

High Performance and Distributed Computing for Big Data

Unit 3: AWS - Networking

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1. Introduction to AWS Networking

- Virtual Private Cloud (VPC)
- Subnets
- Route Tables
- Internet Gateway
- Elastic IP Addresses
- Load Balancers

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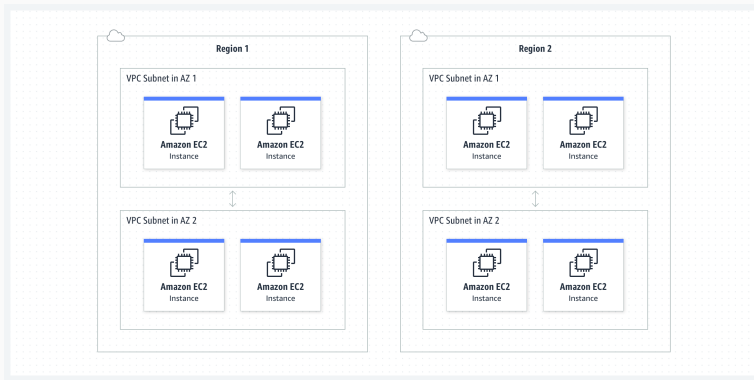
- Virtual Private Cloud (VPC)
- Subnets
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- Load Balancers

2. Hands-on: Deploying Wordpress in a VPC

Networking

What is a virtual private cloud (VPC)?

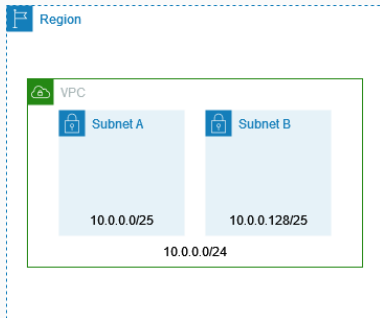
A **virtual private cloud (VPC)** is a virtual network dedicated to your AWS account. It is logically **isolated from other virtual networks in the AWS Cloud**. You can launch your AWS resources, such as *Amazon EC2 instances*.



1. Go to the VPC service.
2. Click on Your VPCs.
3. Click on Create VPC.
4. Fill the form with the following settings:
 - **Name:** hdcv-vpc
 - **IPv4 CIDR block:** 10.0.0.0/16

What is a subnet?

A **subnet** is a range of IP addresses in your VPC. You can launch AWS resources into a subnet that you select.



For example, you can create a **public subnet** for resources that must be connected to the internet, and a **private subnet** for data or other resources that won't be connected to the internet.

Creating a Subnet in a VPC

1. Navigate to the *VPC service* in the *AWS Management Console*.
2. Select **Subnets**.
3. Click on *Create subnet*.
4. Fill in the form with the following settings:
 - **Name:** hdcdb-public-subnet
 - **VPC:** Select the VPC you created (hdcdb-vpc)
 - **Availability Zone:** Select an availability zone
 - **IPv4 CIDR block:** 10.0.1.0/24

Deploying an EC2 instance in the VPC

Creating an EC2 instance

1. Go to the *EC2 service*.
2. Click on *Launch instance*.
3. Fill the form with the following settings:
 - **Name:** WebServer
 - **AMI:** Amazon Linux 2
 - **Instance type:** t2.micro
 - **Network:** hdcb-vpc
 - **Subnet:** hdcb-public-subnet
 - **Auto-assign Public IP:** Enable
 - **Security group:**
 - *Create a new security group*
 - **Name:** WebServer-SG
 - **Description:** Allow SSH traffic
 - **Inbound rules:** Type: SSH, Source: Anywhere

Security Group

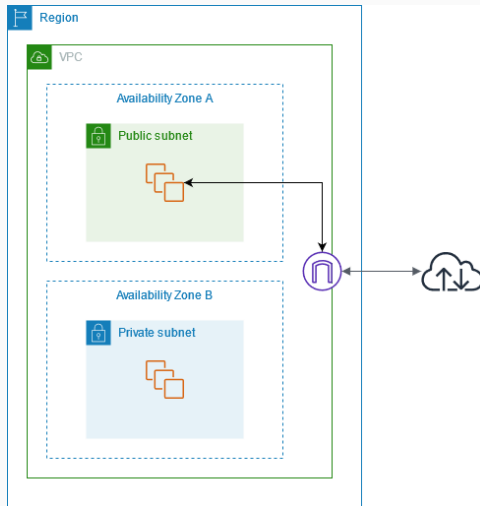
- **Inbound rules:** Relate to the traffic coming into the instance. For example, when you need to connect to the instance using SSH.
- **Outbound rules:** Relate to the traffic leaving the instance. For example, when the instance needs to connect to the internet to download updates.
- **Source/Destination:** The source/destination of the traffic. For example, you can specify a single IP address, a range of IP addresses, or a security group.
- **Protocol:** The protocol that the traffic is using. For example, TCP, UDP, or ICMP.
- **Port:** The port number that the traffic is coming from or going to. For example, port 22 for SSH traffic.

