AWS 3-TIER HIGH AVAILABILITY ARCHITECTURE ON AWS

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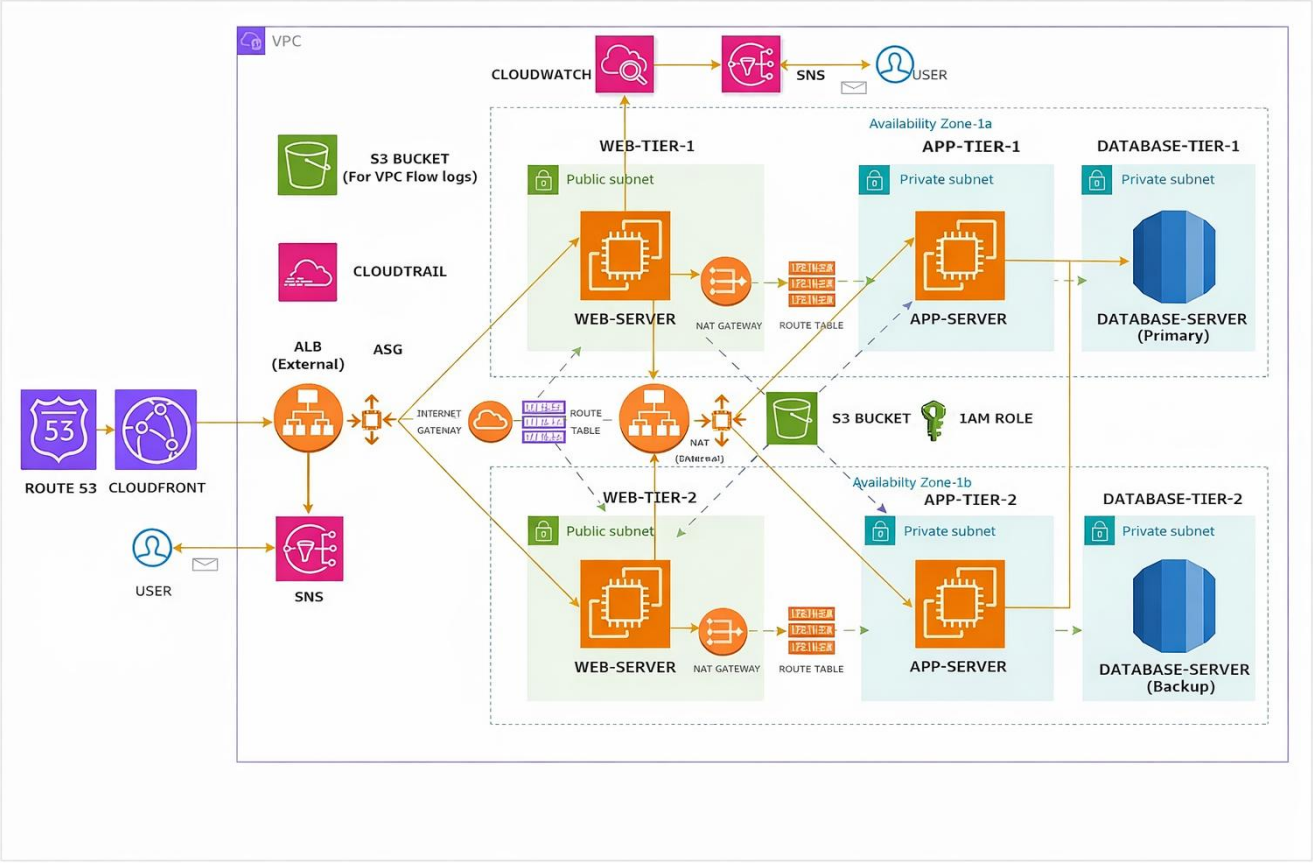
Complete Infrastructure Deployment Guide

Architecture: Multi-Tier Web Application on AWS
Availability: Multi-AZ (Availability Zone 1a & 1b)
Web Tier Stack: Nginx + Node.js (React Frontend)
App Tier Stack: Nginx + MySQL (Backend / Database Proxy)
Database: Amazon RDS (Multi-AZ, Primary + Backup)



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1. Project Overview

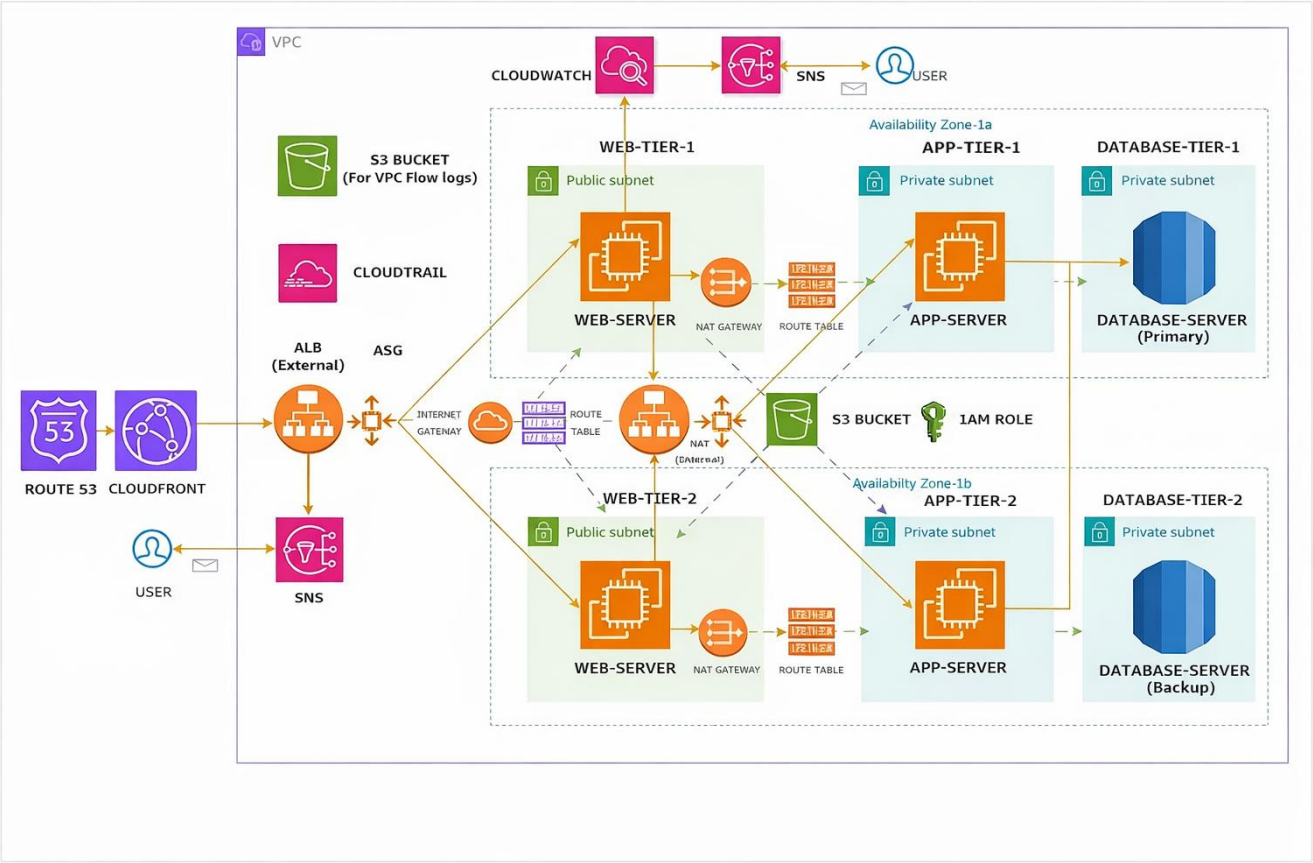
This document is a step-by-step guide to deploy a production-grade, highly available three-tier web application on Amazon Web Services (AWS). The infrastructure is designed with fault tolerance, auto-scaling, monitoring, and security best practices in mind.

Architecture Summary

The deployment spans two Availability Zones (AZ-1a and AZ-1b) within a single AWS VPC. Traffic flows from end users through Route 53 and CloudFront to an External Application Load Balancer, then through the Web Tier, App Tier, and finally to a Multi-AZ RDS database.

Tier	Technology	Subnet Type	Availability
Web Tier	Nginx + Node.js (React)	Public Subnet	AZ-1a & AZ-1b
App Tier	Nginx + MySQL	Private Subnet	AZ-1a & AZ-1b
Database Tier	Amazon RDS MySQL (Multi-AZ)	Private Subnet	Primary + Backup

2. Architecture Diagram & Component Breakdown



Traffic Flow

The following describes how a user request flows through the infrastructure:

1. User sends a DNS request. Route 53 resolves the domain and directs traffic to CloudFront.
2. CloudFront forwards the request to the External ALB (Application Load Balancer).
3. The External ALB distributes traffic to the Web Tier (Web-Server in AZ-1a or AZ-1b).
4. The Web Server (Nginx + Node.js) handles the frontend and forwards API calls to the Internal ALB.
5. The Internal ALB routes API traffic to the App Tier (App-Server in AZ-1a or AZ-1b).
6. The App Server connects to RDS (Primary) in the Database Tier to read/write data.
7. If the Primary RDS fails, RDS automatically fails over to the Backup instance in the other AZ.

Supporting Services

- S3 Bucket (x2): One for application code, one for VPC Flow Logs
- CloudTrail: Audit logging for all AWS API calls
- CloudWatch + SNS: Real-time monitoring and alerting to end user via email/SMS
- NAT Gateway: Allows private subnet instances to initiate outbound internet connections
- IAM Role: Grants EC2 instances permission to access S3 (S3ReadOnly + SSM Managed Instance Core)

3. Prerequisites

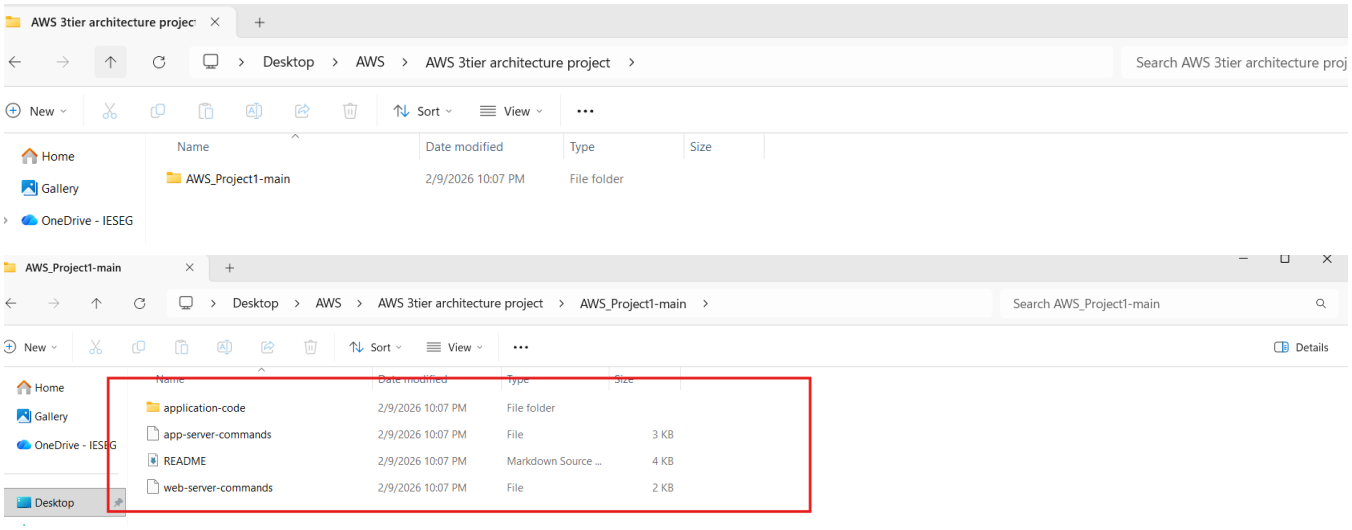
Ensure the following are in place before beginning the deployment:

