Module 5: Networking and Content Delivery

AWS Academy Cloud Foundations

Module overview

Topics

- Networking basics
- Amazon VPC
- VPC networking
- VPC security
- Amazon Route 53
- Amazon CloudFront

Activities

- Label a network diagram
- Design a basic VPC architecture

Demo

- VPC demonstration

Lab

- Build your VPC and launch a web server

Knowledge check

Module objectives

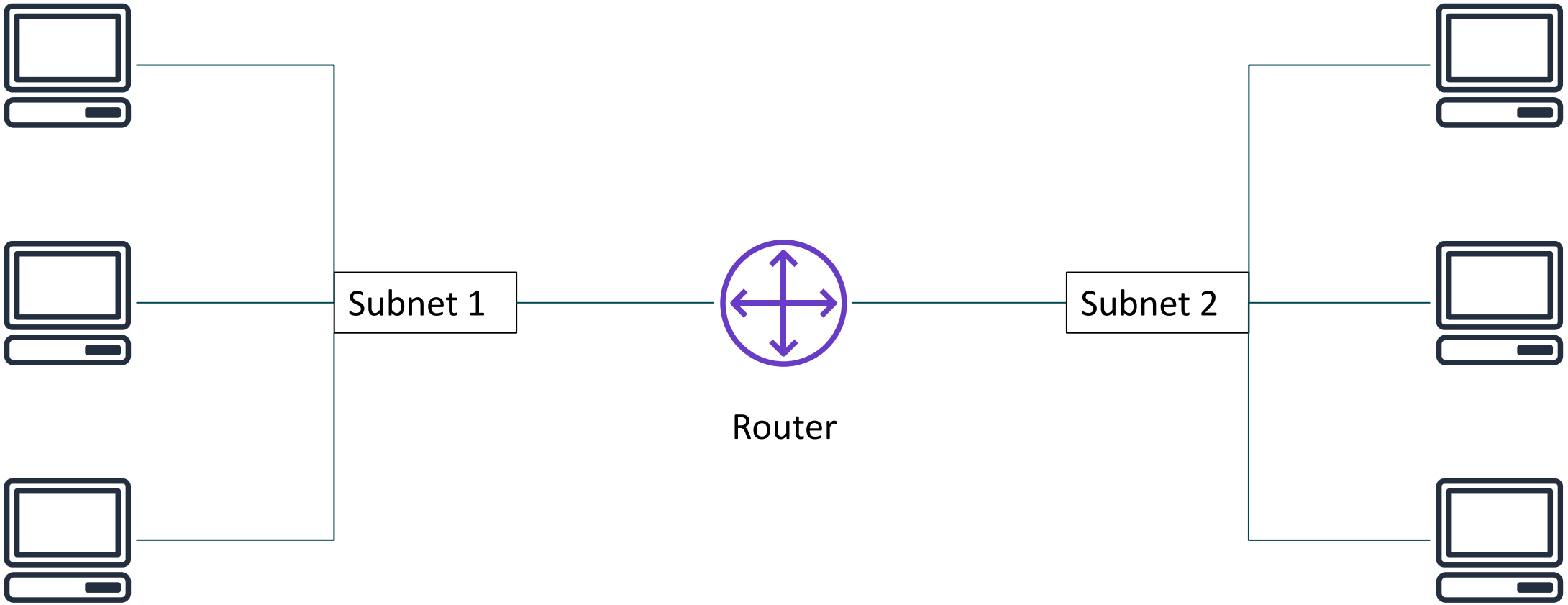
After completing this module, you should be able to:

- Recognize the basics of networking
- Describe virtual networking in the cloud with Amazon VPC
- Label a network diagram
- Design a basic VPC architecture
- Indicate the steps to build a VPC
- Identify security groups
- Create your own VPC and add additional components to it to produce a customized network
- Identify the fundamentals of Amazon Route 53
- Recognize the benefits of Amazon CloudFront

Section 1: Networking basics

Module 5: Networking and Content Delivery

Networks



IP addresses

192 . 0 . 2 . 0

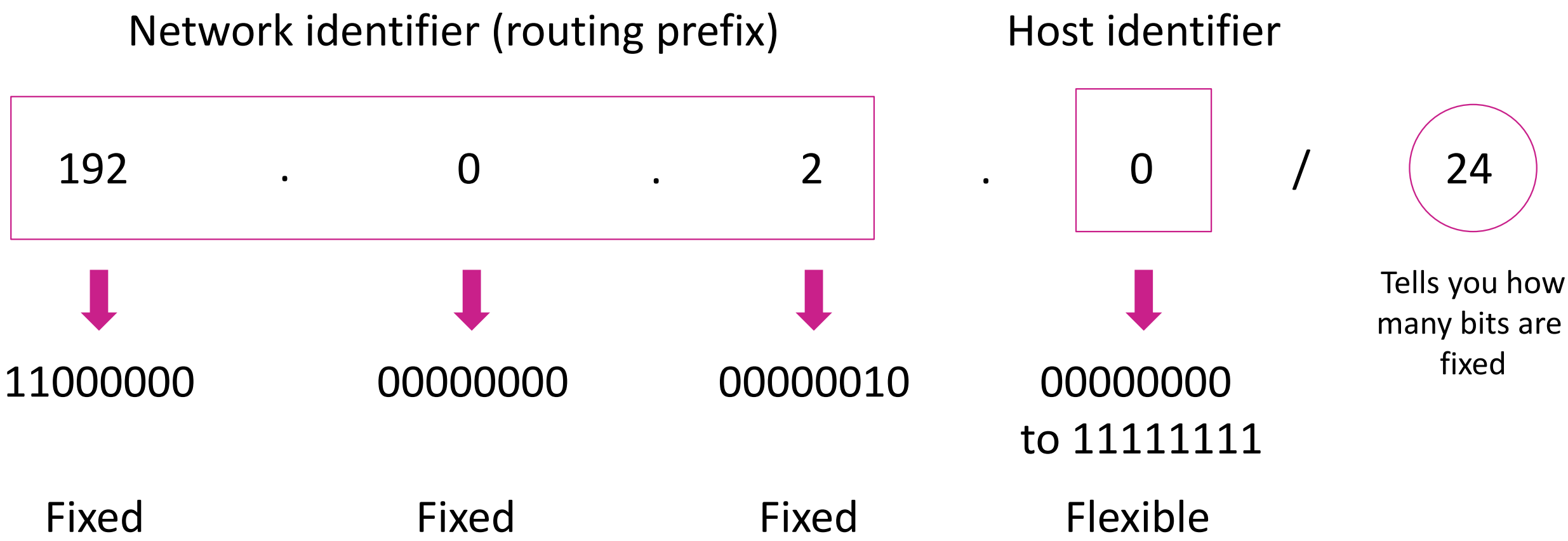
11000000 00000000 00000010 00000000

IPv4 and IPv6 addresses

IPv4 (32-bit) address: 192.0.2.0

IPv6 (128-bit) address: 2600:1f18:22ba:8c00:ba86:a05e:a5ba:00FF

Classless Inter-Domain Routing (CIDR)



Open Systems Interconnection (OSI) model

Layer	Number	Function	Protocol/Address
Application	7	Means for an application to access a computer network	HTTP(S), FTP, DHCP, LDAP
Presentation	6	• Ensures that the application layer can read the data • Encryption	ASCI, ICA
Session	5	Enables orderly exchange of data	NetBIOS, RPC
Transport	4	Provides protocols to support host-to-host communication	TCP, UDP
Network	3	Routing and packet forwarding (routers)	IP
Data link	2	Transfer data in the same LAN network (hubs and switches)	MAC
Physical	1	Transmission and reception of raw bitstreams over a physical medium	Signals (1s and 0s)

