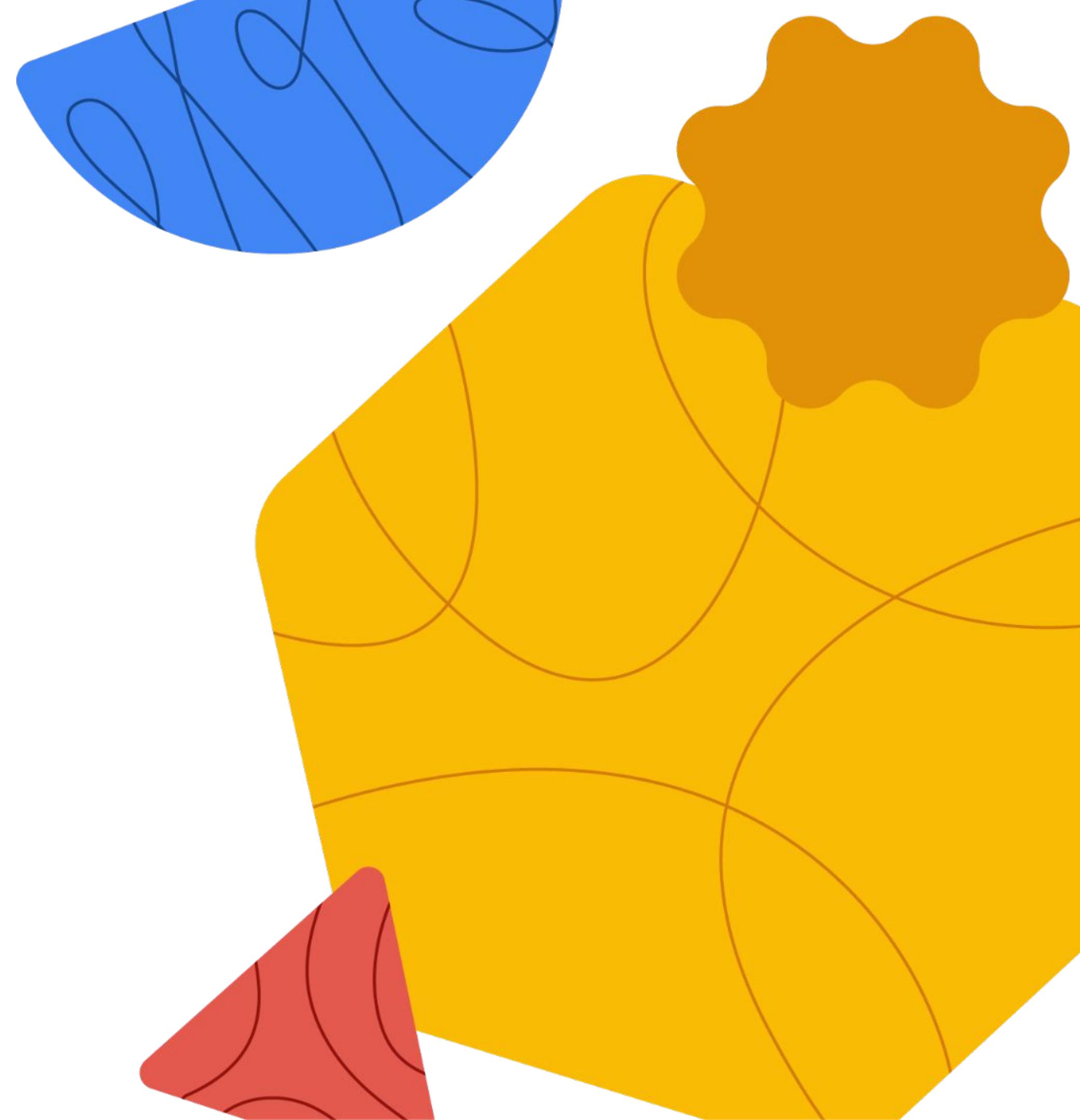
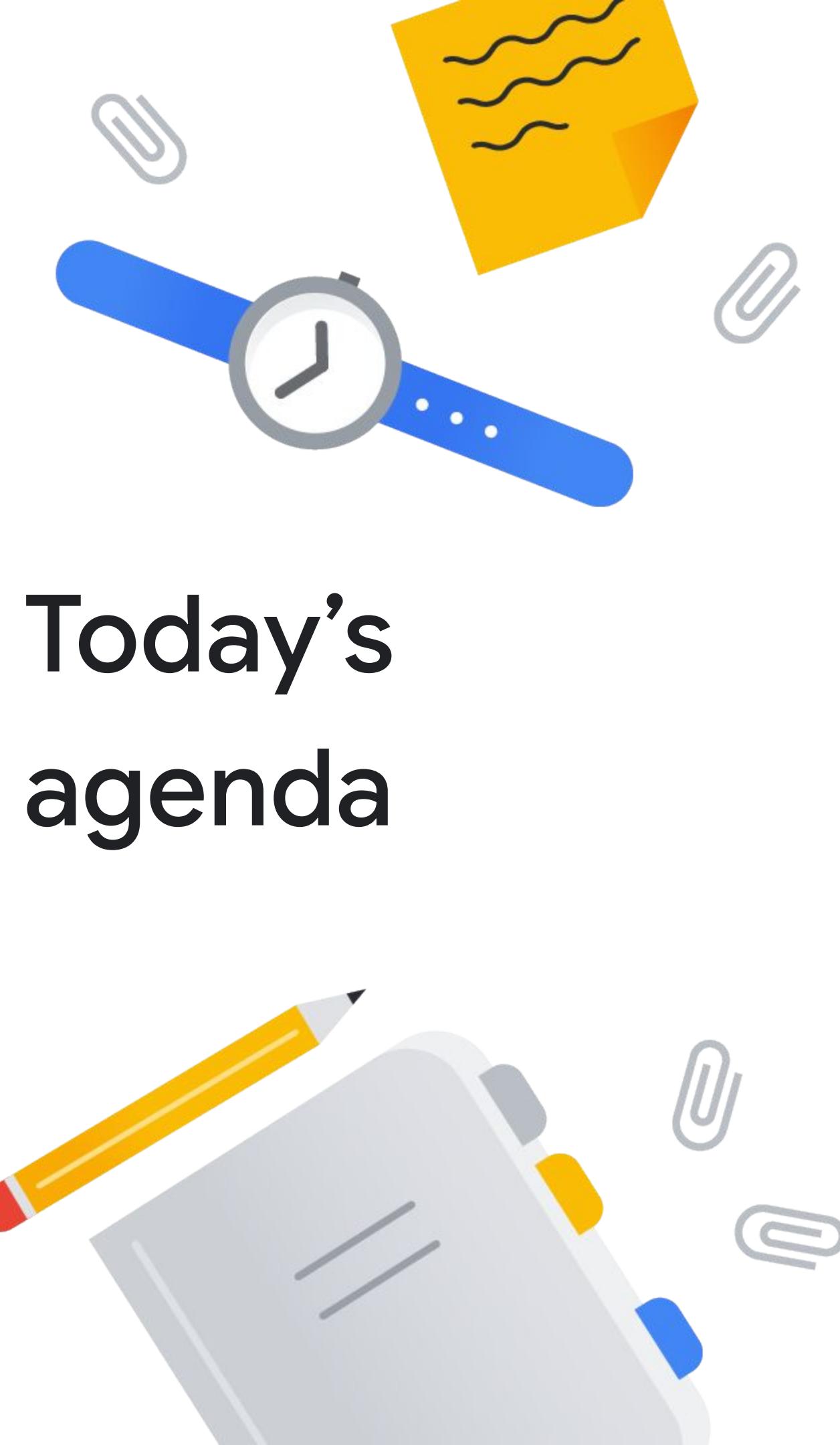


# Networking in Google Cloud

Network Routing and Addressing



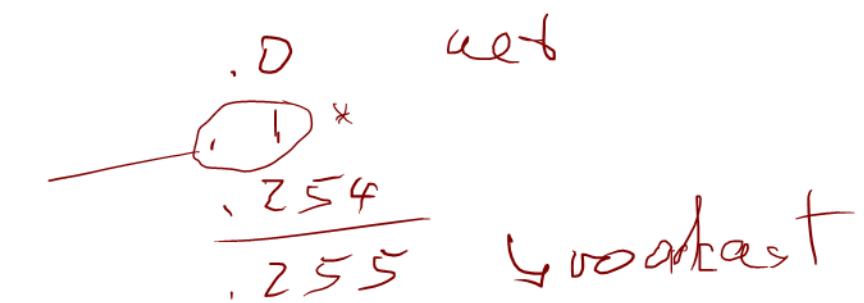
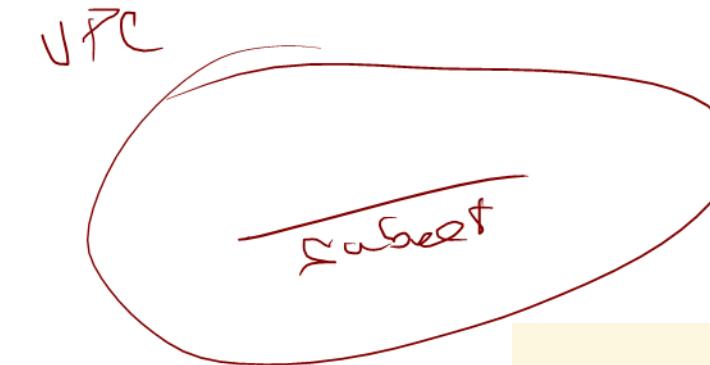


# Today's agenda

- 01 Routes and route preferences
- 02 IPv6
- 03 BYOIP (bring your own IP)
- 04 Cloud DNS
- 05 Lab: Traffic Steering Using Geolocation
- 06 Quiz

