A SUMMER INTERSHIP REPORT ON

"DEMONSTRATE LOAD BALANCER BALANCING LOAD IN DIFFERENT REGIONS"

DEPARTMENT OF COMPUTER ENGINEERING & APPLICATIONS

INSTITUTE OF ENGINEERING & TECHNOLOGY

GLA UNIVERSITY, MATHURA

BATCH 2022-2026

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Declaration

We are the student of B.tech (V Semester) Session 2024-2025, Batch 2022-2026 hereby declare that my work entitled “Load Balancer ”, is the outcome of genuine efforts done by me under the able guidance of Raushan Kumar Singh and being submitted to “Institute of Engineering & Technology”, GLA University, Mathura as summer training project report in partial fulfilment for the award of the degree of Bachelor of Technology (B.tech).

Place : Mathura

Date : 14-08-2024

Course : B.tech (V Semester)

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CONTENT

INTRODUCTION

Load balancing is the method of distributing network traffic equally across a pool of resources that support an application. Modern applications must process millions of users simultaneously and return the correct text, videos, images, and other data to each user in a fast and reliable manner. To handle such high volumes of traffic, most applications have many resource servers with duplicate data between them. A load balancer is a device that sits between the user and the server group and acts as an invisible facilitator, ensuring that all resource servers are used equally. Load balancing is the practice of distributing computational workloads between two or more computers. On the Internet, load balancing is often employed to divide network traffic among several servers. This reduces the strain on each server and makes the servers more efficient, speeding up performance and reducing latency. Load balancing is essential for most Internet applications to function properly. Imagine a checkout line at a grocery store with 8 checkout lines, only one of which is open. All customers must get into the same line, and therefore it takes a long time for a customer to finish paying for their groceries. Now imagine that the store instead opens all 8 checkout lines. In this case, the wait time for customers is about 8 times shorter (depending on factors like how much food each customer is buying). Load balancing essentially accomplishes the same thing. This results in a better user experience — the grocery store customers in the example above would probably look for a more efficient grocery store if they always experienced long wait times.

LOAD BALANCING WORK AND ITS ALGORITHM

Work of load balancing:-

Companies usually have their application running on multiple servers. Such a server arrangement is called a server farm. User requests to the application first go to the load balancer. The load balancer then routes each request to a single server in the server farm best suited to handle the request.

Load balancing is like the work done by a manager in a restaurant. Consider a restaurant with five waiters. If customers were allowed to choose their waiters, one or two waiters could be overloaded with work while the others are idle. To avoid this scenario, the restaurant manager assigns customers to the specific waiters who are best suited to serve them.

Algorithms:-

A load balancing algorithm is the set of rules that a load balancer follows to determine the best server for each of the different client requests. Load balancing algorithms fall into two main categories.

Static load balancing

Static load balancing algorithms follow fixed rules and are independent of the current server state. The following are examples of static load balancing.

Round-robin method

Servers have IP addresses that tell the client where to send requests. The IP address is a long number that is difficult to remember. To make it easy, a Domain Name System maps website names to servers. When you enter aws.amazon.com into your browser, the request first goes to our name server, which returns our IP address to your browser.

In the round-robin method, an authoritative name server does the load balancing instead of specialized hardware or software. The name server returns the IP addresses of different servers in the server farm turn by turn or in a round-robin fashion.

Weighted round-robin method

In weighted round-robin load balancing, you can assign different weights to each server based on their priority or capacity. Servers with higher weights will receive more incoming application traffic from the name server.

IP hash method

In the IP hash method, the load balancer performs a mathematical computation, called hashing, on the client IP address. It converts the

client IP address to a number, which is then mapped to individual servers.

Dynamic load balancing

Dynamic load balancing algorithms examine the current state of the servers before distributing traffic. The following are some examples of dynamic load balancing algorithms.

Least connection method

A connection is an open communication channel between a client and a server. When the client sends the first request to the server, they authenticate and establish an active connection between each other. In the least connection method, the load balancer checks which servers have the fewest active connections and sends traffic to those servers.

Weighted least connection method

Weighted least connection algorithms assume that some servers can handle more active connections than others. Therefore, you can assign different weights or capacities to each server, and the load balancer sends the new client requests to the server with the least connections by capacity.

Least response time method

The response time is the total time that the server takes to process the incoming requests and send a response. The least response time method combines the server response time and the active connections to determine the best server. Load balancers use this algorithm to ensure faster service for all users.

Resource-based method

In the resource-based method, load balancers distribute traffic by analyzing the current server load. Specialized software called an agent runs on each server and calculates usage of server resources, such as

its computing capacity and memory. Then, the load balancer checks the agent for sufficient free resources before distributing traffic to that server.

TYPES OF LOAD BALANCING AND ITS TECHNOLOGY

Types of load balancing:-

We can classify load balancing into three main categories depending on what the load balancer checks in the client request to redirect the traffic.

Application load balancing

Complex modern applications have several server farms with multiple servers dedicated to a single application function. Application load balancers look at the request content, such as HTTP headers or SSL session IDs, to redirect traffic.

For example, an ecommerce application has a product directory, shopping cart, and checkout functions. The application load balancer sends requests for browsing products to servers that contain images and videos but do not need to maintain open connections. By comparison, it sends shopping cart requests to servers that can maintain many client connections and save cart data for a long time.

Network load balancing

Network load balancers examine IP addresses and other network information to redirect traffic optimally. They track the source of the application traffic and can assign a static IP address to several servers. Network load balancers use the static and dynamic load balancing algorithms described earlier to balance server load.

Global server load balancing

Global server load balancing occurs across several geographically distributed servers. For example, companies can have servers in multiple data centres, in different countries, and in third-party cloud providers around the globe. In this case, local load balancers manage the application load within a region or zone. They attempt to redirect traffic to a server destination that is geographically closer to the client. They might redirect traffic to servers outside the client's geographic zone only in case of server failure.

DNS load balancing

In DNS load balancing, you configure your domain to route network requests across a pool of resources on your domain. A domain can correspond to a website, a mail system, a print server, or another service that is made accessible through the internet. DNS load balancing is helpful for maintaining application availability and balancing network traffic across a globally distributed pool of resources.

What are the types of load balancing technology?

Load balancers are one of two types: hardware load balancer and software load balancer.

Hardware load balancers

A hardware-based load balancer is a hardware appliance that can securely process and redirect gigabytes of traffic to hundreds of different servers. You can store it in your data centers and use virtualization to create multiple digital or virtual load balancers that you can centrally manage.

Software load balancers

Software-based load balancers are applications that perform all load balancing functions. You can install them on any server or access them as a fully managed third-party service.

Comparison of hardware balancers to software load balancers

Hardware load balancers require an initial investment, configuration, and ongoing maintenance. You might also not use them to full capacity, especially if you purchase one only to handle peak-time traffic spikes. If traffic volume increases suddenly beyond its current capacity, this will affect users until you can purchase and set up another load balancer.

In contrast, software-based load balancers are much more flexible. They can scale up or down easily and are more compatible with modern cloud computing environments. They also cost less to set up, manage, and use over time.

AWS HELP IN LOAD BALANCING

Elastic Load Balancing (ELB) is a fully managed load balancing service that automatically distributes incoming application traffic to multiple targets and virtual appliances across AWS and on-premises resources. You can use it to scale modern applications without complex configurations or API gateways. You can use ELB to set up four different types of software load balancers.

