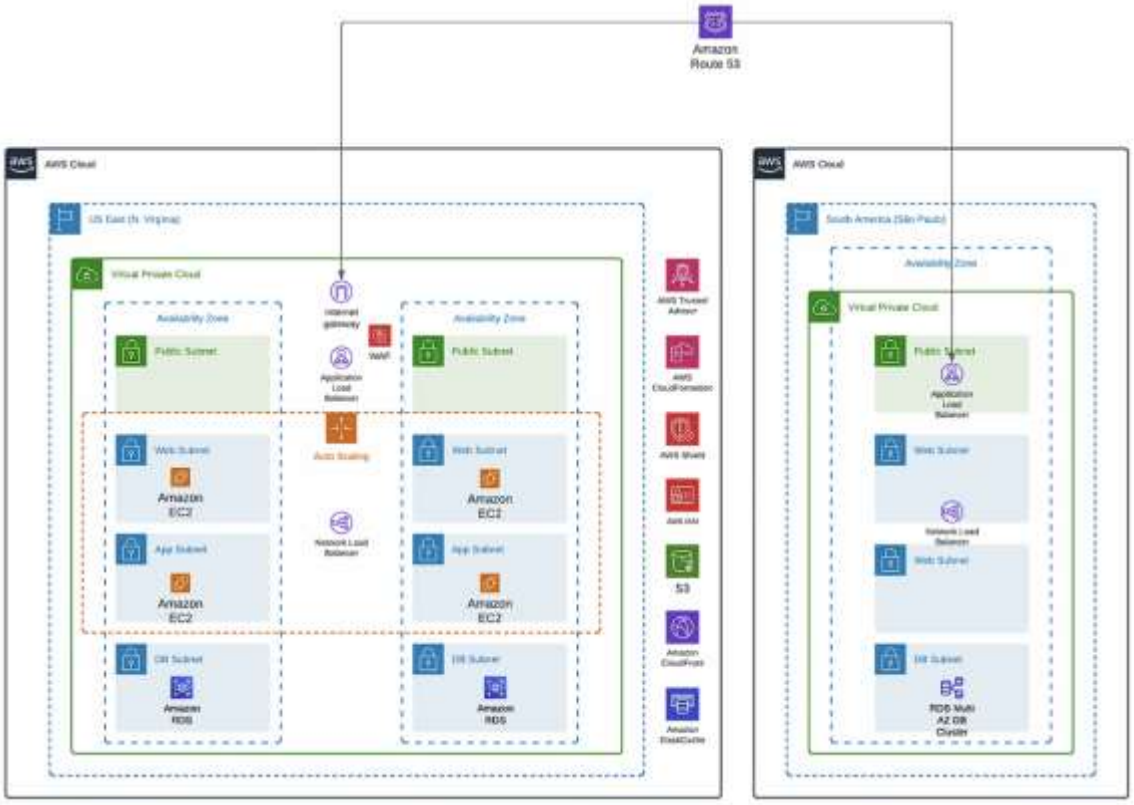
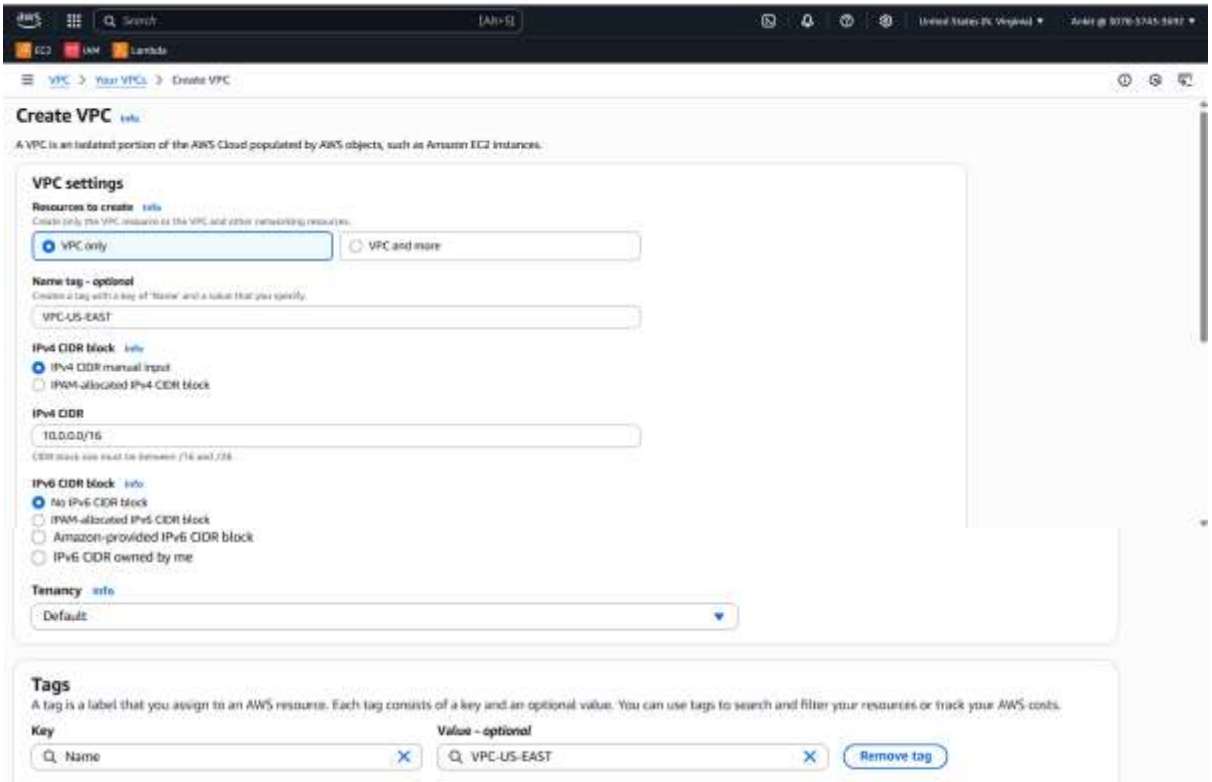
Building Scalable and Secure Web Applications with Three-Tier Architecture on AWS



