Publishing Amazon SNS Messages Privately

NAME: VIKRAM
Industry: Healthcare

Problem Statement:

How to secure patient records online and send them privately to the intended party.

In this project, a hospital's patient reporting system is deployed using AWS services to publish patient reports securely and privately through Amazon SNS. The message publication happens within a private VPC, ensuring secure communication and controlled access through IAM roles.

AWS Services Used

1. AWS CloudFormation – to automate infrastructure setup (VPC, Subnets, EC2, SNS, S3).
2. Amazon EC2 – for hosting and running the application.
3. Amazon SNS – to securely publish messages (notifications).
4. Amazon S3 – for storing reports or data securely.
5. IAM – for defining access permissions and roles.

Architecture Overview

• A VPC is created with public and private subnets.
• EC2 instance is launched inside the VPC with an IAM Role attached.
• SNS topic is created for report notifications.
• A VPC endpoint connects SNS privately within the VPC.
• Reports are uploaded to S3, and SNS notifies via email securely.

Phase 1 – Create AWS resources using CloudFormation

1. Open AWS Management Console → CloudFormation → Create Stack → With new resources.

2. Upload your CloudFormation template (YAML/JSON) defining all resources.

```
AWSTemplateFormatVersion: 2010-09-09

Description: Healthcare Project - Secure Patient Report Sharing with SNS and EC2 (Private VPC)


Parameters:

  KeyName:

    Type: String

    Default: vik-87

    Description: EC2 Key Pair name for SSH access


  AmiId:

    Type: String

    Default: ami-0bdd88bd06d16ba03

    Description: AMI ID for EC2 instance


  S3BucketName:

    Type: String

    Default: vikky-s3-demo-3rd-nov
```

```
    Description: S3 bucket name for storing reports

Resources:
  # ---------------------
  # VPC + Networking
  # ---------------------
  MyVPC:
    Type: AWS::EC2::VPC
    Properties:
      CidrBlock: 10.0.0.0/16
      EnableDnsSupport: true
      EnableDnsHostnames: true
      Tags:
        - Key: Name
          Value: HealthcareVPC

  InternetGateway:
    Type: AWS::EC2::InternetGateway
    Properties:
      Tags:
        - Key: Name
          Value: HealthcareIGW

  VPCGatewayAttachment:
    Type: AWS::EC2::VPCGatewayAttachment
```

```
  Properties:
    InternetGatewayId: !Ref InternetGateway
    VpcId: !Ref MyVPC

PublicSubnet:
  Type: AWS::EC2::Subnet
  Properties:
    VpcId: !Ref MyVPC
    CidrBlock: 10.0.1.0/24
    MapPublicIpOnLaunch: true
    AvailabilityZone: !Select [0, !GetAZs "]
    Tags:
     - Key: Name
       Value: PublicSubnet

RouteTable:
  Type: AWS::EC2::RouteTable
  Properties:
    VpcId: !Ref MyVPC

Route:
  Type: AWS::EC2::Route
  DependsOn: VPCGatewayAttachment
  Properties:
    RouteTableId: !Ref RouteTable
```

```
    DestinationCidrBlock: 0.0.0.0/0
    GatewayId: !Ref InternetGateway

SubnetRouteTableAssociation:
  Type: AWS::EC2::SubnetRouteTableAssociation
  Properties:
    SubnetId: !Ref PublicSubnet
    RouteTableId: !Ref RouteTable

# ---------------------
# Security Group
# ---------------------
InstanceSecurityGroup:
  Type: AWS::EC2::SecurityGroup
  Properties:
    GroupDescription: Enable SSH and HTTP
    VpcId: !Ref MyVPC
    SecurityGroupIngress:
      - IpProtocol: tcp
        FromPort: 22
        ToPort: 22
        CidrIp: 0.0.0.0/0
      - IpProtocol: tcp
        FromPort: 80
        ToPort: 80
```

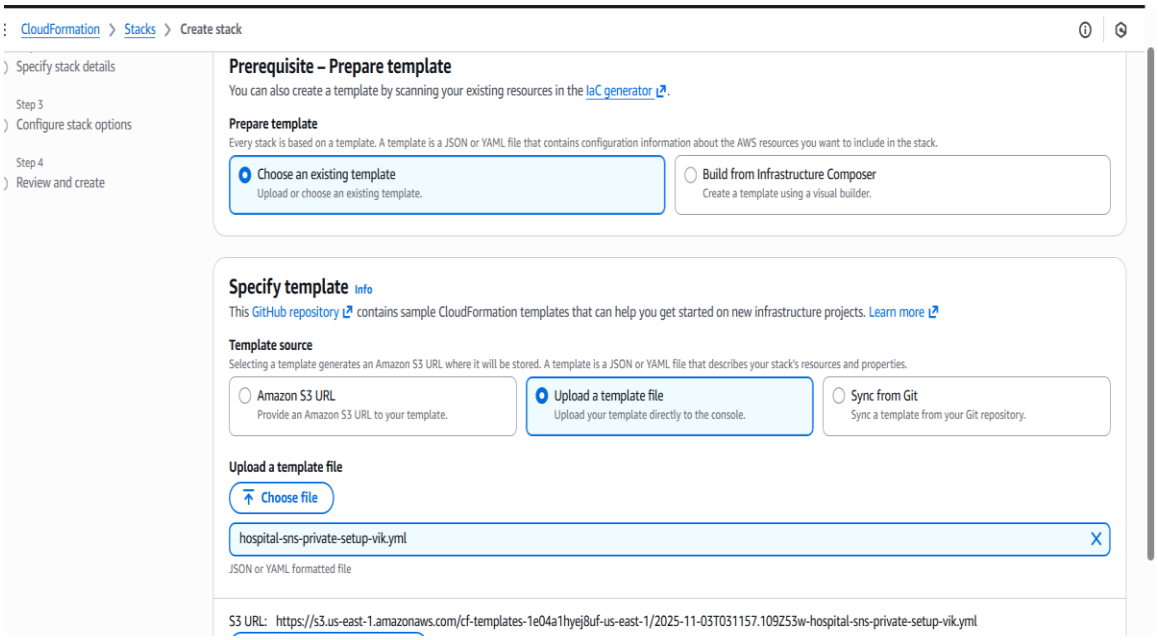
```
        CidrIp: 0.0.0.0/0

# ---------------------
# EC2 Role + Policy
# ---------------------
EC2Role:
  Type: AWS::IAM::Role
  Properties:
    AssumeRolePolicyDocument:
      Version: "2012-10-17"
      Statement:
        - Effect: Allow
          Principal:
            Service: ec2.amazonaws.com
          Action: sts:AssumeRole
    Policies:
      - PolicyName: EC2SNSAccess
        PolicyDocument:
          Version: "2012-10-17"
          Statement:
            - Effect: Allow
              Action:
                - sns:Publish
                - sns:ListTopics
              Resource: "*"
```