- An active AWS account with sufficient IAM permissions (AdministratorAccess recommended for initial setup)
- AWS CLI installed and configured on your local machine
- Git installed on your local machine
- Basic understanding of AWS services: EC2, VPC, RDS, ALB, Route 53
- A registered domain name (for Route 53 DNS configuration)
- Application source code ready in your local repository

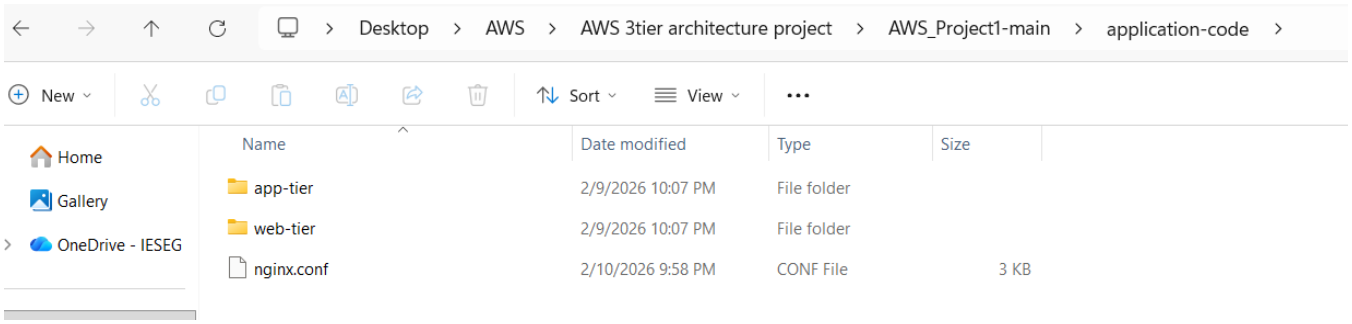
Region Note:
All resources in this guide are created in a single AWS region. Choose a region that supports all required services (e.g., us-east-1, us-west-2, ap-south-1). The VPC CIDR used in this guide is 172.16.0.0/16.

4. Step 1 — Download Folder from github to Local System

Begin by cloning or downloading the application source code to your local machine. This code will later be uploaded to S3 and deployed to the EC2 instances.



> **Note:** *Make sure both the web-tier code (React/Node.js) and app-tier code are present in separate folders before proceeding.*

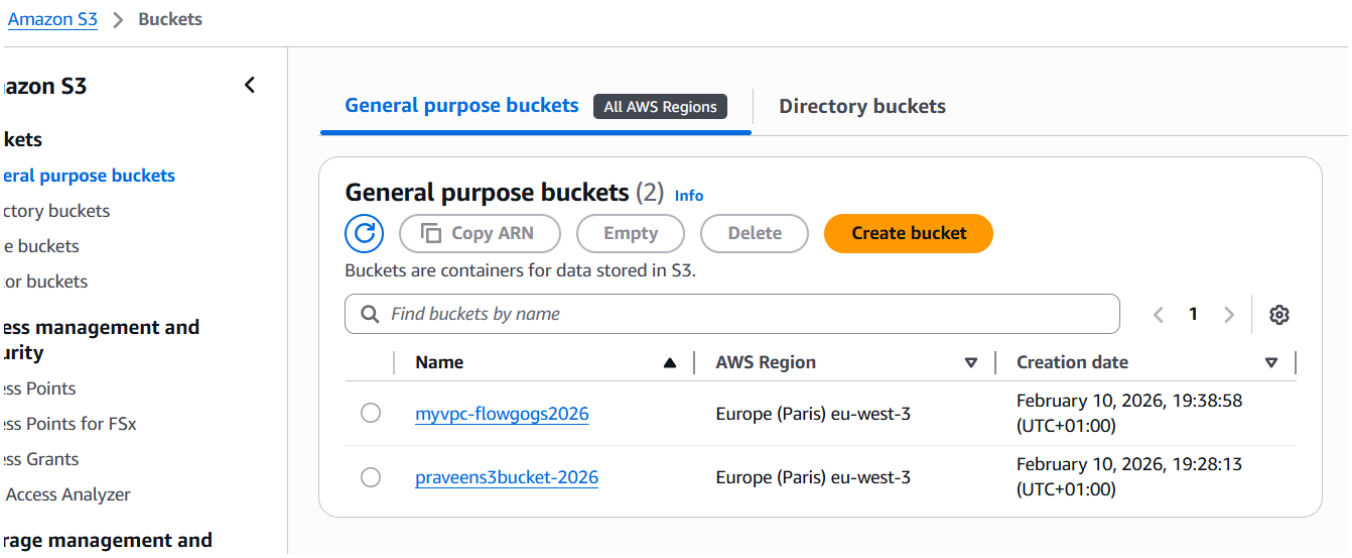


5. Step 2 — Create S3 Buckets & Upload Code

Two S3 buckets are required: one for storing the application code, and one that will be used for VPC Flow Logs.

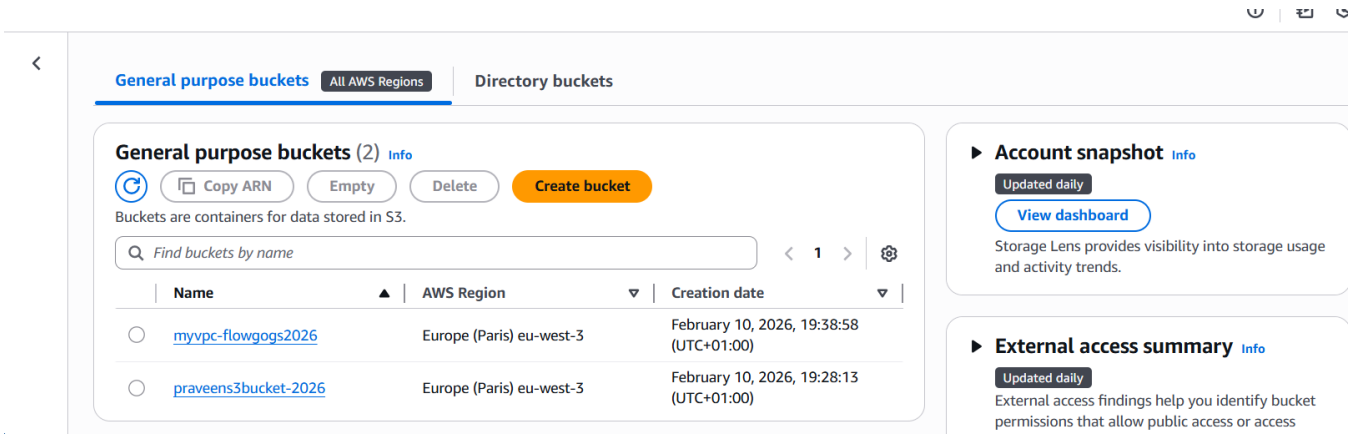
5.1 Create the Application Code Bucket

8. Go to AWS Console → S3 → Create Bucket
9. Enter a unique bucket name (e.g., my-app-code-bucket-2024)
10. Select your target AWS Region
11. Keep all other settings as default → Click Create Bucket, and upload the downloaded folder to the s3 bucket



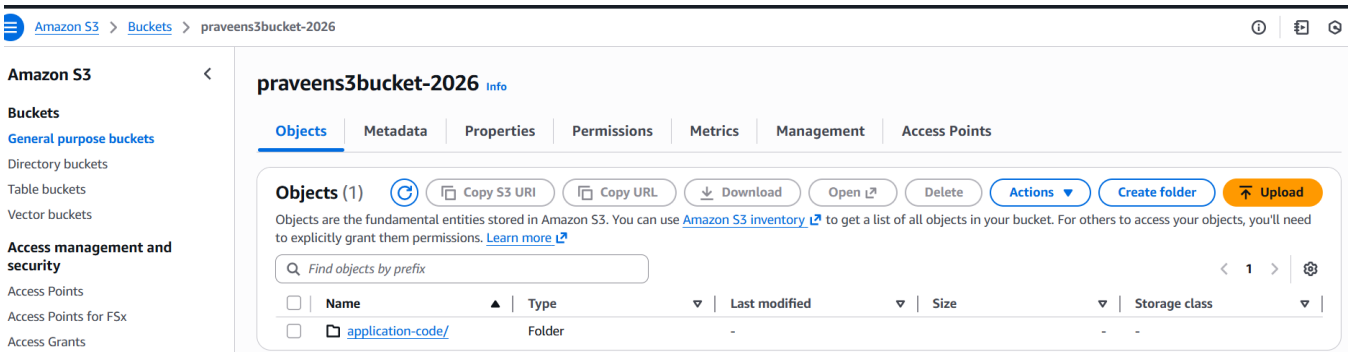
5.2 Create the VPC Flow Logs Bucket

12. Go to AWS Console → S3 → Create Another Bucket to store VPC flow logs
13. Enter a unique bucket name (e.g., my-vpc-flowlogs-bucket-2024)
14. Select the same AWS Region
15. Click Create Bucket



5.3 Upload Application Code to S3

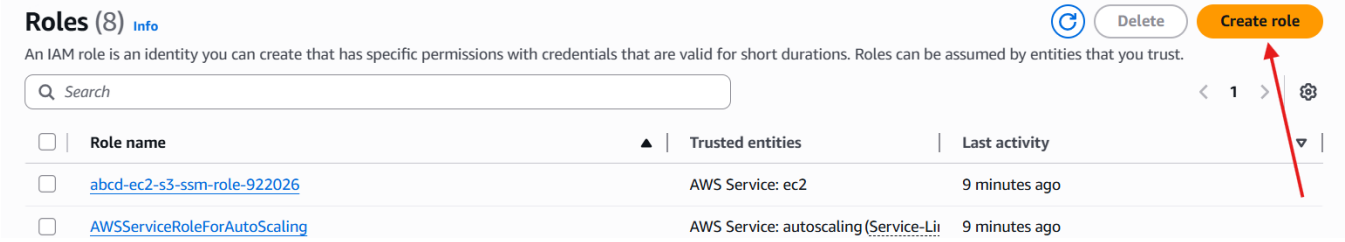
16. Open the application code bucket
17. Click Upload → Add Files/Folder
18. Upload both the web-tier and app-tier code folders
19. Click Upload

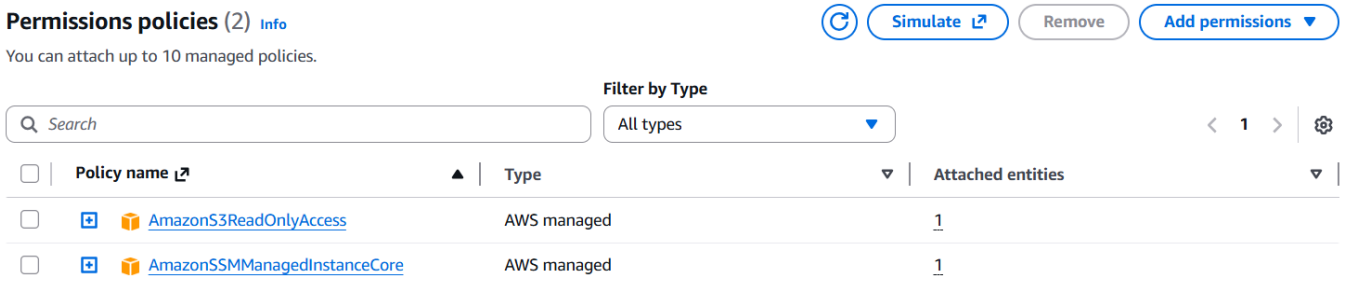


6. Step 3 — Create IAM Role

An IAM Role must be created and attached to EC2 instances so they can securely access S3 (to pull code) and be managed via AWS Systems Manager (SSM) without requiring direct SSH key access.

