

Cloudscale Sentinel – AWS Mini Project

By - Arunkumar M

1. Introduction

This project demonstrates the deployment of a fault-tolerant, highly available, and auto-scalable web application architecture on Amazon Web Services (AWS).

The architecture leverages Amazon VPC, EC2, Auto Scaling Groups (ASG), Application Load Balancer (ALB), CloudWatch, and SNS to deliver:

- High availability through multi-AZ redundancy.
- Scalability with automated instance provisioning.
- Resilience against instance/zone-level failures.
- Observability with proactive monitoring and alerting.

This serves as a hands-on implementation of AWS Well-Architected Framework best practices for reliability, performance efficiency, and operational excellence.

2. Key AWS Components & Architecture

Amazon VPC (Virtual Private Cloud)

- Custom VPC with /16 IPv4 CIDR block for network isolation.
- Two public subnets across separate Availability Zones (AZs) to ensure resilience.
- Internet Gateway (IGW) attached and configured via route tables for outbound Internet traffic.
- Security is enforced using Security Groups and Network ACLs.

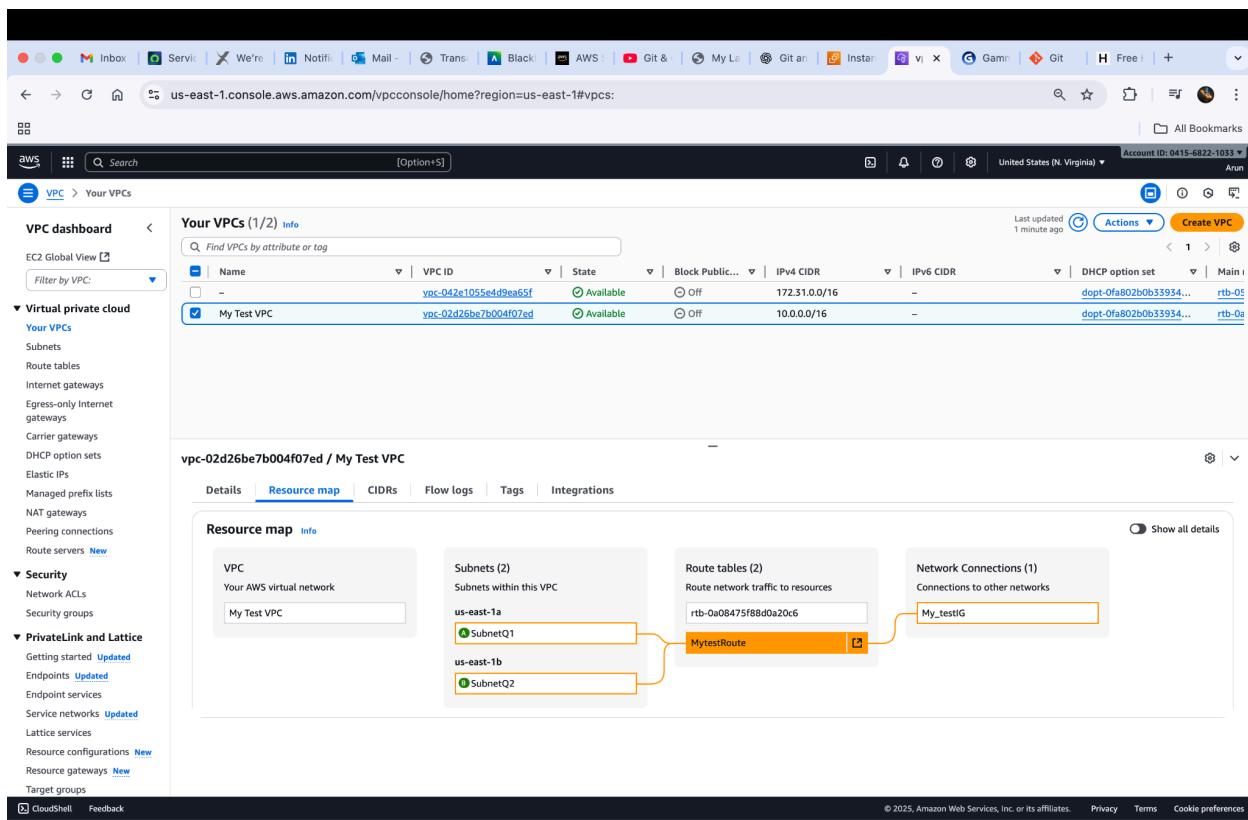


Image 1: VPC & Resource Map

Subnets (1/2) Info

Name	Subnet ID	State	VPC	Block Public Access	IPv4 CIDR	IPv6 CIDR
SubnetQ1	subnet-0563255deacb1fa35	Available	vpc-02d26be7b004f07ed My Test VPC	Off	10.0.1.0/24	-
SubnetQ2	subnet-0e0762ca13d9faa7	Available	vpc-02d26be7b004f07ed My Test VPC	Off	10.0.2.0/24	-

subnet-0563255deacb1fa35 / SubnetQ1

Details

Subnet ID subnet-0563255deacb1fa35	Subnet ARN arn:aws:ec2:us-east-1:041568221033:subnet/subnet-0563255deacb1fa35	State Available	Block Public Access Off
IPv4 CIDR 10.0.1.0/24	Available IPv4 addresses 251	IPv6 CIDR -	IPv6 CIDR association ID -
Availability Zone use1-az2 (us-east-1a)	Network border group us-east-1	VPC vpc-02d26be7b004f07ed My Test VPC	Route table rtb-01ac665c046859941 MytestRoute
Network ACL acl-07cf03e5c2b1af31	Default subnet No	Auto-assign public IPv4 address No	Auto-assign IPv6 address No
Service networks Updated	Customer-owned IPv4 pool -	Outpost ID -	IPv4 CIDR reservations -
Lattice services	IPv6 CIDR reservations -	Hostname type IP name	Resource name DNS A record Disabled