Phase 1: Initial Setup and Networking

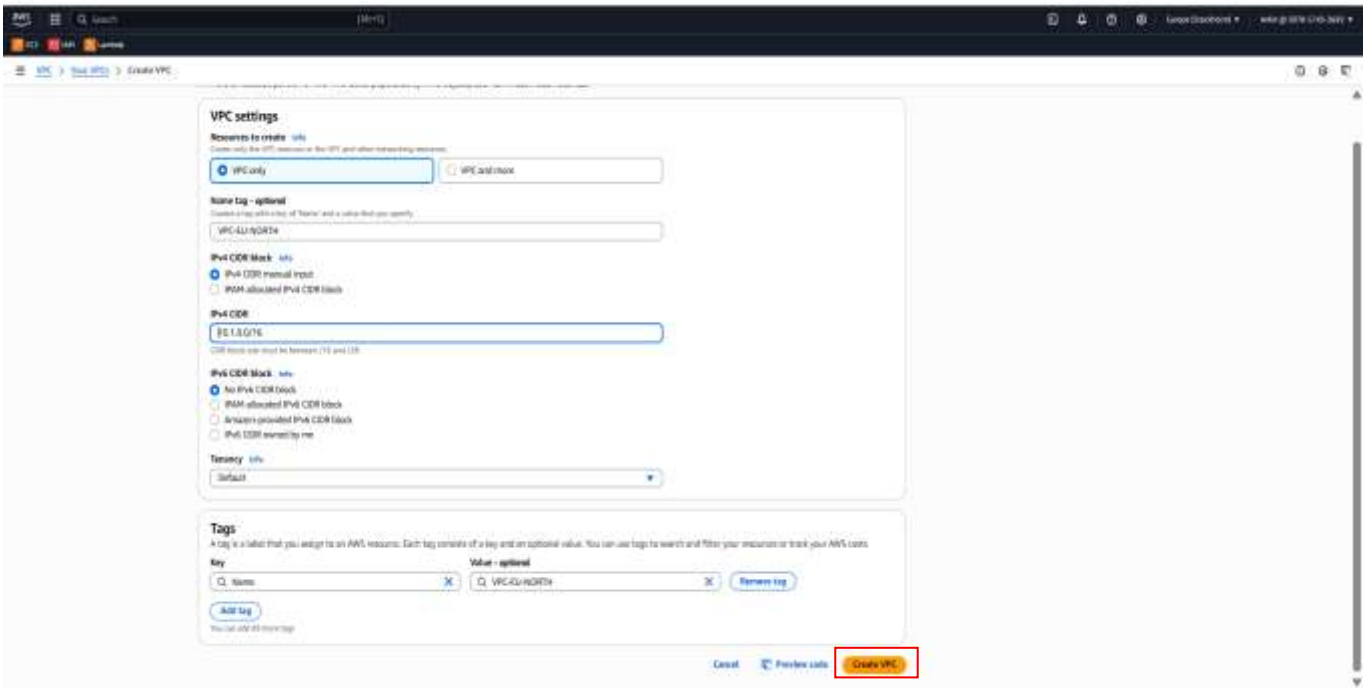
1. Create VPCs in Two Regions: [N. Virginiaus-east-1] & [Stockholmeu-north-1]

- Create Vpc in this Regoin : [N. Virginiaus-east-1]
- Go to the VPC dashboard in AWS Console.
- Enter a name : VPC-US-East
- Set CIDR block: US East: 10.0.0.0/16
- Click on "Create VPC"

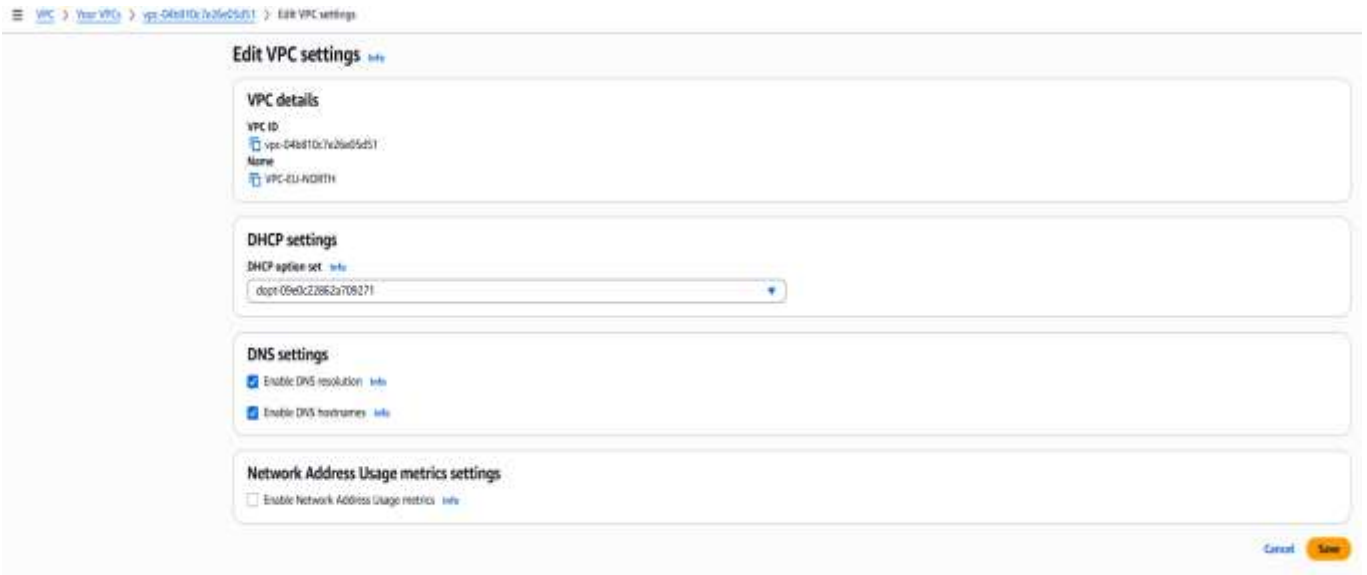


- Enable DNS resolution and hostname support.

- Create Vpc in this Regoin : [Stockholmeu-north-1]
- Go to the VPC dashboard in AWS Console.
- Enter a name : VPC-EU-North
- Set CIDR block: US East: 10.1.0.0/16
- Click on "Create VPC"



- Enable DNS resolution and hostname support.



2. Create Subnets in Each Region:

N. Virginiaus-east-1

Create at least two subnets per Availability Zone:

- Public Subnet: For Load Balancers, NAT Gateway.
- Web Subnet: For Web EC2 Instances.
- App Subnet: For App EC2 Instances.
- DB Subnet: For RDS instances.

Distribute subnets across two Availability Zones for HA.

Allocate CIDR ranges (e.g., /24) within the VPC CIDR.

Subnet CIDR Allocation per AZ

Subnet Type	AZ-A (us-east-1a)	AZ-B (us-east-1b)
Public Subnet	10.0.1.0/24	10.0.5.0/24
Web Subnet	10.0.2.0/24	10.0.6.0/24
App Subnet	10.0.3.0/24	10.0.7.0/24
DB Subnet	10.0.4.0/24	10.0.8.0/24

Stockholmeu-north-1

Create at least two subnets per Availability Zone:

