Project Report for Summer Training 2023 [Cloud Computing using AWS]

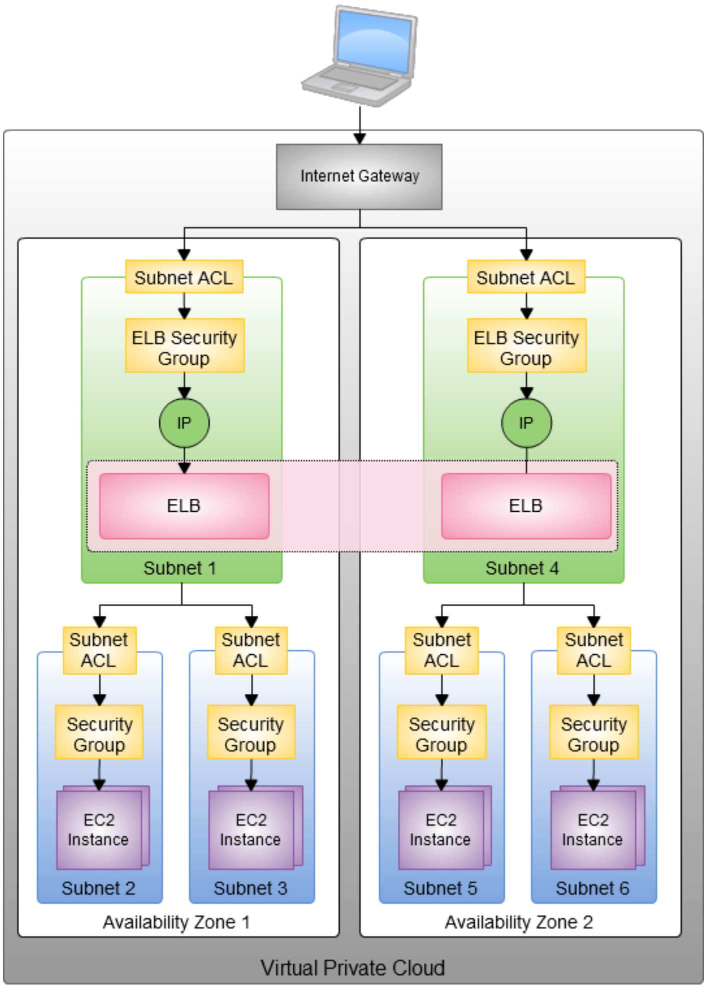
Submitted by: Animesh Kumar

AWS Elastic Load Balancing Inside of a Virtual Private Cloud

The popular AWS Elastic Load Balancing Feature is now available within the Virtual Private Cloud (VPC). Features such as SSL termination, health checks, sticky sessions and CloudWatch monitoring can be configured from the AWS Management Console, the command line, or through the Elastic Load Balancing APIs.

When you provision an Elastic Load Balancer for your VPC, you can assign security groups to it. You can place ELBs into VPC subnets, and you can also use subnet ACLs (Access Control Lists). The EC2 instances that you register with the Elastic Load Balancer do not need to have public IP addresses. The combination of the Virtual Private Cloud, subnets, security groups, and access control lists gives you precise, fine-grained control over access to your Load Balancers and to the EC2 instances behind them and allows you to create a private load balancer.

Here's how it all fits together:



Services used in the project

- **EC2(Elastic Compute Cloud):** Amazon Elastic Compute Cloud (Amazon EC2) is a web service that provides secure, resizable compute capacity in the cloud. It is designed to make web-scale cloud computing easier for developers. Amazon EC2's simple web service interface allows you to obtain and configure capacity with minimal friction.

Amazon EC2

- **VPC(Virtual Private Cloud):** With Amazon Virtual Private Cloud (Amazon VPC), you can launch AWS resources in a logically isolated virtual network that you've defined. This virtual network closely resembles a traditional network that you'd operate in your own data center, with the benefits of using the scalable infrastructure of AWS.

Amazon VPC

Terms related to the project

- **Subnet:** A subnet, or subnetwork, is a network inside a network. Subnets make networks more efficient. Through subnetting, network traffic can travel a shorter distance without passing through unnecessary routers to reach its destination.

- **Internet Gateway:** An internet gateway is a horizontally scaled, redundant, and highly available VPC component that allows communication between your VPC and the internet. It supports IPv4 and IPv6 traffic. It does not cause availability risks or bandwidth constraints on your network traffic.

- **Route Table:** A route table is a set of rules, often viewed in a table format, that's used to determine where data packets traveling over an Internet Protocol (IP) network will be directed.

- **Instance:** An instance in cloud computing is a server resource provided by third-party cloud services. While you can manage and maintain physical server resources on premises, it is costly and inefficient to do so. Cloud providers maintain hardware in their data centers and give you virtual access to compute resources in the form of an instance. You can use the cloud instance for running compute-intensive workloads like containers, databases, microservices, and virtual machines.

- **Target Group:** Target group is a logical grouping of EC2 instances that sits behind a load balancer where traffic is forwarded to, based on protocols and ports defined in a listener rule.

- **Load Balancer:** 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.

- **Region:** An AWS Region is a cluster of data centers in a specific geographic area, such as the Northeastern United States or Western Europe. It is a best practice to choose a region that is geographically close to users; this reduces latency because data reaches the users more quickly. Each AWS Region includes multiple AZs.

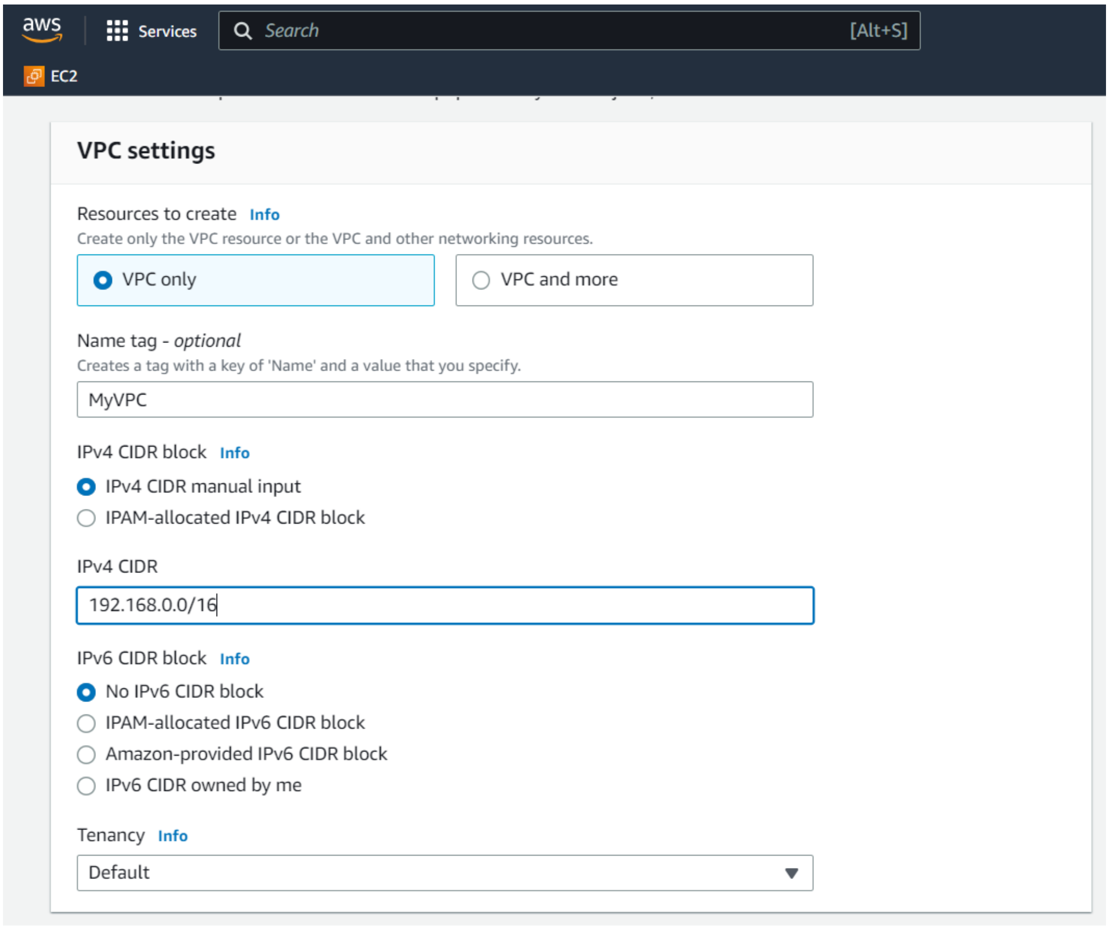
- **Availability Zone:** Availability Zones are distinct locations within an AWS Region that are engineered to be isolated from failures in other Availability Zones. They provide inexpensive, low-latency network connectivity to other Availability Zones in the same AWS Region.

- **Security Group:** A security group acts as a firewall that controls the traffic allowed to and from the resources in your virtual private cloud (VPC). You can choose the ports and protocols to allow for inbound traffic and for outbound traffic.

- **AMI:** An Amazon Machine Image (AMI) is a master image for the creation of virtual servers -- known as EC2 instances -- in the Amazon Web Services (AWS) environment. The machine images are like templates that are configured with an operating system and other software that determine the user's operating environment.

Steps taken in the project

- In your AWS Management Console, search for the Amazon VPC service and create a new VPC.