Resource configurations New	Resource name DNS AAAA record Disabled	Owner 041568221033	

Image 2: Subnets with different zone

EC2 Instances & Launch Template

- Launch Template defines EC2 instance type, AMI, key pairs, and security groups.
- Bootstrapping with User Data ensures instances are pre-configured with Apache HTTP Server.
- All EC2s are stateless and identical, enabling easy scale-in/out.

- User Data bootstrap script:

```
#!/bin/bash
yum update -y
yum install -y httpd
systemctl start httpd
systemctl enable httpd
echo "Hello from Auto Scaling EC2 in $(hostname -f)" >
/var/www/html/index.html

echo "Health check OK" > /var/www/html/health.html
```

- Every EC2 automatically becomes a ready-to-serve web server.

Instances (1/6) Info

Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	Public IPv4 DNS	Public IPv4 ...	Elastic
NewLaunch	i-0a17e43795e446ba6	Running	t2.micro	2/2 checks passed	View alarms +	us-east-1a	-	54.197.179.227	-
ASGNew1	i-0e51574bc8206257b	Terminated	t3.micro	-	△ 1 in alarm +	us-east-1a	-	-	-
NewLaunch2	i-061451984d3901ce5	Running	t2.micro	2/2 checks passed	View alarms +	us-east-1b	-	34.235.135.186	-
ASGtarget	i-01b0e17be40a8e96	Terminated	t3.micro	-	View alarms +	us-east-1a	-	-	-
Templatelaunch	i-0042c917317498821	Running	t3.micro	3/3 checks passed	△ 1 in alarm +	us-east-1a	-	204.236.208.231	-
TestLaunch3	i-0fb79f89e9f3da703	Running	t2.micro	2/2 checks passed	View alarms +	us-east-1a	-	18.205.22.246	-

i-0042c917317498821 (Templatelaunch)

Details | Status and alarms | Monitoring | Security | Networking | Storage | Tags

Instance summary Info

Instance ID: i-0042c917317498821
IPv6 address: -
Hostname type: IP name: ip-10-0-1-155.ec2.internal
Answe private resource DNS name: -
Auto-assigned IP address: 204.236.208.231 [Public IP]
IAM Role: -

Public IPv4 address: 204.236.208.231 [open address]
Instance state: Running
Private IP DNS name (IPv4 only): ip-10-0-1-155.ec2.internal
Instance type: t3.micro
VPC ID: vpcl-02d26be7b004f07ed (My Test VPC)
Subnet ID: -

Private IPv4 addresses: 10.0.1.155
Public DNS: -
Elastic IP addresses: -
AWS Compute Optimizer finding: Opt-in to AWS Compute Optimizer for recommendations. | Learn more

