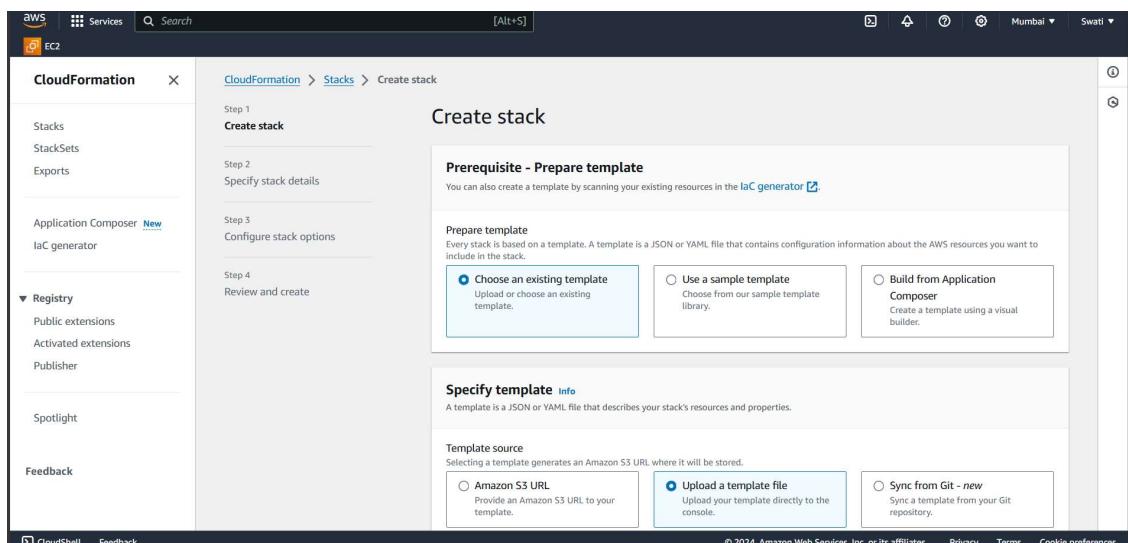


PROJECT

The **Multi-Region Containerized Application Deployment** project utilises AWS CloudFormation to establish a high-availability architecture for a containerized application. It employs Amazon ECS for orchestration and ECR for Docker image storage, while Route 53 routes traffic across regions. The project automates CI/CD using AWS CodePipeline, integrating CodeBuild and CodeDeploy, with manual approval stages and source code replication. Additionally, it implements AWS CloudWatch for monitoring and SNS for real-time alerts, ensuring proactive performance management and efficient resource provisioning.

Step 1: Infrastructure as Code (IAC)

- **CloudFormation Templates:** Parameterize the templates to adapt to different regions, environments, and configurations.
- **Template structure:**
 - VPC, Subnets (public and private), Security Groups.
 - Internet Gateway, NAT Gateway, and routing setup.



Screenshot of the AWS CloudFormation 'Specify template' step.

The left sidebar shows the CloudFormation navigation menu with 'Stacks' selected. The main area is titled 'Specify template' with a sub-section 'Template source'. It shows three options: 'Amazon S3 URL' (radio button), 'Upload a template file' (selected radio button), and 'Sync from Git - new'. Under 'Upload a template file', there is a 'Choose file' button and a text input field containing 'vpc.yaml'. Below the input field is a note: 'S3 URL: https://s3.ap-south-1.amazonaws.com/cf-templates-1uvodblstmapn-ap-south-1/2024-09-17T082834.581Zp5n-vpc.yaml'. At the bottom right are 'Cancel' and 'Next' buttons.

Screenshot of the AWS CloudFormation 'Specify stack details' step.

The left sidebar shows the CloudFormation navigation menu with 'Stacks' selected. The main area is titled 'Specify stack details' and shows four steps: 'Create stack' (Step 1), 'Specify stack details' (Step 2, currently active), 'Configure stack options' (Step 3), and 'Review and create' (Step 4). In the 'Provide a stack name' section, the stack name is set to 'MyVPCStack'. In the 'Parameters' section, it says 'No parameters' and 'There are no parameters defined in your template'. At the bottom right are 'Cancel', 'Previous', and 'Next' buttons.

Screenshot of the AWS CloudFormation 'Review and create' step.

The left sidebar shows the CloudFormation navigation menu with 'Stacks' selected. The main area is titled 'Review and create' and shows four steps: 'Create stack' (Step 1), 'Specify stack details' (Step 2, currently active), 'Configure stack options' (Step 3), and 'Review and create' (Step 4). In the 'Prerequisite - Prepare template' section, it says 'Template is ready'. In the 'Template' section, it shows the 'Template URL' as 'https://s3.ap-south-1.amazonaws.com/cf-templates-1uvodblstmapn-ap-south-1/2024-09-17T082834.581Zp5n-vpc.yaml' and the 'Stack description' as 'VPC and Networking Resources for Multi-Region Architecture'. At the bottom right are 'Edit' and 'Next' buttons.

The screenshot shows the AWS CloudFormation console with the following details:

- Left Sidebar:** Shows navigation options like Stack details, Drifts, StackSets, Exports, Application Composer, Registry, and Spotlight.
- Middle Panel:** Displays the "CloudFormation > Stacks > MyVPCStack" view. It shows a list of stacks with "MyVPCStack" selected. The status is "CREATE_IN_PROGRESS".
- Right Panel:** The "MyVPCStack" details page. The "Events" tab is active, showing one event:

Timestamp	Logical ID	Status	Detailed status
2024-09-17 13:59:54 UTC+0530	MyVPCStack	CREATE_IN_PROGRESS	-

The screenshot shows the AWS CloudFormation console with the following details:

- Left Sidebar:** Shows navigation options like Stack details, Drifts, StackSets, Exports, Application Composer, Registry, and Spotlight.
- Middle Panel:** Displays the "CloudFormation > Stacks" view. It shows a list of stacks with "MyVPCStack" selected. The status is "CREATE_COMPLETE".
- Right Panel:** The "MyVPCStack" details page. The "Events" tab is active, showing one event:

Timestamp	Logical ID	Status	Description
2024-09-17 13:59:54 UTC+0530	MyVPCStack	CREATE_COMPLETE	VPC and Networking Resources for Multi-Region Architecture.