Accessing the EC2 instance

Observation 1

- The EC2 instance is not accessible from the internet.
- The reason is because the VPC and the subnet are private by default.

Solution



Accessing the EC2 instance

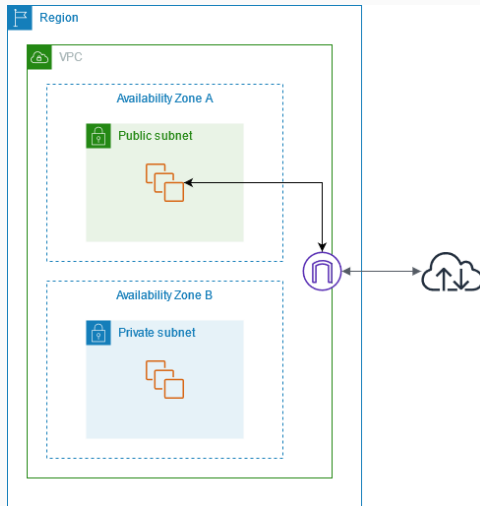
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Solution

We need to create an **internet gateway** and a **routing table**.

- The internet gateway allows the EC2 instance to connect to the internet.
- The route table specifies the rules for the traffic leaving the subnet.



Creating an Internet Gateway

1. Go to the *VPC service*.
2. Click on *Internet Gateways*.
3. Click on *Create internet gateway*.
4. Fill the form with the following settings:
 - **Name:** hdcb-igw
5. Attach the internet gateway to the VPC.

Creating a Route Table

Route Table

Each route in the table contains a *destination* and a *target*. Each subnet must be associated with a route table, which controls the routing for the subnet.

Main Route Table

A **route table** that automatically comes with your *VPC*. It controls the routing for all subnets that are not **explicitly** associated with any other route table.

Routing to the internet

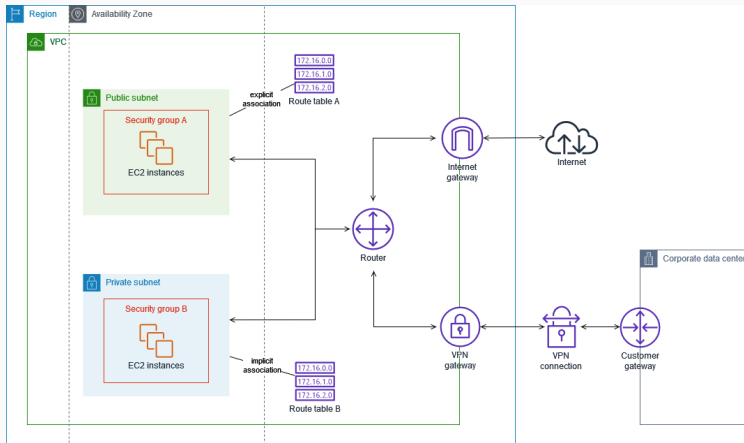
To enable your subnet to access the internet through an **internet gateway**, we need to add the following route. The *destination* for the route is **0.0.0.0/0**, which represents all IPv4 addresses. The *target* is the **internet gateway** that's attached to your VPC.

Creating a routing table

1. Go to the *VPC service*.
2. Click on *Route Tables*.
3. Click on *Create route table*.
4. Fill the form with the following settings:
 - **Name:** hdcb-public-2-internet
 - **VPC:** hdcb-vpc
5. Click on *Create route table*.
6. Associate the route table with the subnet.
7. Edit routes and add a route to the internet gateway.
 - **Destination:** 0.0.0.0/0
 - **Target:** hdcb-igw

