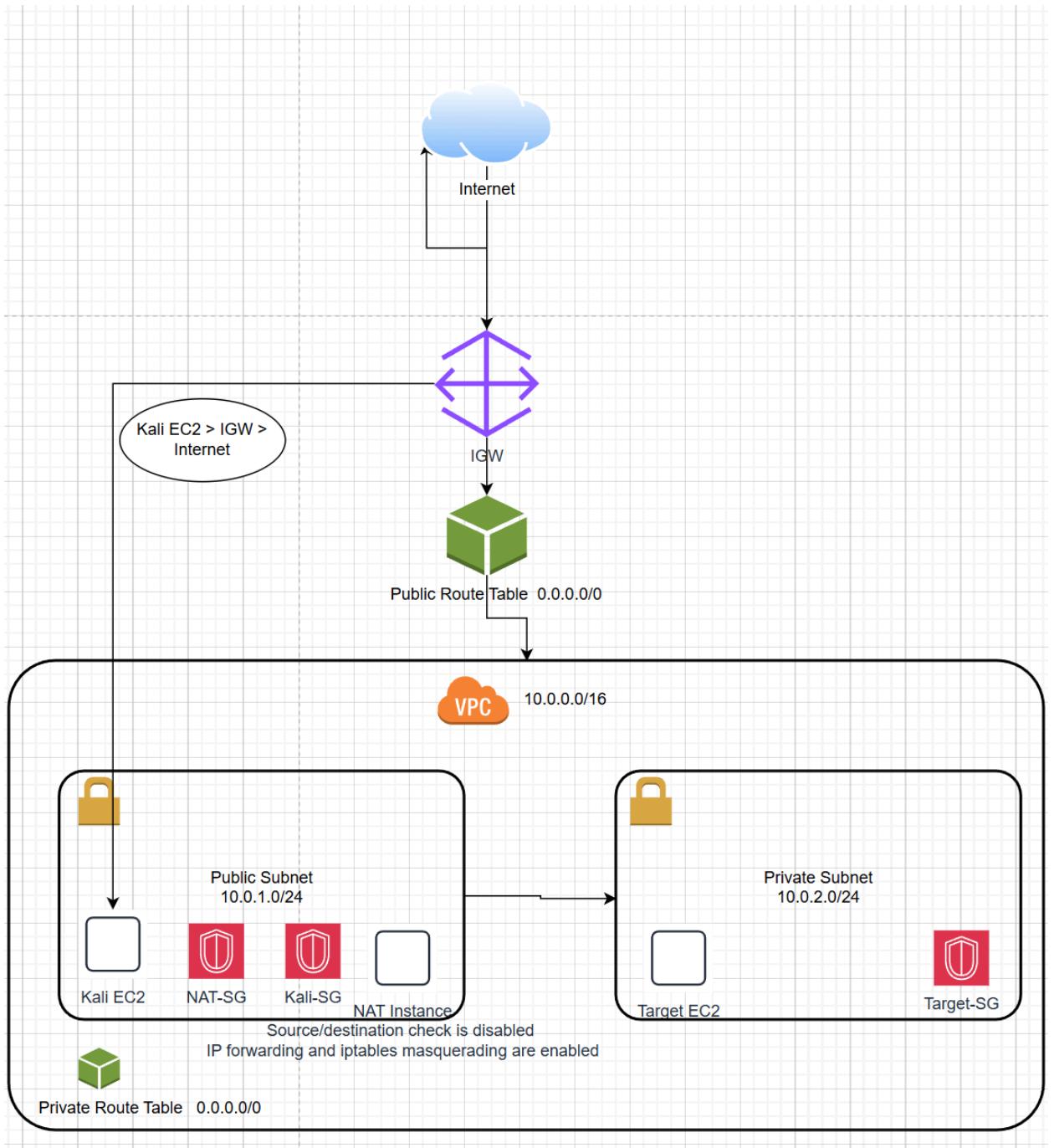


- Design the network
- Deploy Kali linux
- Create a NAT Instance (Free Tier)

This project demonstrates how to design and deploy a secure AWS VPC architecture using public and private subnets, a NAT instance, and a Kali Linux EC2 for controlled testing. It showcases cloud security fundamentals, network segmentation, Linux hardening, and secure outbound routing using free-tier resources.



Network Foundation (AWS SAA CORE)

1. Create the VPC

- AWS Console > VPC > Create VPC
- Name: Cloud-Security-VPC
- IPv4 CIDR: 10.0.0.0/16
- Tenancy: Default

Create VPC [Info](#)

A VPC is an isolated portion of the AWS Cloud populated by AWS objects, such as Amazon EC2 instances.

VPC settings

Resources to create [Info](#)
Create only the VPC resource or the VPC and other networking resources.

VPC only VPC and more

Name tag - optional
Creates a tag with a key of 'Name' and a value that you specify.

Cloud-Security-VPC

IPv4 CIDR block [Info](#)
 IPv4 CIDR manual input
 IPAM-allocated IPv4 CIDR block

IPv4 CIDR
10.0.0.0/16
CIDR block size must be between /16 and /28.