The screenshot shows the AWS CloudFormation console with the following details:

- Left Sidebar:** Shows navigation options like Stack details, Drifts, StackSets, Exports, Application Composer, Registry, and Spotlight.
- Middle Panel:** Displays the "CloudFormation > Stacks > MyVPCStack" view. It shows a list of stacks with "MyVPCStack" selected. The status is "CREATE_IN_PROGRESS".
- Right Panel:** The "MyVPCStack" details page. The "Events" tab is active, showing multiple events:

Timestamp	Logical ID	Status	Detailed status
2024-09-17 14:00:22 UTC+0530	MyVPCStack	CREATE_IN_PROGRESS	-
2024-09-17 14:00:22 UTC+0530	PublicRoute	CREATE_IN_PROGRESS	-
2024-09-17 14:00:21 UTC+0530	PublicRoute	CREATE_IN_PROGRESS	-
2024-09-17 14:00:20 UTC+0530	PublicRoute	CREATE_IN_PROGRESS	-
2024-09-17 14:00:20 UTC+0530	PublicRouteTable	CREATE_COMPLETE	-

VPC dashboard > Your VPCs > vpc-0060ff65b47ad59e3 / MultiRegionVPC

Details

VPC ID	vpc-0060ff65b47ad59e3	State	Available
Tenancy	Default	DNS hostnames	Enabled
Default VPC	No	Main route table	rtb-0ee359bdd5bf43fbc
Network Address Usage metrics	Disabled	IPv6 pool	-
		Route 53 Resolver DNS Firewall rule groups	Owner ID
		-	891612578515

Resource map

- VPC Show details
- Subnets (2)
- Route tables (2)
- Network Connections

VPC dashboard > Your VPCs > vpc-0060ff65b47ad59e3 / MultiRegionVPC

Resource map

- VPC Show details
- Subnets (2)
- Route tables (2)
- Network Connections

The diagram illustrates the network topology:

- VPC:** MultiRegionVPC
- Subnets:** ap-south-1a (PublicSubnet1-Mumbai), ap-south-1b (PublicSubnet2-Mumbai)
- Route tables:** rtb-044b944599000271b, rtb-0ee359bdd5bf43fbc
- Network Connections:** igw-0a084

Step 2: Multi-Region High Availability & Disaster Recovery

- Multi-AZ VPC Setup:** Create VPC with subnets across different Availability Zones (AZs) in each region.
- S3 Cross-Region Replication:** Ensure static content and backups are replicated across regions.
- Route 53 Failover:** Configure Route 53 with DNS failover between regions, enabling seamless disaster recovery.

Screenshot of the AWS CloudFormation 'Create stack' wizard Step 1: Prerequisite - Prepare template.

The sidebar shows the CloudFormation navigation menu with 'Stacks' selected. The main panel shows the 'Create stack' step with the sub-step 'Prerequisite - Prepare template'. It includes a note about creating a template from existing resources using the 'IaC generator' and a section for 'Prepare template' with three options:

- Choose an existing template: Upload or choose an existing template.
- Use a sample template: Choose from our sample template library.
- Build from Application Composer: Create a template using a visual builder.

Below this is the 'Specify template' section with a note about a JSON or YAML file describing stack resources and properties. It includes a 'Template source' section with three options:

- Amazon S3 URL: Provide an Amazon S3 URL to your template.
- Upload a template file: Upload your template directly to the console. A file input field contains 's3.yaml'.
- Sync from Git - new: Sync a template from your Git repository.

At the bottom right are 'Cancel' and 'Next' buttons.

Screenshot of the AWS CloudFormation 'Create stack' wizard Step 2: Specify template.

The sidebar shows the CloudFormation navigation menu with 'Stacks' selected. The main panel shows the 'Specify template' step with a note about a JSON or YAML file describing stack resources and properties. It includes a 'Template source' section with three options:

- Amazon S3 URL: Provide an Amazon S3 URL to your template.
- Upload a template file: Upload your template directly to the console. A file input field contains 's3.yaml'.
- Sync from Git - new: Sync a template from your Git repository.

Below this is the 'Upload a template file' section with a 'Choose file' button and a preview area showing 's3.yaml'. At the bottom right are 'Cancel' and 'Next' buttons.

Screenshot of the AWS CloudFormation 'Create stack' wizard Step 3: Specify stack details.

The sidebar shows the CloudFormation navigation menu with 'Stacks' selected. The main panel shows the 'Specify stack details' step with a note about providing a stack name. It includes a 'Provide a stack name' section with a text input field containing 'MyS3BucketReplicationStack' and a note about character restrictions. Below this is the 'Parameters' section with a note about defining parameters in the template. It shows a message: 'No parameters' and 'There are no parameters defined in your template'. At the bottom right are 'Cancel', 'Previous', and 'Next' buttons.

AWS CloudFormation Stack Details - MyS3Stack

Stacks

- Stack details
- Drifts
- StackSets
- Exports

Application

- Composer **New**
- laC generator

Registry

- Public extensions
- Activated extensions
- Publisher

Spotlight

CloudFormation > Stacks > MyS3Stack

MyS3Stack

Events (1)

Timestamp	Logical ID	Status	Detailed status
2024-09-17 14:11:28 UTC+0530	MyS3Stack	CREATE_IN_PROGRESS	-

AWS CloudFormation Stack Details - MyS3BucketReplicationStack

Stacks

- Stack details
- Drifts
- StackSets
- Exports

Application

- Composer **New**
- laC generator

Registry

- Public extensions
- Activated extensions
- Publisher

Spotlight

CloudFormation > Stacks > MyS3BucketReplicationStack

MyS3BucketReplicationStack

Events (6)

Timestamp	Logical ID	Status	Detailed status
2024-09-17 15:54:37 UTC+0530	S3BucketReplication	CREATE_IN_PROGRESS	-
2024-09-17 15:54:36 UTC+0530	S3BucketReplication	CREATE_IN_PROGRESS	-
2024-09-17 15:54:36 UTC+0530	S3Bucket	CREATE_COMPLETE	-
2024-09-17 15:54:23 UTC+0530	S3Bucket	CREATE_IN_PROGRESS	-
2024-09-17 15:54:22 UTC+0530	S3Bucket	CREATE_IN_PROGRESS	-