KISS

# Subnet and IP address



- ✓ Cannot overlap with other subnets.
- ✓ IP range must be a unique valid CIDR block.
- ✓ New subnet IP ranges have to fall within valid IP ranges.
- ✗ Can expand but not shrink.
- ✓ Auto mode can be expanded from /20 to /16.

$$/24$$

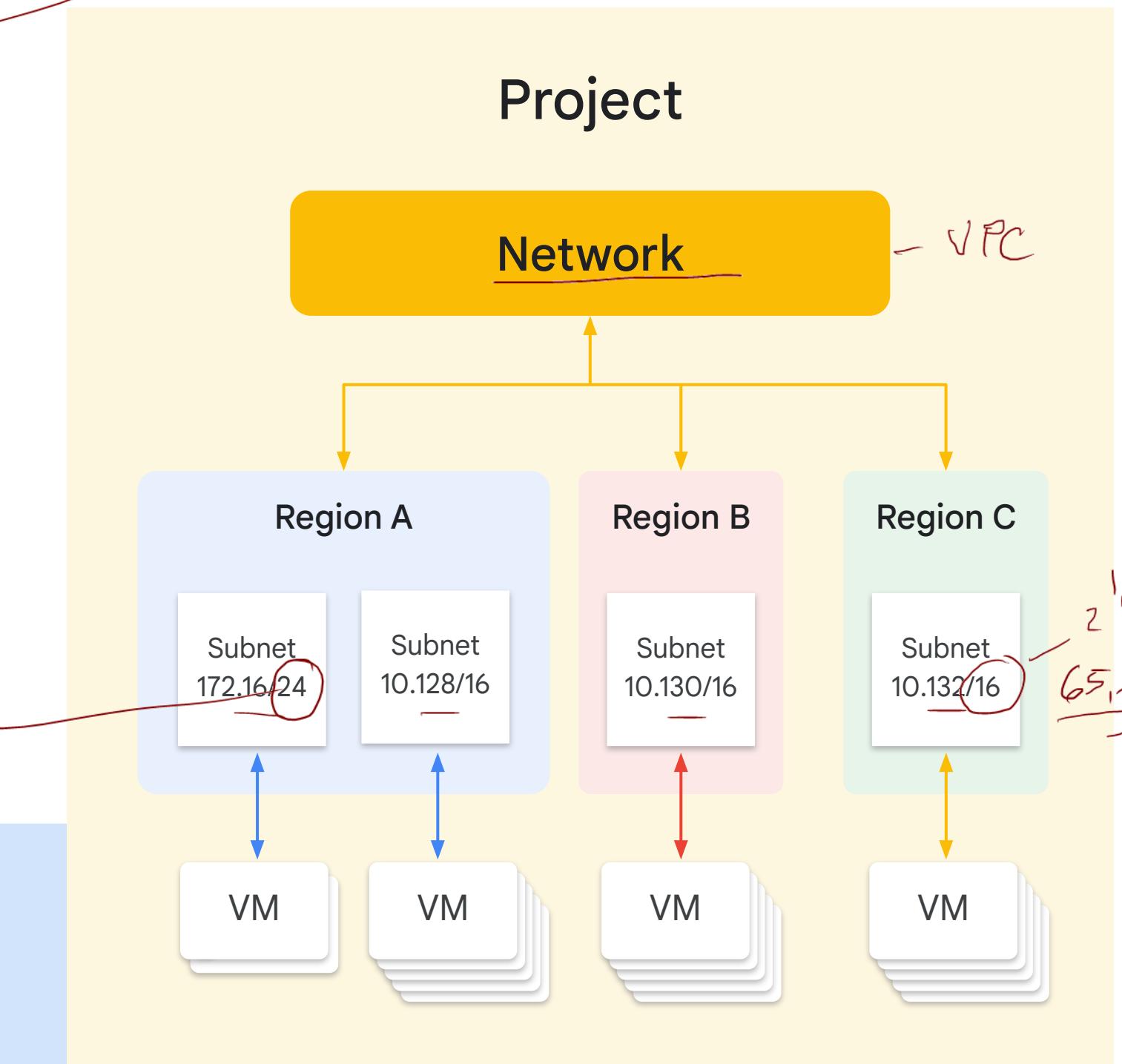
$$2^8 - 4 = 252$$

VMs

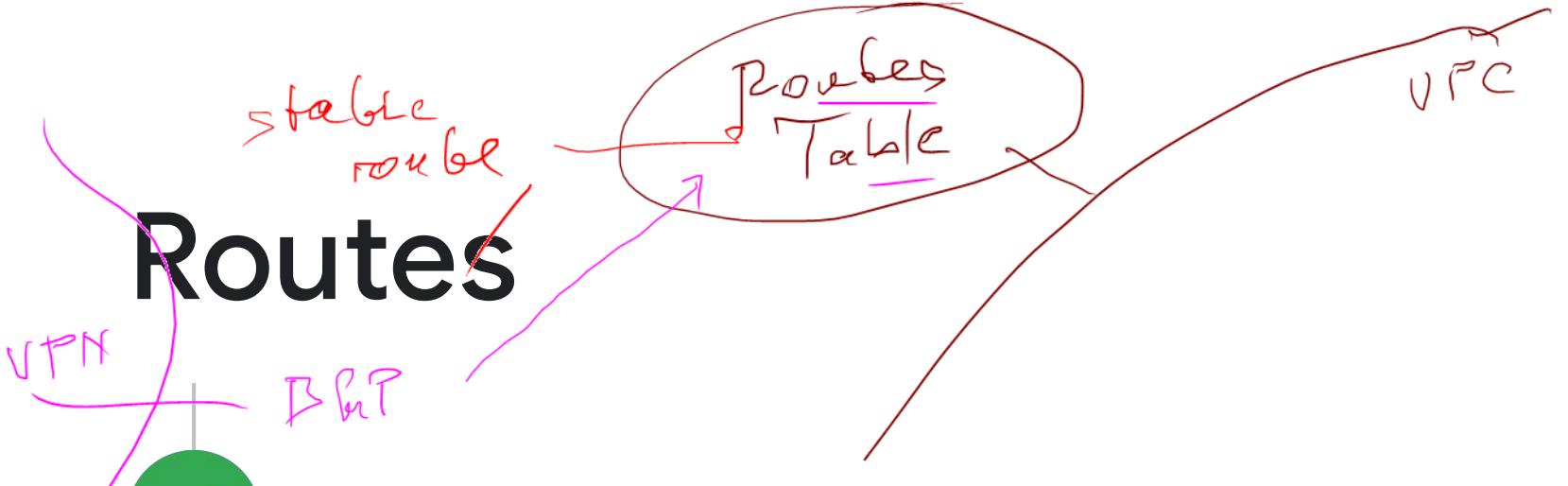
$$/23$$

$$2^9 - 4 = 508$$

Destination: 172.16.0.0/24  
 Next hop: Subnet B router  
 Destination: 0.0.0.0/0(all other),  
 Next hop: Internet gateway



# Routes



Define the paths that network traffic takes from a virtual machine (VM) instance to other destinations.

packet dest IP

Apply to traffic that egresses a VM.

Forward traffic to highest priority or specific route.