20. Navigate to AWS Console → IAM → Roles → Create Role
21. Select Trusted entity type: AWS service
22. Select Use case: EC2 → Click Next
23. Attach the following policies:
    - AmazonS3ReadOnlyAccess
    - AmazonSSMManagedInstanceCore
24. Click Next → Enter Role Name (e.g., ec2-3tier-role)
25. Click Create Role





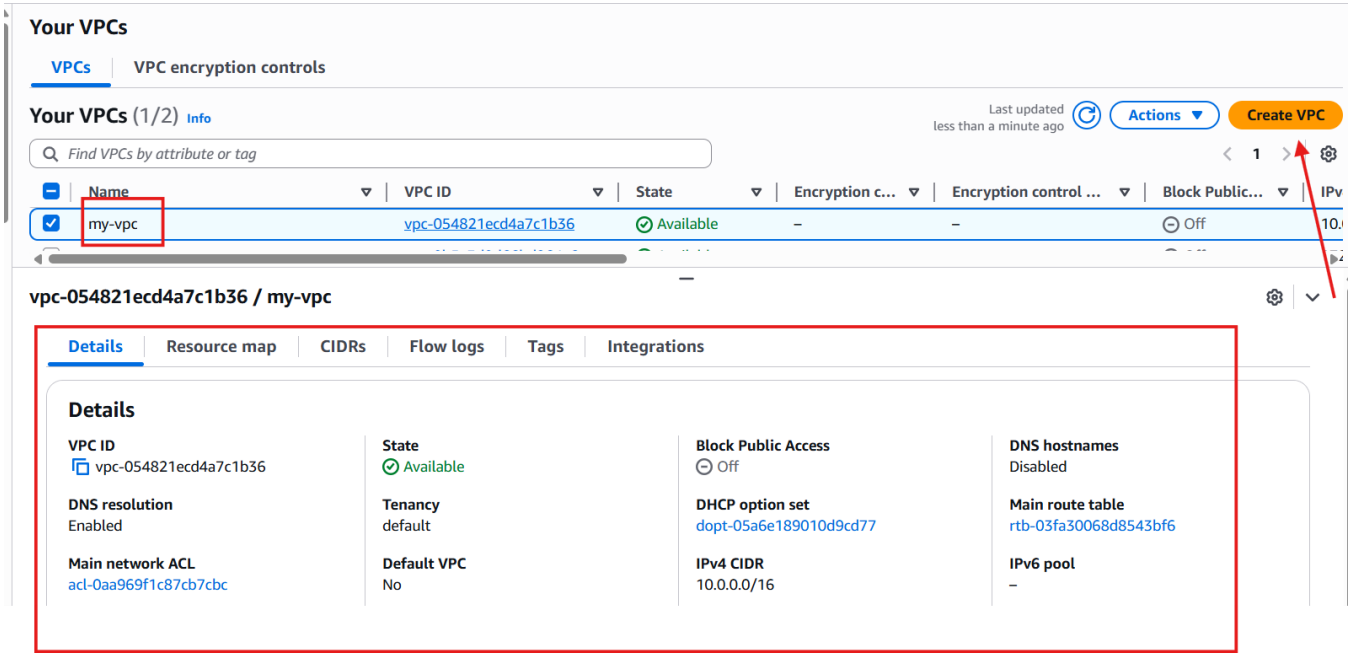
Why SSM Managed Instance Core?

This policy enables AWS Systems Manager Session Manager, which allows you to connect to EC2 instances securely through the AWS Console without needing SSH keys or open port 22. This is a security best practice.

7. Step 4 — Create VPC, Subnets, IGW, NAT Gateway & Route Tables

7.1 Create VPC

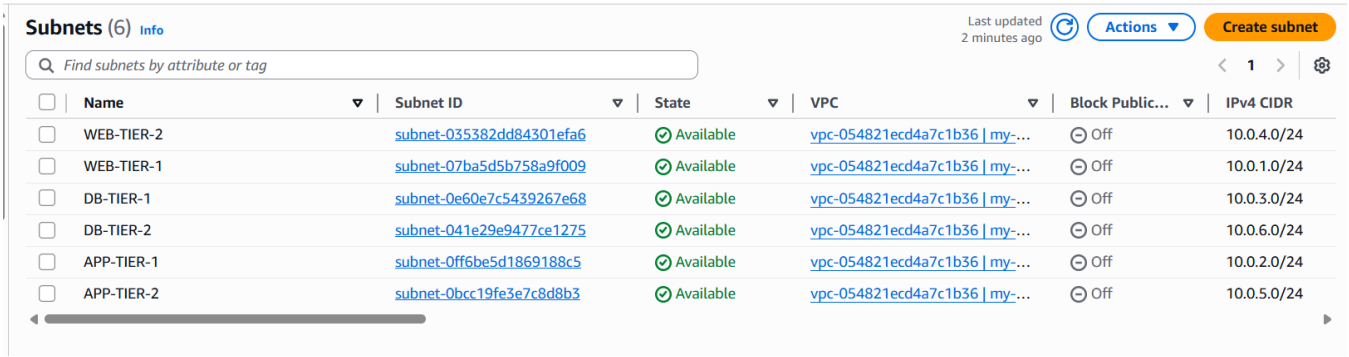
26. Go to AWS Console → VPC → Your VPCs → Create VPC
27. Select VPC Only (not VPC and more)
28. Enter a name (e.g., 3tier-vpc)
29. IPv4 CIDR: 172.16.0.0/16
30. Leave IPv6 CIDR as No IPv6 CIDR block
31. Tenancy: Default → Click Create VPC



7.2 Create Subnets

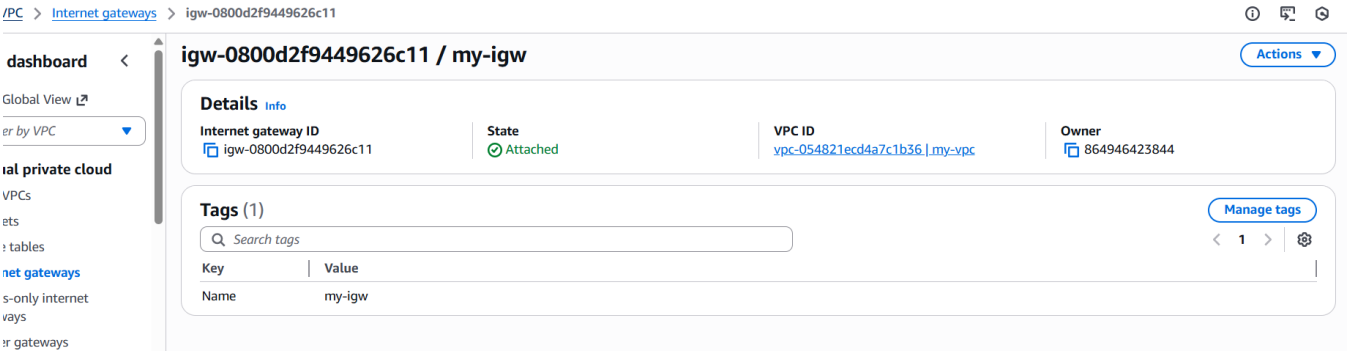
Choose a cidr and configure .Create the following 6 subnets across two Availability Zones: Example :

Subnet Name	Availability Zone	Type	CIDR Block
web-tier-public-1a	AZ-1a	Public	172.16.0.0/24
web-tier-public-1b	AZ-1b	Public	172.16.1.0/24
app-tier-private-1a	AZ-1a	Private	172.16.2.0/24
app-tier-private-1b	AZ-1b	Private	172.16.3.0/24
db-tier-private-1a	AZ-1a	Private	172.16.4.0/24
db-tier-private-1b	AZ-1b	Private	172.16.5.0/24



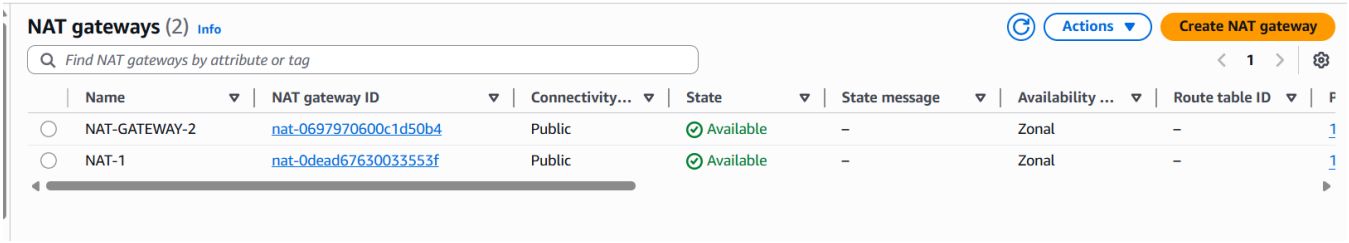
7.3 Create Internet Gateway (IGW)

32. Go to VPC → Internet Gateways → Create Internet Gateway
33. Name: 3tier-igw → Create
34. Select the new IGW → Actions → Attach to VPC → Select 3tier-vpc → Attach



7.4 Create NAT Gateway

35. Go to VPC → NAT Gateways → Create NAT Gateway
36. Subnet: Select web-tier-public-1a (public subnet)
37. Connectivity type: Public
38. Click Allocate Elastic IP → Create NAT Gateway
39. Wait for Status to become Available (takes ~1-2 minutes), repeat the process for another public . we need two nat gateway to this architecture



7.5 Create Route Tables

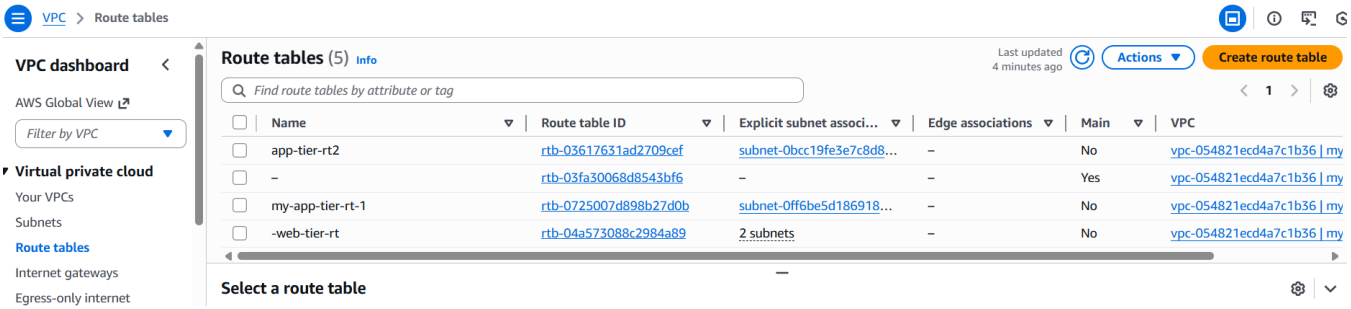
You need two route tables: a Public Route Table (for web tier) and a Private Route Table (for app and database tiers).