AWS CloudFormation Stack Details - MyS3BucketReplicationStack

Stacks

- Stack details
- Drifts
- StackSets
- Exports

Application

- Composer **New**
- laC generator

Registry

- Public extensions
- Activated extensions
- Publisher

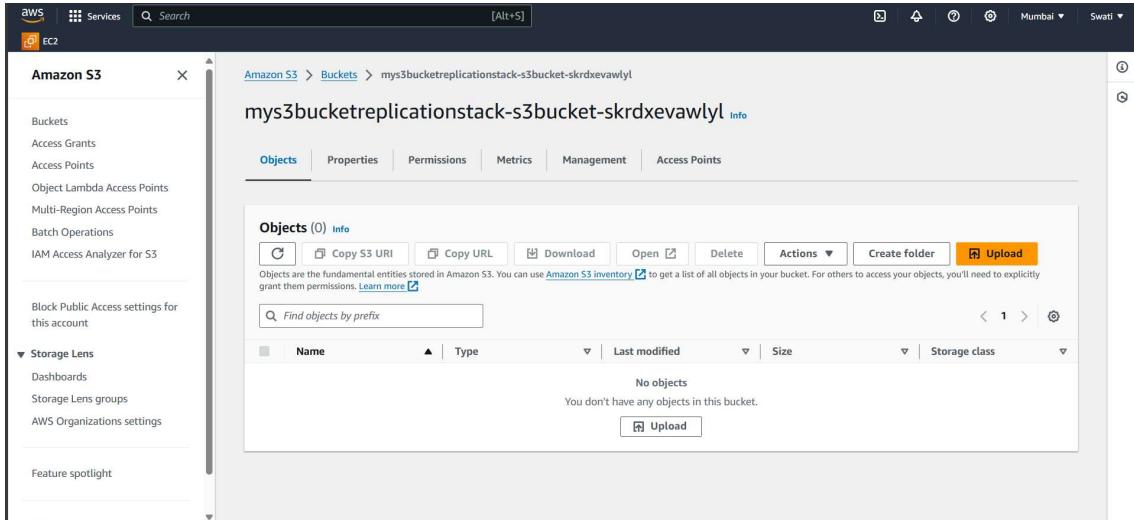
Spotlight

CloudFormation > Stacks > MyS3BucketReplicationStack

MyS3BucketReplicationStack

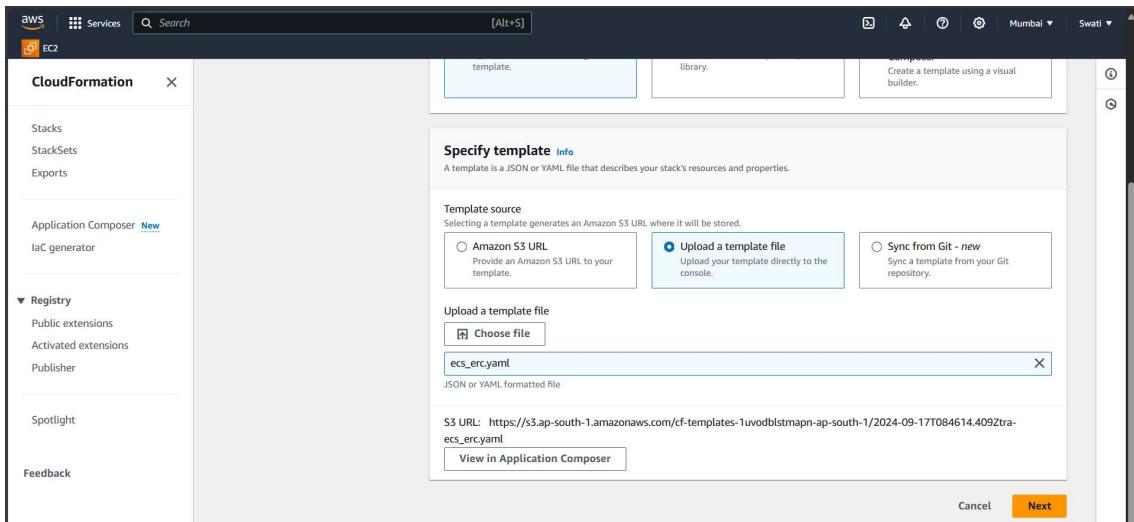
Resources (2)

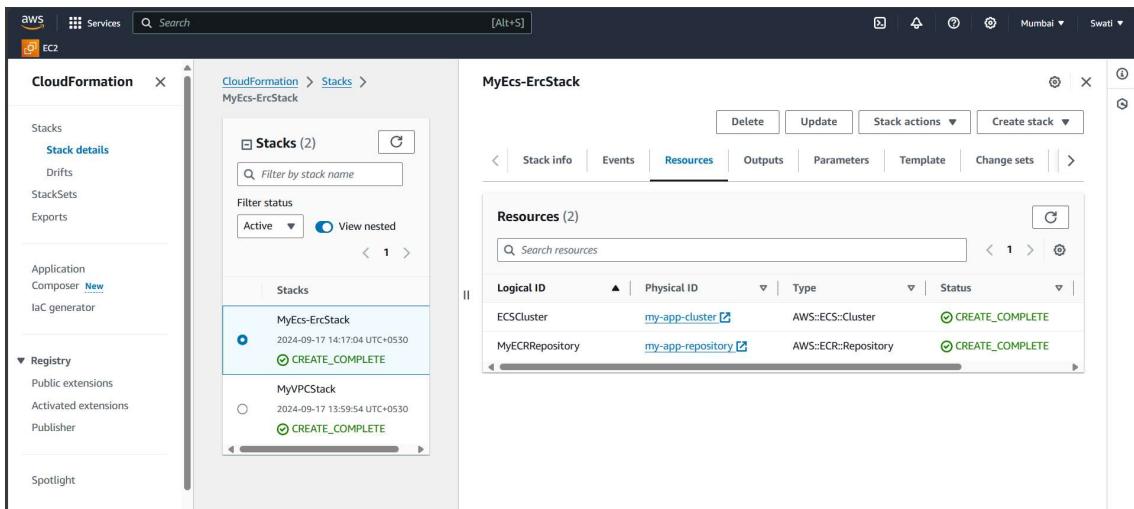
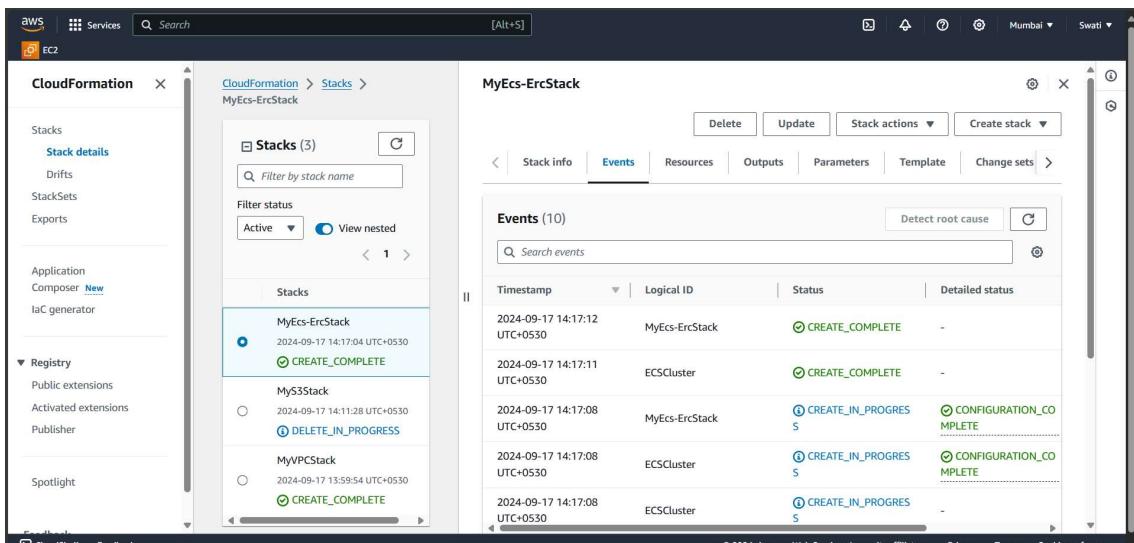
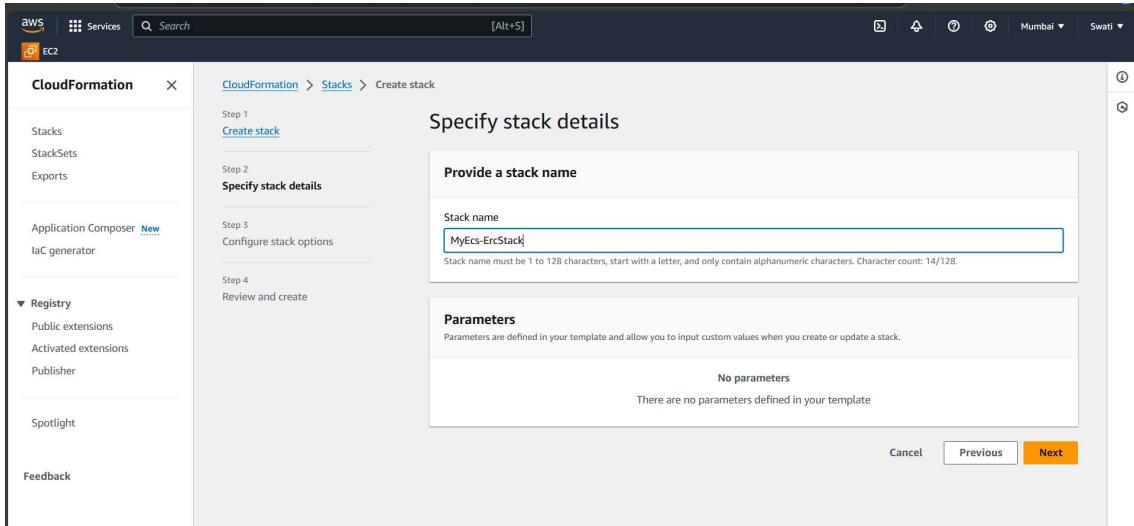
Logical ID	Physical ID	Type	Status
S3Bucket	mys3bucketreplicationsack-s3bucket-skrdxevawyl	AWS::S3::Bucket	CREATE_COMPLETE
S3BucketReplication	mys3bucketreplicationsack-s3bucket-skrdxevawyl	AWS::S3::BucketPolicy	CREATE_IN_PROGRESS