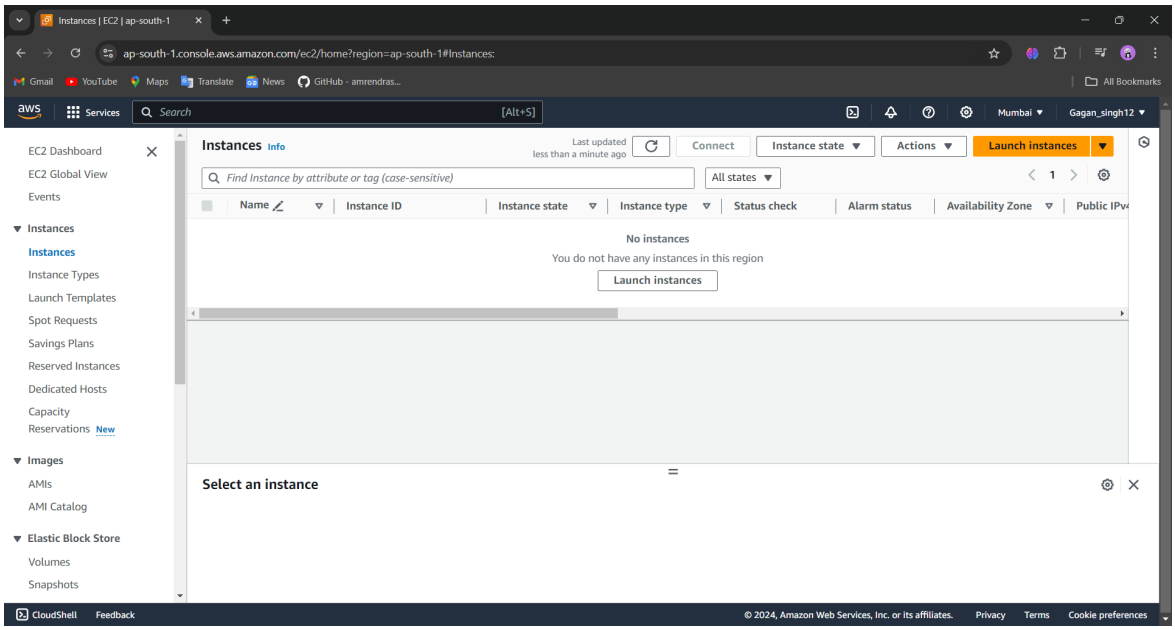
- An Application Load Balancer routes traffic for HTTP-based requests.
- A Network Load Balancer routes traffic based on IP addresses. It is ideal for balancing TCP and User Datagram Protocol (UDP)-based requests.
- A Gateway Load Balancer routes traffic to third-party virtual appliances. It is ideal for incorporating a third-party appliance, such as a network firewall, into your network traffic in a scalable and easy-to-manage way.
- A Classic Load Balancer routes traffic to applications in the Amazon EC2 -Classic network—a single, flat network that you share with other customers.

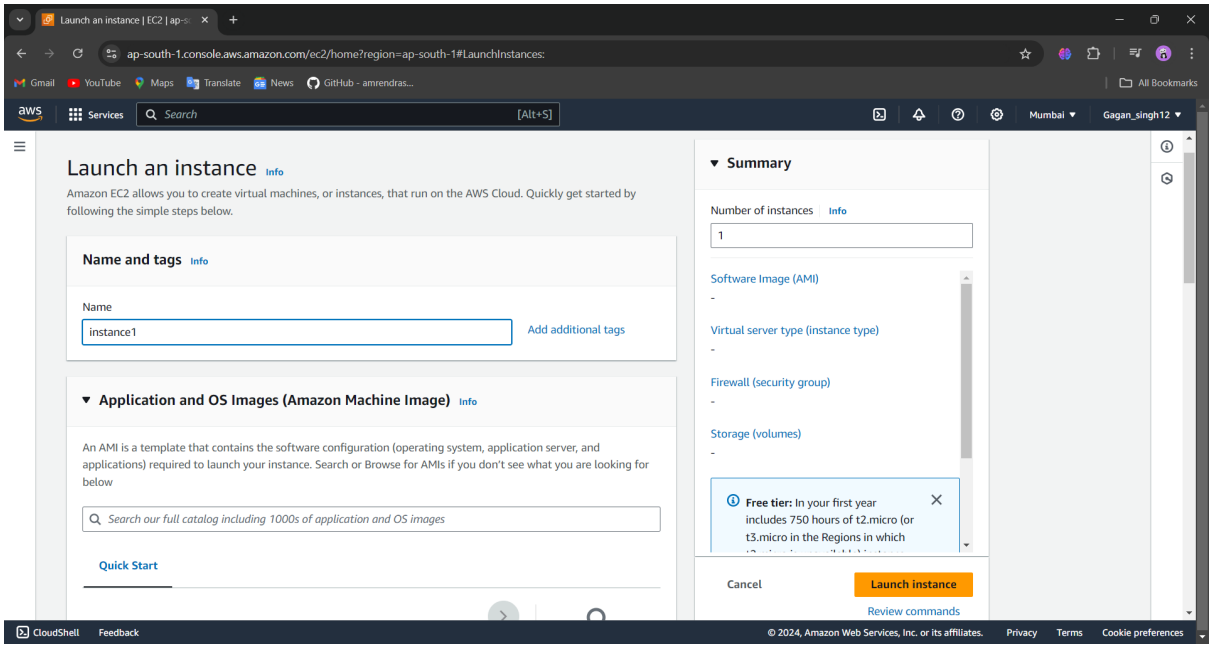
You can select the load balancer based on your requirements. For example, Terminix, a global pest control brand, uses Gateway Load Balancer to handle 300% more throughput. Second Spectrum, a company that provides artificial intelligence-driven tracking technology for sports broadcasts, uses AWS Load Balancer Controller to reduce hosting costs by 90%. Code.org, a nonprofit dedicated to expanding

access to computer science in schools, uses Application Load Balancer to handle a 400% spike in traffic efficiently during online coding events.