IPv6 CIDR block [Info](#)
 No IPv6 CIDR block
 IPAM-allocated IPv6 CIDR block
 Amazon-provided IPv6 CIDR block
 IPv6 CIDR owned by me

Tenancy [Info](#)
Default ▾

2. Create Subnets

Public Subnet

- Name: Public-Subent
- CIDR: 10.0.1.0/24
- Enable auto-assign public IP

Create subnet [Info](#)

VPC

VPC ID
Create subnets in this VPC.
vpc-0889fd29c004efe3b (Cloud-Security-VPC) ▾

Associated VPC CIDRs

IPv4 CIDRs
10.0.0.0/16

Subnet settings
Specify the CIDR blocks and Availability Zone for the subnet.

Subnet 1 of 1

Subnet name
Create a tag with a key of 'Name' and a value that you specify.
Public-Subent
The name can be up to 256 characters long.

Availability Zone [Info](#)
Choose the zone in which your subnet will reside, or let Amazon choose one for you.
United States (Ohio) / us-east-2a (us-east-2a) ▾

IPv4 VPC CIDR block [Info](#)
Choose the VPC's IPv4 CIDR block for the subnet. The subnet's IPv4 CIDR must lie within this block.
10.0.0.0/16 ▾

IPv4 subnet CIDR block

10.0.1.0/24	256 IPs
< > ^ v	

Edit subnet settings [Info](#)

Subnet

Subnet ID

subnet-02df60a62f408a485

Name

Public-Subent

Auto-assign IP settings [Info](#)

Enable AWS to automatically assign a public IPv4 or IPv6 address to a new primary network interface for an instance in this subnet.

Enable auto-assign public IPv4 address [Info](#)

Enable auto-assign customer-owned IPv4 address [Info](#)

Option disabled because no customer owned pools found.

Private Subnet

- Name: Private-Subnet
- CIDR: 10.0.2.0/24
- Auto-assign public IP: Disabled

Create subnet Info

VPC

VPC ID

Create subnets in this VPC.

vpc-0889fd29c004efe3b (Cloud-Security-VPC) ▾

Associated VPC CIDRs

IPv4 CIDRs

10.0.0.0/16

Subnet settings

Specify the CIDR blocks and Availability Zone for the subnet.

Subnet 1 of 1

Subnet name

Create a tag with a key of 'Name' and a value that you specify.

Private-Subnet

The name can be up to 256 characters long.

Availability Zone Info

Choose the zone in which your subnet will reside, or let Amazon choose one for you.

United States (Ohio) / use2-az1 (us-east-2a) ▾

IPv4 VPC CIDR block Info

Choose the VPC's IPv4 CIDR block for the subnet. The subnet's IPv4 CIDR must lie within this block.

10.0.0.0/16

IPv4 subnet CIDR block

10.0.2.0/24

256 IPs

◀ ▶ ⌂ ⌃

✖ Tags - optional

3. Internet Gateway

- Create IG: Cloud-IG
- Attach to Cloud-Security-VPC

Create internet gateway Info

An internet gateway is a virtual router that connects a VPC to the internet. To create a new internet gateway specify the name for the gateway below.

Internet gateway settings

Name tag

Creates a tag with a key of 'Name' and a value that you specify.

Tags - optional

A tag is a label that you assign to an AWS resource. Each tag consists of a key and an optional value. You can use tags to search and filter your resources or track your AWS costs.

Key

Value - optional

RemoveAdd new tag

You can add 49 more tags.

CancelCreate internet gateway

Attach to VPC (igw-04ad395a3b08377f5) Info

VPC

Attach an internet gateway to a VPC to enable the VPC to communicate with the internet. Specify the VPC to attach below.

Available VPCs

Attach the internet gateway to this VPC.



Use: "vpc-0889fd29c004efe3b"

vpc-0889fd29c004efe3b - Cloud-Security-VPC

4. Route Tables

Public Route Table

Routes: 0.0.0.0/0 > IG

Associate: Public-Subnet

Edit routes

Destination	Target	Status	Propagated	Route Origin
10.0.0.0/16	local	<input checked="" type="checkbox"/> Active	No	CreateRouteTable
	<input type="text"/> local			
<input type="text"/> 0.0.0.0/0				
	Internet Gateway	<input type="checkbox"/>	No	CreateRoute
	<input type="text"/> igw-046225b845647b7b8			
<input type="button" value="Add route"/> <input type="button" value="Remove"/>				
<input type="button" value="Cancel"/> <input type="button" value="Preview"/> <input type="button" value="Save changes"/>				

You have successfully updated subnet associations for rtb-082521d9a5e29dd89 / Public Route Table.



rtb-082521d9a5e29dd89 / Public Route Table

Details	Info
Route table ID <input type="text"/> rtb-082521d9a5e29dd89	Main <input type="checkbox"/> No
VPC <input type="text"/> vpc-0889fd29c004efe3b Cloud-Security-VPC	Owner ID <input type="text"/> 277848663122
	Explicit subnet associations <input type="text"/> subnet-02df60a62f408a485 / Public-Subnet
	Edge associations -

Security Controls (AWS SAA CORE)

5. Security Groups

Kali-SG

Inbound: SSH (22) > /32

Outbound: Allow all

Create security group [Info](#)

A security group acts as a virtual firewall for your instance to control inbound and outbound traffic. To create a new security group, complete the fields below.