Section 2: Amazon VPC

Module 5: Networking and Content Delivery

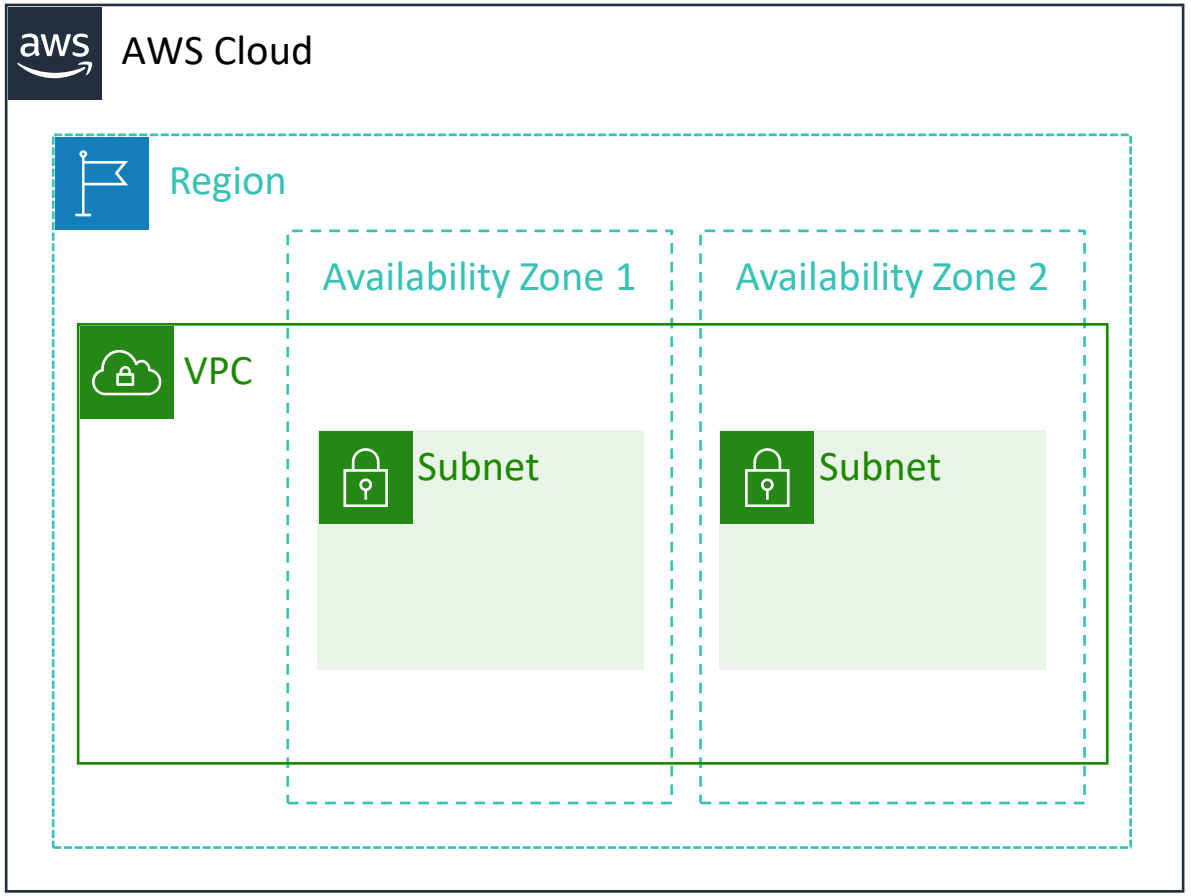
Amazon VPC

Amazon VPC

- Enables you to provision a logically isolated section of the AWS Cloud where you can launch AWS resources in a virtual network that you define
- Gives you control over your virtual networking resources, including:
  - Selection of IP address range
  - Creation of subnets
  - Configuration of route tables and network gateways
- Enables you to customize the network configuration for your VPC
- Enables you to use multiple layers of security

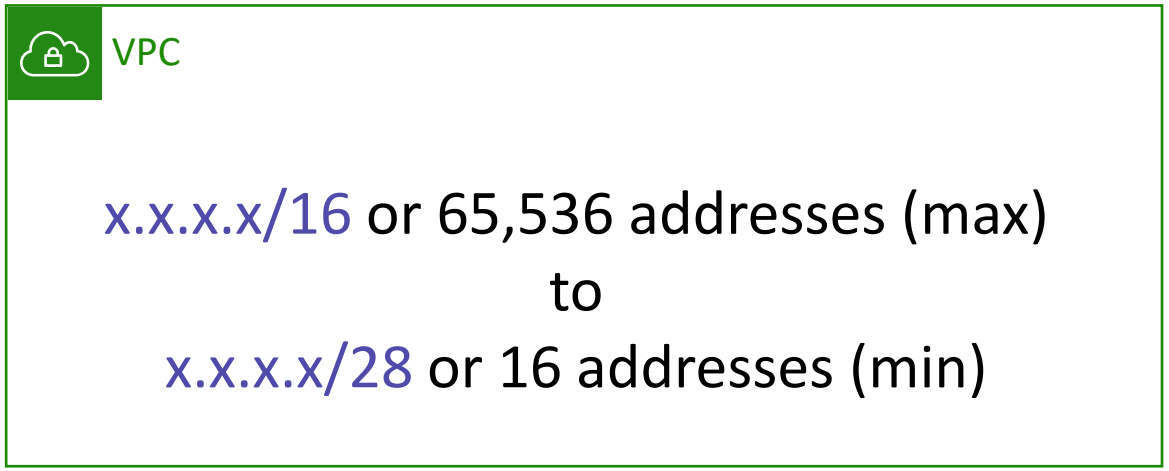
VPCs and subnets

- VPCs:
  - Logically isolated from other VPCs
  - Dedicated to your AWS account
  - Belong to a single AWS Region and can span multiple Availability Zones
- Subnets:
  - Range of IP addresses that divide a VPC
  - Belong to a single Availability Zone
  - Classified as public or private



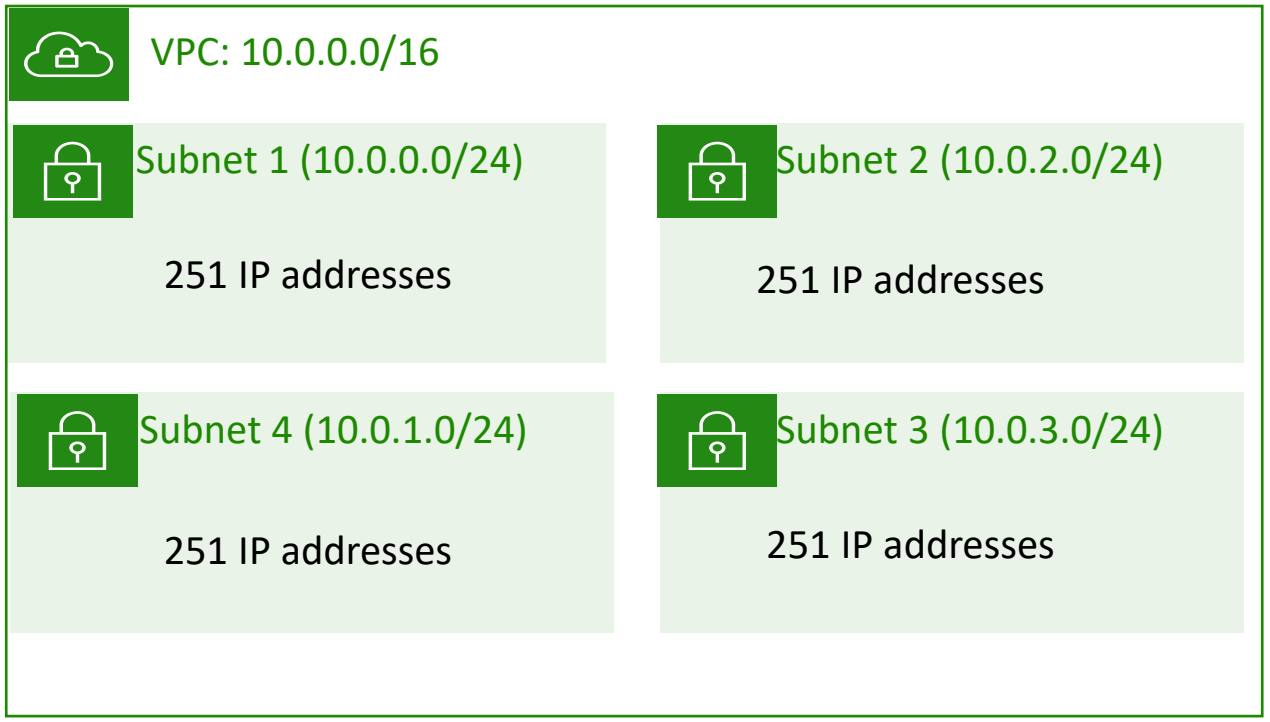
IP addressing

- When you create a VPC, you assign it to an IPv4 CIDR block (range of private IPv4 addresses).
- You cannot change the address range after you create the VPC.
- The largest IPv4 CIDR block size is /16.
- The smallest IPv4 CIDR block size is /28.
- IPv6 is also supported (with a different block size limit).
- CIDR blocks of subnets cannot overlap.