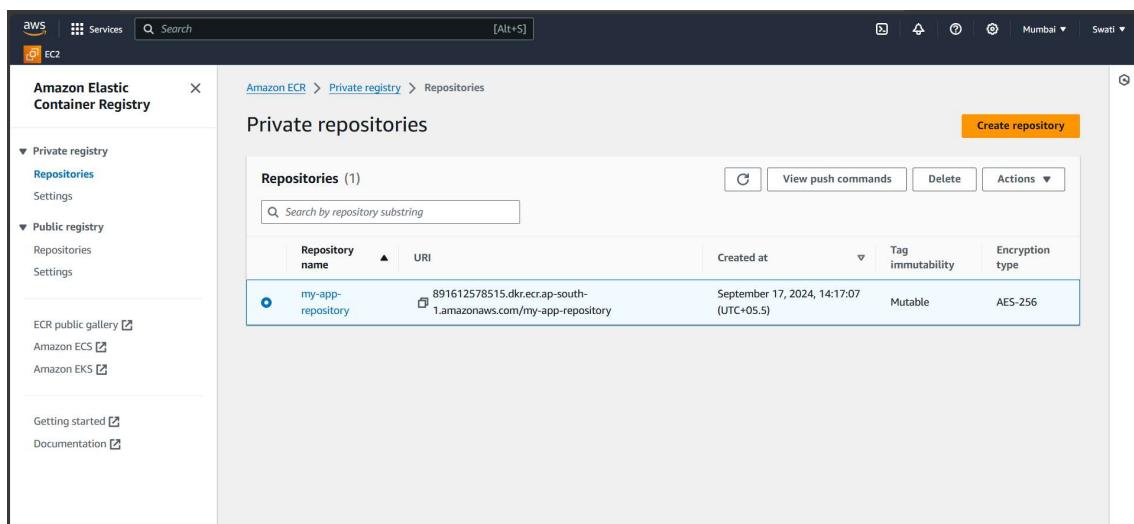
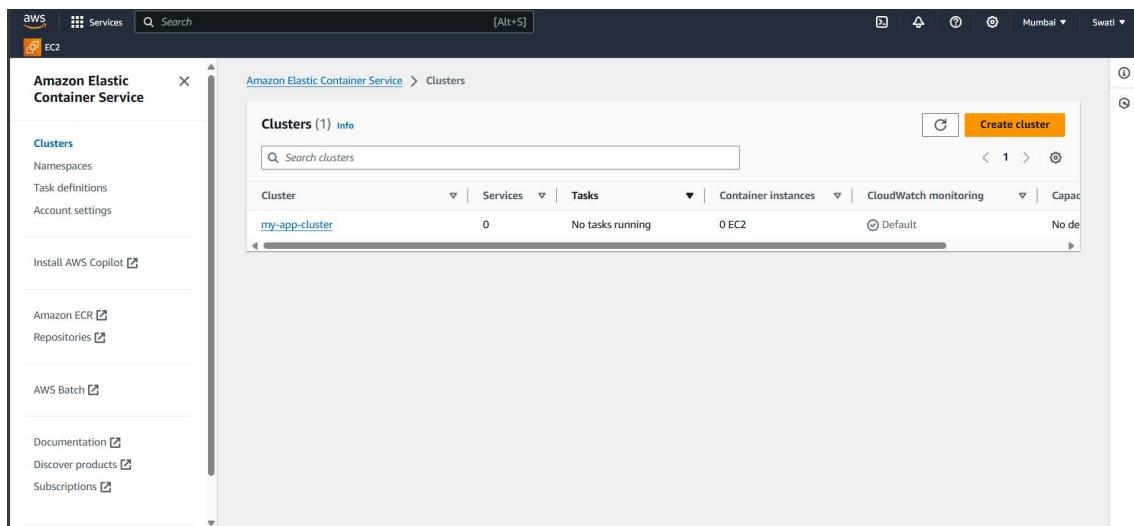


Step 3: Containers and Docker Image Repository

- **ECR:** Set up ECR for storing Docker images.
- **ECS Cluster:** Use ECS with auto-scaling across multiple regions.