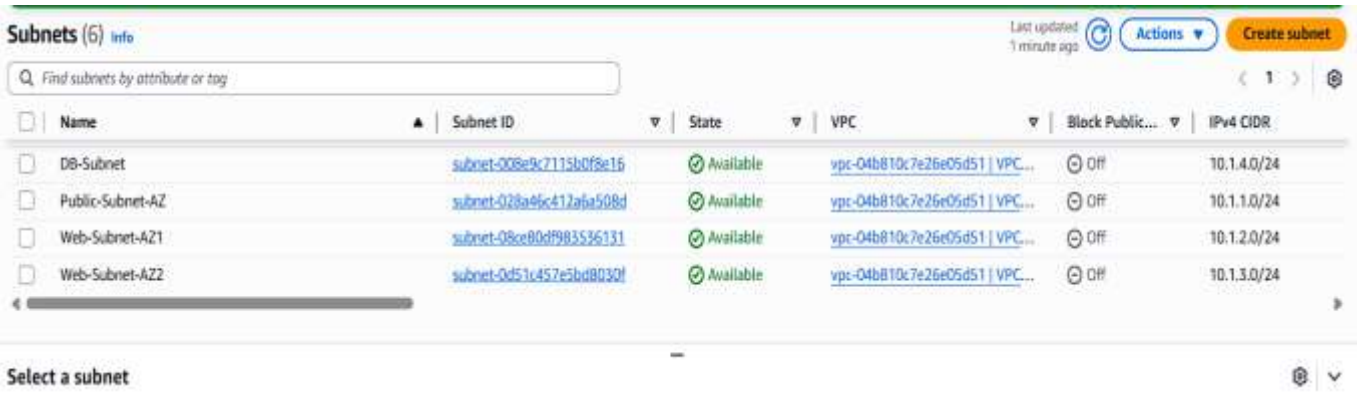
Public Subnet : for Application Load Balancer (ALB).

Web Subnet 1 : for Network Load Balancer (NLB).

Web Subnet 2 : Another web tier subnet (for redundancy or separation of layers).

DB Subnet : for RDS Multi-AZ DB Cluster.

Subnet Type	Example CIDR Block
Public Subnet	10.1.1.0/24
Web Subnet 1	10.1.2.0/24
Web Subnet 2	10.1.3.0/24
DB Subnet	10.1.4.0/24

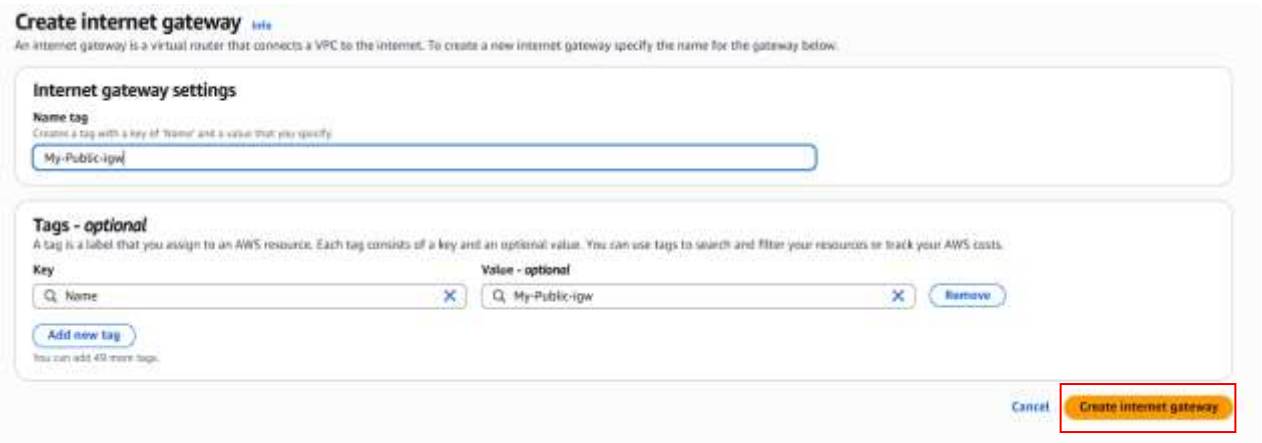


3. Configure Route Tables and Internet Gateway:

N. Virginiaus-east-1

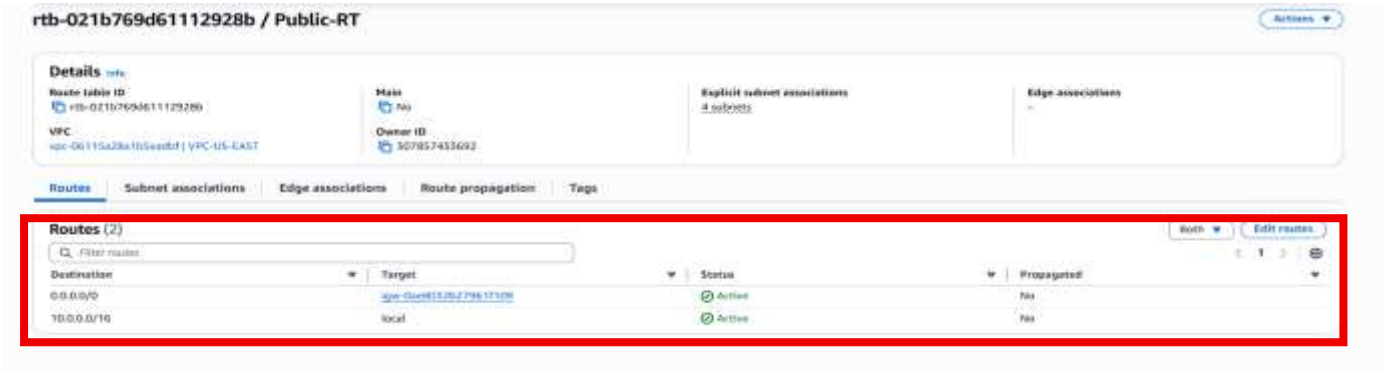
First Create Route Table :

- For Public Route Table Create : Public-RT
- And then Create Neternet Getway : Public-igw

