



Placement Empowerment Program

Cloud Computing and DevOps Centre

Secure Access with a Bastion Host : Set up a bastion host in a public subnet to securely access instances in a private subnet.

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Introduction

A bastion host is a secure server that acts as a bridge between public and private networks. In cloud environments, a bastion host is used to securely access instances in private subnets, as direct internet access is restricted for security reasons. This Proof of Concept (POC) demonstrates how to set up a bastion host in AWS to access private instances while ensuring robust network security.

Overview

In this POC, we design and implement a secure architecture using AWS services. The project involves:

1. Creating a custom Virtual Private Cloud (VPC) with public and private subnets.
2. Launching an EC2 instance (bastion host) in the public subnet and a private instance in the private subnet.
3. Configuring security groups to control network traffic and enable secure access.
4. Using the bastion host as an intermediary to SSH into the private instance without exposing it directly to the internet.

The POC verifies secure access by testing connectivity, verifying the private instance's setup, and ensuring proper configurations.

Objectives

The primary objectives of this POC are:

1. Learn Network Segmentation:

Understand how to segregate public and private resources within a VPC.

2. Secure Private Resources:

Enable access to private instances without exposing them to the internet.

3. Practice Secure Access Techniques:

Use a bastion host to securely SSH into a private instance.

4. Apply Security Best Practices:

Use key-based authentication, restrict inbound traffic, and follow the principle of least privilege in security group configurations.

Importance

This POC is essential for anyone aiming to:

1. Enhance Security Skills: Learn the fundamentals of securing cloud-based architectures by isolating sensitive resources.

2. Prepare for Real-World Scenarios: Bastion hosts are frequently used in enterprise environments where private resources need secure access.

3. Develop Cloud Expertise: Gain hands-on experience with AWS services like EC2, VPC, and security groups.

4. Build Foundational Knowledge: This knowledge is crucial for advanced cloud topics, such as setting up VPNs, NAT gateways, or using AWS Systems Manager for access.

Step-by-Step Overview

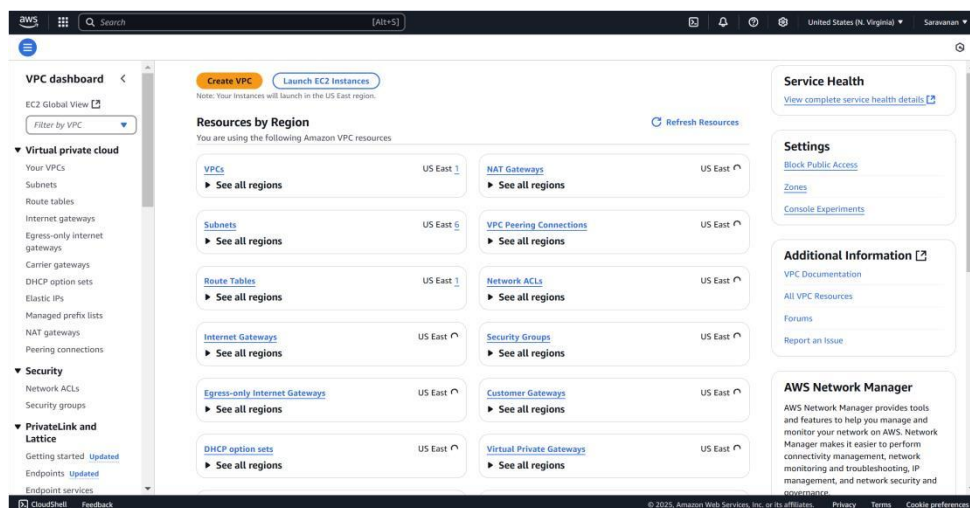
Step 1:

1. Go to [AWS Management Console](#).
2. Enter your username and password to log in.

Step 2:

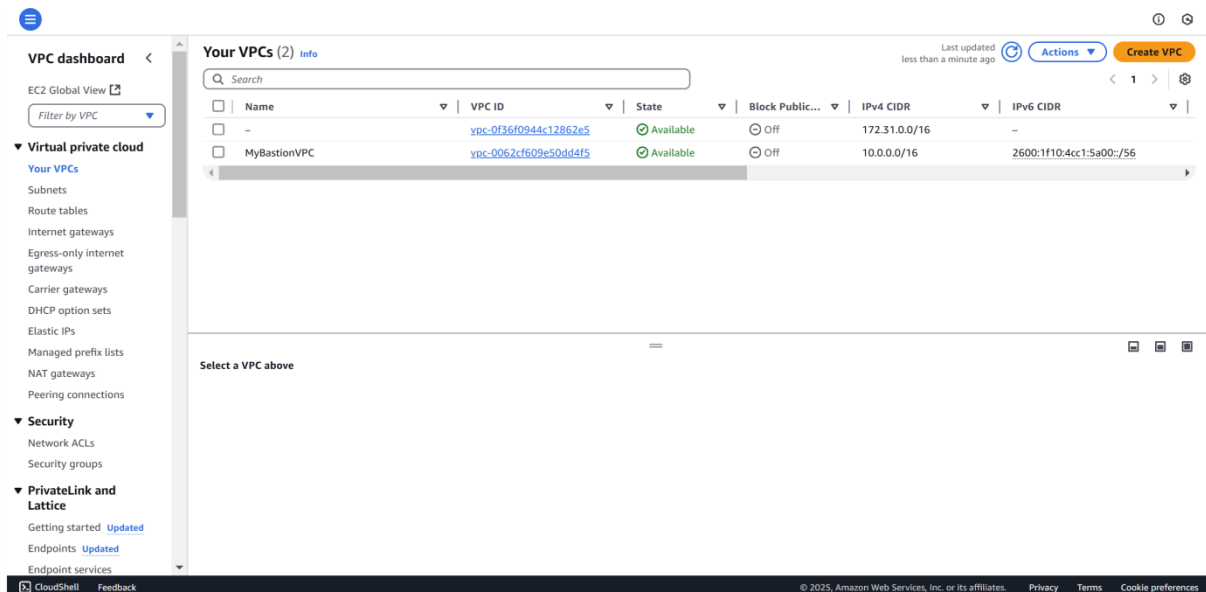
Search for **VPC** in the AWS search bar and click on it.

Click on **Create VPC**.



Step 3:

Create a new VPC by selecting **VPC only** and filling in the following details: set the **Name Tag** as *MyBastionVPC* and the **IPv4 CIDR Block** as *10.0.0.0/16*. Leave all other settings as default, then click **Create VPC**. Once created, the new VPC will appear in the VPC list.



Step 4:

In the **VPC Dashboard**, go to **Subnets** and click **Create Subnet**. Select the **VPC ID** of the VPC you created earlier (*MyBastionVPC*). Enter the **Subnet Name** as *PublicSubnet*, choose an **Availability Zone** (e.g., *us-east-1a*), and set the **IPv4 CIDR Block** as *10.0.1.0/24*. Click **Create Subnet**.

VPC > Subnets > Create subnet

Create subnet info

VPC
VPC ID
Create subnets in this VPC.
vpc-0062cf609e50dd4f5 (MyBastionVPC)

Associated VPC CIDRs

IPv4 CIDRs 10.0.0.0/16	IPv6 CIDRs 2600:1f10:4cc1:5a00::/56 (us-east-1)
----------------------------------	---

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.
PublicSubnet
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.
US East (N. Virginia) / us-east-1

IPv4 CIDR block
☒ Manual input
☐ No IPv4 CIDR

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Step 5:

Select your **PublicSubnet** from the list, click **Actions** → **Modify auto-assign IP settings**, check **Enable auto-assign public IPv4 address**, and click **Save**.

VPC > Subnets > subnet-091d44e9c99cc9a7b > Edit subnet settings

Edit subnet settings info

Subnet
Subnet ID
subnet-091d44e9c99cc9a7b
Name
PublicSubnet

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.

Resource-based name (RBN) settings info
Specify the hostname type for EC2 instances in this subnet and optional RBN DNS query settings.
☐ Enable resource name DNS A record on launch info
☐ Enable resource name DNS AAAA record on launch info

Hostname type info
☐ Resource name
☒ IP name

DNS64 settings
Enable DNS64 to allow IPv6-only services in Amazon VPC to communicate with IPv4-only services and networks.
☐ Enable DNS64 info

Step 6:

Click **Create Subnet** again and fill in the details: select the same **VPC ID** (*MyBastionVPC*), set **Subnet Name** to *PrivateSubnet*, use the same **Availability Zone** as the public subnet (e.g., *us-east-1a*), and set the **IPv4 CIDR Block** to *10.0.2.0/24*. Leave **auto-assign public IP** disabled and click **Create Subnet**.