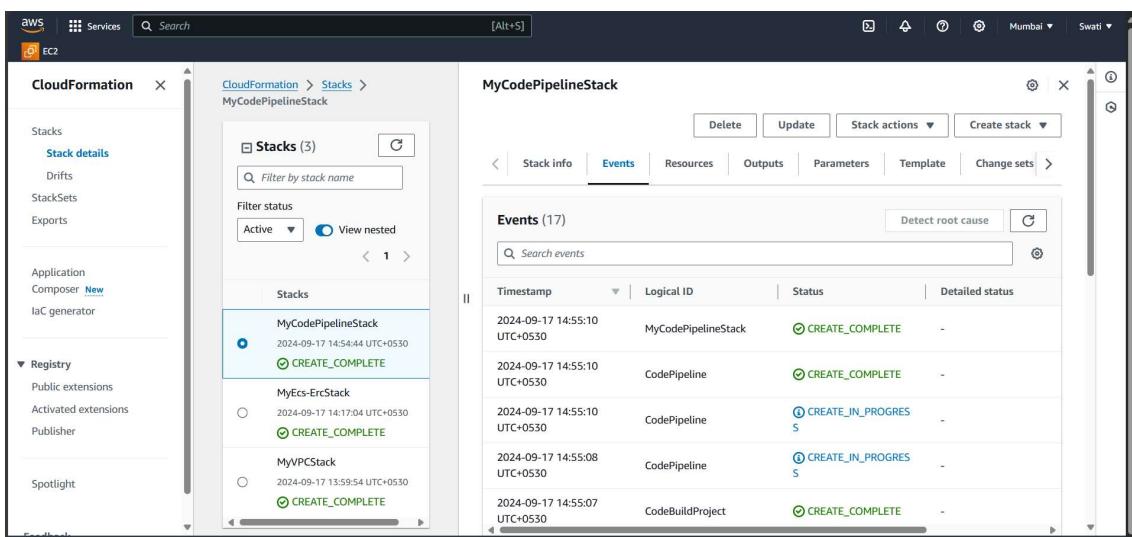
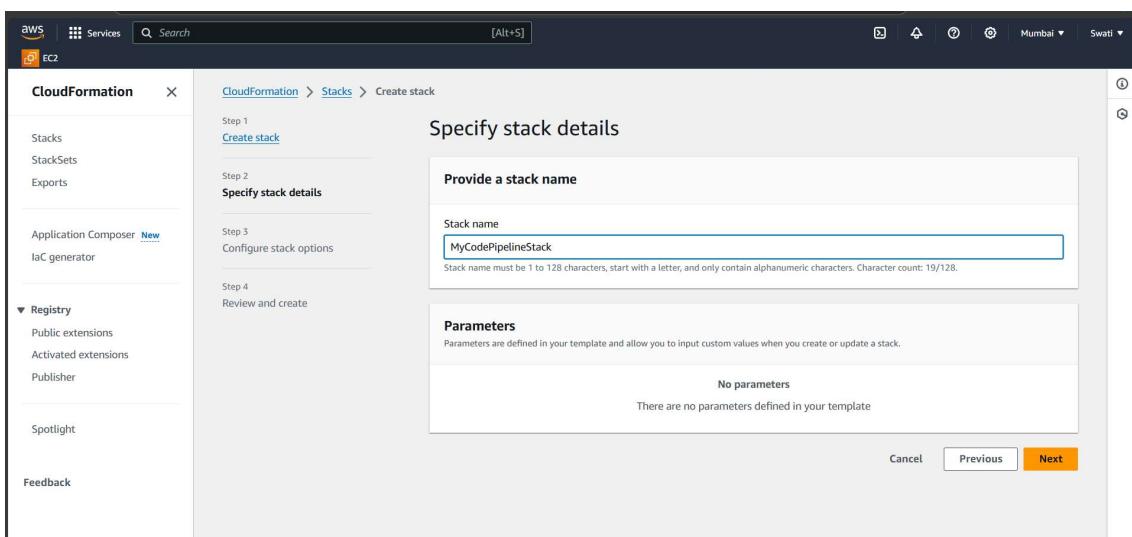
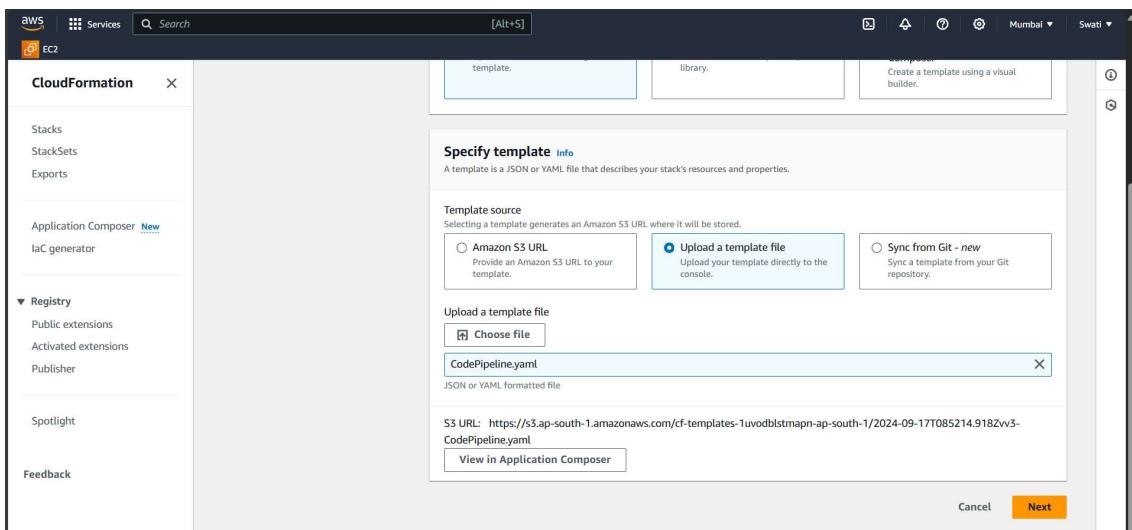






Step 4: CI/CD Pipeline Automation

- **CodePipeline:** Automate the CI/CD pipeline with stages for source, build, manual approval, and deploy.
- **CodeBuild:** Containerize and build the application before deploying to ECS.
- **CodeDeploy:** For deploying containerized apps on ECS.



aws | Services | Search | [Alt+S] | Mumbai | Swati

CloudFormation > **Stacks** > MyCodePipelineStack

MyCodePipelineStack

Stacks (3) | Resources (5)

Stack info | Events | **Resources** | Outputs | Parameters | Template | Change sets

Resources (5)

Logical ID	Physical ID	Type	Status
ArtifactBucket	mycodepipelinestack-artifactbucket-19cjoretj5a	AWS::S3::Bucket	CREATE_COMPLETE
CodeBuildProject	MyCodeBuildProject	AWS::CodeBuild::Project	CREATE_COMPLETE
CodeBuildServiceRole	MyCodePipelineStack-CodeBuildServiceRole-VNnEwkjgjAb	AWS::IAM::Role	CREATE_COMPLETE
CodePipeline	MyCodePipelineStack-CodePipeline-lI6TTQHYM8Dz	AWS::CodePipeline::Pipeline	CREATE_COMPLETE

aws | Services | Search | [Alt+S] | Mumbai | Swati

Developer Tools > **CodeBuild** > Build projects

Build projects

Actions | Create trigger | View details | Start build | **Create project**

Name	Source provider	Repository	Latest build status	Description	Last Modified
MyCodeBuildProject	AWS CodePipeline	-	-	-	12 minutes ago

aws | Services | Search | [Alt+S] | Mumbai | Swati

Amazon S3 > Buckets

General purpose buckets (2)

Info | All AWS Regions

Buckets are containers for data stored in S3.

