

Lecture-10: Networking and Content Delivery

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

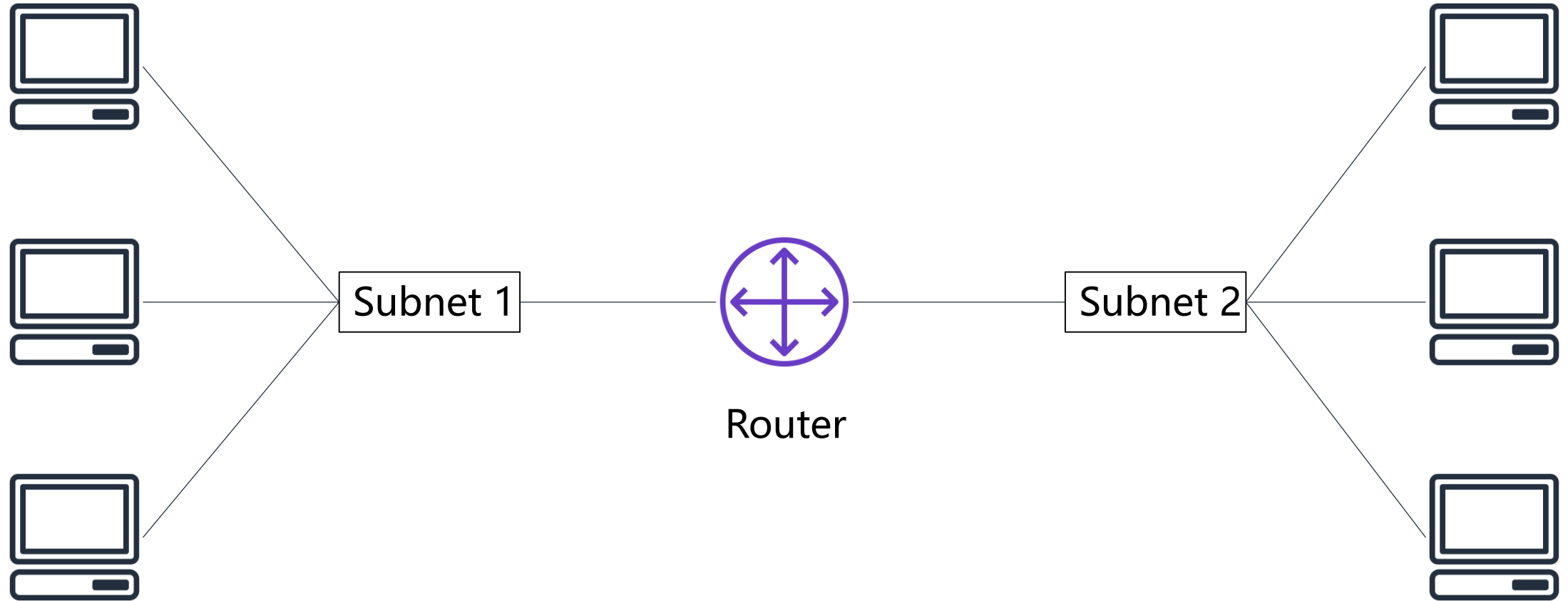


Knowledge check

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



IP addresses

192

.

0

.

2

.

0



11000000

00000000

00000010

00000000

IPv4 and IPv6 addresses

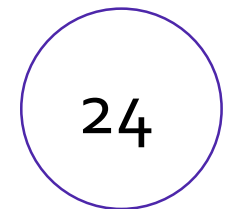
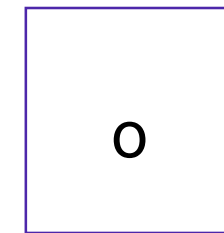
IPv4 (32-bit) address: 192.0.2.0

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

Classless Inter-Domain Routing (CIDR)

Network identifier (routing prefix)

Host identifier



11000000

00000000

00000010

00000000
to 11111111

Fixed

Fixed

Fixed

Flexible

Tells you how many bits are fixed

Open Systems Interconnection (OSI) model

Layer	Number	Function	Protocol/Addresses
Application	7	Means for an application to access a computer network	HTTP(S), FTP, DHCP, LDAP
Presentation	6	<ul style="list-style-type: none">• Ensures that the application layer can read the data• Encryption	ASCII
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

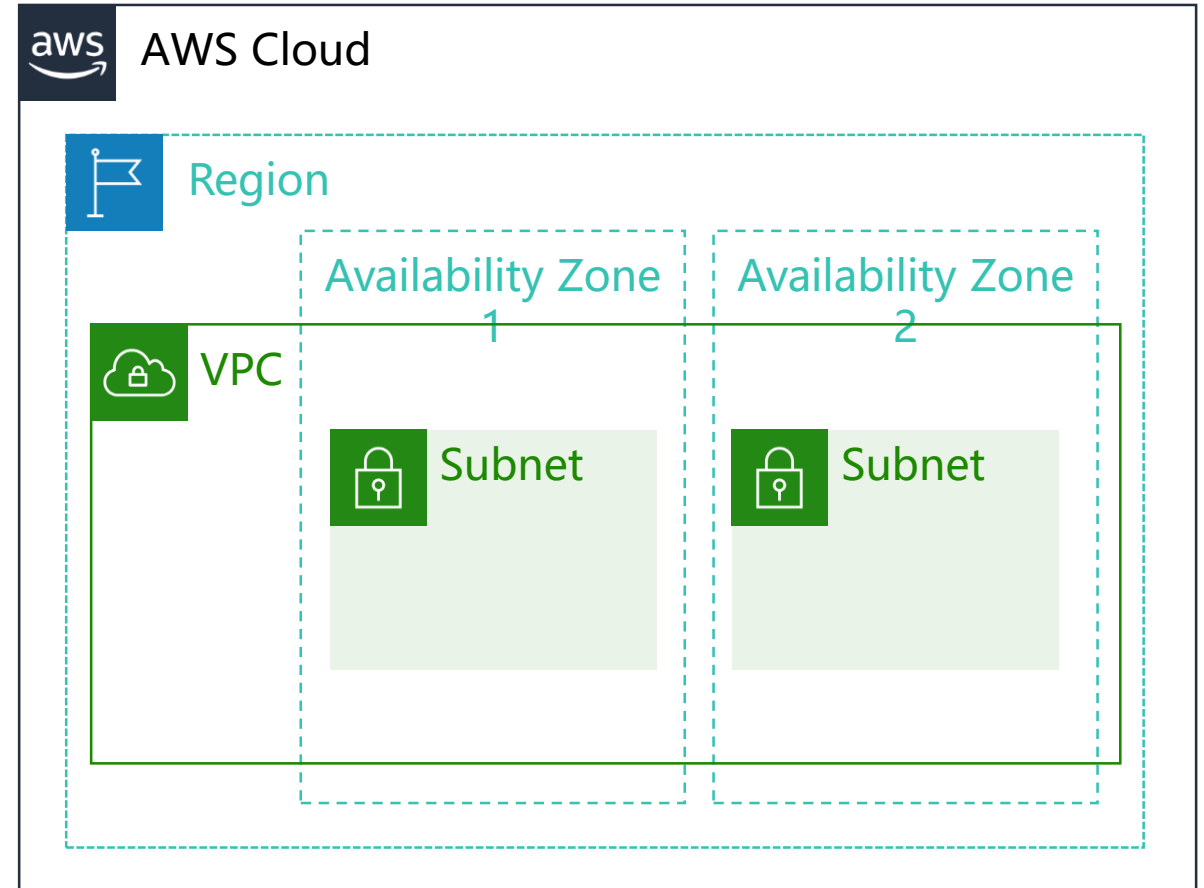


Amazon VPC

- 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**.



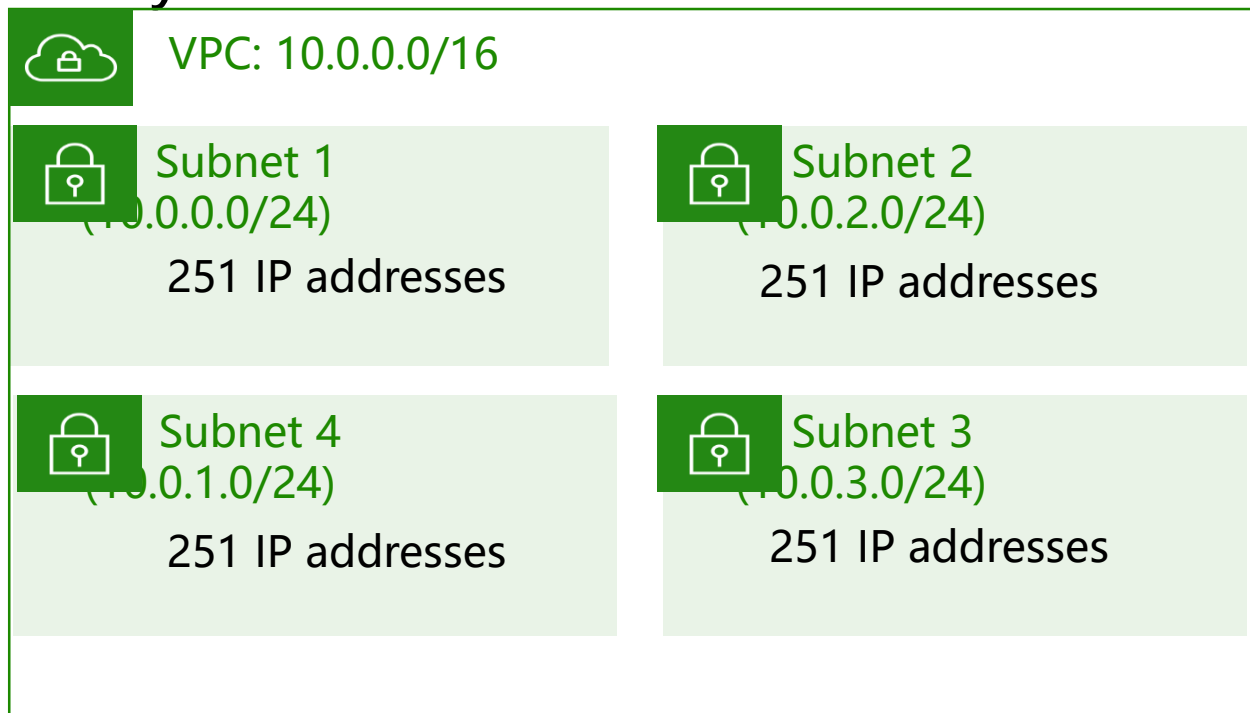
VPC

$x.x.x.x/16$ or 65,536 addresses (max)
to
 $x.x.x.x/28$ or 16 addresses (min)

