Task 12

Jenkins Pipeline Setup for ECS Deployment

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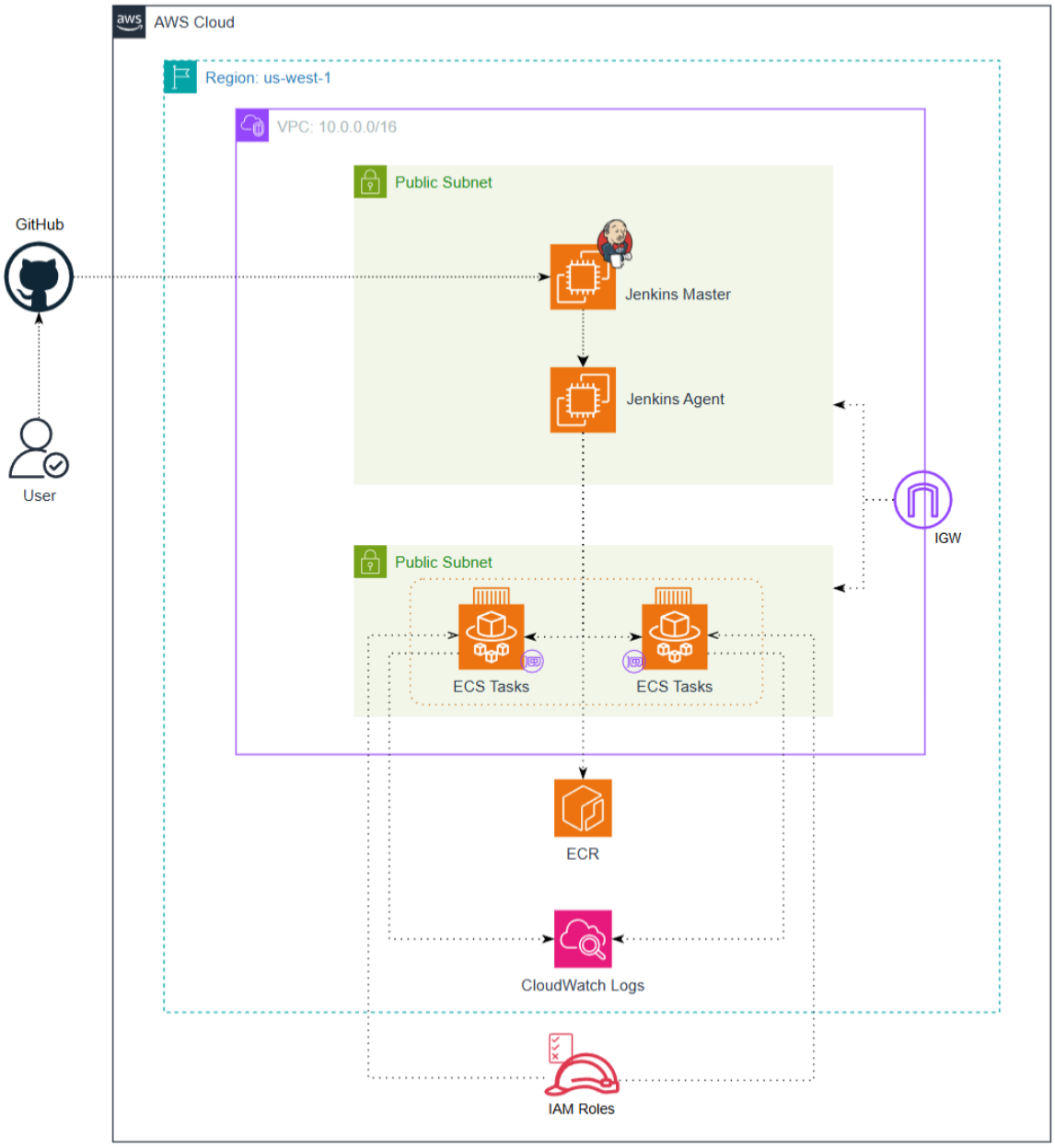
Task Description

This project implements a CI/CD pipeline using Jenkins on an EC2 agent to deploy a Dockerized Node.js application to AWS ECS Fargate. The pipeline integrates with GitHub webhooks to automatically build Docker images, push them to Amazon ECR, and update the ECS service. AWS CLI and scoped IAM roles manage infrastructure updates securely, while the pipeline handles testing, deployment, and rollback.

Architecture Diagram

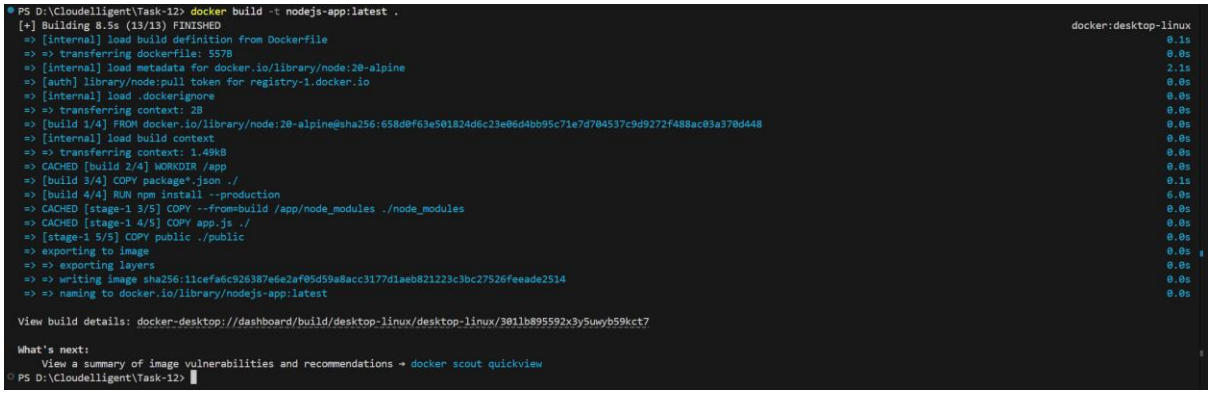


1. Test Application Locally

Before integrating the application into the CI/CD pipeline and deploying it to AWS, the Node.js application was tested locally using Docker. This step ensures that the application builds correctly, runs as expected inside a container, and exposes the intended port before moving to a cloud-based deployment.

i. Build Docker image

- Use ***docker build -t nodejs-app:latest .***
- Validates the Dockerfile and application dependencies.
- Packages the Node.js application into a Docker image.
- Produces a container image ready to be pushed to ECR and deployed to ECS.

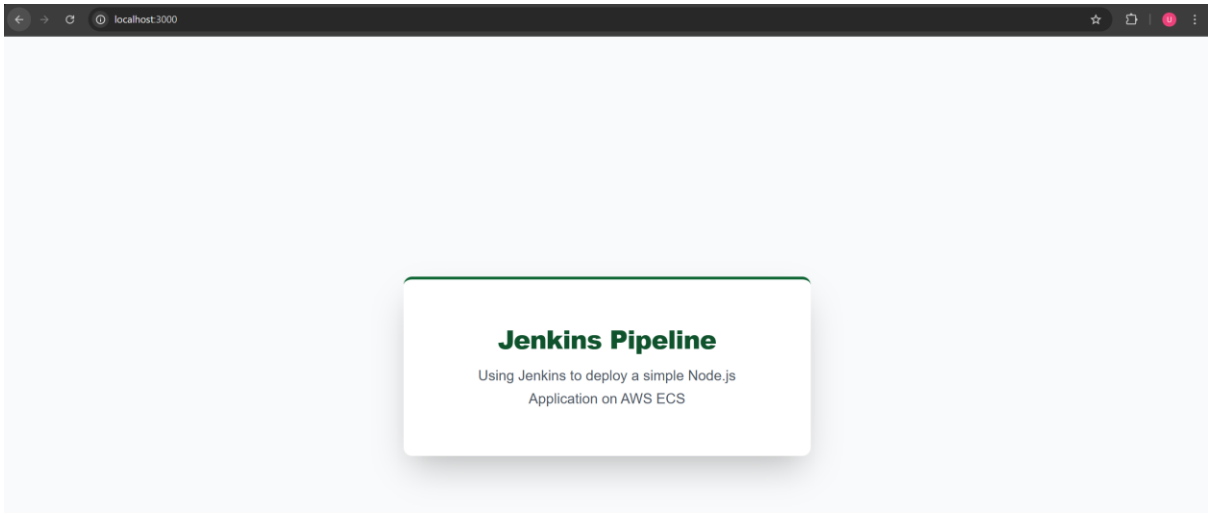


ii. Run the Docker container

- docker run -d -p 3000:3000 nodejs-app:latest
- Runs the container in detached mode.
- Maps local port **3000** to the container's exposed port **3000**.
- Ensures the application starts correctly inside the container.

iii. Verify the application

- Confirm the container is running using docker ps -a.
- Open **http://localhost:3000** in a web browser to verify the Node.js application loads successfully.



Accessing the application through **http://localhost:3000** verified that:

- The Docker image was built correctly
- The application started successfully inside the container
- The exposed port configuration worked as expected

2. VPC Configuration

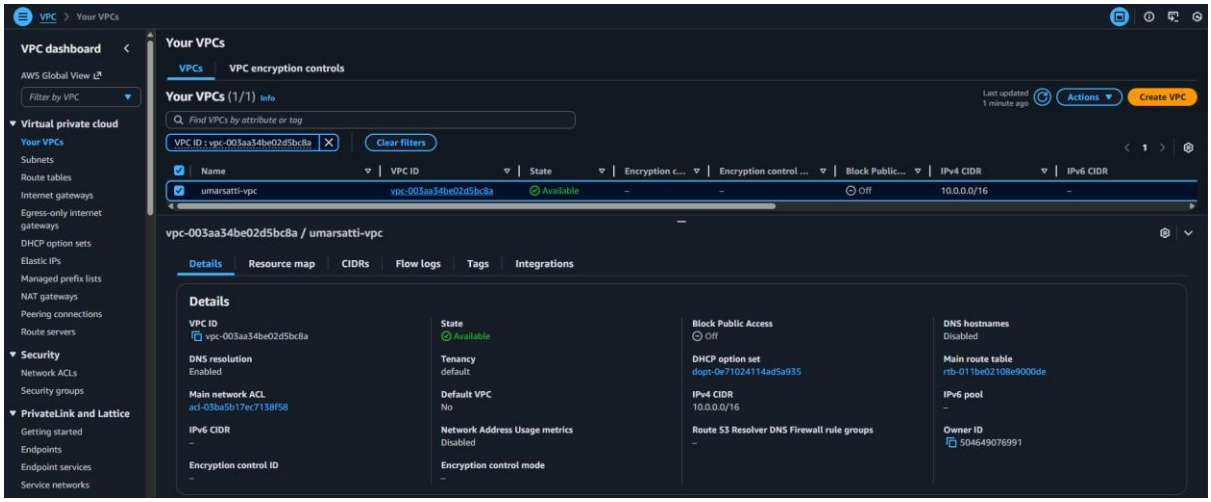
2.1: Create VPC

A **Virtual Private Cloud (VPC)** is a logically isolated network environment within AWS, allowing the creation of secure and private infrastructure.

Steps:

1. Sign in to the AWS Management Console.
2. Navigate to VPC service using the search bar at the top.
3. In the VPC Console, click **Your VPCs.**
4. Click **Create VPC** button on the top right.
5. Choose **VPC only** option for 'Resources to create'.
6. Choose a name for the VPC and add an IPv4 CIDR block.
7. Leave the **Tenancy** as **Default**.

