TargetGroup` • `AvailabilityZone`, `TargetGroup`, `LoadBalancer`
`TargetConnectionErrorCount`	The number of connections that were not successfully established between the load balancer and target. This metric does not apply if the target is a Lambda function. **Reporting criteria**: There is a nonzero value **Statistics**: The most useful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer` • `TargetGroup`, `LoadBalancer` • `TargetGroup`, `AvailabilityZone`, `LoadBalancer`
`TargetResponseTime`	The time elapsed, in seconds, after the request leaves the load balancer until a response from the target is received. This is equivalent to the `target_processing_time` field in the access logs. **Reporting criteria**: There is a nonzero value **Statistics**: The most useful statistics are `Average` and `pNN.NN` (percentiles). **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer` • `TargetGroup`, `LoadBalancer` • `TargetGroup`, `AvailabilityZone`, `LoadBalancer`

Metric	Description
`TargetTLSNegotiationErrorCount`	The number of TLS connections initiated by the load balancer that did not establish a session with the target. Possible causes include a mismatch of ciphers or protocols. This metric does not apply if the target is a Lambda function. **Reporting criteria**: There is a nonzero value **Statistics**: The most useful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer` • `TargetGroup`, `LoadBalancer` • `TargetGroup`, `AvailabilityZone`, `LoadBalancer`
`UnHealthyHostCount`	The number of targets that are considered unhealthy. **Reporting criteria**: Reported if health checks are enabled **Statistics**: The most useful statistics are `Average`, `Minimum`, and `Maximum`. **Dimensions** • `TargetGroup`, `LoadBalancer` • `TargetGroup`, `AvailabilityZone`, `LoadBalancer` • `AvailabilityZone`, `TargetGroup`, `LoadBalancer`

The `AWS/ApplicationELB` namespace includes the following metrics for target group health. For more information, see the section called “Target group health” (p. 83).

Metric	Description
`HealthyStateDNS`	The number of zones that meet the DNS healthy state requirements. **Statistics**: The most useful statistic is `Min`. **Dimensions** • `LoadBalancer`, `TargetGroup` • `AvailabilityZone`, `LoadBalancer`, `TargetGroup`
`HealthyStateRouting`	The number of zones that meet the routing healthy state requirements. **Statistics**: The most useful statistic is `Min`. **Dimensions** • `LoadBalancer`, `TargetGroup` • `AvailabilityZone`, `LoadBalancer`, `TargetGroup`

Metric	Description
`UnhealthyRoutingRequestCount`	The number of requests that are routed using the routing failover action (fail open). **Statistics**: The most useful statistic is `Sum`. **Dimensions** • `LoadBalancer`, `TargetGroup` • `AvailabilityZone`, `LoadBalancer`, `TargetGroup`
`UnhealthyStateDNS`	The number of zones that do not meet the DNS healthy state requirements and therefore were marked unhealthy in DNS. **Statistics**: The most useful statistic is `Min`. **Dimensions** • `LoadBalancer`, `TargetGroup` • `AvailabilityZone`, `LoadBalancer`, `TargetGroup`
`UnhealthyStateRouting`	The number of zones that do not meet the routing healthy state requirements, and therefore the load balancer distributes traffic to all targets in the zone, including the unhealthy targets. **Statistics**: The most useful statistic is `Min`. **Dimensions** • `LoadBalancer`, `TargetGroup` • `AvailabilityZone`, `LoadBalancer`, `TargetGroup`

The `AWS/ApplicationELB` namespace includes the following metrics for Lambda functions that are registered as targets.

Metric	Description
`LambdaInternalError`	The number of requests to a Lambda function that failed because of an issue internal to the load balancer or AWS Lambda. To get the error reason codes, check the error_reason field of the access log. **Reporting criteria**: There is a nonzero value **Statistics**: The only meaningful statistic is `Sum`. **Dimensions** • `TargetGroup` • `TargetGroup`, `LoadBalancer`
`LambdaTargetProcessedBytes`	The total number of bytes processed by the load balancer for requests to and responses from a Lambda function. **Reporting criteria**: There is a nonzero value

Metric	Description
	Statistics: The only meaningful statistic is Sum. **Dimensions** • `LoadBalancer`
`LambdaUserError`	The number of requests to a Lambda function that failed because of an issue with the Lambda function. For example, the load balancer did not have permission to invoke the function, the load balancer received JSON from the function that is malformed or missing required fields, or the size of the request body or response exceeded the maximum size of 1 MB. To get the error reason codes, check the error_reason field of the access log. **Reporting criteria**: There is a nonzero value **Statistics**: The only meaningful statistic is Sum. **Dimensions** • `TargetGroup` • `TargetGroup`, `LoadBalancer`

The `AWS/ApplicationELB` namespace includes the following metrics for user authentication.

Metric	Description
`ELBAuthError`	The number of user authentications that could not be completed because an authenticate action was misconfigured, the load balancer couldn't establish a connection with the IdP, or the load balancer couldn't complete the authentication flow due to an internal error. To get the error reason codes, check the error_reason field of the access log. **Reporting criteria**: There is a nonzero value **Statistics**: The only meaningful statistic is Sum. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`
`ELBAuthFailure`	The number of user authentications that could not be completed because the IdP denied access to the user or an authorization code was used more than once. To get the error reason codes, check the error_reason field of the access log. **Reporting criteria**: There is a nonzero value **Statistics**: The only meaningful statistic is Sum. **Dimensions** • `LoadBalancer`

Metric	Description
	• `AvailabilityZone`, `LoadBalancer`
`ELBAuthLatency`	The time elapsed, in milliseconds, to query the IdP for the ID token and user info. If one or more of these operations fail, this is the time to failure. **Reporting criteria**: There is a nonzero value **Statistics**: All statistics are meaningful. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`
`ELBAuthRefreshTokenSuccess`	The number of times the load balancer successfully refreshed user claims using a refresh token provided by the IdP. **Reporting criteria**: There is a nonzero value **Statistics**: The only meaningful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`
`ELBAuthSuccess`	The number of authenticate actions that were successful. This metric is incremented at the end of the authentication workflow, after the load balancer has retrieved the user claims from the IdP. **Reporting criteria**: There is a nonzero value **Statistics**: The most useful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`
`ELBAuthUserClaimsSizeExceeded`	The number of times that a configured IdP returned user claims that exceeded 11K bytes in size. **Reporting criteria**: There is a nonzero value **Statistics**: The only meaningful statistic is `Sum`. **Dimensions** • `LoadBalancer` • `AvailabilityZone`, `LoadBalancer`

Metric dimensions for Application Load Balancers

To filter the metrics for your Application Load Balancer, use the following dimensions.

Dimension	Description
`AvailabilityZone`	Filters the metric data by Availability Zone.
`LoadBalancer`	Filters the metric data by load balancer. Specify the load balancer as follows: app/*load-balancer-name*/*1234567890123456* (the final portion of the load balancer ARN).
`TargetGroup`	Filters the metric data by target group. Specify the target group as follows: targetgroup/*target-group-name*/*1234567890123456* (the final portion of the target group ARN).

Statistics for Application Load Balancer metrics

CloudWatch provides statistics based on the metric data points published by Elastic Load Balancing. Statistics are metric data aggregations over specified period of time. When you request statistics, the returned data stream is identified by the metric name and dimension. A dimension is a name-value pair that uniquely identifies a metric. For example, you can request statistics for all the healthy EC2 instances behind a load balancer launched in a specific Availability Zone.

The `Minimum` and `Maximum` statistics reflect the minimum and maximum reported by the individual load balancer nodes. For example, suppose there are 2 load balancer nodes. One node has `HealthyHostCount` with a `Minimum` of 2, a `Maximum` of 10, and an `Average` of 6, while the other node has `HealthyHostCount` with a `Minimum` of 1, a `Maximum` of 5, and an `Average` of 3. Therefore, the load balancer has a `Minimum` of 1, a `Maximum` of 10, and an `Average` of about 4.

The `Sum` statistic is the aggregate value across all load balancer nodes. Because metrics include multiple reports per period, `Sum` is only applicable to metrics that are aggregated across all load balancer nodes.

The `SampleCount` statistic is the number of samples measured. Because metrics are gathered based on sampling intervals and events, this statistic is typically not useful. For example, with `HealthyHostCount`, `SampleCount` is based on the number of samples that each load balancer node reports, not the number of healthy hosts.