Reserved IP addresses

Example: A VPC with an IPv4 CIDR block of 10.0.0.0/16 has 65,536 total IP addresses. The VPC has four equal-sized subnets. Only 251 IP addresses are available for use by each subnet.



IP Addresses for CIDR block 10.0.0.0/24	Reserved for
10.0.0.0	Network address
10.0.0.1	Internal communication
10.0.0.2	Domain Name System (DNS) resolution
10.0.0.3	Future use
10.0.0.255	Network broadcast address

Public IP address types

Public IPv4 address

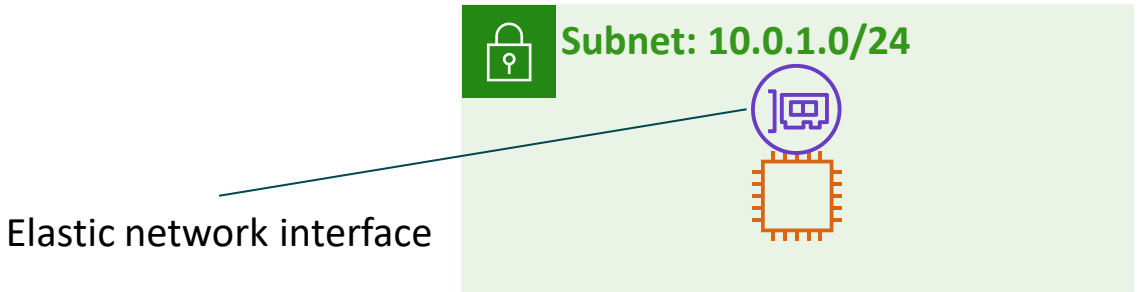
- Manually assigned through an Elastic IP address
- Automatically assigned through the auto-assign public IP address settings at the subnet level

Elastic IP address

- Associated with an AWS account
- Can be allocated and remapped anytime
- Additional costs might apply

Elastic network interface

- An elastic network interface is a virtual network interface that you can:
  - Attach to an instance.
  - Detach from the instance, and attach to another instance to redirect network traffic.
- Its attributes follow when it is reattached to a new instance.
- Each instance in your VPC has a default network interface that is assigned a private IPv4 address from the IPv4 address range of your VPC.



Route tables and routes

- A route table contains a set of rules (or routes) that you can configure to direct network traffic from your subnet.
- Each route specifies a destination and a target.
- By default, every route table contains a local route for communication within the VPC.
- Each subnet must be associated with a route table (at most one).

Main (Default) Route Table

Destination	Target
10.0.0.0/16	local

VPC CIDR block

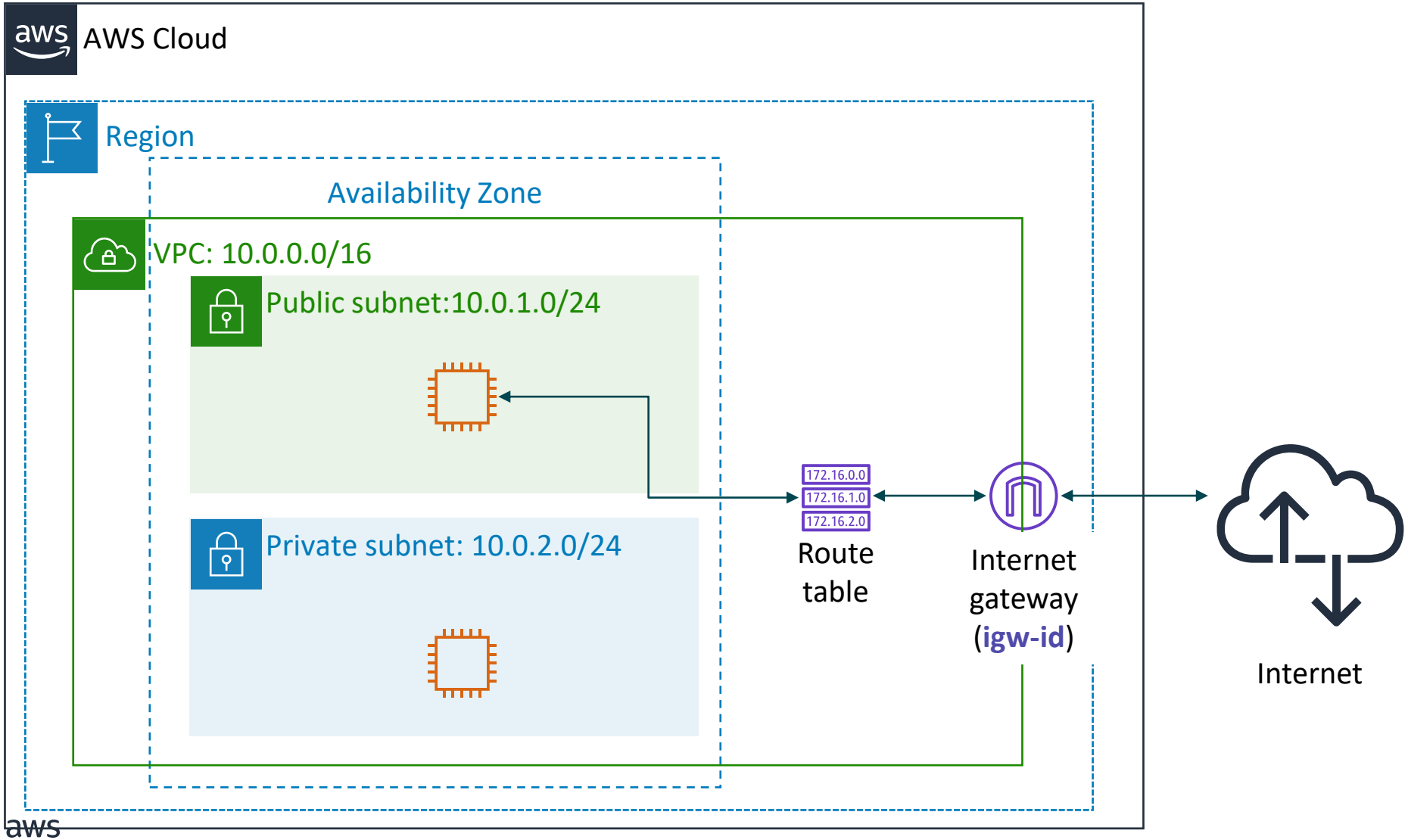
Section 2 key takeaways

- A VPC is a logically isolated section of the AWS Cloud.
- A VPC belongs to one Region and requires a CIDR block.
- A VPC is subdivided into subnets.
- A subnet belongs to one Availability Zone and requires a CIDR block.
- Route tables control traffic for a subnet.
- Route tables have a built-in local route.
- You add additional routes to the table.
- The local route cannot be deleted.

