

COS20019 - Cloud Computing Architecture

Week 2: ACF Lab 2: Build a VPC and launch a Web Server

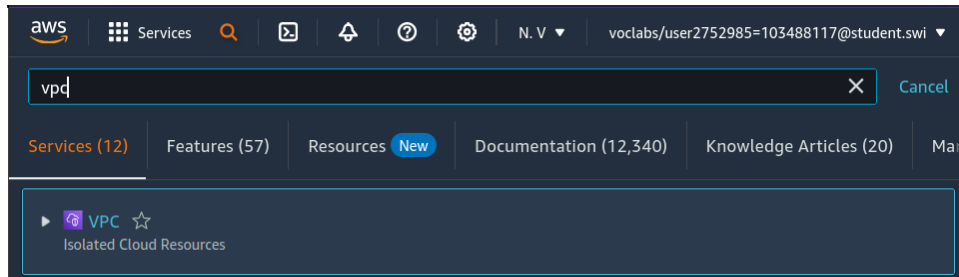
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Due Date: 24/09/2023

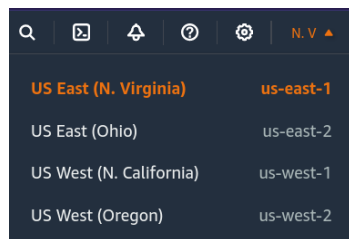
Task 1: Create Your VPC

In this task, you will use the *VPC and more* option in the VPC console to create multiple resources, including a *VPC*, an *Internet Gateway*, a *public subnet* and a *private subnet* in a single Availability Zone, two *route tables*, and a *NAT Gateway*.

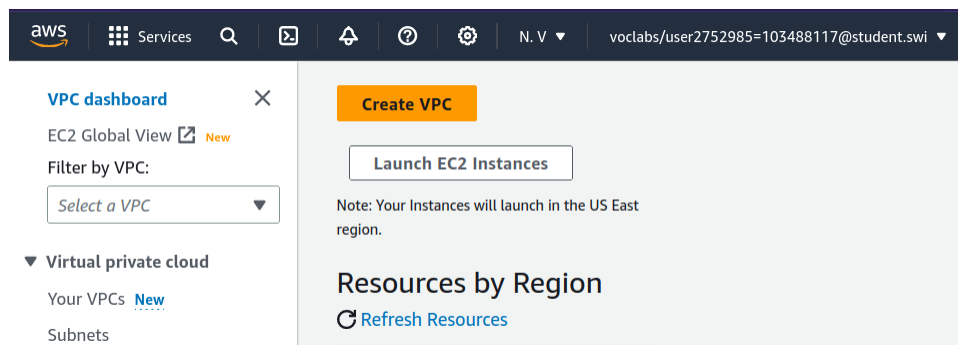
5. In the search box to the right of **Services**, search for and choose **VPC** to open the VPC console.



6. Begin creating a VPC.
 - In the top right of the screen, verify that **N. Virginia (us-east-1)** is the region.



- Choose the **VPC dashboard** link which is also towards the top left of the console.



- Next, choose Create VPC.
Note: If you do not see a button with that name, choose the Launch VPC Wizard button instead.

7. Configure the VPC details in the *VPC settings* panel on the left:
- Choose **VPC and more**.
 - Under **Name tag auto-generation**, keep *Auto-generate* selected, however change the value from project to **lab**.
 - Keep the **IPv4 CIDR block** set to 10.0.0.0/16
 - For **Number of Availability Zones**, choose **1**.
 - For **Number of *public* subnets**, keep the **1** setting.
 - For **Number of *private* subnets**, keep the **1** setting.
 - Expand the **Customize subnets CIDR blocks** section
 - Change **Public subnet CIDR block in us-east-1a** to **10.0.0.0/24**
 - Change **Private subnet CIDR block in us-east-1a** to **10.0.1.0/24**
 - Set **NAT gateways** to **In 1 AZ**.
 - Set **VPC endpoints** to **None**.
 - Keep both **DNS hostnames** and **DNS resolution** *enabled*.

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 auto-generation [Info](#)

Enter a value for the Name tag. This value will be used to auto-generate Name tags for all resources in the VPC.