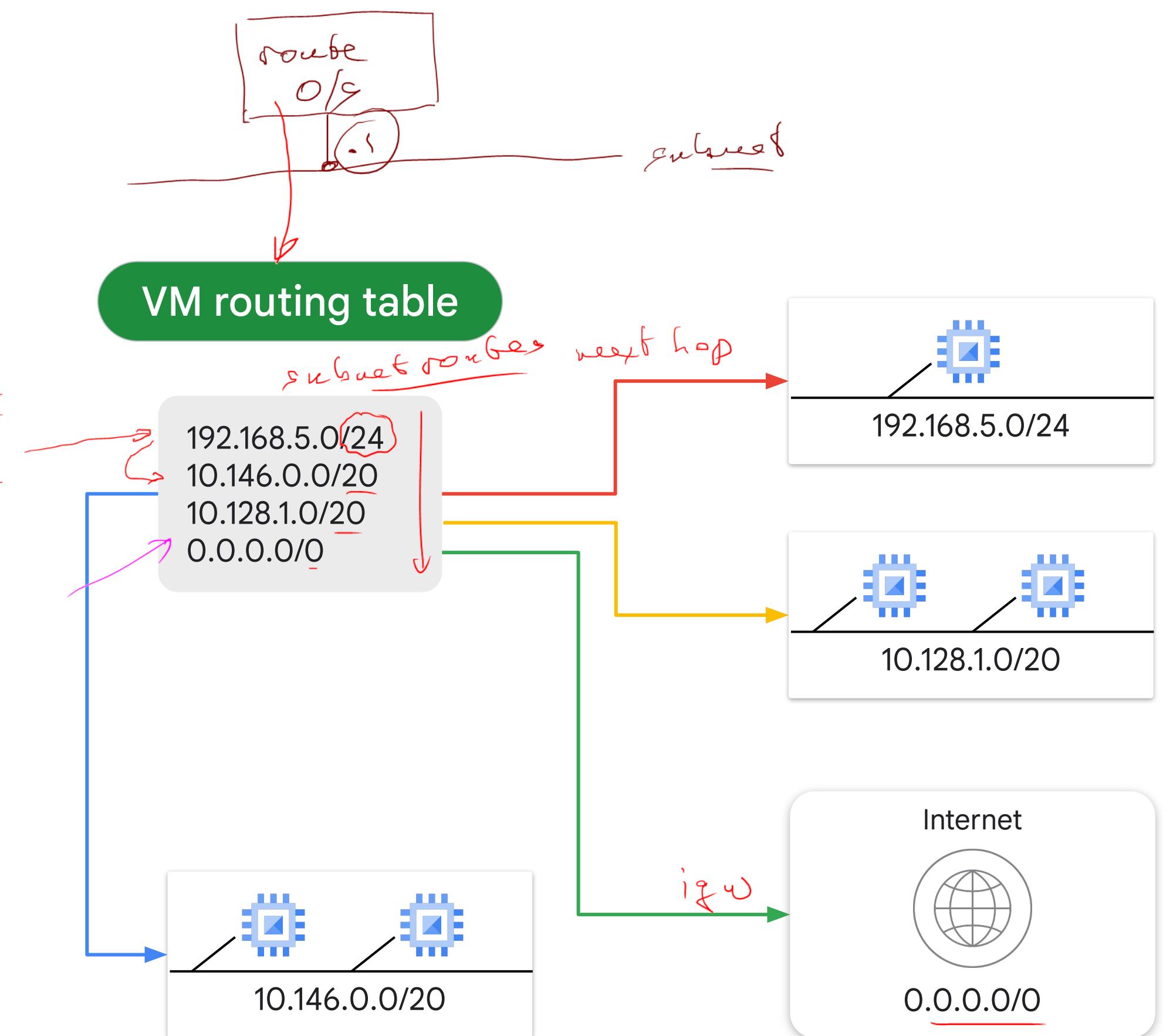
static

Deliver traffic only if it also matches a firewall rule.

Can be fine-tuned using network tags.

146 10010010

128 10000000



# Route types

Routes can be:

System-generated routes

These are default and subnet routes that are automatically created.

Custom routes

These routes are used to route traffic between subnets through a virtual appliance - ~~static~~

VPC Network Peering routes

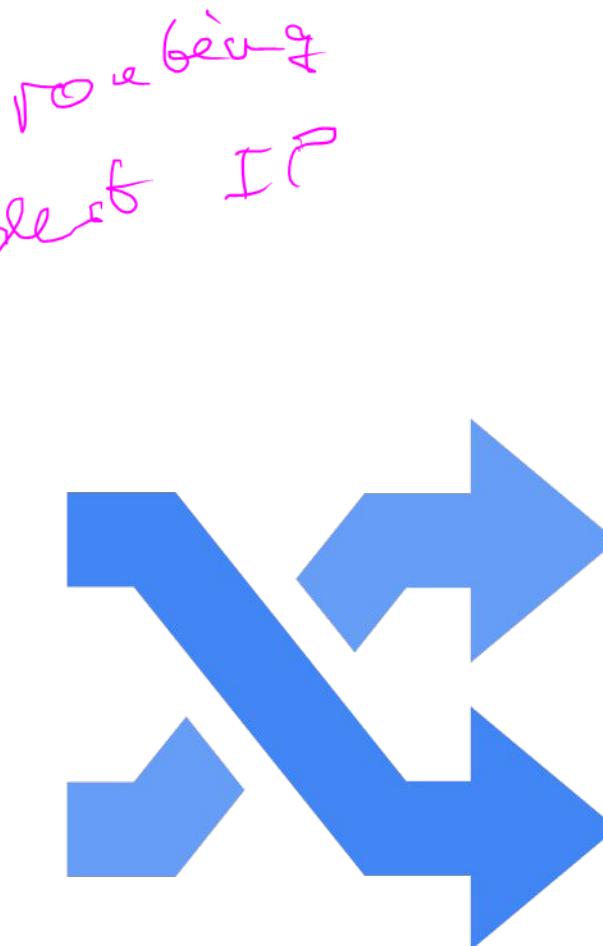
These are routes in a different VPC network connected using peering.

NCC routes

These are routes that represents a subnet IP range in a VPC spoke.

Policy-based routes

These are routes that apply to packets based on source IP, destination IP, protocol, or a combination thereof.



# Overview of system-generated default routes



When you create a VPC network, it includes a system-generated IPv4 default route ( $0.0.0.0/0$ ). *192 bit - 0's*



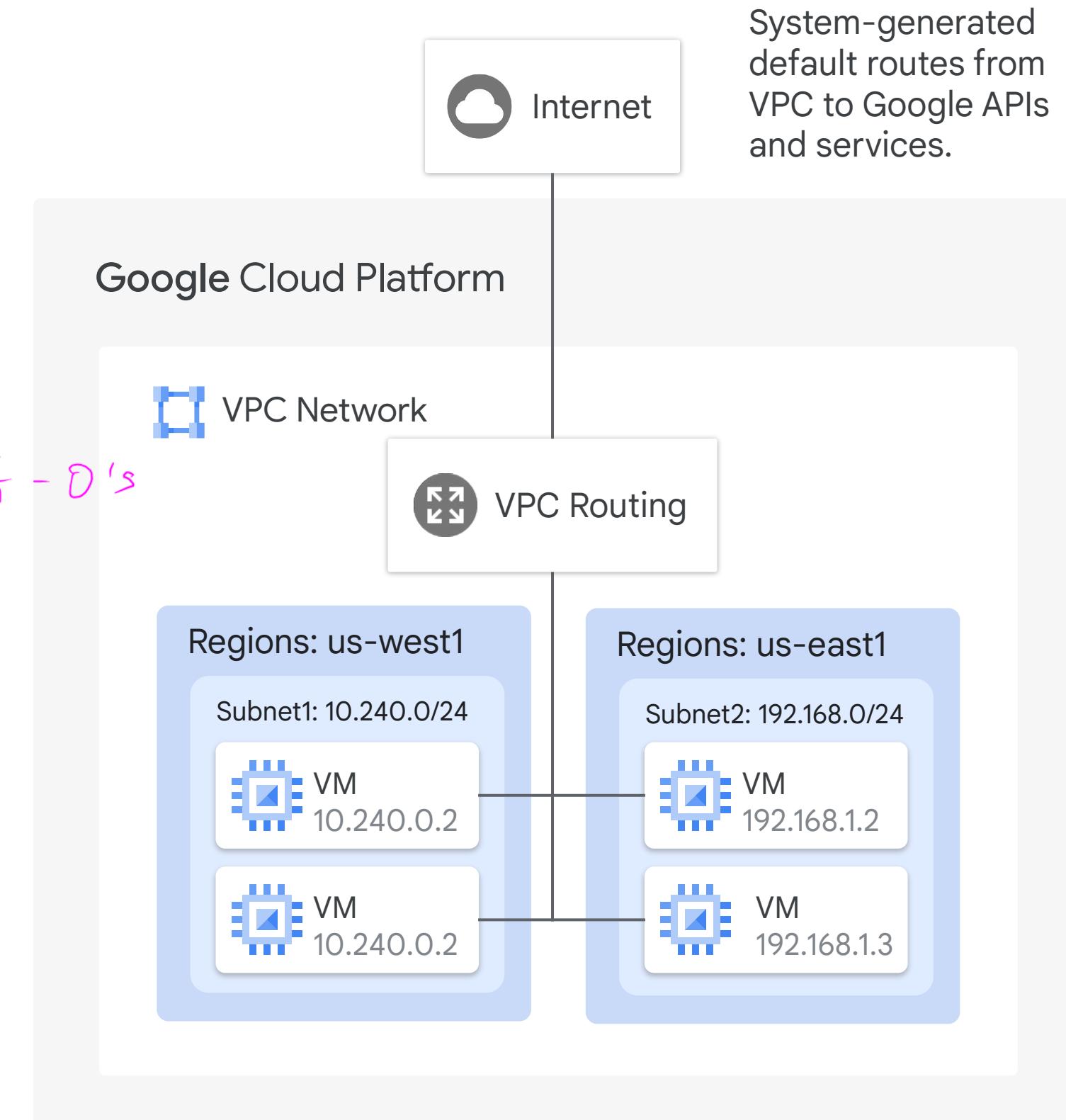
When you create a dual-stack subnet with an external IPv6 address range, a system-generated IPv6 default route ( $::/0$ ) is added to the VPC network. *128 bit - 0's*



The IPv4 and IPv6 default routes define a path to external IP addresses.



Default system-generated routes can serve as a path to Google APIs and services.