As shown in the image below, under **Details** tab, a VPC has been created with the following configuration:



- **Name:** umarsatti-vpc
- **IPv4 CIDR range:** 10.0.0.0/16
- **VPC ID:** vpc-003aa34be02d5bc8a

2.2: Create Internet Gateway

An **Internet Gateway (IGW)** enables communication between instances in the VPC and the public internet.

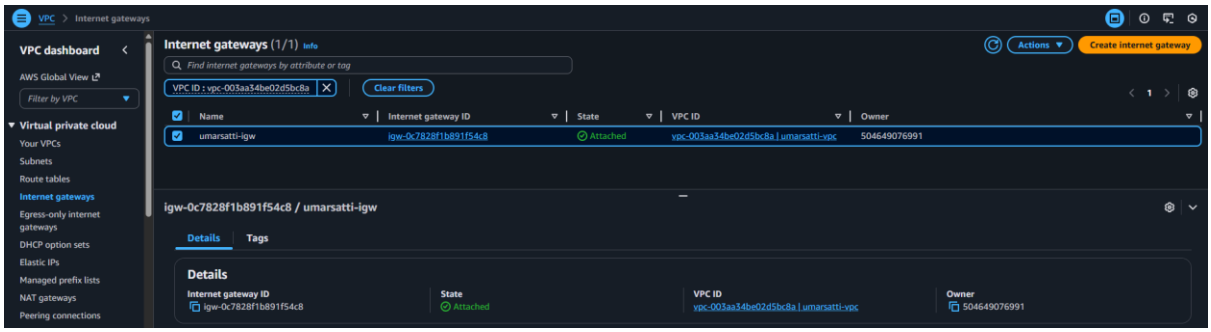
Steps:

1. Within the VPC Console, click **Internet gateways**.

2. Click on **Create internet gateway** button.
3. Choose a **Name** and add optional Tags**.**
4. Click **Create internet gateway** button. This creates an Internet gateway outside the VPC, and it needs to attach to the VPC created earlier.
5. Select **Actions** on the top right and click **Attach to VPC**. Choose the VPC ID (created earlier) and click **Attach internet gateway**. This attaches the Internet gateway to the VPC, allowing internet access.

As shown in the image below under **Details** tab, an internet gateway has been created with the following configuration:

- **Name:** umarsatti-igw
- **State:** Attached
- **VPC ID:** vpc-003aa34be02d5bc8a
- **Internet gateway ID:** igw-0c7828f1b891f54c8

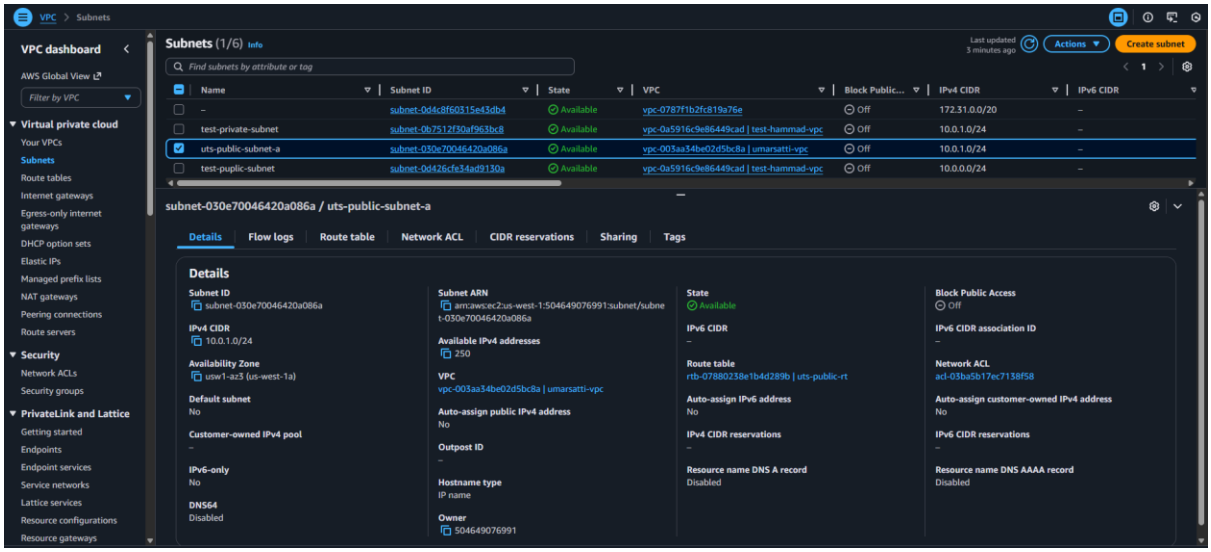


2.3: Create Subnets

Steps:

1. Within the VPC Console, click **Subnets**.
2. Click on **Create subnet** button.
3. Choose a **Subnet name, Availability Zone, IPv4 VPC CIDR block, IPv4 subnet CIDR Block** and optional **Tags.**
4. Repeat this process by clicking on **Add new subnet** button at the bottom to add more subnets (Public and Private).
5. After adding the required subnets, click on **Create subnet** button at the bottom right.

As shown in the image below under **Subnets** section, four subnets have been created with the following configuration:



Public Subnet in us-east-1a:

- **Name:** uts-public-subnet-a
- **IPv4 CIDR:** 10.0.1.0/24

Note: The **Public Subnet** hosts the Jenkins Master and Jenkins Agent. It is not a secure approach and is only suitable for development or testing environment.

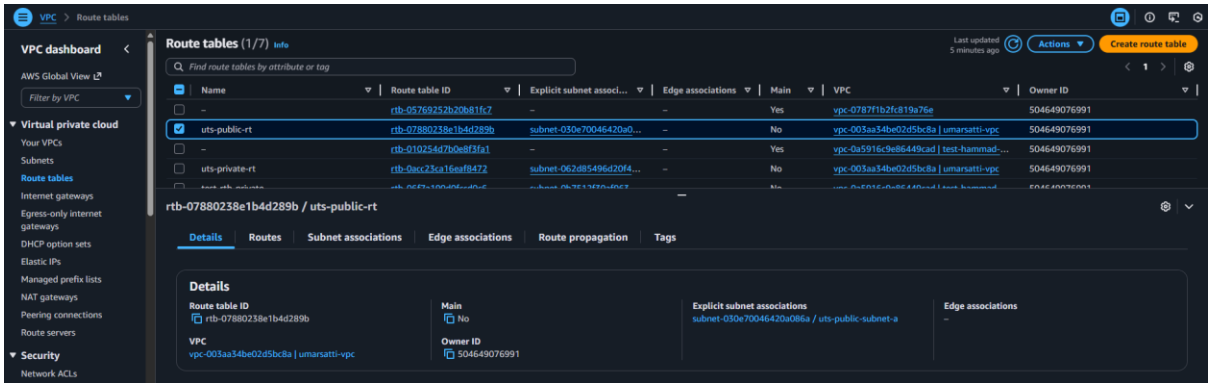
2.4: Create Route Tables

Route Tables define how network traffic moves within the VPC. Each route table directs traffic either internally (within the VPC) or externally (to the internet or a NAT gateway).

Steps:

1. Within the VPC Console, click **Route tables**.
2. Click on **Create route table** button on the top right.
3. Choose a **Name, VPC**, and optional **Tags.**
4. When done, click on **Create route table** button to create the resource.

As shown in the image below under **Route tables** section, two route tables have been created (excluding default route table) with the following configuration:



Public Route table:

- **Name:** uts-public-rt
- **Route table ID:** rtb-07880238e1b4d289b

In this configuration, the public route table directs internet-bound traffic to the **Internet Gateway**.

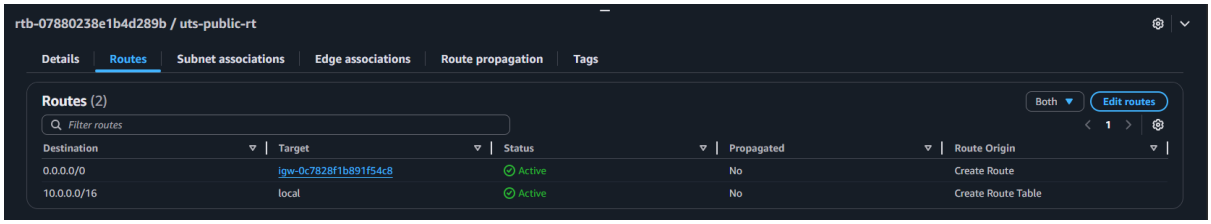
2.5: Setting up Routes for Route tables

Steps:

1. Within the Route tables console, select a Route table (example: Public-Route-Table) and click **Edit routes** on the right.
2. Add a new route by choosing a **Destination** and **Target**.
3. Click **Save changes**. This adds a route to this route table.

Public Routes (Public-Route-Table):

- **Destination:** 0.0.0.0/0
- **Target:** umarsatti-igw | igw-0c7828f1b891f54c8 (Internet gateway)



This step defines how traffic flows between subnets and external networks. The **public route table** sends all internet-bound traffic (0.0.0.0/0) to the **Internet Gateway**, enabling access for public resources.

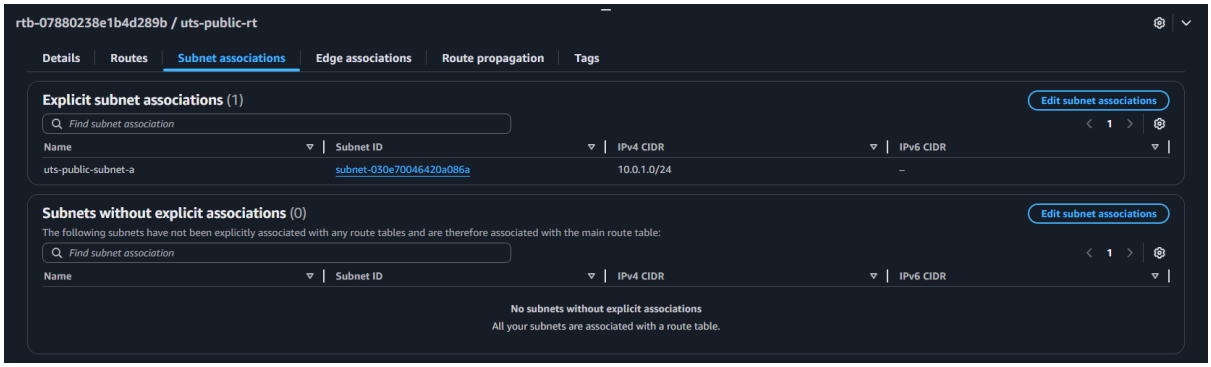
2.6: Route Table Association

Steps:

1. Within the Route tables console, select a Route table (example: Public-Route-Table) and click **Subnet associations** tab under the details section.
2. Click **Edit subnet associations** and select the specific subnet (e.g. nginx-public-subnet)
3. Click **Save associations** button on the bottom right.