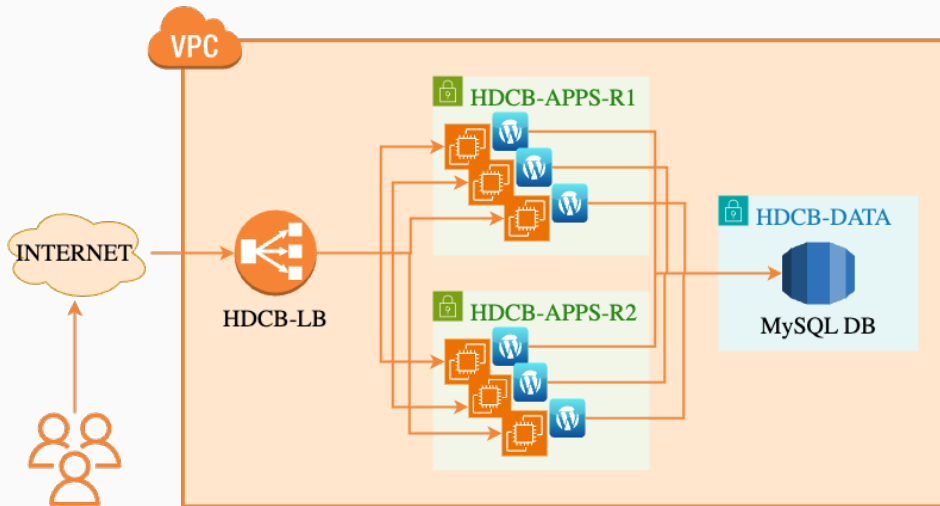
Subnets associations

Each *subnet* in your VPC must be associated with a *route table*. A subnet can be **explicitly** associated with custom route table, or **implicitly** associated with the main route table.



Hands-on: Deploying Wordpress in a VPC

Overview



Step 1: Networking - VPC and Subnets

- Create a VPC.
 - Name: HDCB-VPC
 - IPv4 CIDR block: 10.0.0.0/16
- Create applications subnets.
 - Name: HDCB-APPS-R1
 - VPC: HDCB-VPC
 - Availability Zone: us-east-1a
 - IPv4 CIDR block: 10.0.1.0/24
- Create applications subnets.
 - Name: HDCB-APPS-R1
 - VPC: HDCB-VPC
 - Availability Zone: us-east-1b
 - IPv4 CIDR block: 10.0.2.0/24
- Create a data subnet.
 - Name: HDCB-DATA
 - VPC: HDCB-VPC
 - Availability Zone: No preference
 - IPv4 CIDR block: 10.0.3.0/24
- Create an Internet Gateway.
 - Name: HDCB-IGW
 - Attach it to the VPC.

Step 2: Networking - Route Tables

- Create a route table for the applications subnets.
 - Name: HDCB-APPS-R1-RT
 - VPC: HDCB-VPC
 - Subnet Association: HDCB-APPS-R1
 - Edit Routes:
 - Destination: 0.0.0.0/0
 - Target: HDCB-IGW
- Name: HDCB-APPS-R2-RT
 - VPC: HDCB-VPC
 - Subnet Association: HDCB-APPS-R2
 - Edit Routes:
 - Destination: 0.0.0.0/0
 - Target: HDCB-IGW

Step 3: Deploying an EC2 instance

EC2 instance

- Name: HDCB-WP
- AMI: Amazon Linux 2
- Instance type: t2.micro
- Network: HDCB-VPC
- Subnet: HDCB-APPS-R1
- Auto-assign Public IP: Enable
- Security group: Create a new security group

Security Group

- Name: HDCB-WP-SG
- Description: Allow SSH and HTTP traffic
- Inbound rules:
 - Type: SSH
 - Source: Anywhere
 - Description: Allow SSH traffic
 - Type: HTTP
 - Source: Anywhere
 - Description: Allow HTTP traffic

Step 4: Create an RDS instance

RDS instance

- Name: HDCB-RDS
- Engine: MySQL
- Edition: Free tier
- Version: MySQL 8.0.35
- Templates: Free tier
- Settings:
 - DB instance identifier: wordpress-db
 - Master username: admin
 - Master password: h0dc?r00t?p4ssw0rd
 - Confirm password: h0dc?r00t?p4ssw0rd
 - VPC: HDCB-VPC
 - Public accessibility: No
 - Subnet group: HDCB-RDS-SG
 - Additional configuration:
 - Initial database name: wordpress_db

Security Group

- Name: HDCB-RDS-SG
- Description: Allow MySQL traffic
- Inbound rules: # Delete the exiting one
 - Type: MySQL/Aurora
 - Protocol: TCP
 - Port Range: 3306
 - Source: HDCB-WP-SG
- Outbound rules: delete all

Step 5: Connect to the EC2 instance

1. Connect to the EC2 instance using SSH.
2. Run the installation script for Wordpress. (take the script from the virtual campus)

```
nano install-wordpress.sh  
# paste the script  
# save the file  
sudo bash install-wordpress.sh
```

3. Test the installation by accessing the EC2 instance in a web browser.

Step 6: Test DB connection

1. Once the RDS instance is ready, connect the browser to the EC2 IP address.
2. Fill the initial form with the RDS endpoint, the username and the password.
3. If everything is ok, you should see the Wordpress installation start page.
4. Do not finish the installation.
5. Close the browser.