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User data - optional Info

Upload a file with your user data or enter it in the field.

```
#!/bin/bash
yum update -y
yum install -y httpd
systemctl start httpd
systemctl enable httpd
echo "Hello from Auto Scaling EC2 in $(hostname -f)" > /var/www/html/index.html
```

User data has already been base64 encoded

Image 3: Launch template user data

Application Load Balancer (ALB)

- Layer 7 load balancing distributes HTTP traffic across EC2s.
- Health checks on /health.html endpoint ensure only healthy instances receive traffic.
- Provides a single DNS endpoint for seamless access.
- Supports sticky sessions & path-based routing (future enhancement).

The screenshot shows the AWS EC2 Load Balancers console. On the left, a sidebar navigation menu includes: Instances, Images, Elastic Block Store, Network & Security, Load Balancing (selected), Auto Scaling, and CloudShell/Feedback. The main content area displays the 'Load balancers (1/1)' section for 'MyTestASG29'. It shows the ALB configuration with one listener (HTTP:80) and one rule (Priority default: Forward to target group). The target group 'Instance, HTTP MytestASG29' contains three targets: i-01386780282e273f6 (Unhealthy, Health checks failed), i-061451984d3901ce5 (Healthy), and i-0a17e43795e446ba6 (Healthy). The VPC ID is listed as vpc-02d26be7b004f07ed. The top right corner shows the account ID: 0415-6822-1033 and the region: United States (N. Virginia).

Image 4: ALB Register Target Group & VPC attached

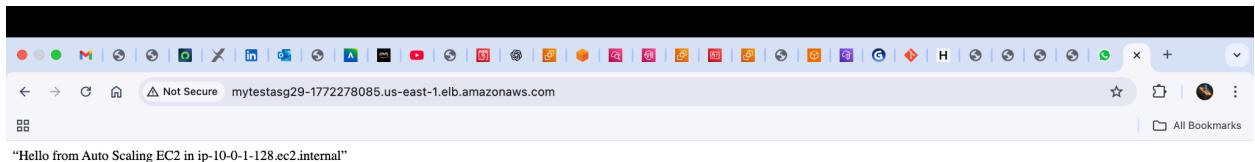
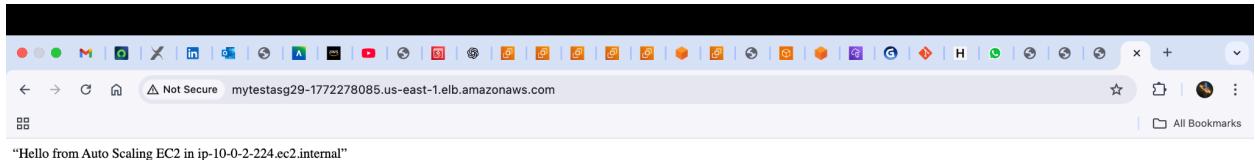


Image 5,6: Browser output from ALB DNS Target group Different zones (cropped)

Auto Scaling Group (ASG)

- Ensures a minimum of 2 instances at all times.
- Scale-out/in policies linked to CloudWatch alarms.
- Spans multiple AZs for high availability and fault tolerance.

Status	Description	Cause	Start time	End time
Successful	Launching a new EC2 instance: i-0771dbc9af1c47a0c	At 2025-09-01T17:35:15Z an instance was launched in response to an unhealthy instance needing to be replaced.	2025 September 01, 06:35:17 PM +01:00	2025 September 01, 06:35:33 PM +01:00
Successful	Terminating EC2 instance: i-0e51574bc8206257b	At 2025-09-01T17:35:15Z an instance was taken out of service in response to an EC2 health check indicating it has been terminated or stopped.	2025 September 01, 06:35:15 PM +01:00	2025 September 01, 06:40:17 PM +01:00
Successful	Launching a new EC2 instance: i-0e51574bc8206257b	At 2025-09-01T17:09:19Z an instance was launched in response to an unhealthy instance needing to be replaced.	2025 September 01, 06:09:20 PM +01:00	2025 September 01, 06:09:26 PM +01:00
Successful	Terminating EC2 instance: i-01b0617be40af8e96	At 2025-09-01T17:09:18Z an instance was taken out of service in response to an EC2 health check indicating it has been terminated or stopped.	2025 September 01, 06:09:18 PM +01:00	2025 September 01, 06:14:21 PM +01:00
Successful	Launching a new EC2 instance: i-01b0617be40af8e96	At 2025-09-01T16:55:14Z a user request created an AutoScalingGroup changing the desired capacity from 0 to 1. At 2025-09-01T16:55:15Z an instance was started in response to a difference between desired and actual capacity, increasing the capacity from 0 to 1.	2025 September 01, 05:55:17 PM +01:00	2025 September 01, 05:55:24 PM +01:00