CREATE APPLICATION LOAD BALANCER ON AWS

First we'll create EC2 instance:-




Launch an instance | EC2 | ap-s
ap-south-1.console.aws.amazon.com/ec2/home?region=ap-south-1#LaunchInstances:
Gmail YouTube Maps Translate News GitHub - amrendras... All Bookmarks
aws Services Search [Alt+S] Mumbai Gagan_singh12
Launch an instance Info
Amazon EC2 allows you to create virtual machines, or instances, that run on the AWS Cloud. Quickly get started by following the simple steps below.
Name and tags Info
Name
instance1
Add additional tags
Application and OS Images (Amazon Machine Image) Info
An AMI is a template that contains the software configuration (operating system, application server, and applications) required to launch your instance. Search or Browse for AMIs if you don't see what you are looking for below
Search our full catalog including 1000s of application and OS images
Quick Start
Summary
Number of instances Info
1
Software Image (AMI)
-
Virtual server type (instance type)
-
Firewall (security group)
-
Storage (volumes)
-
Free tier: In your first year includes 750 hours of t2.micro (or t3.micro in the Regions in which
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Launch instance
Review commands
CloudShell Feedback
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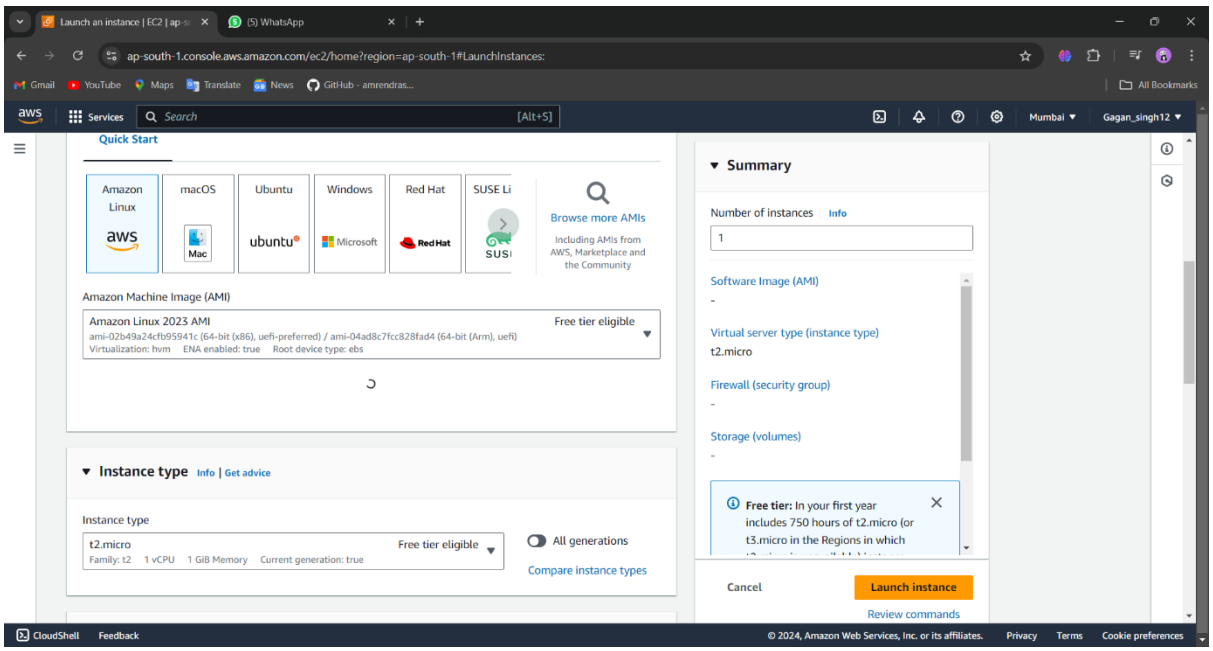
Launch an instance | EC2 | ap-s
(5) WhatsApp
ap-south-1.console.aws.amazon.com/ec2/home?region=ap-south-1#LaunchInstances:
Gmail YouTube Maps Translate News GitHub - amrendras... All Bookmarks
aws Services Search [Alt+S] Mumbai Gagan_singh12
Quick Start
Amazon Linux
macOS
Ubuntu
Windows
Red Hat
SUSE Li
Browse more AMIs
Including AMIs from AWS, Marketplace and the Community
Amazon Machine Image (AMI)
Amazon Linux 2023 AMI
ami-02b49a24cfb95941c (64-bit (x86), uefi-preferred) / ami-04ad8c7fcc828fad4 (64-bit (Arm), uefi)
Virtualization: hvm ENA enabled: true Root device type: ebs
Free tier eligible
Instance type Info | Get advice
Instance type
t2.micro
Family: t2 1 vCPU 1 GiB Memory Current generation: true
Free tier eligible
All generations
Compare instance types
Summary
Number of instances Info
1
Software Image (AMI)
-
Virtual server type (instance type)
t2.micro
Firewall (security group)
-
Storage (volumes)
-
Free tier: In your first year includes 750 hours of t2.micro (or t3.micro in the Regions in which
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Launch instance
Review commands
CloudShell Feedback
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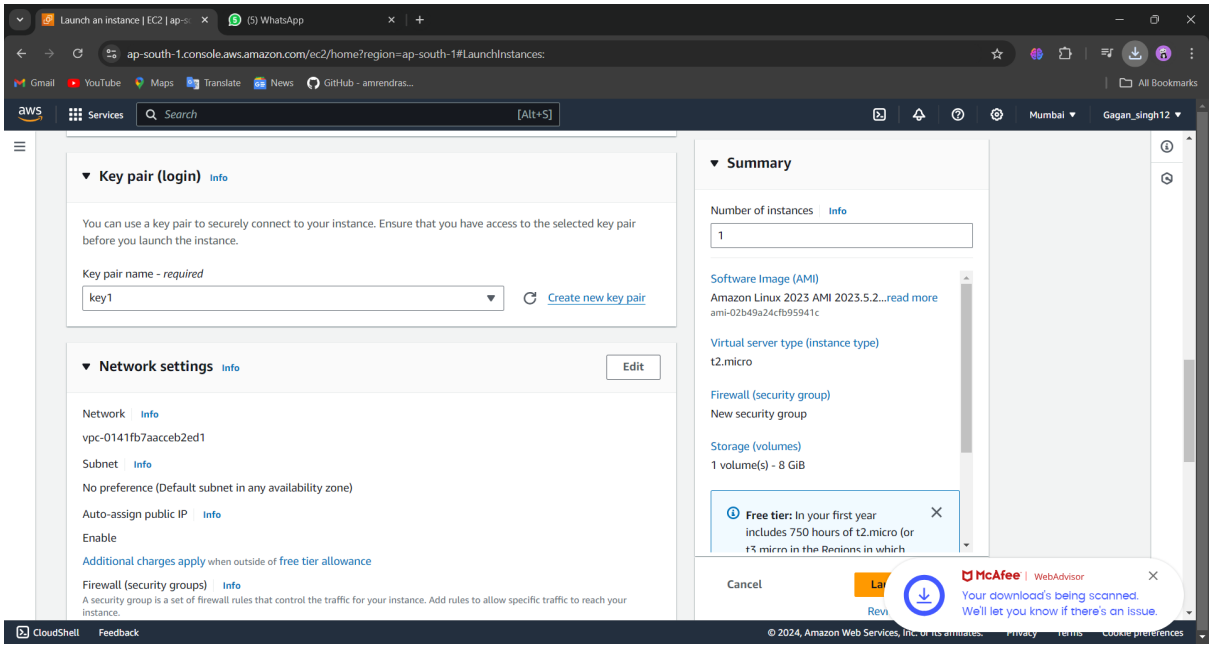
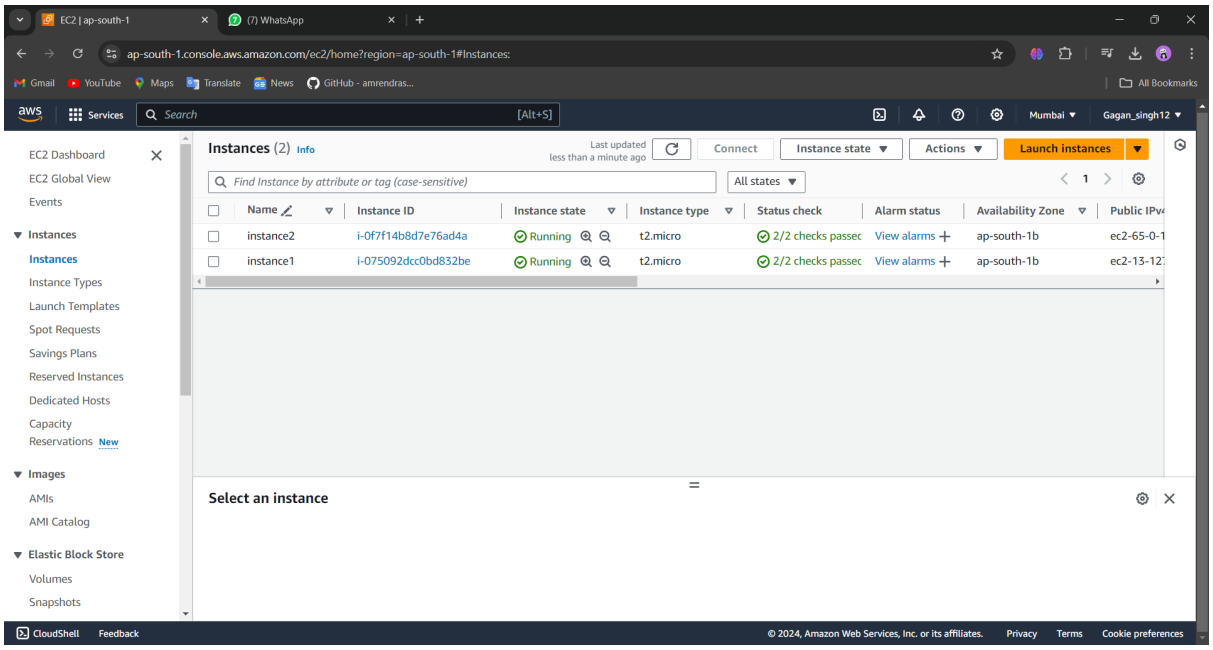
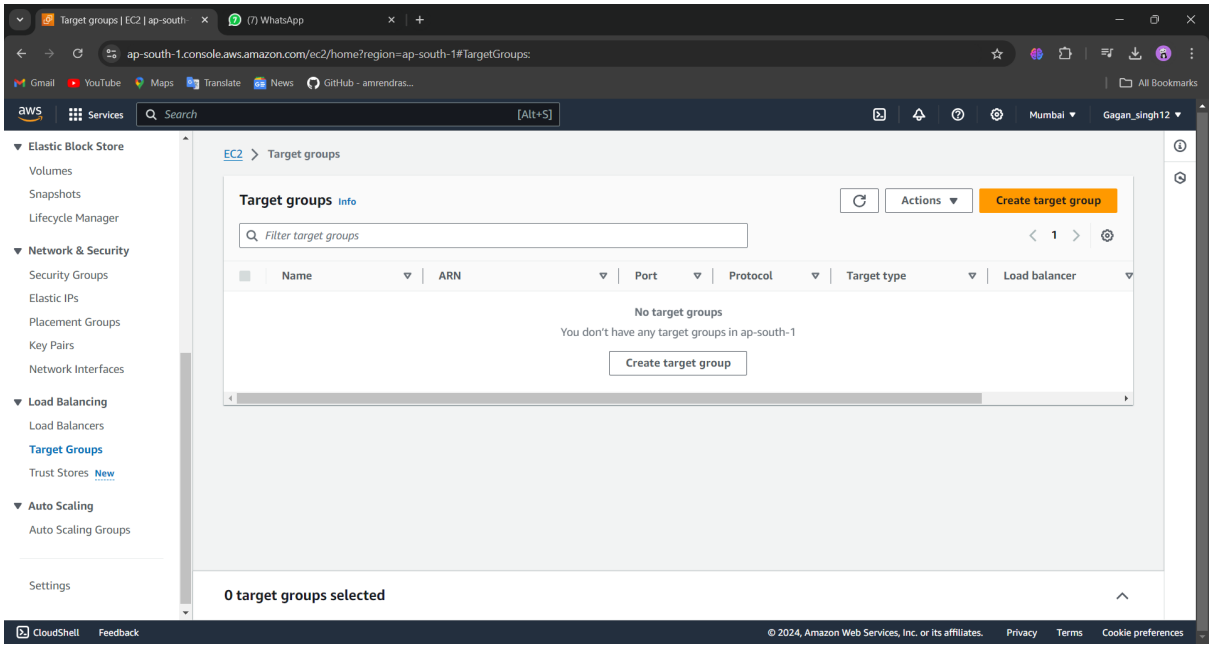