A percentile indicates the relative standing of a value in a data set. You can specify any percentile, using up to two decimal places (for example, p95.45). For example, the 95th percentile means that 95 percent of the data is below this value and 5 percent is above. Percentiles are often used to isolate anomalies. For example, suppose that an application serves the majority of requests from a cache in 1-2 ms, but in 100-200 ms if the cache is empty. The maximum reflects the slowest case, around 200 ms. The average doesn't indicate the distribution of the data. Percentiles provide a more meaningful view of the application's performance. By using the 99th percentile as an Auto Scaling trigger or a CloudWatch alarm, you can target that no more than 1 percent of requests take longer than 2 ms to process.

View CloudWatch metrics for your load balancer

You can view the CloudWatch metrics for your load balancers using the Amazon EC2 console. These metrics are displayed as monitoring graphs. The monitoring graphs show data points if the load balancer is active and receiving requests.

Alternatively, you can view metrics for your load balancer using the CloudWatch console.

To view metrics using the Amazon EC2 console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. To view metrics filtered by target group, do the following:

   a. In the navigation pane, choose **Target Groups**.
   b. Select your target group, and then choose the **Monitoring** tab.
   c. (Optional) To filter the results by time, select a time range from **Showing data for**.
   d. To get a larger view of a single metric, select its graph.
3. To view metrics filtered by load balancer, do the following:
   a. In the navigation pane, choose **Load Balancers**.
   b. Select your load balancer, and then choose the **Monitoring** tab.
   c. (Optional) To filter the results by time, select a time range from **Showing data for**.
   d. To get a larger view of a single metric, select its graph.

To view metrics using the CloudWatch console

1. Open the CloudWatch console at https://console.aws.amazon.com/cloudwatch/.
2. In the navigation pane, choose **Metrics**.
3. Select the **ApplicationELB** namespace.
4. (Optional) To view a metric across all dimensions, enter its name in the search field.
5. (Optional) To filter by dimension, select one of the following:
   - To display only the metrics reported for your load balancers, choose **Per AppELB Metrics**. To view the metrics for a single load balancer, enter its name in the search field.
   - To display only the metrics reported for your target groups, choose **Per AppELB, per TG Metrics**. To view the metrics for a single target group, enter its name in the search field.
   - To display only the metrics reported for your load balancers by Availability Zone, choose **Per AppELB, per AZ Metrics**. To view the metrics for a single load balancer, enter its name in the search field. To view the metrics for a single Availability Zone, enter its name in the search field.
   - To display only the metrics reported for your load balancers by Availability Zone and target group, choose **Per AppELB, per AZ, per TG Metrics**. To view the metrics for a single load balancer, enter its name in the search field. To view the metrics for a single target group, enter its name in the search field. To view the metrics for a single Availability Zone, enter its name in the search field.

To view metrics using the AWS CLI

Use the following list-metrics command to list the available metrics:

```
aws cloudwatch list-metrics --namespace AWS/ApplicationELB
```

To get the statistics for a metric using the AWS CLI

Use the following get-metric-statistics command get statistics for the specified metric and dimension. CloudWatch treats each unique combination of dimensions as a separate metric. You can't retrieve statistics using combinations of dimensions that were not specially published. You must specify the same dimensions that were used when the metrics were created.

```
aws cloudwatch get-metric-statistics --namespace AWS/ApplicationELB \
--metric-name UnHealthyHostCount --statistics Average  --period 3600 \
--dimensions Name=LoadBalancer,Value=app/my-load-balancer/50dc6c495c0c9188 \
Name=TargetGroup,Value=targetgroup/my-targets/73e2d6bc24d8a067 \
--start-time 2016-04-18T00:00:00Z --end-time 2016-04-21T00:00:00Z
```

The following is example output:

```
{
    "Datapoints": [
        {
            "Timestamp": "2016-04-18T22:00:00Z",
            "Average": 0.0,
            "Unit": "Count"
        },
        {
            "Timestamp": "2016-04-18T04:00:00Z",
            "Average": 0.0,
            "Unit": "Count"
        },
        ...
    ],
    "Label": "UnHealthyHostCount"
}
```

Access logs for your Application Load Balancer

Elastic Load Balancing provides access logs that capture detailed information about requests sent to your load balancer. Each log contains information such as the time the request was received, the client's IP address, latencies, request paths, and server responses. You can use these access logs to analyze traffic patterns and troubleshoot issues.

Access logs is an optional feature of Elastic Load Balancing that is disabled by default. After you enable access logs for your load balancer, Elastic Load Balancing captures the logs and stores them in the Amazon S3 bucket that you specify as compressed files. You can disable access logs at any time.

You are charged storage costs for Amazon S3, but not charged for the bandwidth used by Elastic Load Balancing to send log files to Amazon S3. For more information about storage costs, see Amazon S3 pricing.

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Access log files

Elastic Load Balancing publishes a log file for each load balancer node every 5 minutes. Log delivery is eventually consistent. The load balancer can deliver multiple logs for the same period. This usually happens if the site has high traffic.

The file names of the access logs use the following format:

```
bucket[/prefix]/AWSLogs/aws-account-id/elasticloadbalancing/region/yyyy/mm/dd/aws-
account-id_elasticloadbalancing_region_app.load-balancer-id_end-time_ip-address_random-
string.log.gz
```

bucket

The name of the S3 bucket.

prefix

The prefix (logical hierarchy) in the bucket. If you don't specify a prefix, the logs are placed at the root level of the bucket. The prefix that you specify must not include `AWSLogs`. We add the portion of the file name starting with `AWSLogs` after the bucket name and prefix that you specify.

aws-account-id

The AWS account ID of the owner.

region

The Region for your load balancer and S3 bucket.

yyyy/mm/dd

The date that the log was delivered.

load-balancer-id

The resource ID of the load balancer. If the resource ID contains any forward slashes (/), they are replaced with periods (.).

end-time

The date and time that the logging interval ended. For example, an end time of 20140215T2340Z contains entries for requests made between 23:35 and 23:40 in UTC or Zulu time.

ip-address

The IP address of the load balancer node that handled the request. For an internal load balancer, this is a private IP address.

random-string

A system-generated random string.

The following is an example log file name:

```
s3://my-bucket/prefix/AWSLogs/123456789012/elasticloadbalancing/us-
east-2/2016/05/01/123456789012_elasticloadbalancing_us-east-2_app.my-
loadbalancer.1234567890abcdef_20140215T2340Z_172.160.001.192_20sg8hgm.log.gz
```

You can store your log files in your bucket for as long as you want, but you can also define Amazon S3 lifecycle rules to archive or delete log files automatically. For more information, see Object lifecycle management in the *Amazon Simple Storage Service User Guide*.

Access log entries

Elastic Load Balancing logs requests sent to the load balancer, including requests that never made it to the targets. For example, if a client sends a malformed request, or there are no healthy targets to respond to the request, the request is still logged. Elastic Load Balancing does not log health check requests.

Each log entry contains the details of a single request (or connection in the case of WebSockets) made to the load balancer. For WebSockets, an entry is written only after the connection is closed. If the upgraded connection can't be established, the entry is the same as for an HTTP or HTTPS request.

Important
Elastic Load Balancing logs requests on a best-effort basis. We recommend that you use access logs to understand the nature of the requests, not as a complete accounting of all requests.

Contents

Syntax

The following table describes the fields of an access log entry, in order. All fields are delimited by spaces. When new fields are introduced, they are added to the end of the log entry. You should ignore any fields at the end of the log entry that you were not expecting.

Field	**Description**
type	The type of request or connection. The possible values are as follows (ignore any other values): • `http` — HTTP • `https` — HTTP over TLS • `h2` — HTTP/2 over TLS • `grpcs`— gRPC over TLS • `ws` — WebSockets • `wss` — WebSockets over TLS
time	The time when the load balancer generated a response to the client, in ISO 8601 format. For WebSockets, this is the time when the connection is closed.
elb	The resource ID of the load balancer. If you are parsing access log entries, note that resources IDs can contain forward slashes (/).
client:port	The IP address and port of the requesting client. If there is a proxy in front of the load balancer, this field contains the IP address of the proxy.
target:port	The IP address and port of the target that processed this request. If the client didn't send a full request, the load balancer can't dispatch the request to a target, and this value is set to -. If the target is a Lambda function, this value is set to -. If the request is blocked by AWS WAF, this value is set to - and the value of elb_status_code is set to 403.
request_processing_time	The total time elapsed (in seconds, with millisecond precision) from the time the load balancer received the request until the time it sent the request to a target. This value is set to -1 if the load balancer can't dispatch the request to a target. This can happen if the target closes the connection before the idle timeout or if the client sends a malformed request. This value can also be set to -1 if the registered target does not respond before the idle timeout. If AWS WAF is enabled for your Application Load Balancer or the target type is a Lambda function, the time it takes for the client to send the required data for POST requests is counted towards `request_processing_time`.