☒ Auto-generate

lab

IPv4 CIDR block [Info](#)

Determine the starting IP and the size of your VPC using CIDR notation.

10.0.0.0/1665,536 IPs

IPv6 CIDR block [Info](#)

☒ No IPv6 CIDR block

☐ Amazon-provided IPv6 CIDR block

Tenancy [Info](#)

Default

Number of Availability Zones (AZs) [Info](#)

Choose the number of AZs in which to provision subnets. We recommend at least two AZs for high availability.

1

2

3

► Customize AZs

Number of public subnets [Info](#)

The number of public subnets to add to your VPC. Use public subnets for web applications that need to be publicly accessible over the internet.

0

1

Number of private subnets [Info](#)

The number of private subnets to add to your VPC. Use private subnets to secure backend resources that don't need public access.

0

1

2

▼ Customize subnets CIDR blocks

Public subnet CIDR block in us-east-1a

10.0.0.0/24256 IPs

Private subnet CIDR block in us-east-1a

10.0.1.0/24256 IPs

NAT gateways (\$) [Info](#)

Choose the number of Availability Zones (AZs) in which to create NAT gateways. Note that there is a charge for each NAT gateway

None

In 1 AZ

1 per AZ

VPC endpoints [Info](#)

Endpoints can help reduce NAT gateway charges and improve security by accessing S3 directly from the VPC. By default, full access policy is used. You can customize this policy at any time.

None

S3 Gateway

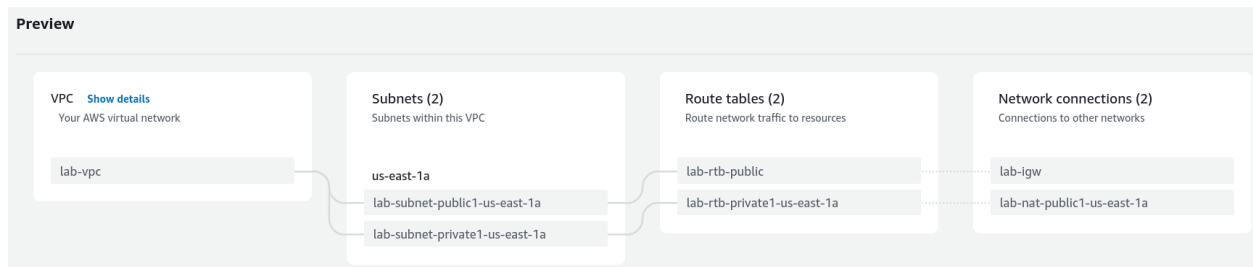
DNS options [Info](#)

☒ Enable DNS hostnames

☒ Enable DNS resolution

► Additional tags

8. In the *Preview* panel on the right, confirm the settings you have configured.
 - **VPC:** `lab-vpc`
 - **Subnets:**
 - `us-east-1a`
 - **Public subnet name:** `lab-subnet-public1-us-east-1a`
 - **Private subnet name:** `lab-subnet-private1-us-east-1a`
 - **Route tables**
 - `lab-rtb-public`
 - `lab-rtb-private1-us-east-1a`
 - **Network connections**
 - `lab-igw`
 - `lab-nat-public1-us-east-1a`



9. At the bottom of the screen, choose Create VPC
The VPC resources are created. The NAT Gateway will take a few minutes to activate.
Please wait until *all* the resources are created before proceeding to the next step.

Create VPC workflow

✔ Success

▼ Details

- ✔ Create VPC: [vpc-0048483b79fd48486](#)
- ✔ Enable DNS hostnames
- ✔ Enable DNS resolution
- ✔ Verifying VPC creation: [vpc-0048483b79fd48486](#)
- ✔ Create subnet: [subnet-051368dd297b0aeef](#)
- ✔ Create subnet: [subnet-04e8822b3c4a979f2](#)
- ✔ Create internet gateway: [igw-0e58540be2d3ba766](#)
- ✔ Attach internet gateway to the VPC
- ✔ Create route table: [rtb-007558b6f3e017308](#)
- ✔ Create route
- ✔ Associate route table
- ✔ Allocate elastic IP: [eipalloc-06531ed5cc0c40dce](#)
- ✔ Create NAT gateway: [nat-0830b212d63b30b74](#)
- ✔ Wait for NAT Gateways to activate
- ✔ Create route table: [rtb-0d3b8f642350a8ffe](#)
- ✔ Create route
- ✔ Associate route table
- ✔ Verifying route table creation