Find buckets by name

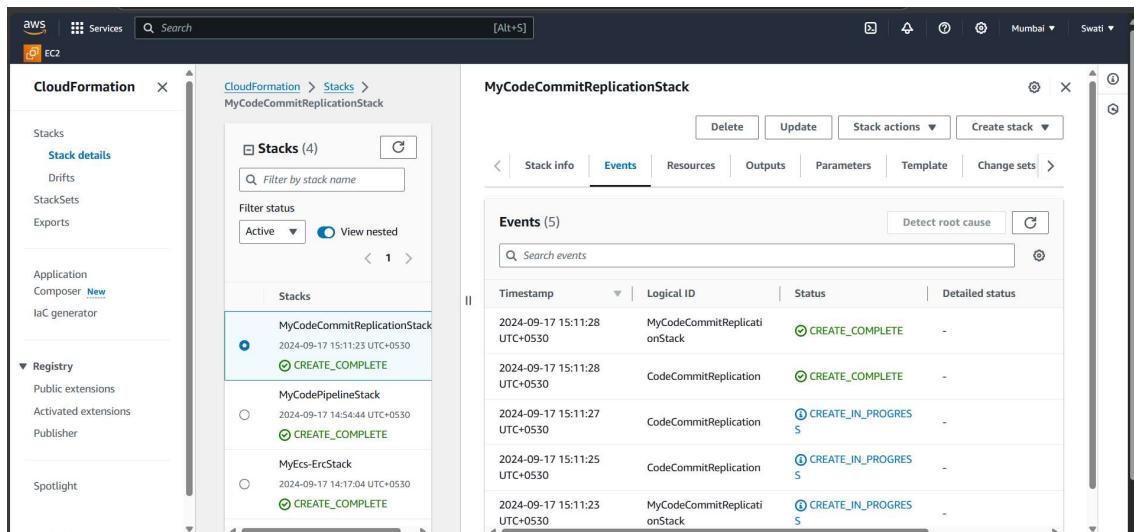
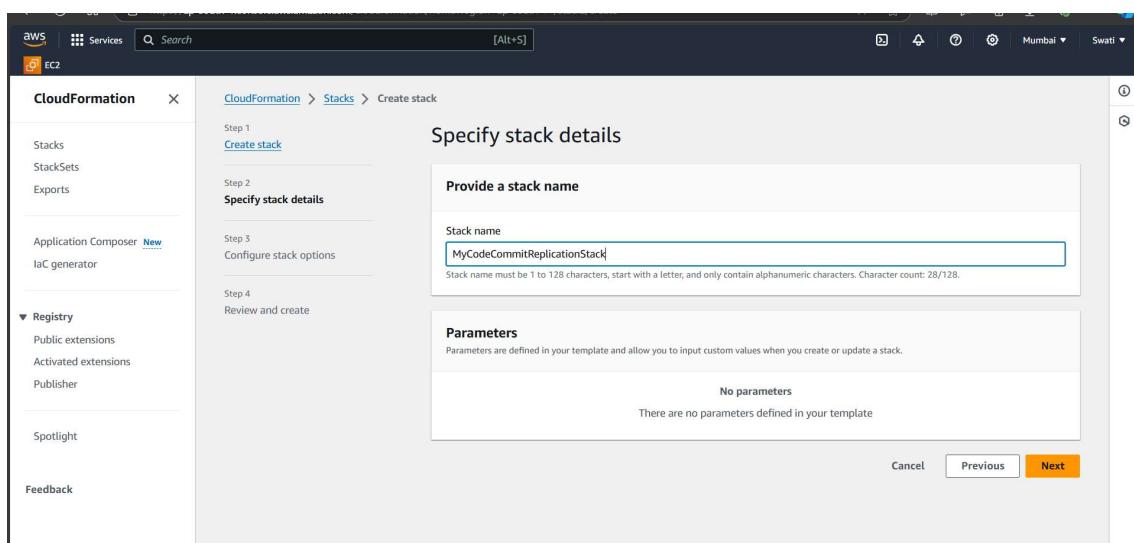
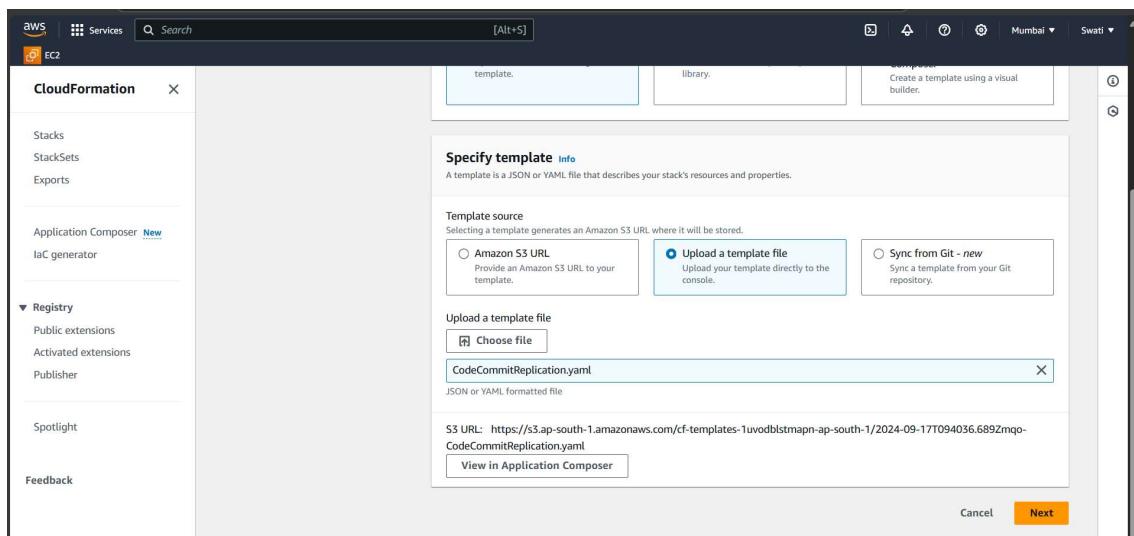
Name	AWS Region	IAM Access Analyzer	Creation date
cftemplates-1uvodblstmapn-ap-south-1	Asia Pacific (Mumbai) ap-south-1	View analyzer for ap-south-1	September 17, 2024, 13:58:33 (UTC+05:30)
mycodepipelinestack-artifactbucket-19cjoretj5a	Asia Pacific (Mumbai) ap-south-1	View analyzer for ap-south-1	September 17, 2024, 14:54:50 (UTC+05:30)