Basic details

Security group name [Info](#)

Name cannot be edited after creation.

Description [Info](#)

VPC [Info](#)

Inbound rules [Info](#)

Type [Info](#)

Protocol [Info](#)

Port range [Info](#)

Source [Info](#)

Description - optional [Info](#)

Info

[Delete](#)[Add rule](#)

Outbound rules [Info](#)

Type [Info](#)

Protocol [Info](#)

Port range [Info](#)

Destination [Info](#)

Description - optional [Info](#)

Info

[Delete](#)[Add rule](#)

NAT-SG

Inbound:

- SSH > /32
- ALL traffic > 10.0.2.0/24

Outbound:

- Allow all

Create security group [Info](#)

A security group acts as a virtual firewall for your instance to control inbound and outbound traffic. To create a new security group, complete the fields below.

Basic details

Security group name [Info](#)

NAT-SG

Name cannot be edited after creation.

Description [Info](#)

NAT

VPC [Info](#)

vpc-0889fd29c004efe3b (Cloud-Security-VPC)

Inbound rules [Info](#)

Type Info	Protocol Info	Port range Info	Source Info	Description - optional Info
---------------------------	-------------------------------	---------------------------------	-----------------------------	---

Info

SSH	TCP	22	My IP	<input type="text"/> X
All traffic	All	All	Cu... ▼	<input type="text"/> X

10.0.2.0/24 X

[Add rule](#)

Outbound rules [Info](#)

Type Info	Protocol Info	Port range Info	Destination Info	Description - optional Info
---------------------------	-------------------------------	---------------------------------	----------------------------------	---

Info

All traffic	All	All	An... ▼	<input type="text"/> X
				0.0.0.0/0 X

[Add rule](#)

Target-SG

Inbound: All traffic > 10.0.1.0/24

Outbound: Allow all

Create security group [Info](#)

A security group acts as a virtual firewall for your instance to control inbound and outbound traffic. To create a new security group, complete the fields below.

Basic details

Security group name [Info](#)
Target-SG
Name cannot be edited after creation.

Description [Info](#)
Target System

VPC [Info](#)
vpc-0889fd29c004efe3b (Cloud-Security-VPC)

Inbound rules [Info](#)

Type	Info	Protocol	Port range	Info	Source	Info	Description - optional	Info
All traffic	▼	All	All	Cu... ▾	<input type="text" value="10.0.1.0/24"/> X	<input type="text" value="10.0.1.0/24"/> X	<input type="button" value="Delete"/>	

[Add rule](#)

Outbound rules [Info](#)

Type	Info	Protocol	Port range	Info	Destination	Info	Description - optional	Info
All traffic	▼	All	All	Cu... ▾	<input type="text" value="0.0.0.0/0"/> X	<input type="button" value="Delete"/>		

[Add rule](#)

Deploy Kali Linux (Red Team)

6. Launch Kali Linux EC2
 - AMI: Official Kali Linux
 - Instance Type: t2.micro
 - Subnet: Public-Subnet
 - Auto-assign public IP: Enabled
 - Security Group: Kali-SG
 - Storage: 20-30 GB

Amazon Machine Images (AMIs) (1/6) Info							
Recycle Bin		EC2 Image Builder		Actions ▾			
Public images ▾		<input type="text"/> Search					
Kali Linux X		Clear filters					
	Name 🔗	AMI name	AMI ID	Source	Owr		
<input type="checkbox"/>	kali-last-snapshot-arm64-2025....	ami-0350e4410f8426251	aws-marketplace/kali-last-snapshot-ar...	679!			
<input checked="" type="checkbox"/>	kali-last-snapshot-amd64-2025....	ami-0723a2f2ccd67a503	aws-marketplace/kali-last-snapshot-am...	679!			
<input type="checkbox"/>	kali-last-snapshot-amd64-2025....	ami-07e20b1379c448040	aws-marketplace/kali-last-snapshot-am...	679!			
<input type="checkbox"/>	kali-last-snapshot-arm64-2025....	ami-0ad66086ac209d4af	aws-marketplace/kali-last-snapshot-ar...	679!			
<input type="checkbox"/>	Kali Linux -AWS-Nuvemnest-pro...	ami-0aa78ade27eae9e0d	aws-marketplace/Kali Linux -AWS-Nuve...	679!			
<input type="checkbox"/>	Kali Linux On AWS-239c5ea9-c...	ami-0b94eb86457a5508a	aws-marketplace/Kali Linux On AWS-23...	679!			