Image 7: ASG Activity page in EC2 Instance

Amazon CloudWatch & SNS

- CloudWatch monitors CPU utilization and other key metrics.
- Alarms trigger SNS notifications, enabling real-time operational awareness.
- Email subscription ensures stakeholders receive instant alerts.

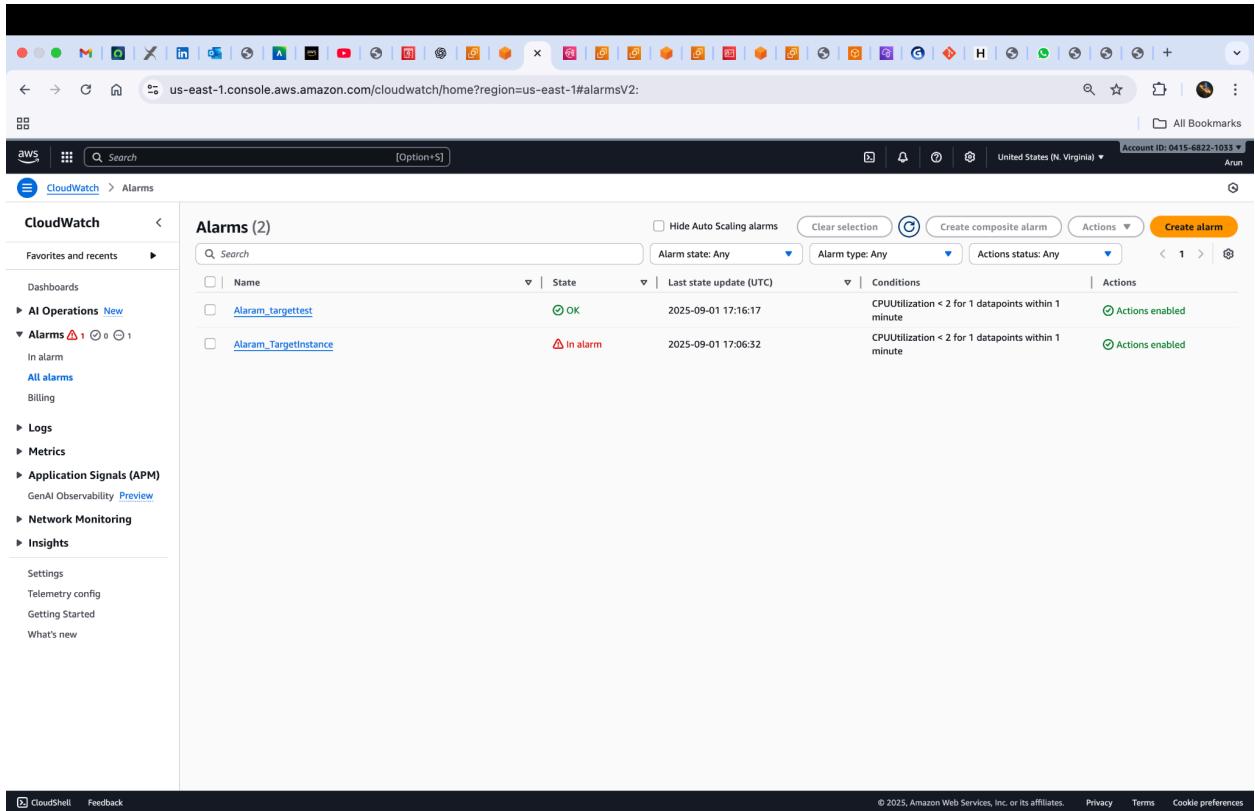


Image 8: CloudWatch alarm in ALARM state.