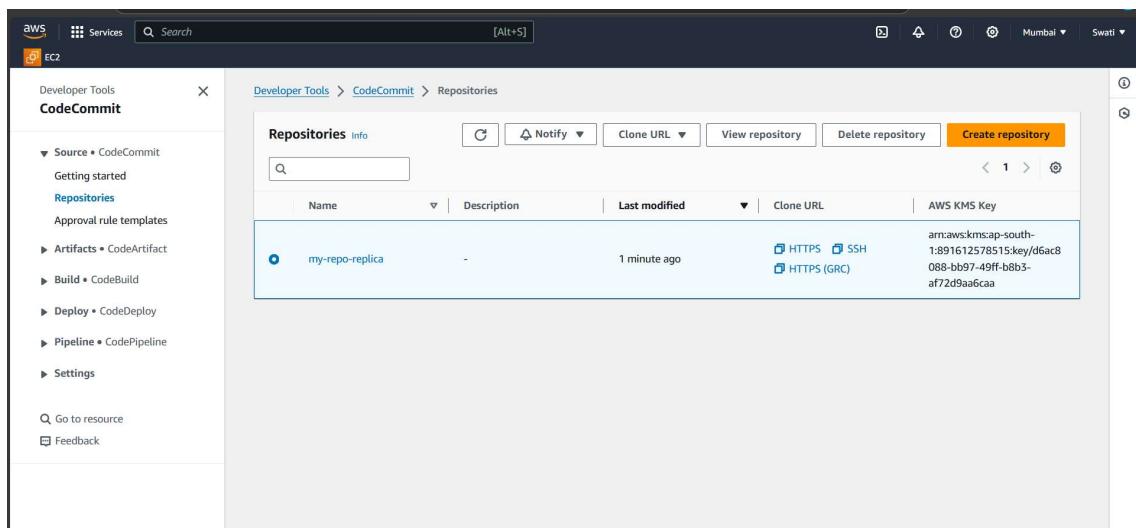
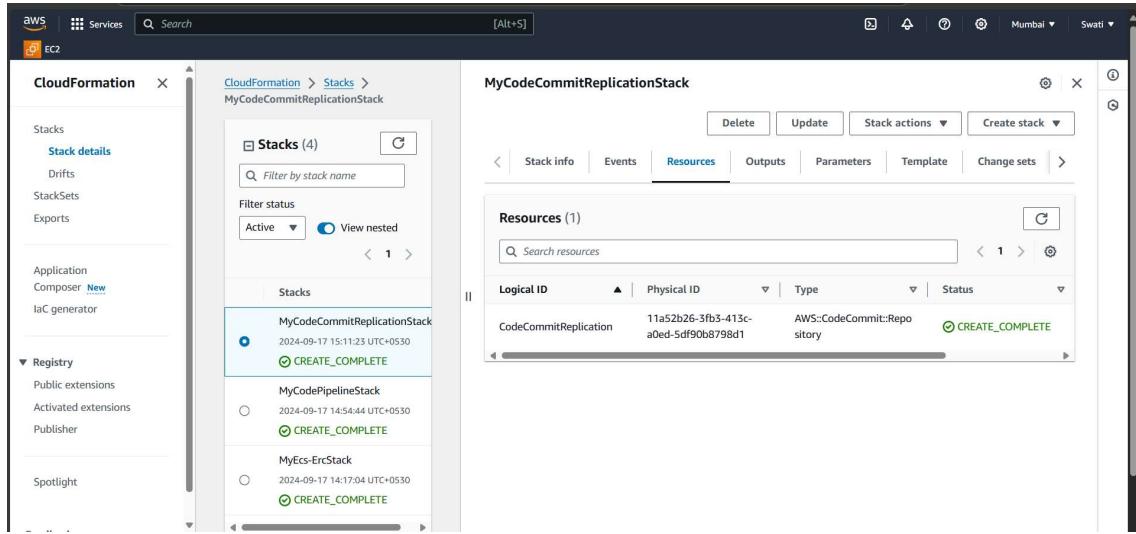
The screenshot shows the AWS IAM Roles page. The left sidebar is titled "Identity and Access Management (IAM)" and includes sections for Dashboard, Access management (User groups, Users, Roles, Policies), Access reports (Access Analyzer, External access, Unused access, Analyzer settings, Credential report), and CloudShell/Feedback. The main content area shows the details for the role "MyCodePipelineStack-CodeBuildServiceRole-VNnrEwkjrjAb". The "Summary" tab is selected, displaying creation date (September 17, 2024, 14:54 UTC+05:30), ARN (arn:aws:iam::891612578515:role/MyCodePipelineStack-CodeBuildServiceRole-VNnrEwkjrjAb), and last activity (Maximum session duration: 1 hour). Below the summary is the "Permissions" tab, which lists "Permissions policies" (Info) and allows for adding managed policies. A search bar and filter options are present.

The screenshot shows the AWS IAM Roles page, similar to the previous one but for a different role. The left sidebar is identical. The main content area shows the details for the role "MyCodePipelineStack-CodePipelineServiceRole-H7vVXrWihuuL". The "Summary" tab is selected, displaying creation date (September 17, 2024, 14:54 UTC+05:30), ARN (arn:aws:iam::891612578515:role/MyCodePipelineStack-CodePipelineServiceRole-H7vVXrWihuuL), and last activity (Maximum session duration: 1 hour). Below the summary is the "Permissions" tab, which lists "Permissions policies (1) Info" and allows for adding managed policies. A search bar and filter options are present.

Step 5: Source Code Replication

- **Cross-Region CodeCommit:** Use CodeCommit's cross-region replication feature to replicate source code in different regions.





Step 6: Continuous Monitoring and Notifications

- **CloudWatch Alarms:** Set up alarms to monitor critical ECS metrics like CPU, memory, and task health.
- **SNS Notifications:** Use SNS to trigger notifications for alarms or deployment failures.

Screenshot of the AWS CloudFormation console showing the 'Specify template' step.

The left sidebar shows the CloudFormation navigation menu with 'Stacks' selected. The main area displays the 'Specify template' configuration screen.