Public Route Table (Web Tier):

40. VPC → Route Tables → Create Route Table → Name: public-rt, VPC: 3tier-vpc
41. Select the route table → Routes → Edit Routes → Add Route: 0.0.0.0/0 → Target: Internet Gateway → Save
42. Subnet Associations → Edit Subnet Associations → Select both public subnets → Save

Private Route Table (App & DB Tiers):

43. Create Route Table → Name: private-rt, VPC: 3tier-vpc
44. Edit Routes → Add Route: 0.0.0.0/0 → Target: NAT Gateway → Save
45. Subnet Associations → Select all 4 private subnets → Save



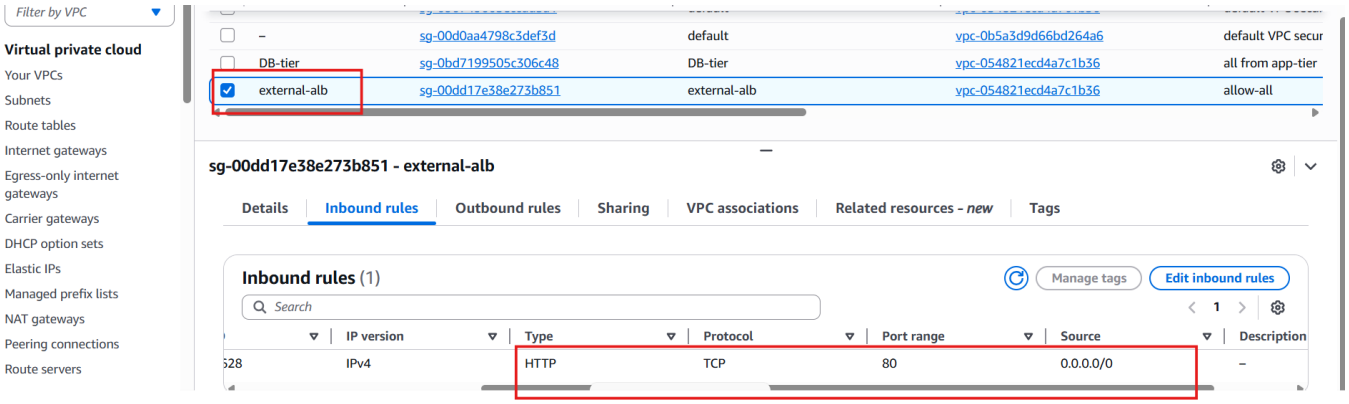
8. Step 5 — Create Security Groups

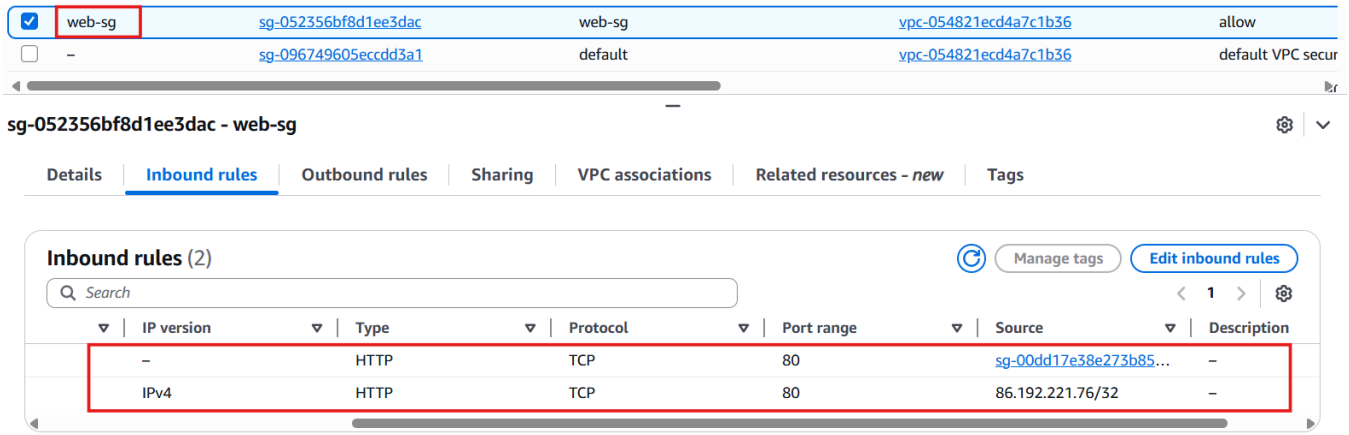
Security groups act as virtual firewalls. Create the following 5 security groups in your VPC, in the order listed below (as later groups reference earlier ones).

Security Group Name	Source	Port	Purpose
external-load-balancer-sg	0.0.0.0/0 (Internet)	HTTP 80	Allow all internet traffic to External ALB
web-tier-sg	external-load-balancer-sg	HTTP 80	Allow traffic from Ext ALB to Web Servers
internal-load-balancer-sg	web-tier-sg	HTTP 80	Allow traffic from Web Servers to Int ALB
app-tier-sg	internal-load-balancer-sg	Port 4000	Allow traffic from Int ALB to App Servers
db-tier-sg	app-tier-sg	MySQL 3306	Allow App Servers to connect to RDS

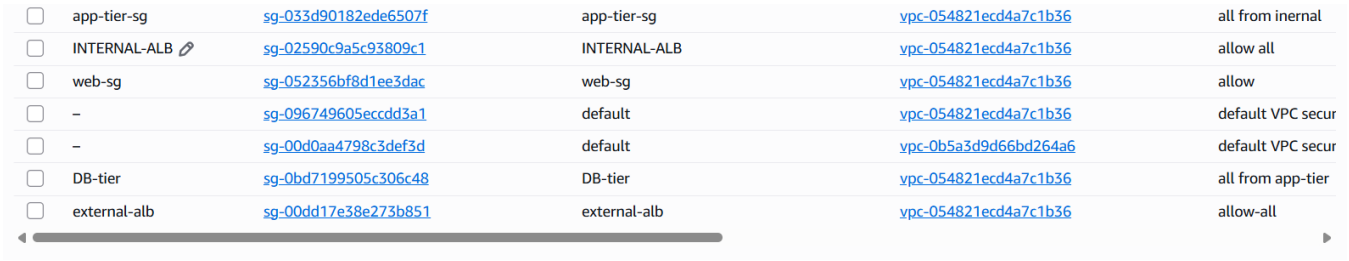
How to Create Each Security Group

46. Go to EC2 Console → Security Groups → Create Security Group
47. Enter the Security Group name and description
48. Select VPC: 3tier-vpc
49. Under Inbound Rules → Add Rule → Select Type (HTTP/Custom TCP/MySQL) → Set Source → Save





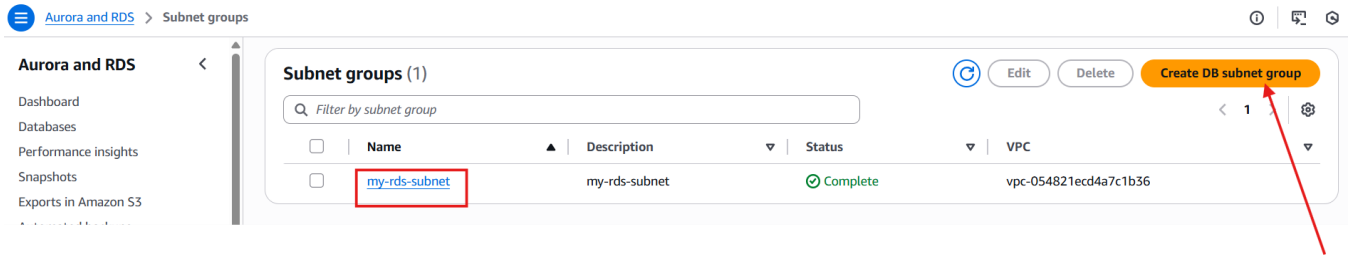
Create the security for all five by mentioned ports, Now you will have five security group

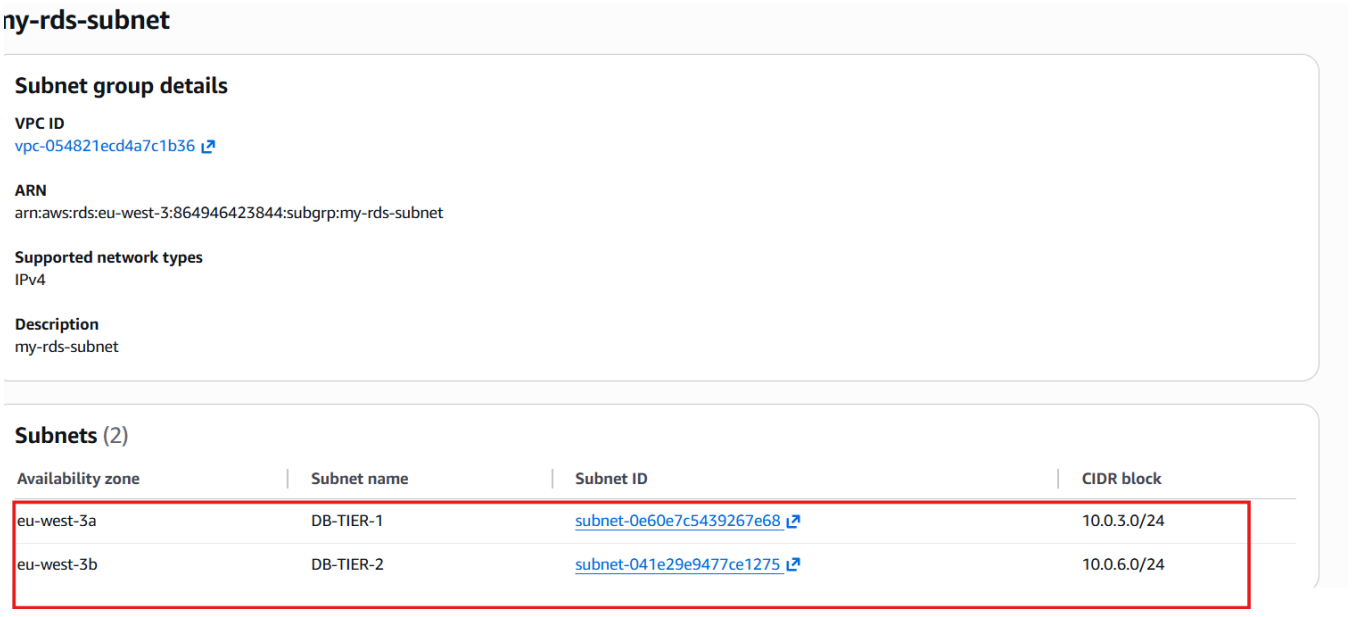


9. Step 6 — Create RDS (Database Tier)

9.1 Create DB Subnet Group

50. Go to RDS Console → Subnet Groups → Create DB Subnet Group
51. Name: 3tier-db-subnet-group
52. VPC: 3tier-vpc
53. Availability Zones: Select AZ-1a and AZ-1b
54. Subnets: Select db-tier-private-1a and db-tier-private-1b → Create