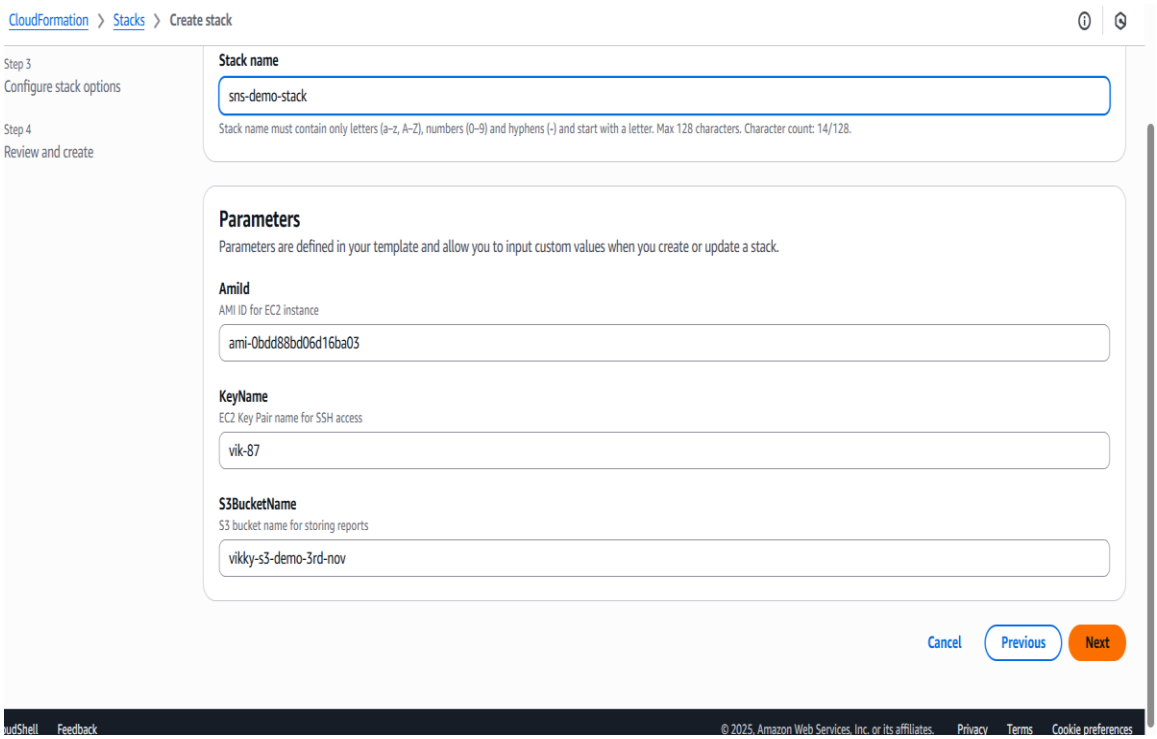
```
            - Effect: Allow
              Action:
                - s3:PutObject
                - s3:GetObject
              Resource: !Sub arn:aws:s3:::${S3BucketName}/*

  InstanceProfile:
    Type: AWS::IAM::InstanceProfile
    Properties:
      Roles:
        - !Ref EC2Role

  # ---------------------
  # EC2 Instance (Free Tier Eligible)
  # ---------------------
  EC2Instance:
    Type: AWS::EC2::Instance
    Properties:
      InstanceType: t3.micro
      ImageId: !Ref AmiId
      KeyName: !Ref KeyName
      SubnetId: !Ref PublicSubnet
      SecurityGroupIds:
        - !Ref InstanceSecurityGroup
      IamInstanceProfile: !Ref InstanceProfile
```

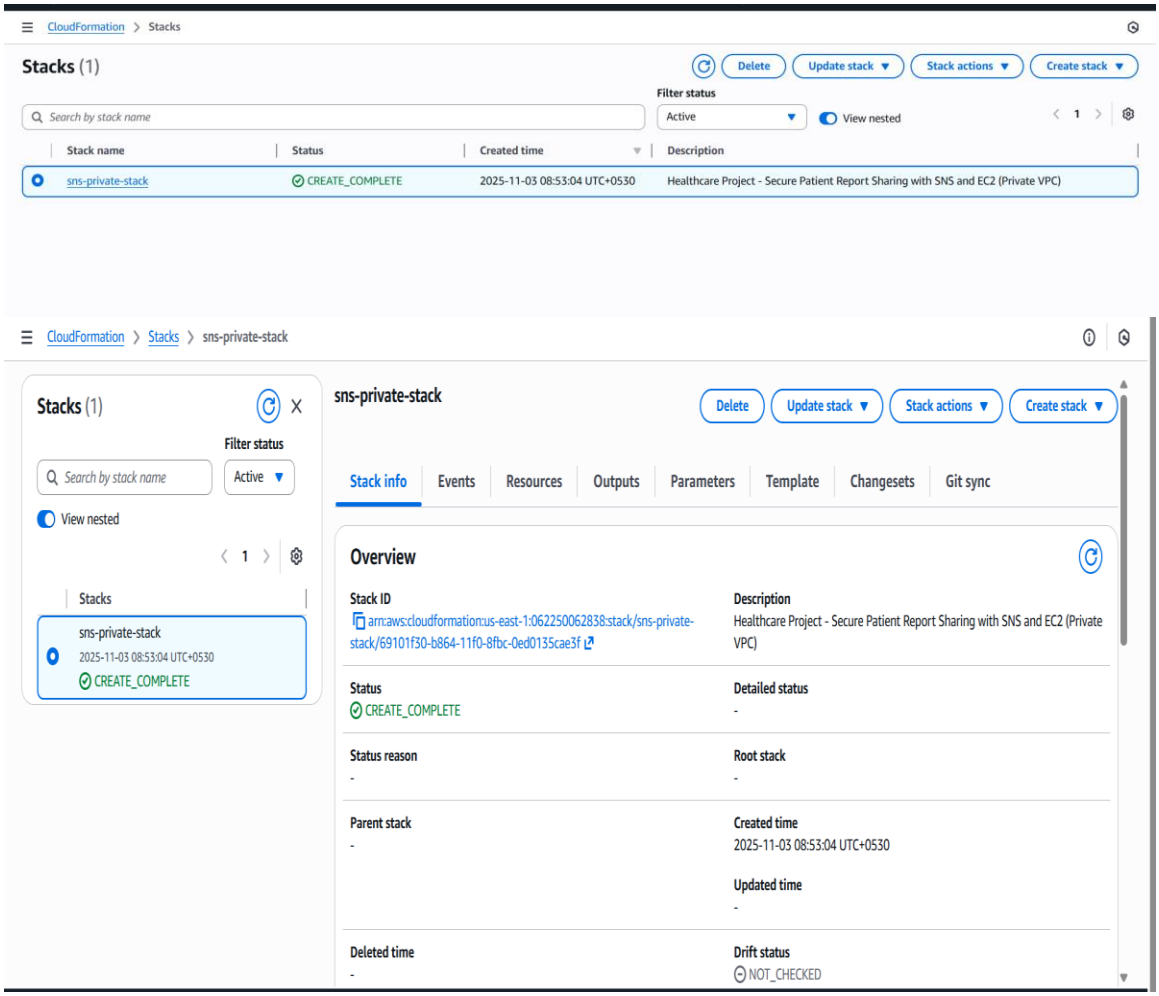
```
      UserData:
        Fn::Base64: !Sub |
          #!/bin/bash
          yum update -y
          yum install -y aws-cli httpd
          systemctl start httpd
          systemctl enable httpd
          echo "<h1>Healthcare SNS Report System is Running</h1>" >
/var/www/html/index.html
      Tags:
        - Key: Name
          Value: HealthcareEC2


  # ---------------------
  # SNS Interface VPC Endpoint (PrivateLink)
  # ---------------------
  SnsVpcEndpoint:
    Type: AWS::EC2::VPCEndpoint
    Properties:
      VpcId: !Ref MyVPC
      ServiceName: !Sub com.amazonaws.${AWS::Region}.sns
      VpcEndpointType: Interface
      SubnetIds:
        - !Ref PublicSubnet
      SecurityGroupIds:
```

```
      - !Ref InstanceSecurityGroup
    PrivateDnsEnabled: true

Outputs:
  VPCId:
    Value: !Ref MyVPC
    Description: ID of the VPC

  EC2InstancePublicIP:
    Value: !GetAtt EC2Instance.PublicIp
    Description: Public IP of EC2 instance

  SnsEndpointId:
    Value: !Ref SnsVpcEndpoint
    Description: SNS VPC Endpoint ID
```