Field	Description
target_processing_time	The total time elapsed (in seconds, with millisecond precision) from the time the load balancer sent the request to a target until the target started to send the response headers. This value is set to -1 if the load balancer can't dispatch the request to a target. This can happen if the target closes the connection before the idle timeout or if the client sends a malformed request. This value can also be set to -1 if the registered target does not respond before the idle timeout. If AWS WAF is not enabled for your Application Load Balancer, the time it takes for the client to send the required data for POST requests is counted towards `target_processing_time`.
response_processing_time	The total time elapsed (in seconds, with millisecond precision) from the time the load balancer received the response header from the target until it started to send the response to the client. This includes both the queuing time at the load balancer and the connection acquisition time from the load balancer to the client. This value is set to -1 if the load balancer can't send the request to a target. This can happen if the target closes the connection before the idle timeout or if the client sends a malformed request.
elb_status_code	The status code of the response from the load balancer.
target_status_code	The status code of the response from the target. This value is recorded only if a connection was established to the target and the target sent a response. Otherwise, it is set to -.
received_bytes	The size of the request, in bytes, received from the client (requester). For HTTP requests, this includes the headers. For WebSockets, this is the total number of bytes received from the client on the connection.
sent_bytes	The size of the response, in bytes, sent to the client (requester). For HTTP requests, this includes the headers. For WebSockets, this is the total number of bytes sent to the client on the connection.
"request"	The request line from the client, enclosed in double quotes and logged using the following format: HTTP method + protocol://host:port/uri + HTTP version. The load balancer preserves the URL sent by the client, as is, when recording the request URI. It does not set the content type for the access log file. When you process this field, consider how the client sent the URL.
"user_agent"	A User-Agent string that identifies the client that originated the request, enclosed in double quotes. The string consists of one or more product identifiers, product[/version]. If the string is longer than 8 KB, it is truncated.
ssl_cipher	[HTTPS listener] The SSL cipher. This value is set to - if the listener is not an HTTPS listener.
ssl_protocol	[HTTPS listener] The SSL protocol. This value is set to - if the listener is not an HTTPS listener.
target_group_arn	The Amazon Resource Name (ARN) of the target group.
"trace_id"	The contents of the **X-Amzn-Trace-Id** header, enclosed in double quotes.

Field	Description
"domain_name"	[HTTPS listener] The SNI domain provided by the client during the TLS handshake, enclosed in double quotes. This value is set to - if the client doesn't support SNI or the domain doesn't match a certificate and the default certificate is presented to the client.
"chosen_cert_arn"	[HTTPS listener] The ARN of the certificate presented to the client, enclosed in double quotes. This value is set to `session-reused` if the session is reused. This value is set to - if the listener is not an HTTPS listener.
matched_rule_priority	The priority value of the rule that matched the request. If a rule matched, this is a value from 1 to 50,000. If no rule matched and the default action was taken, this value is set to 0. If an error occurs during rules evaluation, it is set to -1. For any other error, it is set to -.
request_creation_time	The time when the load balancer received the request from the client, in ISO 8601 format.
"actions_executed"	The actions taken when processing the request, enclosed in double quotes. This value is a comma-separated list that can include the values described in Actions taken (p. 123). If no action was taken, such as for a malformed request, this value is set to -.
"redirect_url"	The URL of the redirect target for the location header of the HTTP response, enclosed in double quotes. If no redirect actions were taken, this value is set to -.
"error_reason"	The error reason code, enclosed in double quotes. If the request failed, this is one of the error codes described in Error reason codes (p. 124). If the actions taken do not include an authenticate action or the target is not a Lambda function, this value is set to -.
"target:port_list"	A space-delimited list of IP addresses and ports for the targets that processed this request, enclosed in double quotes. Currently, this list can contain one item and it matches the target:port field. If the client didn't send a full request, the load balancer can't dispatch the request to a target, and this value is set to -. If the target is a Lambda function, this value is set to -. If the request is blocked by AWS WAF, this value is set to - and the value of elb_status_code is set to 403.
"target_status_code_list"	A space-delimited list of status codes from the responses of the targets, enclosed in double quotes. Currently, this list can contain one item and it matches the target_status_code field. This value is recorded only if a connection was established to the target and the target sent a response. Otherwise, it is set to -.
"classification"	The classification for desync mitigation, enclosed in double quotes. If the request does not comply with RFC 7230, the possible values are Acceptable, Ambiguous, and Severe. If the request complies with RFC 7230, this value is set to -.

Field	Description
"classification_reason"	The classification reason code, enclosed in double quotes. If the request does not comply with RFC 7230, this is one of the classification codes described in Classification reasons (p. 123). If the request complies with RFC 7230, this value is set to -.

Actions taken

The load balancer stores the actions that it takes in the actions_executed field of the access log.

- `authenticate` — The load balancer validated the session, authenticated the user, and added the user information to the request headers, as specified by the rule configuration.
- `fixed-response` — The load balancer issued a fixed response, as specified by the rule configuration.
- `forward` — The load balancer forwarded the request to a target, as specified by the rule configuration.
- `redirect` — The load balancer redirected the request to another URL, as specified by the rule configuration.
- `waf` — The load balancer forwarded the request to AWS WAF to determine whether the request should be forwarded to the target. If this is the final action, AWS WAF determined that the request should be rejected.
- `waf-failed` — The load balancer attempted to forward the request to AWS WAF, but this process failed.

Classification reasons

If a request does not comply with RFC 7230, the load balancer stores one of the following codes in the classification_reason field of the access log. For more information, see Desync mitigation mode (p. 16).

Code	Description	Classification
`AmbiguousUri`	The request URI contains control characters.	Ambiguous
`BadContentLength`	The Content-Length header contains a value that cannot be parsed or is not a valid number.	Severe
`BadHeader`	A header contains a null character or carriage return.	Severe
`BadTransferEncoding`	The Transfer-Encoding header contains a bad value.	Severe
`BadUri`	The request URI contains a null character or carriage return.	Severe
`BadMethod`	The request method is malformed.	Severe
`BadVersion`	The request version is malformed.	Severe
`BothTeClPresent`	The request contains both a Transfer-Encoding header and a Content-Length header.	Ambiguous
`DuplicateContentLength`	There are multiple Content-Length headers with the same value.	Ambiguous

Code	Description	Classification
`EmptyHeader`	A header is empty or there is a line with only spaces.	Ambiguous
`GetHeadZeroContentLength`	There is a Content-Length header with a value of 0 for a GET or HEAD request.	Acceptable
`MultipleContentLength`	There are multiple Content-Length headers with different values.	Severe
`MultipleTransferEncodingChunked`	There are multiple Transfer-Encoding: chunked headers.	Severe
`NonCompliantHeader`	A header contains a non-ASCII or control character.	Acceptable
`NonCompliantVersion`	The request version contains a bad value.	Acceptable
`SpaceInUri`	The request URI contains a space that is not URL encoded.	Acceptable
`SuspiciousHeader`	There is a header that can be normalized to Transfer-Encoding or Content-Length using common text normalization techniques.	Ambiguous
`UndefinedContentLengthSemantics`	There is no Content-Length header defined for a GET or HEAD request.	Ambiguous
`UndefinedTransferEncodingSemantics`	There is no Transfer-Encoding header defined for GET or HEAD request.	Ambiguous

Error reason codes

If the load balancer cannot complete an authenticate action, the load balancer stores one of the following reason codes in the error_reason field of the access log. The load balancer also increments the corresponding CloudWatch metric. For more information, see Authenticate users using an Application Load Balancer (p. 55).