VPC settings

Resources to create Info
Create only the VPC resource or the VPC and other networking resources.
● VPC only ○ VPC and more

Name tag - *optional*
Creates a tag with a key of 'Name' and a value that you specify.
MyVPC

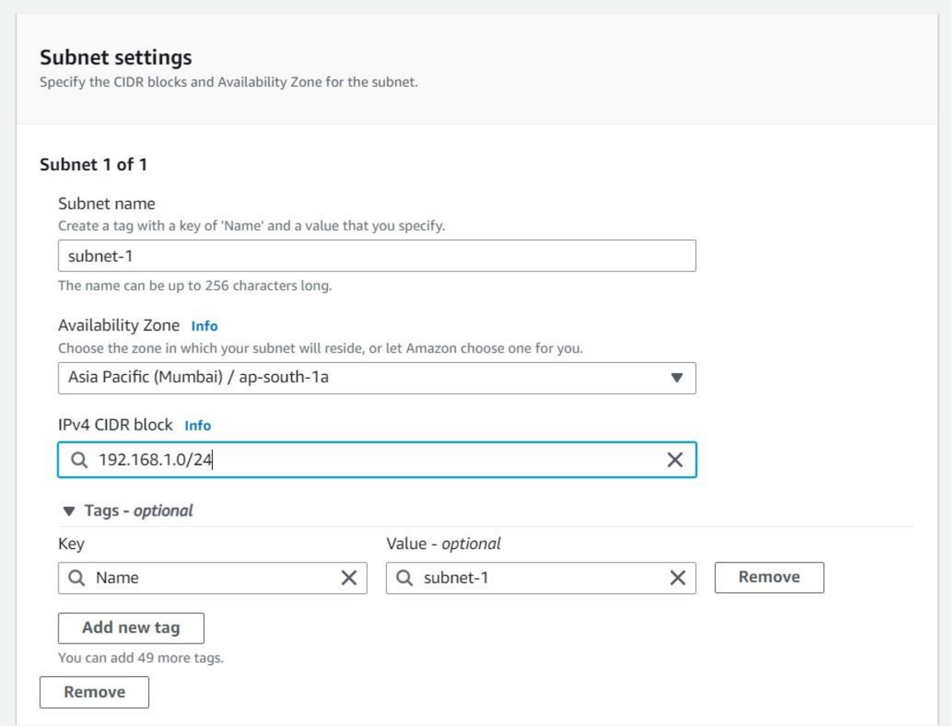
IPv4 CIDR block Info
● IPv4 CIDR manual input
○ IPAM-allocated IPv4 CIDR block

IPv4 CIDR
192.168.0.0/16

IPv6 CIDR block Info
● No IPv6 CIDR block
○ IPAM-allocated IPv6 CIDR block
○ Amazon-provided IPv6 CIDR block
○ IPv6 CIDR owned by me

Tenancy Info
Default ▼

- Once the VPC is created, create four subnets at the different Availability Zones in the region which you have selected. In this project, the **Asia Pacific (Mumbai)** region has been selected, so the four subnets have been created at **ap-south-1a**, **ap-south-1b,** and **ap-south-1c**.



Subnet settings

Specify the CIDR blocks and Availability Zone for the subnet.

Subnet 1 of 1

Subnet name

Create a tag with a key of 'Name' and a value that you specify.

subnet-1

The name can be up to 256 characters long.

Availability Zone Info

Choose the zone in which your subnet will reside, or let Amazon choose one for you.

Asia Pacific (Mumbai) / ap-south-1a

IPv4 CIDR block Info

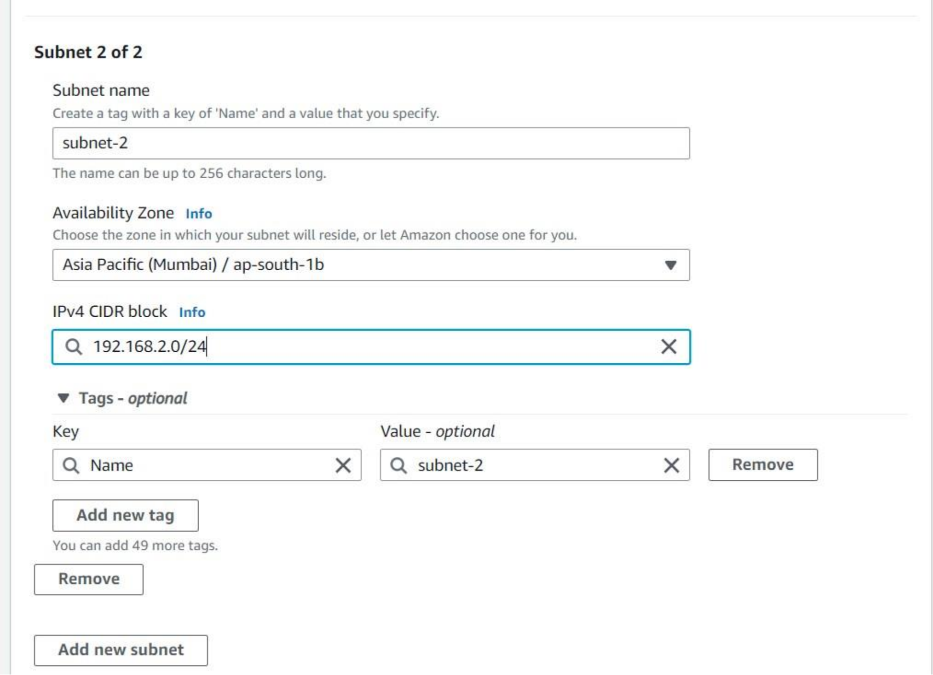
192.168.1.0/24

Tags - *optional*

Key	Value - *optional*
Name	subnet-1

You can add 49 more tags.

Subnet-1



Subnet 2 of 2

Subnet name

Create a tag with a key of 'Name' and a value that you specify.

subnet-2

The name can be up to 256 characters long.

Availability Zone Info

Choose the zone in which your subnet will reside, or let Amazon choose one for you.

Asia Pacific (Mumbai) / ap-south-1b

IPv4 CIDR block Info

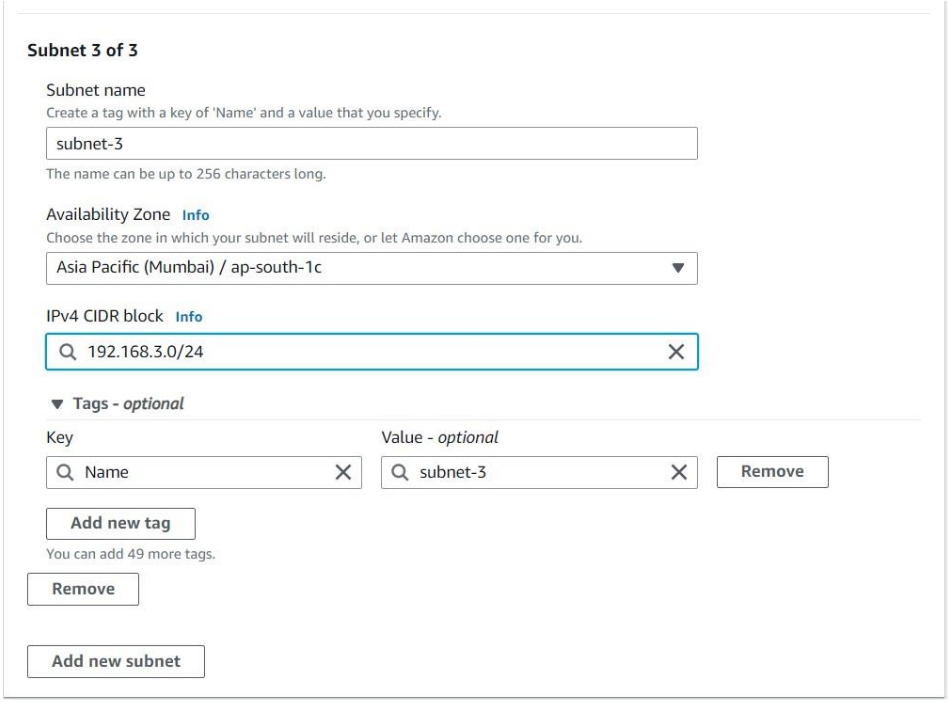
192.168.2.0/24

Tags - *optional*

Key	Value - *optional*
Name	subnet-2

You can add 49 more tags.

Subnet-2



Subnet 3 of 3

Subnet name
Create a tag with a key of 'Name' and a value that you specify.
subnet-3
The name can be up to 256 characters long.

Availability Zone Info
Choose the zone in which your subnet will reside, or let Amazon choose one for you.
Asia Pacific (Mumbai) / ap-south-1c

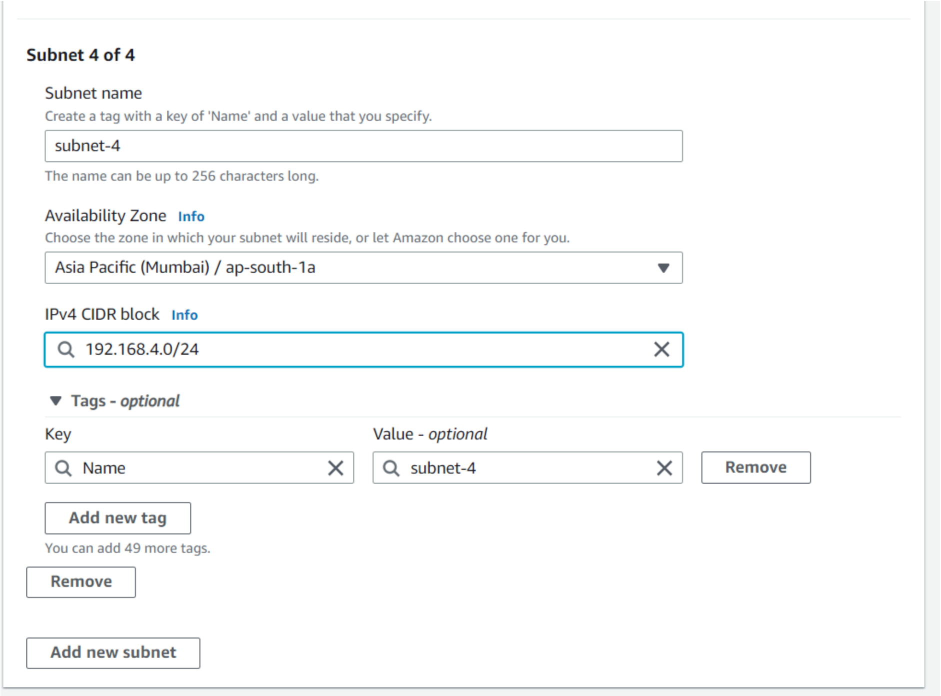
IPv4 CIDR block Info
192.168.3.0/24

Tags - *optional*

Key	Value - *optional*
Name	subnet-3

You can add 49 more tags.

Subnet-3



Subnet 4 of 4

Subnet name
Create a tag with a key of 'Name' and a value that you specify.
subnet-4
The name can be up to 256 characters long.