How to create target group:-


Target groups | EC2 | ap-south-
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ap-south-1.console.aws.amazon.com/ec2/home?region=ap-south-1#TargetGroups:
Gmail
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Maps
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GitHub - amrendras...
All Bookmarks
aws
Services
Search
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Elastic Block Store
Volumes
Snapshots
Lifecycle Manager
Network & Security
Security Groups
Elastic IPs
Placement Groups
Key Pairs
Network Interfaces
Load Balancing
Load Balancers
Target Groups
Trust Stores
New
Auto Scaling
Auto Scaling Groups
Settings
EC2
Target groups
Target groups
Info
Actions
Create target group
Filter target groups
1
Name
ARN
Port
Protocol
Target type
Load balancer
No target groups
You don't have any target groups in ap-south-1
Create target group
0 target groups selected
CloudShell
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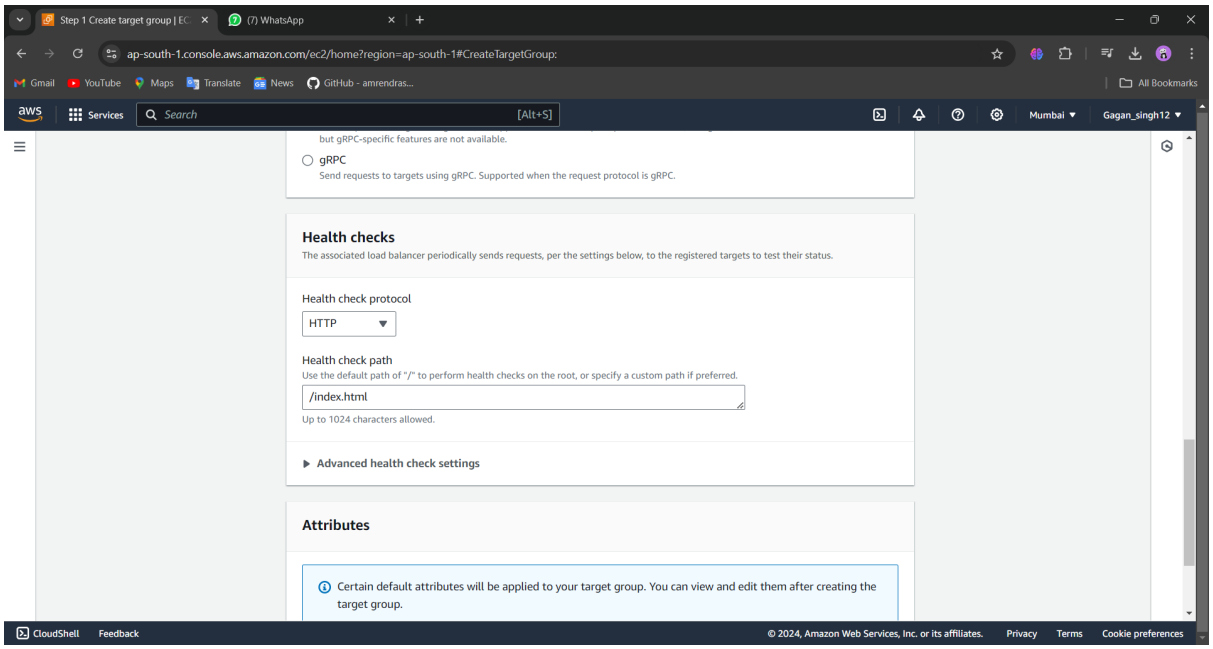
Step 1 Create target group | EC
(7) WhatsApp
ap-south-1.console.aws.amazon.com/ec2/home?region=ap-south-1#CreateTargetGroup:
Gmail
YouTube
Maps
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News
GitHub - amrendras...
All Bookmarks
aws
Services
Search
[Alt+S]
Mumbai
Gagan_singh12
but gRPC-specific features are not available.
gRPC
Send requests to targets using gRPC. Supported when the request protocol is gRPC.
Health checks
The associated load balancer periodically sends requests, per the settings below, to the registered targets to test their status.
Health check protocol
HTTP
Health check path
Use the default path of "/" to perform health checks on the root, or specify a custom path if preferred.
/index.html
Up to 1024 characters allowed.
Advanced health check settings
Attributes
Certain default attributes will be applied to your target group. You can view and edit them after creating the target group.