3. Click Next → Next → Create Stack.
4. Wait until all resources show status “CREATE_COMPLETE”.



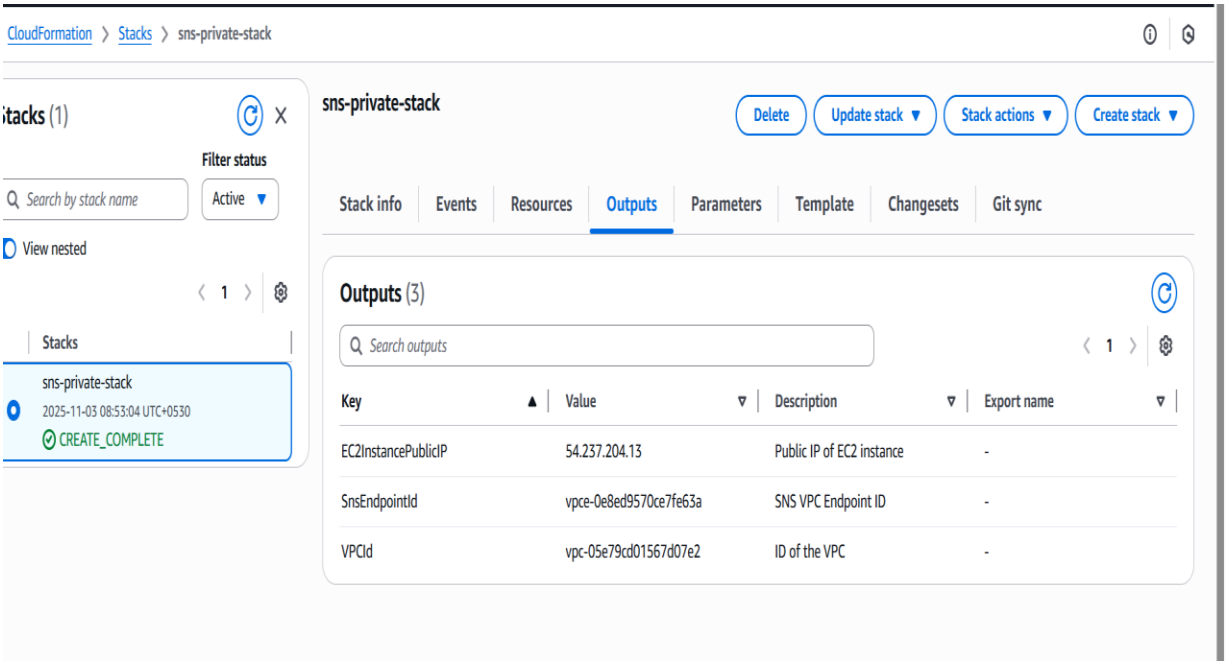

CloudFormation > Stacks > Create stack
Step 3
Configure stack options
Step 4
Review and create
Stack name
sns-demo-stack
Stack name must contain only letters (a-z, A-Z), numbers (0-9) and hyphens (-) and start with a letter. Max 128 characters. Character count: 14/128.
Parameters
Parameters are defined in your template and allow you to input custom values when you create or update a stack.
AmiId
AMI ID for EC2 instance
ami-0bdd88bd06d16ba03
KeyName
EC2 Key Pair name for SSH access
vik-87
S3BucketName
S3 bucket name for storing reports
vikky-s3-demo-3rd-nov
Cancel
Previous
Next
udShell
Feedback
© 2025, Amazon Web Services, Inc. or its affiliates.
Privacy
Terms
Cookie preferences