Availability Zone Info
Choose the zone in which your subnet will reside, or let Amazon choose one for you.
Asia Pacific (Mumbai) / ap-south-1a

IPv4 CIDR block Info
192.168.4.0/24

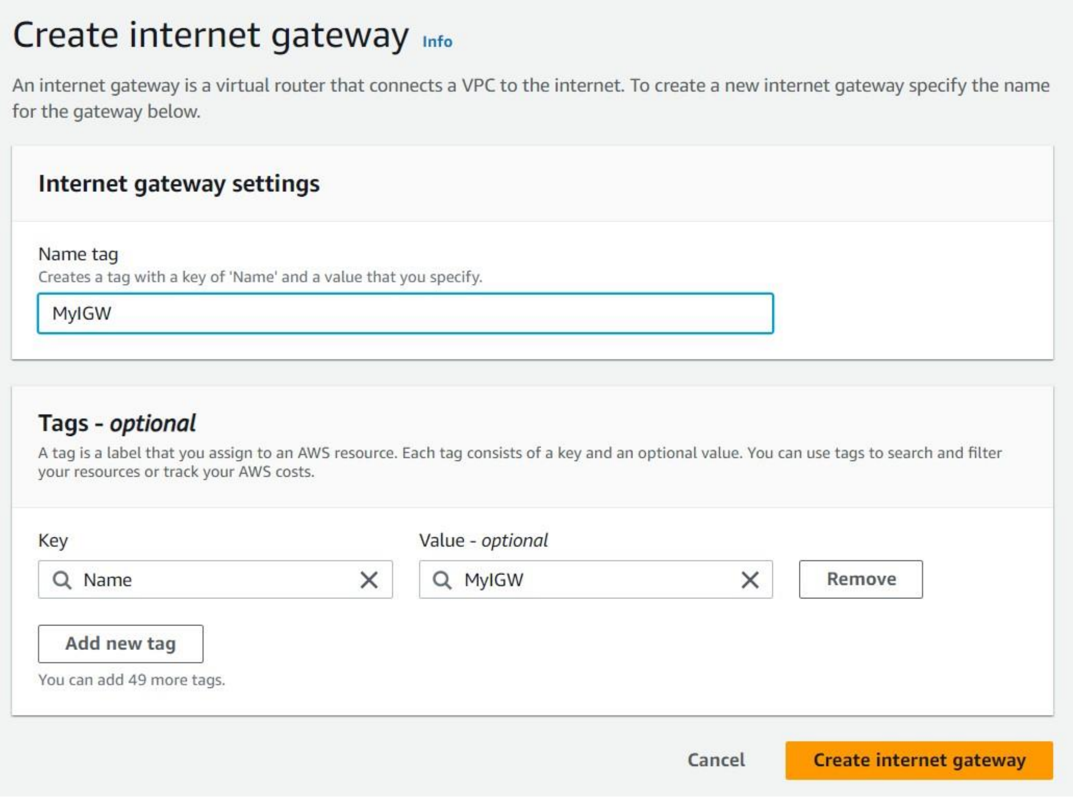
Tags - *optional*

Key	Value - *optional*
Name	subnet-4

You can add 49 more tags.

Subnet-4

- After creating the four subnets, the internet gateway is to be created. The internet gateway created must be attached to the VPC we created earlier.



Create internet gateway Info

An internet gateway is a virtual router that connects a VPC to the internet. To create a new internet gateway specify the name for the gateway below.

Internet gateway settings

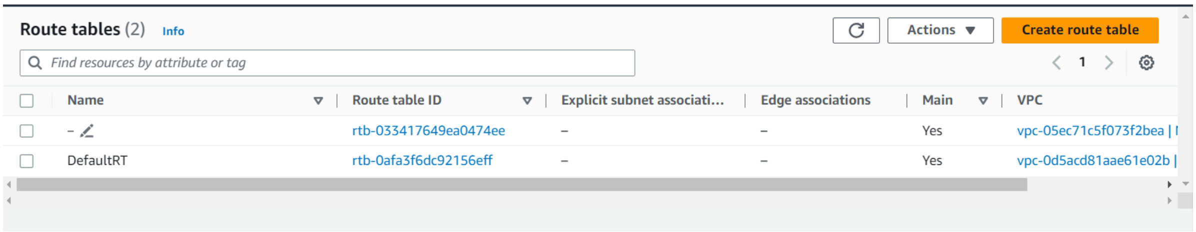
Name tag
Creates a tag with a key of 'Name' and a value that you specify.
MyIGW

Tags - *optional*

A tag is a label that you assign to an AWS resource. Each tag consists of a key and an optional value. You can use tags to search and filter your resources or track your AWS costs.

Key	Value - *optional*
Name	MyIGW

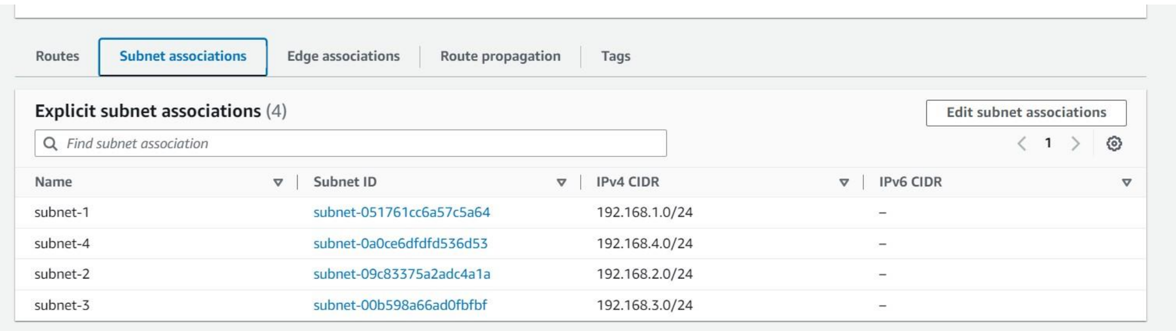
- The next step is to create route table. You will notice that a route table other than the default route table has been created automatically. We will consider it as the public route table.



Route tables (2) Info

□	Name	Route table ID	Explicit subnet associati...	Edge associations	Main	VPC
□	–	rtb-033417649ea0474ee	–	–	Yes	vpc-05ec71c5f073f2bea | I
□	DefaultRT	rtb-0afa3f6dc92156eff	–	–	Yes	vpc-0d5acd81aae61e02b |

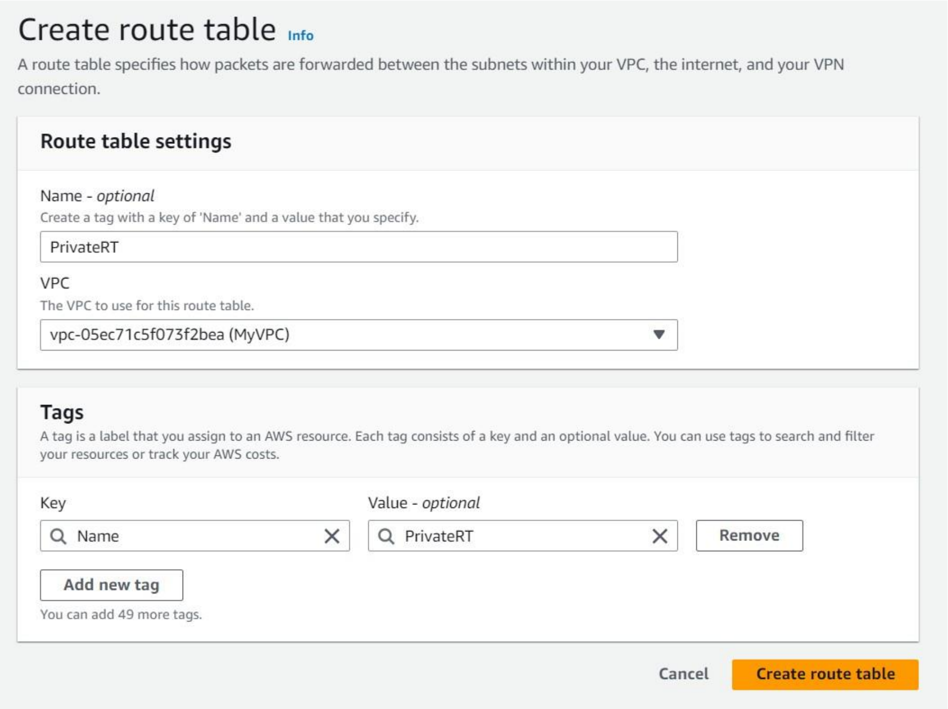
- Now we will associate the four subnets created earlier to the public route table.



Explicit subnet associations (4)

Name	Subnet ID	IPv4 CIDR	IPv6 CIDR
subnet-1	subnet-051761cc6a57c5a64	192.168.1.0/24	–
subnet-4	subnet-0a0ce6dfdfd536d53	192.168.4.0/24	–
subnet-2	subnet-09c83375a2adc4a1a	192.168.2.0/24	–
subnet-3	subnet-00b598a66ad0fbfbf	192.168.3.0/24	–

- A private route table has to be created now.



Create route table

A route table specifies how packets are forwarded between the subnets within your VPC, the internet, and your VPN connection.

Route table settings

Name - *optional*
Create a tag with a key of 'Name' and a value that you specify.
PrivateRT

VPC
The VPC to use for this route table.
vpc-05ec71c5f073f2bea (MyVPC)

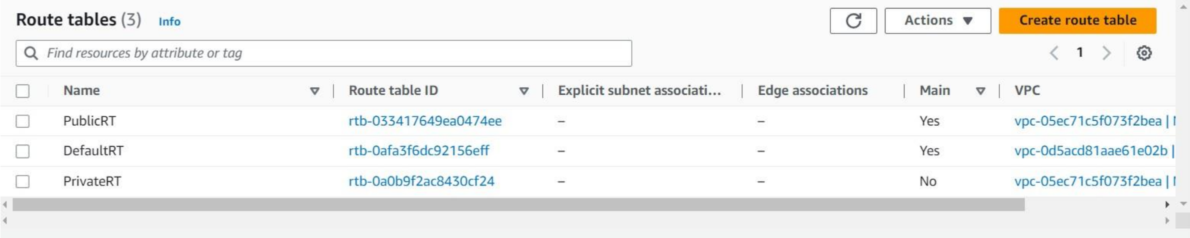
Tags

A tag is a label that you assign to an AWS resource. Each tag consists of a key and an optional value. You can use tags to search and filter your resources or track your AWS costs.