[View VPC](#)

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10. Once it is complete, choose View VPC

VPC > Your VPCs > vpc-0048483b79fd48486

vpc-0048483b79fd48486 / lab-vpc Actions ▼

Details Info			
VPC ID vpc-0048483b79fd48486	State Available	DNS hostnames Enabled	DNS resolution Enabled
Tenancy Default	DHCP option set dopt-05b2c7dfcebd073c7	Main route table rtb-06ac7be2a1ac4a7a1	Main network ACL acl-043aa4aed2c438bc6
Default VPC No	IPv4 CIDR 10.0.0.0/16	IPv6 pool -	IPv6 CIDR (Network border group) -
Network Address Usage metrics Disabled	Route 53 Resolver DNS Firewall rule groups Failed to load rule groups	Owner ID 677185652244	

Task 2: Create Additional Subnets

In this task, you will create two additional subnets for the VPC in a second Availability Zone. Having subnets in multiple Availability Zones within a VPC is useful for deploying solutions that provide *High Availability*.

After creating a VPC as you have already done, you can still configure it further, for example, by adding more **subnets**. Each subnet you create resides entirely within one Availability Zone.

11. In the left navigation pane, choose **Subnets**.

First, you will create a second *public* subnet.

12. Choose Create subnet then configure:

- **VPC ID:** lab-vpc (select from the menu).
- **Subnet name:** lab-subnet-public2
- **Availability Zone:** Select the *second* Availability Zone (for example, us-east-1b)
- **IPv4 CIDR block:** 10.0.2.0/24

Subnet 1 of 1

Subnet name

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

lab-subnet-public2

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-1b ▼

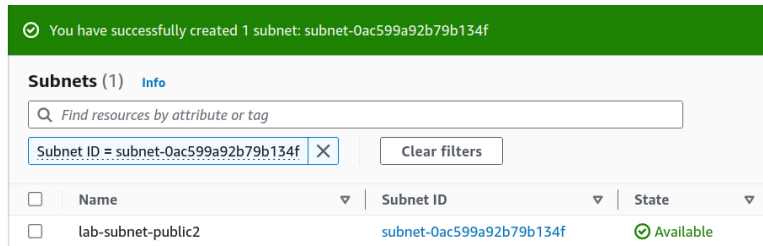
IPv4 CIDR block [Info](#)

10.0.2.0/24

The subnet will have all IP addresses starting with **10.0.2.x**.

13. Choose Create subnet

The second *public* subnet was created. You will now create a second *private* subnet.



14. Choose Create subnet then configure:

- **VPC ID:** lab-vpc
- **Subnet name:** lab-subnet-private2
- **Availability Zone:** Select the *second* Availability Zone (for example, us-east-1b)
- **IPv4 CIDR block:** 10.0.3.0/24

Subnet 1 of 1

Subnet name

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

lab-subnet-private2

The name can be up to 256 characters long.

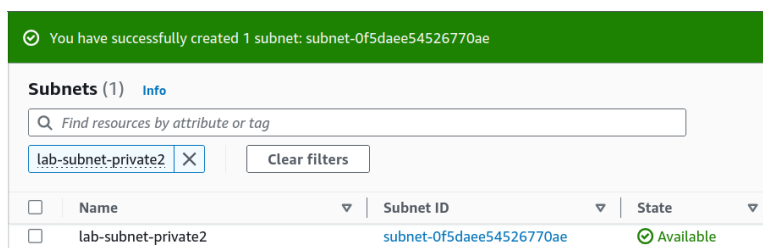
Availability Zone Info

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

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

IPv4 CIDR block Info

10.0.3.0/24



The subnet will have all IP addresses starting with **10.0.3.x**.

15. Choose Create subnet

The second *private* subnet was created.

You will now configure this new *private* subnet to route internet-bound traffic to the NAT Gateway so that resources in the second private subnet are able to connect to the Internet, while still keeping the resources private. This is done by configuring a *Route Table*.

A *route table* contains a set of rules, called *routes*, that are used to determine where network traffic is directed. Each subnet in a VPC must be associated with a route table; the route table

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controls routing for the subnet.