Section 3: VPC networking

Module 5: Networking and Content Delivery

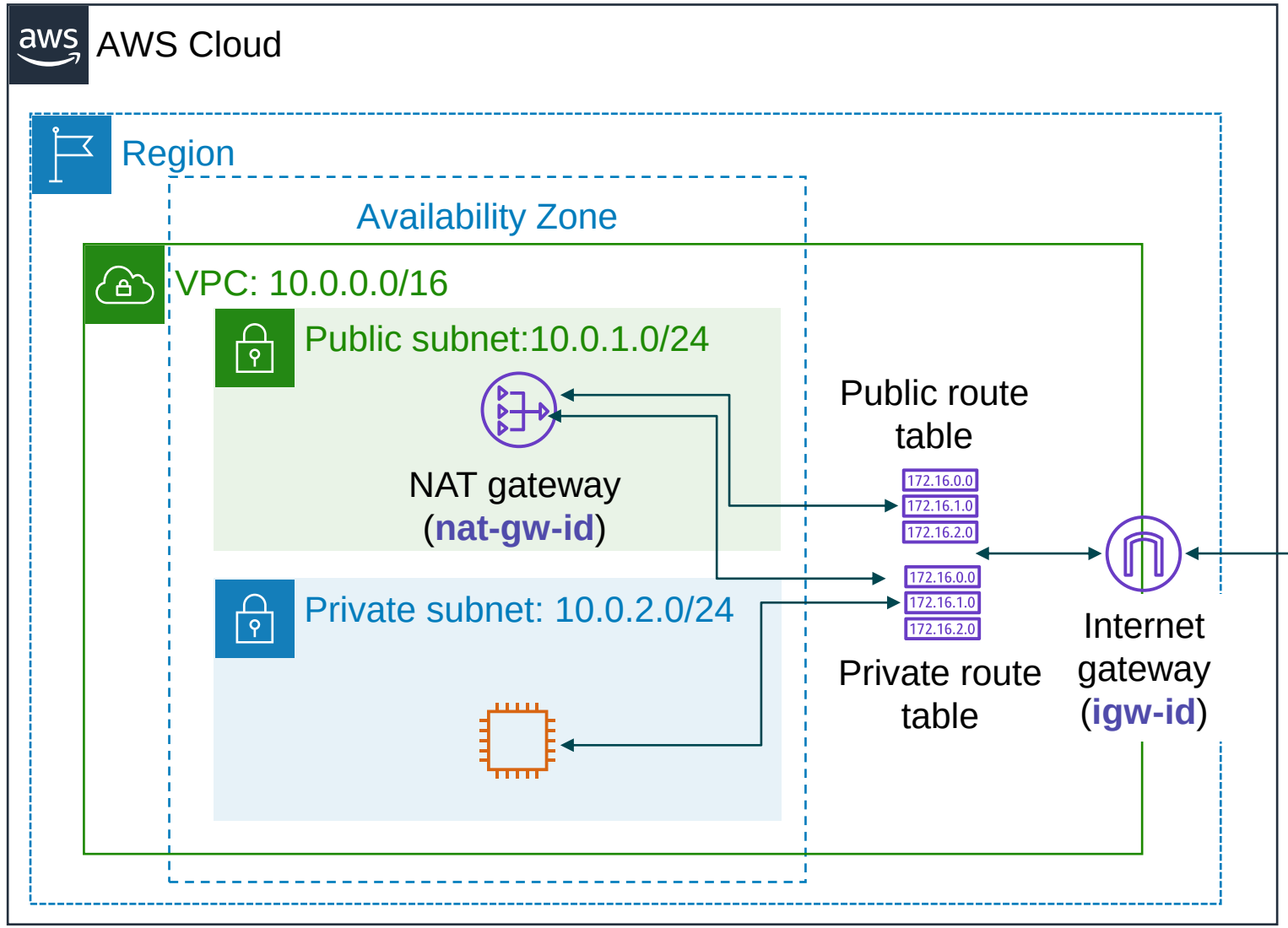
Internet gateway



Public Subnet Route Table

Destination	Target
10.0.0.0/16	local
0.0.0.0/0	igw-id

Network address translation (NAT) gateway



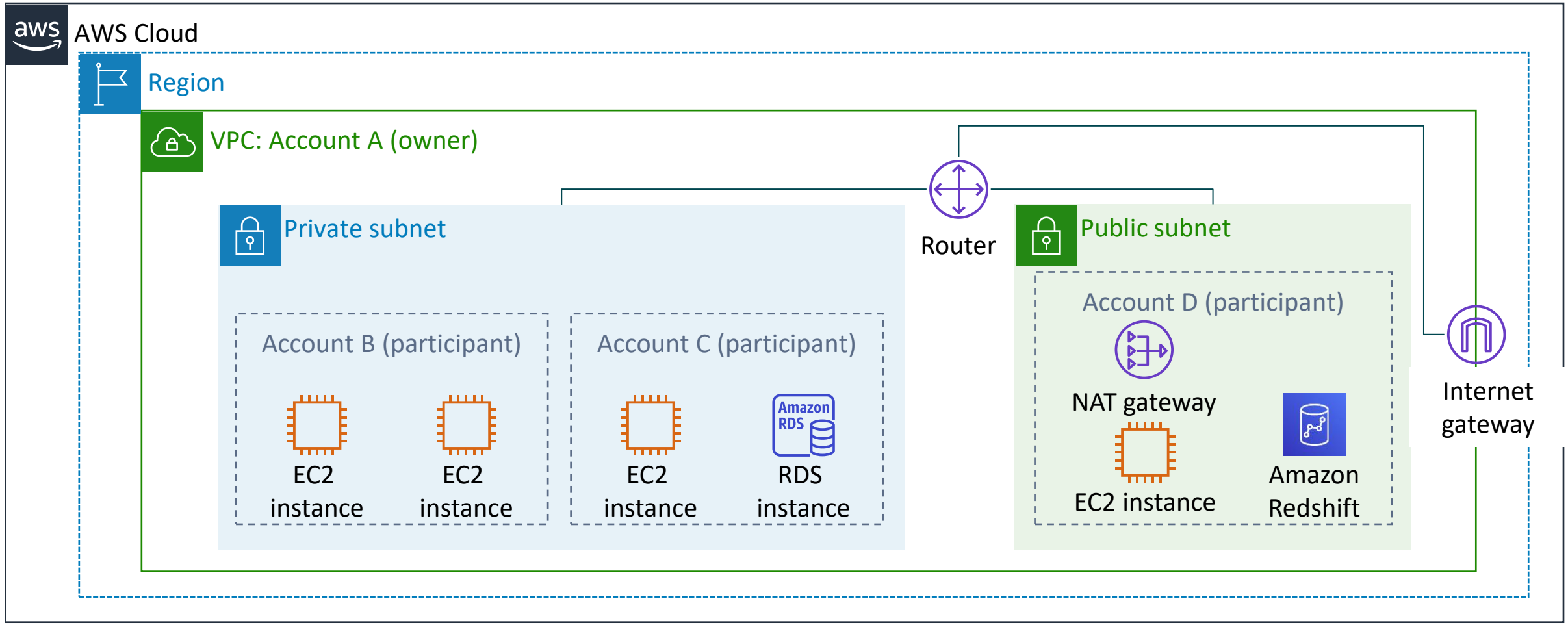
Public Subnet Route Table

Destination	Target
10.0.0.0/16	local
0.0.0.0/0	igw-id

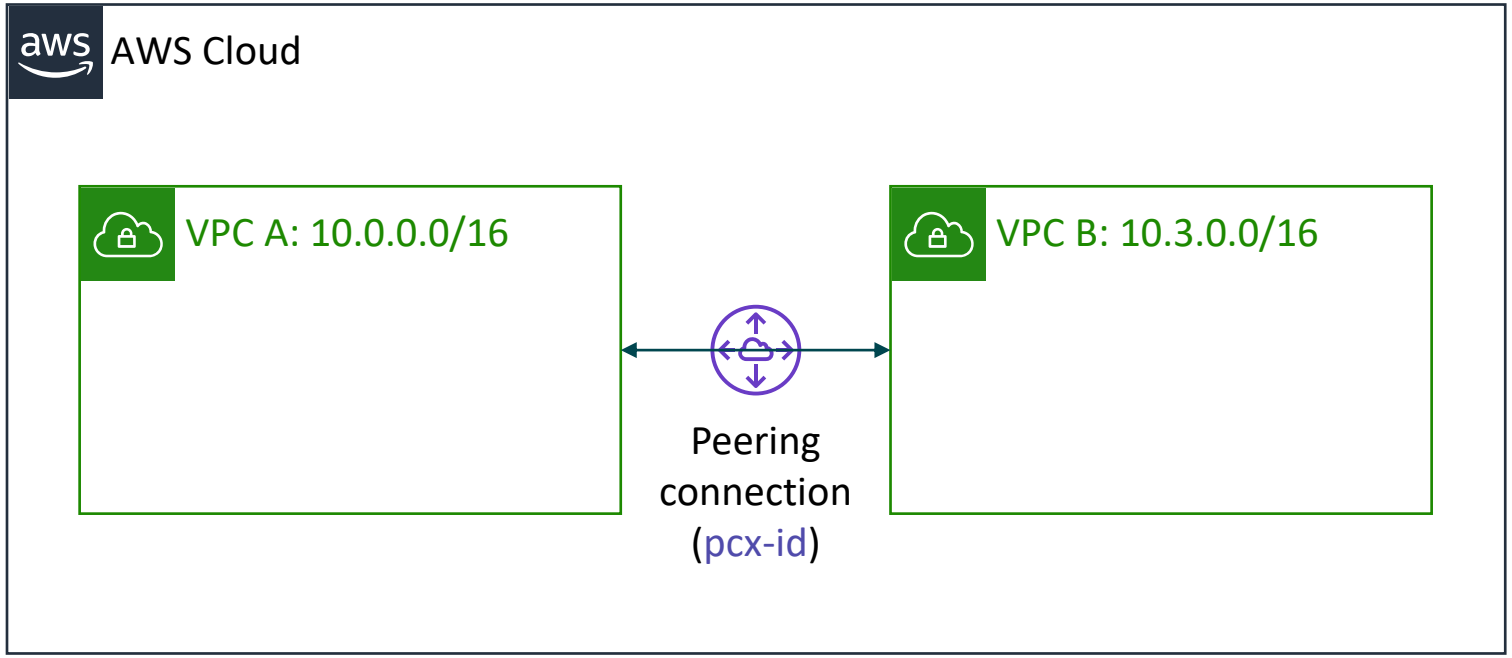
Private Subnet Route Table

Destination	Target
10.0.0.0/16	local
0.0.0.0/0	nat-gw-id

VPC sharing



VPC peering



You can connect VPCs in your own AWS account, between AWS accounts, or between AWS Regions.

Restrictions:

- IP spaces cannot overlap.
- Transitive peering is not supported.
- You can only have one peering resource between the same two VPCs.