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

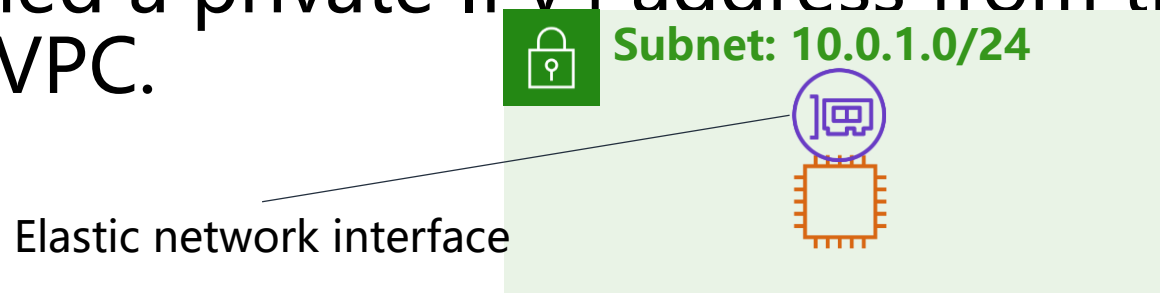
Public IPv4 address

- 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

- 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



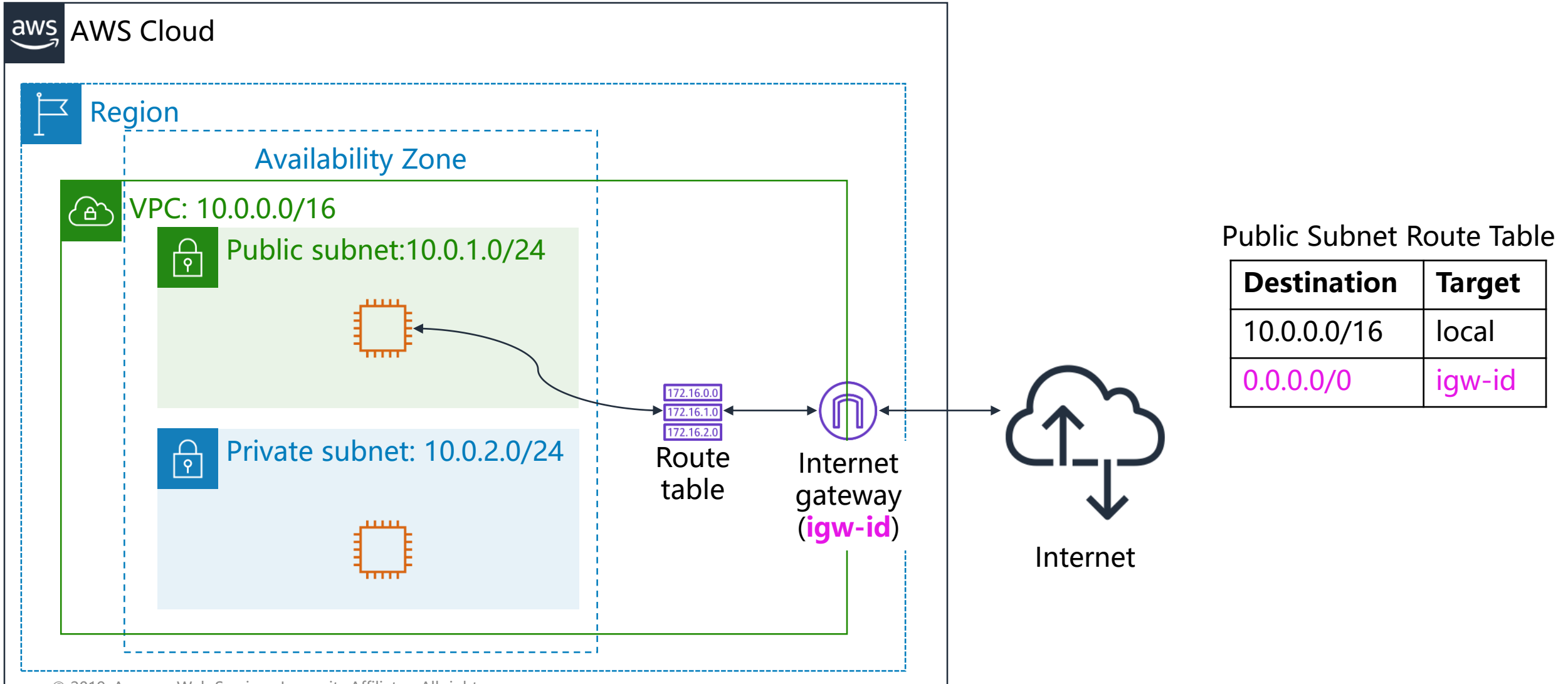
Section 2 key takeaways



- 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.