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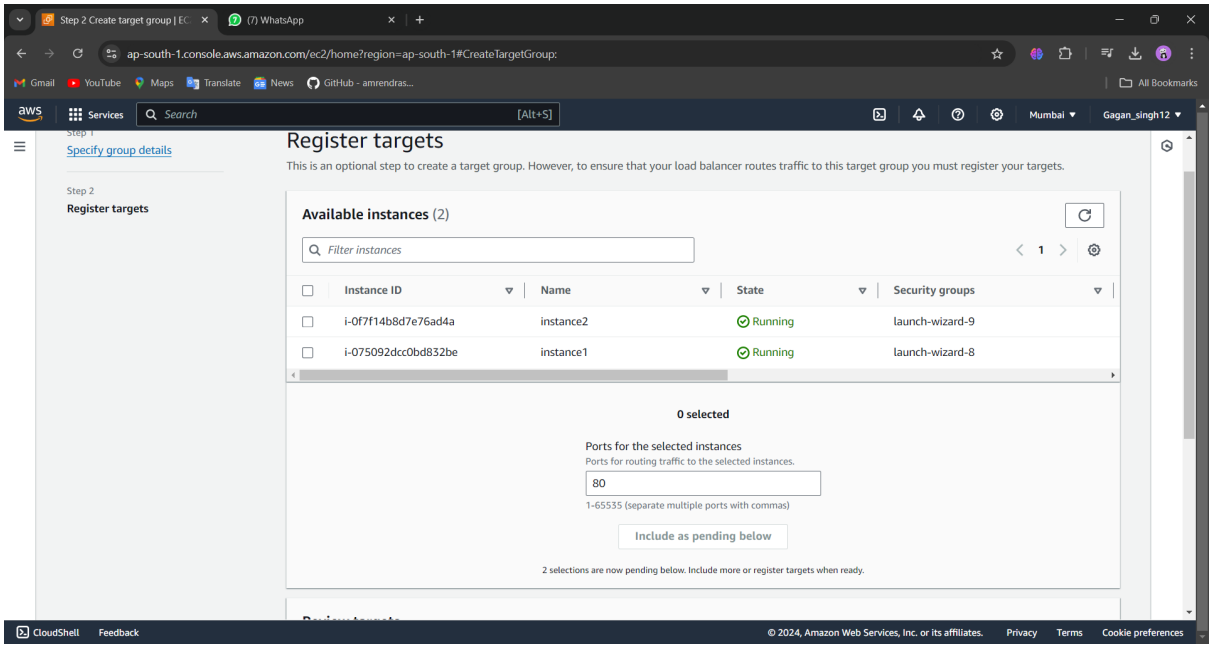
Step 2 Create target group | EC
(7) WhatsApp
ap-south-1.console.aws.amazon.com/ec2/home?region=ap-south-1#CreateTargetGroup:
Gmail
YouTube
Maps
Translate
News
GitHub - amrendras...
All Bookmarks
aws
Services
Search
[Alt+S]
Mumbai
Gagan_singh12
Specify group details
Step 2
Register targets
Register targets
This is an optional step to create a target group. However, to ensure that your load balancer routes traffic to this target group you must register your targets.
Available instances (2)
Filter instances
1
Instance ID
Name
State
Security groups
i-0f7f14b8d7e76ad4a
instance2
Running
launch-wizard-9
i-075092dcc0bd832be
instance1
Running
launch-wizard-8
0 selected
Ports for the selected instances
Ports for routing traffic to the selected instances.
80
1-65535 (separate multiple ports with commas)
Include as pending below
2 selections are now pending below. Include more or register targets when ready.
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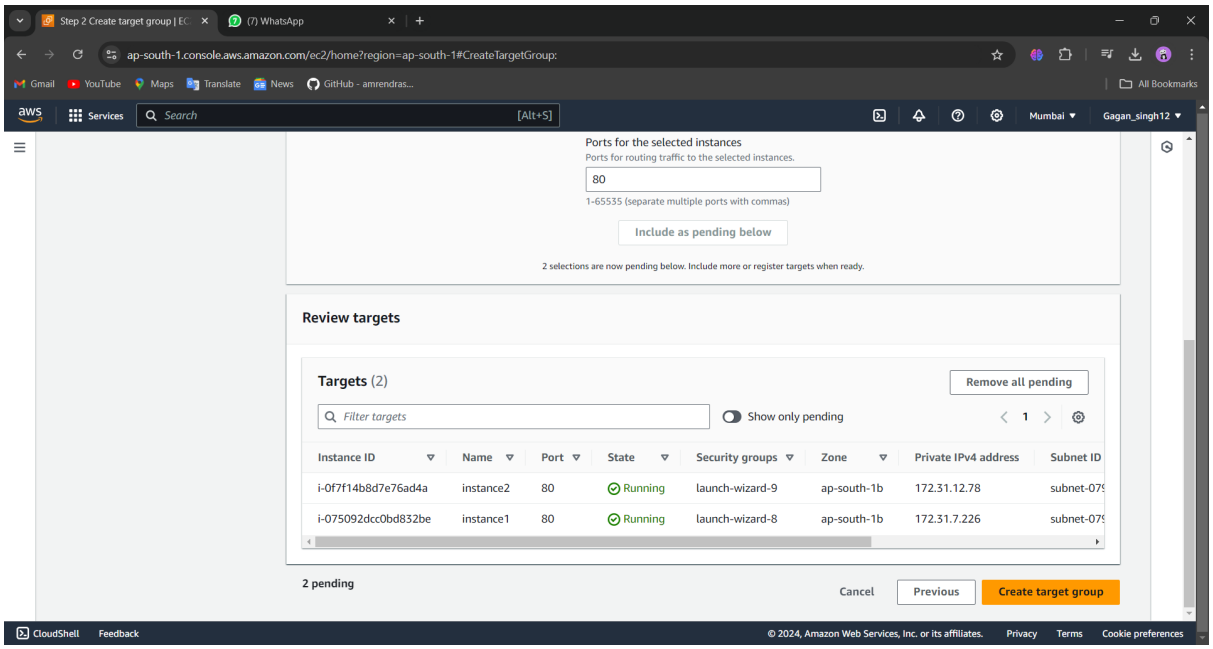
Step 2 Create target group | EC
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Ports for the selected instances
Ports for routing traffic to the selected instances.
80
1-65535 (separate multiple ports with commas)
Include as pending below
2 selections are now pending below. Include more or register targets when ready.
Review targets
Targets (2)
Remove all pending
Filter targets
Show only pending
1
Instance ID
Name
Port
State
Security groups
Zone
Private IPv4 address
Subnet ID
i-0f7f14b8d7e76ad4a
instance2
80
Running
launch-wizard-9
ap-south-1b
172.31.12.78
subnet-079
i-075092dcc0bd832be
instance1
80
Running
launch-wizard-8
ap-south-1b
172.31.7.226
subnet-079
2 pending
Cancel
Previous
Create target group
CloudShell
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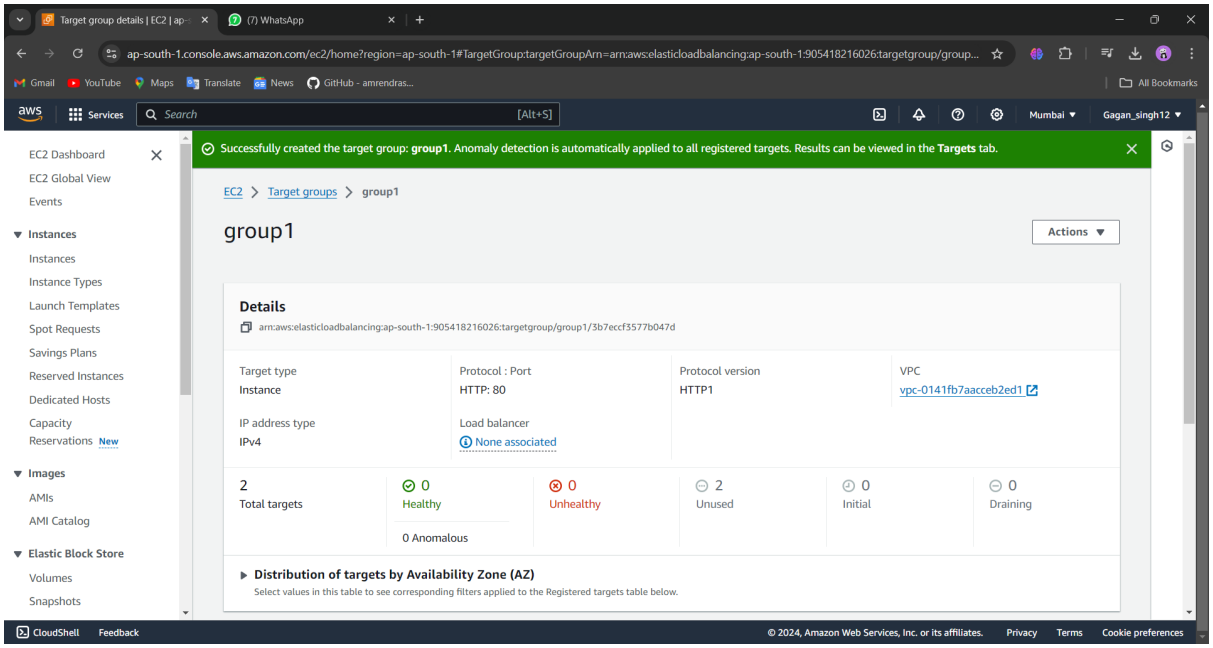
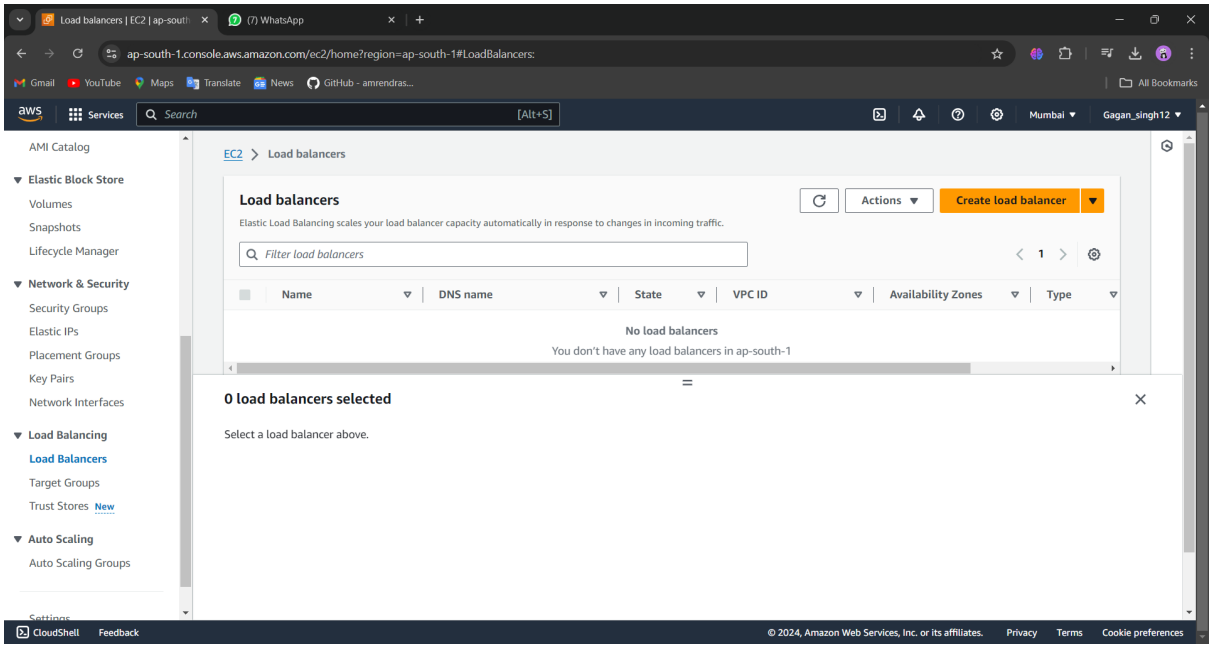