3. Step-by-Step Implementation

Step 1: VPC & Subnet Configuration

1. Create a custom VPC ($10.0.0.0/16$).
2. Create two public subnets in separate AZs (e.g., us-east-1a, us-east-1b).
3. Attach Internet Gateway (IGW) and update route tables.

Step 2: Launch Template with User Data

- Defines EC2 type (t2.micro), AMI (Amazon Linux 2023), Security Groups. (Testsecurity)

The screenshot shows the AWS EC2 console interface. On the left, there's a navigation sidebar with links like Dashboard, EC2 Global View, Events, Instances, Images, AMIs, Elastic Block Store, Network & Security (Security Groups, Elastic IPs, Placement Groups, Key Pairs, Network Interfaces), and Load Balancing. The main content area is titled "Security Groups (1/3) Info". It lists three security groups: "sg-04adb1f25a9375370" (default), "Testsecurity" (selected, with ID "sg-0059457700150356f" and name "Mytest_security"), and "sg-0d73ef5a732376f65" (default). Below this, a detailed view for "sg-0059457700150356f - Mytest_security" is shown, with tabs for Details, Inbound rules (selected), Outbound rules, Sharing - new, VPC associations - new, and Tags. The "Inbound rules (1)" table has one entry: "sgr-01ac1118f4e86b2db" (Security group rule ID), "IPv4" (IP version), "All TCP" (Type), "TCP" (Protocol), "0 - 65535" (Port range), and "0.0.0.0/0" (Source). At the bottom right of the main content area, there are links for "Manage tags", "Edit inbound rules", and navigation arrows.

Image 9: Security group

Step 3: Auto Scaling Group (ASG) & ALB Setup

1. Create ASG with min=2, desired=2, max=4 instances.
2. Register ASG with ALB target group.
3. ALB routes requests only to healthy instances (/health.html).
4. Verify ALB DNS endpoint → responds with server-specific message.

Step 4: Dynamic Scaling Policies

- CloudWatch metrics monitored: CPUUtilization.
- Scale Out: +1 instance if CPU > 70% for 1 minute.
- Scale In: -1 instance if CPU < 20% for 1 minute.
- Scaling actions validated in ASG activity history.

Step 5: Monitoring & Notifications

1. Configure **CloudWatch alarms** for CPU thresholds.
2. Create **SNS topic** → subscribe email.
3. Receive **email alerts** when thresholds are breached.

The screenshot shows the AWS SNS Subscriptions page. On the left, there's a sidebar with 'Amazon SNS' selected. The main area is titled 'Subscriptions (4)'. It has a table with columns: ID, Endpoint, Status, Protocol, and Topic. The data is as follows:

ID	Endpoint	Status	Protocol	Topic
6f608000-7af8-42b5-aed0-...	arunkumarmoorthy247@gmail...	Confirmed	EMAIL	Default_CloudWatch_Alarms_Topic
5ee3e96f-0a81-44cc-879f-e4...	arunkumarmoorthy247@gmail...	Confirmed	EMAIL	Quick_alarmtesttarget
3c0323bb-3d45-4ac3-8ade-7f...	arunkumarmoorthy247@gmail...	Confirmed	EMAIL	Target_Alarmtest
Deleted	arunkumarmoorthy247@gmail...	Confirmed	EMAIL	Alarm_TargetInstance

The screenshot shows an email from 'AWS Notifications <no-reply@sns.amazonaws.com>' to 'me' received at 7:01PM (0 minutes ago). The subject is 'ALARM: "Auic_alarmtesttarget" in US East (N. Virginia)'. The email body contains the following information:

You are receiving this email because your Amazon CloudWatch Alarm "Auic_alarmtesttarget" in the US East (N. Virginia) region has entered the ALARM state, because "Threshold Crossed: 1 out of the last 1 datapoints [0.33338888981483 (01/09/25 18:00:00)] was less than the threshold (2.0) (minimum 1 datapoint for OK -> ALARM transition)." at "Monday 01 September, 2025 18:01:16 UTC".