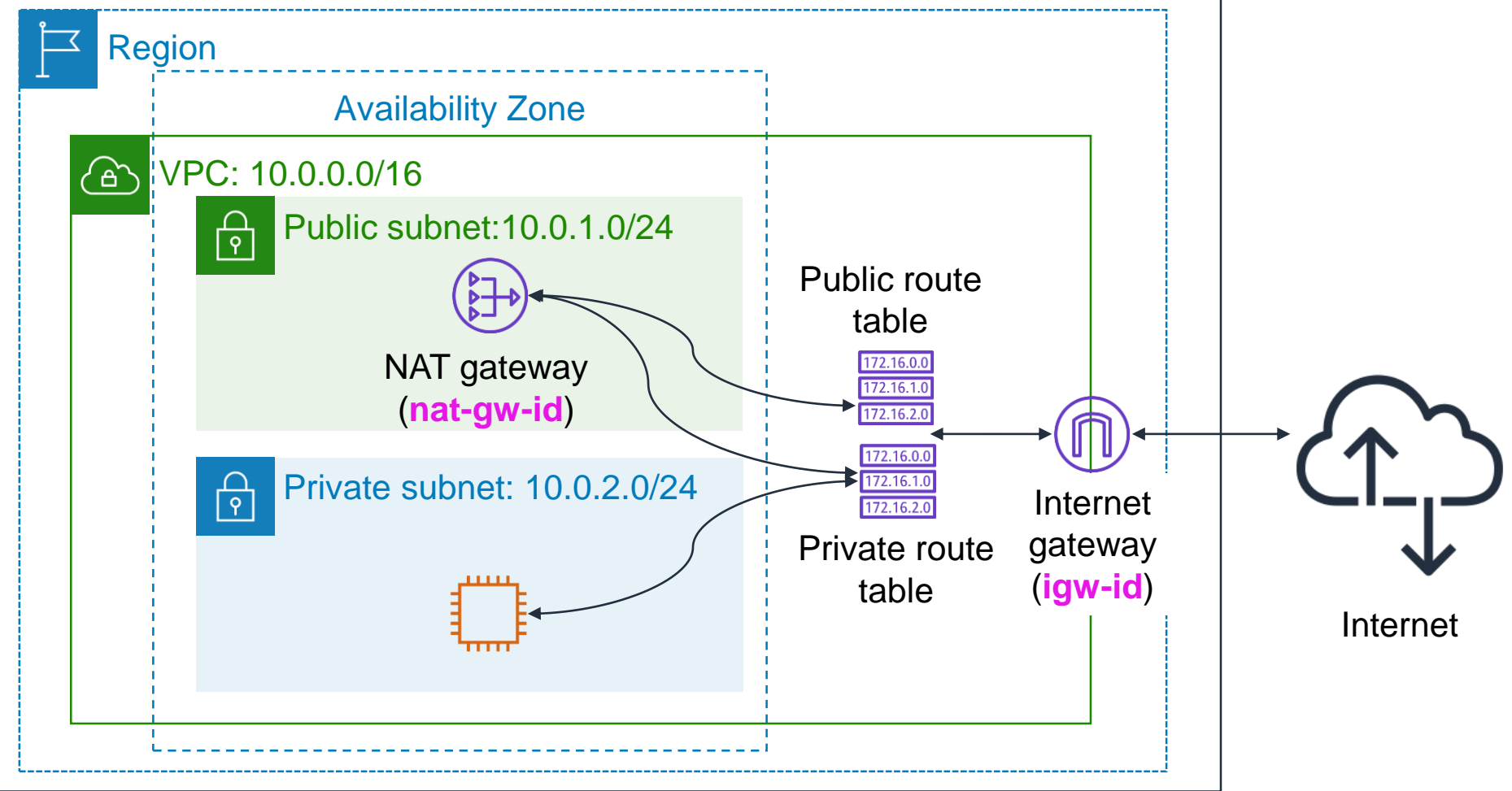
Section 3: VPC networking

Internet gateway



Network address translation (NAT) gateway

aws AWS Cloud



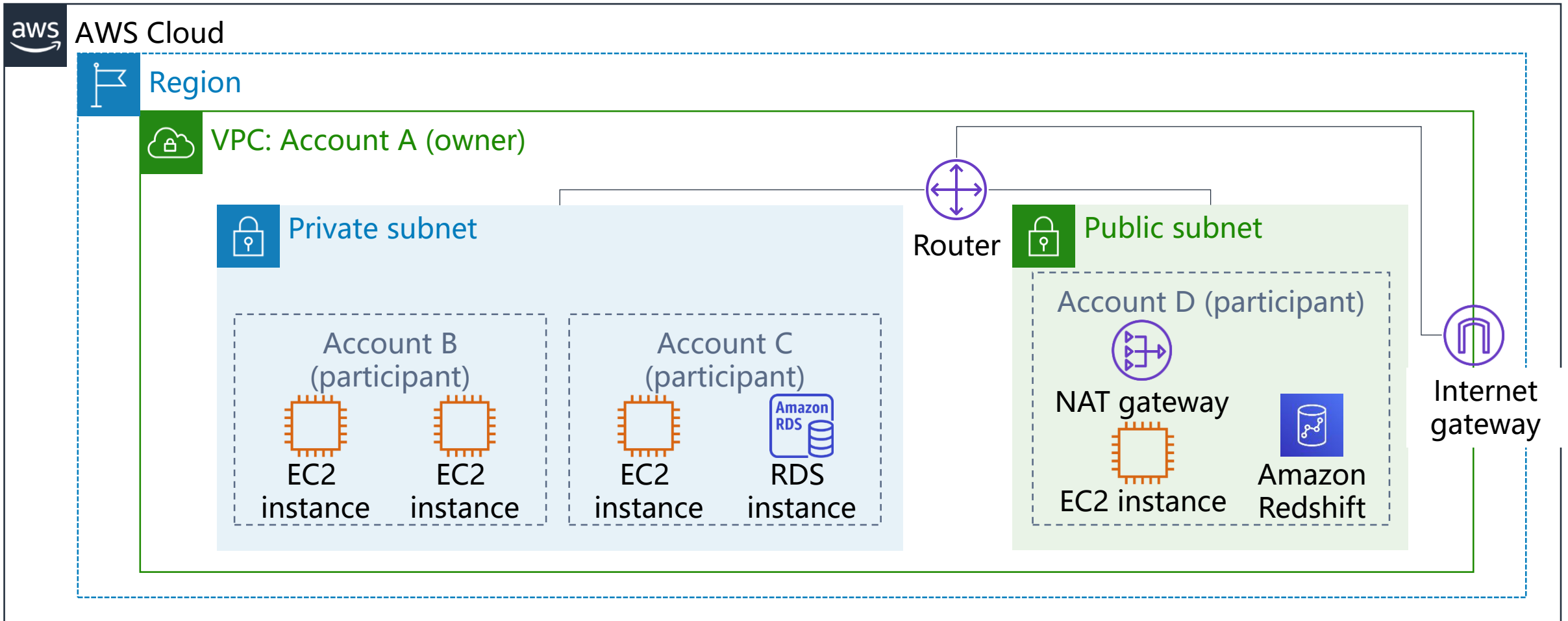
Public Subnet Route Table

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

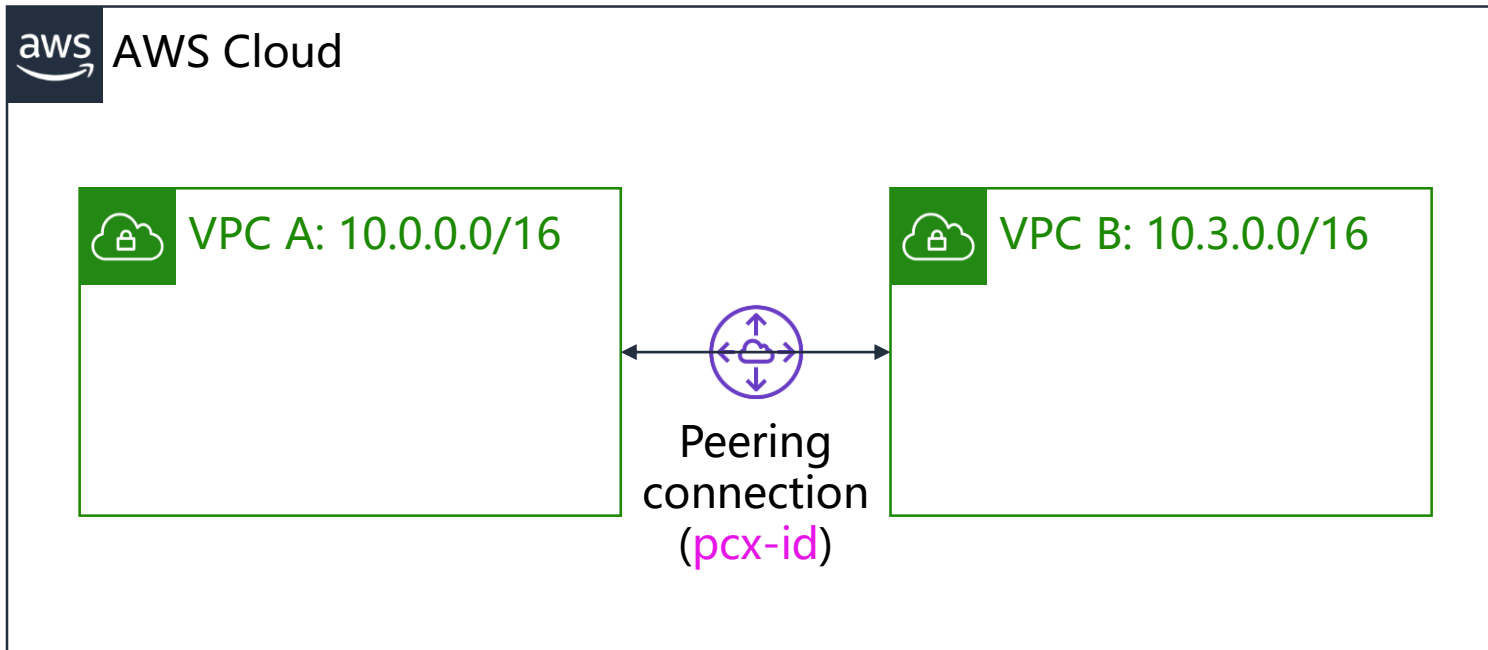
Private Subnet Route Table

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.
- You can only have one peering resource between the same two VPCs.