AMI ID: [ami-0723a2f2ccd67a503](#)

Details	Storage	AMI ancestry - new	Tags
AMI ID ami-0723a2f2ccd67a503	Image type machine	Platform details Linux/UNIX	Root device type EBS
AMI name kali-last-snapshot-amd64-2025.4.0-804fcc46-63fc-4eb6-85a1-50e66d6c7215	Owner account ID 679593333241	Architecture x86_64	Usage operation RunInstances
Root device name /dev/xvda	Status Available	Source aws-marketplace/kali-last-snapshot-amd64-2025.4.0-804fcc46-63fc-4eb6-85a1-50e66d6c7215	Virtualization type hvm
Boot mode -	State reason -	Creation date 2025-12-19T17:18:03.000Z	Kernel ID -
Description Kali Linux kali-last-snapshot (2025.4.0)	Product codes marketplace:7lgvy7mt78lgoi4lant0znp5h	RAM disk ID -	Deprecation time Sun Dec 19 2027 11:18:03 GMT-0600 (Central Standard Time)

AMI from catalog

Quick Start

Name

kali-last-snapshot-amd64-2025.4.0-804fcc46-63fc-4eb6-85a1-50e66d6c7215

Verified provider

Free tier eligible



[Browse more AMIs](#)

Including AMIs from AWS, Marketplace and the Community

Description

Kali Linux kali-last-snapshot (2025.4.0)

Image ID

ami-0723a2f2cccd67a503

Username |

root (Check with the AMI provider.)

Catalog	Published	Architecture	Virtualization	Root device type	ENAv Enabled
AWS	2025-12-	x86_64	hvm		
Marketplace	19T17:18:03.00			ebs	
AMIs	0Z				Yes

If you have an existing license entitlement to use this software, then you can launch this software without creating a new subscription. If you do not have an existing entitlement, then by launching this software, you will be subscribed to this software and agree that your use of this software is subject to the pricing terms and the seller's [End User License Agreement](#) ↗

▼ Instance type [Info](#) | [Get advice](#)

Instance type

t3.micro

Free tier eligible

Family: t3 2 vCPU 1 GiB Memory Current generation: true

All generations

[Compare instance types](#)

The AMI vendor recommends using a t2.medium instance (or larger) for the best experience with this product.

▼ Key pair (login) [Info](#)

You can use a key pair to securely connect to your instance. Ensure that you have access to the selected key pair before you launch the instance.

Key pair name - required

cloud-security-kali-key

[Create new key pair](#)

▼ Network settings [Info](#)

VPC - required [Info](#)

vpc-0889fd29c004efe3b (Cloud-Security-VPC)

10.0.0.0/16



Subnet [Info](#)

subnet-02df60a62f408a485

Public-Subent

VPC: vpc-0889fd29c004efe3b Owner: 277848663122

Availability Zone: us-east-2a (use2-a2z1) Zone type: Availability Zone

IP addresses available: 251 CIDR: 10.0.1.0/24



[Create new subnet](#) ↗

Auto-assign public IP | [Info](#)

Enable



Firewall (security groups) | [Info](#)

A security group is a set of firewall rules that control the traffic for your instance. Add rules to allow specific traffic to reach your instance.

Create security group

Select existing security group

Common security groups | [Info](#)

Select security groups



Kali-SG sg-0ace02431f042c4ad [X](#)

VPC: vpc-0889fd29c004efe3b

Compare security group rules

Security groups that you add or remove here will be added to or removed from all your network interfaces.

► Advanced network configuration

▼ Configure storage [Info](#)

[Advanced](#)

1x

25

GiB

gp2



Root volume, Not encrypted

SSH: ssh -i kali.pem kali@<Public-IP>

```
C:\Users\...>ssh -i C:\Users\...\Downloads\cloud-security-kali-key.pem kali@18.227.111.248
The authenticity of host '18.227.111.248 (18.227.111.248)' can't be established.
ED25519 key fingerprint is SHA256:ABye8cCwUwBR+V0sNdmSsiaNizkODvVxDqSOCGPRe2Q.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '18.227.111.248' (ED25519) to the list of known hosts.
Linux kali 6.16.8+kali-cloud-amd64 #1 SMP PREEMPT_DYNAMIC Kali 6.16.8-1kali1 (2025-09-24) x86_64

The programs included with the Kali GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/*copyright.

Kali GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(Message from Kali developers)

  This is a minimal installation of Kali Linux, you likely
  want to install supplementary tools. Learn how:
  => https://www.kali.org/docs/troubleshooting/common-minimum-setup/

  This is a cloud installation of Kali Linux. Learn more about
  the specificities of the various cloud images:
  => https://www.kali.org/docs/troubleshooting/common-cloud-setup/

(Run: "touch ~/.hushlogin" to hide this message)
(kali㉿kali)-[~]
$
```