View this alarm in the AWS Management Console:
https://us-east-1.console.aws.amazon.com/cloudwatch/deepLink.js?region=us-east-1#alarmsV2:alarm/Auic_alarmtesttarget

Alarm Details:

- Name: Auic_alarmtesttarget
- Description:
- State Change: INSUFFICIENT_DATA->ALARM
- Reason for State Change: Threshold Crossed: 1 out of the last 1 datapoints [0.33338888981483 (01/09/25 18:00:00)] was less than the threshold (2.0) (minimum 1 datapoint for OK -> ALARM transition).
- Timestamp: Monday 01 September, 2025 18:01:16 UTC
- AWS Account: 041568221033
- Alarm Arn: arn:aws:sns:us-east-1:041568221033:alarm:Auic_alarmtesttarget

Threshold:

- The alarm is in the ALARM state when the metric is LessThanThreshold 2.0 for at least 1 of the last 1 period(s) of 30 seconds.

Monitored Metric:

- MetricNamespace: AWSSEC
- MetricName: CPUUtilization
- Dimensions: [InstanceId = i-0771dbc9af1c47a0c]
- Period: 30 seconds
- Statistic: Average
- Unit: not specified
- TreatMissingData: missing

State Change Actions:

- OK:
- ALARM: [arn:aws:sns:us-east-1:041568221033:Quick_alarmtesttarget]
- INSUFFICIENT_DATA:

If you wish to stop receiving notifications from this topic, please click or visit the link below to unsubscribe:
https://sns.us-east-1.amazonaws.com/unsubscribe.htm?SubscriptionArn=arn:aws:sns:us-east-1:041568221033:Quick_alarmtesttarget-5ee3e96f-0a81-44cc-879f-e4cdcf537fb&Endpoint=arunkumarmoorthy247@gmail.com

Please do not reply directly to this email. If you have any questions or comments regarding this email, please contact us at <https://aws.amazon.com/contact-us/>

Image 10,11: SNS & confirmed email subscription, Email alert received

4. Output Validation

- Web Application Availability: ALB DNS serves responses from healthy EC2s.
- Autoscaling in Action: Instances scale automatically under load.
- Monitoring & Alerts: SNS emails confirm CloudWatch alarms trigger successfully.