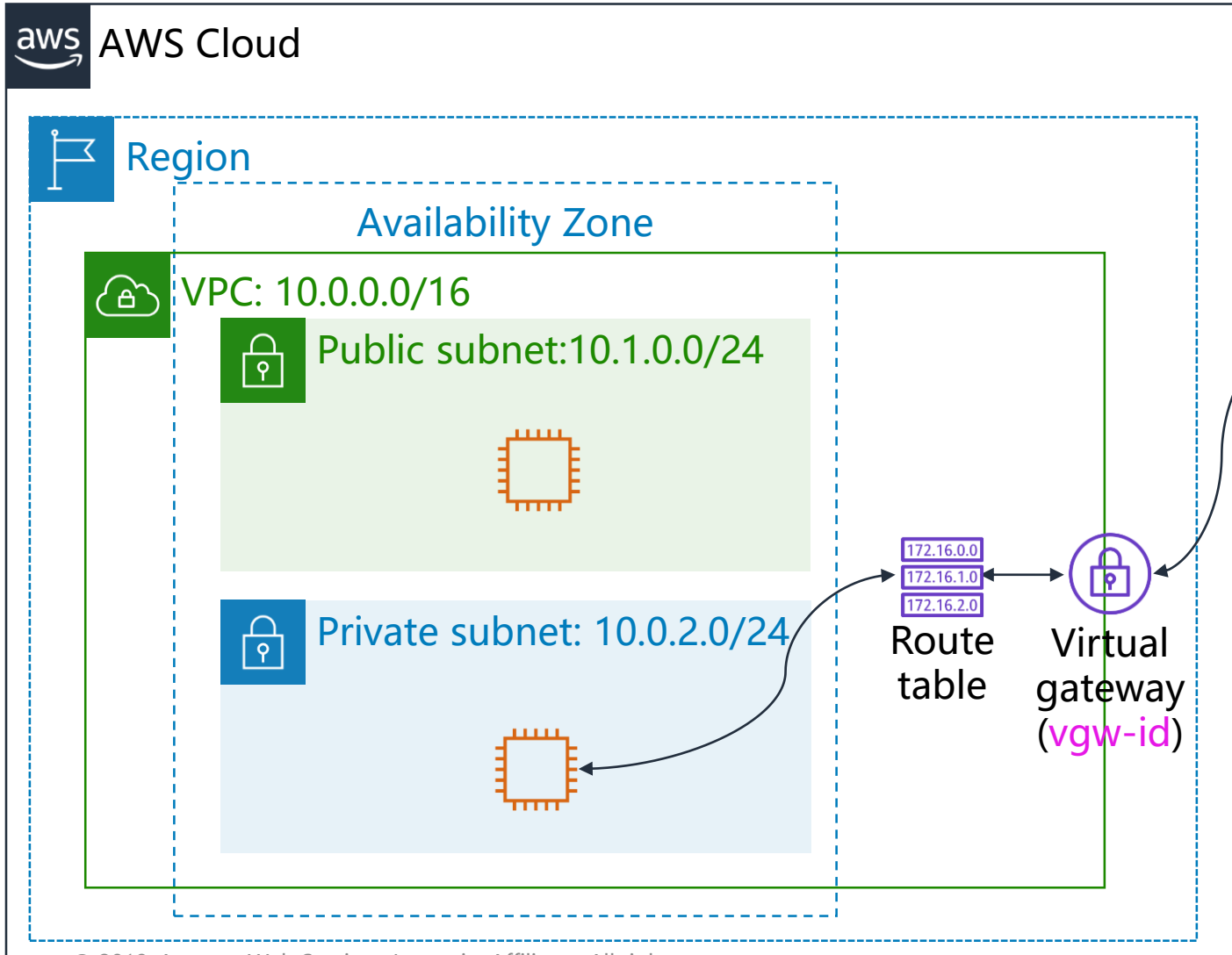
Route Table for VPC A

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

AWS Site-to-Site VPN

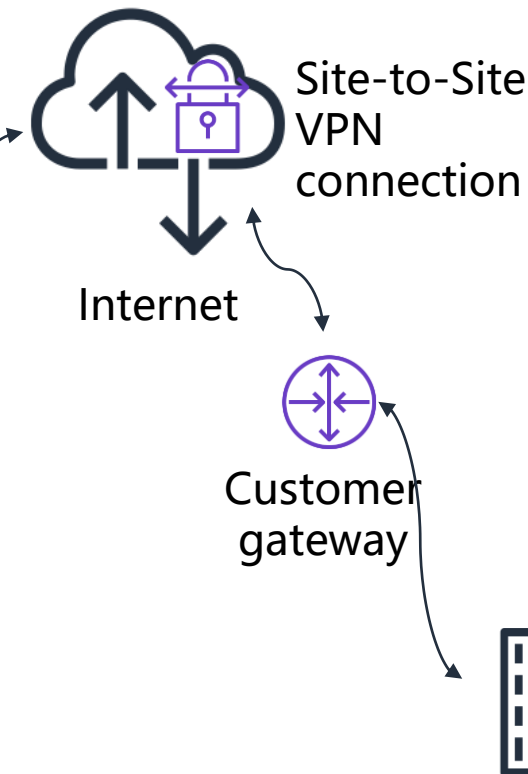


Public subnet route table

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

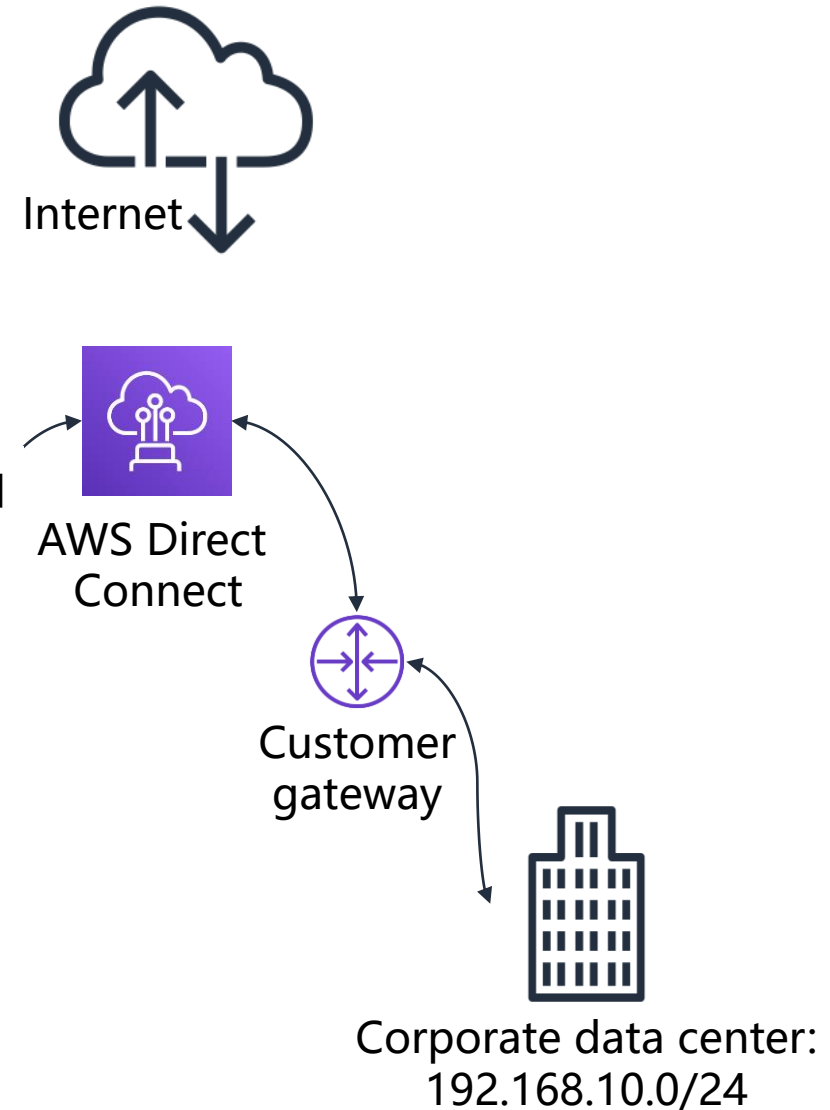
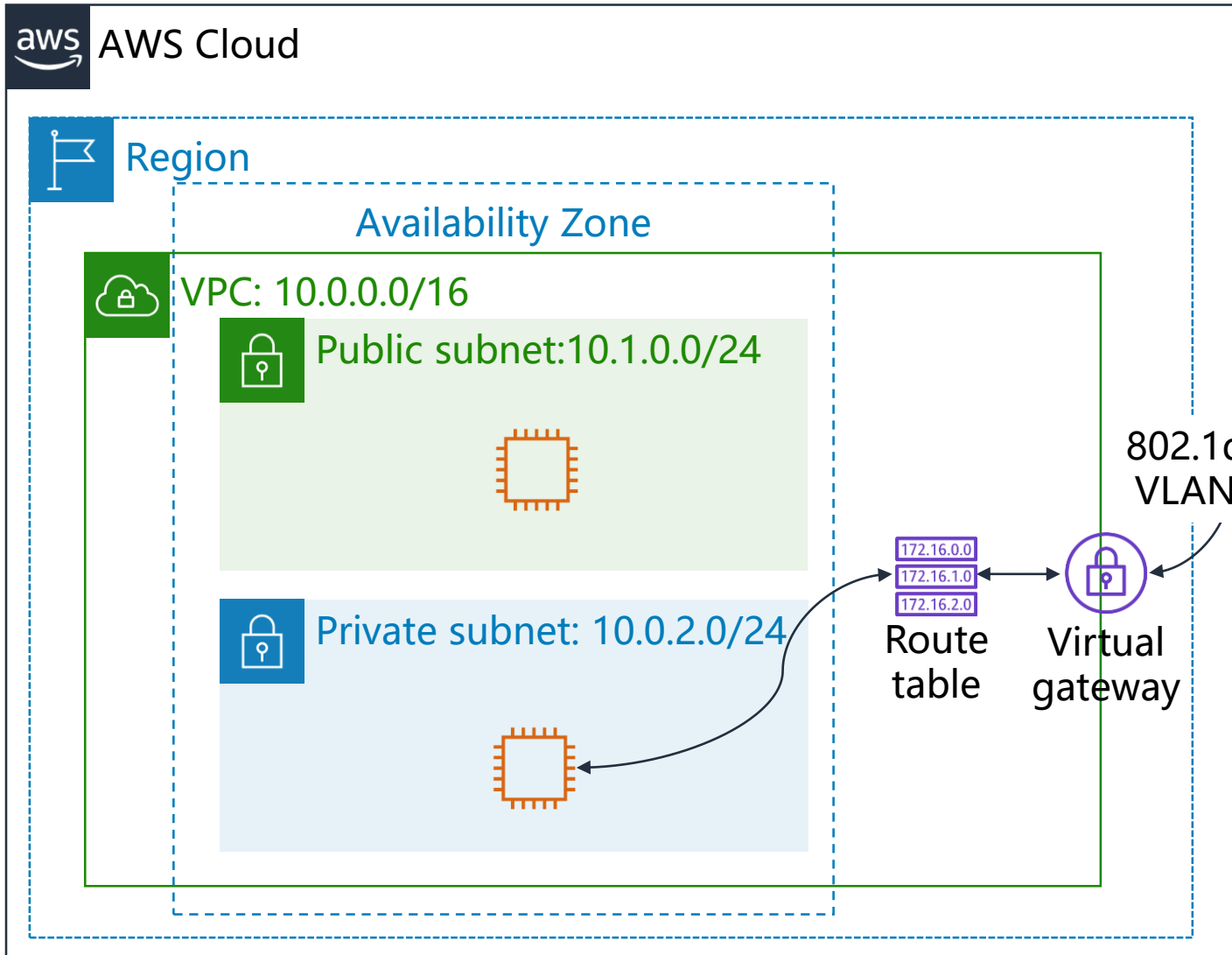
Private subnet route table