How to create a load balancer:-


Load balancers | EC2 | ap-south
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ap-south-1.console.aws.amazon.com/ec2/home?region=ap-south-1#LoadBalancers:
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GitHub - amrendras...
All Bookmarks
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Services
Search
[Alt+S]
Mumbai
Gagan_singh12
AMI Catalog
Elastic Block Store
Volumes
Snapshots
Lifecycle Manager
Network & Security
Security Groups
Elastic IPs
Placement Groups
Key Pairs
Network Interfaces
Load Balancing
Load Balancers
Target Groups
Trust Stores
New
Auto Scaling
Auto Scaling Groups
EC2
Load balancers
Load balancers
Elastic Load Balancing scales your load balancer capacity automatically in response to changes in incoming traffic.
Actions
Create load balancer
Filter load balancers
1
Name
DNS name
State
VPC ID
Availability Zones
Type
No load balancers
You don't have any load balancers in ap-south-1
0 load balancers selected
Select a load balancer above.
CloudShell
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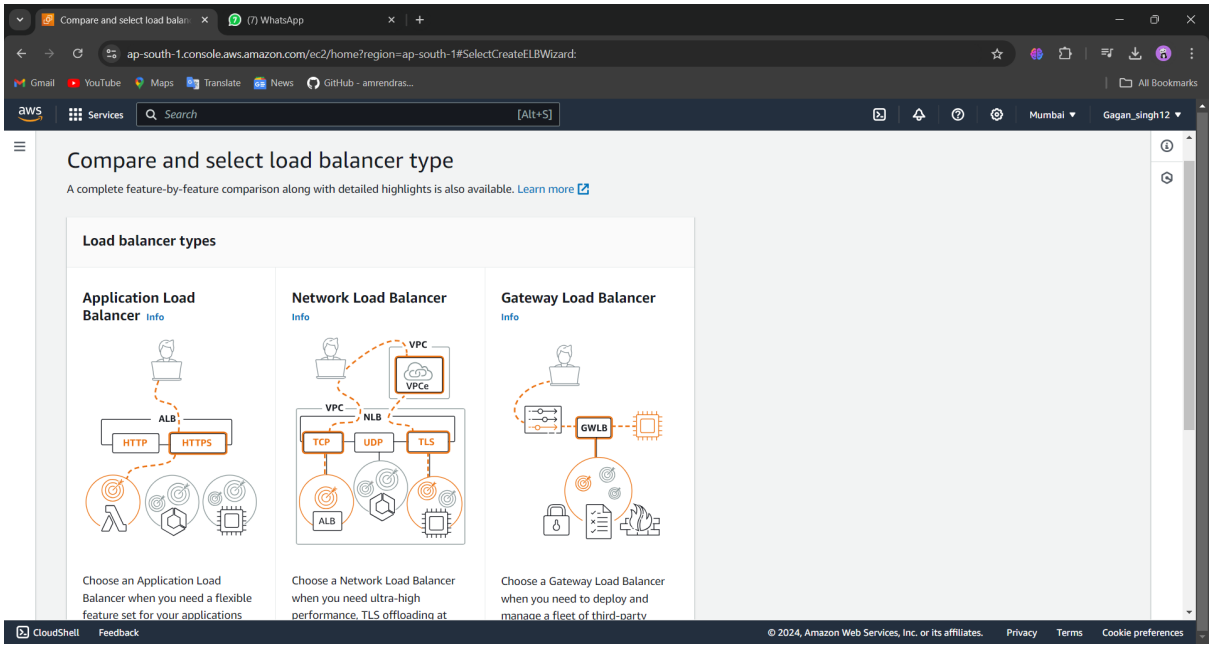
Compare and select load balan
(7) WhatsApp
ap-south-1.console.aws.amazon.com/ec2/home?region=ap-south-1#SelectCreateELBWizard:
Gmail
YouTube
Maps
Translate
News
GitHub - amrendras...
All Bookmarks
aws
Services
Search
[Alt+S]
Mumbai
Gagan_singh12
Compare and select load balancer type
A complete feature-by-feature comparison along with detailed highlights is also available. Learn more
Load balancer types
Application Load Balancer Info
ALB
HTTP
HTTPS
Choose an Application Load Balancer when you need a flexible feature set for your applications
Network Load Balancer
Info
VPC
VPCe
VPC
NLB
TCP
UDP
TLS
ALB
Choose a Network Load Balancer when you need ultra-high performance, TLS offloading at
Gateway Load Balancer
Info
GWLB
Choose a Gateway Load Balancer when you need to deploy and manage a fleet of third-party
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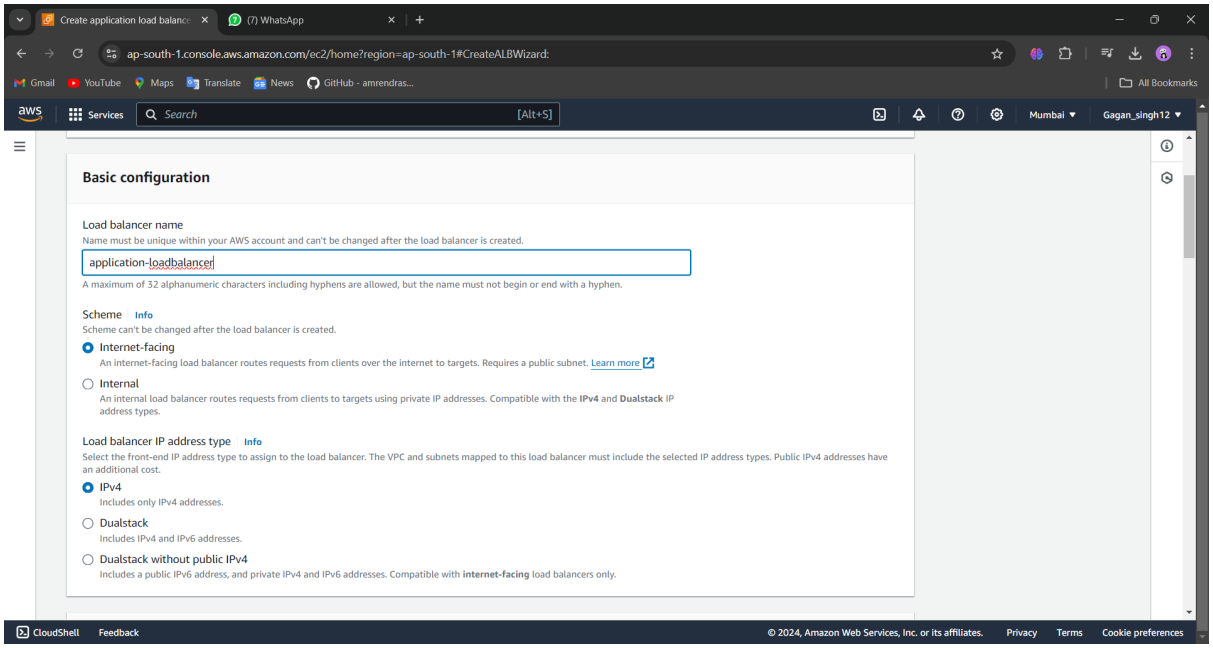
Create application load balanc
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ap-south-1.console.aws.amazon.com/ec2/home?region=ap-south-1#CreateALBWizard:
Gmail
YouTube