16. In the left navigation pane, choose **Route tables**.

17. Select the **lab-rtb-private1-us-east-1a** route table.

18. In the lower pane, choose the **Routes** tab.

Note that **Destination 0.0.0.0/0** is set to **Target nat-xxxxxxx**. This means that traffic destined for the internet (0.0.0.0/0) will be sent to the NAT Gateway. The NAT Gateway will then forward the traffic to the internet.

This route table is therefore being used to route traffic from private subnets.

Selected	Route table	Subnet	Target	Status	Propagated
<input checked="" type="checkbox"/>	lab-rtb-private1-us-east-1a	rtb-0d3b8f642350a8ffe	subnet-04e8822b3c4a97...	-	No
<input type="checkbox"/>	-	rtb-0cf5f2318d2d9d369	-	-	Yes

rtb-0d3b8f642350a8ffe / lab-rtb-private1-us-east-1a
Routes (2)
Filter routes: Both
1
Destination Target Status Propagated
0.0.0.0/0 nat-0830b212d63b30b74 Active No
10.0.0.0/16 local Active No

19. Choose the **Subnet associations** tab.

You created this route table in task 1 when you chose to create a VPC and multiple resources in the VPC. That action also created *lab-subnet-private-1* and associated that subnet with this route table.

Now that you have created another private subnet, lab-subnet-private-2, you will associate this route table with that subnet as well.

Selected	Route table	Subnet	Target	Status	Propagated
<input checked="" type="checkbox"/>	lab-rtb-private1-us-east-1a	rtb-0d3b8f642350a8ffe	subnet-04e8822b3c4a97...	-	No
<input type="checkbox"/>	-	rtb-0cf5f2318d2d9d369	-	-	Yes

Subnet associations
Find subnet association: Edit subnet associations
1
Name Subnet ID IPv4 CIDR IPv6 CIDR
lab-subnet-private1-us-east-1a subnet-04e8822b3c4a979f2 10.0.1.0/24 -
Subnets without explicit associations (2)
The following subnets have not been explicitly associated with any route tables and are therefore associated with the main route table:
Find subnet association: Edit subnet associations
1
Name Subnet ID IPv4 CIDR IPv6 CIDR
lab-subnet-private2 subnet-0f5dae54526770ae 10.0.3.0/24 -
lab-subnet-public2 subnet-0ac599a92b79b134f 10.0.2.0/24 -

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20. In the Explicit subnet associations panel, choose Edit subnet associations

21. Leave **lab-subnet-private1-us-east-1a** selected, but also select **lab-subnet-private2**.

Available subnets (2/4)			
<input type="text" value="Filter subnet associations"/>			
<input checked="" type="checkbox"/>	Name	Subnet ID	IPv4 CIDR
<input checked="" type="checkbox"/>	lab-subnet-private1-us-east-1a	subnet-04e8822b3c4a979f2	10.0.1.0/24
<input checked="" type="checkbox"/>	lab-subnet-private2	subnet-0f5daee54526770ae	10.0.3.0/24
<input type="checkbox"/>	lab-subnet-public1-us-east-1a	subnet-051368dd297b0aeef	10.0.0.0/24
<input type="checkbox"/>	lab-subnet-public2	subnet-0ac599a92b79b134f	10.0.2.0/24

22. Choose Save associations

You will now configure the Route Table that is used by the Public Subnets.

23. Select the **lab-rtb-public** route table (and deselect any other subnets).

24. In the lower pane, choose the **Routes** tab.

Note that **Destination 0.0.0.0/0** is set to Target **igw-xxxxxxx**, which is an Internet Gateway. This means that internet-bound traffic will be sent straight to the internet via this Internet Gateway.

You will now associate this route table to the second public subnet you created.

Route tables (1/6) Info

lab-rtb-public

rtb-007558b6f3e017308

subnet-051368dd297b0a...

-

No

vpc-0048483b79fd48486 | lab-...

Work Public Route Table

rtb-05d5f9ae79c088ba8

subnet-08a7ffe0e6df970...