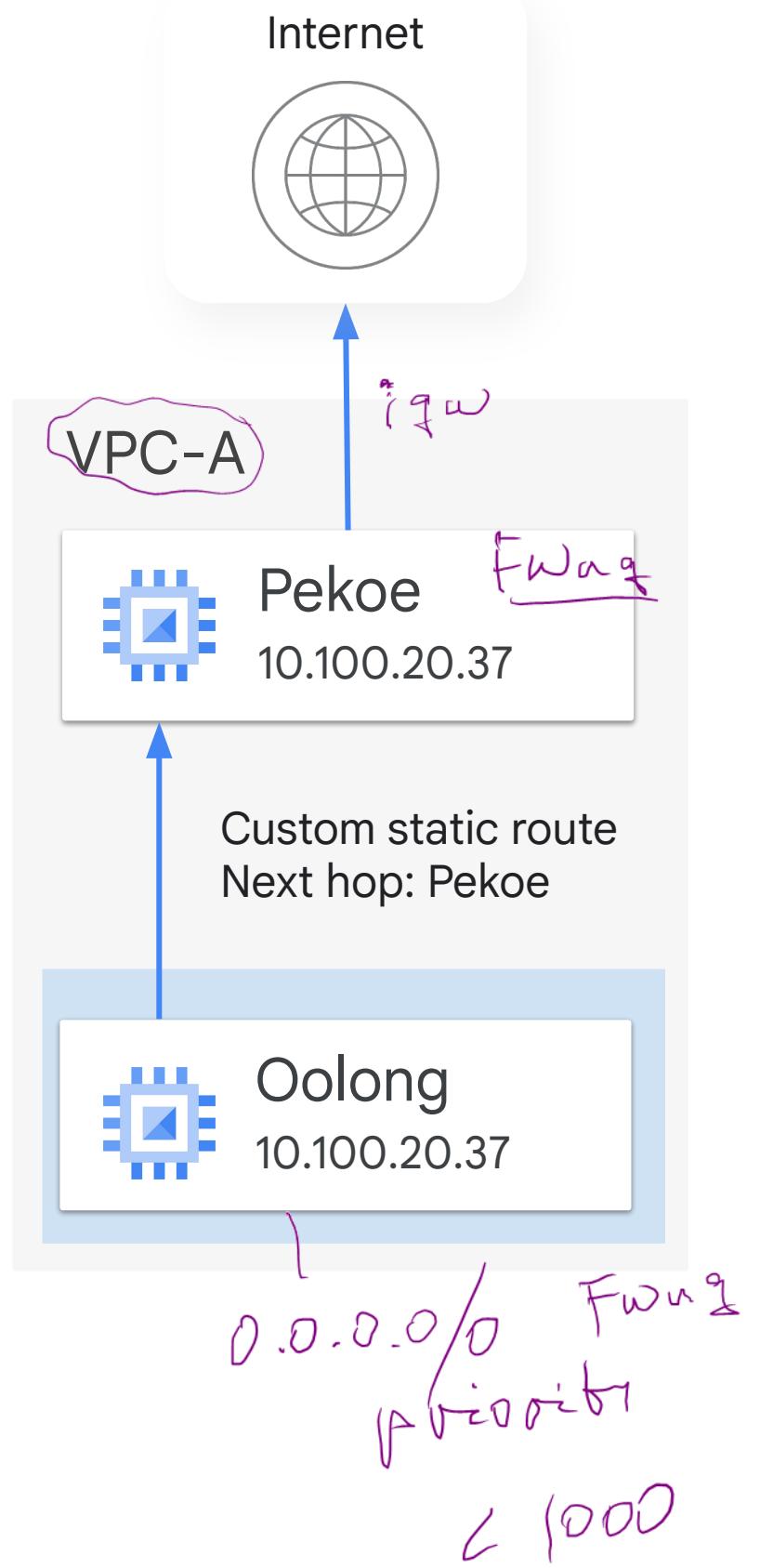
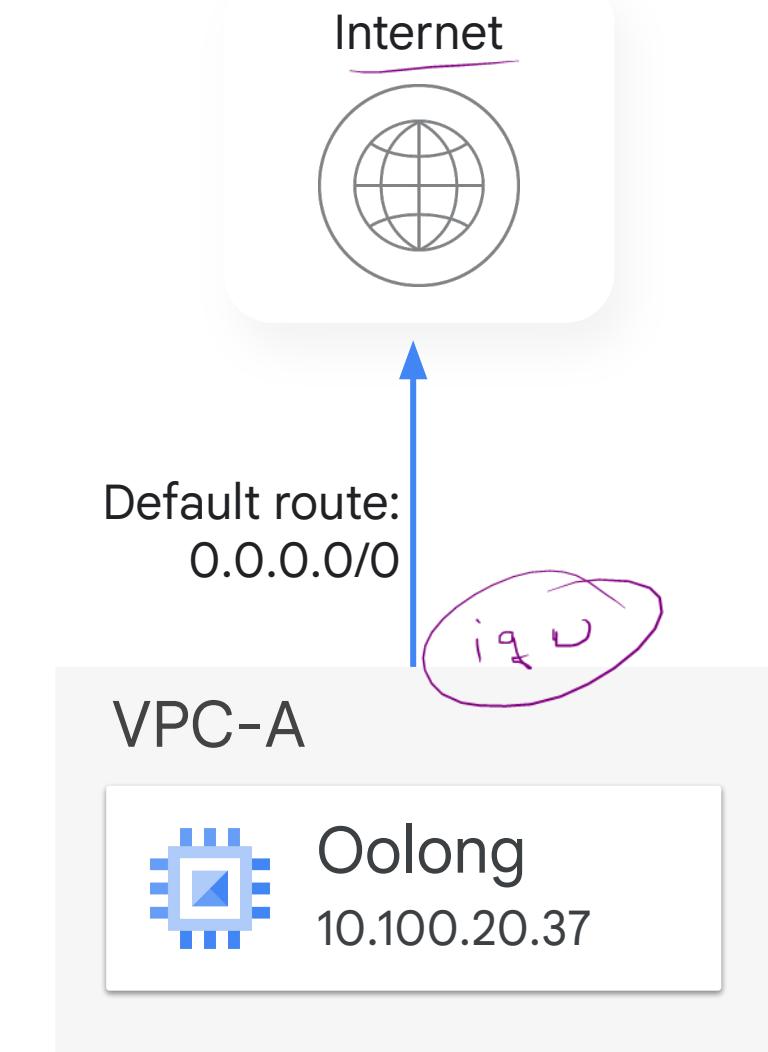


System-generated default routes from VPC to Google APIs and services.

# Using system-generated default routes

- ✓ A default route is used only if a route with a more specific destination does not apply to a packet.
- \* To completely isolate a network, delete the default route:

IPv4 only: to route internet traffic to a different next hop, replace the default route with a custom static or dynamic route.



# Overview of system-generated subnet routes

- When you create a subnet, system-generated subnet routes are automatically created and cannot be modified or deleted.
- Subnet routes:
  - Are highest priority routes after policy-based routes.
  - Cannot be overridden by higher priority routes (lower number equals higher priority).
- Each subnet has at least one subnet route whose destination matches the subnet's primary IP range.
- If the subnet has secondary IP ranges, each secondary IP address range has a corresponding subnet route.

## Routes

### EFFECTIVE ROUTES

### ROUTE MANAGEMENT

Select the VPC network and region for which you want to view routes

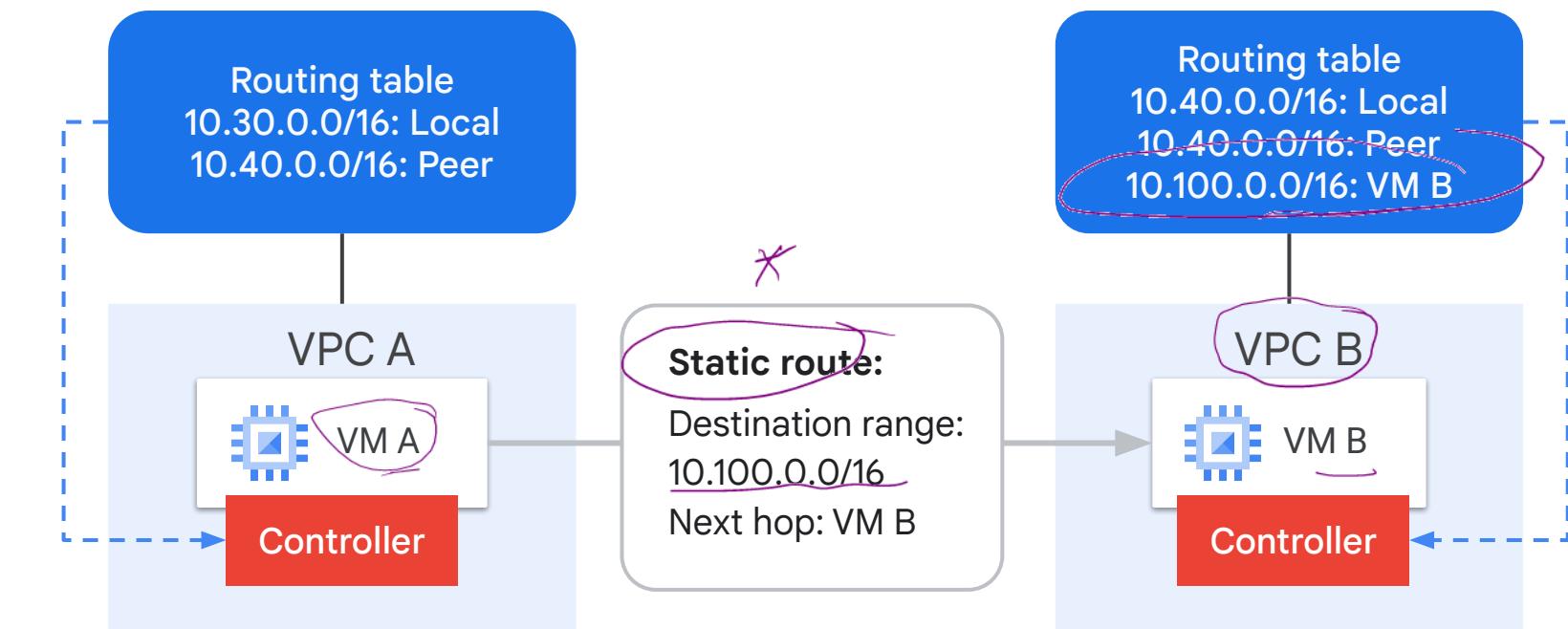
Network \* default Region \* us-south1 (Dallas) ? VIEW