CloudFormation > Stacks
Stacks (1)
Delete
Update stack
Stack actions
Create stack
Filter status
Search by stack name
Active
View nested
Stack name
Status
Created time
Description
sns-private-stack
CREATE_COMPLETE
2025-11-03 08:53:04 UTC+0530
Healthcare Project - Secure Patient Report Sharing with SNS and EC2 (Private VPC)
CloudFormation > Stacks > sns-private-stack
Stacks (1)
Filter status
Search by stack name
Active
View nested
Stacks
sns-private-stack
2025-11-03 08:53:04 UTC+0530
CREATE_COMPLETE
sns-private-stack
Delete
Update stack
Stack actions
Create stack
Stack info
Events
Resources
Outputs
Parameters
Template
Changesets
Git sync
Overview
Stack ID
arn:aws:cloudformation:us-east-1:062250062838:stack/sns-private-stack/69101f30-b864-11f0-8fbc-0ed0135cae3f
Description
Healthcare Project - Secure Patient Report Sharing with SNS and EC2 (Private VPC)
Status
CREATE_COMPLETE
Detailed status
-
Status reason
-
Root stack
-
Parent stack
-
Created time
2025-11-03 08:53:04 UTC+0530
Updated time
-
Deleted time
-
Drift status
NOT_CHECKED

VERIFY STACK OUTPUTS

- Open AWS Console → **CloudFormation → Stacks**
- Select your stack → open the **Outputs** tab
  You will see 3 values:

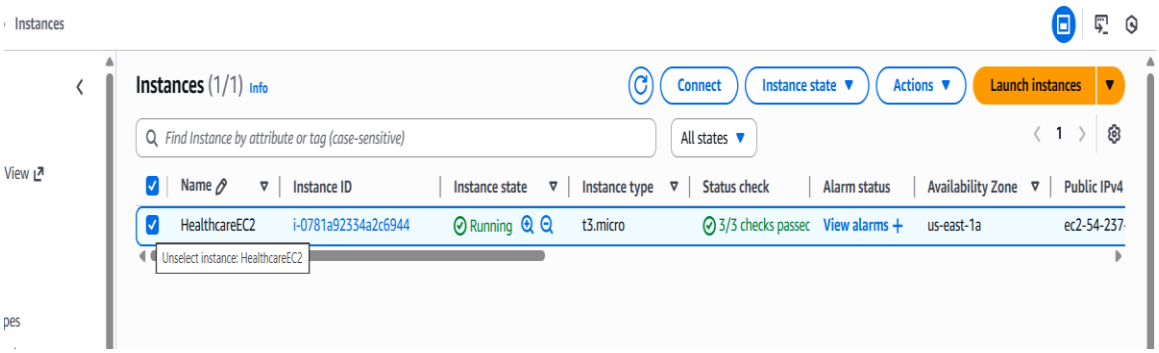
• **Output Name**	• **Description**	• **Example value**
• VPCId	• ID of the VPC	• vpc-0a1b2c3d4e5f6g7h
• EC2InstancePublicIP	• Public IP to access EC2	• 13.232.98.45
• SnsEndpointId	• ID of your SNS VPC Endpoint	• vpce-0a12bc34def56789



PHASE 2 — CONNECT TO EC2 INSTANCE

1. Go to EC2 → Instances
2. Select instance named HealthcareEC2
3. Click Connect → EC2 Instance Connect (browser-based) → Connect

You'll now see a Linux terminal prompt.



PHASE 3 — VERIFY EC2 ENVIRONMENT

Verify Apache Web Server

Run:

sudo systemctl status httpd

You should see:

active (running)

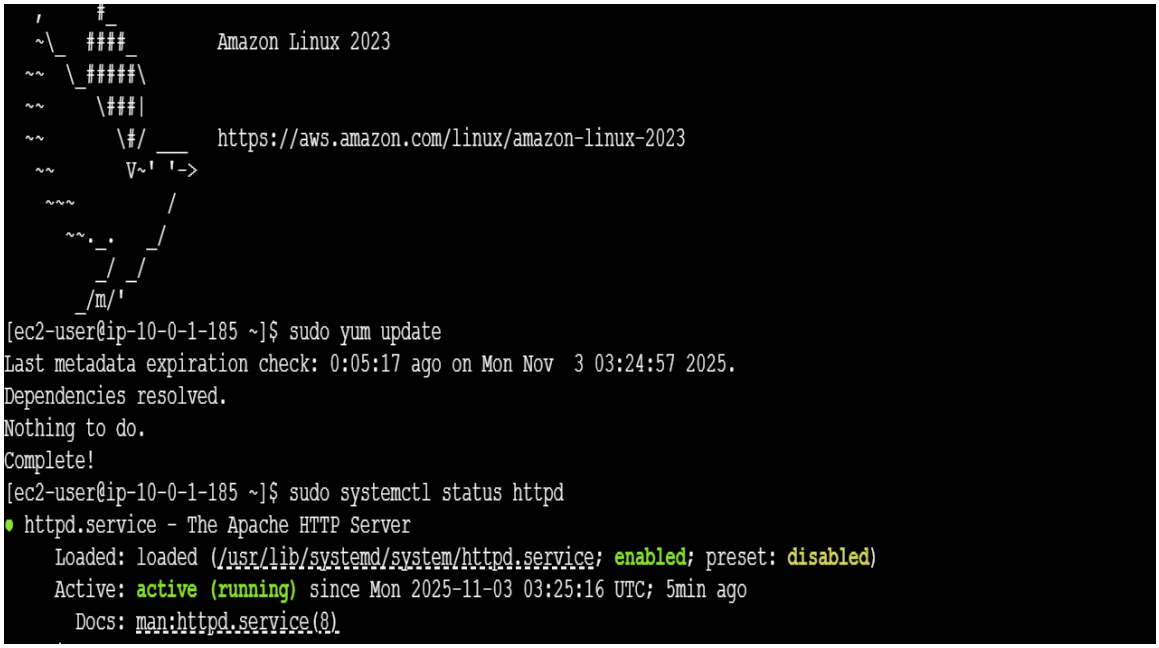
Then open your web page:

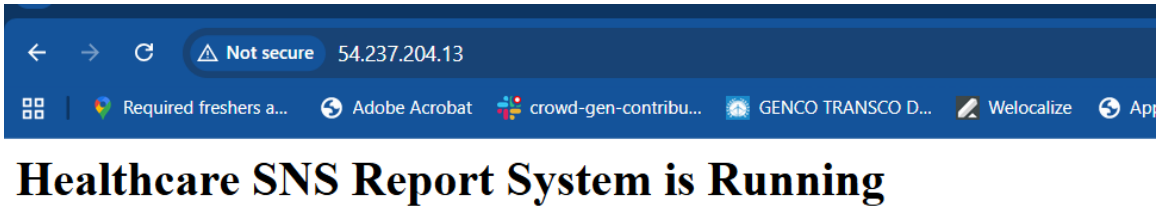
Browser URL:

http://<EC2InstancePublicIP>

Expected Output:

Healthcare SNS Report System is Running





PHASE 4 — VERIFY AWS CLI & IAM ROLE ACCESS

Check IAM Role Attachment

Run this command inside your EC2 terminal:

curl http://169.254.169.254/latest/meta-data/iam/info

Expected Output:

{

"Code" : "Success",

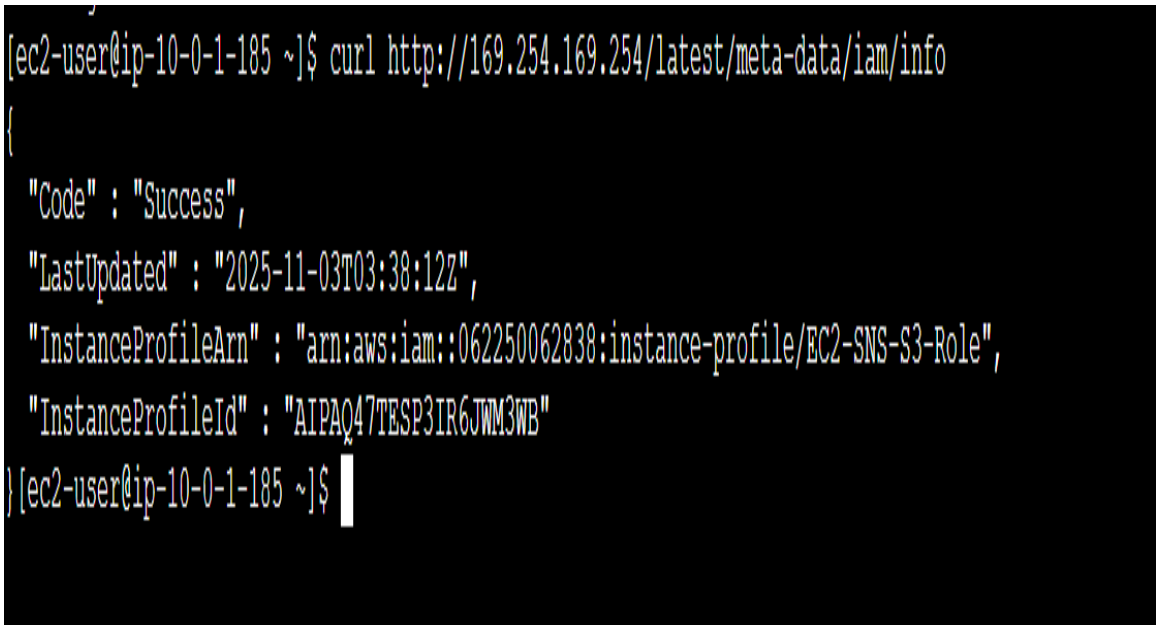
"LastUpdated" : "2025-11-03T12:30:45Z",

"InstanceProfileArn" : "arn:aws:iam::123456789012:instance-profile/EC2-SNS-S3-Role",

"InstanceProfileId" : "AIPAXXXXXXXXXXXXXXX"

}

This confirms that the EC2 instance has a valid IAM Role attached with the correct permissions for accessing Amazon SNS and S3.



⚠ If the Command Shows No Output

If the command returns nothing, it usually means your EC2 instance does not yet have an IAM Role attached — so there's no IAM metadata to show.

Follow these exact steps to fix it 👇

Create and Attach an IAM Role

1. Go to AWS Management Console → IAM → Roles
2. Click Create role
3. Under Trusted entity type, select AWS service

4. Choose EC2 and click Next
5. In permissions, search and check:
    - AmazonS3FullAccess
    - AmazonSNSFullAccess
    - AmazonEC2ReadOnlyAccess
6. Click Next
7. Name the role: EC2-SNS-S3-Role
8. Click Create role

Now attach this role to your instance:

1. Go to EC2 Console → Instances
2. Select your instance
3. Click Actions → Security → Modify IAM role
4. Choose EC2-SNS-S3-Role → click Update IAM role

If Still No Output — Verify Metadata Options

If there's still no response from the curl command even after attaching the role, check your EC2 metadata service settings.

1. Go to EC2 → Instances → Select your instance
2. Scroll down to Metadata options

Ensure the following settings are correct:

Setting	Required Value
Access to instance metadata	Enabled
IMDSv2 required	No (optional)
Hop limit	1

If IMDSv2 is set to "Yes", modify it:

- Click Actions → Instance settings → Edit instance metadata options
- Set:
- Access to instance metadata: Enable
- IMDSv2 required: No
- Hop limit: 1
- Save changes

Re-run Verification Command

After saving the metadata changes, wait ~30 seconds and run again:

curl http://169.254.169.254/latest/meta-data/iam/info

Expected Result: {

A JSON response with your IAM Role details confirms proper IAM and metadata configuration.

PHASE 5 — VERIFY SNS PRIVATE CONNECTION (VPC ENDPOINT)

List all SNS Topics

Run:

aws sns list-topics

Expected output:

```
{
   "Topics": []
}
```

(Empty array is fine — means connection is successful but no topics yet.)

If no error appears → SNS PrivateLink is working.

PHASE 6 — CREATE SNS TOPIC

Create a Private SNS Topic

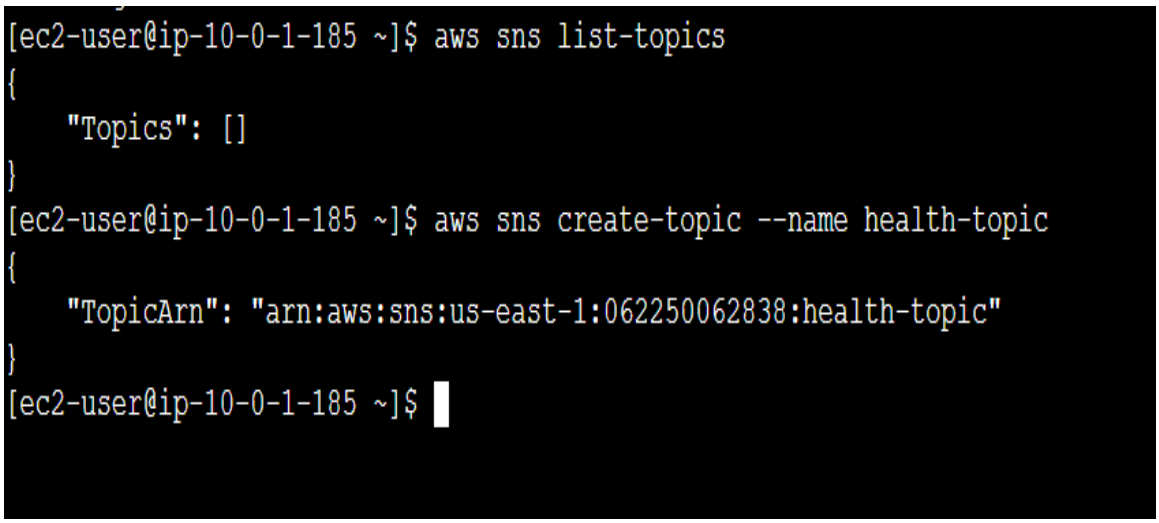
Run:

```
aws sns create-topic --name health-topic
```

Output example:

```
{
   "TopicArn": "arn:aws:sns:us-east-1:062250062838:health-topic"
}
```

Copy that **Topic ARN** — we'll use it in the next step.