Key	Value - *optional*
Name	PrivateRT

You can add 49 more tags.

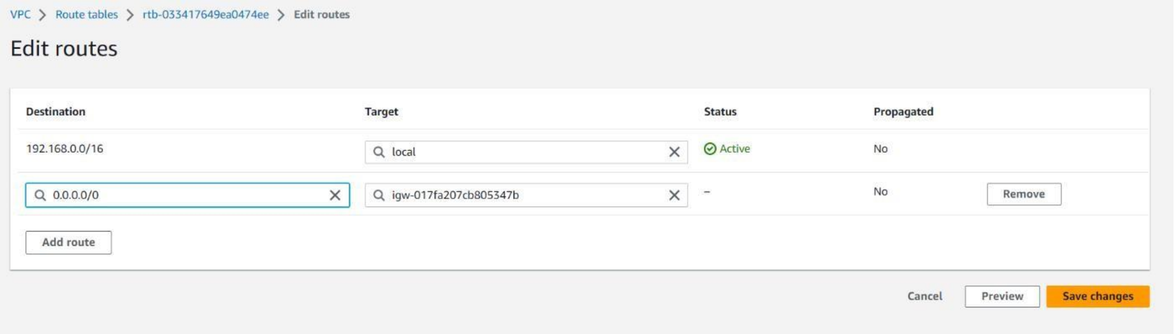
- We have named the private route table as **PrivateRT** and the public one as **PublicRT**.



Route tables (3)

□	Name	Route table ID	Explicit subnet associati...	Edge associations	Main	VPC
□	PublicRT	rtb-033417649ea0474ee	–	–	Yes	vpc-05ec71c5f073f2bea | I
□	DefaultRT	rtb-0afa3f6dc92156eff	–	–	Yes	vpc-0d5acd81aae61e02b |
□	PrivateRT	rtb-0a0b9f2ac8430cf24	–	–	No	vpc-05ec71c5f073f2bea | I

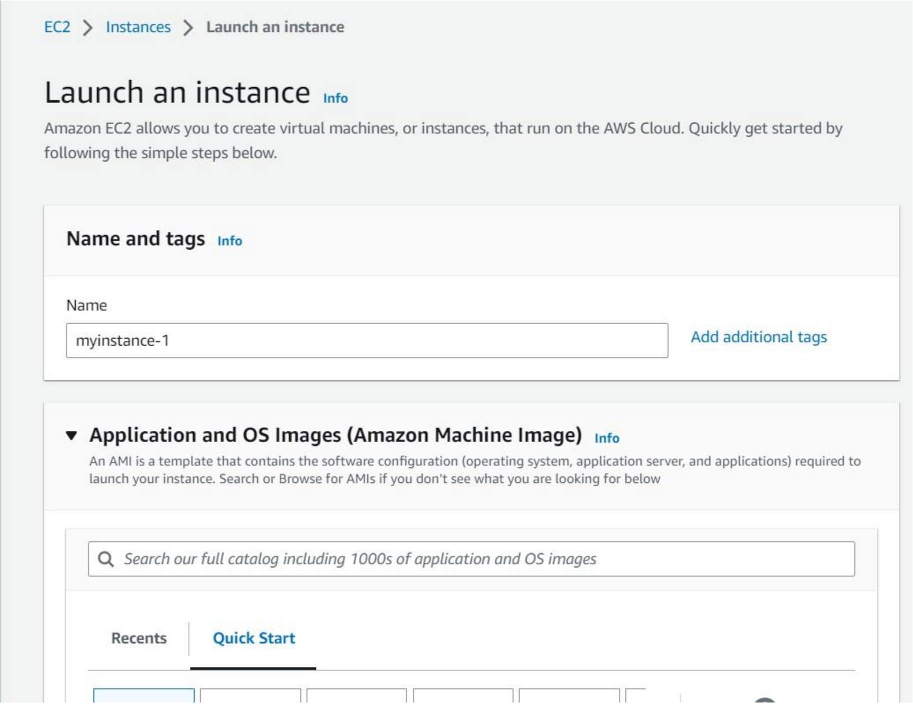
- The four subnets must be associated with the private route table too. Now the routes in the route tables are to be edited as shown in the figure below.



Edit routes

Destination	Target	Status	Propagated
192.168.0.0/16	local	Active	No
0.0.0.0/0	igw-017fa207cb805347b	-	No

- Now using the EC2 service, launch four instances.



EC2 > Instances > Launch an instance

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

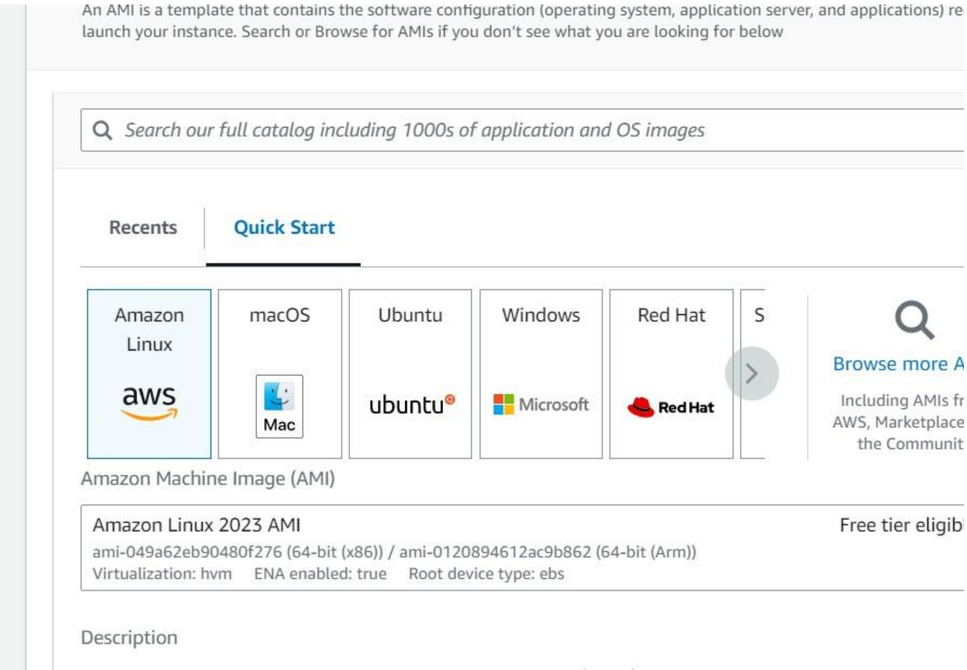
Name: myinstance-1

▼ 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
Recents
Quick Start

- Select the AMI of the Operating System which you desire to use. We are using **Amazon Linux** for this project.



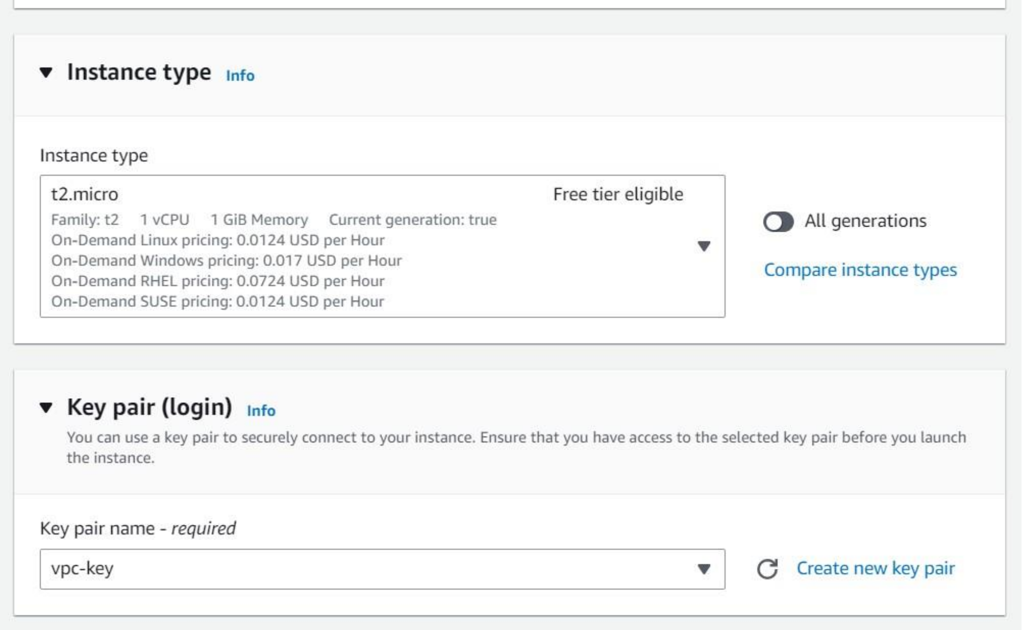
An AMI is a template that contains the software configuration (operating system, application server, and applications) re
launch your instance. Search or Browse for AMIs if you don't see what you are looking for below

Amazon Machine Image (AMI)

Amazon Linux 2023 AMI — Free tier eligib
ami-049a62eb90480f276 (64-bit (x86)) / ami-0120894612ac9b862 (64-bit (Arm))
Virtualization: hvm ENA enabled: true Root device type: ebs

Description

- Now select the instance type (we have selected **t2.micro**) and create a key pair (we have created one named **vpc-key** for this project).