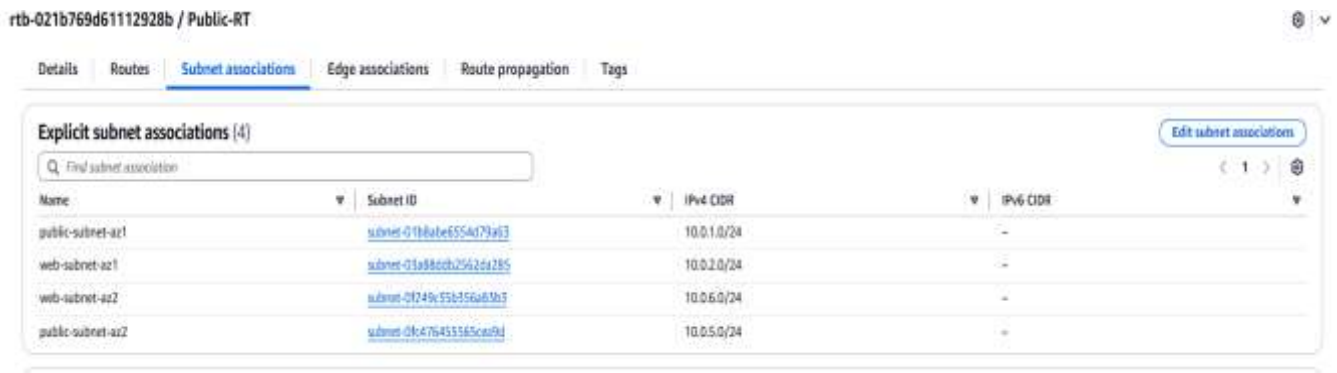


- Attach to Current Regoin VPC

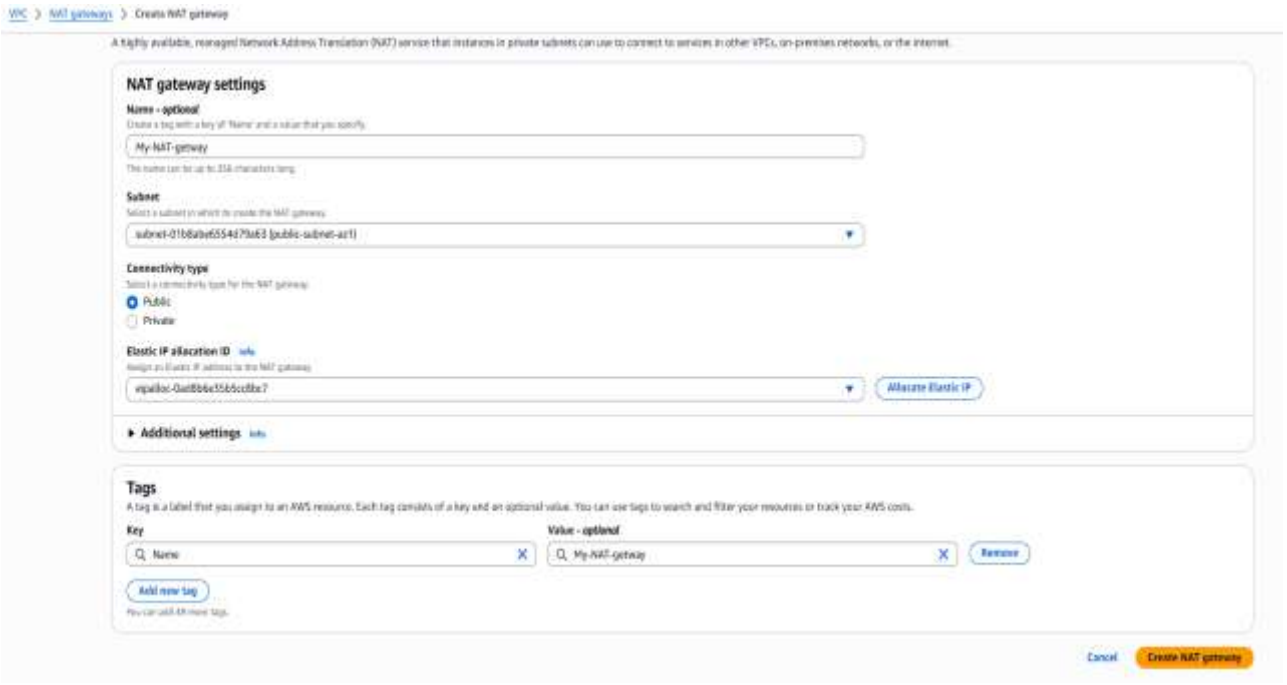
- Route the Internet Getway in Public Route Table



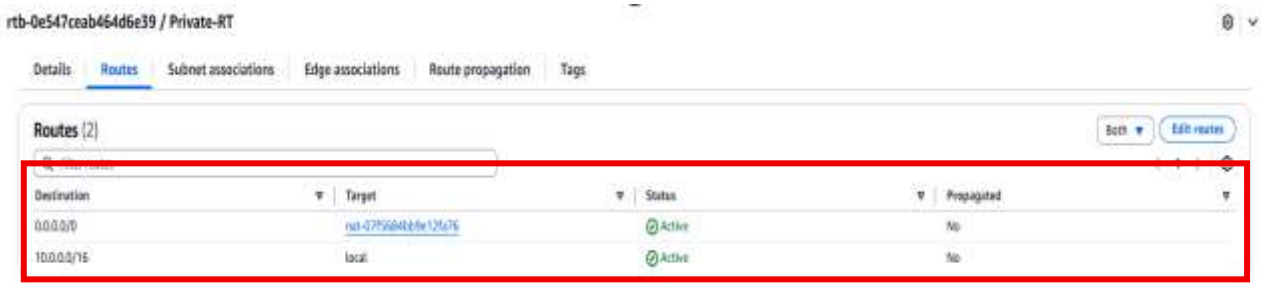
- And **Subnet Associations :**
    1. public-subnet-az1
    2. public-subnet-az2
    3. web-subnet-az1
    4. web-subnet-az2



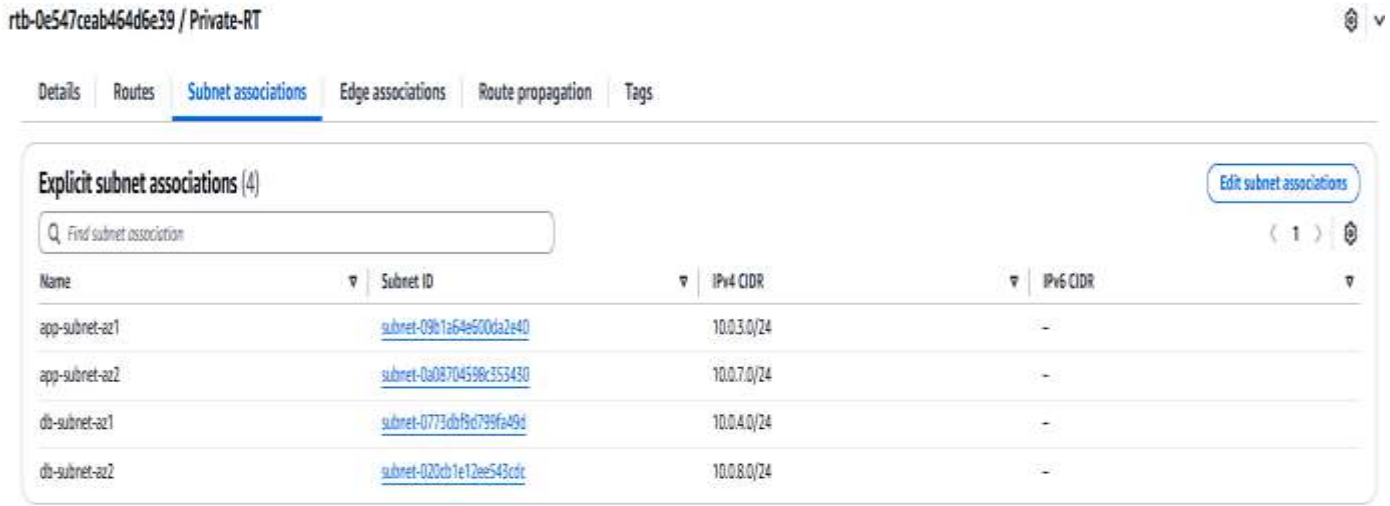
- For Private Route Table : Private-RT
- And then Create NAT Getway for Private internet to private subnet : My-NAT-getway
- Select Subnet in Nat Creation is Public Subnet and Allocate Elastic IP