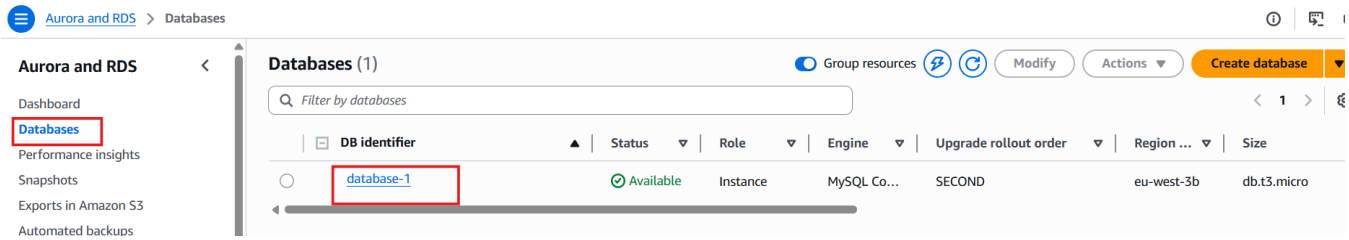




9.2 Create RDS Instance (Multi-AZ)

55. RDS Console → Databases → Create Database
56. Engine: MySQL, Version: (latest stable)
57. Template: Production (for Multi-AZ)
58. DB Instance Class: db.t3.micro (or appropriate tier)
59. Storage: 20 GiB (gp2), Enable storage autoscaling
60. Multi-AZ: Yes (creates Primary in AZ-1a, Backup/Standby in AZ-1b)
61. VPC: 3tier-vpc
62. Subnet Group: 3tier-db-subnet-group
63. Public Access: No

64. Security Group: db-tier-sg
65. Database Authentication: Password authentication
66. Set Master username and password (save these securely!)
67. Initial Database Name: appdb (or your preferred name)
68. Click Create Database and wait ~10-15 minutes for it to become available



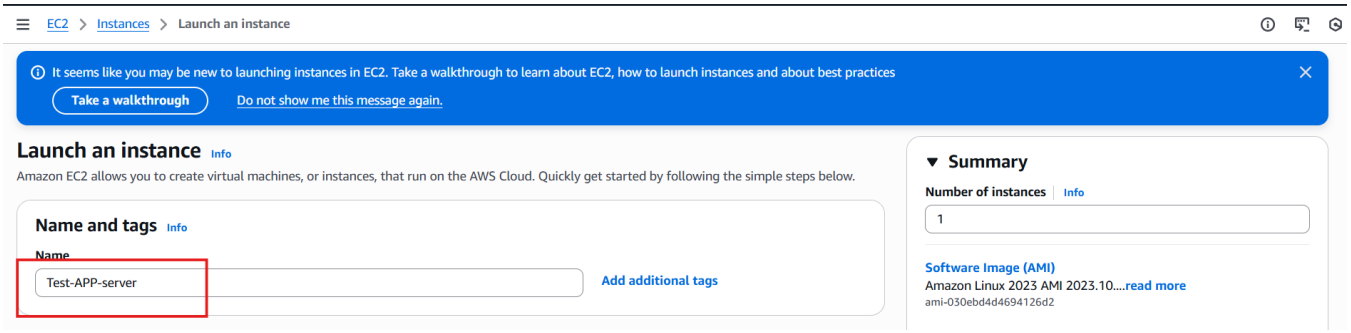
Note: *Note the RDS endpoint URL — you will need this when configuring the App Server's database connection.*

10. Step 7 — Create App Server (App Tier)

The App Tier is responsible for handling business logic and database communication. It uses Nginx as a reverse proxy and MySQL client to connect to RDS.

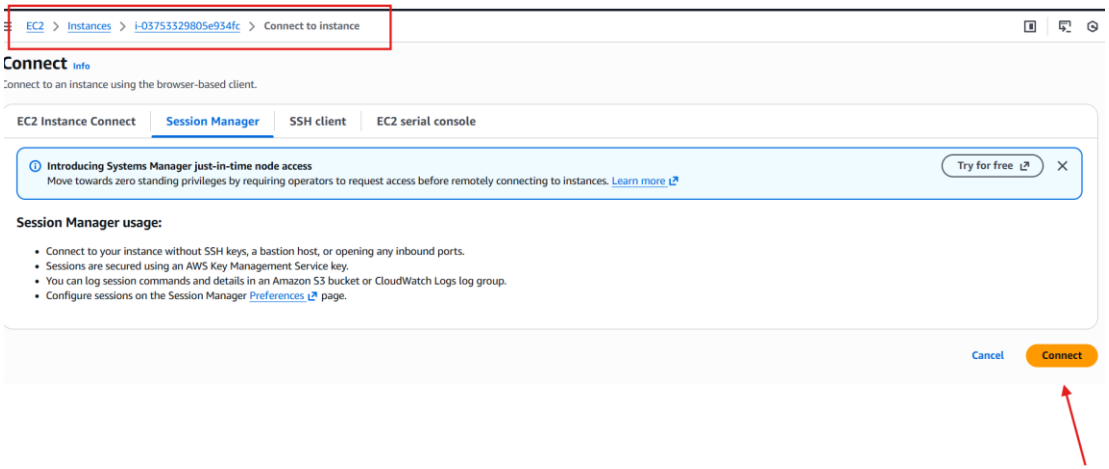
10.1 Launch Test App Server

69. EC2 Console → Launch Instance
70. Name: test-app-server
71. AMI: Amazon Linux 2023 (or Amazon Linux 2)
72. Instance type: t2.micro
73. Key pair: (Select existing or create new)
74. VPC: 3tier-vpc, Subnet: app-tier-private-1a
75. Auto-assign public IP: Disable
76. Security Group: app-tier-sg
77. IAM Instance Profile: ec2-3tier-role
78. Launch Instance



10.2 Connect via SSM Session Manager

79. Select the instance in EC2 Console
80. Click Connect → Session Manager → Connect



10.3 Install Node.js on App Server

```
# Switch to root
sudo su

# Update packages
yum update -y

# Install Node.js (using NVM - Node Version Manager)
curl -o- https://raw.githubusercontent.com/nvm-sh/nvm/v0.39.7/install.sh | bash
source ~/.bashrc
nvm install 16
nvm use 16

# Verify Node.js installation
node -v
npm -v
```

Flow the comments in the file “web-server-commands”

10.4 Install MySQL Client on App Server

```
# Install MySQL client (to connect to RDS)
yum install mysql -y

# Test connection to RDS (replace with your RDS endpoint)
mysql -h <RDS-ENDPOINT> -u <DB-USERNAME> -p

# If successful, you'll see MySQL prompt
# Type 'exit' to quit
```

10.5 Download and Configure App Code from S3

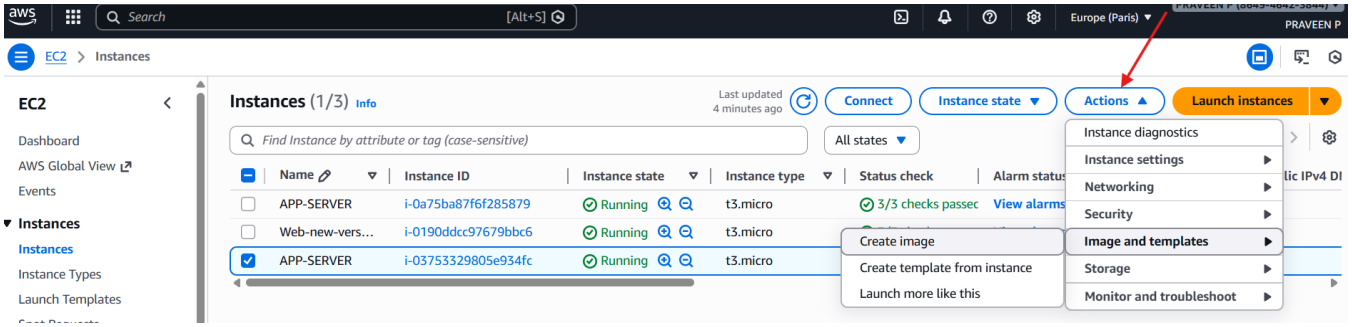
```
# Create app directory
mkdir -p /home/ec2-user/app-tier
cd /home/ec2-user/app-tier

# Download code from S3
aws s3 cp s3://<YOUR-CODE-BUCKET>/app-tier/ . --recursive

# Install npm dependencies
npm install

# Configure database connection in your config file
# Edit the DB config to point to your RDS endpoint
```

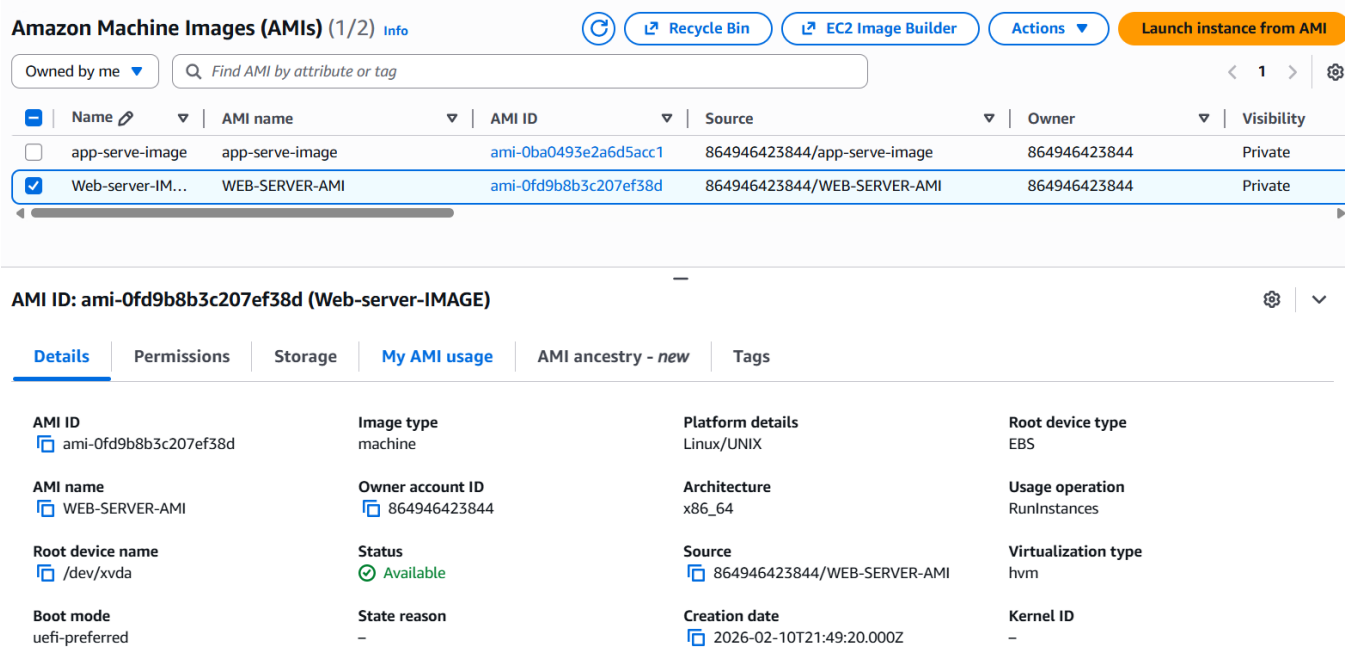
10.6 Start the App Server

```
# Install PM2 process manager to keep app running
npm install -g pm2

# Start app server on port 4000
pm2 start index.js

# Save PM2 config and set to restart on reboot
pm2 save
pm2 startup

# Verify app is running
pm2 list
curl http://localhost:4000/health
```