Filter Enter property name or value

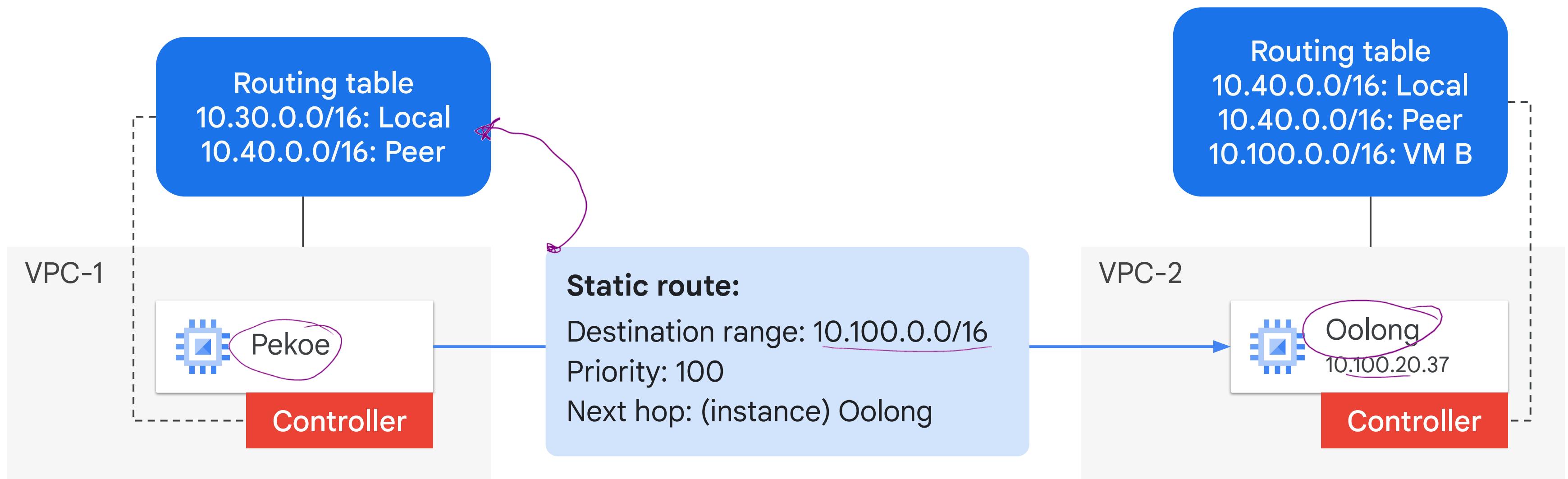
Name ↑	Type	IP version	Destination IP range
<a href="#">default-route-0d0e39bdd08da15b</a>	Subnet	IPv4	10.220.0.0/20
<a href="#">default-route-1c948e8137220ccd</a>	Subnet	IPv4	10.164.0.0/20
<a href="#">default-route-289891f309f1baa9</a>	Subnet	IPv4	10.152.0.0/20
<a href="#">default-route-305801596e6bf299</a>	Subnet	IPv4	10.202.0.0/20
<a href="#">default-route-32a898e23fc01e59</a>	Subnet	IPv4	10.142.0.0/20

# Overview of custom static routes

- ✓ Custom static routes forward packets to a static route next hop and are useful for all topologies.
- ✓ Benefits over dynamic routing include:
  - Quicker routing performance (lower processing overhead).
  - More security (no route advertisement). *BGP*
- It has its limitations:
  - Cannot point to a VLAN attachment.
  - Require more maintenance, because routes are not dynamically updated.



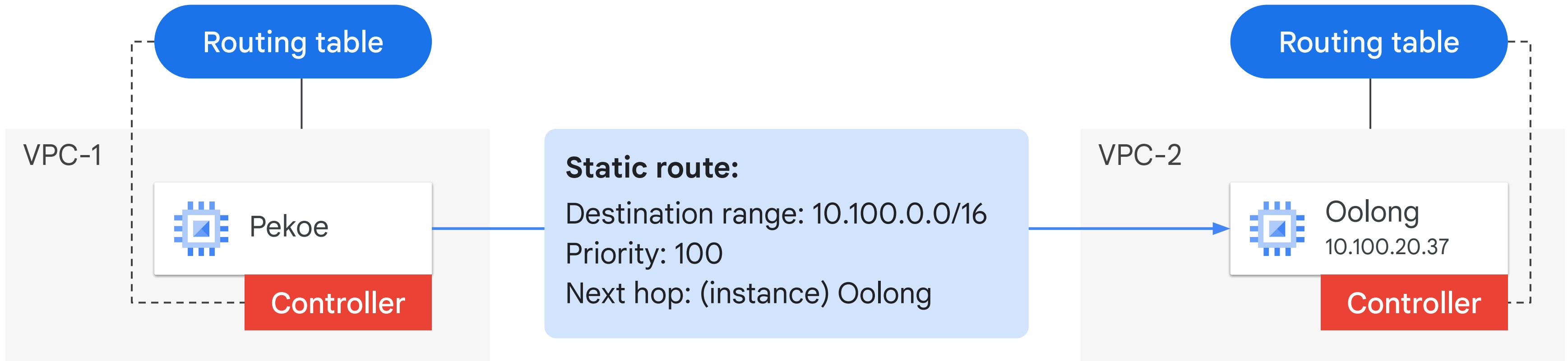
# Use case: Forward packets to a static route next hop



VIT

# Controller

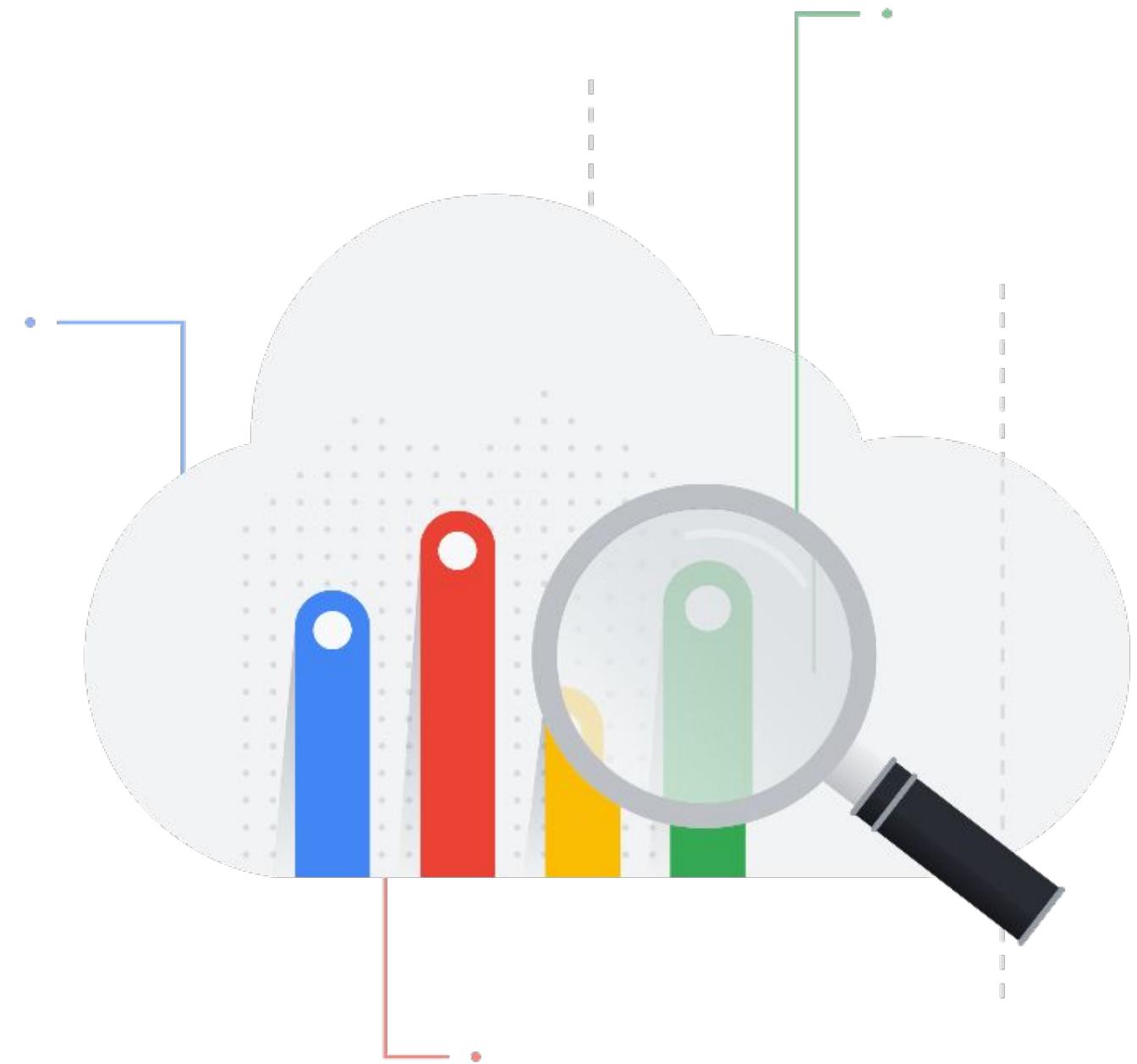
- The controller is kept informed of all routes from the network's routing table.
- Route changes are propagated to the VM controllers.