▼ Instance type Info

Instance type

t2.micro Free tier eligible
Family: t2 1 vCPU 1 GiB Memory Current generation: true
On-Demand Linux pricing: 0.0124 USD per Hour
On-Demand Windows pricing: 0.017 USD per Hour
On-Demand RHEL pricing: 0.0724 USD per Hour
On-Demand SUSE pricing: 0.0124 USD per Hour

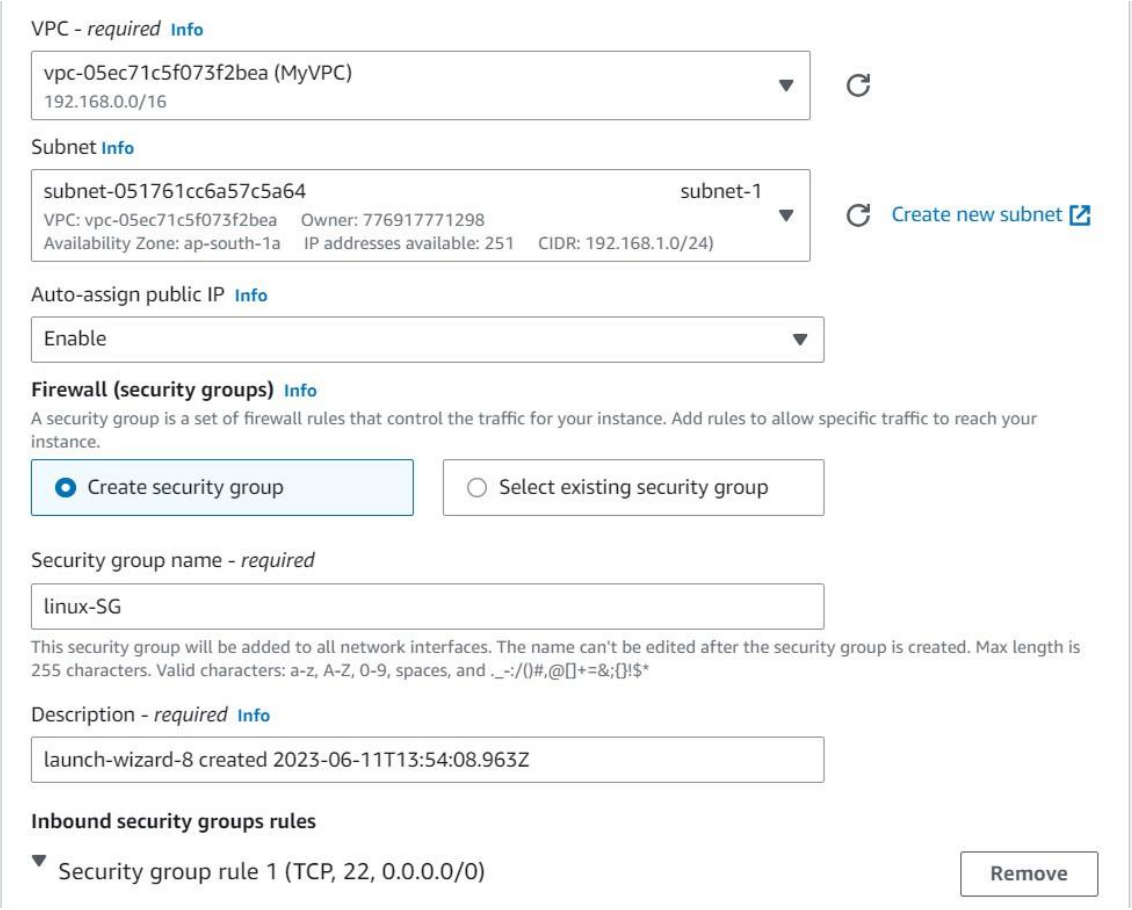
▼ Key pair (login) Info

You can use a key pair to securely connect to your instance. Ensure that you have access to the selected key pair before you launch the instance.

Key pair name - *required*

vpc-key

- Now in the Network Settings, select the VPC which you created and select a subnet from among the subnets you created (select a different subnet for each of the four instances). The **Auto-assign public IP** must be enabled.



VPC - *required* Info

vpc-05ec71c5f073f2bea (MyVPC)
192.168.0.0/16

Subnet Info

subnet-051761cc6a57c5a64 subnet-1
VPC: vpc-05ec71c5f073f2bea Owner: 776917771298
Availability Zone: ap-south-1a IP addresses available: 251 CIDR: 192.168.1.0/24)

Auto-assign public IP Info

Enable

Firewall (security groups) Info

A security group is a set of firewall rules that control the traffic for your instance. Add rules to allow specific traffic to reach your instance.

● Create security group ○ Select existing security group

Security group name - *required*

linux-SG

This security group will be added to all network interfaces. The name can't be edited after the security group is created. Max length is 255 characters. Valid characters: a-z, A-Z, 0-9, spaces, and ._-:/()#,@[]+=&;{}!$*

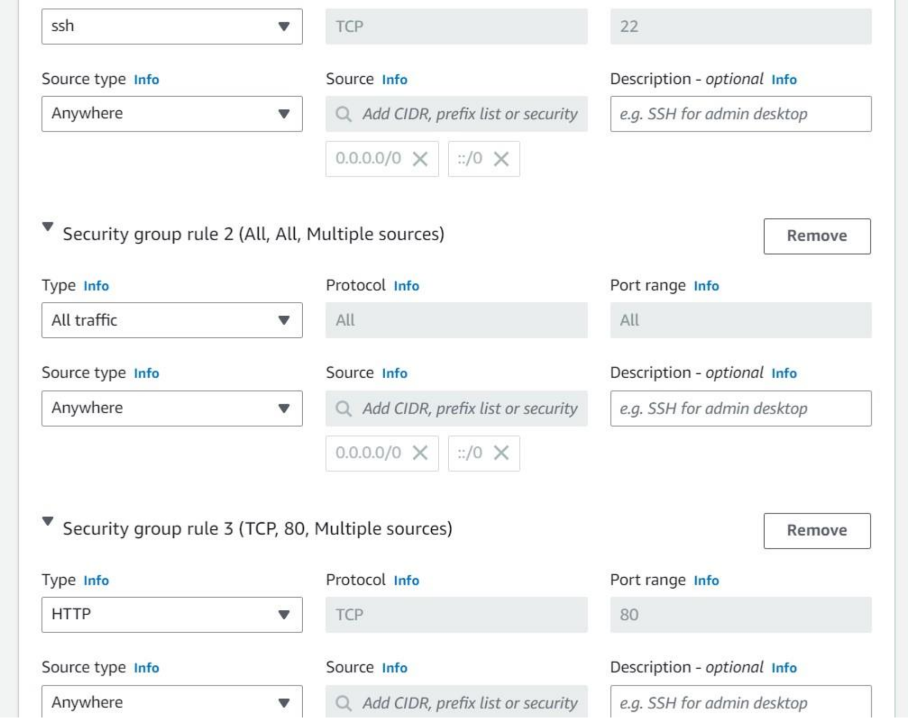
Description - *required* Info

launch-wizard-8 created 2023-06-11T13:54:08.963Z

Inbound security groups rules

▼ Security group rule 1 (TCP, 22, 0.0.0.0/0)

- Create a security group with the inbound rule settings of **SSH**, **HTTP** and **All traffic**.



ssh | TCP | 22

Source type Info: Anywhere
Source Info: Add CIDR, prefix list or security — 0.0.0.0/0 ✕ ::/0 ✕
Description - *optional* Info: *e.g. SSH for admin desktop*

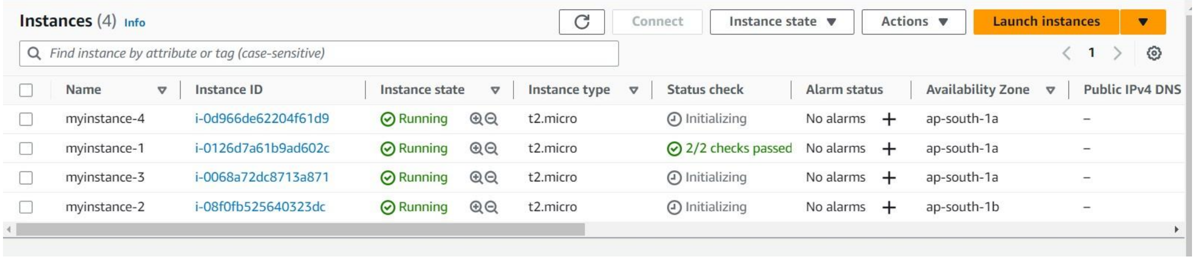
▼ Security group rule 2 (All, All, Multiple sources) — Remove

Type Info: All traffic
Protocol Info: All
Port range Info: All
Source type Info: Anywhere
Source Info: Add CIDR, prefix list or security — 0.0.0.0/0 ✕ ::/0 ✕
Description - *optional* Info: *e.g. SSH for admin desktop*

▼ Security group rule 3 (TCP, 80, Multiple sources) — Remove

Type Info: HTTP
Protocol Info: TCP
Port range Info: 80
Source type Info: Anywhere
Source Info: Add CIDR, prefix list or security
Description - *optional* Info: *e.g. SSH for admin desktop*

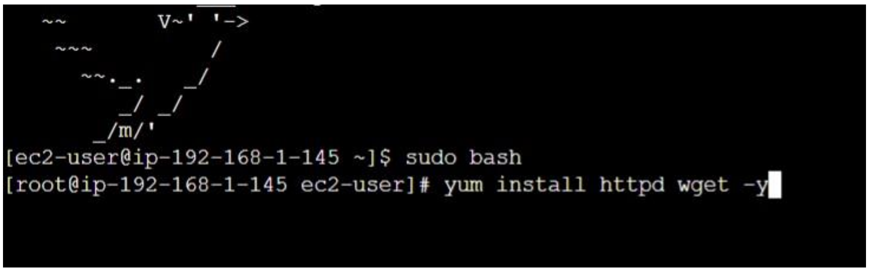
- The other three instances must be created with settings similar to the first one (only the subnet chosen can be different).