10.7 Create AMI from App Server

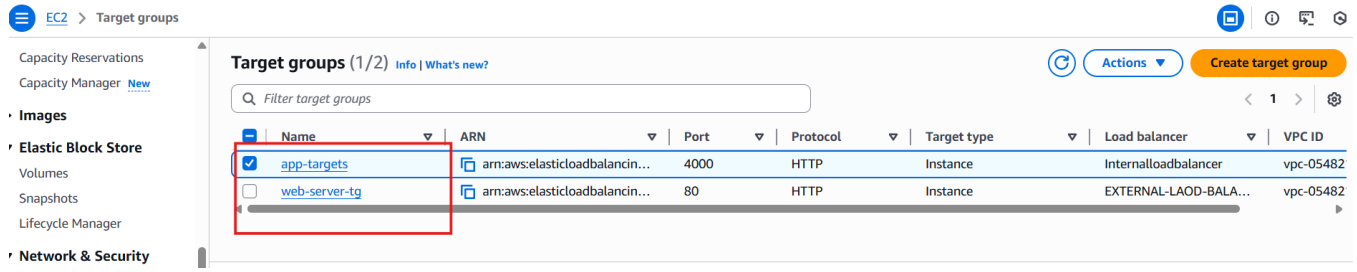
81. EC2 Console → Select test-app-server → Actions → Image and Templates → Create Image
82. Image Name: app-tier-ami
83. No reboot: Check (to avoid downtime) → Create Image
84. Wait for AMI status to become Available (EC2 → AMIs)





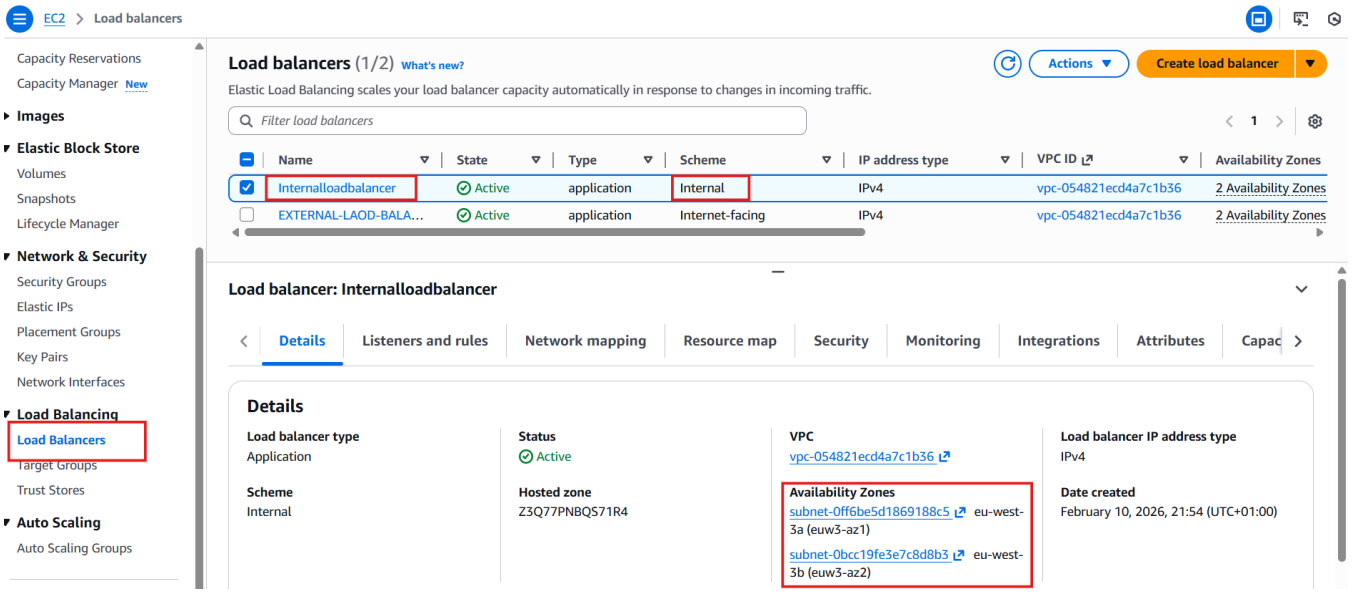
10.8 Create App Tier Target Group

85. EC2 Console → Target Groups → Create Target Group
86. Target type: Instances
87. Target group name: app-tier-tg
88. Protocol: HTTP, Port: 4000
89. VPC: 3tier-vpc
90. Health check path: /health → Create Target Group



10.9 Create Internal Load Balancer (ALB)

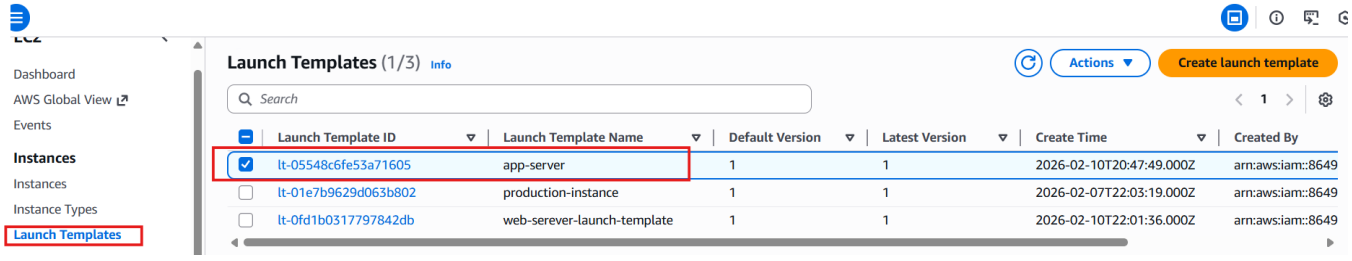
91. EC2 Console → Load Balancers → Create Load Balancer → Application Load Balancer
92. Name: internal-alb
93. Scheme: Internal
94. VPC: 3tier-vpc
95. Subnets: app-tier-private-1a and app-tier-private-1b
96. Security Group: internal-load-balancer-sg
97. Listener: HTTP:80 → Forward to: app-tier-tg → Create



10.10 Create App Tier Launch Template

98. EC2 Console → Launch Templates → Create Launch Template
99. Name: app-tier-lt
100. AMI: Select app-tier-ami (created above)
101. Instance type: t2.micro
102. Security Group: app-tier-sg
103. IAM Instance Profile: ec2-3tier-role
104. Advanced Details → User Data: Add startup script to launch app on boot

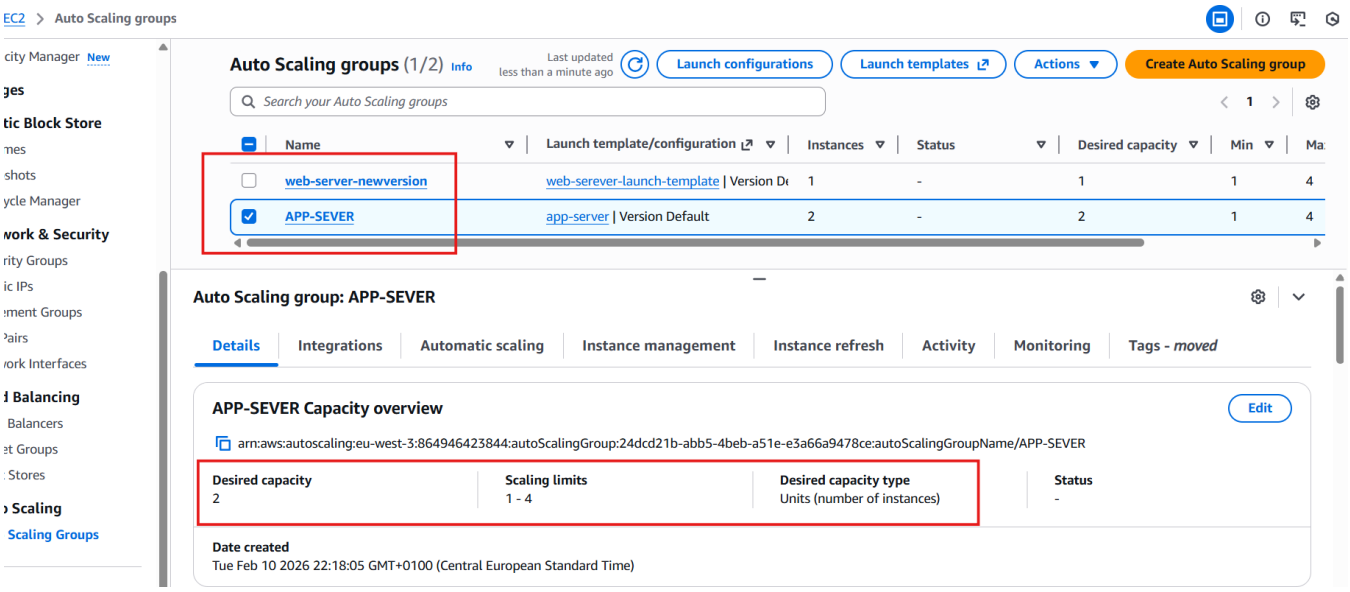
```
#!/bin/bash
# User Data script for App Server
cd /home/ec2-user/app-tier
pm2 start index.js
pm2 save
```



10.11 Create App Tier Auto Scaling Group (ASG)

105. EC2 Console → Auto Scaling Groups → Create Auto Scaling Group
106. Name: app-tier-asg
107. Launch Template: app-tier-lt
108. VPC and Subnets: app-tier-private-1a, app-tier-private-1b
109. Load Balancing: Attach to existing load balancer → Choose app-tier-tg

110. Desired: 2, Minimum: 2, Maximum: 4 (adjust based on your needs)
111. Scaling Policies: Target tracking — CPU Utilization 70% → Create



11. Step 8 — Create Web Server (Web Tier)

The Web Tier serves the React frontend and proxies API calls to the App Tier through the Internal ALB. It uses Nginx as a reverse proxy and Node.js to serve the React application.

11.1 Launch Test Web Server

112. EC2 Console → Launch Instance
113. Name: test-web-server
114. AMI: Amazon Linux 2023
115. Instance type: t2.micro
116. VPC: 3tier-vpc, Subnet: web-tier-public-1a
117. Auto-assign public IP: Enable
118. Security Group: web-tier-sg
119. IAM Instance Profile: ec2-3tier-role → Launch

11.2 Install Nginx on Web Server

```
# Connect via SSM Session Manager
sudo su
yum update -y

# Install Nginx
yum install nginx -y

# Start and enable Nginx
systemctl start nginx
systemctl enable nginx

# Verify Nginx is running
systemctl status nginx
```

11.3 Install Node.js on Web Server

```
# Install NVM and Node.js
curl -o- https://raw.githubusercontent.com/nvm-sh/nvm/v0.39.7/install.sh | bash
source ~/.bashrc
nvm install 16
nvm use 16

# Verify installation
node -v
npm -v
```

11.4 Download Web Code from S3 and Build React

```
# Create web directory
mkdir -p /home/ec2-user/web-tier
cd /home/ec2-user/web-tier

# Download from S3
aws s3 cp s3://<YOUR-CODE-BUCKET>/web-tier/ . --recursive

# Install dependencies
npm install

# Build the React app for production
npm run build
```

11.5 Configure Nginx

Edit the Nginx configuration to serve the React app and proxy API requests to the Internal ALB:

```
# Edit Nginx config
nano /etc/nginx/nginx.conf

# Or create a new server block:
nano /etc/nginx/conf.d/app.conf
```