- And then Route the NAT getway in Private Route Table



- And **Subnet Associations :**
    1. App-subnet-az1
    2. App-subnet-az2
    3. DB-subnet-az1
    4. DB-subnet-az2



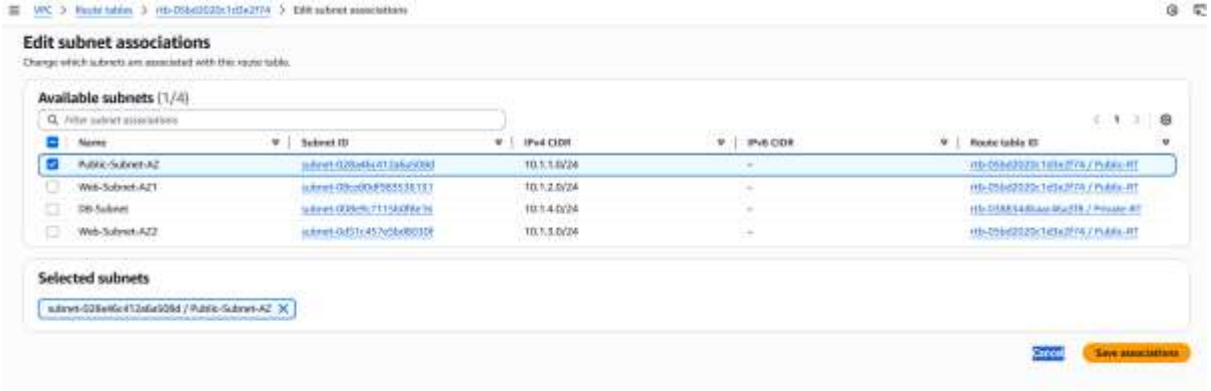
Configure Route Tables :

[Stockholmeu-north-1]

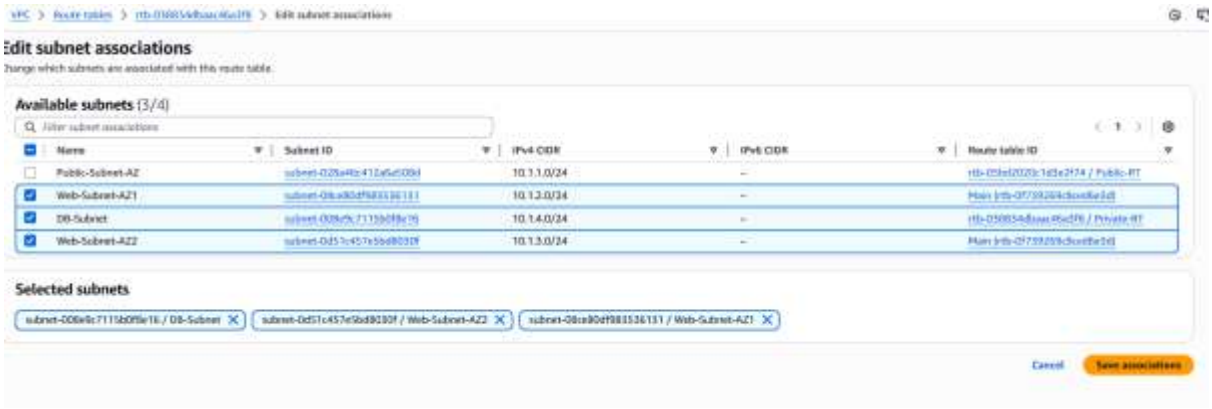
1. Create Public Route Table : Public-RT
2. Create Igw : igw-Public
3. And Attach to your Current VPC

Associated Subnet(s):

- **Public Subnet** (where the **Application Load Balancer** is placed)



4. Create Private Route Taqble : Private-RT



4. Enable VPC Peering or Route53 Latency-Based Routing:

If inter-region communication is required, configure VPC peering between US East and South America.

Alternatively, configure Route 53 with latency-based routing to direct users to the nearest region.

1. Create VPC Peering Connection

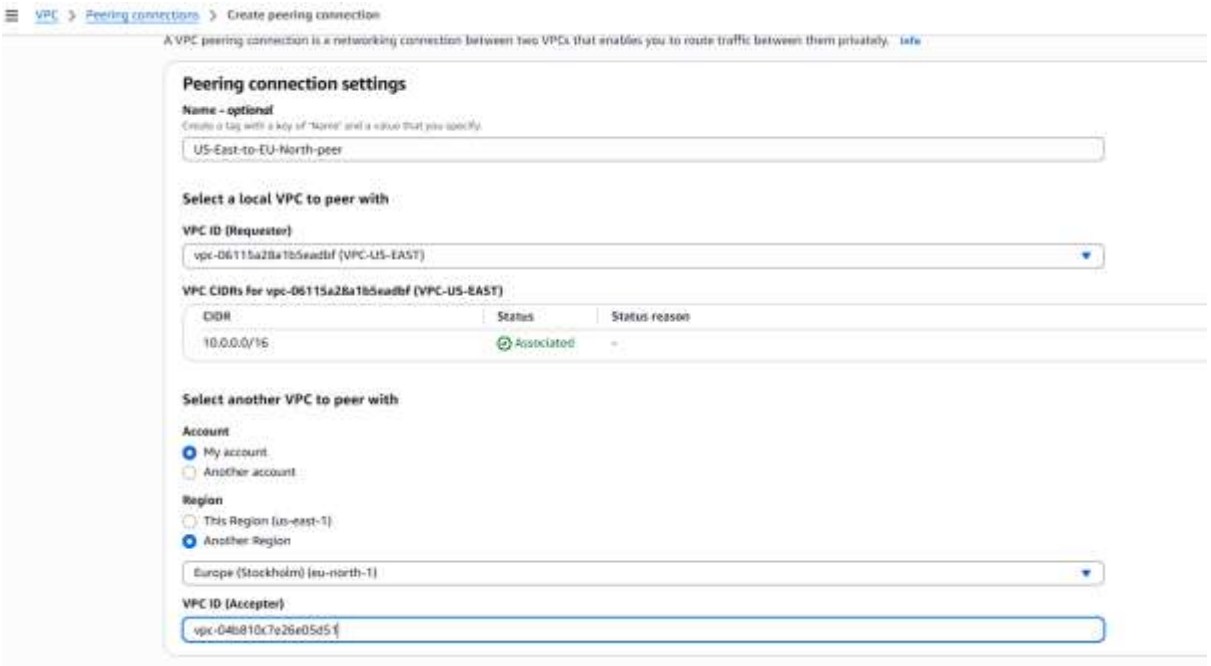
- In the US East region: **N. Virginiaus-east-1**