Maps
Translate
News
GitHub - amrendras...
All Bookmarks
aws
Services
Search
[Alt+S]
Mumbai
Gagan_singh12
Basic configuration
Load balancer name
Name must be unique within your AWS account and can't be changed after the load balancer is created.
application-loadbalancer
A maximum of 32 alphanumeric characters including hyphens are allowed, but the name must not begin or end with a hyphen.
Scheme Info
Scheme can't be changed after the load balancer is created.
Internet-facing
An internet-facing load balancer routes requests from clients over the internet to targets. Requires a public subnet. Learn more
Internal
An internal load balancer routes requests from clients to targets using private IP addresses. Compatible with the IPv4 and Dualstack IP address types.
Load balancer IP address type Info
Select the front-end IP address type to assign to the load balancer. The VPC and subnets mapped to this load balancer must include the selected IP address types. Public IPv4 addresses have an additional cost.
IPv4
Includes only IPv4 addresses.
Dualstack
Includes IPv4 and IPv6 addresses.
Dualstack without public IPv4
Includes a public IPv6 address, and private IPv4 and IPv6 addresses. Compatible with internet-facing load balancers only.
CloudShell
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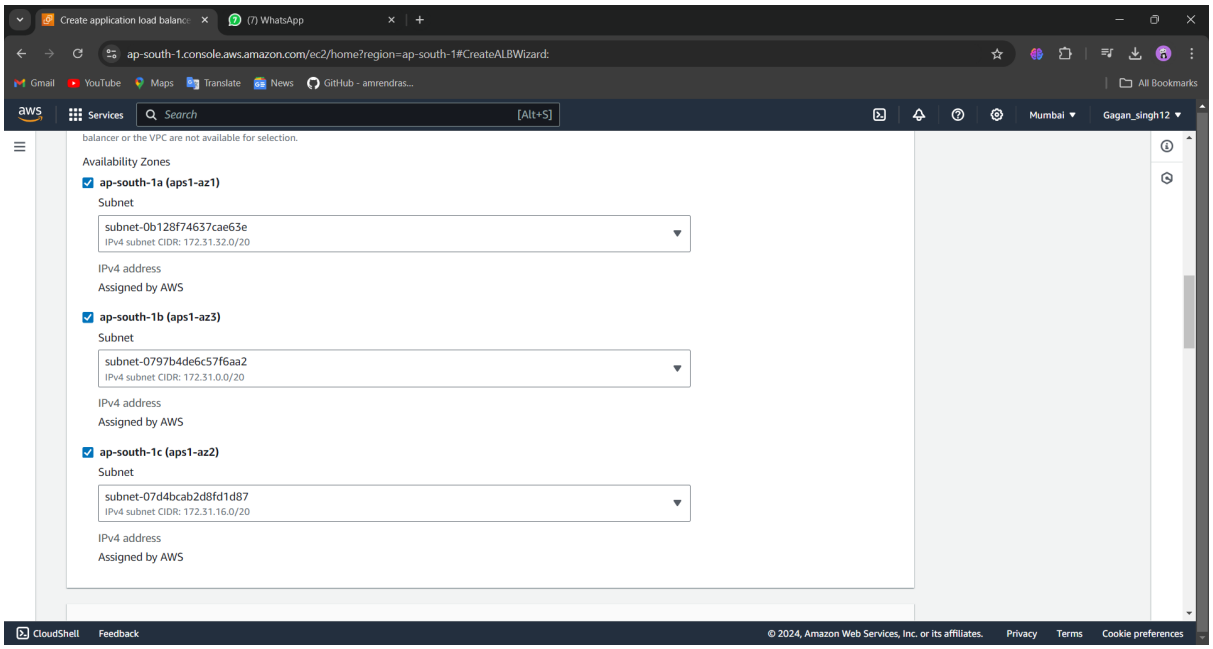
Create application load balanc
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ap-south-1.console.aws.amazon.com/ec2/home?region=ap-south-1#CreateALBWizard:
Gmail
YouTube
Maps
Translate
News
GitHub - amrendras...
All Bookmarks
aws
Services
Search
[Alt+S]
Mumbai
Gagan_singh12
balancer or the VPC are not available for selection.
Availability Zones
ap-south-1a (aps1-az1)
Subnet
subnet-0b128f74637cae63e
IPv4 subnet CIDR: 172.31.32.0/20
IPv4 address
Assigned by AWS
ap-south-1b (aps1-az3)
Subnet
subnet-0797b4de6c57f6aa2
IPv4 subnet CIDR: 172.31.0.0/20
IPv4 address
Assigned by AWS
ap-south-1c (aps1-az2)
Subnet
subnet-07d4bcab2d8fd1d87
IPv4 subnet CIDR: 172.31.16.0/20
IPv4 address
Assigned by AWS
CloudShell
Feedback
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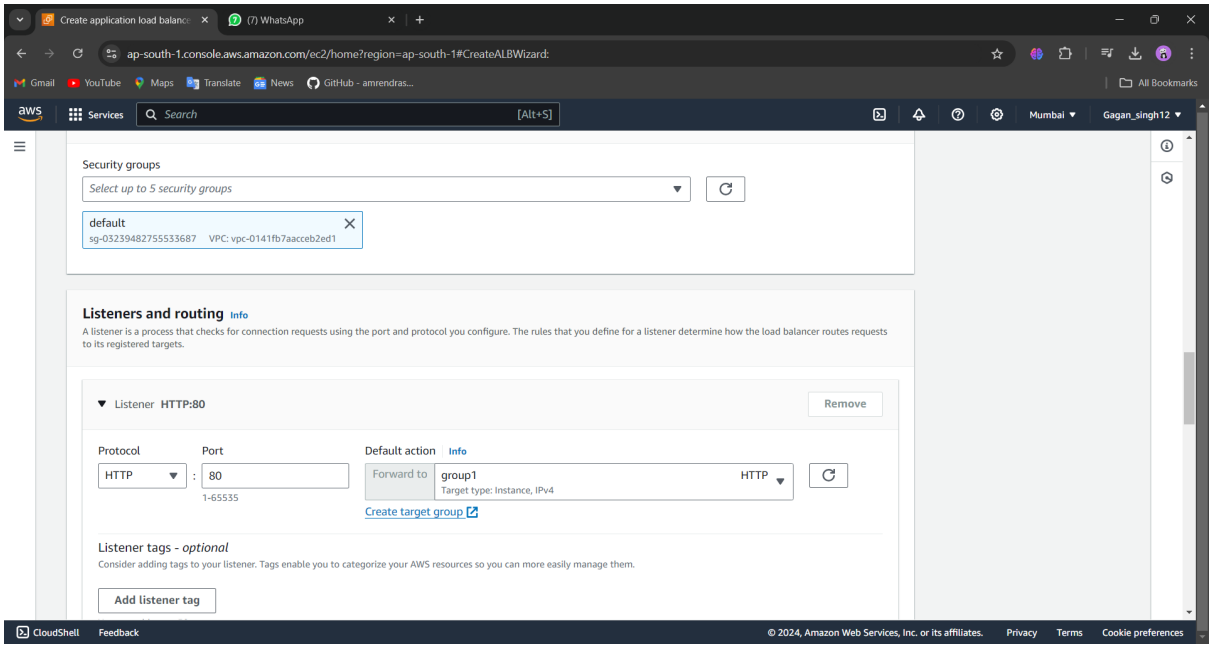
Privacy
Terms
Cookie preferences