Public Route table Subnet associations

- **Names:** uts-public-rt
- **Subnets:** uts-public-subnet-a
- **IPv4 CIDR:** 10.0.1.0/24



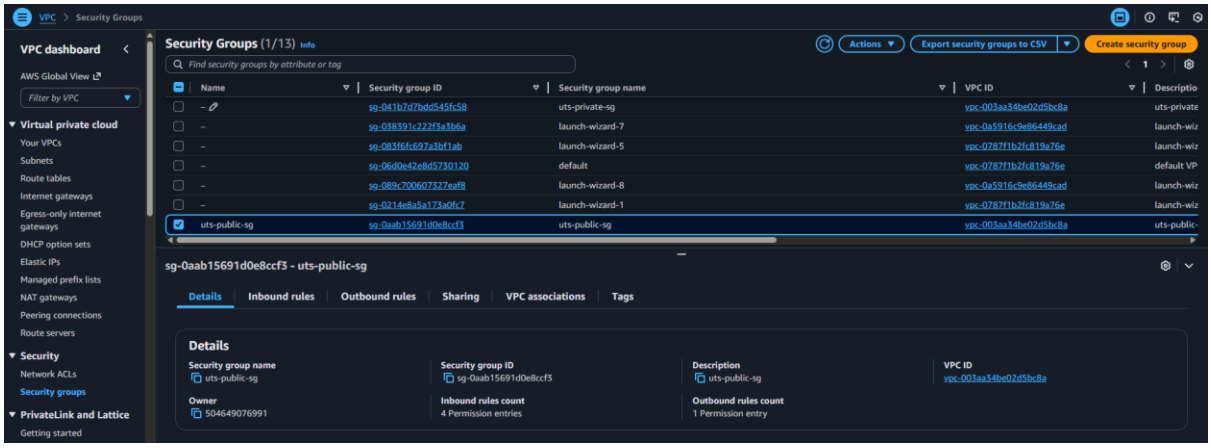
Public subnet uses the **Internet Gateway** for external communication. Without this association, subnets would rely on the default main route table, potentially misrouting traffic.

2.7: Security Groups

Security Groups act as virtual firewalls that regulate inbound and outbound traffic at the instance level.

Steps:

1. Within the VPC Console, click **Security Groups**.
2. Click on **Create security gateway** button on the top right.
3. Choose a **Security group name**, **Description**, and **VPC** (umarsatti-vpc).
4. Add Inbound rules by selecting **Type, Protocol, Port range, Source,** and **Description** (optional).
5. Leave Outbound rules as default (All traffic).

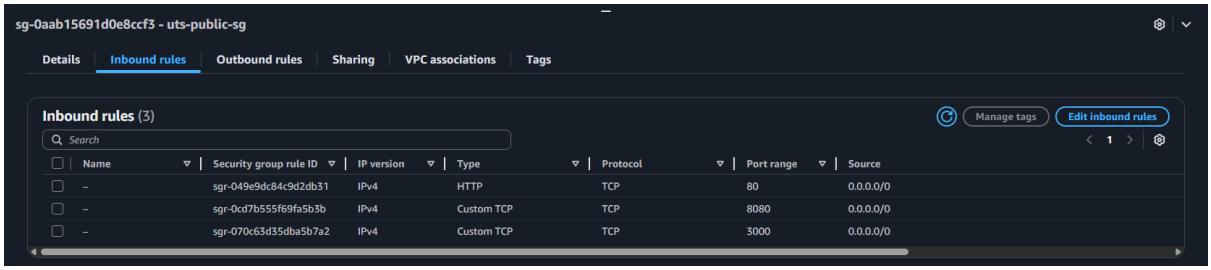


Security Group for Instances and ECS Tasks

Here is the configuration for the public subnet security group:

- **Security group name:** uts-public-sg
- **Security group ID:** sg-0aab15691d0e8ccf3
- Inbound Rules:

Type	Protocol	Port range	Source
HTTP	TCP	80	0.0.0.0/0
Custom TCP	TCP	3000	0.0.0.0/0
Custom TCP	TCP	8080	0.0.0.0/0



In this configuration, the **uts-public-sg** security group allows HTTP traffic and TCP port 5000/8080 traffic from internet. Port 3000 is for Node.js application and port 8080 is for Jenkins access.

3. IAM Roles

IAM roles are used to securely grant AWS permissions to services without storing access keys. In this project, IAM roles allow Jenkins to interact with ECR and ECS, and enable ECS tasks to pull images and send logs.

3.1: IAM Role for Jenkins EC2 Instances

An IAM role was created and attached to the Jenkins Master and Agent EC2 instances to allow Jenkins to deploy resources in AWS.

IAM Role Details

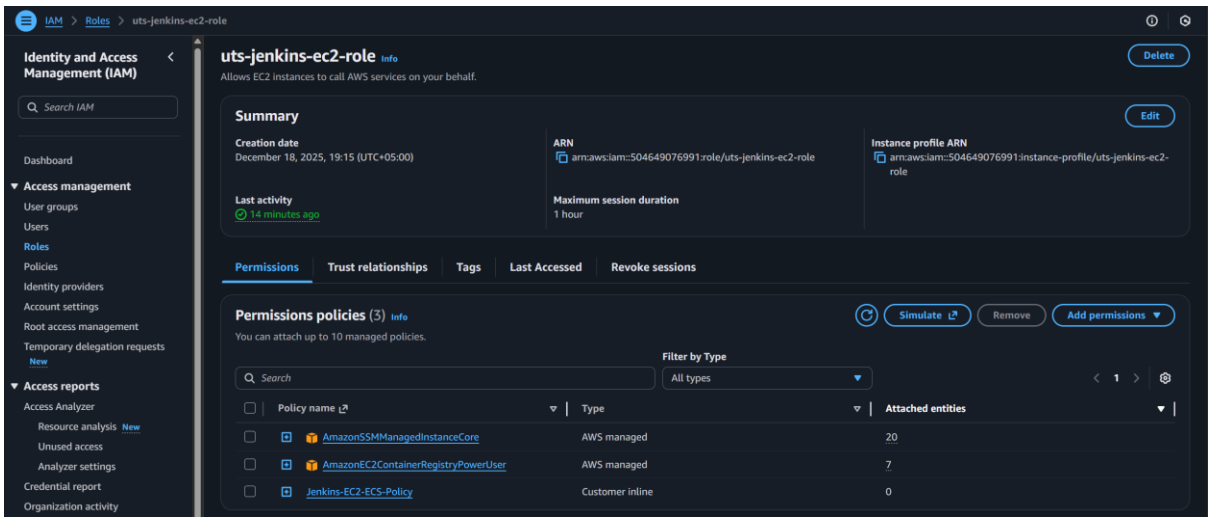
- **Role Name:** uts-jenkins-ec2-role
- **Trusted Service:** EC2

Attached Managed Policies

- **AmazonSSMManagedInstanceCore**: Enables secure instance management using AWS Systems Manager.
- **AmazonEC2ContainerRegistryPowerUser**: Allows Jenkins to authenticate with ECR and push/pull Docker images.

Inline Policy: Jenkins-EC2-ECS-Policy

- Grants permissions to register task definitions
- Update ECS services.
- Create and update CloudWatch Log stream.



This role enables Jenkins to use AWS CLI securely without hardcoding credentials.

3.2: ECS Task Execution Role

ECS tasks use the default execution role to access AWS services at runtime.

Role Name: ecsTaskExecutionRole

Purpose

- Pull container images from Amazon ECR.
- Send application logs to Amazon CloudWatch Logs.

This role is referenced in the ECS task definition and is required for Fargate tasks to start successfully.

4. EC2 Instances for Jenkins

Two Ubuntu EC2 instances were launched to host the Jenkins Master and Jenkins Agent. This separation allows the master to manage pipelines while the agent performs builds and deployments.

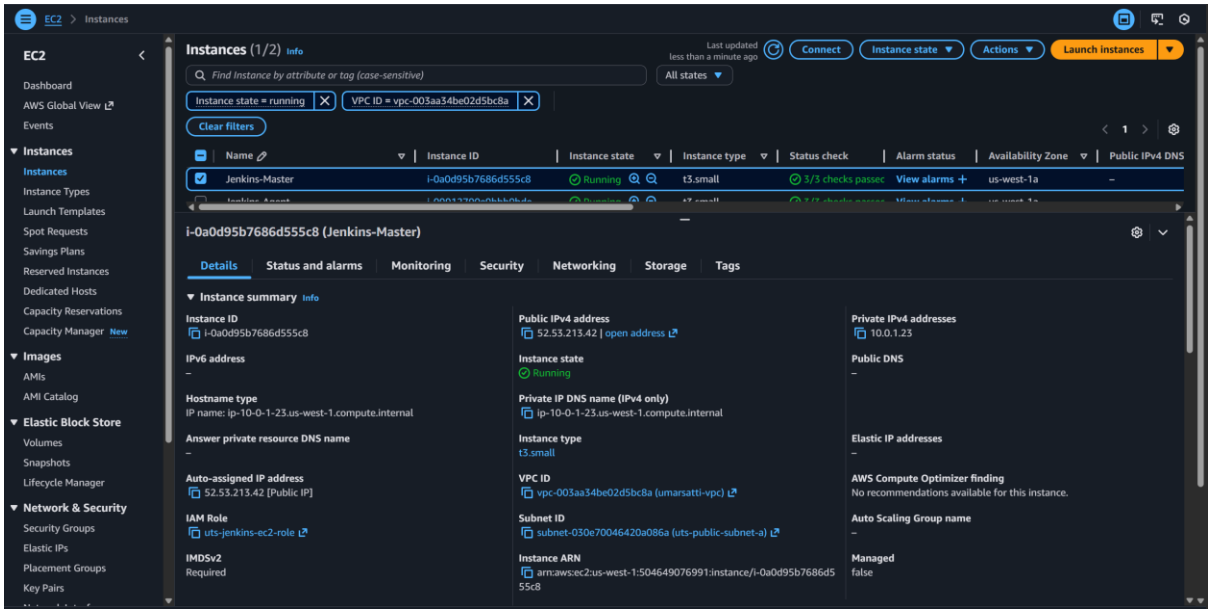
4.1: EC2 Instance Configuration

The following configuration was used for **both** Jenkins Master and Jenkins Agent:

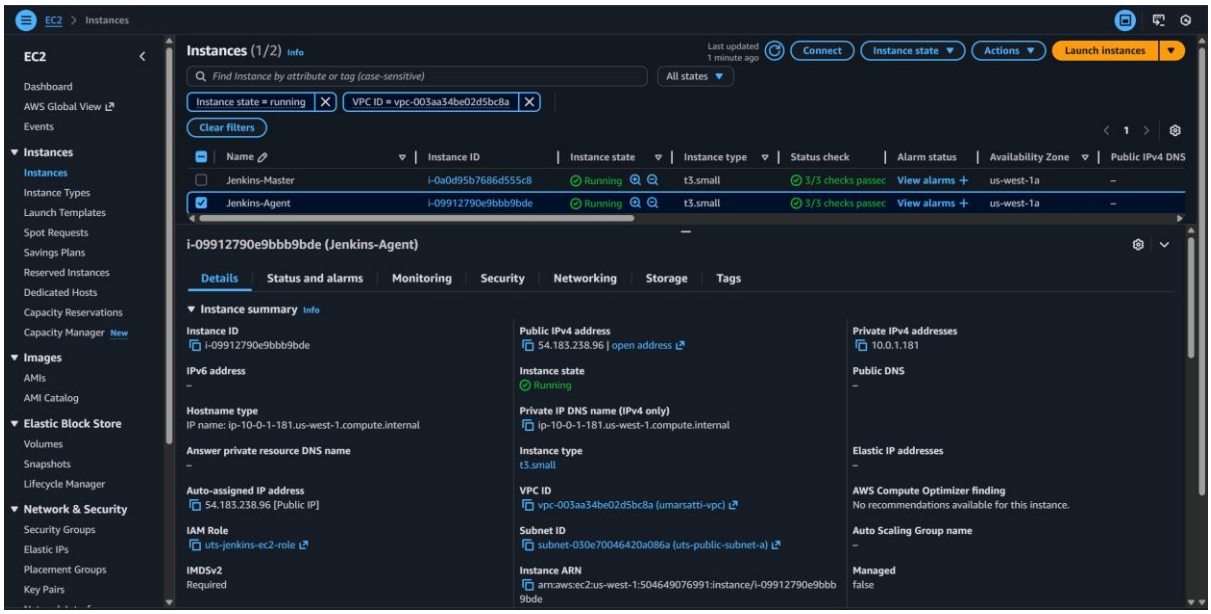
- **Number of instances:** 2
- **Operating System:** Ubuntu (x86_64)
- **Instance type:** t3.small
- **Key pair:** None (AWS Systems Manager used for access)
- **VPC:** Custom VPC created earlier
- **Subnet:** Public subnet
- **Security Group:** uts-public-sg
- **IAM Role:** uts-jenkins-ec2-role
- **Storage:** 20 GB gp3 EBS volume

This setup provides sufficient resources for Jenkins operations in a development/testing environment.