-

No

vpc-04a8087277c02be46 | Wor...

lab-rtb-private1-us-east-1a

rtb-0d3b8f642350a8ffe

2 subnets

-

No

vpc-0048483b79fd48486 | lab-...

rtb-007558b6f3e017308 / lab-rtb-public

Details

Routes

Subnet associations

Edge associations

Route propagation

Tags

Routes (2)

Both

1

Destination	Target	Status	Propagated
0.0.0.0/0	igw-0e58540be2d3ba766	Active	No
10.0.0.0/16	local	Active	No

25. Choose the **Subnet associations** tab.

26. In the Explicit subnet associations area, choose Edit subnet associations

27. Leave **lab-subnet-public1-us-east-1a** selected, but also select **lab-subnet-public2**.

Available subnets (2/4)			
<input type="text" value="Filter subnet associations"/>			
<input checked="" type="checkbox"/>	Name	Subnet ID	IPv4 CIDR
<input type="checkbox"/>	lab-subnet-private1-us-east-1a	subnet-04e8822b3c4a979f2	10.0.1.0/24
<input type="checkbox"/>	lab-subnet-private2	subnet-0f5daee54526770ae	10.0.3.0/24
<input checked="" type="checkbox"/>	lab-subnet-public1-us-east-1a	subnet-051368dd297b0aeef	10.0.0.0/24
<input checked="" type="checkbox"/>	lab-subnet-public2	subnet-0ac599a92b79b134f	10.0.2.0/24

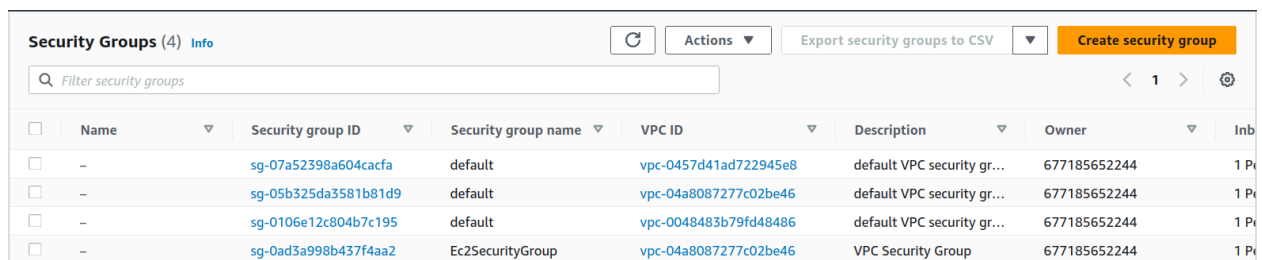
28. Choose Save associations

Your VPC now has public and private subnets configured in two Availability Zones. The route tables you created in task 1 have also been updated to route network traffic for the two new subnets.

Task 3: Create a VPC Security Group

In this task, you will create a VPC security group, which acts as a virtual firewall. When you launch an instance, you associate one or more security groups with the instance. You can add rules to each security group that allow traffic to or from its associated instances.

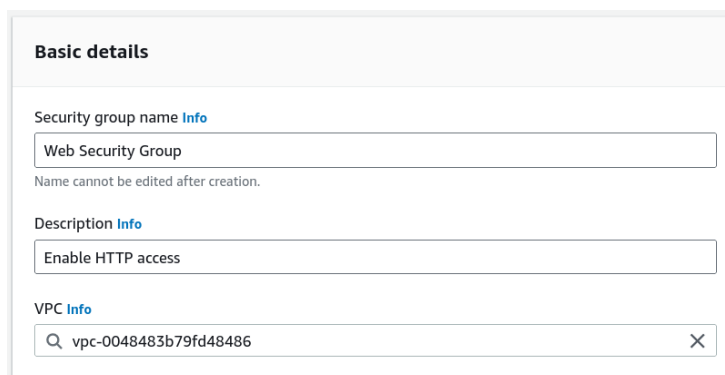
29. In the left navigation pane, choose **Security groups**.