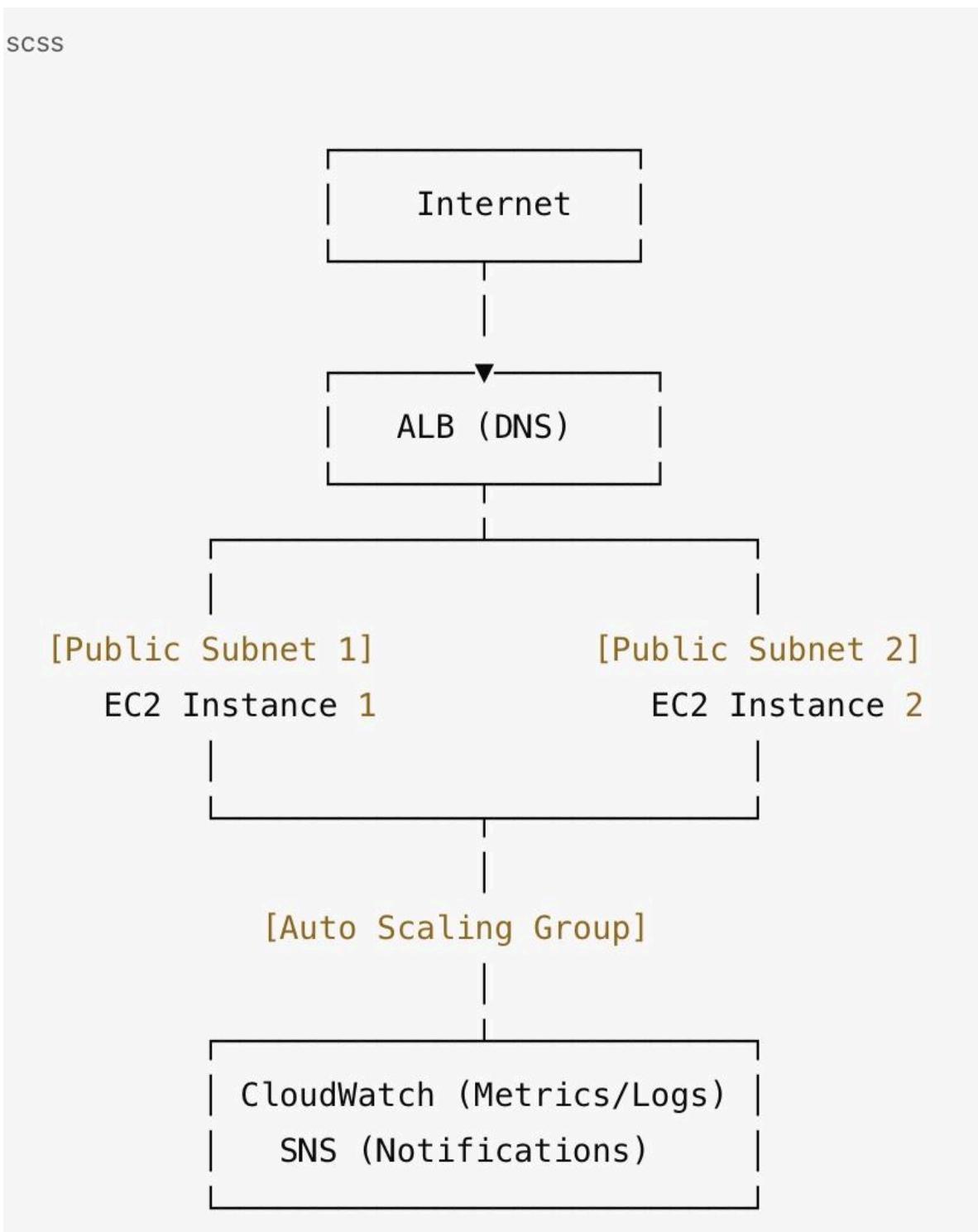
The screenshot shows the AWS EC2 Instances page. On the left, there's a navigation sidebar with links like Dashboard, EC2 Global View, Events, Instances (selected), Instance Types, Launch Templates, Spot Requests, Savings Plans, Reserved Instances, Dedicated Hosts, Capacity Reservations, Images, AMIs, and AMI Catalog. The main content area has a header 'Instances (1/6) Info' with filters for Name, Instance ID, Instance state, Instance type, Status check, Alarm status, Availability Zone, Public IPv4 DNS, and Public IPv4. A table lists six instances, with 'Templatelaunch' selected. The table columns include Name, Instance ID, Instance state (Running or Terminated), Instance type (t2.micro or t3.micro), Status check (2/2 or 3/3 checks passed), Alarm status (green circle), Availability Zone, Public IPv4 DNS, and Public IPv4. Below the table, a detailed view for 'i-0042c917317498821 (Templatelaunch)' is shown with tabs for Details, Status and alarms, Monitoring, Security, Networking, Storage, and Tags. Under Details, sections include Instance ID (i-0042c917317498821), IPv6 address (empty), Hostname type (IP name: ip-10-0-1-155.ec2.internal), Answer private resource DNS name (empty), Instance type (t3.micro), VPC ID (vpc-02d26be7b004f07ed (My Test VPC)), and Subnet ID (empty). To the right, there are sections for Public IPv4 address (204.236.208.231), Private IP DNS name (ip-10-0-1-155.ec2.internal), Instance state (Running), Public DNS (empty), Private IP addresses (10.0.1.155), Public IP addresses (empty), AWS Compute Optimizer finding (Opt-in to AWS Compute Optimizer for recommendations), and Auto Scaling Group name (empty).

Image12 : Instance Terminating & launch via Autoscaling by Cloud watch and notified by SNS.

5. Future Enhancements

- **Predictive & Scheduled Scaling** → Optimize for traffic patterns.
- **Cost Optimization** → Use **Spot Instances** + Savings Plans.
- **Enhanced Observability** → AWS CloudWatch Logs, AWS X-Ray.
- **Security Hardening** → IAM roles, Security Groups, and WAF integration.
- **Multi-Tier Architecture** → Extend with RDS and S3 for persistence.

6. Architecture Diagram



7. Project Resource Details

- **VPC ID:** vpc-02d26be7b004f07ed
- **CIDR Block:** 10.0.0.0/16
- **Subnets:**
 - subnetQ1-10.0.1.0/24 0563e255dca9faa7 (us-east-1b)
 - subnetQ2 -10.0.2.0/24 0e627eaf13d9faaa7 (us-east-1a)
- **Route Table:** rtb-MyTestRoute
- **Internet Gateway:** igw-MyIGtest
- **ALB DNS:**
<http://mytestalb-737003934.us-east-1.elb.amazonaws.com/>