Jenkins Master EC2 Instance



Jenkins Agent EC2 Instance



4.2: Jenkins Master EC2 Installation

The Jenkins Master instance hosts the Jenkins UI and controls pipeline execution.

Access Method

- Connected to the instance using **AWS Systems Manager Session Manager**, avoiding SSH key usage.

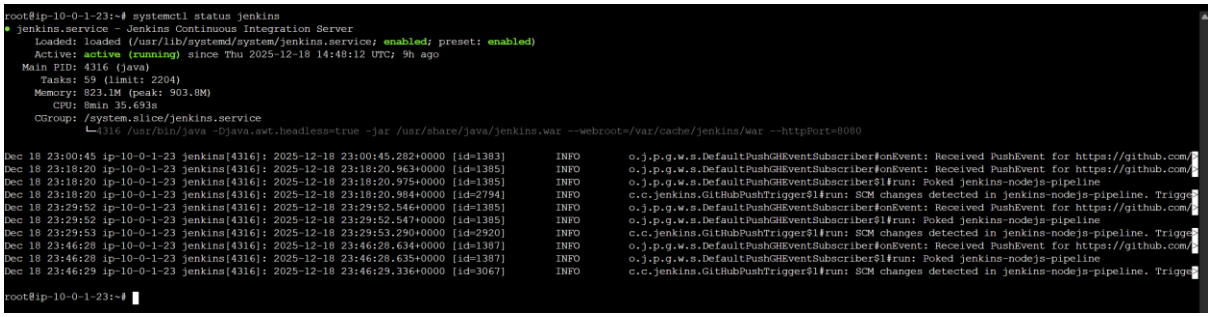
Java Installation

- Installed OpenJDK 21 to meet Jenkins runtime requirements.
- Verified installation using java -version.

```
root@ip-10-0-1-23:~# java -version
openjdk version "21.0.9" 2025-10-21
OpenJDK Runtime Environment (build 21.0.9+10-Ubuntu-124.04)
OpenJDK 64-Bit Server VM (build 21.0.9+10-Ubuntu-124.04, mixed mode, sharing)
root@ip-10-0-1-23:~#
```

Jenkins Installation

- Added the official Jenkins repository and signing key.
- Installed Jenkins using the system package manager.
- Enabled the Jenkins service and verified it was running using systemctl.



4.3: Jenkins Agent EC2 Installation

The Jenkins Agent instance is responsible for executing build and deployment tasks.

Java Installation

- Installed OpenJDK 21, required to run the Jenkins agent process.

```
root@ip-10-0-1-181:~# java -version
openjdk version "21.0.9" 2025-10-21
OpenJDK Runtime Environment (build 21.0.9+10-Ubuntu-124.04)
OpenJDK 64-Bit Server VM (build 21.0.9+10-Ubuntu-124.04, mixed mode, sharing)
root@ip-10-0-1-181:~#
```

AWS CLI Installation

- Installed AWS CLI v2 to allow Jenkins jobs to authenticate with AWS services.
- Required for pushing Docker images to Amazon ECR and updating ECS services.

To install the AWS CLI, run the following commands.

```
$ curl "https://awscli.amazonaws.com/awscli-exe-linux-x86_64.zip" -o "awscliv2.zip"
unzip awscliv2.zip
sudo ./aws/install
```

Docker Installation

- Installed Docker to build, tag, and push container images during pipeline execution.

4.4: Accessing Jenkins UI and Initial Setup

- Accessed Jenkins via http://<Jenkins-Master-Public-IP>:8080
- Retrieved the initial admin password from:
  - /var/lib/jenkins/secrets/initialAdminPassword
- Installed suggested plugins during setup.
- Created an admin user with basic details.

- **Username:** admin
- **Password:** admin
- **Full name:** Admin
- **Email:** admin@example.com

Agent Configuration

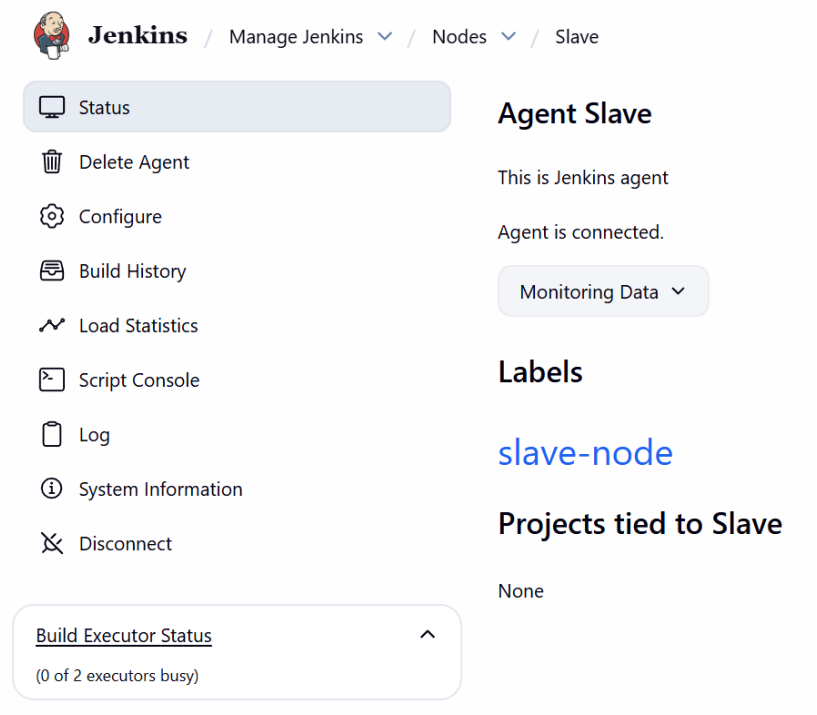
Configured a new node:

- **Node name:** Slave
- **Type:** Permanent Agent
- **Remote root directory:** /opt/build

4.5: Connecting Jenkins Agent to Master

The agent was connected to the Jenkins Master using the JNLP method.

- Downloaded the Jenkins agent JAR from the master.
- Executed the agent command with:
  - Jenkins URL
  - Secret token
  - Agent name
  - Agent Label: slave-node
  - Working directory (/opt/build)



This established a persistent connection between the master and agent.

4.6: Jenkins Plugin Installation

Required plugins were installed on the Jenkins Master to support GitHub integration, Docker builds, and AWS deployments.

Installed Plugins

- **Git & Node.js:** Git plugin, NodeJS plugin
- **AWS & ECR:** AWS SDK, AWS Credentials, Amazon ECR, Pipeline AWS Steps
- **ECS:** AWS SDK for ECS, Amazon ECS/Fargate plugin
- **Docker:** Docker, Docker Pipeline, Docker API, Docker Commons

These plugins enable end-to-end CI/CD functionality.

4.7: Jenkins AWS Credentials Configuration

Configure Jenkins to authenticate with AWS using IAM roles.

- Navigate to **Manage Jenkins** → **Credentials**
- Added **AWS Credentials** with:
    - No access keys provided
    - **IAM Role:** Add role ARN
    - **STS Token Duration:** 3600 seconds

This allows Jenkins to securely access AWS services without storing static credentials.

5. Elastic Container Registry (ECR)

Amazon Elastic Container Registry (ECR) is used to store, manage, and version Docker container images. In this project, ECR serves as the central image repository from which ECS pulls the application image during deployment.

5.1: Create ECR Repository

A private ECR repository was created to store the Node.js application image.

Navigate to the **ECR console** using the search bar. On the left navigation bar, select **Private repository**. Click the **Create** button to configure ECR.

Repository Configuration

- **Repository name:** nodejs-app
- **Visibility:** Private
- **Tag mutability:** Mutable
- **Encryption:** AES-256
- **Repository URI:** 504649076991.dkr.ecr.us-west-1.amazonaws.com/nodejs-app

This repository stores Docker images and allows controlled access via IAM roles.

5.2: Push Docker Image to ECR

The Docker image was built locally and pushed to the ECR repository using AWS CLI and Docker. Click the **View push commands** button and execute the commands to push docker image to ECR.

1. **Authenticate Docker with ECR**
    - Uses AWS CLI to retrieve a temporary authentication token.
    - Allows Docker to interact with the private ECR repository.
2. **Build the Docker image**
    - Builds the Node.js application image using the local Dockerfile.
    - Tags the image as nodejs-app.
3. **Tag the image for ECR**
    - Retags the local image with the ECR repository URI.
    - Prepares the image for upload to ECR.
4. **Push the image to ECR**

- Uploads the Docker image to the private ECR repository.
- Makes the image available for ECS deployments.

After the push is completed successfully, the Docker image appears in the ECR repository and is ready to be referenced in the ECS task definition.

6. Elastic Container Service (ECS)

Amazon Elastic Container Service (ECS) is used to run and manage the Dockerized Node.js application on AWS Fargate. This setup includes creating a task definition, an ECS cluster, and an ECS service to ensure scalable and highly available deployments.

6.1: Create ECS Task Definition

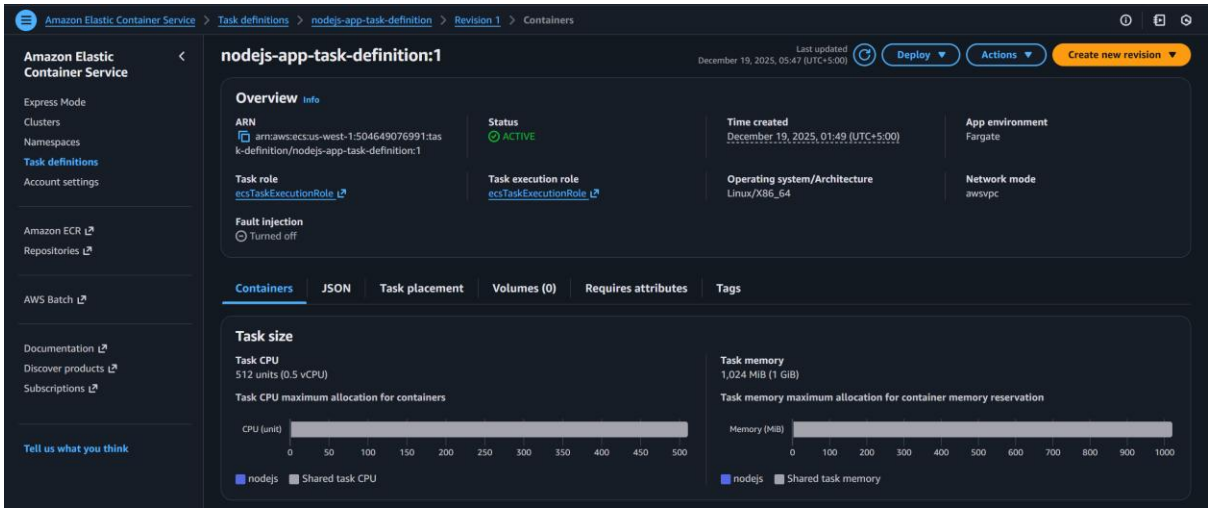
The task definition defines how the container runs, including resource requirements, networking, and logging. Navigate to the **ECS** console using the search bar at the top. Select **Task Definition** and add the configuration defined below.