<input type="checkbox"/>	Name	Security group ID	Security group name	VPC ID	Description	Owner	Inbound rules
<input type="checkbox"/>	-	sg-07a52398a604cacfa	default	vpc-0457d41ad722945e8	default VPC security gr...	677185652244	1 Permitted
<input type="checkbox"/>	-	sg-05b325da3581b81d9	default	vpc-04a8087277c02be46	default VPC security gr...	677185652244	1 Permitted
<input type="checkbox"/>	-	sg-0106e12c804b7c195	default	vpc-0048483b79fd48486	default VPC security gr...	677185652244	1 Permitted
<input type="checkbox"/>	-	sg-0ad3a998b437f4aa2	Ec2SecurityGroup	vpc-04a8087277c02be46	VPC Security Group	677185652244	1 Permitted

30. Choose Create security group and then configure:

- **Security group name:** Web Security Group
- **Description:** Enable HTTP access
- **VPC:** choose the X to remove the currently selected VPC, then from the drop down list choose **lab-vpc**



Basic details

Security group name [Info](#)

Web Security Group

Name cannot be edited after creation.

Description [Info](#)

Enable HTTP access

VPC [Info](#)

Q vpc-0048483b79fd48486 X

31. In the **Inbound rules** pane, choose Add rule

32. Configure the following settings:

- **Type:** HTTP
- **Source:** Anywhere-IPv4
- **Description:** Permit web requests

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Inbound rules [Info](#)

Type [Info](#)

Protocol [Info](#)

Port range [Info](#)

Source [Info](#)

Description - optional [Info](#)

HTTP ▼

TCP

80

Anywh... ▼

✕

Delete

Add rule

33. Scroll to the bottom of the page and choose Create security group

You will use this security group in the next task when launching an Amazon EC2 instance.

✔ Security group (sg-056cd0b0f585da5e1 | Web Security Group) was created successfully
▶ Details

VPC > Security Groups > sg-056cd0b0f585da5e1 - Web Security Group

sg-056cd0b0f585da5e1 - Web Security Group

Actions ▼

Details

Security group name Web Security Group	Security group ID sg-056cd0b0f585da5e1	Description Enable HTTP access	VPC ID vpc-0048483b79fd48486
Owner 677185652244	Inbound rules count 1 Permission entry	Outbound rules count 1 Permission entry	

Task 4: Launch a Web Server Instance

In this task, you will launch an Amazon EC2 instance into the new VPC. You will configure the instance to act as a web server.

34. In the search box to the right of **Services**, search for and choose **EC2** to open the EC2 console.
35. From the Launch instance menu choose **Launch instance**.
36. Name the instance:

- Give it the name **Web Server 1**

When you name your instance, AWS creates a tag and associates it with the instance. A tag is a key value pair. The key for this pair is **Name**, and the value is the name you enter for your EC2 instance.

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

Web Server 1

Add additional tags

37. Choose an AMI from which to create the instance:

- In the list of available *Quick Start* AMIs, keep the default **Amazon Linux** selected.
- Also keep the default **Amazon Linux 2023 AMI** selected.

The type of *Amazon Machine Image (AMI)* you choose determines the Operating System that will run on the EC2 instance that you launch.

▼ Application and OS Images (Amazon Machine Image) Info

An AMI is a template that contains the software configuration (operating system, application server, and applications) required to launch your instance. Search or Browse for AMIs if you don't see what you are looking for below

Q Search our full catalog including 1000s of application and OS images

Recents

Quick Start

Amazon Linux

aws

macOS

Mac

Ubuntu

ubuntu

Windows

Microsoft

Red Hat

Red Hat

SUSE Li

SUS

Browse more AMIs

Including AMIs from AWS, Marketplace and the Community

Amazon Machine Image (AMI)

Free tier eligible ▼

Amazon Linux 2023 AMI

ami-04cb4ca688797756f (64-bit (x86)) / ami-06f9c0b2ce386dda7 (64-bit (Arm))

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

Description

Amazon Linux 2023 AMI 2023.1.20230912.0 x86_64 HVM kernel-6.1

Architecture

AMI ID

Verified provider

64-bit (x86)

ami-04cb4ca688797756f

Verified provider

38. Choose an Instance type:

- In the *Instance type* panel, keep the default **t2.micro** selected.
The *Instance Type* defines the hardware resources assigned to the instance.