Specify template Info

A template is a JSON or YAML file that describes your stack's resources and properties.

Template source

Selecting a template generates an Amazon S3 URL where it will be stored.

Amazon S3 URL Provide an Amazon S3 URL to your template.

Upload a template file Upload your template directly to the console.

Sync from Git - new Sync a template from your Git repository.

Upload a template file

Choose file

CloudWatchAlarm.yaml

JSON or YAML-formatted file

S3 URL: <https://s3.ap-south-1.amazonaws.com/cf-templates-1uvodblstmapn-ap-south-1/2024-09-17T094437.645Z2en-CloudWatchAlarm.yaml>

View in Application Composer

Cancel **Next**

Screenshot of the AWS CloudFormation console showing the 'Specify stack details' step.

The left sidebar shows the CloudFormation navigation menu with 'Stacks' selected. The main area displays the 'Specify stack details' configuration screen.

Step 1 [Create stack](#)

Step 2 [Specify stack details](#) **Provide a stack name**

Step 3 [Configure stack options](#)

Step 4 [Review and create](#)

Stack name

MyCloudWatchAlarmStack

Stack name must be 1 to 128 characters, start with a letter, and only contain alphanumeric characters. Character count: 22/128.

Parameters

Parameters are defined in your template and allow you to input custom values when you create or update a stack.

No parameters

There are no parameters defined in your template

Cancel **Previous** **Next**

Screenshot of the AWS CloudFormation console showing the 'MyCloudWatchAlarmStack' stack details.

The left sidebar shows the CloudFormation navigation menu with 'Stacks' selected. The main area displays the stack details for 'MyCloudWatchAlarmStack'.

Stacks **Stack details**

MyCloudWatchAlarmStack

Events

Timestamp	Logical ID	Status	Detailed status
2024-09-17 15:17:21 UTC+0530	MyCloudWatchAlarmStack	CREATE_COMPLETE	-
2024-09-17 15:17:21 UTC+0530	CloudWatchAlarm	CREATE_COMPLETE	-
2024-09-17 15:17:19 UTC+0530	CloudWatchAlarm	CREATE_IN_PROGRESS	-
2024-09-17 15:17:18 UTC+0530	CloudWatchAlarm	CREATE_IN_PROGRESS	-
2024-09-17 15:17:18 UTC+0530	MySNS	CREATE_COMPLETE	-

AWS CloudFormation Stack Details

CloudFormation > Stacks > MyCloudWatchAlarmStack

MyCloudWatchAlarmStack

Resources (2)

Logical ID	Physical ID	Type	Status
CloudWatchAlarm	HighCPUAlarm	AWS::CloudWatch::Alarm	CREATE_COMPLETE
MySNS	arn:aws:sns:ap-south-1:891612578515:MySNS	AWS::SNS::Topic	CREATE_COMPLETE

AWS Amazon SNS Topic Details

Amazon SNS > Topics > MySNSTopic

MySNSTopic

Details

Name	MySNSTopic	Display name	-
ARN	arn:aws:sns:ap-south-1:891612578515:MySNSTopic	Topic owner	891612578515
Type	Standard		

Subscriptions (0)

Create subscription

AWS CloudWatch Alarms

CloudWatch > Alarms

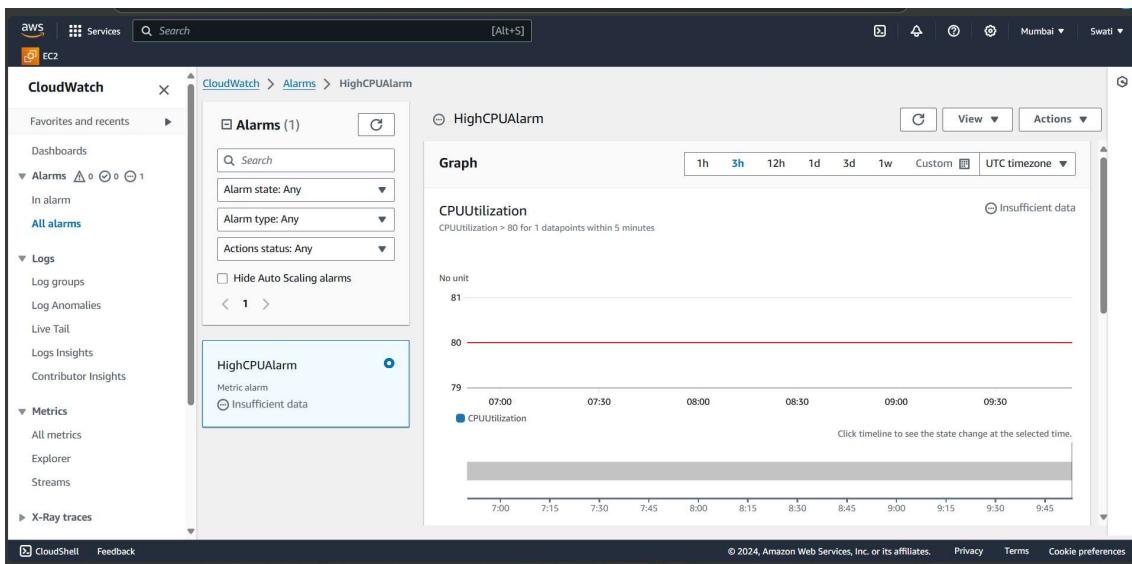
Alarms (1/1)

Name	State	Last state update (UTC)	Conditions	Actions
HighCPUAlarm	Insufficient data	2024-09-17 09:47:20	CPUUtilization > 80 for 1 datapoints within 5 minutes	Actions enabled Warn

The screenshot shows the AWS CloudWatch Alarms interface. On the left, a sidebar lists various monitoring services like Dashboards, Logs, Metrics, and X-Ray traces. The main area displays a search bar and filters for Alarm state, Type, and Actions status. A single alarm, "HighCPUAlarm", is listed under "Alarms (1)". The "Details" tab is selected, showing the following configuration:

Name	State	Namespace	Datapoints to alarm
HighCPUAlarm	Insufficient data	AWS/ECS	1 out of 1

Type: Metric alarm
Description: No description
Last state update: 2024-09-17 09:47:20 (UTC)
Metric name: CPUUtilization
Statistic: Average
Period: 5 minutes
Actions: Actions enabled



Explanation of Resources

- VPC and Subnets:** A VPC with two public subnets in two availability zones (**ap-south-1a** and **ap-south-1b**).
- ECS Cluster:** The ECS cluster will run containerized applications.
- ECR Repository:** Stores Docker images for containerized applications.
- CodePipeline:** Automates CI/CD with stages for Source, Build, and Deploy.
- CloudWatch Alarm:** Monitors the EC2 instance's CPU usage and triggers notifications when CPU exceeds 80%.