Task Definition Configuration

- **Family name:** nodejs-app-task-definition
- **Launch type:** AWS Fargate
- **OS / Architecture:** Linux, x86_64
- **Network mode:** awsvpc
- **Task size:**
    - CPU: 0.5 vCPU
    - Memory: 1 GB
- **Task role / Execution role:** ecsTaskExecutionRole

Container Configuration

- **Container name:** nodejs
- **Essential:** Yes
- **Image URI:** 504649076991.dkr.ecr.us-west-1.amazonaws.com/nodejs-app
- **Port mapping:**
    - **Container port:** 3000
    - **Protocol:** TCP
    - **App protocol:** HTTP
- **Logging Configuration**
- **Log driver:** Amazon CloudWatch Logs
- **Log group:** /ecs/jenkins-nodejs-app-task-definition
- **Region:** us-west-1
- **Stream prefix:** ecs
- **Auto-create log group:** Enabled



Default settings were used for storage, monitoring, and tags.

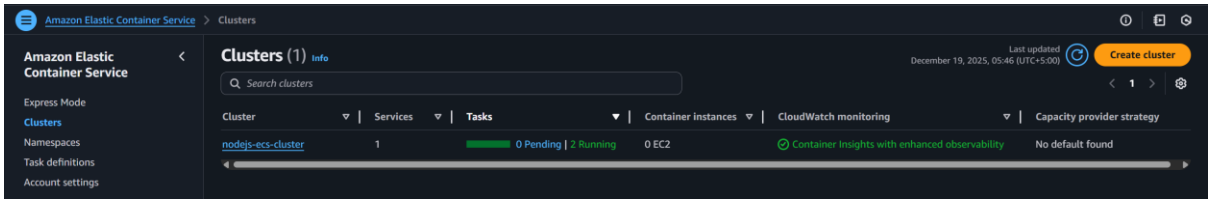
6.2 Create ECS Cluster

An ECS cluster was created to host and manage the Fargate tasks.

Navigate to the **ECS** console using the search bar at the top. Select **Cluster** and add the configuration defined below.

Cluster Configuration

- **Cluster name:** nodejs-ecs-cluster
- **Compute capacity:** Fargate only
- **Monitoring:**
    - Container Insights enabled with enhanced observability
    - ECS Exec logging enabled
- **Encryption:** Default (none)
- **Tags:** None



This cluster provides the runtime environment for the application containers.

6.3: Create ECS Service

The ECS service ensures that the desired number of application tasks are running and handles deployments and rollbacks. Within the cluster console, Click the **Create service** button and add the following configurations.

Service Details

- **Service name:** nodejs-app-task-definition-service
- **Task definition:** nodejs-app-task-definition (LATEST revision)

Compute and Environment

- **Capacity provider:** FARGATE
- **Platform version:** LATEST
- **ECS Exec:** Enabled

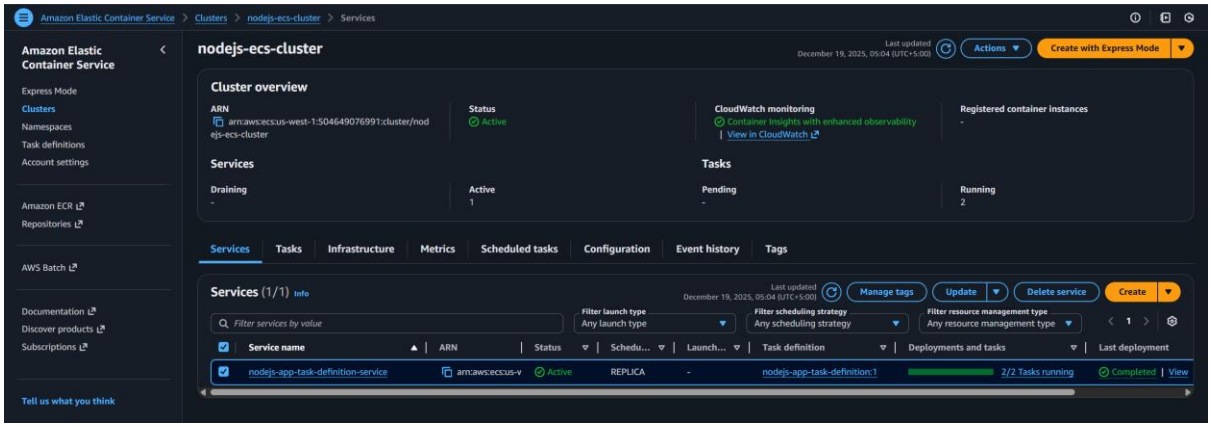
Deployment Configuration

- **Scheduling strategy:** Replica
- **Desired tasks:** 2
- **Deployment strategy:** Rolling update
- **Minimum healthy tasks:** 50%
- **Maximum running tasks:** 100%
- **Deployment circuit breaker:** Enabled with automatic rollback

Networking Configuration

- **VPC:** Custom VPC created earlier
- **Subnets:** Previously created subnets
- **Security groups:** Existing security group with required inbound rules

All remaining settings were left at their default values.



7. Jenkins Pipeline Using Jenkinsfile

The Jenkins pipeline automates the complete CI/CD workflow for the Node.js application. It pulls source code from GitHub, builds and tests a Docker image, pushes the image to Amazon ECR, and deploys the updated image to Amazon ECS. The pipeline is defined declaratively using a Jenkinsfile stored in the GitHub repository.

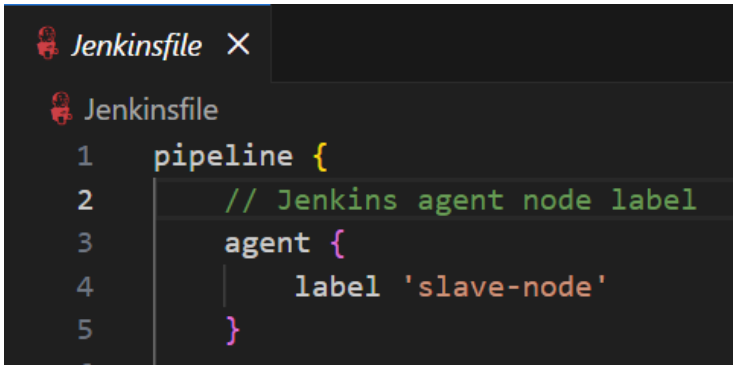
7.1: Pipeline Overview

Stage	Description
Checkout	Pulls application source code and Jenkinsfile from GitHub
Build	Builds the Docker image for the Node.js application
Test	Runs a basic container test to validate the image
Push to ECR	Tags and pushes the Docker image to Amazon ECR
Deploy	Triggers ECS service update with the new image
Rollback	Handled automatically by ECS deployment circuit breaker

7.2: Jenkins Agent Configuration

The pipeline is configured to run on a dedicated Jenkins agent node:

- **Agent label:** slave-node
- Ensures all build and deployment steps execute on the Agent EC2 instance.
- Keeps the Jenkins Master lightweight and focused on orchestration.



7.3: Environment Variables

Global environment variables are defined to make the pipeline reusable and configurable.

- **AWS_DEFAULT_REGION:** Specifies the AWS region for ECR and ECS operations
- **ECR_REPO:** Stores the full ECR repository URI
- **IMAGE_TAG:** Uses the latest tag for the Docker image

```
// Environment variables for AWS and Docker
environment {
    // AWS region where ECS and ECR are located
    AWS_DEFAULT_REGION = 'us-west-1'

    // ECR repository URI for storing Docker images
    ECR_REPO = '504649076991.dkr.ecr.us-west-1.amazonaws.com/nodejs-app'

    // Use "latest" tag for Docker image
    IMAGE_TAG = "latest"
}
```

These variables are referenced across multiple pipeline stages to maintain consistency.

7.4: Pipeline Stages Explanation

Stage 1: Source

- Pulls the application source code and Jenkinsfile from the GitHub repository.
- Pipeline always runs against the latest committed code on the main branch.

```
stages {
    // Stage 1: Pull source code from GitHub repository
    stage('Source') {
        steps {
            git branch: 'main', url: 'https://github.com/Umarsatti1/Task-12-Jenkins-Setup-and-ECS-Deployment-Pipeline.git'
        }
    }
```

Stage 2: Build

- Builds the Docker image using the application's Dockerfile.
- Tags the image locally using the defined IMAGE_TAG.
- Verifies that the application can be successfully containerized.

```
// Stage 2: Build Docker image for the application
stage('Build') {
    steps {
        script {
            sh "docker build -t nodejs-app:${IMAGE_TAG} ."
        }
    }
}
```

Stage 3: Test

- Runs the Docker container temporarily to validate startup.
- Confirms that the Node.js application launches correctly inside the container.
- Stops and removes the container automatically after verification.

```
// Stage 3: Optional test to run container briefly
stage('Test') {
    steps {
        script {
            sh "docker run --rm nodejs-app:${IMAGE_TAG} node app.js & sleep 5; docker ps -q | xargs docker stop || true"
        }
    }
}
```

This stage provides basic validation even in the absence of formal unit tests.

Stage 4: Push to ECR

- Authenticates Docker with Amazon ECR using AWS CLI.
- Tags the locally built image with the ECR repository URI.
- Pushes the Docker image to the private ECR repository.

```
// Stage 4: Push Docker image to Amazon ECR
stage('Push') {
    steps {
        script {
            sh """
            aws ecr get-login-password --region ${AWS_DEFAULT_REGION} | docker login --username AWS --password-stdin ${ECR_REPO}
            docker tag nodejs-app:${IMAGE_TAG} ${ECR_REPO}:${IMAGE_TAG}
            docker push ${ECR_REPO}:${IMAGE_TAG}
            """
        }
    }
}
```

Authentication relies on the IAM role attached to the EC2 instance, eliminating the need for static credentials.

Stage 5: Deploy to ECS

- Triggers a new deployment of the ECS service using AWS CLI.
- Forces ECS to pull the latest Docker image from ECR.
- ECS performs a rolling update based on the service configuration.

```
// Stage 5: Deploy new Docker image to ECS service
stage('Deploy') {
    steps {
        script {
            sh """
            aws ecs update-service \
                --cluster nodejs-ecs-cluster \
                --service nodejs-app-task-definition-service \
                --force-new-deployment \
                --region ${AWS_DEFAULT_REGION}
            """
        }
    }
}
```

Deployment failures are automatically handled using the ECS deployment circuit breaker.

Post-Build Actions

- **On Success:** Displays a successful ECS deployment message.
- **On Failure:** Displays an error message prompting investigation of Jenkins and ECS logs.

```
// Post-build actions: notify success or failure
post {
    success {
        echo 'Deployment succeeded! ECS service has been updated with the latest image.'
    }
    failure {
        echo 'Deployment failed. Please check Jenkins and ECS logs for errors.'
    }
}
```

These post-build steps provide immediate feedback on pipeline execution status.

This Jenkins pipeline enables fully automated CI/CD, ensuring that every code change pushed to GitHub results in a new Docker image build and a controlled ECS deployment.

8. Running and Triggering the Jenkins CI/CD Pipeline

This section describes how the Jenkins pipeline is executed, triggered by GitHub events, and verified after deployment to Amazon ECS.

8.1: Commit and Push Jenkinsfile to GitHub

The Jenkins pipeline configuration is stored as code using a Jenkinsfile in the GitHub repository.