Instances (4) Info

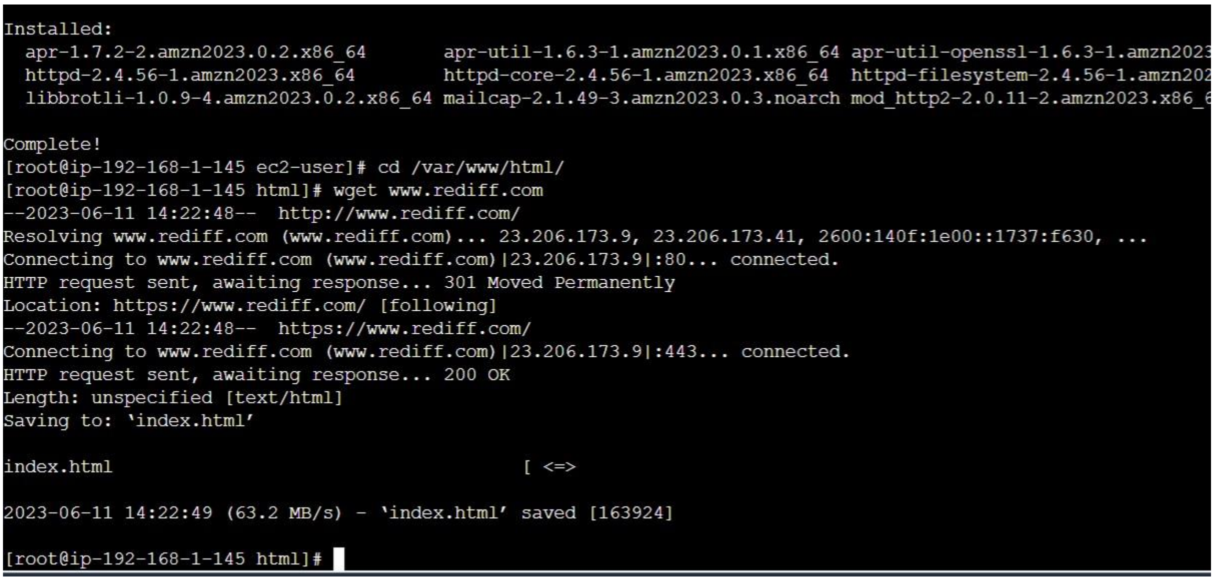
Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	Public IPv4 DNS
myinstance-4	i-0d966de62204f61d9	Running	t2.micro	Initializing	No alarms	ap-south-1a	–
myinstance-1	i-0126d7a61b9ad602c	Running	t2.micro	2/2 checks passed	No alarms	ap-south-1a	–
myinstance-3	i-0068a72dc8713a871	Running	t2.micro	Initializing	No alarms	ap-south-1a	–
myinstance-2	i-08f0fb525640323dc	Running	t2.micro	Initializing	No alarms	ap-south-1b	–

- Now connect the instances and configure each with a different website. In the console, type **sudo bash** (to gain the superuser access) and then install **httpd** and **wget** packages.



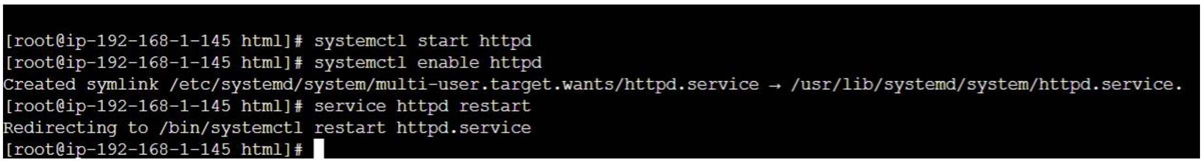
```
   ~~         V~' '->
    ~~~         /
      ~~._.   _/
         _/ _/
       _/m/'
[ec2-user@ip-192-168-1-145 ~]$ sudo bash
[root@ip-192-168-1-145 ec2-user]# yum install httpd wget -y
```

- We are configuring the first instance with the **www.rediff.com** website.



```
Installed:
  apr-1.7.2-2.amzn2023.0.2.x86_64       apr-util-1.6.3-1.amzn2023.0.1.x86_64 apr-util-openssl-1.6.3-1.amzn2023
  httpd-2.4.56-1.amzn2023.x86_64        httpd-core-2.4.56-1.amzn2023.x86_64  httpd-filesystem-2.4.56-1.amzn202
  libbrotli-1.0.9-4.amzn2023.0.2.x86_64 mailcap-2.1.49-3.amzn2023.0.3.noarch mod_http2-2.0.11-2.amzn2023.x86_6

Complete!
[root@ip-192-168-1-145 ec2-user]# cd /var/www/html/
[root@ip-192-168-1-145 html]# wget www.rediff.com
--2023-06-11 14:22:48--  http://www.rediff.com/
Resolving www.rediff.com (www.rediff.com)... 23.206.173.9, 23.206.173.41, 2600:140f:1e00::1737:f630, ...
Connecting to www.rediff.com (www.rediff.com)|23.206.173.9|:80... connected.
HTTP request sent, awaiting response... 301 Moved Permanently
Location: https://www.rediff.com/ [following]
--2023-06-11 14:22:48--  https://www.rediff.com/
Connecting to www.rediff.com (www.rediff.com)|23.206.173.9|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: unspecified [text/html]
Saving to: 'index.html'

index.html                                    [ <=>

2023-06-11 14:22:49 (63.2 MB/s) - 'index.html' saved [163924]

[root@ip-192-168-1-145 html]#
```

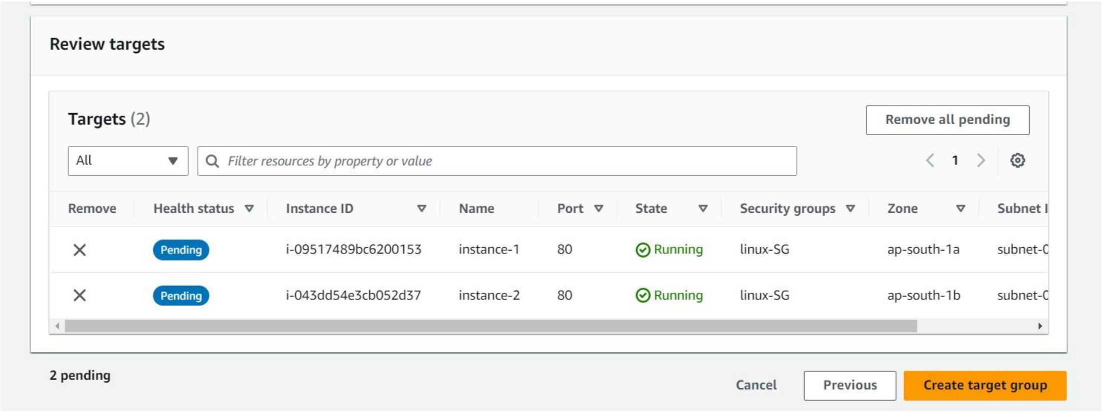
- Now start and enable the **httpd** service.



```
[root@ip-192-168-1-145 html]# systemctl start httpd
[root@ip-192-168-1-145 html]# systemctl enable httpd
Created symlink /etc/systemd/system/multi-user.target.wants/httpd.service → /usr/lib/systemd/system/httpd.service.
[root@ip-192-168-1-145 html]# service httpd restart
Redirecting to /bin/systemctl restart httpd.service
[root@ip-192-168-1-145 html]#
```

- Similarly, configure the other three instances with the websites. We will configure the other three with www.yahoo.com, www.outlook.com, and www.gmail.com respectively.

- After configuration, we have to create a load balancer to distribute the load on the servers. For that, we will create two target groups. In each target group, we will include two of the four instances.



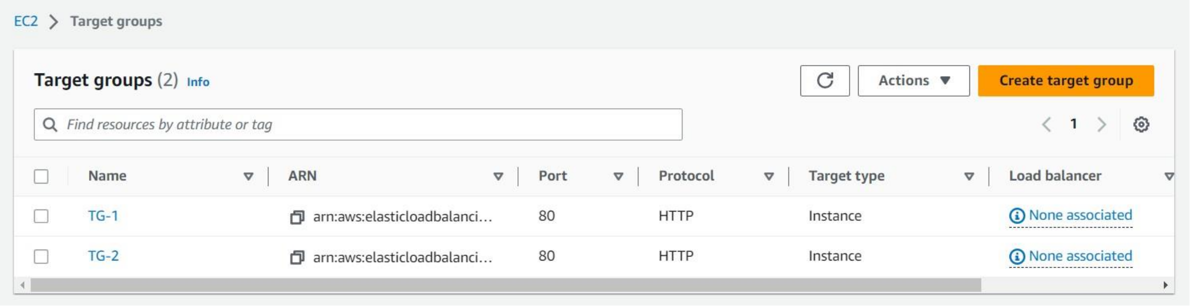
Review targets

Targets (2)

Remove	Health status	Instance ID	Name	Port	State	Security groups	Zone	Subnet I
✕	Pending	i-09517489bc6200153	instance-1	80	✓ Running	linux-SG	ap-south-1a	subnet-C
✕	Pending	i-043dd54e3cb052d37	instance-2	80	✓ Running	linux-SG	ap-south-1b	subnet-C

2 pending

- The other two instances will be included in the next target group and we have the two target groups ready.



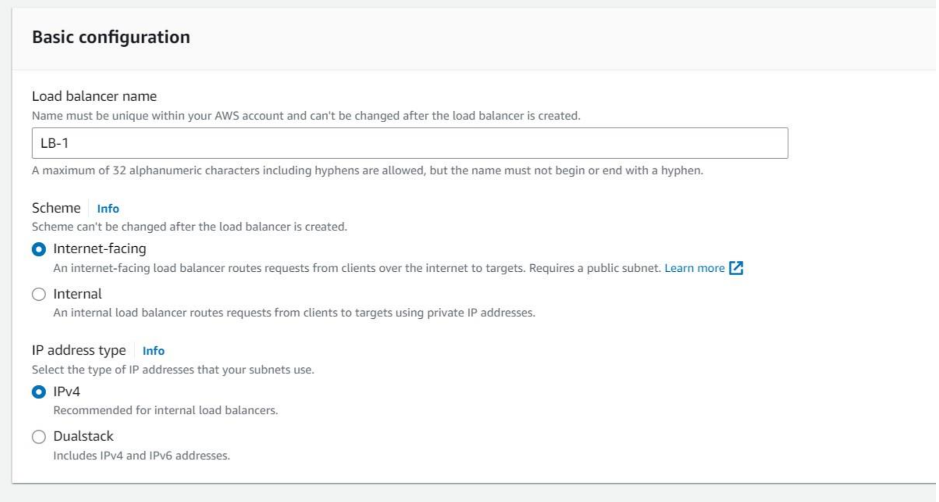
EC2 > Target groups

Target groups (2) Info

Find resources by attribute or tag

	Name	ARN	Port	Protocol	Target type	Load balancer
□	TG-1	arn:aws:elasticloadbalanci...	80	HTTP	Instance	None associated
□	TG-2	arn:aws:elasticloadbalanci...	80	HTTP	Instance	None associated

- Now we will create a load balancer.