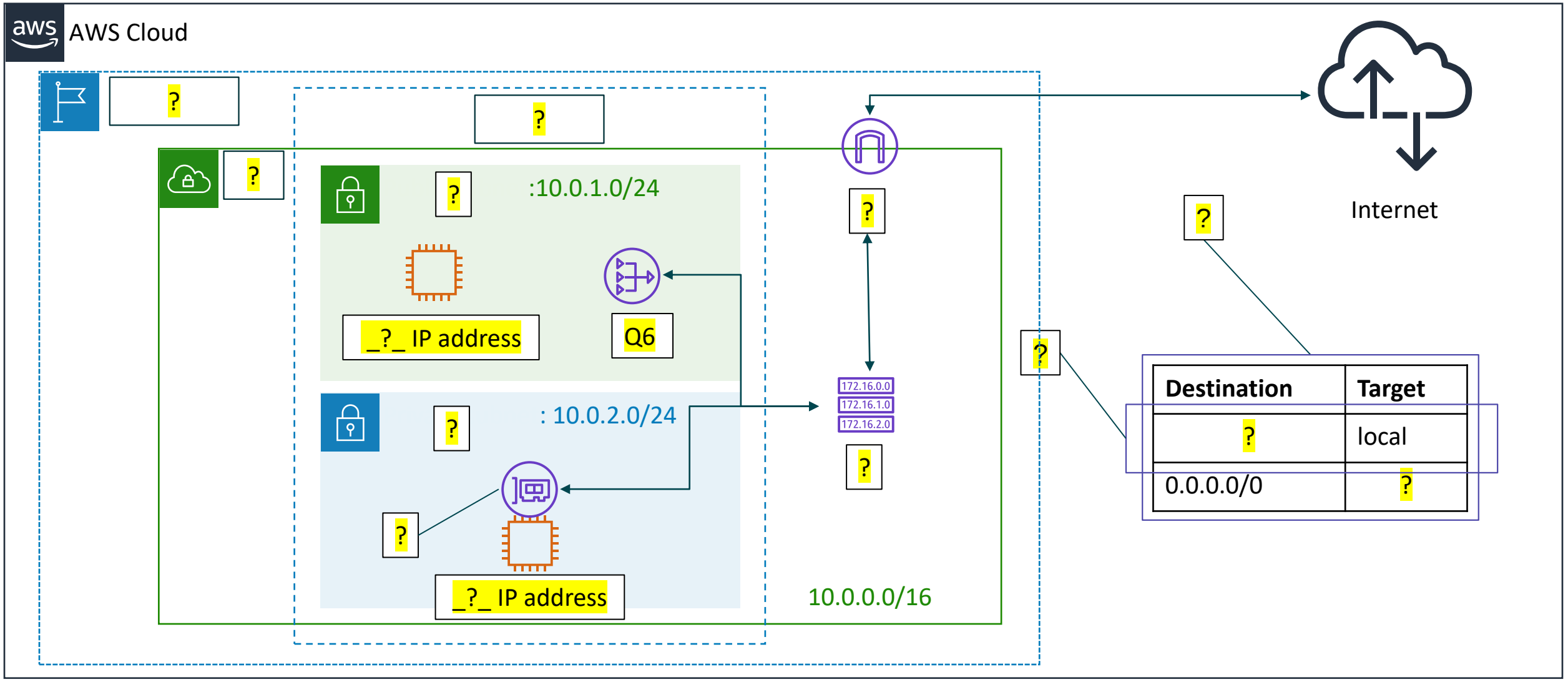
Route Table for VPC A

Destination	Target
10.0.0.0/16	local
10.3.0.0/16	pcx-id

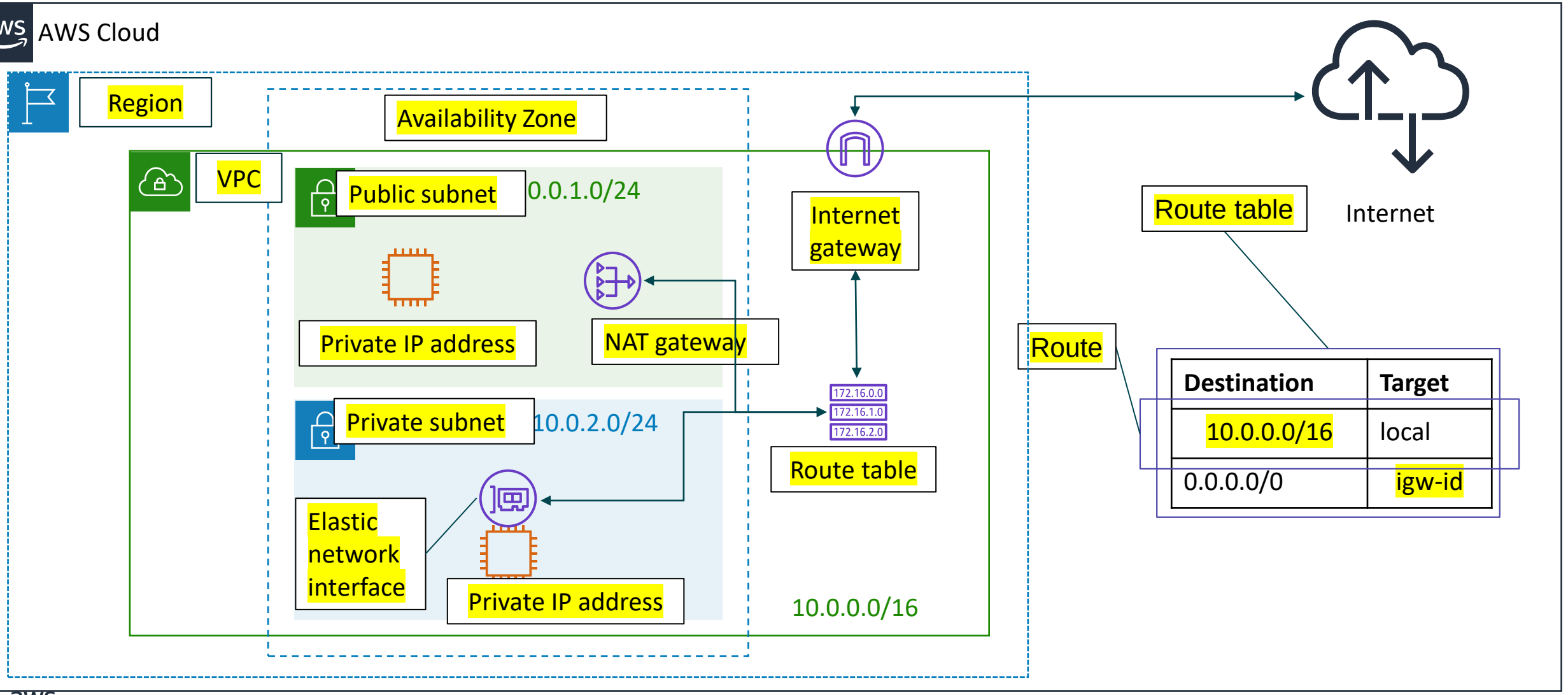
Route Table for VPC B

Destination	Target
10.3.0.0/16	local
10.0.0.0/16	pcx-id

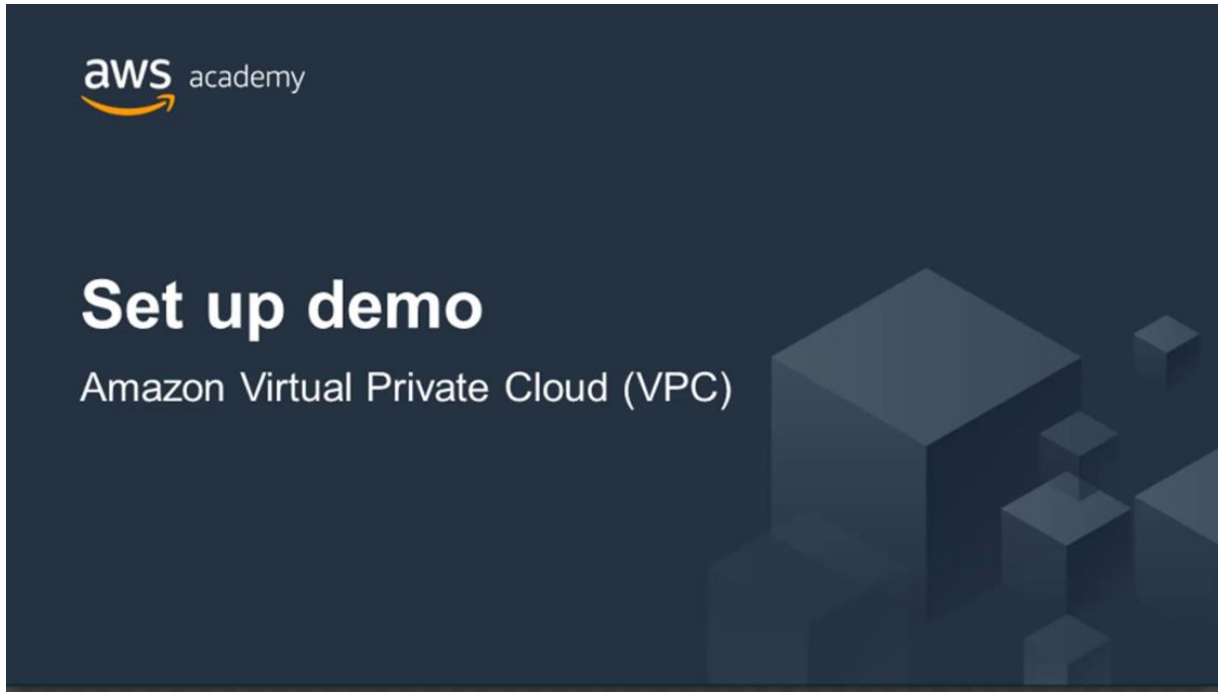
Activity: Label this network diagram



Activity: Solution