- Added the Jenkinsfile to version control.
- Committed the pipeline configuration.
- Pushed changes to the main branch.

This ensures the CI/CD pipeline is reproducible and versioned alongside the application code.

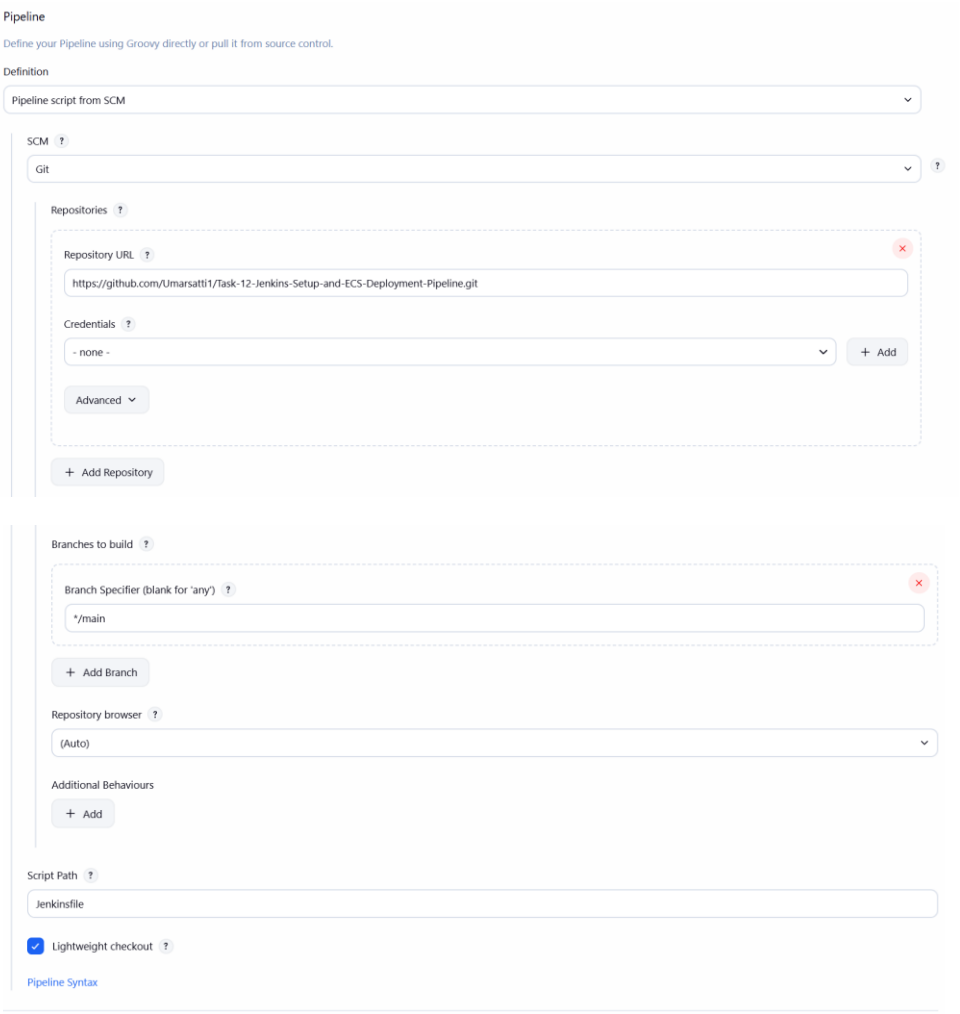
8.2: Create a Jenkins Pipeline Job

A new Jenkins pipeline job was created to execute the CI/CD workflow.

- **Job Configuration**
- **Job name:** jenkins-nodejs-pipeline
- **Job type:** Pipeline
- **Description:** Pipeline for building, testing, and deploying Node.js app to ECS using Jenkins, Docker, and ECR.

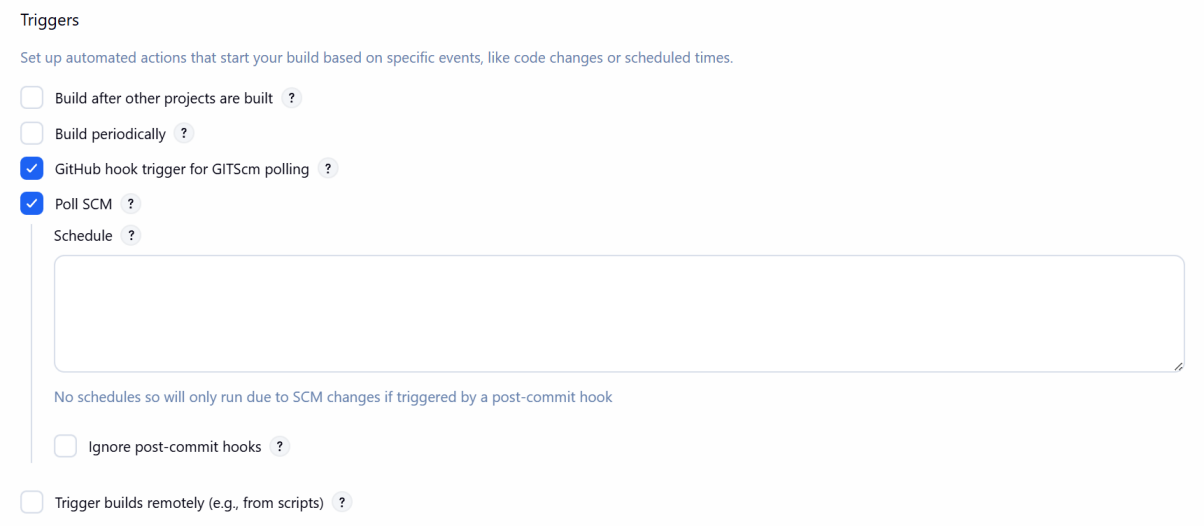
Pipeline Settings

- **Definition:** Pipeline script from SCM
- **SCM:** Git
- **Repository URL:** https://github.com/Umarsatti1/Task-12-Jenkins-Setup-and-ECS-Deployment-Pipeline.git
- **Branch specifier:** */main
- **Script path:** Jenkinsfile
- **Lightweight checkout:** Enabled



Triggers

- GitHub hook trigger for GITScm polling
- Poll SCM

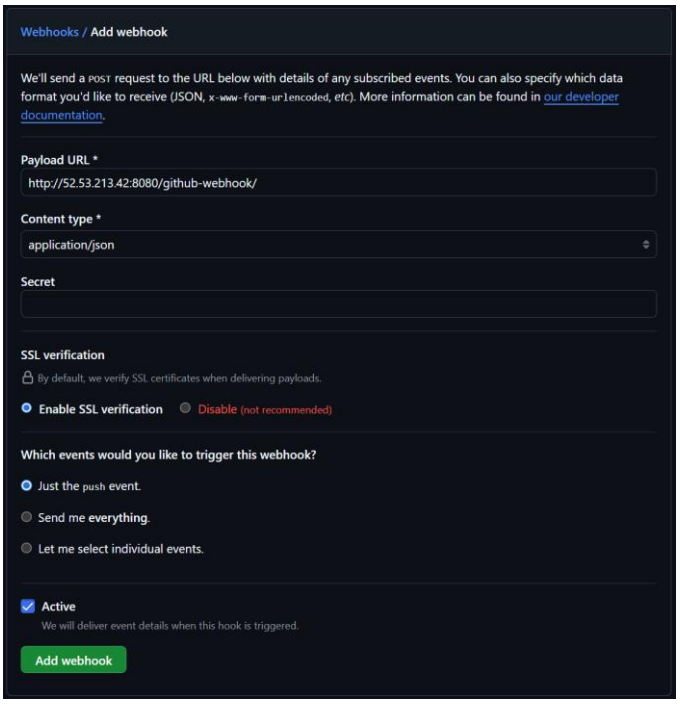


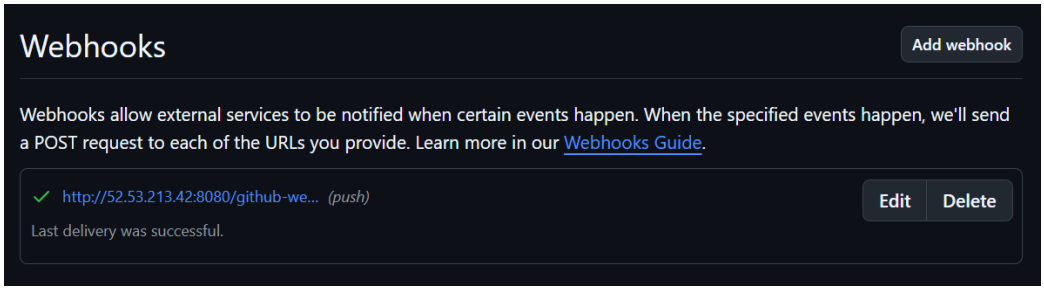
After configuration, the job was saved and made ready for execution.

8.3: GitHub Webhook Configuration (Optional)

To enable automatic pipeline execution on every code push, a GitHub webhook was configured.

- **Payload URL:** http://<Jenkins-Master-IP>:8080/github-webhook/
- **Content type:** application/json
- **Trigger event:** Push events only
- **Status:** Active



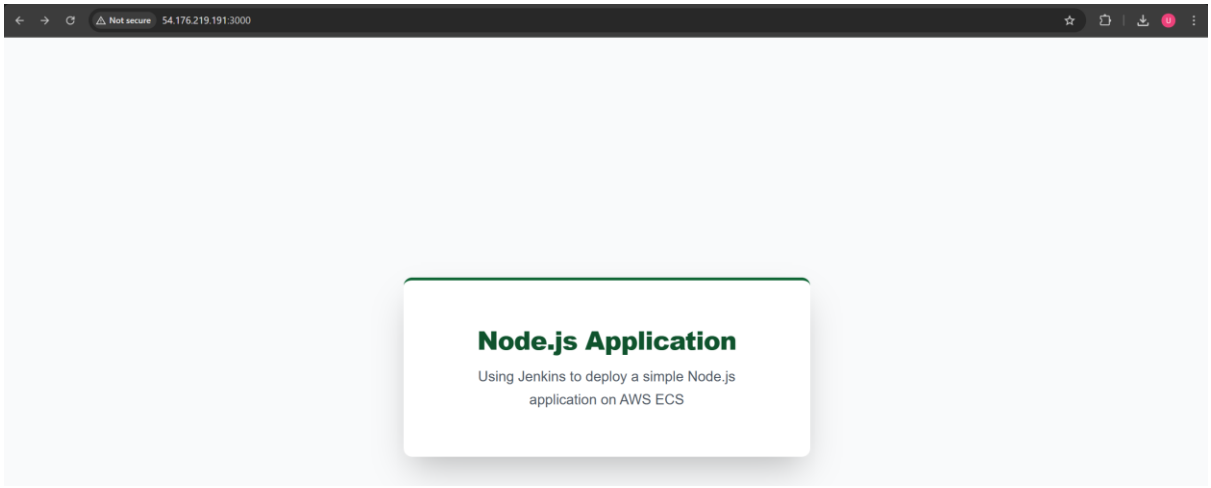


This webhook notifies Jenkins whenever changes are pushed to the repository.

8.4: Test the Current Application Deployment

Before triggering an update, the currently deployed application was verified:

- Retrieved the **Elastic Network Interface (ENI)** IP associated with ECS tasks.
- Accessed the application using: http://<ENI-IP>:3000
- Example: http://54.175.219.191:3000



This confirmed the existing ECS deployment was running successfully.

8.5: Trigger the Jenkins Pipeline

The pipeline is automatically triggered on every new commit to the GitHub repository.