Destination	Target
10.0.0.0/16	local
192.168.10.0/24	vgw-id

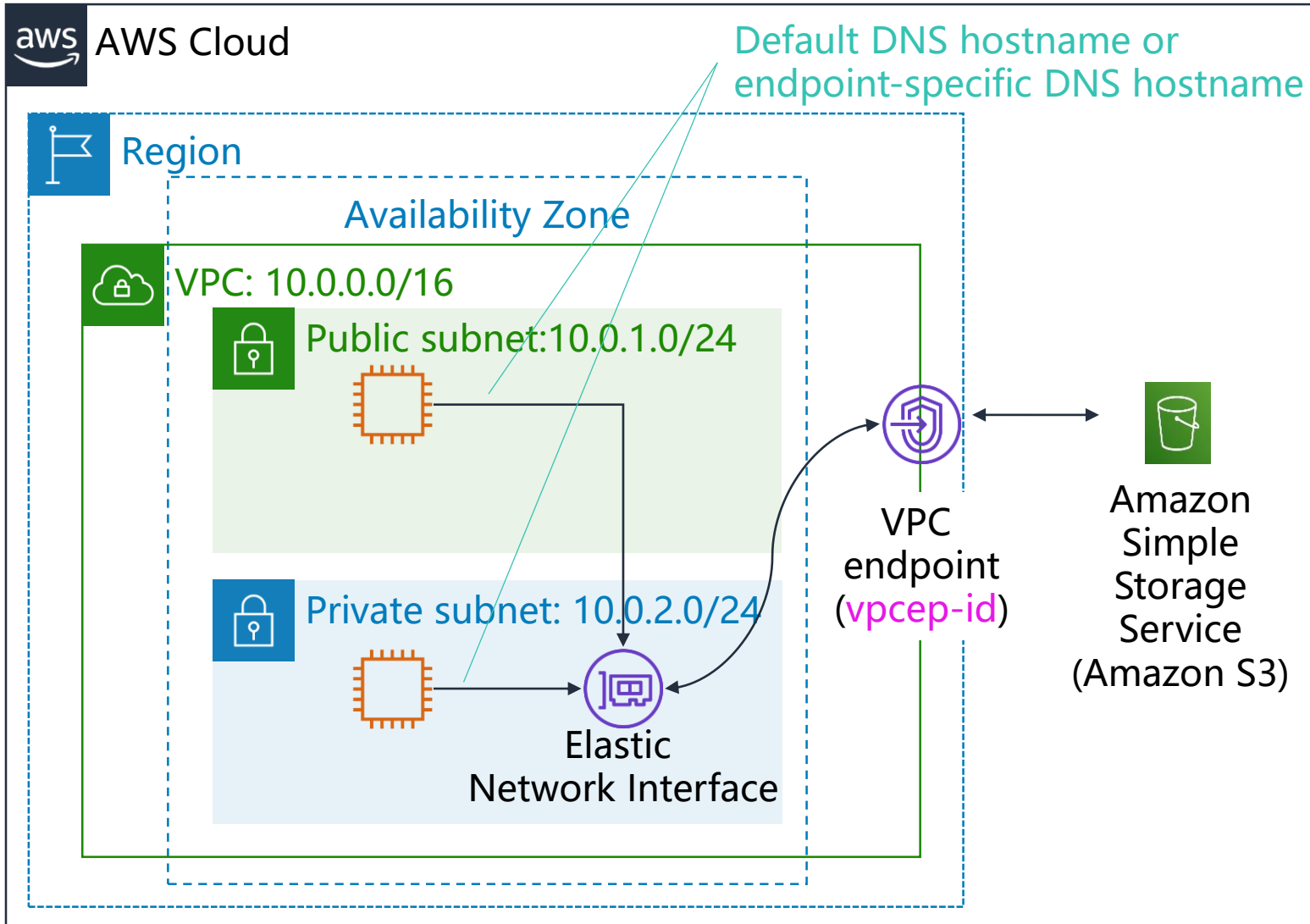


Corporate data center:
192.168.10.0/24

AWS Direct Connect



VPC endpoints

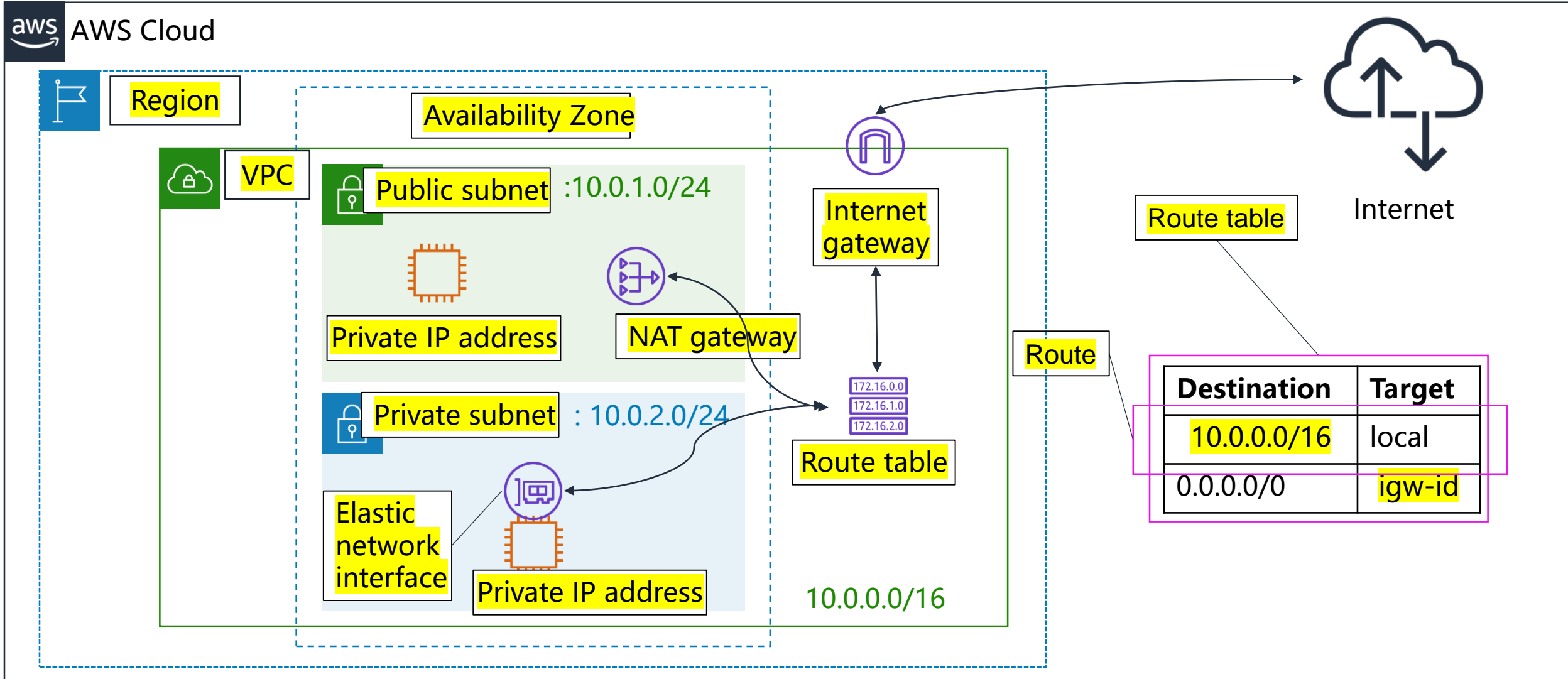


Public Subnet Route Table

Destination	Target
10.0.0.0/16	local
Amazon S3 ID	vpcep-id

- Two types of endpoints:
- **Interface** endpoints (powered by AWS PrivateLink)
 - **Gateway** endpoints (Amazon S3 and Amazon DynamoDB)

Activity: Solution



Recorded Amazon VPC demonstration

Set up demo

Amazon Virtual Private Cloud (VPC)

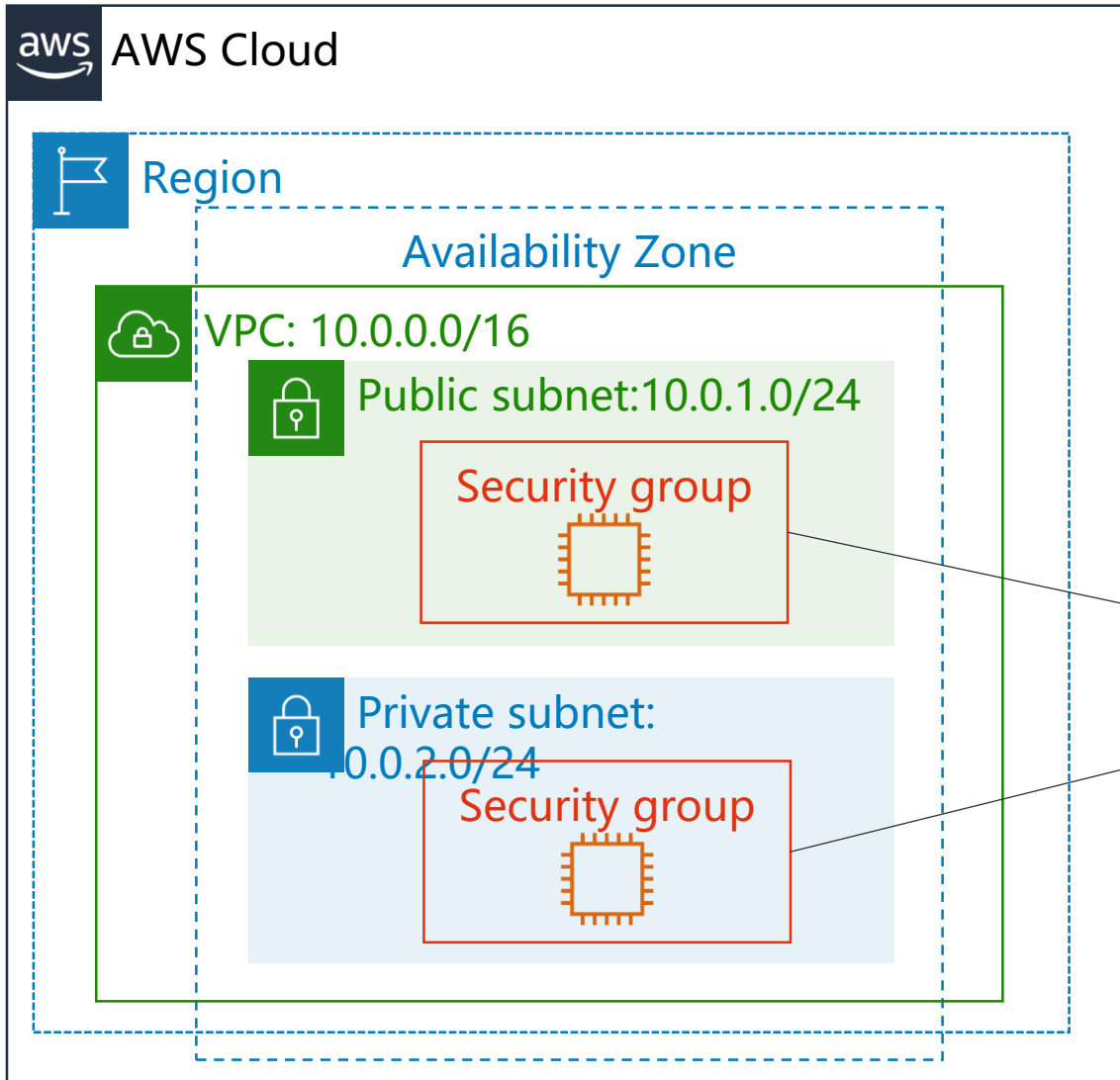
Section 3 key takeaways



- 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

Security groups



Security groups act at the **instance level**.