Basic configuration

Load balancer name

Name must be unique within your AWS account and can't be changed after the load balancer is created.

LB-1

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.

IP address type Info

Select the type of IP addresses that your subnets use.

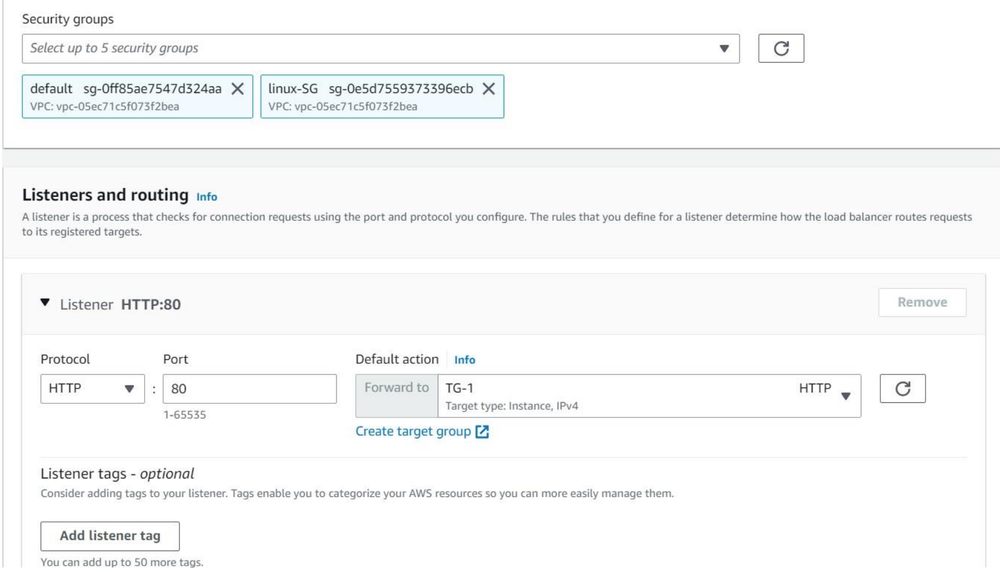
● IPv4

Recommended for internal load balancers.

○ Dualstack

Includes IPv4 and IPv6 addresses.

- Select a target group. We will add the second one further.



Security groups

Select up to 5 security groups

default sg-0ff85ae7547d324aa
VPC: vpc-05ec71c5f073f2bea

linux-SG sg-0e5d7559373396ecb
VPC: vpc-05ec71c5f073f2bea

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

Protocol: HTTP

Port: 80
1-65535

Default action Info

Forward to TG-1 HTTP
Target type: Instance, IPv4

Create target group

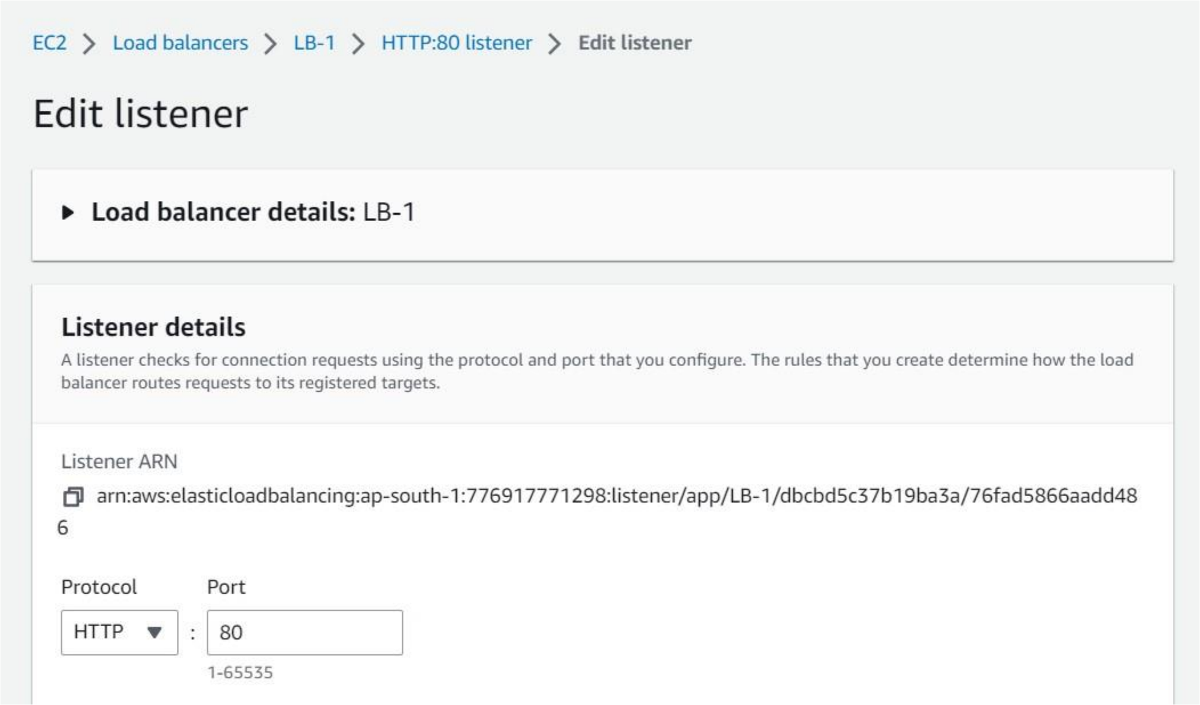
Listener tags - *optional*

Consider adding tags to your listener. Tags enable you to categorize your AWS resources so you can more easily manage them.

Add listener tag

You can add up to 50 more tags.

- When the load balancer has been created, edit the listener settings.



EC2 > Load balancers > LB-1 > HTTP:80 listener > Edit listener

Edit listener

▸ **Load balancer details:** LB-1

Listener details

A listener checks for connection requests using the protocol and port that you configure. The rules that you create determine how the load balancer routes requests to its registered targets.

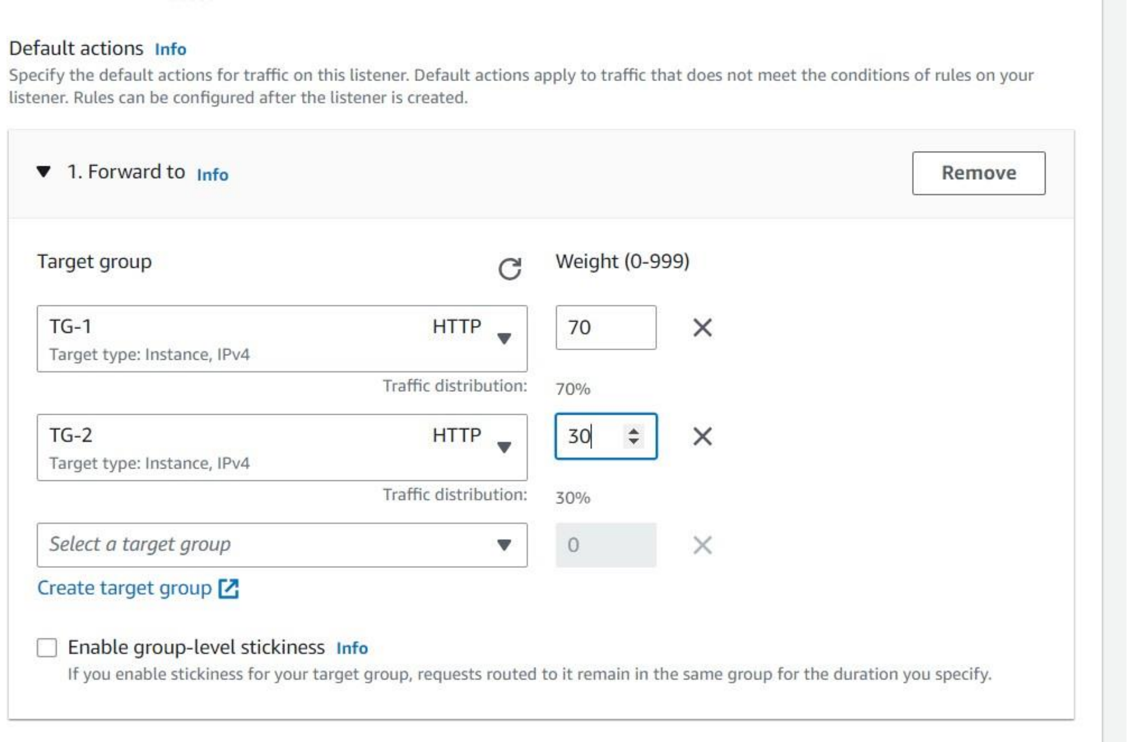
Listener ARN

arn:aws:elasticloadbalancing:ap-south-1:776917771298:listener/app/LB-1/dbcbd5c37b19ba3a/76fad5866aadd48
6

Protocol: HTTP ▾ : Port: 80

1-65535

- Now add the second target group and distribute the weightage in the 70%-30% ratio.



Default actions Info

Specify the default actions for traffic on this listener. Default actions apply to traffic that does not meet the conditions of rules on your listener. Rules can be configured after the listener is created.