# Different ways to create custom static routes

Create custom static routes:

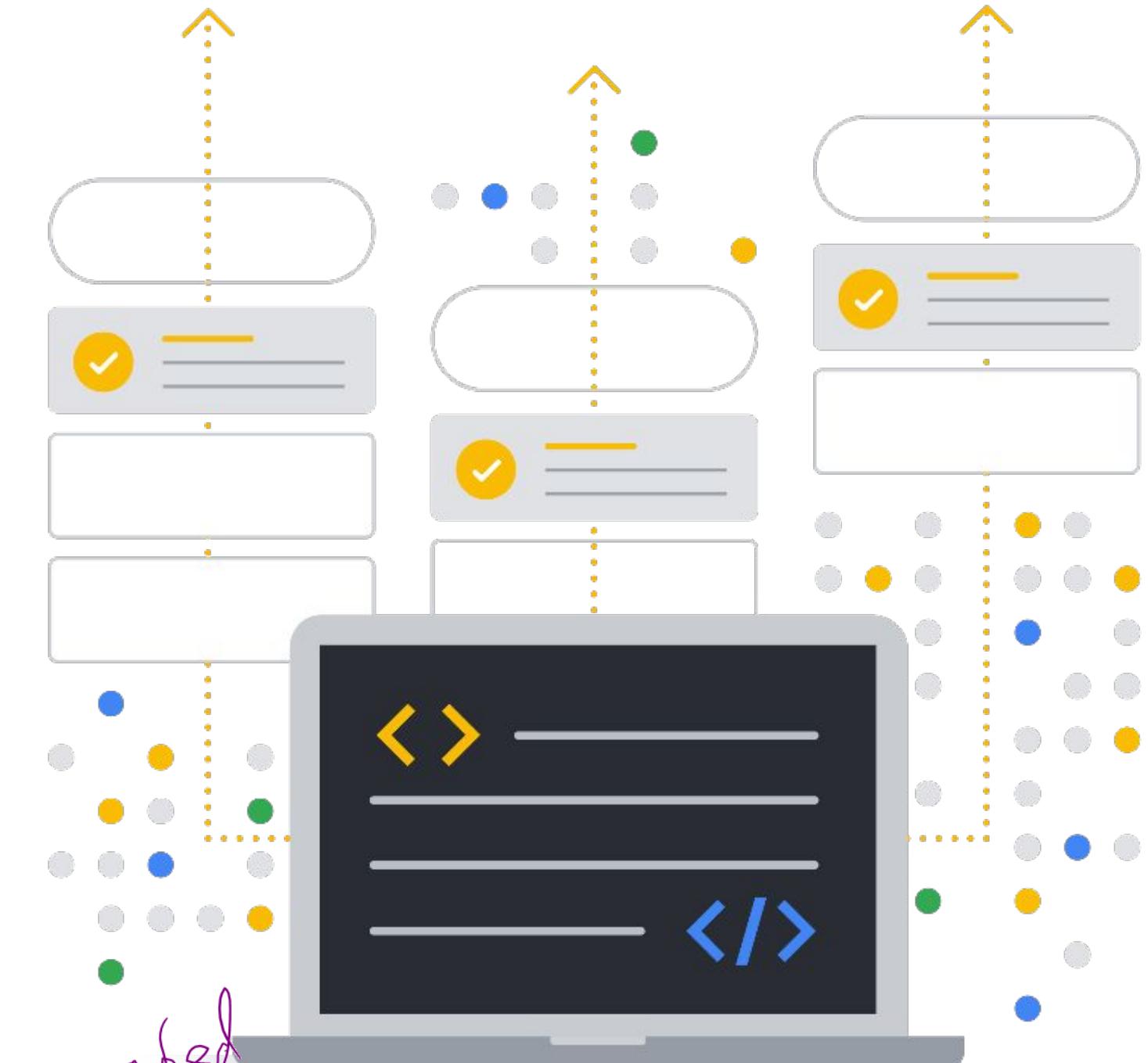
- ✓ Manually, by using either the Google Cloud console, gcloud CLI compute routes create command, or the routes.insert API.
- ✓ When creating a Classic VPN tunnel without dynamic routing in the Google Cloud console, Cloud VPN may automatically generate static routes.
- ✓ You can also use an IaC system such as Terraform.



# Dynamic routes

BGP

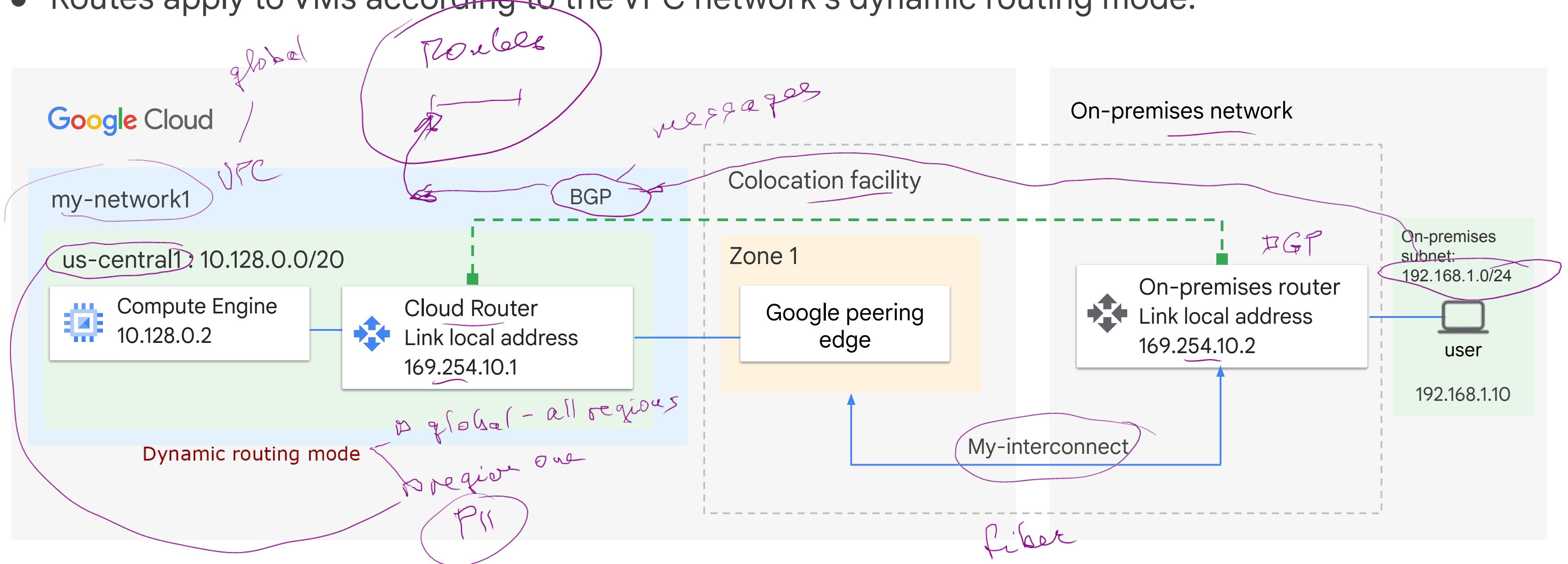
- ✓ Are managed by Cloud Routers.
- ✓ Typically represent IP address ranges outside your VPC network, which are advertised from a BGP peer.
- ✓ Dynamic routes are used by:
  - ✓ Dedicated Interconnect
  - ✓ Partner Interconnect
  - ✓ Cross-Cloud Interconnect
  - ✗ HA VPN tunnels
  - ✗ Classic VPN tunnels that use dynamic routing
  - ✗ NCC Router appliances



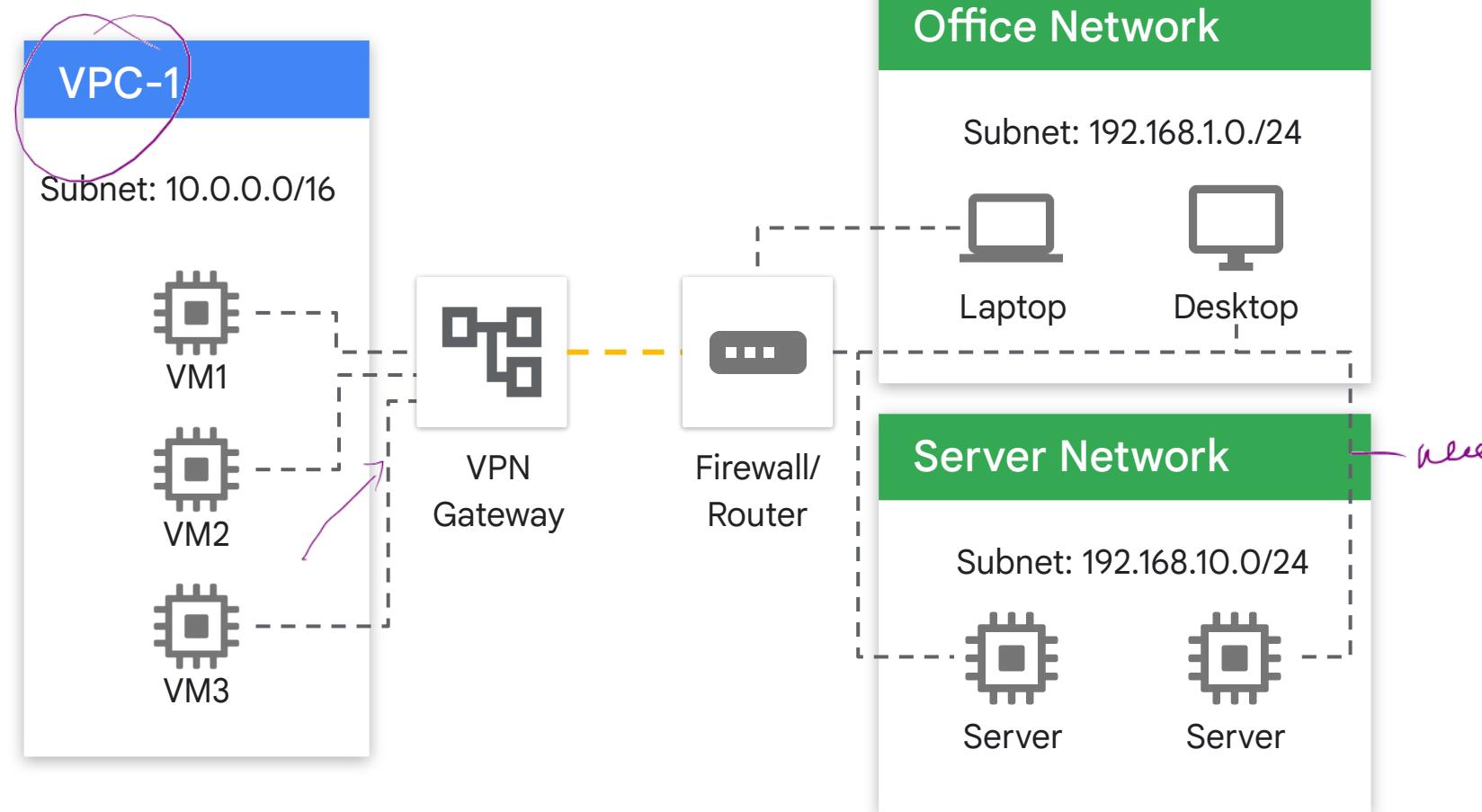
# A dynamic routing example

FGP

- Routes are added and removed automatically by Cloud Routers in your VPC network.
- Routes apply to VMs according to the VPC network's dynamic routing mode.