Inbound				
Type	Protocol	Port Range	Source	Description
All traffic	All	All	sg-xxxxxxx	

Outbound				
Type	Protocol	Port Range	Source	Description
All traffic	All	All	sg-xxxxxxx	

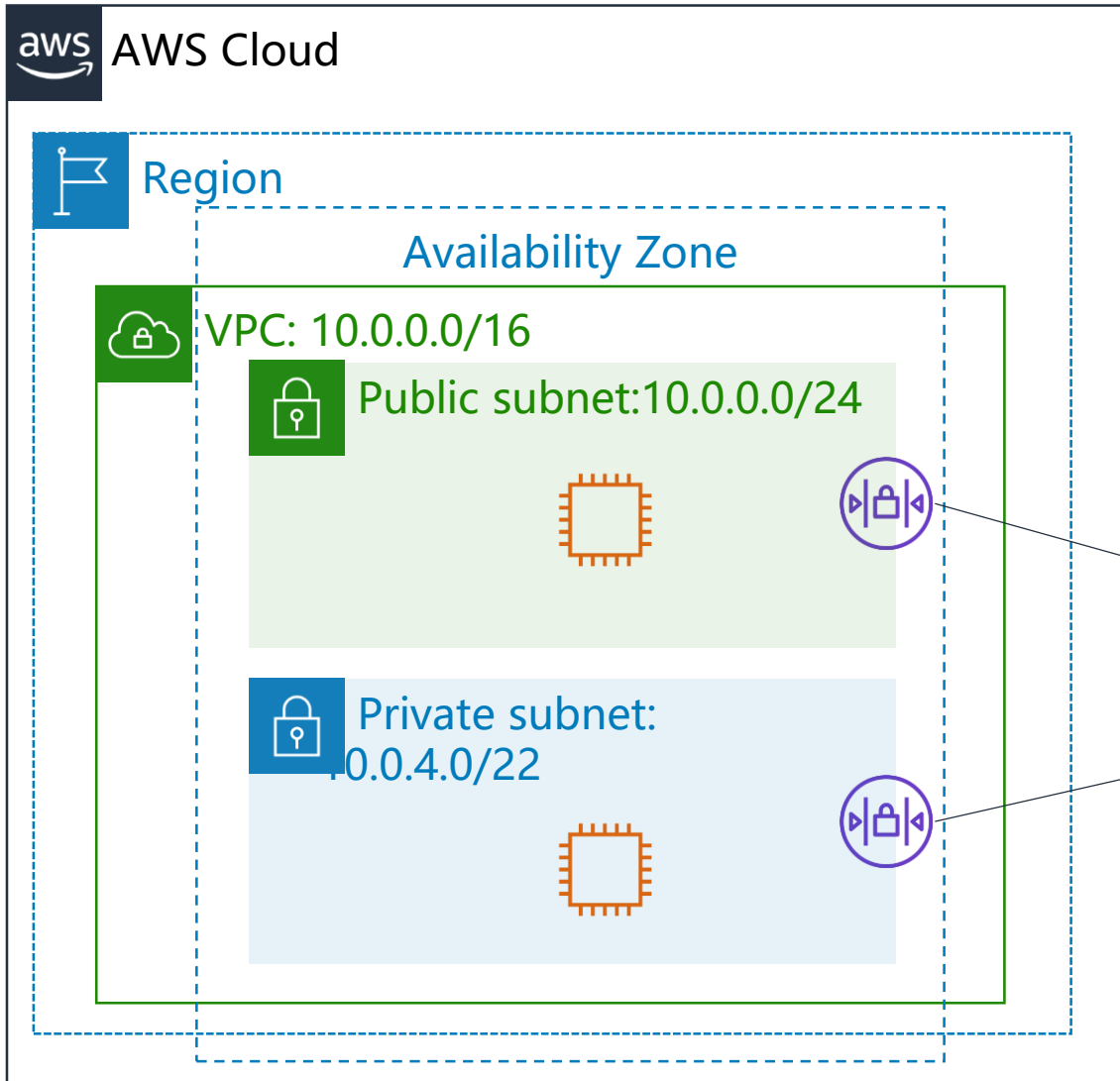
- Security groups have **rules** that control inbound and outbound instance traffic.
- Default security groups **deny all inbound** traffic and **allow all outbound** traffic.
- Security groups are **stateful**.

Custom security groups

Inbound				
Type	Protocol	Port Range	Source	Description
HTTP	TCP	80	0.0.0.0/0	All web traffic
HTTPS	TCP	443	0.0.0.0/0	All web traffic
SSH	TCP	22	54.24.12.19/32	Office address
Outbound				
Type	Protocol	Port Range	Source	Description
All traffic	All	All	0.0.0.0/0	
All traffic	All	All	::/0	

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

Network access control lists (network ACLs)



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

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	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

- 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**.

Custom network ACLs

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

- **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**.

Security groups versus network ACLs

Attribute	Security Groups	Network ACLs
Scope	Instance level	Subnet level
Supported Rules	Allow rules only	Allow and deny rules
State	Stateful (return traffic is automatically allowed, regardless of rules)	Stateless (return traffic must be explicitly allowed by rules)
Order of Rules	All rules are evaluated before decision to allow traffic	Rules are evaluated in number order before decision to allow traffic

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.

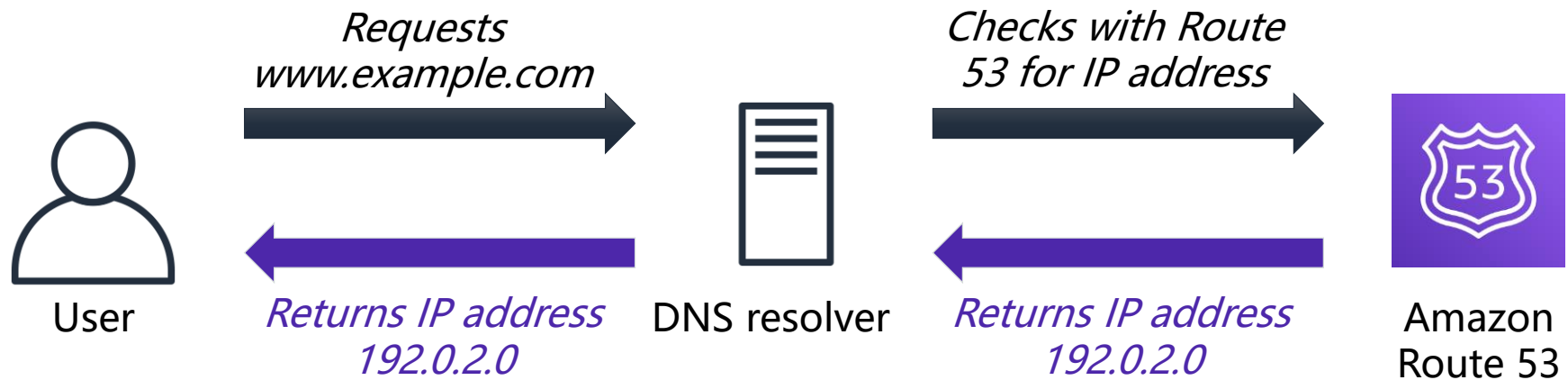
Section 5: Amazon Route 53



Amazon
Route 53

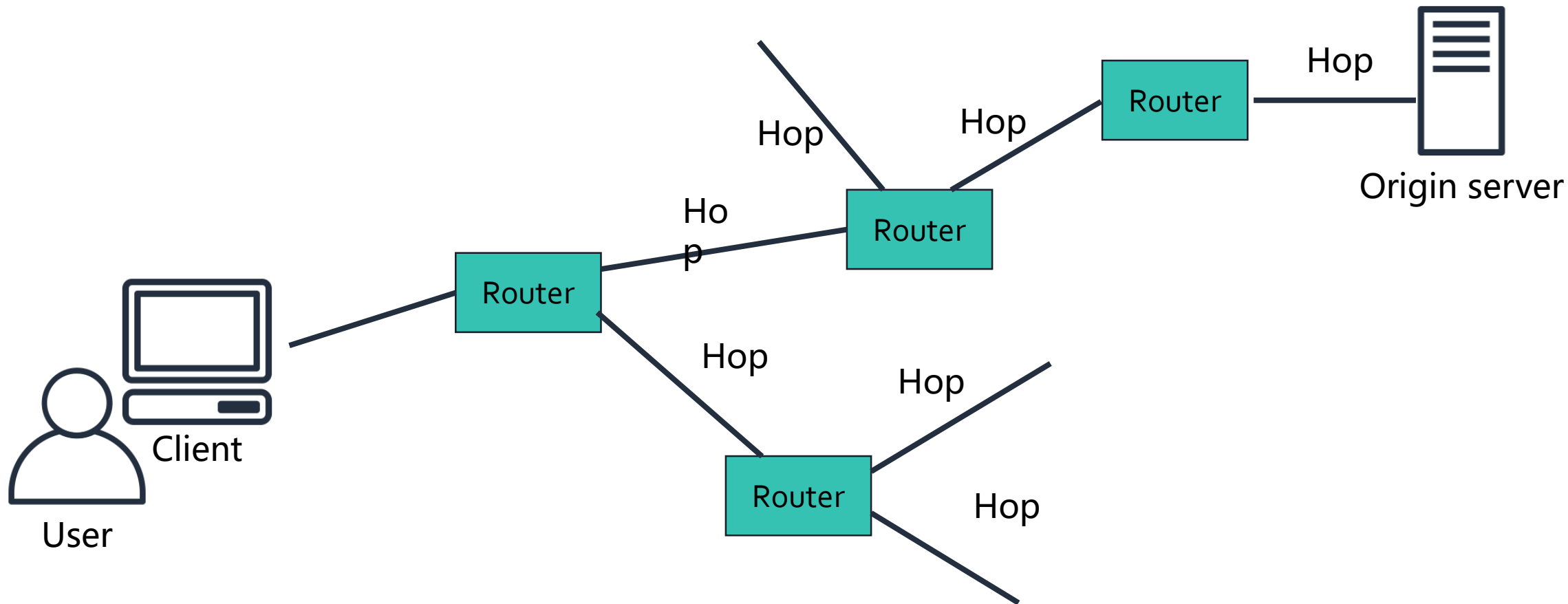
- Is a highly available and scalable Domain Name System (DNS) web service
- Is used to route end users to Internet applications by translating names (like www.example.com) into numeric IP addresses (like *192.0.2.1*) that computers use to connect to each other
- Is fully compliant with IPv4 and IPv6
- Connects user requests to infrastructure running in AWS and also outside of AWS
- Is used to check the health of your resources
- Features traffic flow
- Enables you to register domain names

Amazon Route 53 DNS resolution



Section 6: Amazon CloudFront

Content delivery and network latency



Content delivery network (CDN)

- Is a globally distributed system of caching servers
- Caches copies of commonly requested files (static content)
- Delivers a local copy of the requested content from a nearby cache edge or Point of Presence
- Accelerates delivery of dynamic content
- Improves application performance and scaling