Code	Description	Metric
`AuthInvalidCookie`	The authentication cookie is not valid.	`ELBAuthFailure`
`AuthInvalidGrantError`	The authorization grant code from the token endpoint is not valid.	`ELBAuthFailure`
`AuthInvalidIdToken`	The ID token is not valid.	`ELBAuthFailure`
`AuthInvalidStateParam`	The state parameter is not valid.	`ELBAuthFailure`
`AuthInvalidTokenResponse`	The response from the token endpoint is not valid.	`ELBAuthFailure`
`AuthInvalidUserinfoResponse`	The response from the user info endpoint is not valid.	`ELBAuthFailure`
`AuthMissingCodeParam`	The authentication response from the authorization endpoint is missing a query parameter named 'code'.	`ELBAuthFailure`

Code	Description	Metric
`AuthMissingHostHeader`	The authentication response from the authorization endpoint is missing a host header field.	`ELBAuthError`
`AuthMissingStateParam`	The authentication response from the authorization endpoint is missing a query parameter named 'state'.	`ELBAuthFailure`
`AuthTokenEpRequestFailed`	There is an error response (non-2XX) from the token endpoint.	`ELBAuthError`
`AuthTokenEpRequestTimeout`	The load balancer is unable to communicate with the token endpoint.	`ELBAuthError`
`AuthUnhandledException`	The load balancer encountered an unhandled exception.	`ELBAuthError`
`AuthUserinfoEpRequestFailed`	There is an error response (non-2XX) from the IdP user info endpoint.	`ELBAuthError`
`AuthUserinfoEpRequestTimeout`	The load balancer is unable to communicate with the IdP user info endpoint.	`ELBAuthError`
`AuthUserinfoResponseSizeExceeded`	The size of the claims returned by the IdP exceeded 11K bytes.	`ELBAuthUserClaimsSizeExceeded`

If a request to a weighted target group fails, the load balancer stores one of the following error codes in the error_reason field of the access log.

Code	Description
`AWSALBTGCookieInvalid`	The AWSALBTG cookie, which is used with weighted target groups, is not valid. For example, the load balancer returns this error when cookie values are URL encoded.
`WeightedTargetGroupsUnhandledException`	The load balancer encountered an unhandled exception.

If a request to a Lambda function fails, the load balancer stores one of the following reason codes in the error_reason field of the access log. The load balancer also increments the corresponding CloudWatch metric. For more information, see the Lambda Invoke action.

Code	Description	Metric
`LambdaAccessDenied`	The load balancer did not have permission to invoke the Lambda function.	`LambdaUserError`
`LambdaBadRequest`	Lambda invocation failed because the client request headers or body did not contain only UTF-8 characters.	`LambdaUserError`
`LambdaConnectionError`	The load balancer cannot connect to Lambda.	`LambdaInternalError`
`LambdaConnectionTimeout`	An attempt to connect to Lambda timed out.	`LambdaInternalError`

Code	Description	Metric
`LambdaEC2AccessDeniedException`	Amazon EC2 denied access to Lambda during function initialization.	`LambdaUserError`
`LambdaEC2ThrottledException`	Amazon EC2 throttled Lambda during function initialization.	`LambdaUserError`
`LambdaEC2UnexpectedException`	Amazon EC2 encountered an unexpected exception during function initialization.	`LambdaUserError`
`LambdaENILimitReachedException`	Lambda couldn't create a network interface in the VPC specified in the configuration of the Lambda function because the limit for network interfaces was exceeded.	`LambdaUserError`
`LambdaInvalidResponse`	The response from the Lambda function is malformed or is missing required fields.	`LambdaUserError`
`LambdaInvalidRuntimeException`	The specified version of the Lambda runtime is not supported.	`LambdaUserError`
`LambdaInvalidSecurityGroupIDException`	The security group ID specified in the configuration of the Lambda function is not valid.	`LambdaUserError`
`LambdaInvalidSubnetIDException`	The subnet ID specified in the configuration of the Lambda function is not valid.	`LambdaUserError`
`LambdaInvalidZipFileException`	Lambda could not unzip the specified function zip file.	`LambdaUserError`
`LambdaKMSAccessDeniedException`	Lambda could not decrypt environment variables because access to the KMS key was denied. Check the KMS permissions of the Lambda function.	`LambdaUserError`
`LambdaKMSDisabledException`	Lambda could not decrypt environment variables because the specified KMS key is disabled. Check the KMS key settings of the Lambda function.	`LambdaUserError`
`LambdaKMSInvalidStateException`	Lambda could not decrypt environment variables because the state of the KMS key is not valid. Check the KMS key settings of the Lambda function.	`LambdaUserError`
`LambdaKMSNotFoundException`	Lambda could not decrypt environment variables because the KMS key was not found. Check the KMS key settings of the Lambda function.	`LambdaUserError`
`LambdaRequestTooLarge`	The size of the request body exceeded 1 MB.	`LambdaUserError`
`LambdaResourceNotFound`	The Lambda function could not be found.	`LambdaUserError`
`LambdaResponseTooLarge`	The size of the response exceeded 1 MB.	`LambdaUserError`
`LambdaServiceException`	Lambda encountered an internal error.	`LambdaInternalError`
`LambdaSubnetIPAddressLimitReachedException`	Lambda could not set up VPC access for the Lambda function because one or more subnets have no available IP addresses.	`LambdaUserError`

Code	Description	Metric
`LambdaThrottling`	The Lambda function was throttled because there were too many requests.	`LambdaUserError`
`LambdaUnhandled`	The Lambda function encountered an unhandled exception.	`LambdaUserError`
`LambdaUnhandledException`	The load balancer encountered an unhandled exception.	`LambdaInternalError`
`LambdaWebsocketNotSupported`	WebSockets are not supported with Lambda.	`LambdaUserError`

If the load balancer encounters an error when forwarding requests to AWS WAF, it stores one of the following error codes in the error_reason field of the access log.

Code	Description
`WAFConnectionError`	The load balancer cannot connect to AWS WAF.
`WAFConnectionTimeout`	The connection to AWS WAF timed out.
`WAFResponseReadTimeout`	A request to AWS WAF timed out.
`WAFServiceError`	AWS WAF returned a 5XX error.
`WAFUnhandledException`	The load balancer encountered an unhandled exception.

Example log entries

The following are example log entries. Note that the text appears on multiple lines only to make them easier to read.

Example HTTP Entry

The following is an example log entry for an HTTP listener (port 80 to port 80):

```
http 2018-07-02T22:23:00.186641Z app/my-loadbalancer/50dc6c495c0c9188
192.168.131.39:2817 10.0.0.1:80 0.000 0.001 0.000 200 200 34 366
"GET http://www.example.com:80/ HTTP/1.1" "curl/7.46.0" - -
arn:aws:elasticloadbalancing:us-east-2:123456789012:targetgroup/my-targets/73e2d6bc24d8a067
"Root=1-58337262-36d228ad5d99923122bbe354" "-" "-"
0 2018-07-02T22:22:48.364000Z "forward" "-" "-" "10.0.0.1:80" "200" "-" "-"
```

Example HTTPS Entry

The following is an example log entry for an HTTPS listener (port 443 to port 80):

```
https 2018-07-02T22:23:00.186641Z app/my-loadbalancer/50dc6c495c0c9188
192.168.131.39:2817 10.0.0.1:80 0.086 0.048 0.037 200 200 0 57
"GET https://www.example.com:443/ HTTP/1.1" "curl/7.46.0" ECDHE-RSA-AES128-GCM-SHA256
 TLSv1.2
arn:aws:elasticloadbalancing:us-east-2:123456789012:targetgroup/my-targets/73e2d6bc24d8a067
"Root=1-58337281-1d84f3d73c47ec4e58577259" "www.example.com" "arn:aws:acm:us-
east-2:123456789012:certificate/12345678-1234-1234-1234-123456789012"
1 2018-07-02T22:22:48.364000Z "authenticate,forward" "-" "-" "10.0.0.1:80" "200" "-" "-"
```

Example HTTP/2 Entry

The following is an example log entry for an HTTP/2 stream.

```
h2 2018-07-02T22:23:00.186641Z app/my-loadbalancer/50dc6c495c0c9188
10.0.1.252:48160 10.0.0.66:9000 0.000 0.002 0.000 200 200 5 257
"GET https://10.0.2.105:773/ HTTP/2.0" "curl/7.46.0" ECDHE-RSA-AES128-GCM-SHA256 TLSv1.2
arn:aws:elasticloadbalancing:us-east-2:123456789012:targetgroup/my-targets/73e2d6bc24d8a067
"Root=1-58337327-72bd00b0343d75b906739c42" "-" "-"
1 2018-07-02T22:22:48.364000Z "redirect" "https://example.com:80/" "-" "10.0.0.66:9000"
 "200" "-" "-"
```

Example WebSockets Entry

The following is an example log entry for a WebSockets connection.

```
ws 2018-07-02T22:23:00.186641Z app/my-loadbalancer/50dc6c495c0c9188
10.0.0.140:40914 10.0.1.192:8010 0.001 0.003 0.000 101 101 218 587
"GET http://10.0.0.30:80/ HTTP/1.1" "-" - -
arn:aws:elasticloadbalancing:us-east-2:123456789012:targetgroup/my-targets/73e2d6bc24d8a067
"Root=1-58337364-23a8c76965a2ef7629b185e3" "-" "-"
1 2018-07-02T22:22:48.364000Z "forward" "-" "-" "10.0.1.192:8010" "101" "-" "-"
```