PHASE 7 — PUBLISH A TEST MESSAGE

Send a Message to the Topic

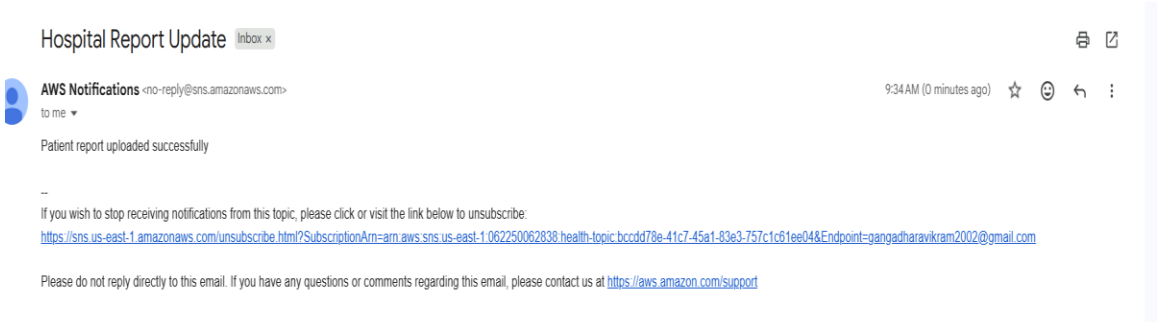
Run the following command inside your EC2 terminal:

```
aws sns publish \
  --topic-arn arn:aws:sns:us-east-1:062250062838:health-topic \
  --message "Patient report uploaded successfully" \
  --subject "Hospital Report Update"
```

Example Output:

```
{
    "MessageId": "b1a2c3d4-5678-9012-3456-7890abcd1234"
}
```

If you see a MessageId, your message was successfully published privately through the VPC Endpoint.
Within a few seconds, you should receive an email notification from Amazon SNS containing the message.



If You Do Not Receive the Email

If no email arrives after running the publish command, it means your SNS topic subscription is not yet confirmed.

Go to AWS Console → SNS → Topics → health-topic

- If you see your subscription status as "Pending confirmation", open your email inbox and click the confirmation link sent by AWS.
- If you don't see any subscription listed, create one and then confirm it through the email you receive.

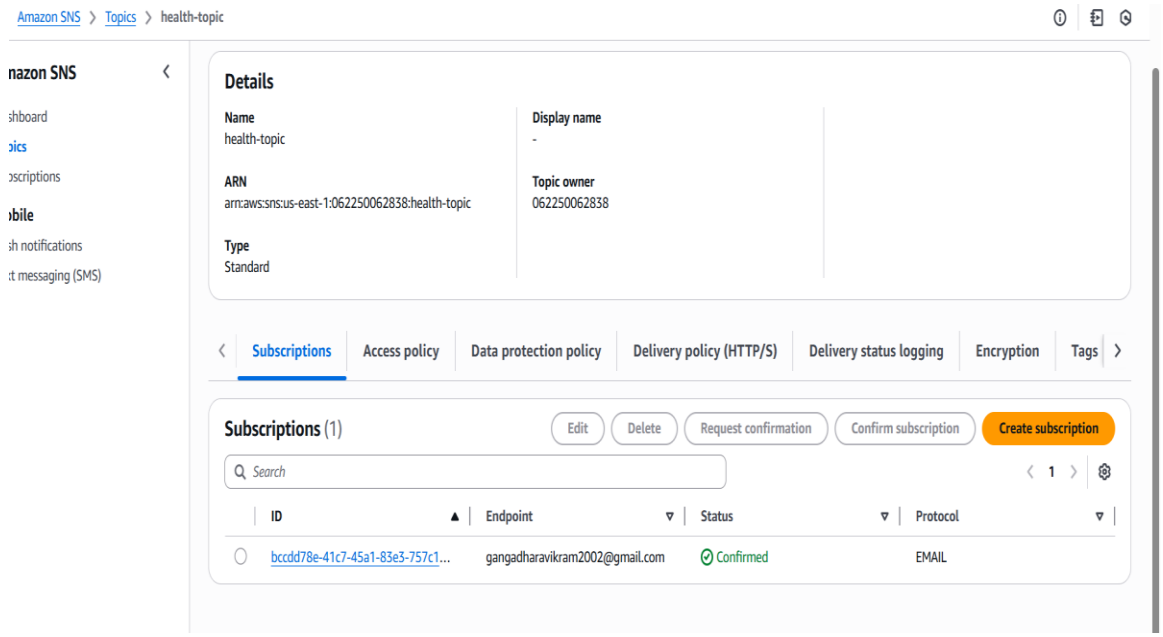
After confirming the subscription, re-run the same publish command.
You will then receive the email successfully**.**

PHASE 8 — VERIFY IN SNS CONSOLE

Check Message Delivery

- Go to AWS Console → SNS → Topics
- Click on health-topic
- Under Details, verify:
    - Topic ARN matches your CLI output
    - The topic exists (no red errors)

This confirms the EC2 instance published securely through your private SNS VPC Endpoint.