Upon trigger, Jenkins performs the following steps:

- Checks out the latest source code
- Builds a new Docker image
- Pushes the image to Amazon ECR
- Deploys the updated image to the ECS service

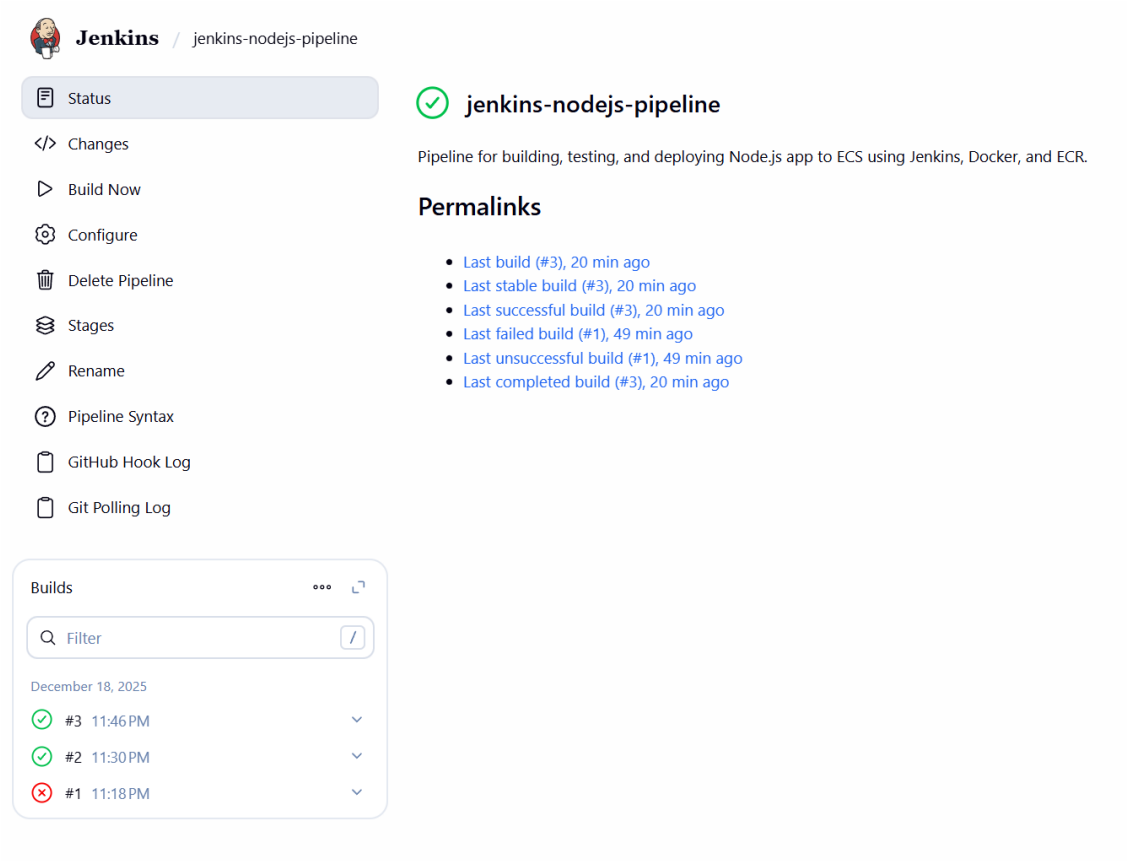
To validate automation:

- Application code (e.g., index.html) was modified.
- Changes were pushed to GitHub.
- Jenkins pipeline executed successfully without manual intervention.

```
PS D:\Cloudelligent\Task-12> git add .
PS D:\Cloudelligent\Task-12> git commit -m "Testing Jenkins pipeline"
[main 653c36c] Testing Jenkins pipeline
 1 file changed, 5 insertions(+), 9 deletions(-)
PS D:\Cloudelligent\Task-12> git push origin main
Enumerating objects: 5, done.
Counting objects: 100% (5/5), done.
Delta compression using up to 16 threads
Compressing objects: 100% (3/3), done.
Writing objects: 100% (3/3), 424 bytes | 424.00 KiB/s, done.
Total 3 (delta 2), reused 0 (delta 0), pack-reused 0 (from 0)
remote: Resolving deltas: 100% (2/2), completed with 2 local objects.
To https://github.com/Umarsatti1/Task-12-Jenkins-Setup-and-ECS-Deployment-Pipeline.git
   f9212f2..653c36c  main -> main
PS D:\Cloudelligent\Task-12>
```

8.6: Jenkins Console Output

Confirmed successful execution of each pipeline stage.



1. Pipeline Initialization & Checkout

```
Started by GitHub push by Umarsatti1
Obtained Jenkinsfile from git https://github.com/Umarsatti1/Task-12-Jenkins-Setup-and-ECS-Deployment-Pipeline.git
[Pipeline] Start of Pipeline
[Pipeline] node
Running on Slave in /opt/build/workspace/jenkins-nodejs-pipeline
[Pipeline] {
[Pipeline] stage
[Pipeline] { (Declarative: Checkout SCM)
[Pipeline] checkout
Selected Git installation does not exist. Using Default
The recommended git tool is: NONE
No credentials specified
Fetching changes from the remote Git repository
Checking out Revision 653c36c72e467efc7969b95161d96fc242d95f35 (refs/remotes/origin/main)
Commit message: "Testing Jenkins pipeline"
 > git rev-parse --resolve-git-dir /opt/build/workspace/jenkins-nodejs-pipeline/.git # timeout=10
 > git config remote.origin.url https://github.com/Umarsatti1/Task-12-Jenkins-Setup-and-ECS-Deployment-Pipeline.git # timeout=10
Fetching upstream changes from https://github.com/Umarsatti1/Task-12-Jenkins-Setup-and-ECS-Deployment-Pipeline.git
 > git --version # timeout=10
 > git --version # 'git version 2.43.0'
 > git fetch --tags --force --progress -- https://github.com/Umarsatti1/Task-12-Jenkins-Setup-and-ECS-Deployment-Pipeline.git +refs/heads/*:refs/remotes/origin/* # timeout=10
 > git rev-parse refs/remotes/origin/main^{commit} # timeout=10
 > git config core.sparsecheckout # timeout=10
 > git checkout -f 653c36c72e467efc7969b95161d96fc242d95f35 # timeout=10
 > git rev-list --no-walk f9212f2af9c98d432dc11a3c77c1e88bf4273812 # timeout=10
```

The pipeline starts on a slave node. It performs a declarative checkout from Git, fetching the Jenkinsfile from the GitHub repository. The system checks out a specific commit (653c36c72e467efc7969b95161d96fc242d95f35) with the message "Testing Jenkins pipeline" and configures Git with sparse checkout for efficiency.

2. Source Stage

```
[Pipeline] }
[Pipeline] // stage
[Pipeline] withEnv
[Pipeline] {
[Pipeline] withEnv
[Pipeline] {
[Pipeline] stage
[Pipeline] { (Source)
[Pipeline] git
Selected Git installation does not exist. Using Default
The recommended git tool is: NONE
No credentials specified
Fetching changes from the remote Git repository
Checking out Revision 653c36c72e467efc7969b95161d96fc242d95f35 (refs/remotes/origin/main)
Commit message: "Testing Jenkins pipeline"
```

This shows the Source stage where Jenkins detects that no Git installation is configured (using default). It successfully fetches changes from the remote repository and checks out the main branch commit, preparing the workspace for the build process.

3. Build Stage

```
[Pipeline] }
[Pipeline] // stage
[Pipeline] stage
[Pipeline] { (Build)
[Pipeline] script
[Pipeline] {
[Pipeline] sh
+ docker build -t nodejs-app:latest .
#0 building with "default" instance using docker driver

#1 [internal] load build definition from Dockerfile
 > git rev-parse --resolve-git-dir /opt/build/workspace/jenkins-nodejs-pipeline/.git # timeout=10
 > git config remote.origin.url https://github.com/Umarsatti1/Task-12-Jenkins-Setup-and-ECS-Deployment-Pipeline.git # timeout=10
Fetching upstream changes from https://github.com/Umarsatti1/Task-12-Jenkins-Setup-and-ECS-Deployment-Pipeline.git
 > git --version # timeout=10
 > git --version # 'git version 2.43.0'
 > git fetch --tags --force --progress -- https://github.com/Umarsatti1/Task-12-Jenkins-Setup-and-ECS-Deployment-Pipeline.git +refs/heads/*:refs/remotes/origin/* # timeout=10
 > git rev-parse refs/remotes/origin/main^{commit} # timeout=10
 > git config core.sparsecheckout # timeout=10
 > git checkout -f 653c36c72e467efc7969b95161d96fc242d95f35 # timeout=10
 > git branch -a -v --no-abbrev # timeout=10
 > git branch -D main # timeout=10
 > git checkout -b main 653c36c72e467efc7969b95161d96fc242d95f35 # timeout=10
#1 transferring dockerfile: 534B done
#1 DONE 0.0s

#2 [internal] load metadata for docker.io/library/node:20-alpine
#2 DONE 0.6s

#3 [internal] load .dockerignore
#3 transferring context: 2B done
#3 DONE 0.0s

#4 [internal] load build context
#4 transferring context: 123B done
#4 DONE 0.0s
```

The Build stage executes a Docker build command (docker build -t nodejs-app:latest). It creates a Docker image using the default driver, transfers the Dockerfile, loads Docker metadata and context, and completes the build process.

4. Test Stage

```
[Pipeline] }
[Pipeline] // script
[Pipeline] }
[Pipeline] // stage
[Pipeline] stage
[Pipeline] { (Test)
[Pipeline] script
[Pipeline] {
[Pipeline] sh
+ sleep 5
+ docker run --rm nodejs-app:latest node app.js
Server is now serving static files from the 'public' folder.
Access the application at http://localhost:3000
+ docker ps -q
+ xargs docker stop
a9572b959df9
```

The **Test stage** runs the application in a Docker container with docker run --rm nodejs-app:latest node app.js. The output confirms the Node.js server is running and serving static files from the 'public' folder, accessible at http://localhost:3000. It then lists and stops the Docker container.

5. Push Stage

```
[Pipeline] }
[Pipeline] // script
[Pipeline] }
[Pipeline] // stage
[Pipeline] stage
[Pipeline] { (Push)
[Pipeline] script
[Pipeline] {
[Pipeline] sh
+ aws ecr get-login-password --region us-west-1
+ docker login --username AWS --password-stdin 504649076991.dkr.ecr.us-west-1.amazonaws.com/nodejs-app

WARNING! Your credentials are stored unencrypted in '/root/.docker/config.json'.
Configure a credential helper to remove this warning. See
https://docs.docker.com/go/credential-store/

Login Succeeded
+ docker tag nodejs-app:latest 504649076991.dkr.ecr.us-west-1.amazonaws.com/nodejs-app:latest
+ docker push 504649076991.dkr.ecr.us-west-1.amazonaws.com/nodejs-app:latest
The push refers to repository [504649076991.dkr.ecr.us-west-1.amazonaws.com/nodejs-app]
f9e26c244f7f: Waiting
f8bc6c62be16: Layer already exists
fd1849a5c548: Layer already exists
d62659c90dbd: Layer already exists
1074353eec0d: Layer already exists
8d06ba6946d1: Layer already exists
fcb8b8ee4622: Layer already exists
cf4ab8ea3408: Layer already exists
cb3325e64457: Layer already exists
f9e26c244f7f: Pushed
latest: digest: sha256:0e7638478c970433d9259fedb45264961467d3afce35077af391125d406098f7 size: 856
```

The Push stage authenticates with AWS ECR using aws ecr get-login-password, then tags and pushes the Docker image to the ECR repository (504649076991.dkr.ecr.us-west-1.amazonaws.com/nodejs-app). "Layer already exists" indicates efficient caching, with the final image digest and size displayed after successful push.