Example Secured WebSockets Entry

The following is an example log entry for a secured WebSockets connection.

```
wss 2018-07-02T22:23:00.186641Z app/my-loadbalancer/50dc6c495c0c9188
10.0.0.140:44244 10.0.0.171:8010 0.000 0.001 0.000 101 101 218 786
"GET https://10.0.0.30:443/ HTTP/1.1" "-" ECDHE-RSA-AES128-GCM-SHA256 TLSv1.2
arn:aws:elasticloadbalancing:us-west-2:123456789012:targetgroup/my-targets/73e2d6bc24d8a067
"Root=1-58337364-23a8c76965a2ef7629b185e3" "-" "-"
1 2018-07-02T22:22:48.364000Z "forward" "-" "-" "10.0.0.171:8010" "101" "-" "-"
```

Example Entries for Lambda Functions

The following is an example log entry for a request to a Lambda function that succeeded:

```
http 2018-11-30T22:23:00.186641Z app/my-loadbalancer/50dc6c495c0c9188
192.168.131.39:2817 - 0.000 0.001 0.000 200 200 34 366
"GET http://www.example.com:80/ HTTP/1.1" "curl/7.46.0" - -
arn:aws:elasticloadbalancing:us-east-2:123456789012:targetgroup/my-targets/73e2d6bc24d8a067
"Root=1-58337364-23a8c76965a2ef7629b185e3" "-" "-"
0 2018-11-30T22:22:48.364000Z "forward" "-" "-" "-" "-" "-" "-"
```

The following is an example log entry for a request to a Lambda function that failed:

```
http 2018-11-30T22:23:00.186641Z app/my-loadbalancer/50dc6c495c0c9188
192.168.131.39:2817 - 0.000 0.001 0.000 502 - 34 366
"GET http://www.example.com:80/ HTTP/1.1" "curl/7.46.0" - -
arn:aws:elasticloadbalancing:us-east-2:123456789012:targetgroup/my-targets/73e2d6bc24d8a067
"Root=1-58337364-23a8c76965a2ef7629b185e3" "-" "-"
0 2018-11-30T22:22:48.364000Z "forward" "-" "LambdaInvalidResponse" "-" "-" "-" "-"
```

Processing access log files

The access log files are compressed. If you open the files using the Amazon S3 console, they are uncompressed and the information is displayed. If you download the files, you must uncompress them to view the information.

If there is a lot of demand on your website, your load balancer can generate log files with gigabytes of data. You might not be able to process such a large amount of data using line-by-line processing. Therefore, you might have to use analytical tools that provide parallel processing solutions. For example, you can use the following analytical tools to analyze and process access logs:

- Amazon Athena is an interactive query service that makes it easy to analyze data in Amazon S3 using standard SQL. For more information, see Querying Application Load Balancer logs in the *Amazon Athena User Guide*.
- Loggly
- Splunk
- Sumo logic

Enable access logs for your Application Load Balancer

When you enable access logs for your load balancer, you must specify the name of the S3 bucket where the load balancer will store the logs. The bucket must have a bucket policy that grants Elastic Load Balancing permission to write to the bucket.

Tasks

Create an S3 bucket

When you enable access logs, you must specify an S3 bucket for the access logs. The bucket must meet the following requirements.

Requirements

- The bucket must be located in the same Region as the load balancer. The bucket and the load balancer can be owned by different accounts.
- The prefix that you specify must not include `AWSLogs`. We add the portion of the file name starting with `AWSLogs` after the bucket name and prefix that you specify.
- The only server-side encryption option that's supported is Amazon S3-managed keys (SSE-S3). For more information, see Amazon S3-managed encryption keys (SSE-S3).

Use one of the following options to create and configure an S3 bucket for access logs.

Options

- To create a bucket and enable access logs using the Elastic Load Balancing console, skip to the section called "Configure access logs" (p. 132) and select the option to have the console create the bucket and bucket policy for you.
- To use an existing bucket and add the required bucket policy using the Amazon S3 console, skip to the section called "Attach a policy to your S3 bucket" (p. 130).
- To create a bucket and add the required bucket policy using the Amazon S3 console manually (for example, if you are using the AWS CLI or an API to enable access logs), use the procedure below and then continue to the section called "Attach a policy to your S3 bucket" (p. 130).

Use the following procedure to create a bucket manually using the Amazon S3 console, if you aren't using the Elastic Load Balancing console to create and configure the bucket on your behalf.

To create an S3 bucket manually using the Amazon S3 console

1. Open the Amazon S3 console at https://console.aws.amazon.com/s3/.
2. Choose **Create bucket**.
3. On the **Create bucket** page, do the following:

   a. For **Bucket name**, enter a name for your bucket. This name must be unique across all existing bucket names in Amazon S3. In some Regions, there might be additional restrictions on bucket names. For more information, see Bucket restrictions and limitations in the *Amazon Simple Storage Service User Guide*.

   b. For **AWS Region**, select the Region where you created your load balancer.

   c. (Optional) Enable server-side encryption using Amazon S3-managed keys (SSE-S3).

   d. Choose **Create bucket**.

Attach a policy to your S3 bucket

Your S3 bucket must have a bucket policy that grants Elastic Load Balancing permission to write the access logs to the bucket. Bucket policies are a collection of JSON statements written in the access policy language to define access permissions for your bucket. Each statement includes information about a single permission and contains a series of elements.

If you're using an existing bucket that already has an attached policy, you can add the statement for Elastic Load Balancing access logs to the policy. If you do so, we recommend that you evaluate the resulting set of permissions to ensure that they are appropriate for the users that need access to the bucket for access logs.

To attach a bucket policy for access logs to your bucket

1. Open the Amazon S3 console at https://console.aws.amazon.com/s3/.
2. Select the name of the bucket to open its details page.
3. Choose **Permissions** and then choose **Bucket policy**, **Edit**.
4. Create or update the bucket policy to grant the required permissions. The bucket policy you'll use depends on the AWS Region of the bucket and the type of zone.
   - [Availability Zones and Local Zones] For the Regions in the list below, use the following policy, which grants permissions to the specified Elastic Load Balancing account ID.

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "AWS": "arn:aws:iam::elb-account-id:root"
      },
      "Action": "s3:PutObject",
      "Resource": "arn:aws:s3:::bucket-name/prefix/AWSLogs/your-aws-account-id/*"
    }
  ]
}
```

     Replace *elb-account-id* with the ID of the AWS account for Elastic Load Balancing for your Region:

  - US East (N. Virginia) – 127311923021
  - US East (Ohio) – 033677994240
  - US West (N. California) – 027434742980
  - US West (Oregon) – 797873946194
  - Africa (Cape Town) – 098369216593
  - Asia Pacific (Hong Kong) – 754344448648
  - Asia Pacific (Jakarta) – 589379963580
  - Asia Pacific (Mumbai) – 718504428378
  - Asia Pacific (Osaka) – 383597477331
  - Asia Pacific (Seoul) – 600734575887
  - Asia Pacific (Singapore) – 114774131450
  - Asia Pacific (Sydney) – 783225319266
  - Asia Pacific (Tokyo) – 582318560864
  - Canada (Central) – 985666609251
  - Europe (Frankfurt) – 054676820928
  - Europe (Ireland) – 156460612806
  - Europe (London) – 652711504416
  - Europe (Milan) – 635631232127
  - Europe (Paris) – 009996457667
  - Europe (Stockholm) – 897822967062
  - Middle East (Bahrain) – 076674570225
  - South America (São Paulo) – 507241528517
  - AWS GovCloud (US-West) – 048591011584
  - AWS GovCloud (US-East) – 190560391635
- [Availability Zones and Local Zones] For the Regions that do not appear in the list above, such as Middle East (UAE), use the following policy, which grants permissions to the specified log delivery service.

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Principal": {
        "Service": "logdelivery.elasticloadbalancing.amazonaws.com"
      },
      "Action": "s3:PutObject",
      "Resource": "arn:aws:s3:::bucket-name/prefix/AWSLogs/aws-account-id/*"
    }
  ]
}
```

- [Outpost] Use the following policy, which grants permissions to the specified log delivery service.

```
{
    "Effect": "Allow",
    "Principal": {
        "Service": "logdelivery.elb.amazonaws.com"
    },
    "Action": "s3:PutObject",
    "Resource": "arn:aws:s3:::bucket-name/prefix/AWSLogs/your-aws-account-id/*",
    "Condition": {
        "StringEquals": {
            "s3:x-amz-acl": "bucket-owner-full-control"
        }
    }
}
```

5. Choose **Save changes**.

Configure access logs

Use the following procedure to configure access logs to capture and deliver log files to your S3 bucket. Note that you can optionally have Elastic Load Balancing create the bucket and add the required policy, if you did not use the previous steps to do so manually. If you specify an existing bucket, be sure that you own the bucket and that you added the required bucket policy.