PHASE 9 — VERIFY S3 ACCESS (SECURE FILE UPLOAD)

Upload a Sample Report to S3 from EC2

Run:

echo "Patient Report - Private Upload Test" > report.txt

aws s3 cp report.txt s3://bucket name/

Expected output:

upload: ./report.txt to s3://s3-demo-3rd-nov/report.txt

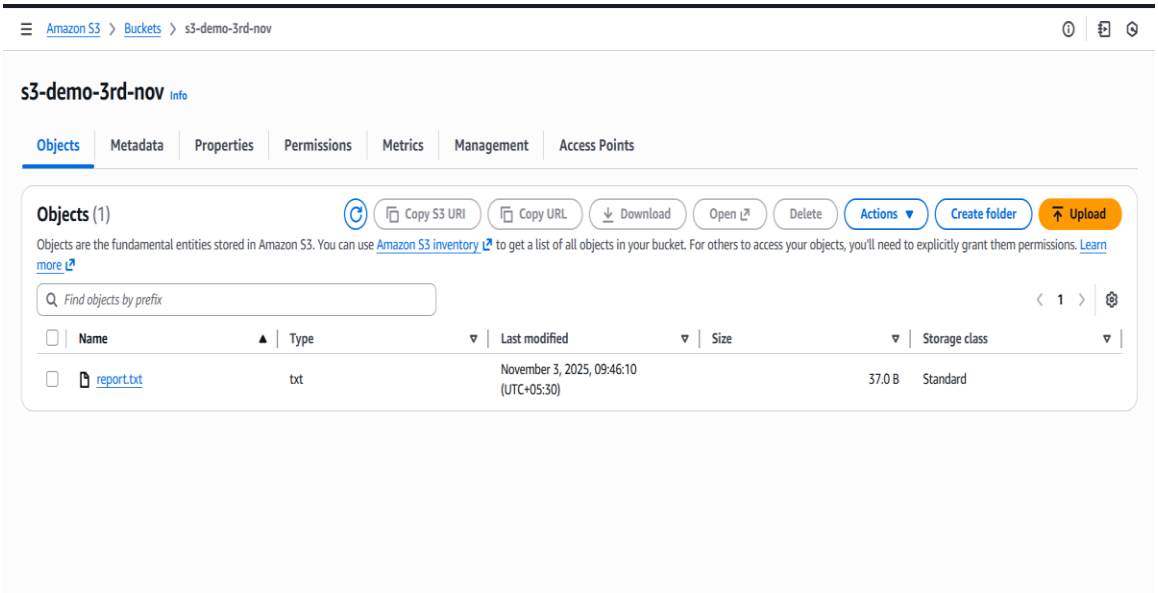
Then verify:

aws s3 ls s3:/ s3-demo-3rd-nov //

You should see:

2025-11-03 12:45:01 37 report.txt

```
[ec2-user@ip-10-0-1-185 ~]$ aws s3 ls s3://s3-demo-3rd-nov/
[ec2-user@ip-10-0-1-185 ~]$ echo "Patient Report - Private Upload Test" > report.txt
[ec2-user@ip-10-0-1-185 ~]$ aws s3 cp report.txt s3://s3-demo-3rd-nov/
upload: ./report.txt to s3://s3-demo-3rd-nov/report.txt
[ec2-user@ip-10-0-1-185 ~]$ aws s3 ls s3://s3-demo-3rd-nov/

2025-11-03 04:16:10         37 report.txt
[ec2-user@ip-10-0-1-185 ~]$
```



PHASE 10 — SECURE PRIVATE SNS COMMUNICATION (INSIDE VPC)

Go to the VPC Console and Verify the Endpoint

1. Open AWS Console → VPC → Endpoints
2. Locate your SNS VPC Endpoint in the list.
3. Click on it to open its details page.
4. Under the details section, copy your VPC Endpoint ID
5. Confirm that the Status shows Available and the Type is Interface.

Verify the Endpoint from EC2

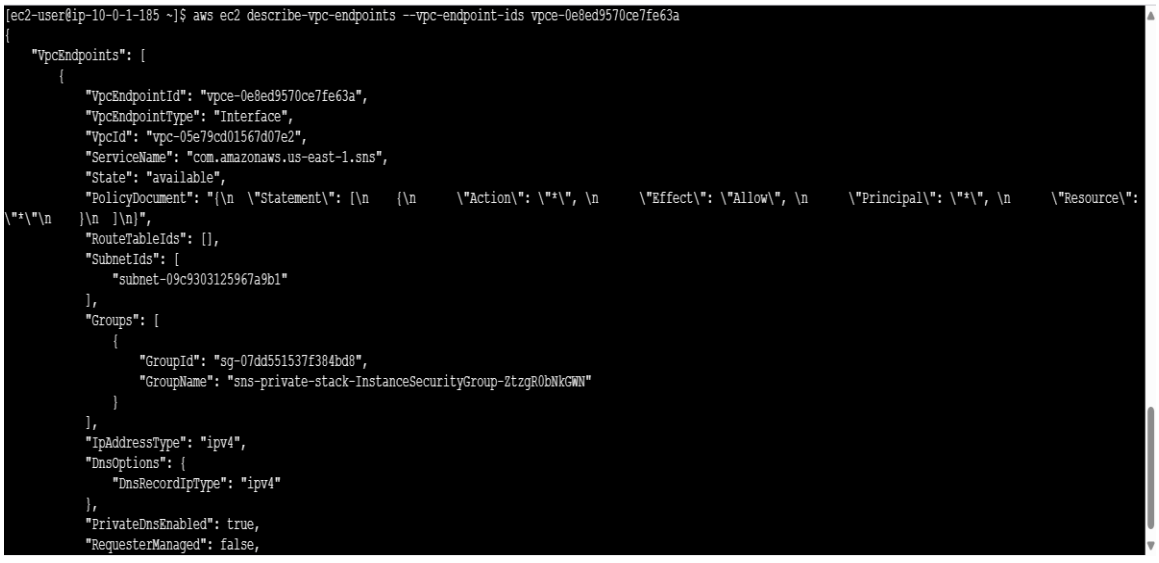
From your EC2 terminal, verify the SNS VPC Endpoint status using the copied ID:

```
aws ec2 describe-vpc-endpoints --vpc-endpoint-ids vpce-0a1b2c3d4e5f6g7h8
```

Expected Output:


```
{
  "VpcEndpoints": [
    {
      "VpcEndpointId": "vpce-0a1b2c3d4e5f6g7h8",
      "VpcEndpointType": "Interface",
      "ServiceName": "com.amazonaws.us-east-1.sns",
      "State": "available"
    }
  ]
}
```


If "State": "available", the endpoint is active and ready for use.