Go to VPC Console → Peering Connections → Create Peering Connection

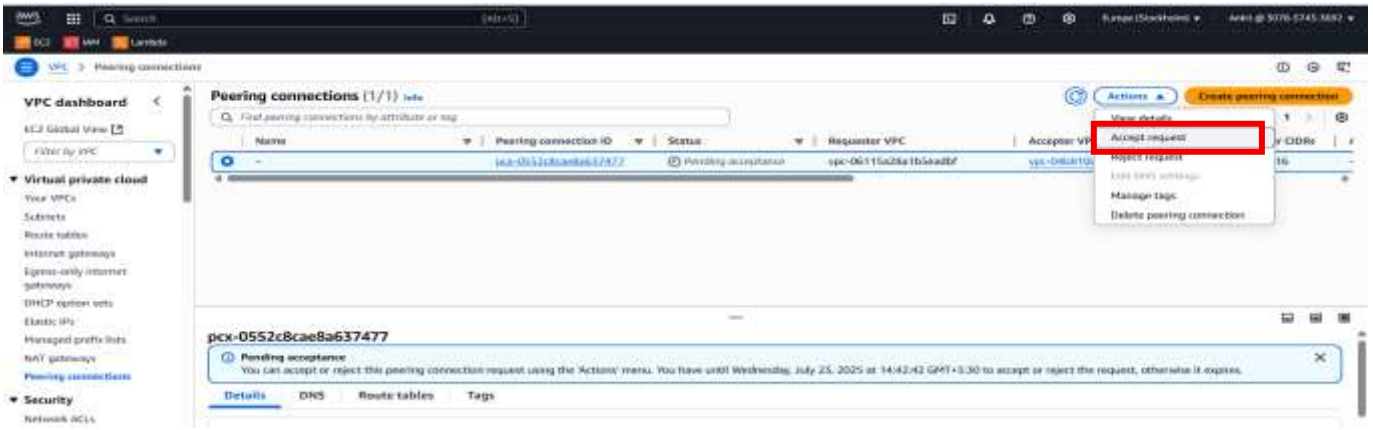
Requester VPC: e.g., vpc-06115a28a1b5eadbf (US East)

Accepter VPC: **Stockholmeu-north-1** VPC (you'll select the region and VPC ID)

Copy VPC ID from another Regoin and Paste in this Accepter Vpc ID



And After Created VPC Peering then Go to another regoin - **Stockholmeu-north-1** in that regoin in that vpc go to VPC peering connection in that after refresh that you will see one peering connection you can select that peering connection and click on Action Tab one icon will Pop-up in that Select the Accept request



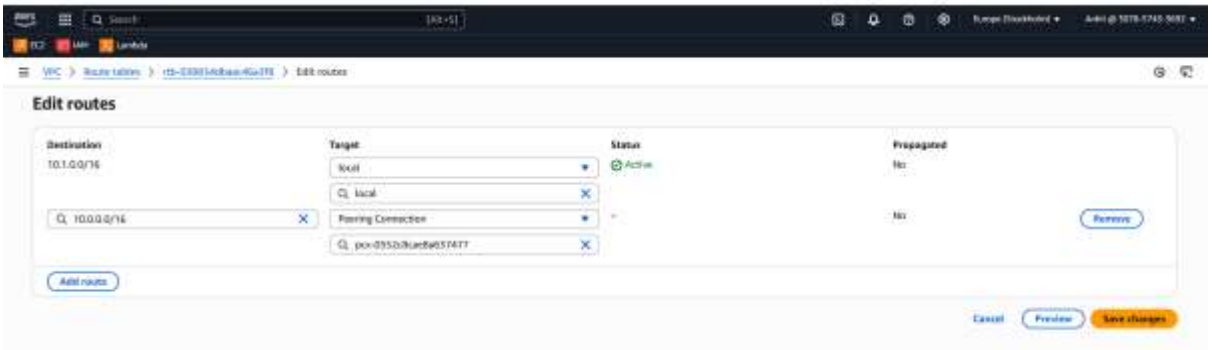
After that you will see the Peering Connection is Accepted And After that you will see one green Icon will Pop-up for Modify the route table So you can modify the route table

If you Clicking on Modify route table now should redirect you to the route table screen.

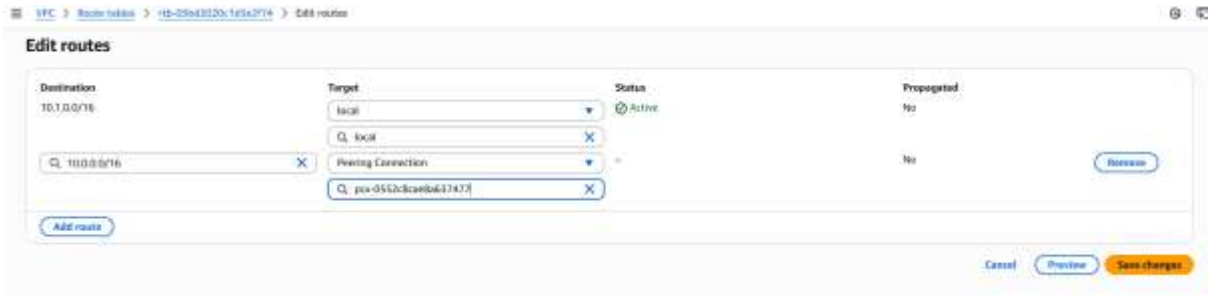
Then in that route table, Modify All Route Table those RT will use like Public and Private Route table

First modify the **Public Route** table for Peering conncetion route – in that click on route and click on Add route

The Destination(Like CIDR) will be the from another region (10.0.0.0/16)