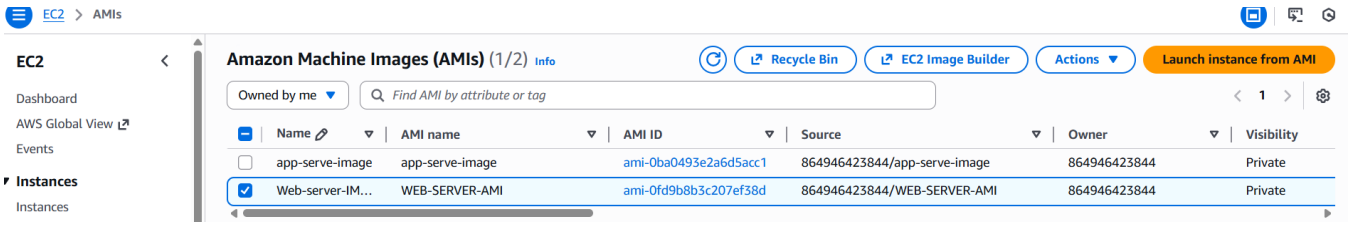
Nginx configuration to serve React and proxy API calls to Internal ALB:

```
server {
    listen 80;
    server_name _;

    # Serve the React build folder
    root /home/ec2-user/web-tier/build;
    index index.html;

    # For React Router support
    location / {
        try_files $uri $uri/ /index.html;
    }

    # Proxy API requests to Internal ALB
    location /api/ {
        proxy_pass http://<INTERNAL-ALB-DNS>/;
        proxy_http_version 1.1;
        proxy_set_header Host $host;
        proxy_set_header X-Real-IP $remote_addr;
    }
}
```

```
# Test Nginx configuration
nginx -t

# Reload Nginx to apply changes
systemctl reload nginx
```

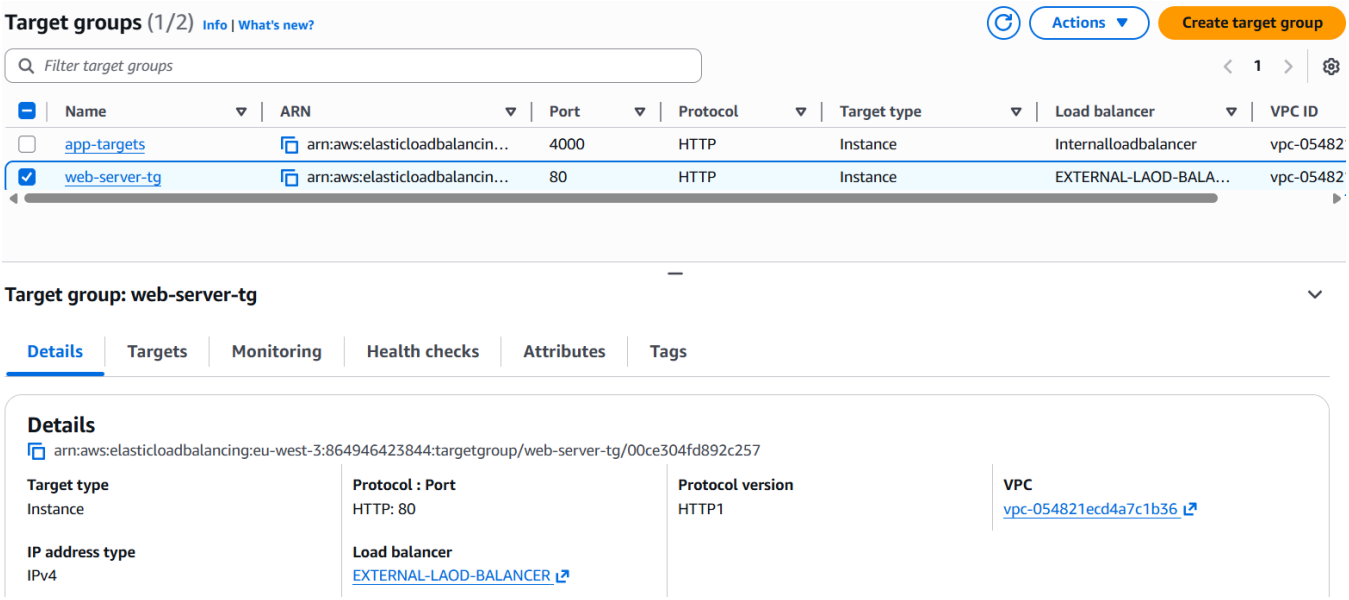
11.6 Create AMI from Web Server

120. EC2 → Select test-web-server → Actions → Image and Templates → Create Image
121. Image Name: web-tier-ami → Create Image → Wait for Available status



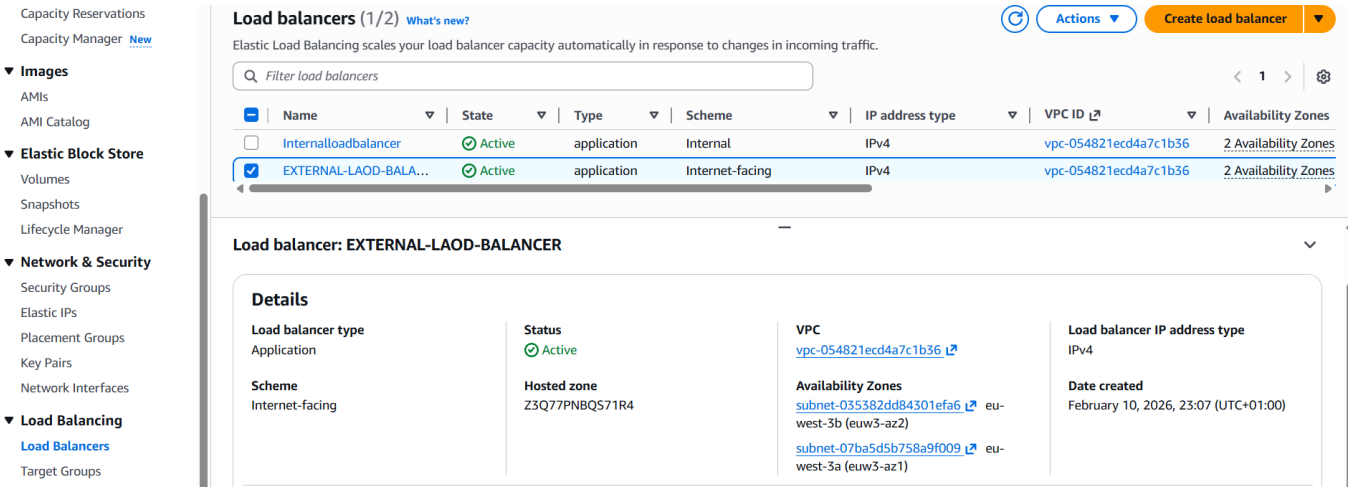
11.7 Create Web Tier Target Group

122. EC2 Console → Target Groups → Create Target Group
123. Target type: Instances, Name: web-tier-tg
124. Protocol: HTTP, Port: 80, VPC: 3tier-vpc
125. Health check path: / → Create



11.8 Create External Load Balancer

126. EC2 Console → Load Balancers → Create → Application Load Balancer
127. Name: external-alb, Scheme: Internet-facing
128. VPC: 3tier-vpc, Subnets: web-tier-public-1a and web-tier-public-1b
129. Security Group: external-load-balancer-sg
130. Listener: HTTP:80 → Forward to: web-tier-tg → Create

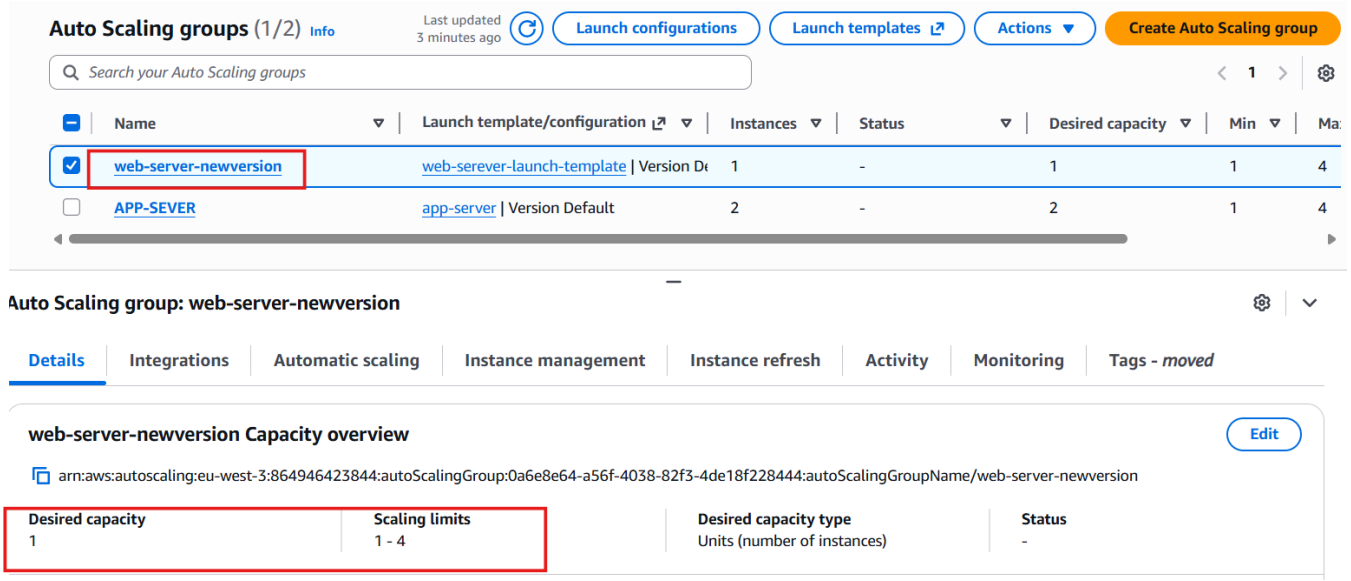


11.9 Create Web Tier Launch Template

131. Launch Templates → Create → Name: web-tier-lt
132. AMI: web-tier-ami, Instance type: t2.micro
133. Security Group: web-tier-sg, IAM Profile: ec2-3tier-role

11.10 Create Web Tier Auto Scaling Group

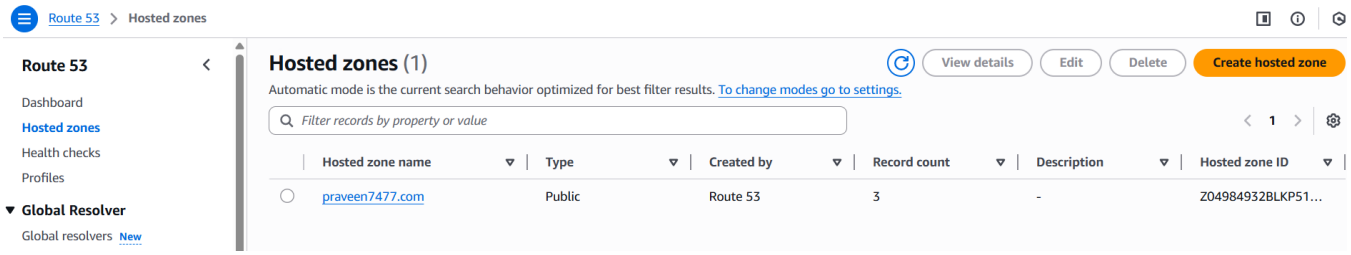
134. Auto Scaling Groups → Create → Name: web-tier-asg
135. Launch Template: web-tier-lt
136. Subnets: web-tier-public-1a, web-tier-public-1b
137. Load Balancing: Attach to web-tier-tg
138. Desired: 2, Min: 2, Max: 4 → Create



12. Step 9 — Create ALB DNS Record in Route 53

Point your domain to the External ALB by creating an Alias A record in Route 53.