Create application load balancer
(7) WhatsApp
ap-south-1.console.aws.amazon.com/ec2/home?region=ap-south-1#CreateALBWizard:
Gmail
YouTube
Maps
Translate
News
GitHub - amrendras...
All Bookmarks
aws
Services
Search
[Alt+S]
Mumbai
Gagan_singh12
Security groups
Select up to 5 security groups
default
sg-03239482755533687 VPC: vpc-0141fb7aacceb2ed1
Listeners and routing Info
A listener is a process that checks for connection requests using the port and protocol you configure. The rules that you define for a listener determine how the load balancer routes requests to its registered targets.
Listener HTTP:80
Remove
Protocol
Port
Default action Info
HTTP
80
1-65535
Forward to
group1
HTTP
Target type: Instance, IPv4
Create target group
Listener tags - optional
Consider adding tags to your listener. Tags enable you to categorize your AWS resources so you can more easily manage them.
Add listener tag
CloudShell
Feedback
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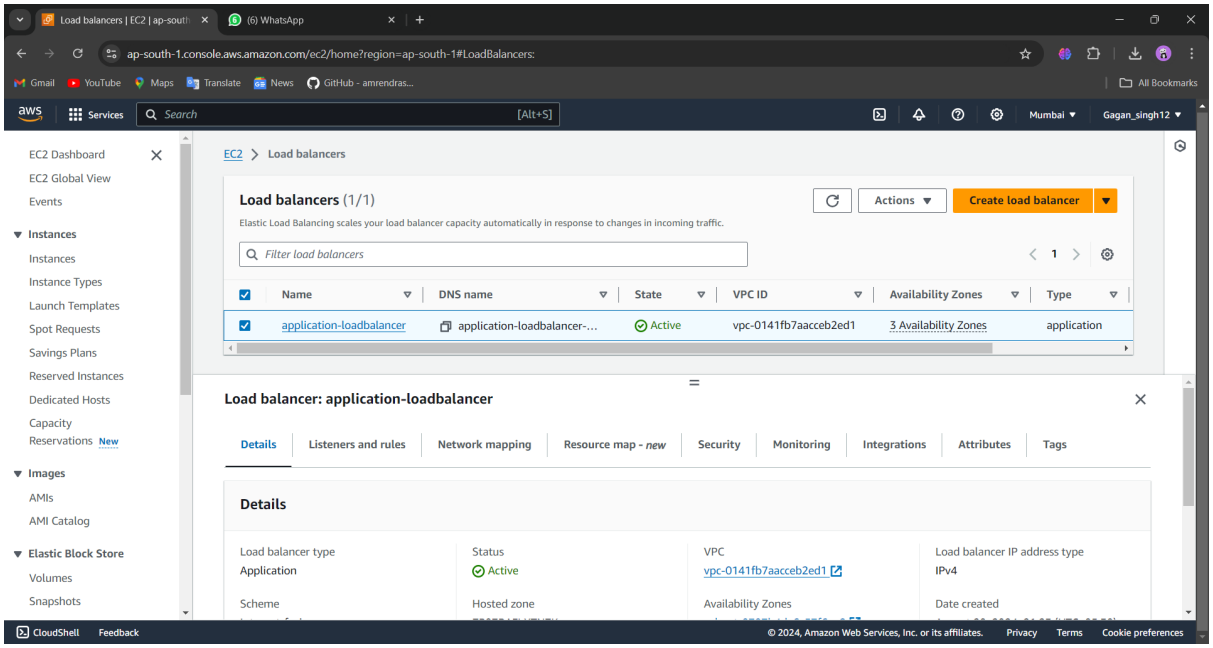
Load balancers | EC2 | ap-south
(6) WhatsApp
ap-south-1.console.aws.amazon.com/ec2/home?region=ap-south-1#LoadBalancers:
Gmail
YouTube
Maps
Translate
News
GitHub - amrendras...
All Bookmarks
aws
Services
Search
[Alt+S]
Mumbai
Gagan_singh12
EC2 Dashboard
EC2 Global View
Events
Instances
Instances
Instance Types
Launch Templates
Spot Requests
Savings Plans
Reserved Instances
Dedicated Hosts
Capacity Reservations New
Images
AMIs
AMI Catalog
Elastic Block Store
Volumes
Snapshots
EC2 > Load balancers
Load balancers (1/1)
Actions
Create load balancer
Elastic Load Balancing scales your load balancer capacity automatically in response to changes in incoming traffic.
Filter load balancers
Name
DNS name
State
VPC ID
Availability Zones
Type
application-loadbalancer
application-loadbalancer-...
Active
vpc-0141fb7aacceb2ed1
3 Availability Zones
application
Load balancer: application-loadbalancer
Details
Listeners and rules
Network mapping
Resource map - new
Security
Monitoring
Integrations
Attributes
Tags
Details
Load balancer type
Application
Status
Active
VPC
vpc-0141fb7aacceb2ed1
Load balancer IP address type
IPv4
Scheme
Hosted zone
Availability Zones
Date created
CloudShell
Feedback
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CONCLUSION

Load balancing is a critical concept in network management, particularly for systems that need to handle large volumes of traffic or requests. It involves distributing incoming network traffic across multiple servers to ensure no single server becomes overwhelmed, leading to optimal resource use, reduced latency, and improved reliability.

Here's a brief explanation with a conclusion:

Demonstration of Load Balancing

1. **Scenario**: Imagine a web application that receives requests from users all over the world. Without load balancing, all these requests would go to a single server. If this server gets overloaded, users would experience slow response times or even complete downtime.
2. **Load Balancer in Action**:
    - **Step 1**: A load balancer is introduced between the users and the servers.
    - **Step 2**: The load balancer receives incoming requests and decides which server to forward each request to, based on various algorithms (e.g., Round Robin, Least Connections, IP Hashing).
    - **Step 3**: The servers process the requests and send responses back to the users through the load balancer.

- **Step 4**: If one server fails or becomes too slow, the load balancer automatically reroutes traffic to the remaining servers, ensuring continuity and efficiency.

3. **Types of Load Balancing Algorithms**:
   - **Round Robin**: Distributes requests sequentially across the servers.
   - **Least Connections**: Directs traffic to the server with the fewest active connections.
   - **IP Hashing**: Routes requests based on the client's IP address.

Conclusion

Load balancing plays a vital role in maintaining the performance and availability of applications. By efficiently distributing incoming traffic among multiple servers, it prevents any single server from being overwhelmed, ensuring that applications remain responsive and reliable even under heavy load. This not only enhances user experience but also contributes to the scalability and resilience of the system.