▾ 1. Forward to Info

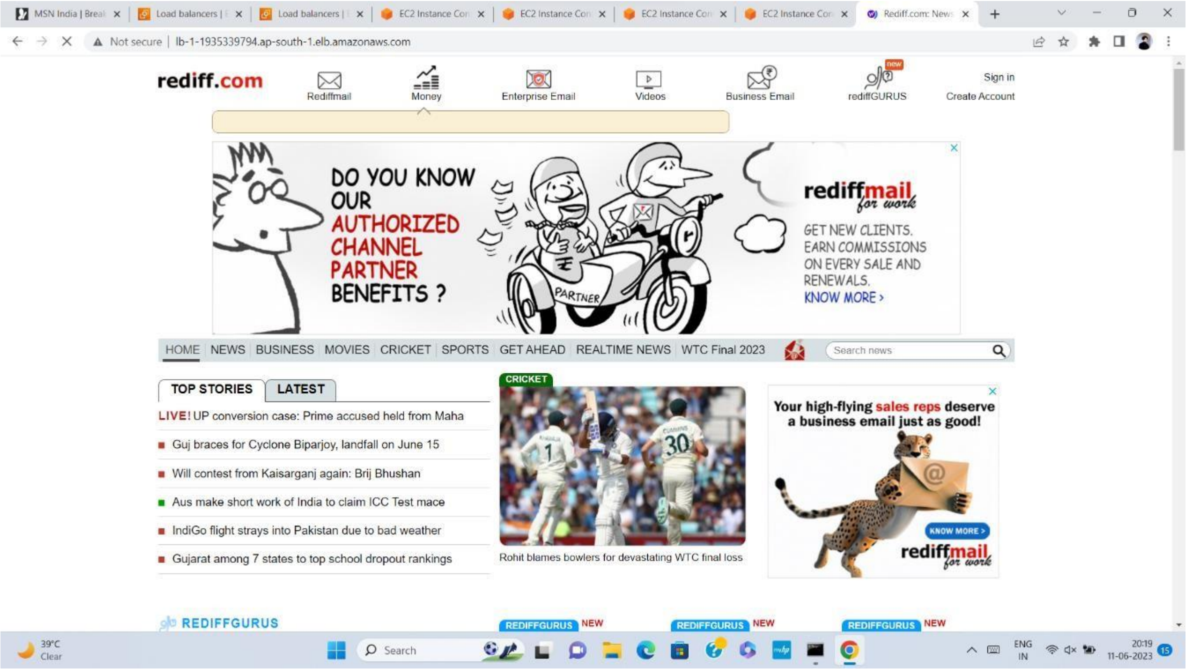
Target group	Weight (0-999)
TG-1 HTTP ▾ Target type: Instance, IPv4	70
Traffic distribution:	70%
TG-2 HTTP ▾ Target type: Instance, IPv4	30
Traffic distribution:	30%
Select a target group ▾	0

Create target group

□ Enable group-level stickiness Info

If you enable stickiness for your target group, requests routed to it remain in the same group for the duration you specify.

- Now copy the DNS of the load balancer and open it in the new tab. You will see four different websites each time you refresh.



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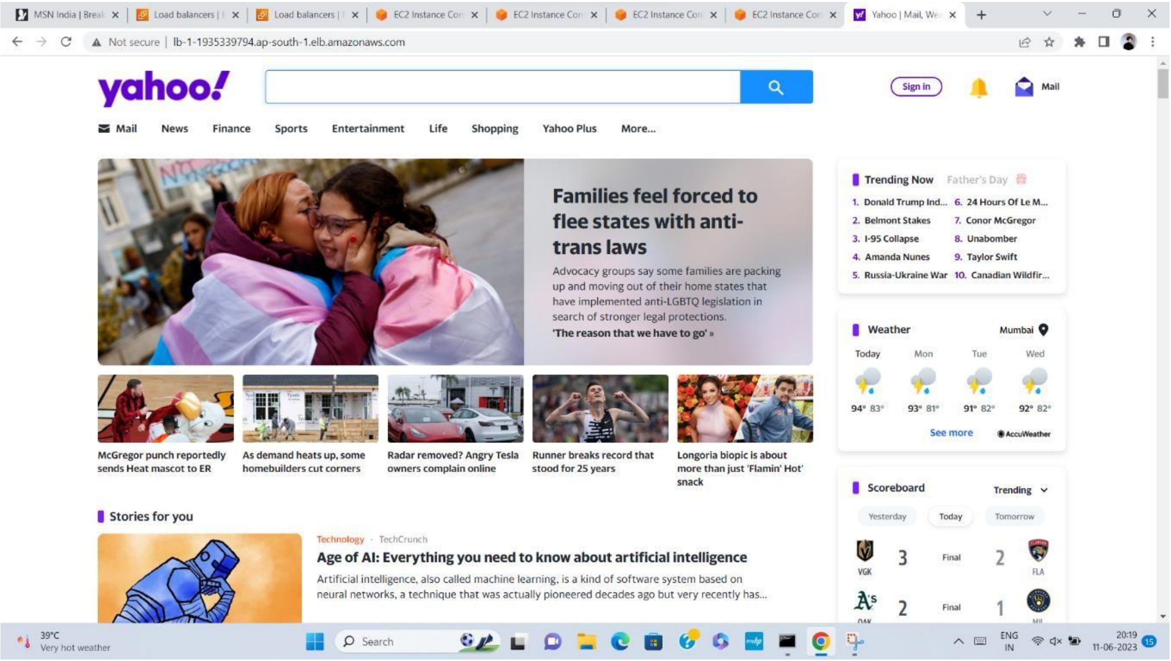

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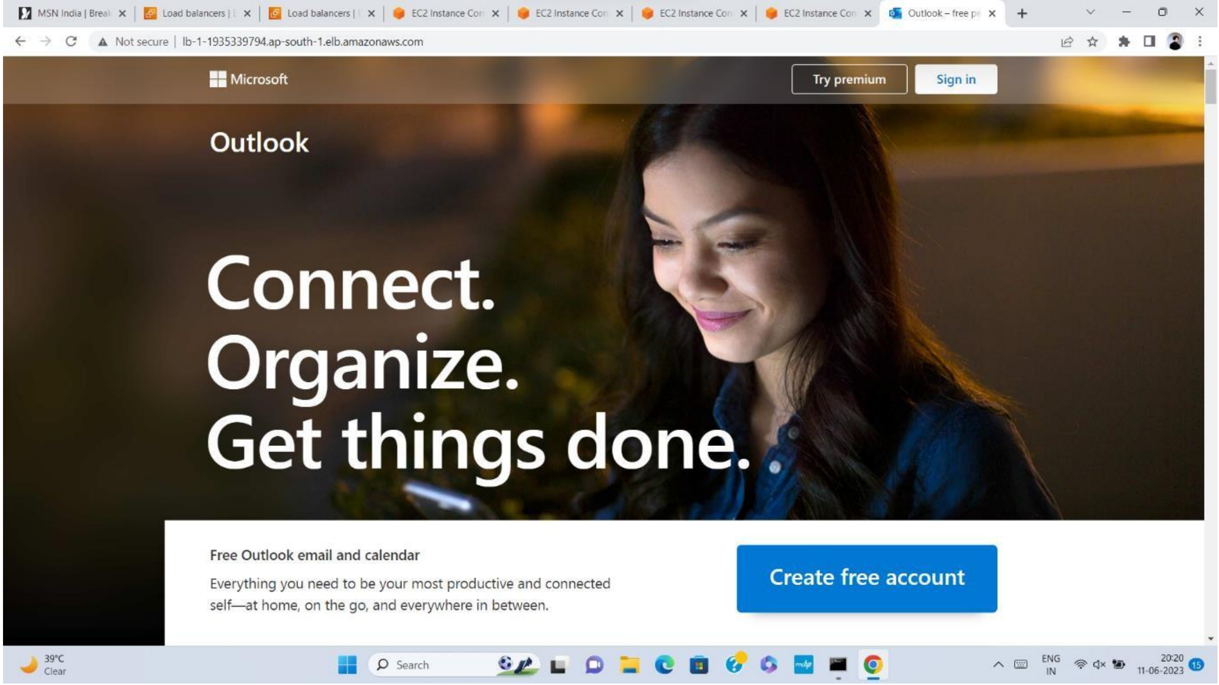

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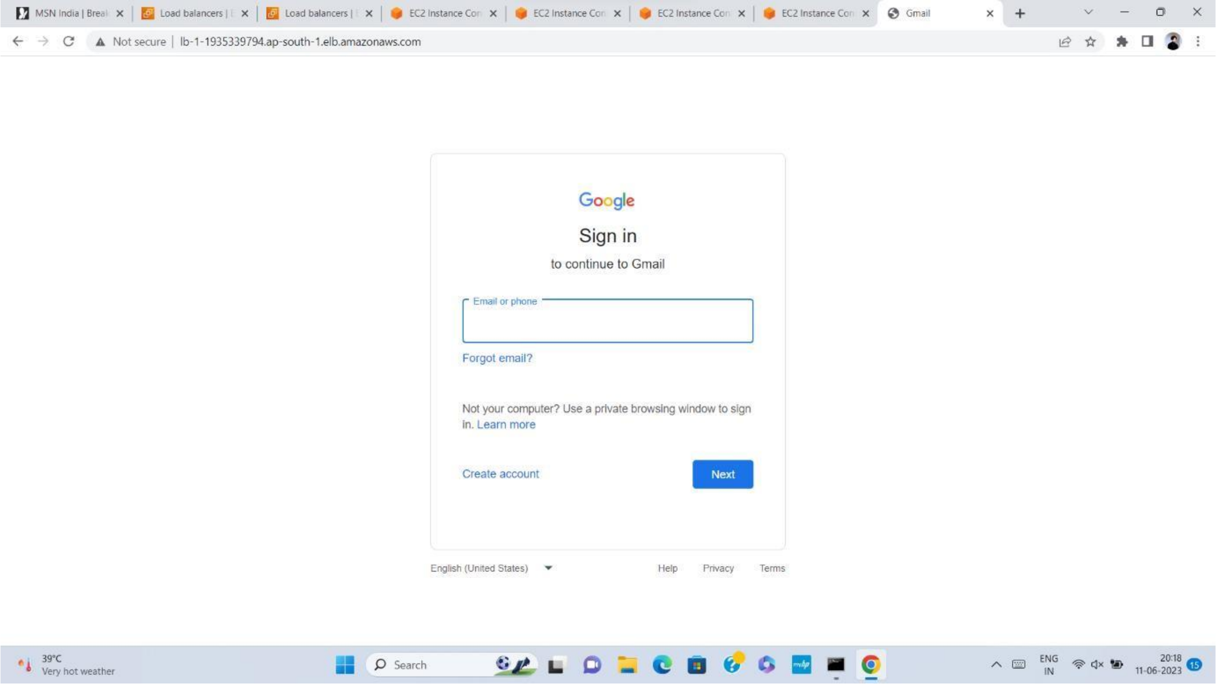

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Website-4

References

- www.google.com
- www.wikipedia.com
- www.docs.aws.amazon.com