Verify:
Ping google.com

```
(kali㉿kali)-[~]
$ ping google.com
PING google.com (142.250.191.142) 56(84) bytes of data.
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=1 ttl=117 time=8.69 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=2 ttl=117 time=8.79 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=3 ttl=117 time=8.70 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=4 ttl=117 time=8.71 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=5 ttl=117 time=8.70 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=6 ttl=117 time=8.69 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=7 ttl=117 time=8.72 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=8 ttl=117 time=8.78 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=9 ttl=117 time=8.72 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=10 ttl=117 time=8.80 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=11 ttl=117 time=8.72 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=12 ttl=117 time=8.70 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=13 ttl=117 time=8.71 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=14 ttl=117 time=8.72 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=15 ttl=117 time=8.71 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=16 ttl=117 time=8.72 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=17 ttl=117 time=8.73 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=18 ttl=117 time=8.69 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=19 ttl=117 time=8.69 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=20 ttl=117 time=8.72 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=21 ttl=117 time=8.71 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=22 ttl=117 time=8.70 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=23 ttl=117 time=8.73 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=24 ttl=117 time=8.70 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=25 ttl=117 time=8.71 ms
64 bytes from ord38s29-in-f14.1e100.net (142.250.191.142): icmp_seq=26 ttl=117 time=8.70 ms
^C
--- google.com ping statistics ---
61 packets transmitted, 61 received, 0% packet loss, time 60113ms
rtt min/avg/max/mdev = 8.685/8.714/8.797/0.022 ms
```

NAT Instance (FREE TIER MAGIC)

7. Launch NAT Instance
 - AMI: Amazon Linux 2
 - Instance Type: t2.micro
 - Subnet: Public-subnet
 - Auto-assign Public IP: Enabled
 - Security Groups: NAT-SG

Launch an instance Info

Amazon EC2 allows you to create virtual machines, or instances, that run on the AWS Cloud. Quickly get started by following the simple steps below.

Name and tags Info

Name

[Add additional tags](#)

▼ Application and OS Images (Amazon Machine Image) Info

An AMI contains the operating system, application server, and applications for your instance. If you don't see a suitable AMI below, use the search field or choose **Browse more AMIs**.

[Recents](#)[Quick Start](#)[Amazon Linux](#)[macOS](#)[Ubuntu](#)[Windows](#)[Red Hat](#)[SUSE Linu](#)[Browse more AMIs](#)

Including AMIs from AWS, Marketplace and the Community

Amazon Machine Image (AMI)

[Amazon Linux 2023 kernel-6.1 AMI](#)

ami-06f1fc9ae5ae7f31e (64-bit (x86), uefi-preferred) / ami-058e74ab207ed2b33 (64-bit (Arm), uefi)

Virtualization: hvm ENA enabled: true Root device type: ebs



Description

Amazon Linux 2023 (kernel-6.1) is a modern, general purpose Linux-based OS that comes with 5 years of long term support. It is optimized for AWS and designed to provide a secure, stable and high-performance execution environment to develop and run your cloud applications.

Amazon Linux 2023 AMI 2023.10.20260105.0 x86_64 HVM kernel-6.1

Architecture

Boot mode

AMI ID

Publish Date

Username i

64-bit ... ▼

uefi-preferred

ami-06f1fc9ae5ae7f31e

2026-01-02

ec2-user

Verified provider

▼ Instance type [Info](#) | [Get advice](#)

Instance type

t3.micro

Family: t3 2 vCPU 1 GiB Memory Current generation: true
On-Demand RHEL base pricing: 0.0392 USD per Hour
On-Demand Ubuntu Pro base pricing: 0.0139 USD per Hour
On-Demand Windows base pricing: 0.0196 USD per Hour
On-Demand SUSE base pricing: 0.0104 USD per Hour
On-Demand Linux base pricing: 0.0104 USD per Hour

Free tier eligible

All generations

[Compare instance types](#)

Additional costs apply for AMIs with pre-installed software

▼ Key pair (login) [Info](#)

You can use a key pair to securely connect to your instance. Ensure that you have access to the selected key pair before you launch the instance.

Key pair name - **required**

cloud-security-kali-key

[Create new key pair](#)

▼ Network settings [Info](#)

VPC - **required** [Info](#)

vpc-0889fd29c004efe3b (Cloud-Security-VPC)
10.0.0.0/16

[Create new VPC](#)

Subnet [Info](#)

subnet-02df60a62f408a485 Public-Subnet
VPC: vpc-0889fd29c004efe3b Owner: 277848663122
Availability Zone: us-east-2a (use2-az1) Zone type: Availability Zone
IP addresses available: 250 CIDR: 10.0.1.0/24

[Create new subnet](#)

Auto-assign public IP [Info](#)

Enable

Firewall (security groups) [Info](#)

A security group is a set of firewall rules that control the traffic for your instance. Add rules to allow specific traffic to reach your instance.

Create security group

Select existing security group

Common security groups [Info](#)

Select security groups

[Compare security group rules](#)

NAT-SG sg-01d741fc8ae3c57a3 [X](#)

VPC: vpc-0889fd29c004efe3b

Security groups that you add or remove here will be added to or removed from all your network interfaces.