Recorded Amazon VPC demonstration



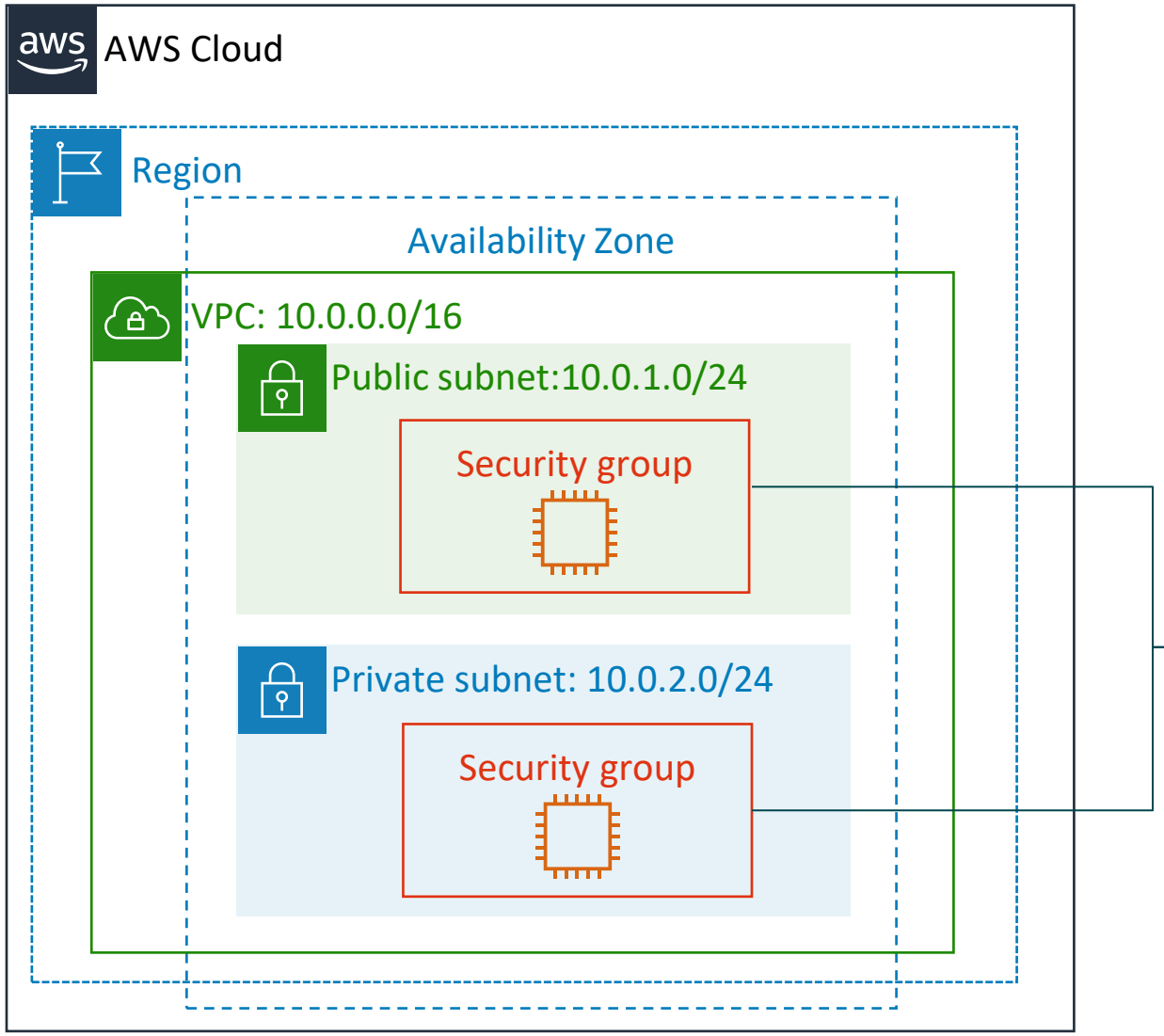
Section 3 key takeaways

- There are several VPC networking options, which include:
  - Internet gateway
  - NAT gateway
  - VPC endpoint
  - VPC peering
  - VPC sharing
  - AWS Site-to-Site VPN
  - AWS Direct Connect
  - AWS Transit Gateway
- You can use the VPC Wizard to implement your design.