6. Deploy Stage

```
[Pipeline] }
[Pipeline] // script
[Pipeline] }
[Pipeline] // stage
[Pipeline] stage
[Pipeline] { (Deploy)
[Pipeline] script
[Pipeline] {
[Pipeline] sh
+ aws ecs update-service --cluster nodejs-ecs-cluster --service nodejs-app-task-definition-service --force-new-deployment --region us-west-1
```

The **Deploy stage** executes an AWS ECS update-service command to deploy the new image to the ECS cluster named "nodejs-ecs-cluster" in the us-west-1 region, forcing a new deployment of the service "nodejs-app-task-definition-service."

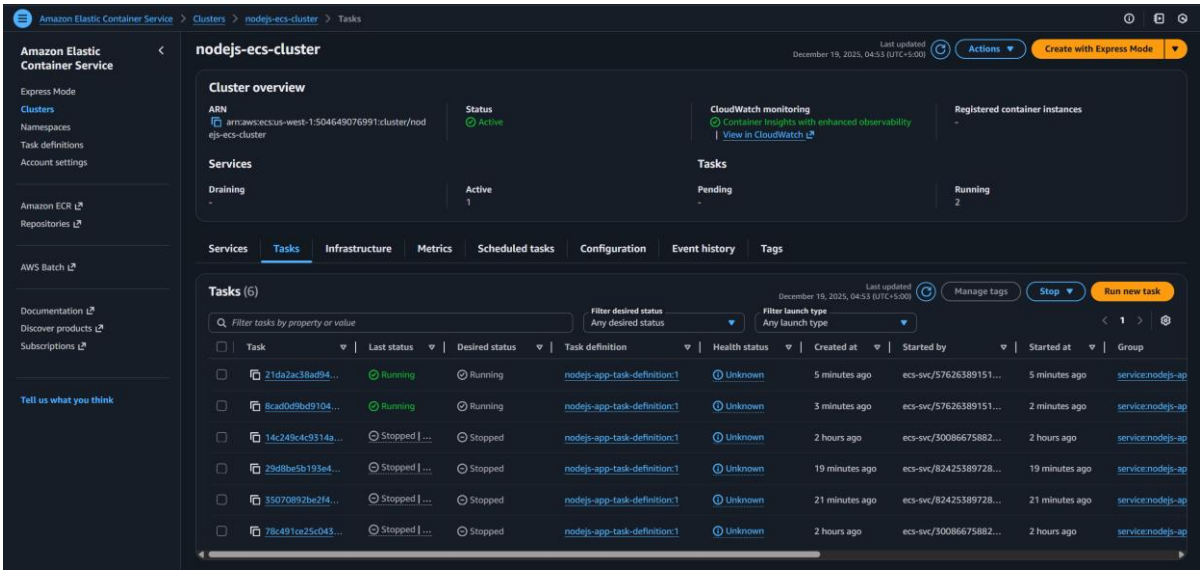
7. Pipeline Success

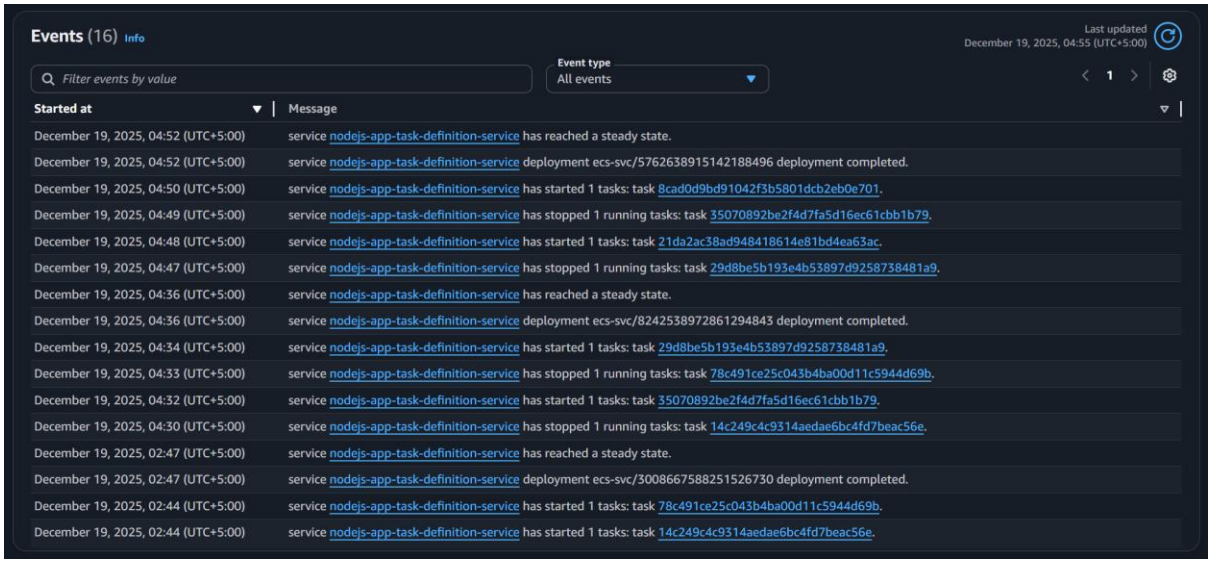
```
Deployment succeeded! The ECS service has been updated with the new image.
[Pipeline] }
[Pipeline] // stage
[Pipeline] }
[Pipeline] // withEnv
[Pipeline] }
[Pipeline] // withEnv
[Pipeline] }
[Pipeline] // node
[Pipeline] End of Pipeline
Finished: SUCCESS
```

The pipeline concludes with "Deployment succeeded! The ECS service has been updated with the new image." The pipeline finishes with a SUCCESS status, confirming all stages (checkout, build, test, push, deploy) completed successfully.

8.7: ECS Service Events

Verified new task revisions and successful rolling deployment.



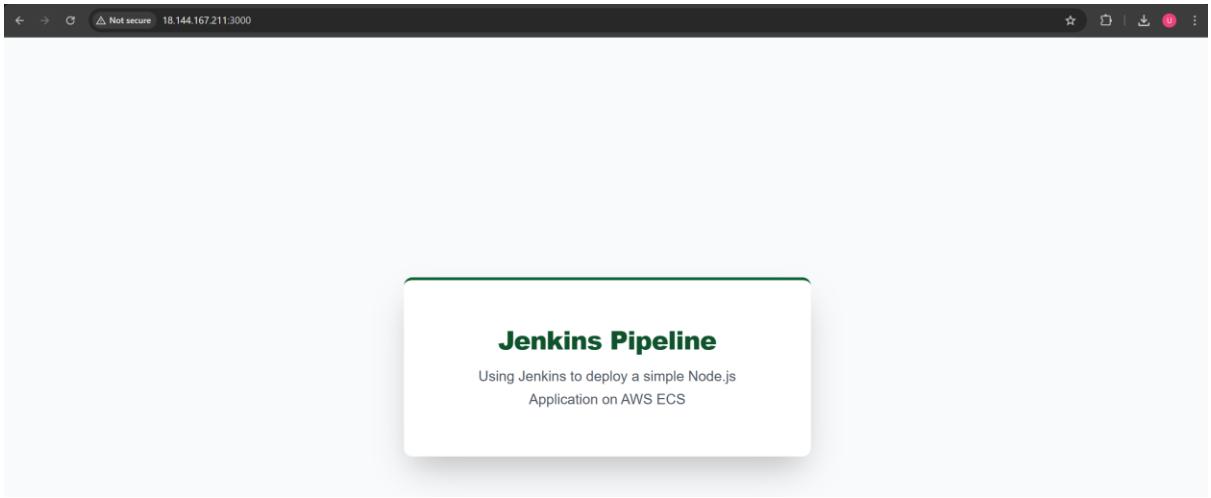


8.8: Application Access

Accessed the application using the new ECS task ENI IP.

Updated Application Confirmation

- The updated UI confirmed the new Docker image was deployed.
- ECS launched new tasks, resulting in a different ENI IP.
- Old tasks were terminated as part of the rolling update process.



This completes the end-to-end CI/CD workflow, demonstrating automated build, image management, and deployment to Amazon ECS using Jenkins.

9. Troubleshooting

The following issues were encountered during the setup and execution of the Jenkins CI/CD pipeline, Docker image deployment, and ECS service updates. Each issue outlines the observed problem, root cause, and the steps taken to resolve it.

Issue 1: Jenkins Pipeline Failed During ECR Authentication

Problem Description
During pipeline execution, the build failed at the ECR authentication stage with the following error:

```
aws: not found
error: cannot perform an interactive login from a non TTY device
```

Root Cause
The Jenkins Agent EC2 instance did not have the AWS CLI installed. Since Jenkins uses the AWS CLI to authenticate with Amazon ECR and push Docker images, the aws ecr get-login-password command could not be executed.

Solution
Installed AWS CLI v2 on the Jenkins Agent EC2 instance:

- Downloaded and installed AWS CLI using the official AWS installer.
- Verified installation using aws --version.

After installing AWS CLI, the pipeline was able to authenticate with ECR and successfully push Docker images.

Issue 2: ECS Service Continued Running Old Application Version

Problem Description
After a successful Jenkins pipeline run and Docker image push to ECR, the application UI did not reflect recent changes. ECS was still running the old application version.

Root Cause
The ECS service was still using **task definition revision 1**, which referenced an older container image. Although new Docker images were being built and pushed to ECR using ${BUILD_NUMBER}, ECS does not automatically deploy new images unless a new task definition revision is created and applied to the service.

As a result, new images existed in ECR but ECS continued running the old task definition. Hence, the old container image and HTML content remained active.

Solution
Updated the Jenkins pipeline to use the latest image tag instead of ${BUILD_NUMBER}.

- ECS pulls the latest image on every forced deployment.
- Ensures ECS always runs the most recently pushed image without requiring task definition updates.

This change resolved the issue and allowed ECS to consistently deploy updated application versions.

Issue 3: GitHub Webhook Trigger Not Working

Problem Description
GitHub pushes were not triggering the Jenkins pipeline automatically.

Root Cause
The Jenkins Master EC2 instance IP address changed after stopping and restarting the instance. Since the GitHub webhook was configured using the old public IP, webhook requests were no longer reaching Jenkins.

Solution
Assigned an **Elastic IP (EIP)** to the Jenkins Master EC2 instance.

- Ensured a static public IP address for Jenkins.
- Updated the GitHub webhook to use the Elastic IP.

After assigning the Elastic IP, GitHub webhook triggers functioned reliably.

Issue 4: Jenkins Agent Showing Offline After Restarting Jenkins Master

Problem Description
After restarting the Jenkins Master EC2 instance, the Jenkins Agent appeared as **offline** in the Jenkins UI.

Root Cause
The Jenkins Master IP address changed after restart. The agent was still attempting to connect to the old master IP, causing the connection to fail.

Solution
Reconnected the Jenkins Agent using the updated Jenkins Master IP.

- Downloaded the agent JAR from the new Jenkins Master URL.
- Re-ran the agent connection command with the updated IP address.

```
curl -sO http://<NEW-JENKINS-MASTER-IP>:8080/jnlpJars/agent.jar
java -jar agent.jar -url http://<NEW-JENKINS-MASTER-IP>:8080/ \
-secret <SECRET> -name Slave -webSocket -workDir "/opt/build"
```

After re-running the command, the agent successfully reconnected and became online.