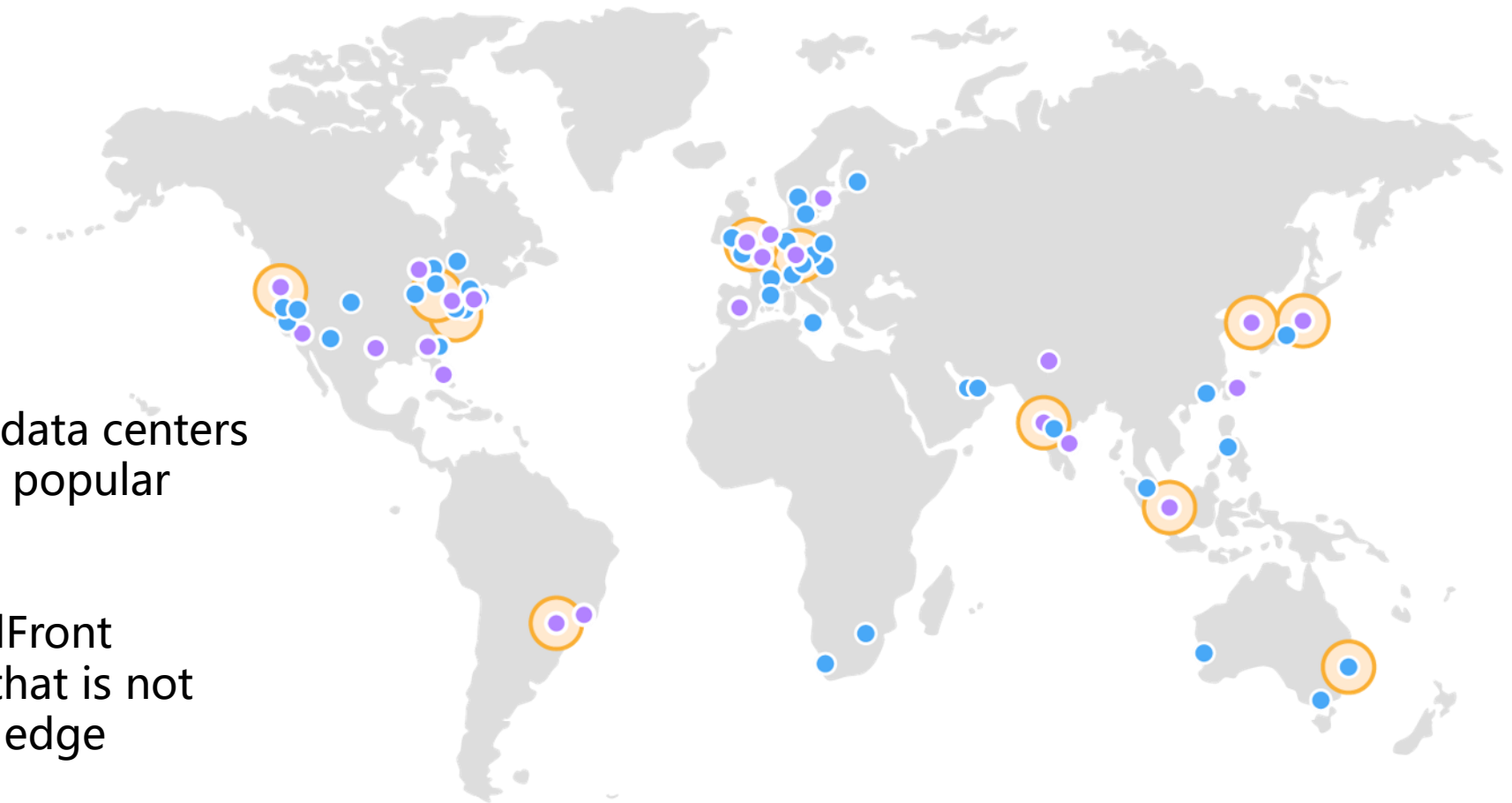


Amazon
CloudFront

- Fast, global, and secure CDN service
- Global network of edge locations and Regional edge caches
- Self-service model
- Pay-as-you-go pricing

Amazon CloudFront infrastructure

- Edge locations
- Multiple edge locations
- Regional edge caches



- **Edge locations** – Network of data centers that CloudFront uses to serve popular content quickly to customers.
- **Regional edge cache** – CloudFront location that caches content that is not popular enough to stay at an edge location. It is located between the origin server and the global edge location.

Amazon CloudFront benefits

- Fast and global
- Security at the edge
- Highly programmable
- Deeply integrated with AWS
- Cost-effective

Section 6 key takeaways



- A CDN is a globally distributed system of caching servers that accelerates delivery of content.
- Amazon CloudFront is a fast CDN service that securely delivers data, videos, applications, and APIs over a global infrastructure with low latency and high transfer speeds.
- Amazon CloudFront offers many benefits.

Module wrap-up

In summary, in this module you learned how 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 added additional components to it to produce a customized network
- Identify the fundamentals of Amazon Route 53
- Recognize the benefits of Amazon CloudFront

Complete the knowledge check



Sample exam question

Which AWS networking service enables a company to create a virtual network within AWS?

- A. AWS Config
- B. Amazon Route 53
- C. AWS Direct Connect
- D. Amazon VPC

- [Amazon VPC overview page](#)
- [Amazon Virtual Private Cloud Connectivity Options](#) whitepaper
- [One to Many: Evolving VPC Design](#) AWS Architecture blog post
- [Amazon VPC User Guide](#)
- [Amazon CloudFront overview page](#)

Thank you

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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:

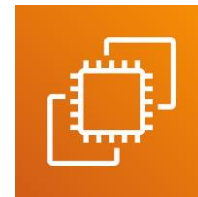
- Your web server and database server must be in separate subnets.
- The first address of your network must be 10.0.0.0. Each subnet must have 256 total IPv4 addresses.
- Your customers must always be able to access your web server.
- Your database server must be able to access the internet to make patch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

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



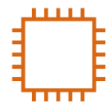
- Create a VPC.



- Create additional subnets.