Section 4: VPC security

Module 5: Networking and Content Delivery

Security groups (1 of 2)



Security groups act at the instance level.

Security groups (2 of 2)

- Security groups have rules that control inbound and outbound instance traffic.
- Default security groups deny all inbound traffic and allow all outbound traffic.
- Security groups are stateful.

Inbound			
Source	**Protocol**	**Port Range**	**Description**
sg-*xxxxxxxx*	All	All	Allow inbound traffic from network interfaces assigned to the same security group.

Outbound			
Destination	Protocol	Port Range	Description
0.0.0.0/0	All	All	Allow all outbound IPv4 traffic.
::/0	All	All	Allow all outbound IPv6 traffic.

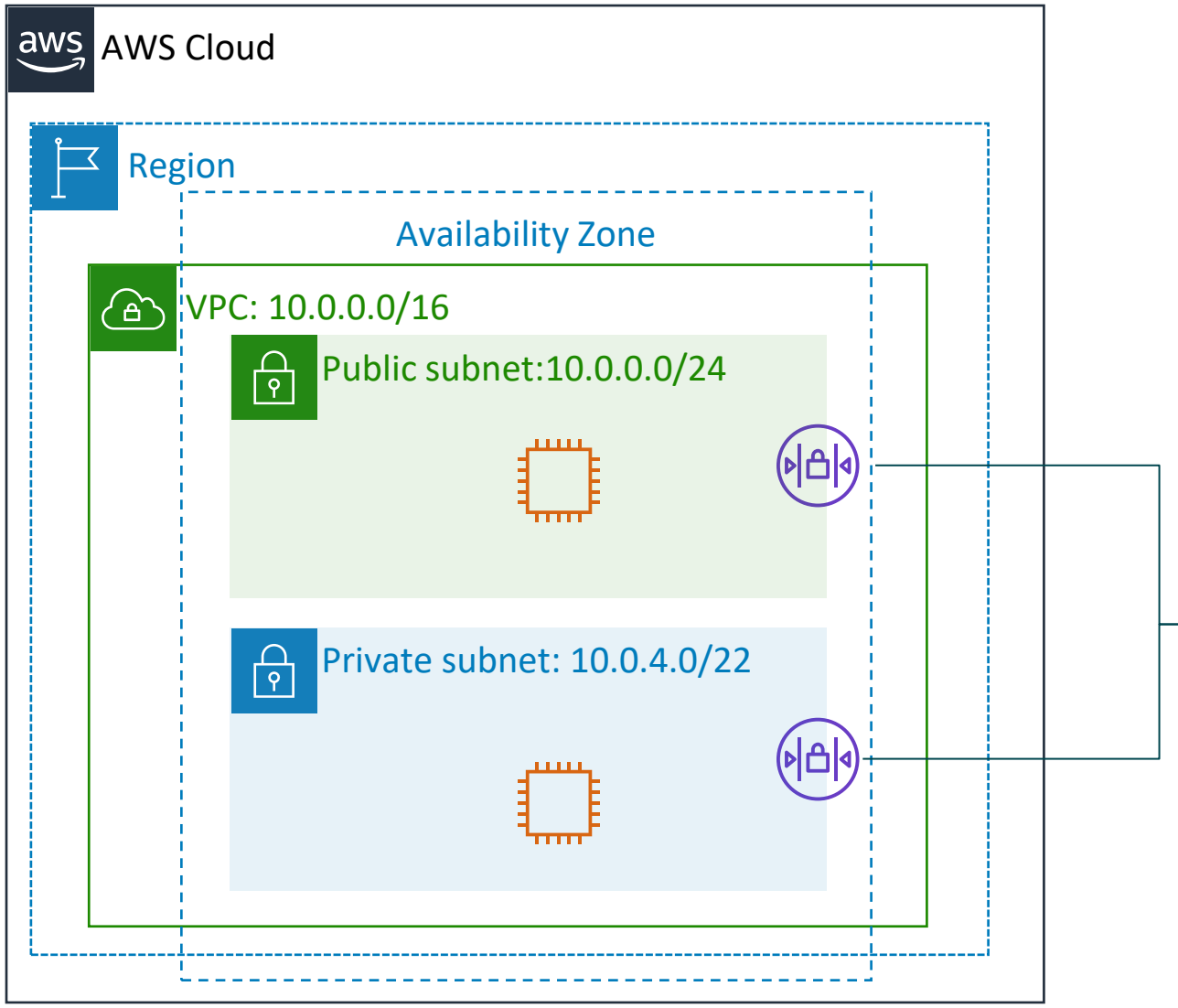
Custom security group examples

- You can **specify allow** rules, but not deny rules.
- **All rules are evaluated** before the decision to allow traffic.

Inbound			
Source	**Protocol**	**Port Range**	**Description**
0.0.0.0/0	TCP	80	Allow inbound HTTP access from all IPv4 addresses
0.0.0.0/0	TCP	443	Allow inbound HTTPS access from all IPv4 addresses
Your network's public IPv4 address range	TCP	22	Allow inbound SSH access to Linux instances from IPv4 IP addresses in your network (over the internet gateway)

Outbound			
Destination	Protocol	Port Range	Description
The ID of the security group for your Microsoft SQL Server database servers	TCP	1433	Allow outbound Microsoft SQL Server access to instances in the specified security group

Network access control lists (network ACLs 1 of 2)



Network ACLs act at the **subnet level**.

Network access control lists (network ACLs 2 of 2)

- A network ACL has separate inbound and outbound rules, and each rule can either allow or deny traffic.
- Default network ACLs allow all inbound and outbound IPv4 traffic.
- Network ACLs are stateless.

Inbound					
Rule	**Type**	**Protocol**	**Port Range**	**Source**	**Allow/Deny**
100	All IPv4 traffic	All	All	0.0.0.0/0	ALLOW
*	All IPv4 traffic	All	All	0.0.0.0/0	DENY

Outbound					
Rule	**Type**	**Protocol**	**Port Range**	**Destination**	**Allow/Deny**
100	All IPv4 traffic	All	All	0.0.0.0/0	ALLOW
*	All IPv4 traffic	All	All	0.0.0.0/0	DENY

Custom network ACLs examples

- **Custom** network ACLs **deny** all inbound and outbound traffic until you add rules.
- You can specify **both allow and deny** rules.
- Rules are evaluated in number order, starting with the **lowest number**.