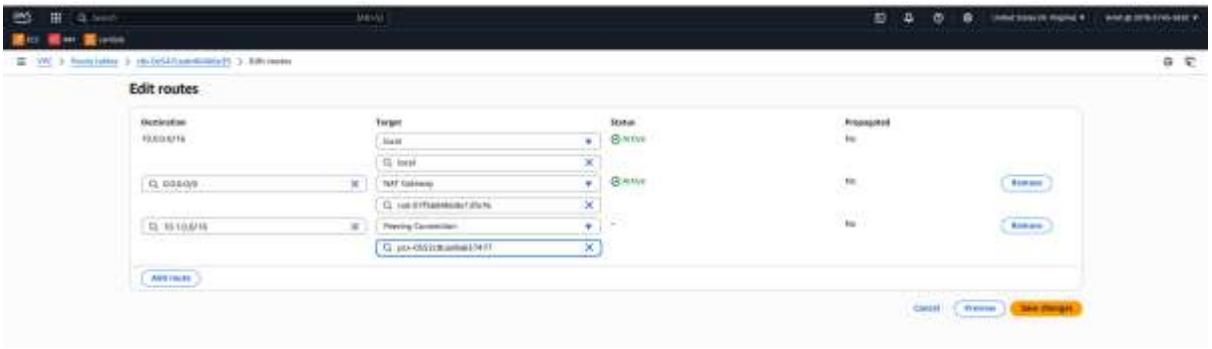


First modify the **Private Route** table

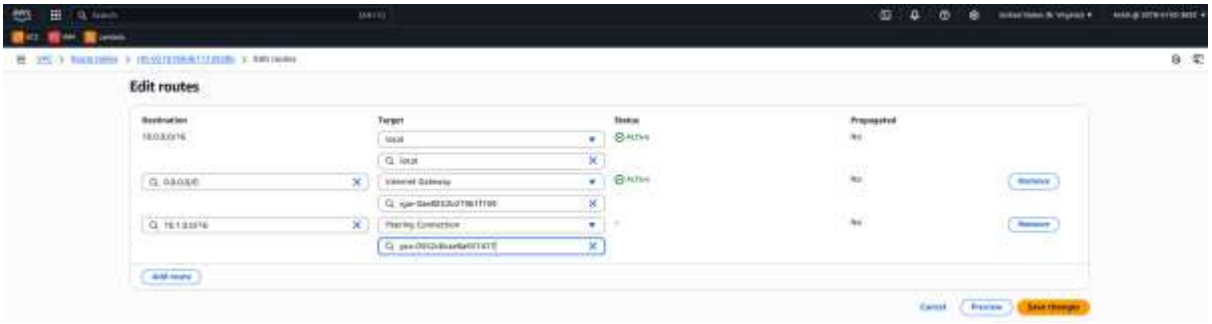


After that go to another region **N. Virginiaus-east-1** in that Regoin go to VPC and click on Route table, in that Route table same process will follow as like upper routing for peering for all Public and Private Route Table

Public Route Table :



Private Route Table :



- Security Group Both Region : **N. Virginiaus-east-1** & **Stockholmeu-north-1**

1. Create Security Groups: **N. Virginiaus-east-1**
   ALB SG:

- Inbound: Allow HTTP (80) and HTTPS (443) from 0.0.0.0/0.
- Outbound: Allow all.

Web SG:

- Inbound: Allow traffic from ALB SG on port 80/443.
- Outbound: Allow to App SG and Internet (if needed).

App SG:

- Inbound: Allow traffic from Web SG on application ports (e.g., 3000, 8080).
- Outbound: Allow to DB SG.

DB SG:

- Inbound: Allow traffic from App SG on DB port (e.g., 3306 for MySQL).
- Outbound: Allow as required (typically restricted).

Security Groups : Stockholmeu-north-1

1. SG-ALB
   - Inbound: Allow 80, 443 from 0.0.0.0/0
   - Outbound:Allow to SG-Web on 80/443
2. SG-Web
   - Inbound: Allow 80 from SG-ALB-SA
   - Outbound: Allow to SG-DB on 3306
3. SG-DB
   - Inbound: Allow 3306 from SG-Web
   - Outbound: Allow all (default)

Network ACLs (Stateless, per subnet) :

Nacl for **N. Virginiaus-east-1** Regoin :

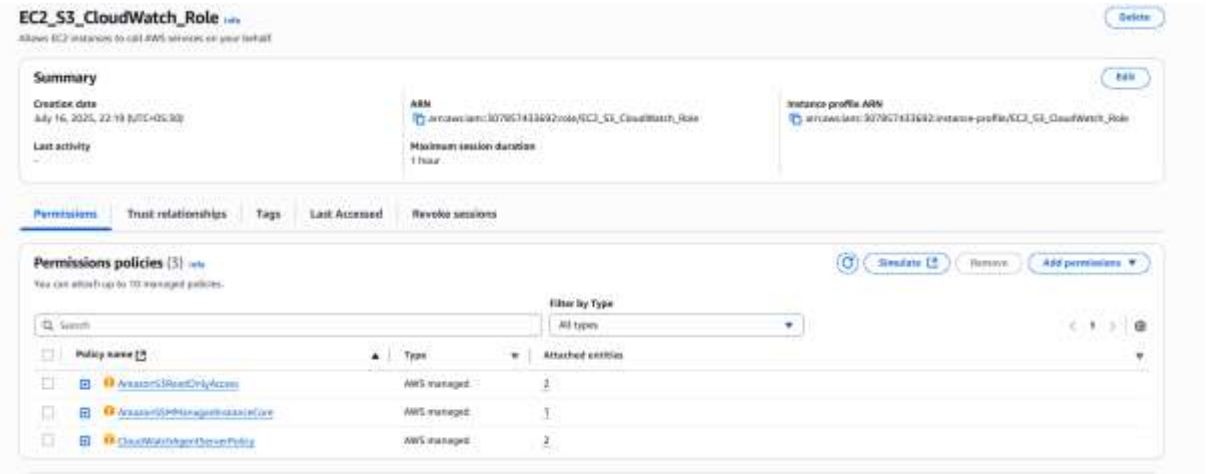
1. Public Subnet (ALB, NAT, IGW)
   - Inbound:
     - Allow 80, 443 from 0.0.0.0/0
     - Allow 1024–65535 from everywhere (for return traffic)
   - Outbound:
     - Allow 80, 443 to 0.0.0.0/0
     - Allow ephemeral ports 1024–65535 to 0.0.0.0/0
2. Web Subnet
   - Inbound:
     - Allow 80 from ALB subnet IPs
     - Allow 22 from Bastion/your IP
     - Allow 1024–65535 from App subnet (for responses)
   - Outbound:
     - Allow 8080 to App subnet
     - Allow 1024–65535 to everywhere
3. App Subnet
   - Inbound:
     - Allow 8080 from Web subnet
     - Allow 1024–65535 from DB subnet
   - Outbound:
     - Allow 3306 to DB subnet
     - Allow 1024–65535 to everywhere
4. DB Subnet
   - Inbound:
     - Allow 3306 from App subnet
   - Outbound:
     - Allow 1024–65535 to App subnet

Nacl for **Stockholmeu-north-1** Regoin :

1. Public Subnet
   - Inbound:
     - Allow 80, 443 from 0.0.0.0/0
   - Outbound:
     - Allow 80, 443 to 0.0.0.0/0
2. Web Subnet
   - Inbound:
     - Allow 80 from ALB subnet
   - Outbound:
     - Allow 3306 to DB subnet
3. DB Subnet
   - Inbound:
     - Allow 3306 from Web subnet
   - Outbound:
     - Allow ephemeral ports 1024–65535 to Web subnet

Create EC2 Role : In N. Virginiaus-east-1 Regoin
Role Name: EC2-S3-CloudWatch-Role
Attach these AWS managed policies:

- AmazonS3ReadOnlyAccess
- CloudWatchAgentServerPolicy
- AmazonSSMManagedInstanceCore



Web Tier ASG (with ALB)
Create a Launch Template (Recommended)
You need a Launch Template before creating an Auto Scaling Group.