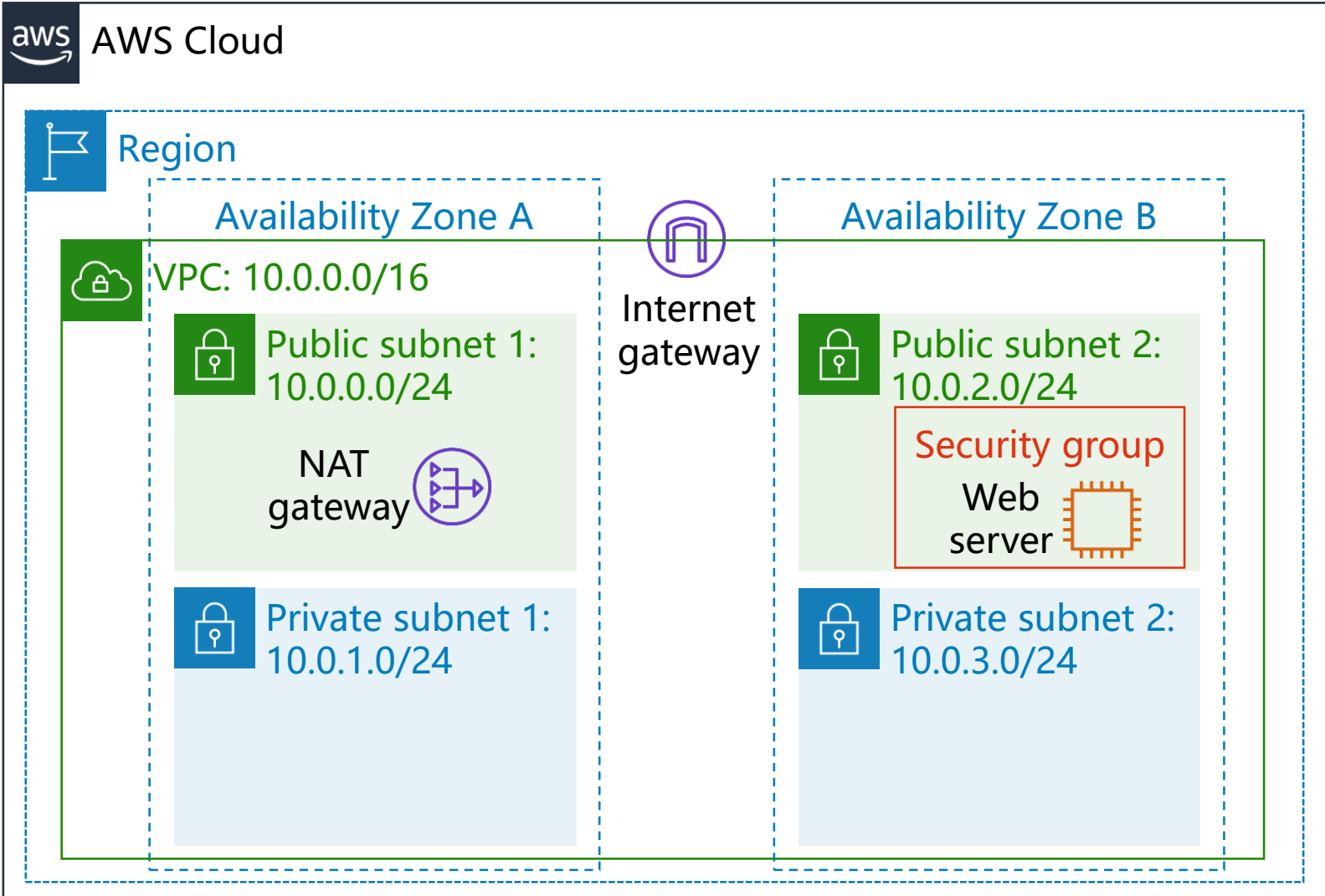
Security
group

- 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



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

Lab debrief: Key takeaways



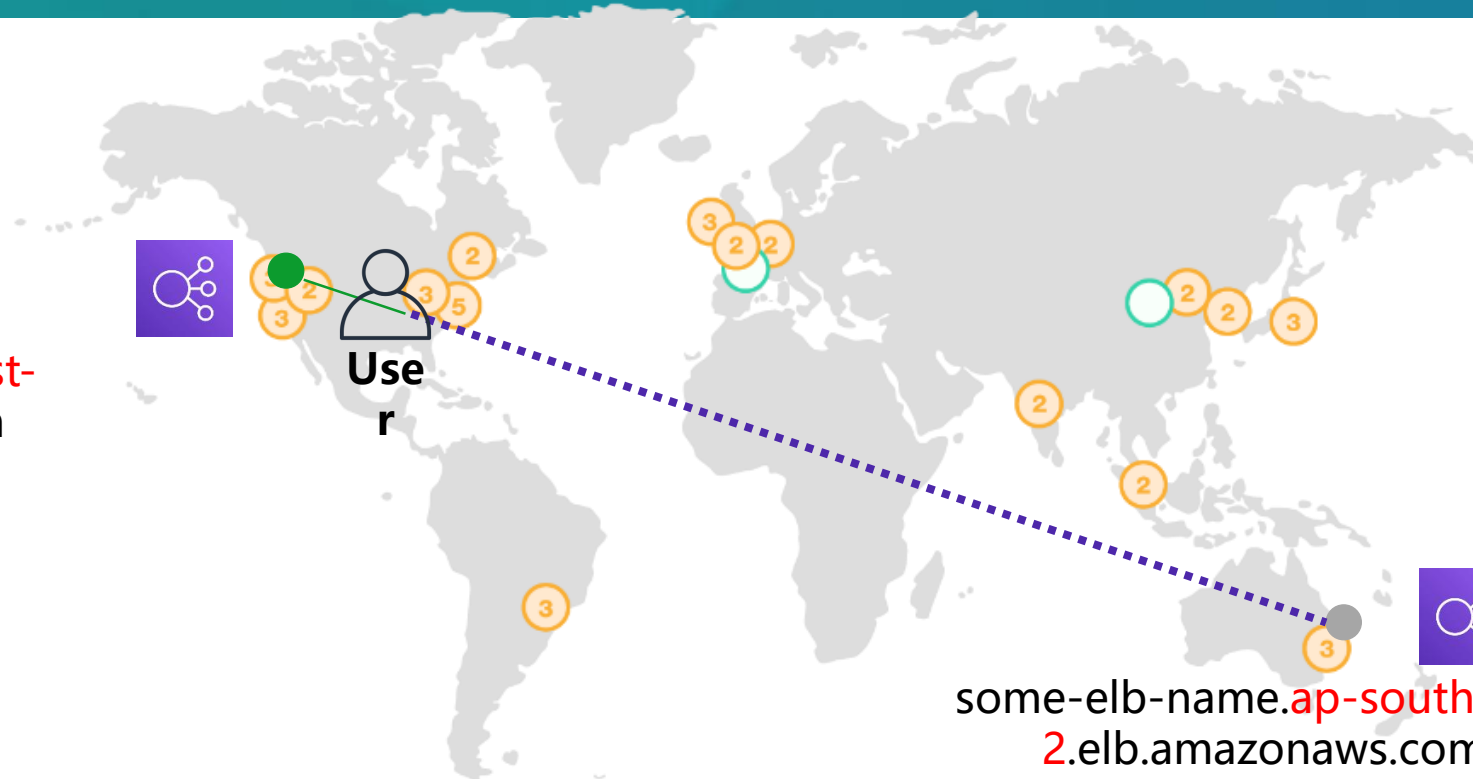
- **Simple routing** – Use in single-server environments
- **Weighted round robin routing** – Assign weights to resource record sets to specify the frequency
- **Latency routing** – Help improve your global applications
- **Geolocation routing** – Route traffic based on location of your users
- **Geoproximity routing** – Route traffic based on location of your resources
- **Failover routing** – Fail over to a backup site if your primary site becomes unreachable
- **Multivalue answer routing** – Respond to DNS queries with up to eight healthy records selected at random

Use case: Multi-region deployment



Amazon Route 53

some-elb-name.us-west-2.elb.amazonaws.com



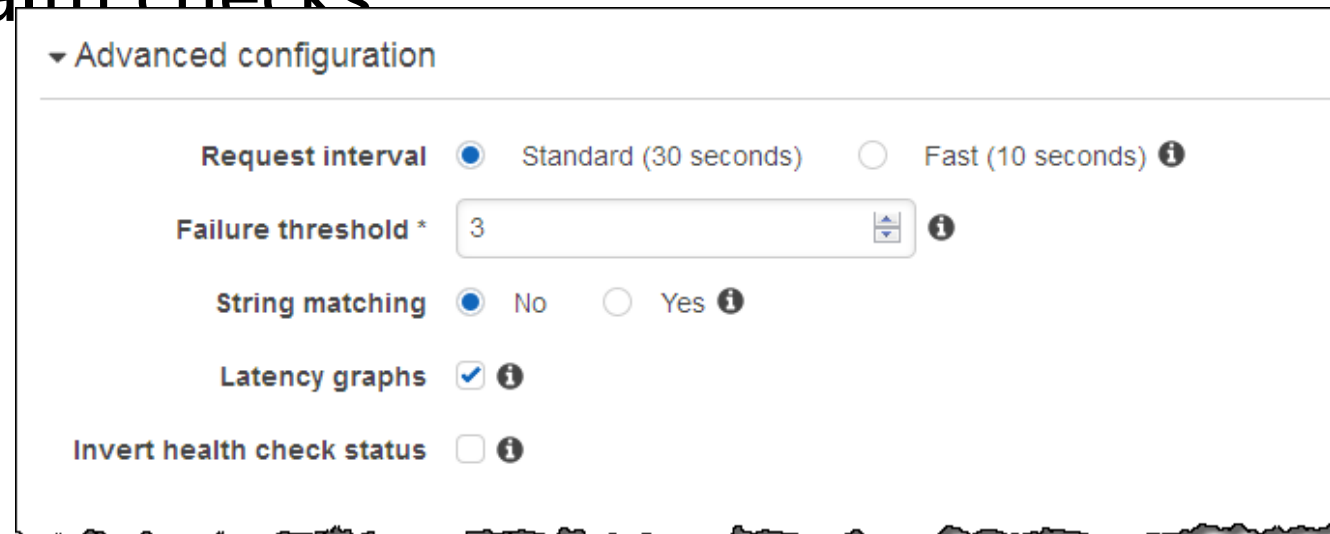
some-elb-name.ap-southeast-2.elb.amazonaws.com

Name	Type	Value
example.com	ALIAS	some-elb-name.us-west-2.elb.amazonaws.com
example.com	ALIAS	some-elb-name.ap-southeast-2.elb.amazonaws.com

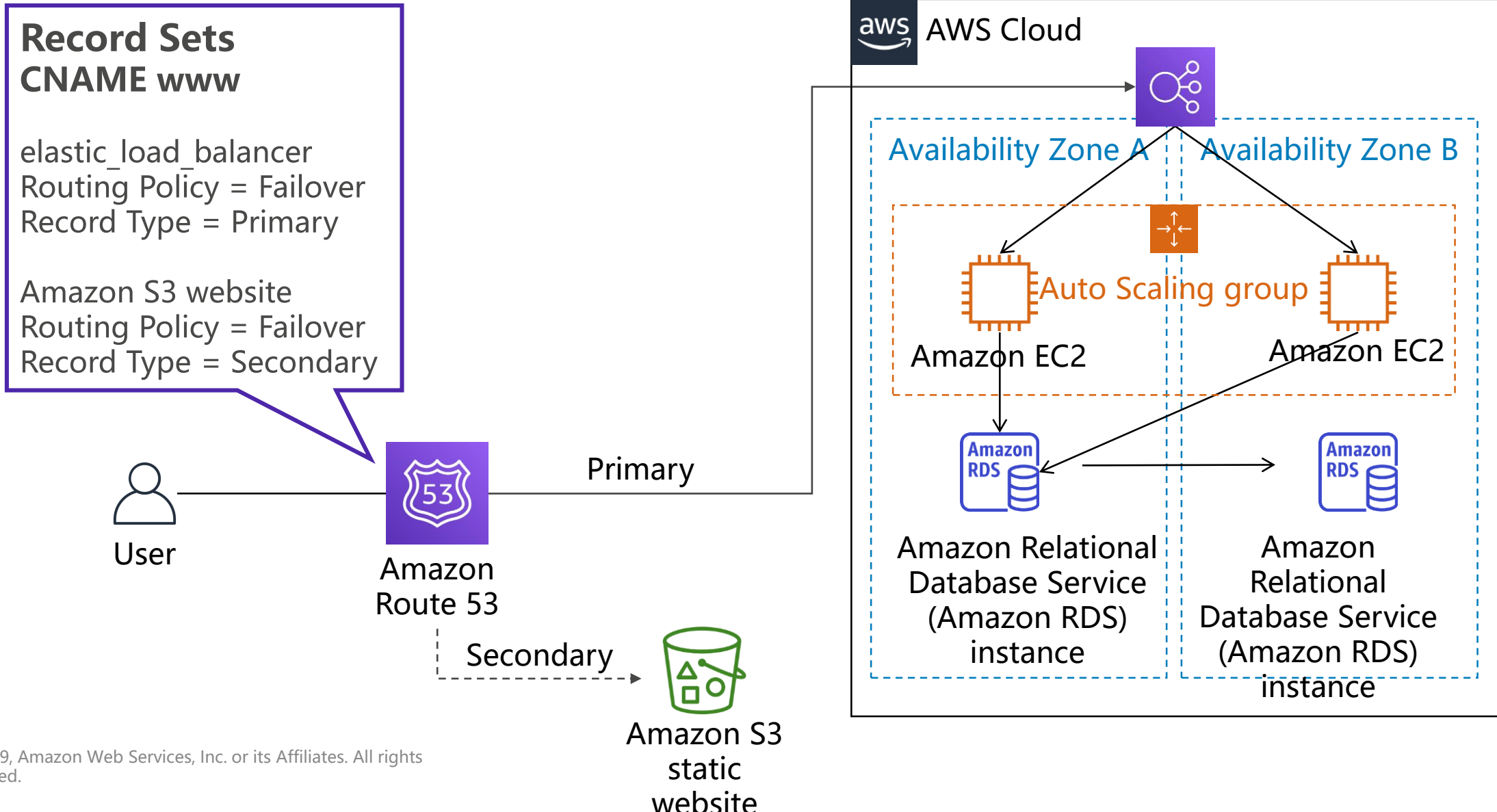
Amazon Route 53 DNS failover

Improve the availability of your applications that run on AWS by:

- Configuring backup and failover scenarios for your own applications
- Enabling highly available multi-region architectures on AWS
- Creating health checks



DNS failover for a multi-tiered web application



Section 5 key takeaways



- Amazon Route 53 is a highly available and scalable cloud DNS web service that translates domain names into numeric IP addresses.
- Amazon Route 53 supports several types of routing policies.
- Multi-Region deployment improves your application's performance for a global audience.
- You can use Amazon Route 53 failover to improve the availability of your applications.