► Advanced network configuration

▼ Configure storage [Info](#)

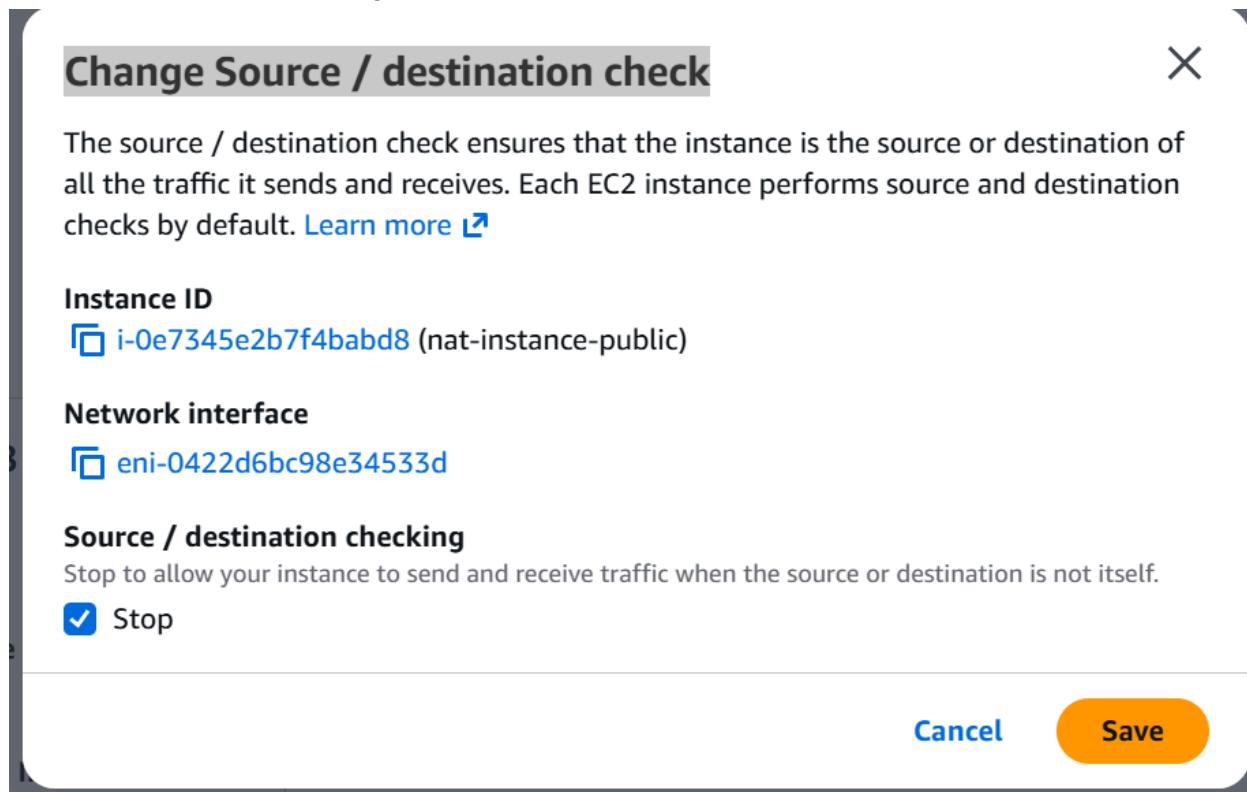
[Advanced](#)

1x 8

GiB gp3

Root volume, 3000 IOPS, Not encrypted

Disable Source/Destination Check
EC2 > Instance > Networking > Disable



Enable Fowarding
sudo sysctl -w net.ipv4.ip_forward=1

Persist:
sudo nano /etc/sysctl.conf

```
C:\Users\MGFel\Downloads>cloud-security-kali-key.pem
C:\Users\MGFel\Downloads>ssh -i cloud-security-kali-key.pem ec2-user@3.143.7.149
,      #
~\_ #####      Amazon Linux 2023
~~ \#####\
~~ \###|
~~  \#/ __ https://aws.amazon.com/linux/amazon-linux-2023
~~   \~' '-'>
~~   /
~~ ._./
~~ /_/
~~ /m/
[ec2-user@ip-10-0-1-172 ~]$ sudo sysctl -w net.ipv4.ip_forward=1
net.ipv4.ip_forward = 1
```

Add:
net.ipv4.ip_forward=1

```
ec2-user@ip-10-0-1-172:~  
GNU nano 8.3  
net.ipv4.ip_forward = 1  
/etc/sysctl.conf
```