Launch Template -1

- Name: New-launch-template
- AMI: Amazon Linux 2 or your custom AMI
- Instance Type: t3.micro or as required
- Key Pair: Select your key
- IAM Role: EC2_S3_CloudWatch_Role
- Security Group: SG-Web
- User Data

Create Auto Scaling Group (ASG) : : Web Tier ASG (with ALB) & App Tier ASG (with NLB)

Create Target Group for Web Tier

- Go to EC2 → Target Groups → Create target group
- Type: Instances
- Protocol: HTTP, Port: 80
- Name: web-tg
- Health checks: Path /
- Register no targets

Create Application Load Balancer

- Go to EC2 → Load Balancers → Create Load Balancer
- Choose Application Load Balancer
- Name: web-alb
- Scheme: Internet-facing
- Listeners: HTTP (port 80)
- Subnets: Public subnets – 1&2
- Security Group: Allow HTTP (port 80) from 0.0.0.0/0
- Target group: Attach web-tg
- Create

Create Auto Scaling Group

- Go to EC2 → Auto Scaling Groups → Create
- Choose web-launch-template
- Name: web-asg
- VPC: Select
- Subnets: Public subnets
- Attach to ALB: Yes → select web-alb → target group web-tg
- Desired/Min/Max capacity: 2 / 2 / 4
- Enable health checks (ALB + EC2)
- Scaling Policy:
    - Choose Target tracking
    - Metric: CPU utilization @ 50%
- Instance refresh: Enable
- Create ASG

App Tier ASG (with NLB)

Create Launch Template

- Go to Launch Templates → Create
- Name: app-launch-template
- AMI: Ubuntu 22.04
- Instance Type: t2.micro
- Key Pair: Use the same or new
- Security Group: APP-SG
    - Allow port 8080 from NLB SG only
- User Data

Create Target Group for App Tier

- Go to Target Groups → Create
- Type: Instances
- Protocol: TCP, Port: 8080
- Name: app-tg
- Health checks: TCP on port 8080
- Register no targets yet

Create Network Load Balancer

- Go to Load Balancers → Create Load Balancer
- Choose Network Load Balancer
- Name: app-nlb
- Scheme: Internal
- Listener: TCP on 8080
- Subnets: Private subnets in 2 AZs
- Target group: app-tg
- Create

Create Auto Scaling Group

- EC2 → Auto Scaling Groups → Create
- Launch Template: app-launch-template
- Name: app-asg
- VPC: Same as web tier
- Subnets: Private subnets – APP -1&2
- Attach to NLB: Yes → select app-nlb → target group app-tg
- Desired/Min/Max capacity: 2 / 2 / 4
- Scaling Policy: CPU @ 50%
- Health Checks: EC2 + NLB
- Create ASG

Install and Deploy Applications:

- Web Tier: i. Install Nginx/Apache, deploy frontend code.
- App Tier: i. Install backend dependencies (Node.js, Java, Python).
    - ii. Connect to RDS.

Create database :

- Choose a database creation method : Standard create
- Engine options-Engine type : MySQl
- Choose a Template : Free tier
- Settings : DB instance identifier - mydb-instance
    - Master username – admin
    - Master password : Click on Self Manage
    - Enable Auto generate password
- Connectivity : Your Virtual private cloud (VPC)
        - Existing VPC security groups : DB-SG
        - Availability Zone : us-east-1a or us-east-2a

ALB & NLB for Stockholmeu-north-1 Regoin

Create Application Load Balancer (ALB)

Go to EC2 > Load Balancers > Create Load Balancer > Application Load Balancer

Configure Load Balancer

- Name: my-alb
- Scheme: Internet-facing
- IP Address type: IPv4
- Listeners: HTTP (Port 80) or HTTPS (Port 443)
- Availability Zones: Select your VPC, then select 2 Public Subnets in EU-North (e.g., eu-north-1a, eu-north-1b)

Configure Security Groups

- Create or use an SG that allows:
    - Port 80 (HTTP) or 443 (HTTPS) from the internet (0.0.0.0/0)
    - Attach this to ALB

Configure Target Group

- Name: web-target-group
- Target type: Instance
- Protocol: HTTP (or HTTPS)
- Port: 80 (or your app port)
- Health checks: HTTP → / or your app's health check path

Create Network Load Balancer (NLB)

Go to EC2 > Load Balancers > Create Load Balancer > Network Load Balancer

Configure Load Balancer

- Name: my-nlb
- Scheme: Internal (for internal app communication)
- IP Address type: IPv4
- Listeners: TCP (e.g., port 3000 or 8080)
- Availability Zones: Select 2 Private Web Subnets (same region)

Configure Target Group

- Name: app-target-group
- Target type: Instance
- Protocol: TCP
- Port: 3000 (or your backend port)
- Health checks: TCP or custom HTTP path if needed

Create database :

- Choose a database creation method : Standard create
- Engine options-Engine type : MySQl
- Choose a Template : Free tier
- Settings : DB instance identifier - mydb-instance
    - Master username – admin
    - Master password : Click on Self Manage
    - Enable Auto generate password
- Connectivity : Your Virtual private cloud (VPC)
        - Existing VPC security groups : DB-SG
        - Availability Zone : eu-north-1

Create S3 Buckets (for static files / backups)

- Create Bucket
- Go to S3 → Create bucket
- Name: your-project-assets-bucket
- Region: same as app
- Enable Versioning : Under Bucket Versioning, select Enable
- Enable Encryption : Choose: Amazon S3-managed keys (SSE-S3) or KMS
- Create bucket

Create a Public Hosted Zone

- Go to Route 53 → Hosted Zones → Create Hosted Zone
    - Domain name: harshitraj8507.wixsite.com/my-site
    - Type: Public hosted zone
- Add Latency-Based Routing Records
    - In your hosted zone, click Create Record
    - Add 2 records pointing to your ALBs in both regions:

Name	Type	Alias	Region	Routing Policy
https://harshitraj8507.wixsite.com/my-site	A (alias)	☑ Alias to ALB	us-east-1	**Latency-based**
https://harshitraj8507.wixsite.com/my-site	A (alias)	☑ Alias to ALB	Eu-north-1	**Latency-based**

Configure Health Checks

- Go to Route 53 → Health Checks → Create health check
    - Target: Public IP or domain of ALB
    - Protocol: HTTP
    - Path: /health or / (depends on your app)
- Associate health check with the Route 53 record
- If a region fails health check, Route 53 reroutes to healthy region

Enable AWS WAF for ALB

Create a Web ACL (WAF)

- Go to WAF → Web ACLs → Create Web ACL
    - Name: myapp-waf
    - Region: same as your ALB
    - Resource type: Application Load Balancer

- Associate with your ALB(s)

Add Rules to WAF

- Add Managed Rule Groups:
  - AWSManagedRulesCommonRuleSet (includes SQLi, XSS protection)
  - AWSManagedRulesKnownBadInputsRuleSet
- Optional: Add Custom rules
  - e.g., Block IPs, Rate-based rules

Add CloudWatch Alarms (Optional)

- Go to CloudWatch → Alarms → Create Alarm
- Set threshold for metrics (e.g., CPU > 70%)
- Set actions:
  - Trigger scale out/in
  - Send notification (SNS topic)

Enable CloudWatch Monitoring

Setup Dashboards (EC2, ALB, RDS)

- Go to CloudWatch → Dashboards → Create dashboard
- Name: prod-monitoring-dashboard
- Add widgets:
  - EC2: CPUUtilization, StatusCheckFailed
  - ALB: RequestCount, TargetResponseTime, HTTPCode_ELB_5XX_Count
  - RDS: FreeStorageSpace, CPUUtilization, DatabaseConnections