To enable access logs using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. In the navigation pane, choose **Load Balancers**.
3. Select your load balancer.
4. On the **Description** tab, choose **Edit attributes**.
5. On the **Edit load balancer attributes** page, do the following:

   a. For **Access logs**, select **Enable**.
   b. For **S3 location**, enter the name of your S3 bucket, including any prefix (for example, `my-loadbalancer-logs/my-app`). You can enter the name of an existing bucket or a name for a new bucket.
   c. (Optional) If the bucket does not exist, choose **Create this location for me**. The name for a new bucket must be unique across all existing bucket names in Amazon S3 and follow DNS naming conventions. For more information, see Rules for bucket naming in the *Amazon Simple Storage Service User Guide*.
   d. Choose **Save**.

To enable access logs using the AWS CLI

Use the modify-load-balancer-attributes command.

To manage the S3 bucket for your access logs

Be sure to disable access logs before you delete the bucket that you configured for access logs. Otherwise, if there is a new bucket with the same name and the required bucket policy but created in an AWS account that you don't own, Elastic Load Balancing could write the access logs for your load balancer to this new bucket.

Verify bucket permissions

After access logs are enabled for your load balancer, Elastic Load Balancing validates the S3 bucket and creates a test file to ensure that the bucket policy specifies the required permissions. You can use the Amazon S3 console to verify that the test file was created. The test file is not an actual access log file; it doesn't contain example records.

To verify that Elastic Load Balancing created a test file in your S3 bucket

1. Open the Amazon S3 console at https://console.aws.amazon.com/s3/.

2. Select the name of the bucket that you specified for access logs.
3. Navigate to the test file, `ELBAccessLogTestFile`, in the following location:

```
my-bucket/prefix/AWSLogs/123456789012/ELBAccessLogTestFile
```

Disable access logs for your Application Load Balancer

You can disable access logs for your load balancer at any time. After you disable access logs, your access logs remain in your S3 bucket until you delete them. For more information, see Working with buckets in the *Amazon Simple Storage Service User Guide*.

To disable access logs using the console

1. Open the Amazon EC2 console at https://console.aws.amazon.com/ec2/.
2. In the navigation pane, choose **Load Balancers**.
3. Select your load balancer.
4. On the **Description** tab, choose **Edit attributes**.
5. For **Access logs**, clear **Enable**.
6. Choose **Save**.

To disable access logs using the AWS CLI

Use the modify-load-balancer-attributes command.

Request tracing for your Application Load Balancer

You can use request tracing to track HTTP requests from clients to targets or other services. When the load balancer receives a request from a client, it adds or updates the **X-Amzn-Trace-Id** header before sending the request to the target. Any services or applications between the load balancer and the target can also add or update this header.

If you enable access logs, the contents of the **X-Amzn-Trace-Id** header are logged. For more information, see Access logs for your Application Load Balancer (p. 118).

Syntax

The **X-Amzn-Trace-Id** header contains fields with the following format:

```
Field=version-time-id
```

Field

The name of the field. The supported values are `Root` and `Self`.

An application can add arbitrary fields for its own purposes. The load balancer preserves these fields but does not use them.

version

The version number.

time

The epoch time, in seconds.

id

The trace identifier.

Examples

If the **X-Amzn-Trace-Id** header is not present on an incoming request, the load balancer generates a header with a `Root` field and forwards the request. For example:

```
X-Amzn-Trace-Id: Root=1-63441c4a-abcdef012345678912345678
```

If the **X-Amzn-Trace-Id** header is present and has a `Root` field, the load balancer inserts a `Self` field and forwards the request. For example:

```
X-Amzn-Trace-Id: Self=1-63441c4a-12456789abcdef012345678;Root=1-67891233-
abcdef012345678912345678
```

If an application adds a header with a `Root` field and a custom field, the load balancer preserves both fields, inserts a `Self` field, and forwards the request:

```
X-Amzn-Trace-Id: Self=1-63441c4a-12456789abcdef012345678;Root=1-67891233-
abcdef012345678912345678;CalledFrom=app
```

If the **X-Amzn-Trace-Id** header is present and has a `Self` field, the load balancer updates the value of the `Self` field.

Limitations

- The load balancer updates the header when it receives an incoming request, not when it receives a response.
- If the HTTP headers are greater than 7 KB, the load balancer rewrites the **X-Amzn-Trace-Id** header with a `Root` field.
- With WebSockets, you can trace only until the upgrade request is successful.

Logging API calls for your Application Load Balancer using AWS CloudTrail

Elastic Load Balancing is integrated with AWS CloudTrail, a service that provides a record of actions taken by a user, role, or an AWS service in Elastic Load Balancing. CloudTrail captures all API calls for Elastic Load Balancing as events. The calls captured include calls from the AWS Management Console and code calls to the Elastic Load Balancing API operations. If you create a trail, you can enable continuous delivery of CloudTrail events to an Amazon S3 bucket, including events for Elastic Load Balancing. If you don't configure a trail, you can still view the most recent events in the CloudTrail console in **Event history**. Using the information collected by CloudTrail, you can determine the request that was made to Elastic Load Balancing, the IP address from which the request was made, who made the request, when it was made, and additional details.

To learn more about CloudTrail, see the AWS CloudTrail User Guide.

To monitor other actions for your load balancer, such as when a client makes a request to your load balancer, use access logs. For more information, see Access logs for your Application Load Balancer (p. 118).

Elastic Load Balancing information in CloudTrail

CloudTrail is enabled on your AWS account when you create the account. When activity occurs in Elastic Load Balancing, that activity is recorded in a CloudTrail event along with other AWS service events in **Event history**. You can view, search, and download recent events in your AWS account. For more information, see Viewing events with CloudTrail event history.

For an ongoing record of events in your AWS account, including events for Elastic Load Balancing, create a trail. A *trail* enables CloudTrail to deliver log files to an Amazon S3 bucket. By default, when you create a trail in the console, the trail applies to all AWS Regions. The trail logs events from all Regions in the AWS partition and delivers the log files to the Amazon S3 bucket that you specify. Additionally, you can configure other AWS services to further analyze and act upon the event data collected in CloudTrail logs. For more information, see the following:

- Overview for creating a trail
- CloudTrail supported services and integrations
- Configuring Amazon SNS notifications for CloudTrail
- Receiving CloudTrail log files from multiple regions and Receiving CloudTrail log files from multiple accounts

All Elastic Load Balancing actions for Application Load Balancers are logged by CloudTrail and are documented in the Elastic Load Balancing API Reference version 2015-12-01. For example, calls to the `CreateLoadBalancer` and `DeleteLoadBalancer` actions generate entries in the CloudTrail log files.

Every event or log entry contains information about who generated the request. The identity information helps you determine the following:

- Whether the request was made with root or AWS Identity and Access Management (IAM) user credentials.
- Whether the request was made with temporary security credentials for a role or federated user.
- Whether the request was made by another AWS service.

For more information, see the CloudTrail userIdentity element.

Understanding Elastic Load Balancing log file entries

A trail is a configuration that enables delivery of events as log files to an Amazon S3 bucket that you specify. CloudTrail log files contain one or more log entries. An event represents a single request from any source and includes information about the requested action, the date and time of the action, request parameters, and so on. CloudTrail log files aren't an ordered stack trace of the public API calls, so they don't appear in any specific order.

The log files include events for all AWS API calls for your AWS account, not just Elastic Load Balancing API calls. You can locate calls to the Elastic Load Balancing API by checking for `eventSource` elements with the value `elasticloadbalancing.amazonaws.com`. To view a record for a specific action, such as `CreateLoadBalancer`, check for `eventName` elements with the action name.

The following are example CloudTrail log records for Elastic Load Balancing for a user who created an Application Load Balancer and then deleted it using the AWS CLI. You can identify the CLI using the `userAgent` elements. You can identify the requested API calls using the `eventName` elements. Information about the user (`Alice`) can be found in the `userIdentity` element.