▼ Instance type [Info](#)

Instance type

t2.micro Free tier eligible

Family: t2 1 vCPU 1 GiB Memory Current generation: true

On-Demand Windows base pricing: 0.0162 USD per Hour

On-Demand SUSE base pricing: 0.0116 USD per Hour

On-Demand RHEL base pricing: 0.0716 USD per Hour

On-Demand Linux base pricing: 0.0116 USD per Hour

☐ All generations

[Compare instance types](#)

[Additional costs apply for AMIs with pre-installed software](#)

39. Select the key pair to associate with the instance:

- From the **Key pair name** menu, select **vockey**.
The vockey key pair you selected will allow you to connect to this instance via SSH after it has launched. Although you will not need to do that in this lab, it is still required to identify an existing key pair, or create a new one, when you launch an instance.

▼ 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*

[Create new key pair](#)

40. Configure the Network settings:

- Next to Network settings, choose **Edit**, then configure:
 - **Network:** *lab-vpc*
 - **Subnet:** *lab-subnet-public2 (not Private!)*
 - **Auto-assign public IP:** *Enable*
- Next, you will configure the instance to use the *Web Security Group* that you created earlier.
 - Under Firewall (security groups), choose **Select existing security group**.
 - For **Common security groups**, select **Web Security Group**.
This security group will permit HTTP access to the instance.

▼ Network settings Info

VPC - required Info

vpc-0048483b79fd48486 (lab-vpc)
10.0.0.0/16

↻

Subnet Info

subnet-0ac599a92b79b134f lab-subnet-public2
VPC: vpc-0048483b79fd48486 Owner: 677185652244
Availability Zone: us-east-1b IP addresses available: 251 CIDR: 10.0.2.0/24

↻ 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

Web Security Group sg-056cd0b0f585da5e1 X
VPC: vpc-0048483b79fd48486

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

► Advanced network configuration

41. In the *Configure storage* section, keep the default settings.

Note: The default settings specify that the *root volume* of the instance, which will host the Amazon Linux guest operating system that you specified earlier, will run on a general purpose SSD (*gp3*) hard drive that is 8 GiB in size. You could alternatively add more storage volumes, however that is not needed in this lab.

▼ Configure storage Info Advanced

1x 8 GiB gp3 Root volume (Not encrypted)

Free tier eligible customers can get up to 30 GB of EBS General Purpose (SSD) or Magnetic storage X

Add new volume

0 x File systems Edit

42. Configure a script to run on the instance when it launches:

- Expand the **Advanced details** panel.
- Scroll to the bottom of the page and then copy and paste the code shown below into the **User data** box:

User data - optional [Info](#)

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

 Choose file

```
#!/bin/bash

# Install Apache Web Server and PHP

dnf install -y httpd wget php mariadb105-server

# Download Lab files

wget https://aws-tc-largeobjects.s3.us-west-2.amazonaws.com/CUR-TF-100-ACCLFO-2/2-lab2-vpc/s3/lab-app.zip

unzip lab-app.zip -d /var/www/html/


# Turn on web server

chkconfig httpd on



service httpd start
```

- This script will run with root user permissions on the guest OS of the instance. It will run automatically when the instance launches for the first time. The script installs a web server, a database, and PHP libraries, and then it downloads and installs a PHP web application on the web server.

43. At the bottom of the **Summary** panel on the right side of the screen choose Launch instance
You will see a Success message.

 **Success**
Successfully initiated launch of instance ([i-0bd343a61bd418b56](#))

▼ Launch log





Initializing requests	 Succeeded
Launch initiation	 Succeeded

44. Choose View all instances

45. Wait until **Web Server 1** shows *2/2 checks passed* in the **Status check** column.

This may take a few minutes. Choose the refresh icon at the top of the page every 30 seconds or so to more quickly become aware of the latest status of the instance.

You will now connect to the web server running on the EC2 instance.

Instances (2) Info							Connect
<input type="text" value="Find instance by attribute or tag (case-sensitive)"/>							
<input type="checkbox"/>	Name	Instance ID	Instance state	Instance type	Status check		
<input type="checkbox"/>	Web Server 1	i-0bd343a61bd418b56	 Running 	t2.micro	 2/2 checks passed		

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46. Select **Web Server 1**.

47. Copy the **Public IPv4 DNS** value shown in the **Details** tab at the bottom of the page.

48. Open a new web browser tab, paste the **Public DNS** value and press Enter.
You should see a web page displaying the AWS logo and instance meta-data values.