139. Go to Route 53 Console → Hosted Zones → Select your domain
140. Click Create Record
141. Record type: A (IPv4)
142. Toggle Alias to ON
143. Route traffic to: Alias to Application and Classic Load Balancer
144. Region: Select your deployment region
145. Choose the External ALB from the dropdown
146. Routing Policy: Simple → Create Record



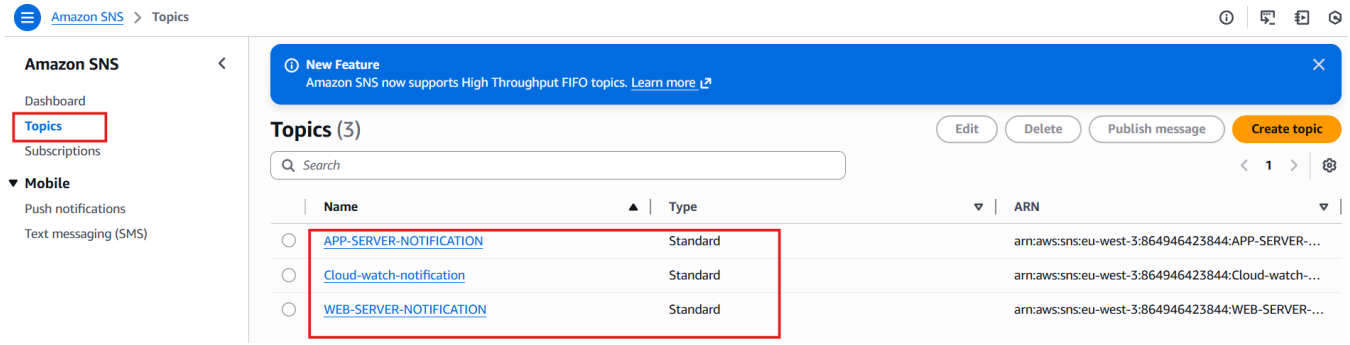
DNS Propagation Note:
DNS changes can take up to 60 seconds to propagate. Test by navigating to your domain in a browser after a short wait.

13. Step 10 — Create CloudWatch Alarms with SNS

Set up monitoring and alerting to be notified when instances experience high CPU usage or health check failures.

13.1 Create SNS Topic

147. Go to SNS Console → Topics → Create Topic
148. Type: Standard, Name: 3tier-alerts
149. Create Topic
150. Click the topic → Create Subscription
151. Protocol: Email, Endpoint: your-email@example.com → Create Subscription
152. Check your email and confirm the subscription



13.2 Create CloudWatch Alarms

153. Go to CloudWatch Console → Alarms → Create Alarm
154. Select metric: EC2 → By Auto Scaling Group → CPUUtilization
155. Select the web-tier-asg metric → Next
156. Conditions: Greater than 80% for 2 consecutive periods
157. Notification: Send to 3tier-alerts SNS topic
158. Alarm Name: web-tier-high-cpu → Create Alarm
159. Repeat for app-tier-asg CPU alarm

13.3 Configure VPC Flow Logs

160. Go to VPC Console → Select 3tier-vpc → Flow Logs tab → Create Flow Log
161. Filter: All
162. Destination: Send to Amazon S3 bucket
163. S3 Bucket ARN: arn:aws:s3:::<YOUR-FLOWLOGS-BUCKET>
164. Click Create Flow Log

14. Step 11 — Create CloudTrail

CloudTrail records all AWS API activity in your account, providing a complete audit trail for security and compliance.

165. Go to CloudTrail Console → Trails → Create Trail
166. Trail name: 3tier-cloudtrail
167. Storage location: Create new S3 bucket (or use existing logs bucket)
168. Log file SSE-KMS encryption: Optional (recommended for production)
169. Enable CloudWatch Logs: Yes → Create new log group: 3tier-cloudtrail-logs
170. Management events: Read and Write
171. Data events: Optional (S3 and Lambda)
172. Insights: Optional
173. Click Create Trail

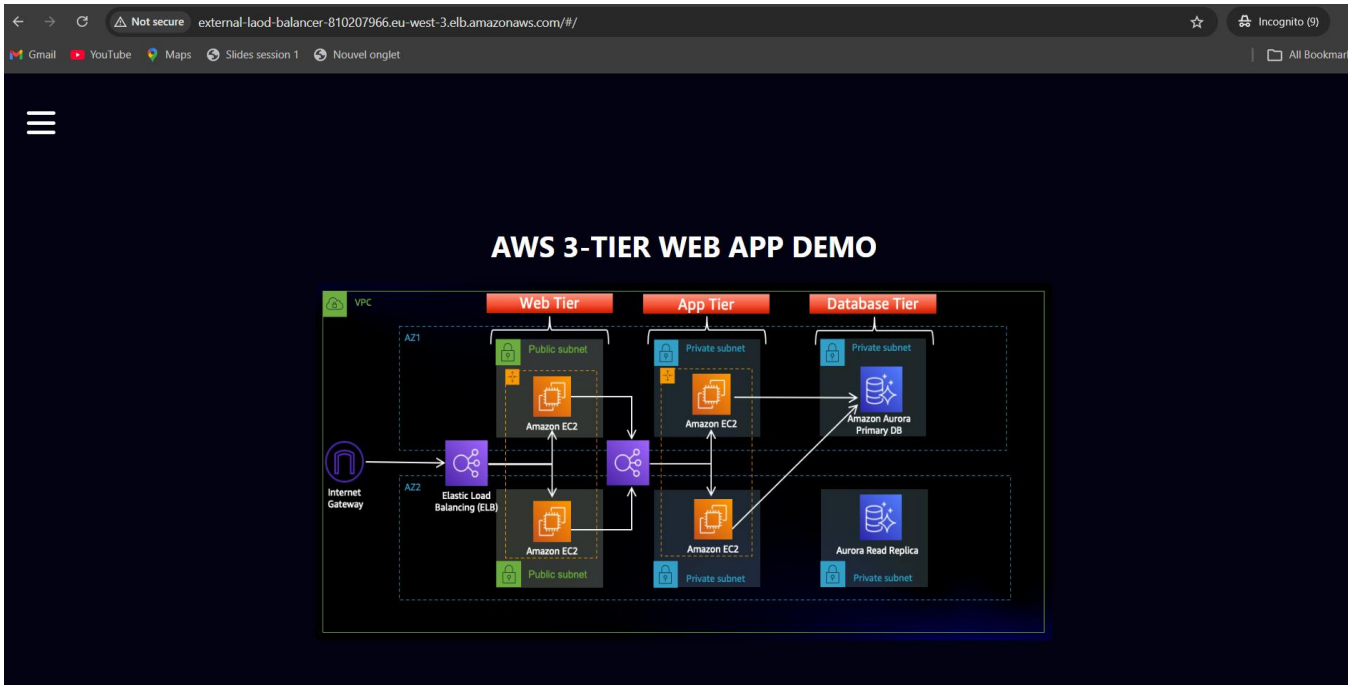
Important:
CloudTrail records every API call (Console, CLI, SDK). This is essential for auditing who did what and when. Store logs in a secure S3 bucket with restricted access.

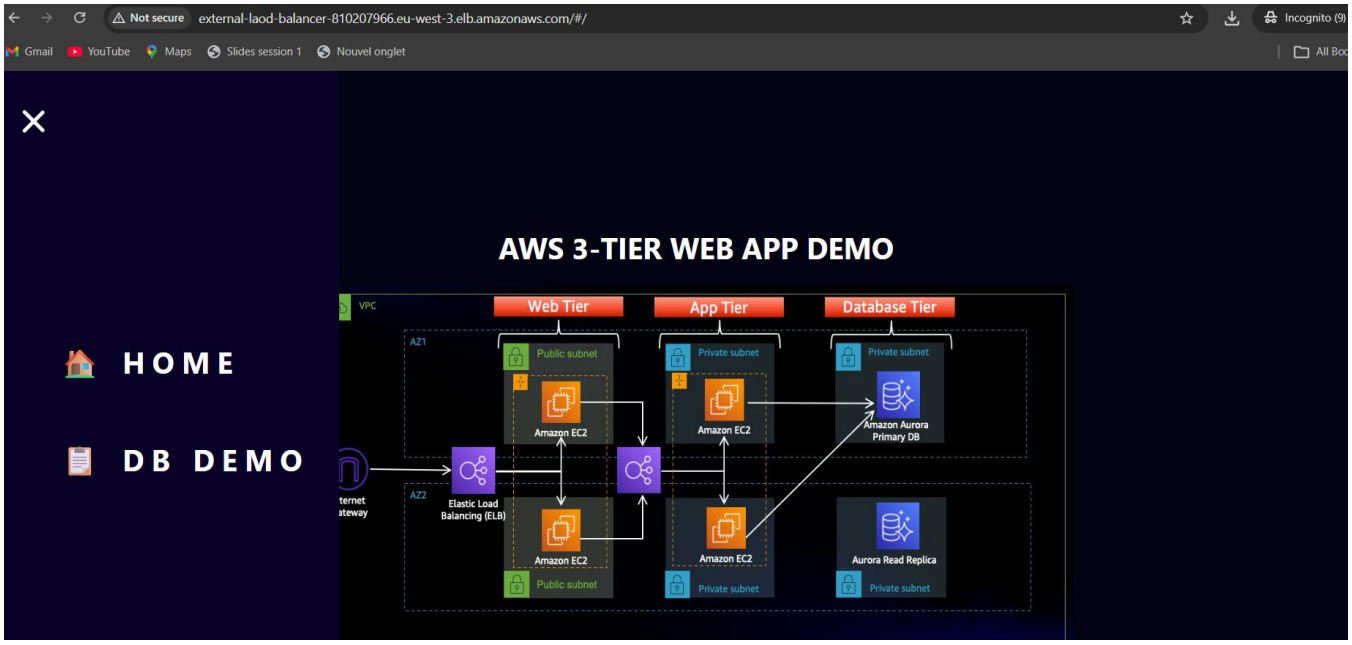
15. Verification & Testing

After completing all steps, perform the following checks to validate the deployment:

End-to-End Test Checklist

- Open your domain in a browser — the React application should load
- Verify HTTPS (if SSL was configured via ACM and ALB listener)
- Test API functionality — form submissions, data retrieval should work
- Verify data is being written to and read from RDS correctly
- Check EC2 Console — both ASGs should show healthy instances in each AZ
- Check Target Group health — all registered instances should be Healthy
- Simulate high load — verify ASG scales out correctly
- Test Multi-AZ failover — RDS failover should complete within 60 seconds
- Verify CloudWatch alarms trigger and SNS email is received
- Check CloudTrail logs are appearing in S3




Not secure
external-laod-balancer-810207966.eu-west-3.elb.amazonaws.com/#/
Incognito (9)
Gmail
YouTube
Maps
Slides session 1
Nouvel onglet
HOME
DB DEMO
AWS 3-TIER WEB APP DEMO
VPC
Web Tier
App Tier
Database Tier
AZ1
AZ2
Public subnet
Private subnet
Amazon EC2
Amazon Aurora Primary DB
Elastic Load Balancing (ELB)
Aurora Read Replica

16. Troubleshooting Tips

Issue	Solution
Target Group targets showing Unhealthy	Check security group rules. Ensure the ALB SG is allowed as a source in the instance SG on the correct port.
Cannot connect to RDS from App Server	Verify db-tier-sg allows MySQL port 3306 from app-tier-sg. Check RDS subnet group includes the correct private subnets.
NAT Gateway not routing traffic	Ensure private route table has a route 0.0.0.0/0 pointing to the NAT Gateway. Check NAT GW is in a public subnet.
SSM Session Manager not connecting	Confirm ec2-3tier-role is attached to the instance. Verify AmazonSSMManagedInstanceCore policy is included.
React app showing blank page	Check Nginx configuration root path. Ensure 'npm run build' completed successfully and build folder exists.
CloudWatch alarm not triggering	Verify the metric namespace and dimension are correctly set to the ASG name. Confirm SNS subscription is confirmed.

— End of Document —

AWS 3-Tier High Availability Architecture — Infrastructure Deployment Guide