Inbound					
Rule	**Type**	**Protocol**	**Port Range**	**Source**	**Allow/Deny**
100	HTTPS	TCP	443	0.0.0.0/0	ALLOW
120	SSH	TCP	22	192.0.2.0/24	ALLOW
*	All IPv4 traffic	All	All	0.0.0.0/0	DENY

Outbound					
Rule	**Type**	**Protocol**	**Port Range**	**Destination**	**Allow/Deny**
100	HTTPS	TCP	443	0.0.0.0/0	ALLOW
120	SSH	TCP	22	192.0.2.0/24	ALLOW
*	All IPv4 traffic	All	All	0.0.0.0/0	DENY

Activity: Design a VPC

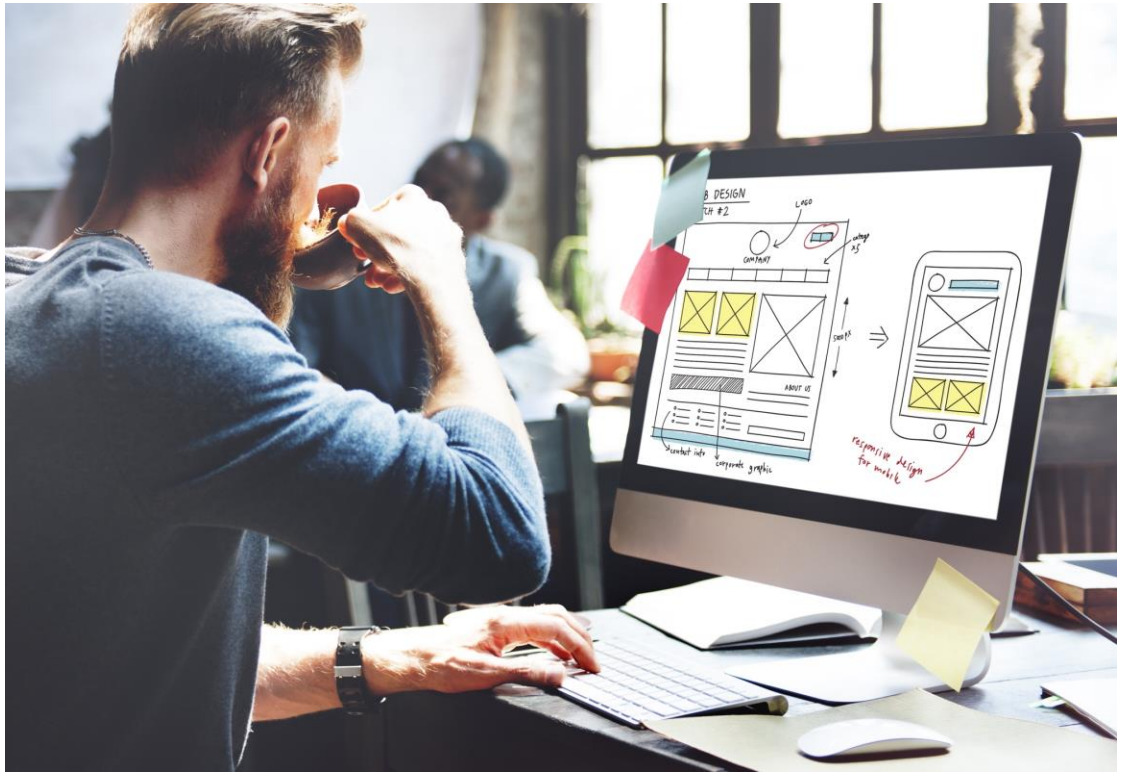
Scenario: You have a small business with a website that is hosted on an Amazon Elastic Compute Cloud (Amazon EC2) instance. You have customer data that is stored on a backend database that you want to keep private. You want to use Amazon VPC to set up a VPC that meets the following requirements:

- Your web server and database server must be in separate subnets.
- The first address of your network must be 10.0.0.0. Each subnet must have 256 total IPv4 addresses.
- Your customers must always be able to access your web server.
- Your database server must be able to access the internet to make patch updates.
- Your architecture must be highly available and use at least one custom firewall layer.

Section 4 key takeaways

- Build security into your VPC architecture:
  - Isolate subnets if possible.
  - Choose the appropriate gateway device or VPN connection for your needs.
  - Use firewalls.
- Security groups and network ACLs are firewall options that you can use to secure your VPC.

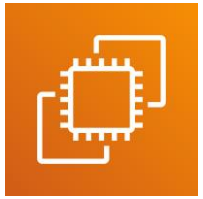
Lab 2: Build Your VPC and Launch a Web Server



Lab 2: Scenario

In this lab, you use Amazon VPC to create your own VPC and add some components to produce a customized network. You create a security group for your VPC. You also create an EC2 instance and configure it to run a web server and to use the security group. You then launch the EC2 instance into the VPC.

Amazon VPC



Amazon EC2

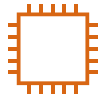
Lab 2: Tasks

- Create a VPC.

- Create additional subnets.

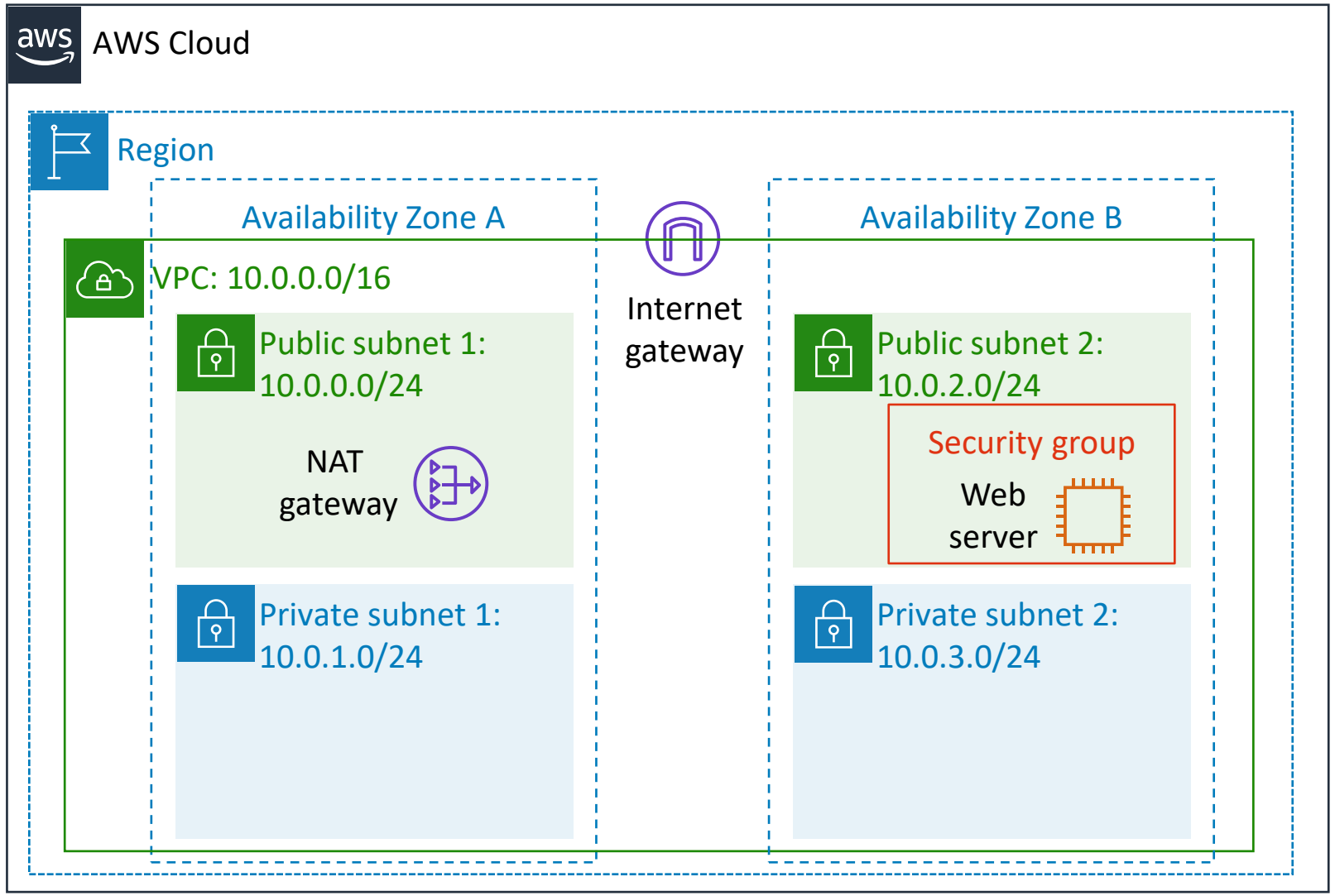
Security group

- Create a VPC security group.



- Launch a web server instance.

Lab 2: Final product



Public Route Table

Destination	Target
10.0.0.0/16	Local
0.0.0.0/0	Internet gateway

Private Route Table

Destination	Target
10.0.0.0/16	Local
0.0.0.0/0	NAT gateway

~ 30 minutes

Begin Lab 2: Build Your VPC and Launch a Web Server

Lab debrief: Key takeaways