Publish a Private SNS Message

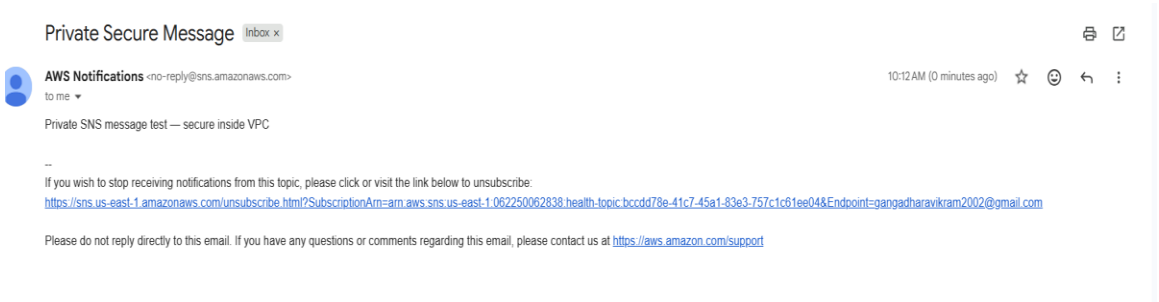
Now publish a private message from your EC2 instance through the endpoint:

```
aws sns publish \
  --topic-arn arn:aws:sns:us-east-1:<your-account-id>:health-topic \
  --message "Private SNS message test — secure inside VPC" \
  --subject "Private Secure Message"
```

Verification:

- The command returns a MessageId
- You receive the email instantly
- The message is transmitted privately via the VPC Endpoint, not over the public internet

```
[ec2-user@ip-10-0-1-185 ~]$ aws sns publish \
>  --topic-arn arn:aws:sns:us-east-1:062250062838:health-topic \
>  --message "Private SNS message test – secure inside VPC" \
>  --subject "Private Secure Message"
{
    "MessageId": "ad9d1610-8bb4-59b3-8785-7792bf4ed8d6"
}
[ec2-user@ip-10-0-1-185 ~]$
```

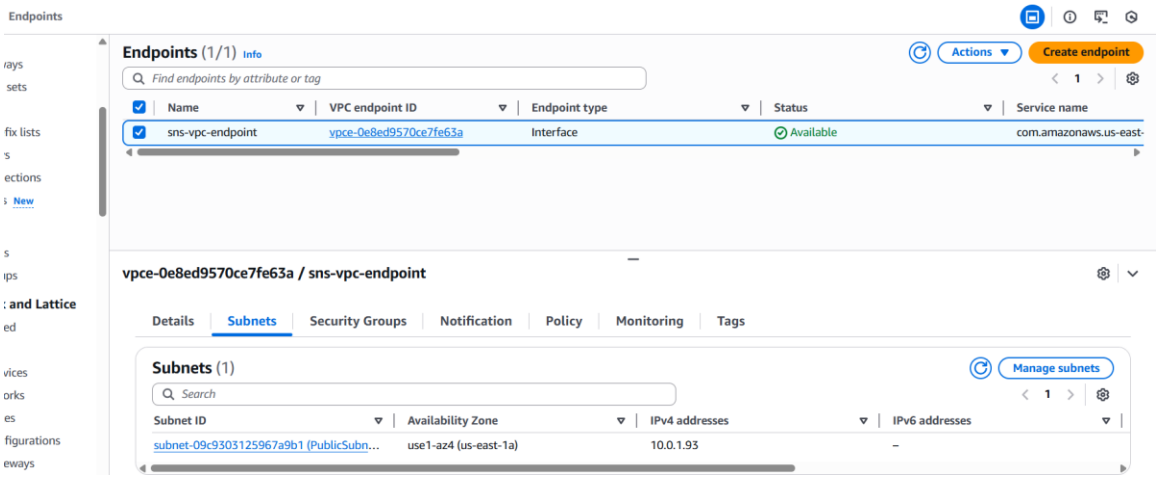


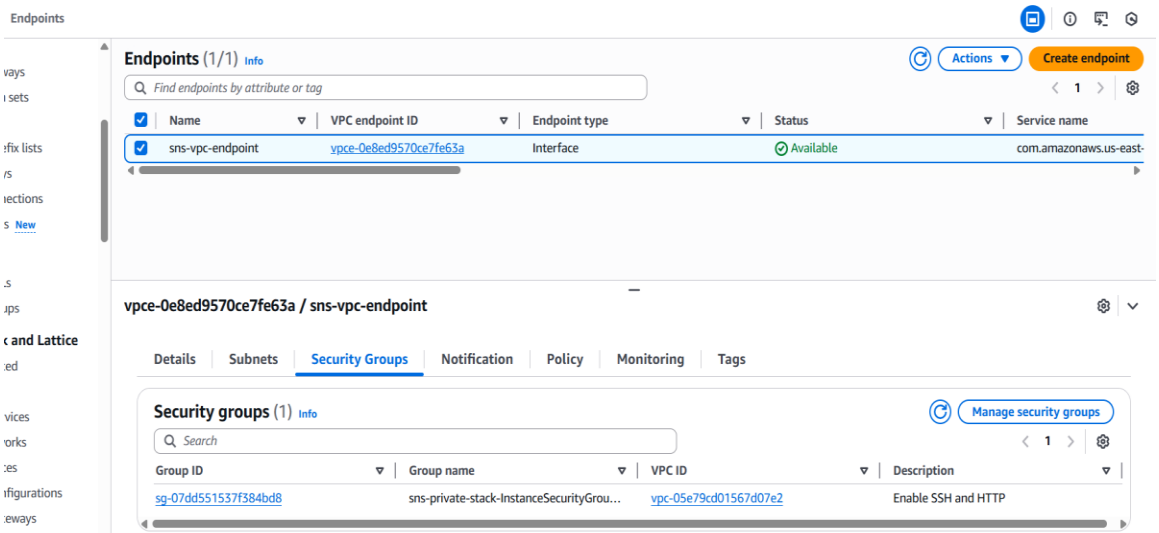
Confirm Endpoint Configuration in the Console

1. Go to VPC → Endpoints → Select your SNS endpoint
2. Verify these details:

Setting	Expected Value
Type	Interface
Status	Available
DNS	Enabled
Subnet	Your VPC Subnet ID
Security Group	InstanceSecurityGroup

If all these configurations are correct, it confirms that SNS communication between EC2 and SNS is private, secure, and routed entirely through AWS's internal network.





VERIFICATION CHECKLIST

- Web Server Running — Returns “Healthcare SNS Report System is Running”
- SNS Access — Executes successfully — no errors
- Topic Created — Returns a valid Topic ARN
- Message Published — Returns a valid MessageId
- S3 Upload — File uploaded successfully to S3
- Endpoint Status — Status shows Available

FINAL CONFIRMATION

If all verifications above are successful:
The Healthcare SNS Project is fully functional, private, and secure.
All messages and data transfers occur within the AWS VPC, ensuring end-to-end protection through PrivateLink (Interface Endpoint).