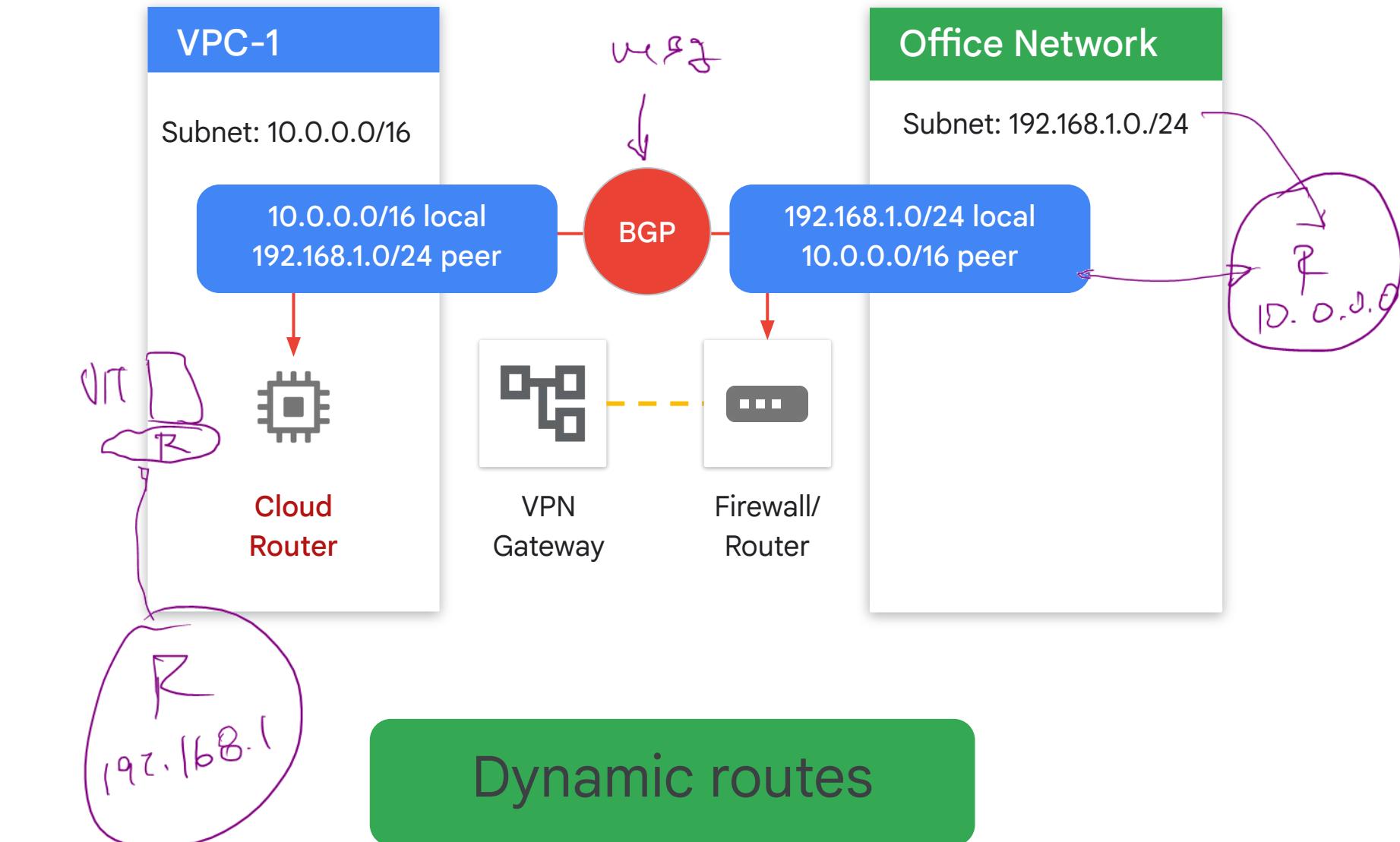


# Use case: Automatically reroute traffic

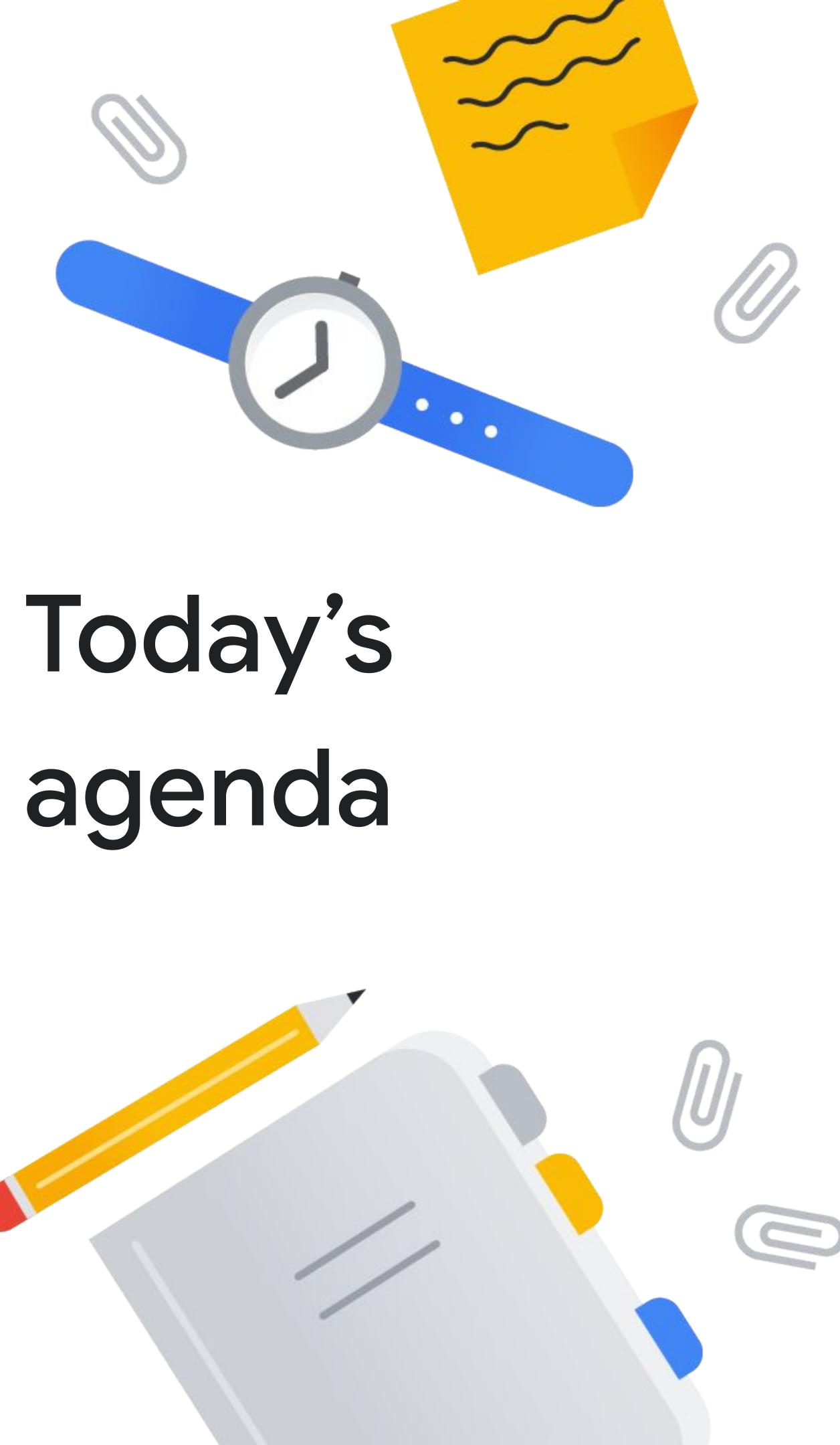


During a link failure, **static routing**:

- Has to be manually updated.
- Cannot reroute automatically.