Example Example: CreateLoadBalancer

```
{
    "eventVersion": "1.03",
    "userIdentity": {
        "type": "IAMUser",
        "principalId": "123456789012",
        "arn": "arn:aws:iam::123456789012:user/Alice",
        "accountId": "123456789012",
        "accessKeyId": "AKIAIOSFODNN7EXAMPLE",
        "userName": "Alice"
    },
    "eventTime": "2016-04-01T15:31:48Z",
    "eventSource": "elasticloadbalancing.amazonaws.com",
    "eventName": "CreateLoadBalancer",
    "awsRegion": "us-west-2",
    "sourceIPAddress": "198.51.100.1",
    "userAgent": "aws-cli/1.10.10 Python/2.7.9 Windows/7 botocore/1.4.1",
    "requestParameters": {
        "subnets": ["subnet-8360a9e7","subnet-b7d581c0"],
        "securityGroups": ["sg-5943793c"],
        "name": "my-load-balancer",
        "scheme": "internet-facing"
    },
    "responseElements": {
        "loadBalancers":[{
            "type": "application",
            "loadBalancerName": "my-load-balancer",
            "vpcId": "vpc-3ac0fb5f",
            "securityGroups": ["sg-5943793c"],
            "state": {"code":"provisioning"},
            "availabilityZones": [
               {"subnetId":"subnet-8360a9e7","zoneName":"us-west-2a"},
               {"subnetId":"subnet-b7d581c0","zoneName":"us-west-2b"}
            ],
            "dNSName": "my-load-balancer-1836718677.us-west-2.elb.amazonaws.com",
            "canonicalHostedZoneId": "Z2P70J7HTTTPLU",
            "createdTime": "Apr 11, 2016 5:23:50 PM",
            "loadBalancerArn": "arn:aws:elasticloadbalancing:us-
west-2:123456789012:loadbalancer/app/my-load-balancer/ffcddace1759e1d0",
            "scheme": "internet-facing"
        }]
    },
    "requestID": "b9960276-b9b2-11e3-8a13-f1ef1EXAMPLE",
    "eventID": "6f4ab5bd-2daa-4d00-be14-d92efEXAMPLE",
    "eventType": "AwsApiCall",
    "apiVersion": "2015-12-01",
    "recipientAccountId": "123456789012"
}
```

Example Example: DeleteLoadBalancer

```
{
    "eventVersion": "1.03",
    "userIdentity": {
        "type": "IAMUser",
        "principalId": "123456789012",
        "arn": "arn:aws:iam::123456789012:user/Alice",
        "accountId": "123456789012",
        "accessKeyId": "AKIAIOSFODNN7EXAMPLE",
        "userName": "Alice"
    },
    "eventTime": "2016-04-01T15:31:48Z",
    "eventSource": "elasticloadbalancing.amazonaws.com",
    "eventName": "DeleteLoadBalancer",
    "awsRegion": "us-west-2",
    "sourceIPAddress": "198.51.100.1",
    "userAgent": "aws-cli/1.10.10 Python/2.7.9 Windows/7 botocore/1.4.1",
    "requestParameters": {
        "loadBalancerArn": "arn:aws:elasticloadbalancing:us-
west-2:123456789012:loadbalancer/app/my-load-balancer/ffcddace1759e1d0"
    },
    "responseElements": null,
    "requestID": "349598b3-000e-11e6-a82b-298133eEXAMPLE",
    "eventID": "75e81c95-4012-421f-a0cf-babdaEXAMPLE",
    "eventType": "AwsApiCall",
    "apiVersion": "2015-12-01",
    "recipientAccountId": "123456789012"
}
```

Troubleshoot your Application Load Balancers

The following information can help you troubleshoot issues with your Application Load Balancer.

Issues

A registered target is not in service

If a target is taking longer than expected to enter the `InService` state, it might be failing health checks. Your target is not in service until it passes one health check. For more information, see Health checks for your target groups (p. 77).

Verify that your instance is failing health checks and then check for the following issues:

A security group does not allow traffic

The security group associated with an instance must allow traffic from the load balancer using the health check port and health check protocol. You can add a rule to the instance security group to allow all traffic from the load balancer security group. Also, the security group for your load balancer must allow traffic to the instances.

A network access control list (ACL) does not allow traffic

The network ACL associated with the subnets for your instances must allow inbound traffic on the health check port and outbound traffic on the ephemeral ports (1024-65535). The network ACL associated with the subnets for your load balancer nodes must allow inbound traffic on the ephemeral ports and outbound traffic on the health check and ephemeral ports.

The ping path does not exist

Create a target page for the health check and specify its path as the ping path.

The connection times out

First, verify that you can connect to the target directly from within the network using the private IP address of the target and the health check protocol. If you can't connect, check whether the instance is over-utilized, and add more targets to your target group if it is too busy to respond. If you can connect, it is possible that the target page is not responding before the health check timeout period. Choose a simpler target page for the health check or adjust the health check settings.

The target did not return a successful response code

By default, the success code is 200, but you can optionally specify additional success codes when you configure health checks. Confirm the success codes that the load balancer is expecting and that your application is configured to return these codes on success.

The target response code was malformed or there was an error connecting to the target

Verify that your application responds to the load balancer's health check requests. Some applications require additional configuration to respond to health checks, such as a virtual host configuration to respond to the HTTP host header sent by the load balancer. The host header value contains the private IP address of the target, followed by the health check port. For example, if your target's private IP address is `10.0.0.10` and health check port is `8080`, the HTTP Host header sent by the load balancer in health checks is `Host: 10.0.0.10:8080`. A virtual host configuration to respond to that host, or a default configuration, may be required to successfully health check your application. Health check requests have the following attributes: the `User-Agent` is set to `ELB-HealthChecker/2.0`, the line terminator for message-header fields is the sequence CRLF, and the header terminates at the first empty line followed by a CRLF.

Clients cannot connect to an internet-facing load balancer

If the load balancer is not responding to requests, check for the following issues:

Your internet-facing load balancer is attached to a private subnet

You must specify public subnets for your load balancer. A public subnet has a route to the Internet Gateway for your virtual private cloud (VPC).

A security group or network ACL does not allow traffic

The security group for the load balancer and any network ACLs for the load balancer subnets must allow inbound traffic from the clients and outbound traffic to the clients on the listener ports.

Load balancer shows elevated processing times

The load balancer counts processing times differently based on configuration.

- If AWS WAF is associated with your Application Load Balancer and a client sends an HTTP POST request, the time to send the data for POST requests is reflected in the `request_processing_time` field in the load balancer access logs. This behavior is expected for HTTP POST requests.
- If AWS WAF is not associated with your Application Load Balancer and a client sends an HTTP POST request, the time to send the data for POST requests is reflected in the `target_processing_time` field in the load balancer access logs. This behavior is expected for HTTP POST requests.

The load balancer sends a response code of 000

With HTTP/2 connections, if the compressed length of any of the headers exceeds 8 K bytes or if the number of requests served through one connection exceeds 10,000, the load balancer sends a GOAWAY frame and closes the connection with a TCP FIN.

The load balancer generates an HTTP error

The following HTTP errors are generated by the load balancer. The load balancer sends the HTTP code to the client, saves the request to the access log, and increments the `HTTPCode_ELB_4XX_Count` or `HTTPCode_ELB_5XX_Count` metric.

Errors

HTTP 400: Bad request

Possible causes:

- The client sent a malformed request that does not meet the HTTP specification.
- The request header exceeded 16 K per request line, 16 K per single header, or 64 K for the entire request header.
- The client closed the connection before sending the full request body.

HTTP 401: Unauthorized

You configured a listener rule to authenticate users, but one of the following is true:

- You configured `OnUnauthenticatedRequest` to deny unauthenticated users or the IdP denied access.
- The size of the claims returned by the IdP exceeded the maximum size supported by the load balancer.
- A client submitted an HTTP/1.0 request without a host header, and the load balancer was unable to generate a redirect URL.
- The requested scope doesn't return an ID token.
- You don't complete the login process before the client login timeout expires. For more information see, Client login timeout (p. 62).

HTTP 403: Forbidden

You configured an AWS WAF web access control list (web ACL) to monitor requests to your Application Load Balancer and it blocked a request.

HTTP 405: Method not allowed

The client used the TRACE method, which is not supported by Application Load Balancers.

HTTP 408: Request timeout

The client did not send data before the idle timeout period expired. Sending a TCP keep-alive does not prevent this timeout. Send at least 1 byte of data before each idle timeout period elapses. Increase the length of the idle timeout period as needed.

HTTP 413: Payload too large

The target is a Lambda function and the request body exceeds 1 MB.

HTTP 414: URI too long

The request URL or query string parameters are too large.

HTTP 460

The load balancer received a request from a client, but the client closed the connection with the load balancer before the idle timeout period elapsed.