Configure iptables

```
sudo iptables -t nat -A POSTROUTING -o eth0 -j MASQUERADE  
sudo yum install iptables-services -y  
sudo service iptables save
```

```

sudo: iptables: command not found
[ec2-user@ip-10-0-1-172 ~]$ sudo yum install iptables-services -y
Amazon Linux 2023 Kernel Livepatch repository
Last metadata expiration check: 0:00:01 ago on Thu Jan  8 02:47:22 2026.
Dependencies resolved.
=====
Package           Architecture      Version       Repository   Size
=====
Installing:
iptables-services    noarch        1.8.8-3.amzn2023.0.2   amazonlinux  18 k
Installing dependencies:
iptables-libs        x86_64        1.8.8-3.amzn2023.0.2   amazonlinux  401 k
iptables-nft         x86_64        1.8.8-3.amzn2023.0.2   amazonlinux  183 k
iptables-utils       x86_64        1.8.8-3.amzn2023.0.2   amazonlinux  43 k
libnetfilter_conntrack x86_64        1.0.8-2.amzn2023.0.2   amazonlinux  58 k
libnfnetworklink    x86_64        1.0.1-19.amzn2023.0.2   amazonlinux  30 k
libnftnl            x86_64        1.2.2-2.amzn2023.0.2   amazonlinux  84 k
Transaction Summary
=====
Install 7 Packages

Total download size: 816 k
Installed size: 2.9 M
Downloading Packages:
(1/7): iptables-services-1.8.8-3.amzn2023.0.2.noarch.rpm          495 kB/s | 18 kB  00:00
(2/7): iptables-libs-1.8.8-3.amzn2023.0.2.x86_64.rpm             8.4 MB/s | 401 kB  00:00
(3/7): iptables-nft-1.8.8-3.amzn2023.0.2.x86_64.rpm            3.4 MB/s | 183 kB  00:00
(4/7): iptables-utils-1.8.8-3.amzn2023.0.2.x86_64.rpm           1.5 MB/s | 43 kB  00:00
(5/7): libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64.rpm     1.9 MB/s | 58 kB  00:00
(6/7): libnfnetworklink-1.0.1-19.amzn2023.0.2.x86_64.rpm         1.0 MB/s | 30 kB  00:00
(7/7): libnftnl-1.2.2-2.amzn2023.0.2.x86_64.rpm                 2.7 MB/s | 84 kB  00:00
Total                                         5.9 MB/s | 816 kB  00:00

Running transaction check
Transaction check succeeded.
Running transaction test
Transaction test succeeded.
Running transaction
Preparing :                                                 1/1
Installing : libnfnetworklink-1.0.1-19.amzn2023.0.2.x86_64          1/7
Installing : libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64        2/7
Installing : iptables-libs-1.8.8-3.amzn2023.0.2.x86_64            3/7
Installing : libnftnl-1.2.2-2.amzn2023.0.2.x86_64                  4/7
Installing : iptables-nft-1.8.8-3.amzn2023.0.2.x86_64            5/7
Running scriptlet: iptables-nft-1.8.8-3.amzn2023.0.2.x86_64        5/7
Installing : iptables-utils-1.8.8-3.amzn2023.0.2.x86_64            6/7
Installing : iptables-services-1.8.8-3.amzn2023.0.2.noarch        7/7
Running scriptlet: iptables-services-1.8.8-3.amzn2023.0.2.noarch    7/7
Verifying  : iptables-libs-1.8.8-3.amzn2023.0.2.x86_64            1/7
Verifying  : iptables-nft-1.8.8-3.amzn2023.0.2.x86_64            2/7
Verifying  : iptables-services-1.8.8-3.amzn2023.0.2.noarch        3/7
Verifying  : iptables-utils-1.8.8-3.amzn2023.0.2.x86_64            4/7
Verifying  : libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64     5/7
Verifying  : libnfnetworklink-1.0.1-19.amzn2023.0.2.x86_64          6/7
Verifying  : libnftnl-1.2.2-2.amzn2023.0.2.x86_64                  7/7

Installed:
iptables-libs-1.8.8-3.amzn2023.0.2.x86_64                     iptables-nft-1.8.8-3.amzn2023.0.2.x86_64
iptables-services-1.8.8-3.amzn2023.0.2.noarch                   iptables-utils-1.8.8-3.amzn2023.0.2.x86_64
libnetfilter_conntrack-1.0.8-2.amzn2023.0.2.x86_64              libnfnetworklink-1.0.1-19.amzn2023.0.2.x86_64
libnftnl-1.2.2-2.amzn2023.0.2.x86_64

Complete!
[ec2-user@ip-10-0-1-172 ~]$ iptables --version
iptables v1.8.8 (nf_tables)
[ec2-user@ip-10-0-1-172 ~]$ sudo systemctl start iptables
[ec2-user@ip-10-0-1-172 ~]$ sudo systemctl enable iptables
Created symlink /etc/systemd/system/multi-user.target.wants/iptables.service → /usr/lib/systemd/system/iptables.service.
[ec2-user@ip-10-0-1-172 ~]$ sudo iptables -t nat -A POSTROUTING -o eth0 -j MASQUERADE
[ec2-user@ip-10-0-1-172 ~]$ sudo iptables -t nat -L -n -v
Chain PREROUTING (policy ACCEPT 0 packets, 0 bytes)
 pkts bytes target  prot opt in     out     source          destination

Chain INPUT (policy ACCEPT 0 packets, 0 bytes)
 pkts bytes target  prot opt in     out     source          destination

Chain OUTPUT (policy ACCEPT 0 packets, 0 bytes)
 pkts bytes target  prot opt in     out     source          destination

Chain POSTROUTING (policy ACCEPT 0 packets, 0 bytes)
 pkts bytes target  prot opt in     out     source          destination
  0     0 MASQUERADE  all  --  *      eth0   0.0.0.0/0          0.0.0.0/0