The screenshot shows the 'Create subnet' page in the AWS Management Console. The breadcrumb navigation at the top reads 'VPC > Subnets > Create subnet'. The page is divided into several sections:

- VPC ID:** A dropdown menu showing 'vpc-0062cf609e50dd4f5 (MyBastionVPC)'.
- Associated VPC CIDRs:** A table with two columns: 'IPv4 CIDRs' (showing '10.0.0.0/16') and 'IPv6 CIDRs' (showing '2600:1f10:4cc1:5a00::/56 (us-east-1)').
- Subnet settings:** A section with the instruction 'Specify the CIDR blocks and Availability Zone for the subnet.'
 - Subnet 1 of 1:**
 - Subnet name:** A text input field containing 'PrivateSubnet'. Below it, a note says 'The name can be up to 256 characters long.'
 - Availability Zone:** A dropdown menu showing 'US East (N. Virginia) / us-east-1a'.
 - IPv4 CIDR block:** Two radio buttons: 'Manual input' (selected) and 'No IPv4 CIDR'.
 - IPv4 VPC CIDR block:** A dropdown menu showing '10.0.0.0/16'.

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Step 7:

In the **VPC Dashboard**, go to **Internet Gateways** and click **Create Internet Gateway**. Name it *MyInternetGateway* and click **Create Internet Gateway**. Select your new gateway, click **Actions** → **Attach to VPC**, choose your VPC (*MyBastionVPC*), and click **Attach Internet Gateway**.

VPC > Internet gateways > Create internet gateway

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	
<input type="text" value="Name"/>	<input type="text" value="MyInternetGateway"/>	<input type="button" value="Remove"/>

You can add 49 more tags.

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VPC > Internet gateways > Attach to VPC (igw-0f2d01304813527f5)

☒ The following internet gateway was created: igw-0f2d01304813527f5 - MyInternetGateway. You can now attach to a VPC to enable the VPC to communicate with the internet.

Attach to VPC (igw-0f2d01304813527f5) 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.

In the **VPC Dashboard**, go to **Route Tables** and click **Create Route Table**. Name it *PublicRouteTable*, select your VPC (*MyBastionVPC*), and click **Create Route Table**. Then, select *PublicRouteTable*, go to the **Routes** tab, click **Edit routes**, and add a route with **Destination** as *0.0.0.0/0* and **Target** as *MyInternetGateway*. Click **Save changes**.

Step 8:

VPC > Route tables > Create route table

1 ⓘ

Create route table Info

A route table specifies how packets are forwarded between the subnets within your VPC, the internet, and your VPN connection.

Route table settings

Name - optional

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

PublicRouteTable

VPC

The VPC to use for this route table.

vpc-0062cf609e50dd4f5 (MyBastionVPC)

Tags

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

Q Name X

Value - optional

Q PublicRouteTable X Remove

Add new tag

You can add 49 more tags.

Cancel

Create route table

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☰

VPC dashboard <

EC2 Global View

Filter by VPC

▼ Virtual private cloud

Your VPCs

Subnets

Route tables

Internet gateways

Egress-only internet gateways

Carrier gateways

DHCP option sets

Elastic IPs

Managed prefix lists

NAT gateways

Peering connections

▼ Security

Network ACLs

Security groups

▼ PrivateLink and Lattice

Getting started Updated

Endpoints Updated

Endpoint services

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Route table rtb-03e764b95de7259c7 | PublicRouteTable was created successfully.

Last updated less than a minute ago Actions Create route table

Route tables (1/3) Info

Find resources by attribute or tag

	Name	Route table ID	Explicit subnet associ...	Edge associations	Main	VPC	
<input type="checkbox"/>	-	rtb-09ac4cf7007b1ed8a	-	-	Yes	vpc-0f36f0944c12862e5	34
<input checked="" type="checkbox"/>	PublicRouteTable	rtb-03e764b95de7259c7	-	-	No	vpc-0062cf609e50dd4f5 MyB...	34
<input type="checkbox"/>	-	rtb-013655e0739d83668	-	-	Yes	vpc-0062cf609e50dd4f5 MyB...	34

rtb-03e764b95de7259c7 / PublicRouteTable

Details Routes Subnet associations Edge associations Route propagation Tags

Routes (2)

Filter routes

Both Edit routes

Destination	Target	Status	Propagated
2600:1f10:4cc1:5a00::/56	local	Active	No
10.0.0.0/16	local	Active	No

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Step 9:

Next, go to the **Subnet associations** tab of *PublicRouteTable*, click **Edit subnet associations**, check the box for *PublicSubnet*, and click **Save associations**.

VPC > Route tables > rtb-03e764b95de7259c7 > Edit subnet associations

Edit subnet associations

Change which subnets are associated with this route table.