Check whether the client timeout period is greater than the idle timeout period for the load balancer. Ensure that your target provides a response to the client before the client timeout period elapses, or increase the client timeout period to match the load balancer idle timeout, if the client supports this.

HTTP 463

The load balancer received an **X-Forwarded-For** request header with too many IP addresses. The upper limit for IP addresses is 30.

HTTP 464

The load balancer received an incoming request protocol that is incompatible with the version config of the target group protocol.

Possible causes:

- The request protocol is an HTTP/1.1, while the target group protocol version is a gRPC or HTTP/2.
- The request protocol is a gRPC, while the target group protocol version is an HTTP/1.1.
- The request protocol is an HTTP/2 and the request is not POST, while target group protocol version is a gRPC.

HTTP 500: Internal server error

Possible causes:

- You configured an AWS WAF web access control list (web ACL) and there was an error executing the web ACL rules.
- The load balancer is unable to communicate with the IdP token endpoint or the IdP user info endpoint.
  - Verify that the IdP's DNS is publicly resolvable.

- Verify that the security groups for your load balancer and the network ACLs for your VPC allow outbound access to these endpoints.
- Verify that your VPC has internet access. If you have an internal-facing load balancer, use a NAT gateway to enable internet access.

HTTP 501: Not implemented

The load balancer received a **Transfer-Encoding** header with an unsupported value. The supported values for **Transfer-Encoding** are `chunked` and `identity`. As an alternative, you can use the **Content-Encoding** header.

HTTP 502: Bad gateway

Possible causes:

- The load balancer received a TCP RST from the target when attempting to establish a connection.
- The load balancer received an unexpected response from the target, such as "ICMP Destination unreachable (Host unreachable)", when attempting to establish a connection. Check whether traffic is allowed from the load balancer subnets to the targets on the target port.
- The target closed the connection with a TCP RST or a TCP FIN while the load balancer had an outstanding request to the target. Check whether the keep-alive duration of the target is shorter than the idle timeout value of the load balancer.
- The target response is malformed or contains HTTP headers that are not valid.
- The target response header exceeded 32 K for the entire response header.
- The load balancer encountered an SSL handshake error or SSL handshake timeout (10 seconds) when connecting to a target.
- The deregistration delay period elapsed for a request being handled by a target that was deregistered. Increase the delay period so that lengthy operations can complete.
- The target is a Lambda function and the response body exceeds 1 MB.
- The target is a Lambda function that did not respond before its configured timeout was reached.
- The target is a Lambda function that returned an error or the function was throttled by the Lambda service.

For more information see How do I troubleshoot Application Load Balancer HTTP 502 errors in the AWS Support Knowledge Center.

HTTP 503: Service unavailable

The target groups for the load balancer have no registered targets.

HTTP 504: Gateway timeout

Possible causes:

- The load balancer failed to establish a connection to the target before the connection timeout expired (10 seconds).
- The load balancer established a connection to the target but the target did not respond before the idle timeout period elapsed.
- The network ACL for the subnet did not allow traffic from the targets to the load balancer nodes on the ephemeral ports (1024-65535).

- The target returns a content-length header that is larger than the entity body. The load balancer timed out waiting for the missing bytes.
- The target is a Lambda function and the Lambda service did not respond before the connection timeout expired.

HTTP 505: Version not supported

The load balancer received an unexpected HTTP version request. For example, the load balancer established an HTTP/1 connection but received an HTTP/2 request.

HTTP 561: Unauthorized

You configured a listener rule to authenticate users, but the IdP returned an error code when authenticating the user. Check your access logs for the related error reason code (p. 124).

A target generates an HTTP error

The load balancer forwards valid HTTP responses from targets to the client, including HTTP errors. The HTTP errors generated by a target are recorded in the `HTTPCode_Target_4XX_Count` and `HTTPCode_Target_5XX_Count` metrics.

Quotas for your Application Load Balancers

Your AWS account has default quotas, formerly referred to as limits, for each AWS service. Unless otherwise noted, each quota is Region-specific. You can request increases for some quotas, and other quotas cannot be increased.

To view the quotas for your Application Load Balancers, open the Service Quotas console. In the navigation pane, choose **AWS services** and select **Elastic Load Balancing**. You can also use the describe-account-limits (AWS CLI) command for Elastic Load Balancing.

To request a quota increase, see Requesting a quota increase in the *Service Quotas User Guide*. If the quota is not yet available in Service Quotas, use the Elastic Load Balancing limit increase form.

Load balancers

Your AWS account has the following quotas related to Application Load Balancers.

Name	Default	Adjustable
Application Load Balancers per Region	50	Yes
Certificates per Application Load Balancer (excluding default certificates)	25	Yes
Listeners per Application Load Balancer	50	Yes
Number of times a target can be registered per Application Load Balancer	1,000	Yes
Target Groups per Action per Application Load Balancer	5	No
Target Groups per Application Load Balancer	100	No
Targets per Application Load Balancer	1,000	Yes

Target groups

The following quotas are for target groups.

Name	Default	Adjustable
Target Groups per Region	3,000 *	Yes
Targets per Target Group per Region (instances or IP addresses)	1,000	Yes
Targets per Target Group per Region (Lambda functions)	1	No

* This quota is shared by Application Load Balancers and Network Load Balancers.

Rules

The following quotas are for rules.

Name	Default	Adjustable
Rules per Application Load Balancer (excluding default rules)	100	Yes
Condition Values per Rule	5	No
Condition Wildcards per Rule	5	No
Match evaluations per rule	5	No

HTTP headers

The following are the size limits for HTTP headers.

Name	Default	Adjustable
Request line	16 K	No
Single header	16 K	No
Entire response header	32 K	No
Entire request header	64 K	No

Document history for Application Load Balancers

The following table describes the releases for Application Load Balancers.

Change	Description	Date
Target group health (p. 146)	This release adds support to configure the minimum count or percentage of targets that must be healthy, and what actions the load balancer takes when the threshold is not met.	November 17, 2022
Cross-zone load balancing (p. 146)	This release adds support to configure cross-zone load balancing at the level group level.	November 17, 2022
IPv6 target groups (p. 146)	This release adds support to configure IPv6 target groups for Application Load Balancers.	September 20, 2021
Client port preservation (p. 146)	This release adds an attribute to preserve the source port that the client used to connect to the load balancer.	July 29, 2021
TLS headers (p. 146)	This release adds an attribute to indicate that the TLS headers, which contain information about the negotiated TLS version and cipher suite, are added to the client request before sending it to the target	July 21, 2021
Additional ACM certificates (p. 146)	This release supports RSA certificates with 2048, 3072, and 4096-bit key lengths, and all ECDSA certificates.	July 14, 2021
Application-based stickiness (p. 146)	This release adds an application-based cookie to support sticky sessions for your load balancer.	February 8, 2021
Least outstanding requests (p. 146)	This release adds support for the least outstanding requests algorithm.	November 25, 2020
Security policy for FS supporting TLS version 1.2 (p. 146)	This release adds a security policy for Forward Secrecy (FS) supporting TLS version 1.2.	November 24, 2020

WAF fail open support (p. 146)	This release adds support for configuring the behavior of your load balancer if it integrates with AWS WAF.	November 13, 2020
gRPC and HTTP/2 support (p. 146)	This release adds support for gRPC workloads and end-to-end HTTP/2.	October 29, 2020
Outpost support (p. 146)	You can provision an Application Load Balancer on your Outpost.	September 8, 2020
Desync mitigation mode (p. 146)	This release adds support for desync mitigation mode.	August 17, 2020
Weighted target groups (p. 146)	This release adds support for forward actions with multiple target groups. Requests are distributed to these target groups based on the weight you specify for each target group.	November 19, 2019
New attribute (p. 146)	This release adds support for the routing.http.drop_invalid_header_fields.enabled attribute.	November 15, 2019
Advanced request routing (p. 146)	This release adds support for additional condition types for your listener rules.	March 27, 2019
Lambda functions as a target (p. 146)	This release adds support for registering Lambda functions as a target.	November 29, 2018
Redirect actions (p. 146)	This release adds support for the load balancer to redirect requests to a different URL.	July 25, 2018
Fixed-response actions (p. 146)	This release adds support for the load balancer to return a custom HTTP response.	July 25, 2018
Security policies for FS and TLS 1.2 (p. 146)	This release adds support for two additional predefined security policies.	June 6, 2018
User authentication (p. 146)	This release adds support for the load balancer to authenticate users of your applications using their corporate or social identities before routing requests.	May 30, 2018