Dynamic and Static IP Addresses in AWS

IP addresses serve as unique identifiers for devices on a network. AWS offers two distinct types of IP addresses to cater to different needs:

Dynamic IP Addresses

- Temporary and assigned upon instance launch.
- Released when the instance is stopped or terminated.
- Can change throughout the instance's lifecycle.

Elastic IP Addresses

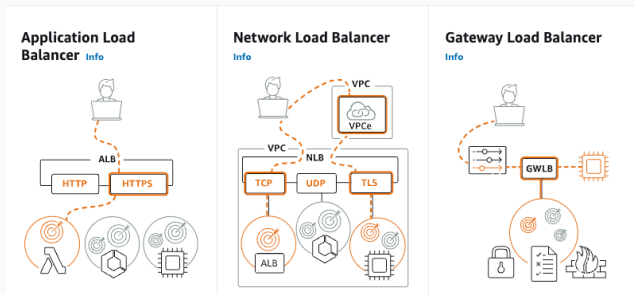
- Static and assigned to an instance.
- Retained despite stopping or terminating the instance.
- Provides a consistent IP address for services.

Best Practices

- To keep continuous services running, Elastic IPs are recommended for web servers.
- To ensure high availability and fault tolerance, load balancers take advantage of elastic IPs.

Load balancers in AWS

A load balancer is a device that distributes network or application traffic across a cluster of servers. It ensures that no single server becomes overwhelmed with traffic, and it provides high availability and reliability by sending requests only to servers that are online and operational.



- **Application Load Balancer:** Best suited for load balancing of HTTP and HTTPS traffic.
- **Network Load Balancer:** Best suited for load balancing of TCP traffic where extreme performance is required.
- **Classic Load Balancer:** Provides basic load balancing across multiple Amazon EC2 instances.
- **Gateway Load Balancer:** A new managed service to deploy, scale, and manage third-party virtual appliances.

Step 6: Deploy Load Balancer

- Name: HDCB-LB
- Type: Application Load Balancer
- Scheme: internet-facing
- VPC: HDCB-VPC
- Security Group: Create a new security group
- Mapping:
 - Availability Zones:
 - us-east-1a: HDCB-APPS-R1
 - us-east-1b: HDCB-APPS-R2
- Listeners: Port 80 as default
- Target group: Create new target group
- Register the instances to the target group:
HDCB-WP

Target Group

- Name: HDCB-WP-TG (Target type: Instance, Protocol: HTTP1, Health checks: Keep the default)

Security Group

- Name: HDCB-LB-SG
- Description: Allow HTTP traffic from the internet and to the HDCB-WP instances
- Inbound rules:
 - Type: HTTP
 - Source: Anywhere
 - Description: Allow HTTP traffic
 - Port: 80
- Outbound rules:
 - Type: All traffic
 - Protocol: All
 - Port Range: All
 - Destination: HDCB-WP-SG

Step 7: Finish the Wordpress installation

1. Wait for the load balancer to be ready.
2. Access the load balancer DNS name and finish the installation.
3. Fill the form with:
 - Title: HDCB-WP
 - Username: wordpress_user
 - Password: ??????????
 - Email: a@gmail.com

Step 8: Access the wordpress site

Now, you can access your wordpress either by using the load balancer or the EC2 instance public IP address.

To block the access from internet to the EC2 instance:

- Go to the security group of the EC2 instance
- Edit the inbound rules:
 - Delete the HTTP rule
 - Add a new rule:
 - Type: All traffic
 - Protocol: All
 - Port Range: All
 - Source: HDCB-LB-SG

Conclusions

Recap

- We learned about VPCs, subnets, route tables, internet gateways, elastic IP addresses, and load balancers.
- We deployed a simple Wordpress in a VPC using networking and load balancers.
- We learned about how to set up a relational database in AWS.

Questions?

Thanks for your attention!