Available subnets (1/2)

Filter subnet associations

<input type="checkbox"/>	Name	Subnet ID	IPv4 CIDR	IPv6 CIDR	Route table ID
<input checked="" type="checkbox"/>	PublicSubnet	subnet-091d44e9c99cc9a7b	10.0.1.0/24	-	Main (rtb-013655e0739d83668)
<input type="checkbox"/>	PrivateSubnet	subnet-003fd108a7f51501e	10.0.2.0/24	-	Main (rtb-013655e0739d83668)

Selected subnets

subnet-091d44e9c99cc9a7b / PublicSubnet

Cancel Save associations

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VPC > Route tables > rtb-03e764b95de7259c7 > Edit routes

Edit routes

Destination	Target	Status	Propagated
2600:1f10:4cc1:5a00::/56	local	Active	No
10.0.0.0/16	local	Active	No
0.0.0.0/0	Internet Gateway	-	No

Add route

Remove

Cancel Preview Save changes

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Step 10:

In the **EC2 Dashboard**, click **Launch Instance** and configure: set **Name** as *BastionHost*, select *Amazon Linux 2 AMI (HVM)* - Free Tier eligible, and choose **t2.micro** as the **Instance Type**. For **Key Pair**, create or select one, downloading the .pem file if creating. Under **Network Settings**, select *MyBastionVPC* for the **VPC**, *PublicSubnet* for the **Subnet**, and ensure **Auto-assign Public IP** is enabled. Create a **Security Group** to allow SSH (port 22) access, setting **Source** to *MyIP*. Use the default storage of 8 GiB, click **Launch Instance**, and wait for it to initialize.

▼ Network settings [Info](#)

VPC - required [Info](#)

vpc-0062cf609e50dd4f5 (MyBastionVPC)
10.0.0.0/16 2600:1f10:4cc1:5a00::/56



Subnet [Info](#)

subnet-091d44e9c99cc9a7b PublicSubnet
VPC: vpc-0062cf609e50dd4f5 Owner: 343218194491
Availability Zone: us-east-1a Zone type: Availability Zone
IP addresses available: 251 CIDR: 10.0.1.0/24
subnet-091d44e9c99cc9a7b



[Create new subnet](#)

Auto-assign public IP [Info](#)

Enable

Additional charges apply when outside of [free tier allowance](#)

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

Security group name - required

launch-wizard-27

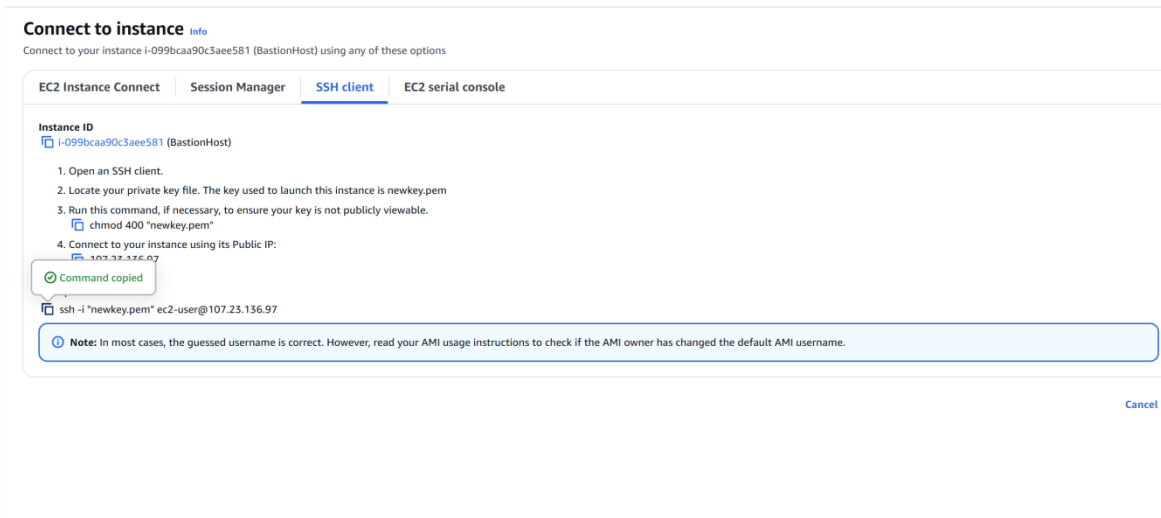
This security group will be added to all network interfaces. The name can't be edited after the security group is created. Max length is 25! characters. Valid characters: a-z, A-Z, 0-9, spaces, and _-:/()#,@[]+=&;{}!\$*

Description - required [Info](#)

launch-wizard-27 created 2025-02-06T05:34:23.118Z

Step 10:

Connect with your PowerShell terminal by copying the ssh command in the SSH client of the *BastionHost(Ec2)*.