```

```
[ec2-user@ip-10-0-1-172 ~]$ sudo service iptables save
iptables: Saving firewall rules to /etc/sysconfig/iptables: [  OK  ]
[ec2-user@ip-10-0-1-172 ~]$ cat /proc/sys/net/ipv4/ip_forward
1
[ec2-user@ip-10-0-1-172 ~]$ sudo iptables -t nat -L
Chain PREROUTING (policy ACCEPT)
target    prot opt source          destination
target    prot opt source          destination

Chain INPUT (policy ACCEPT)
target    prot opt source          destination
target    prot opt source          destination

Chain OUTPUT (policy ACCEPT)
target    prot opt source          destination
MASQUERADE  all  --  anywhere       anywhere

Chain POSTROUTING (policy ACCEPT)
target    prot opt source          destination

```

8. Update Private Routing Table

0.0.0.0/0 > NAT Instance ID (Private subnet now has outbound internet without exposure)

The screenshot shows the AWS Route Tables interface. At the top, there's a navigation bar with tabs: 'Private-RT' (selected), 'rtb-09154683224b0fdfd', 'subnet-05edc509e37269...', and 'No'. Below the navigation bar, the title 'Edit routes' is displayed.

The main area is a table titled 'Edit routes' with the following columns: Destination, Target, Status, Propagated, and Route Origin. There are two rows of data:

Destination	Target	Status	Propagated	Route Origin	
10.0.0.0/16	local	<input checked="" type="checkbox"/> Active	No	CreateRouteTable	
0.0.0.0/0	Network Interface	<input checked="" type="checkbox"/> Active	No	CreateRoute	Remove

At the bottom left of the table, there is a button labeled 'Add route'.

Edit subnet associations

Change which subnets are associated with this route table.

Available subnets (1/2)					
<input type="text"/> Filter subnet associations					
Name	Subnet ID	IPv4 CIDR	IPv6 CIDR	Route table ID	
Public-Subnet	subnet-02df60a62f408a485	10.0.1.0/24	-	rtb-082521d9a5e29dd89 / Public Ro	
<input checked="" type="checkbox"/> Private-Subnet	subnet-05edc509e37269107	10.0.2.0/24	-	Main (rtb-0be16b26f8b06f1ad)	

Selected subnets

subnet-05edc509e37269107 / Private-Subnet

```
(kali㉿ kali) - [~]
$ ping google.com
PING google.com (142.250.190.14) 56(84) bytes of data.
64 bytes from ord37s32-in-f14.1e100.net (142.250.190.14): icmp_seq=1 ttl=117 time=8.43 ms
64 bytes from ord37s32-in-f14.1e100.net (142.250.190.14): icmp_seq=2 ttl=117 time=8.43 ms
64 bytes from ord37s32-in-f14.1e100.net (142.250.190.14): icmp_seq=3 ttl=117 time=8.52 ms
64 bytes from ord37s32-in-f14.1e100.net (142.250.190.14): icmp_seq=4 ttl=117 time=8.48 ms
64 bytes from ord37s32-in-f14.1e100.net (142.250.190.14): icmp_seq=5 ttl=117 time=8.45 ms
64 bytes from ord37s32-in-f14.1e100.net (142.250.190.14): icmp_seq=6 ttl=117 time=8.44 ms
64 bytes from ord37s32-in-f14.1e100.net (142.250.190.14): icmp_seq=7 ttl=117 time=8.45 ms
64 bytes from ord37s32-in-f14.1e100.net (142.250.190.14): icmp_seq=8 ttl=117 time=8.45 ms
^C
--- google.com ping statistics ---
8 packets transmitted, 8 received, 0% packet loss, time 7011ms
rtt min/avg/max/mdev = 8.427/8.455/8.516/0.026 ms
```

Threat Model

Threats Considered

- Public subnet exposure
- SSH brute-force attempts
- NAT instance compromise
- Misconfigured route tables
- Lateral movement from public > private subnet
- Privilege escalation on EC2 instances
- Data exfiltration from private subnet

Mitigations

- SSH restricted top /32

- No public IPs in private subnet
- NAT instance hardened (IP forwarding, iptables)
- Strict SGs and NACLs
- CloudTrail + GuardDuty monitoring
- VPC Flow Logs for anomaly detection

Monitoring & Detection Plan

Logging

- VPC Flow Logs > CloudWatch
- CloudTrail > S3
- EC2 system logs

Detection

- GuardDuty for threat intelligence
- CloudWatch alarms for:
 - Unusual outbound traffic
 - SSH attempts
 - Route table changes
 - IAM changes

Visibility

- CloudWatch dashboards
- Flow log analysis

Cost-Control Strategy

- All EC2 instances free-tier eligible (t2.micro/t3.micro)
- NAT instance used instead of NAT Gateway
- No load balancers, RDS, or high-cost services
- Instances stopped when not in use
- No attack traffic to avoid egress charges
- CloudWatch logs retained minimally

This project demonstrates my ability to design secure cloud architectures, implement Linux-based NAT routing, enforce least-privilege network segmentation, and validate

connectivity in AWS. It reflects my interest in cloud security engineering and DevSecOps practices.