Step 11:

Paste the command copied in the SSH client and connect it by using your key pair.

```
PS C:\Users\Hi> cd Downloads
PS C:\Users\Hi\Downloads> ssh -i "newkey.pem" ec2-user@44.212.36.24
The authenticity of host '44.212.36.24 (44.212.36.24)' can't be established.
ED25519 key fingerprint is SHA256:G5t53dqZ4PoDFHzgf/SJYBIc509HxQC7ROVSqDKom/Y.
This host key is known by the following other names/addresses:
  C:\Users\Hi/.ssh/known_hosts:28: 107.23.136.97
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
```

While connected to the bastion host, run this command to create a .ssh folder:

```
[ec2-user@ip-10-0-1-208 ~]$ mkdir -p ~/.ssh
```

Step 13:

On your local machine, upload the key file to the bastion host

Step 12:

```
scp -i /path/to/your-key.pem /path/to/your-key.pem  
ec2user@<BastionHost-Public-IP>:~/.ssh/
```

```
PS C:\Users\Hi> scp -i "C:\Users\Hi\Downloads\newkey.pem" "C:\Users\Hi\Downloads\newkey.pem" ec2-user@44.212.36.24:~/.ssh/  
newkey.pem 100% 1678 4.0KB/s 00:00
```

Step 14:

On the bastion host, run the following command to secure the key:

```
[ec2-user@ip-10-0-1-208 ~]$ chmod 400 ~/.ssh/newkey.pem
```

Step 15:

Use the private IP of the private instance (e.g., 10.0.2.x) and run: **ssh -i ~/.ssh/your-key.pem ec2-user@<PrivateInstance-PrivateIP>**

```
[ec2-user@ip-10-0-1-208 ~]$ ssh -i ~/.ssh/newkey.pem ec2-user@10.0.2.68  
The authenticity of host '10.0.2.68 (10.0.2.68)' can't be established.  
ED25519 key fingerprint is SHA256:MGRZMakTZuL8b0oak307T50//sj23zJJQJn+Zl9lzc4.  
This key is not known by any other names  
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes  
Warning: Permanently added '10.0.2.68' (ED25519) to the list of known hosts.
```

Step 16:

To verify network access and security, follow these steps:

1. **Check Internet Connectivity (Optional):** If your private instance has internet access via a NAT gateway or instance, verify by running `ping google.com`. If there's no internet, it's fine as long as the private instance can communicate with the bastion host.
2. **Inspect Instance Details:** Connect to your private instance and run:
 - `hostname` to check the instance hostname.
 - `ifconfig` to verify the private IP address.

```
[ec2-user@ip-10-0-2-68 ~]$ ping google.com
PING google.com (172.253.62.102) 56(84) bytes of data.
^C
--- google.com ping statistics ---
37 packets transmitted, 0 received, 100% packet loss, time 37458ms

[ec2-user@ip-10-0-2-68 ~]$ ^C
[ec2-user@ip-10-0-2-68 ~]$ hostname
ip-10-0-2-68.ec2.internal
[ec2-user@ip-10-0-2-68 ~]$ ifconfig
enX0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 9001
    inet 10.0.2.68 netmask 255.255.255.0 broadcast 10.0.2.255
    inet6 fe80::1019:f0ff:fe5e:c45b prefixlen 64 scopeid 0x20<link>
    ether 12:19:f0:5e:c4:5b txqueuelen 1000 (Ethernet)
    RX packets 1223 bytes 142227 (138.8 KiB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 1531 bytes 159827 (156.0 KiB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 12 bytes 1020 (1020.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 12 bytes 1020 (1020.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

Outcome

By completing this POC of setting up a Bastion Host in AWS, you will:

1. Deploy a bastion host in a public subnet and a private instance in a private subnet for secure access.
2. Enable SSH access to the private instance through the bastion host, ensuring the private instance remains isolated from the internet.
3. Configure security groups to restrict network traffic and enforce access control based on best practices.
4. Verify connectivity and communication between the bastion host and private instance within the VPC.
5. Gain a practical understanding of secure cloud networking and foundational AWS services like EC2, VPC, and key-based authentication.