Dynamic routes



# Today's agenda

- 01 Routes and route preferences
- 02 IPv6
- 03 BYOIP (Bring your own IP)
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- 06 Quiz

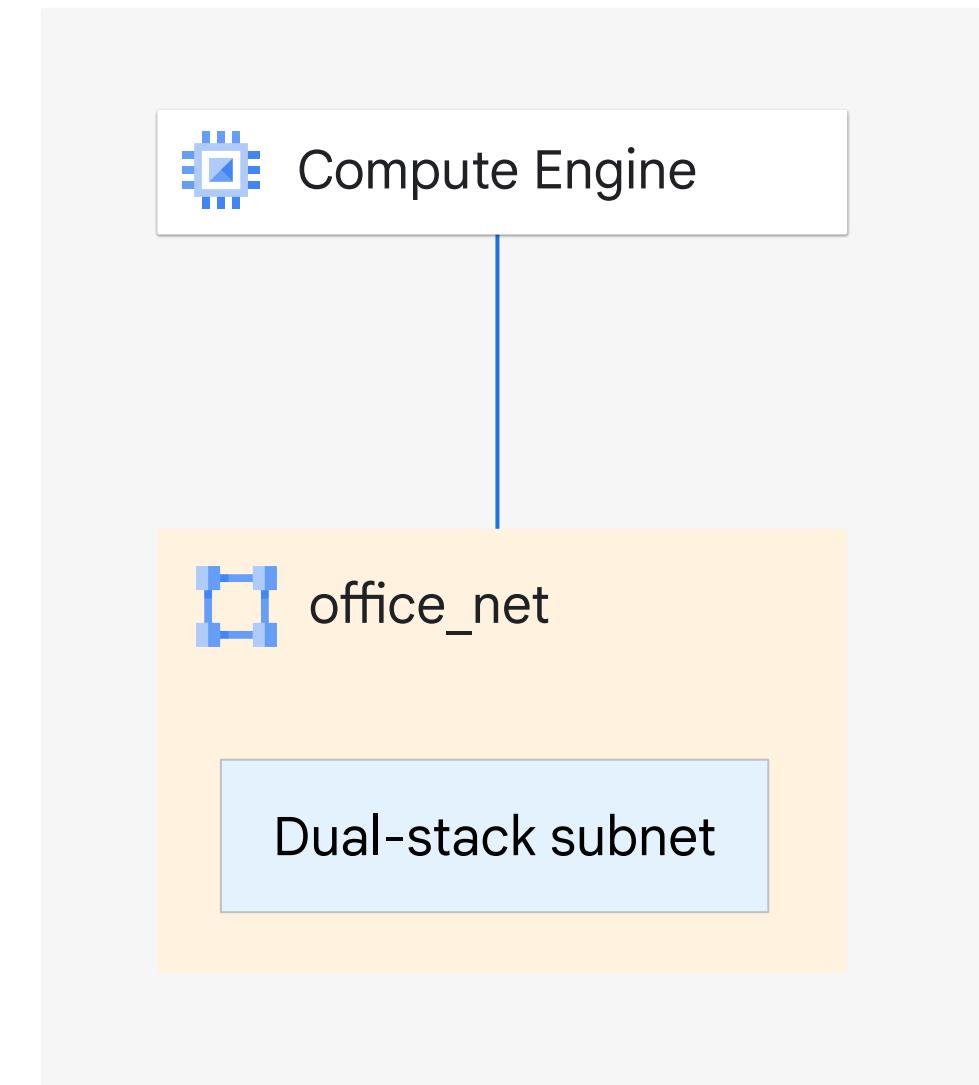
# Subnets and IPv6 support

- VPC networks now support IPv6 addresses.
- Support for IPv6 addresses can vary per subnet.
- To support IPv6, Google Cloud has introduced the concept of a subnet stack.
  - Single-stack subnets support IPv4.
  - Dual-stack subnets support IPv4 and IPv6.
- IPv6 addresses can be assigned to objects in a subnet that supports IPv6.

SUBNETS	STATIC INTERNAL IP ADDRESSES	FIREWALLS	ROUTES	VPC NETWORK PEERING																		
<a href="#">ADD SUBNET</a>	<a href="#">FLOW LOGS</a> ▾																					
Filter <input type="text"/> Enter property name or value																						
<table><thead><tr><th><input type="checkbox"/></th><th>Name</th><th>Region</th><th>Stack Type</th><th>Internal IP ranges ↓</th><th>External IP ranges</th></tr></thead><tbody><tr><td><input type="checkbox"/></td><td><a href="#">sn-india-mumbai</a></td><td>asia-south1</td><td>IPv4 and IPv6</td><td>192.168.6.0/24, fd20:476:674b</td><td>None</td></tr><tr><td><input type="checkbox"/></td><td><a href="#">sn-eu-us-central</a></td><td>us-central1</td><td>IPv4 and IPv6</td><td>192.168.1.0/24</td><td>2600:1900:4000:4a23:0:0:0/64</td></tr></tbody></table>					<input type="checkbox"/>	Name	Region	Stack Type	Internal IP ranges ↓	External IP ranges	<input type="checkbox"/>	<a href="#">sn-india-mumbai</a>	asia-south1	IPv4 and IPv6	192.168.6.0/24, fd20:476:674b	None	<input type="checkbox"/>	<a href="#">sn-eu-us-central</a>	us-central1	IPv4 and IPv6	192.168.1.0/24	2600:1900:4000:4a23:0:0:0/64
<input type="checkbox"/>	Name	Region	Stack Type	Internal IP ranges ↓	External IP ranges																	
<input type="checkbox"/>	<a href="#">sn-india-mumbai</a>	asia-south1	IPv4 and IPv6	192.168.6.0/24, fd20:476:674b	None																	
<input type="checkbox"/>	<a href="#">sn-eu-us-central</a>	us-central1	IPv4 and IPv6	192.168.1.0/24	2600:1900:4000:4a23:0:0:0/64																	

# To use IPv6, set up a dual-stack subnet

- You can configure the IPv6 access type as internal or external.
- Internal IPv6 addresses are used for communication between VMs within VPC networks. *fd 20*
- External IPv6 addresses:  
  - Can be used for communication between VMs within VPC networks.
  - Are also routable on the internet.
- Connected VMs inherit the IPv6 access type from the subnet.



# IPv6 caveats

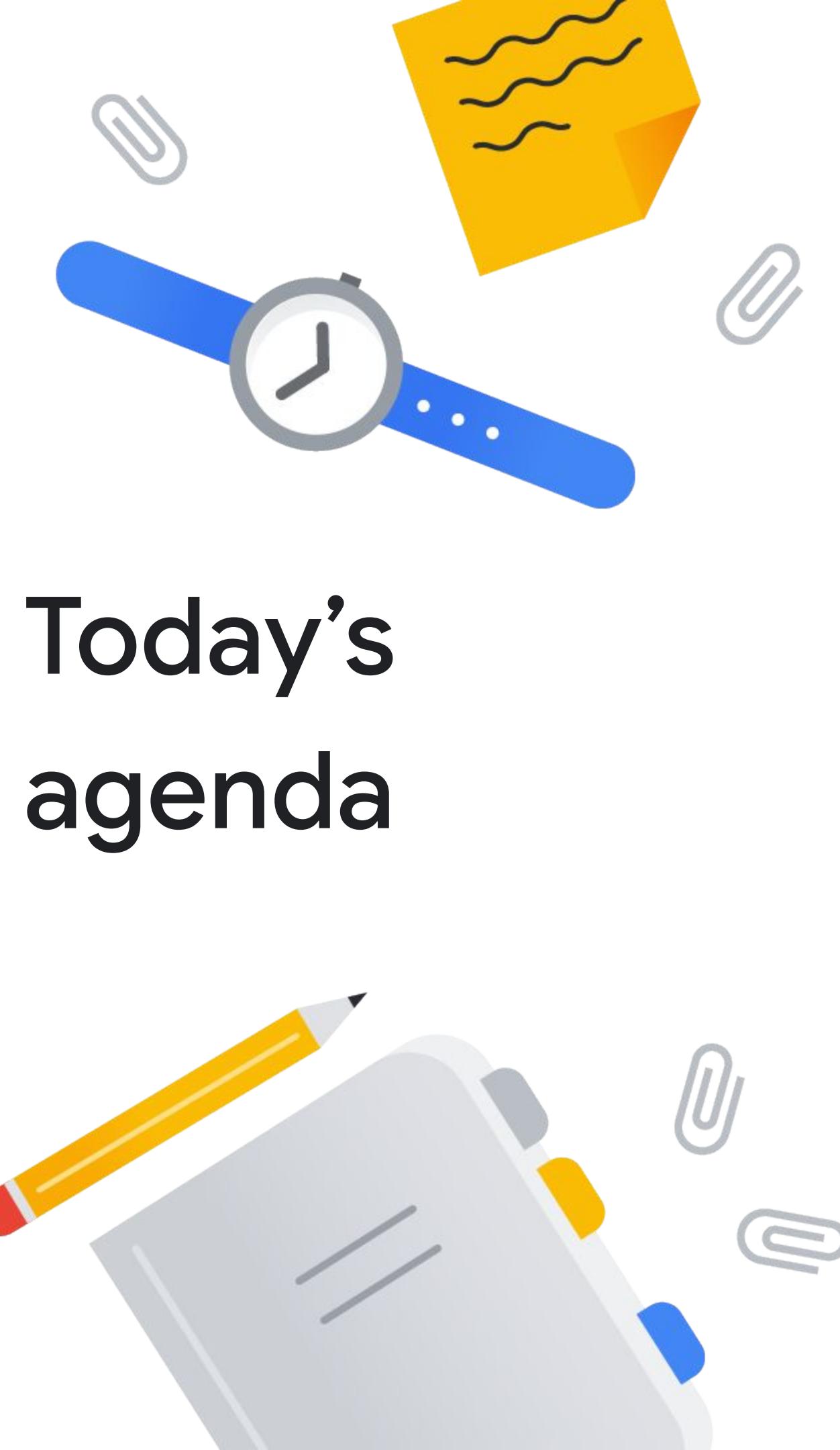


Dual-stack subnets  
are not supported on  
auto mode VPC  
networks or legacy  
networks.



~~Single stack IPv6  
subnets are not  
supported. If IPv6 is  
required, IPv4 must  
also be configured  
on a subnet.~~

*files are supported*



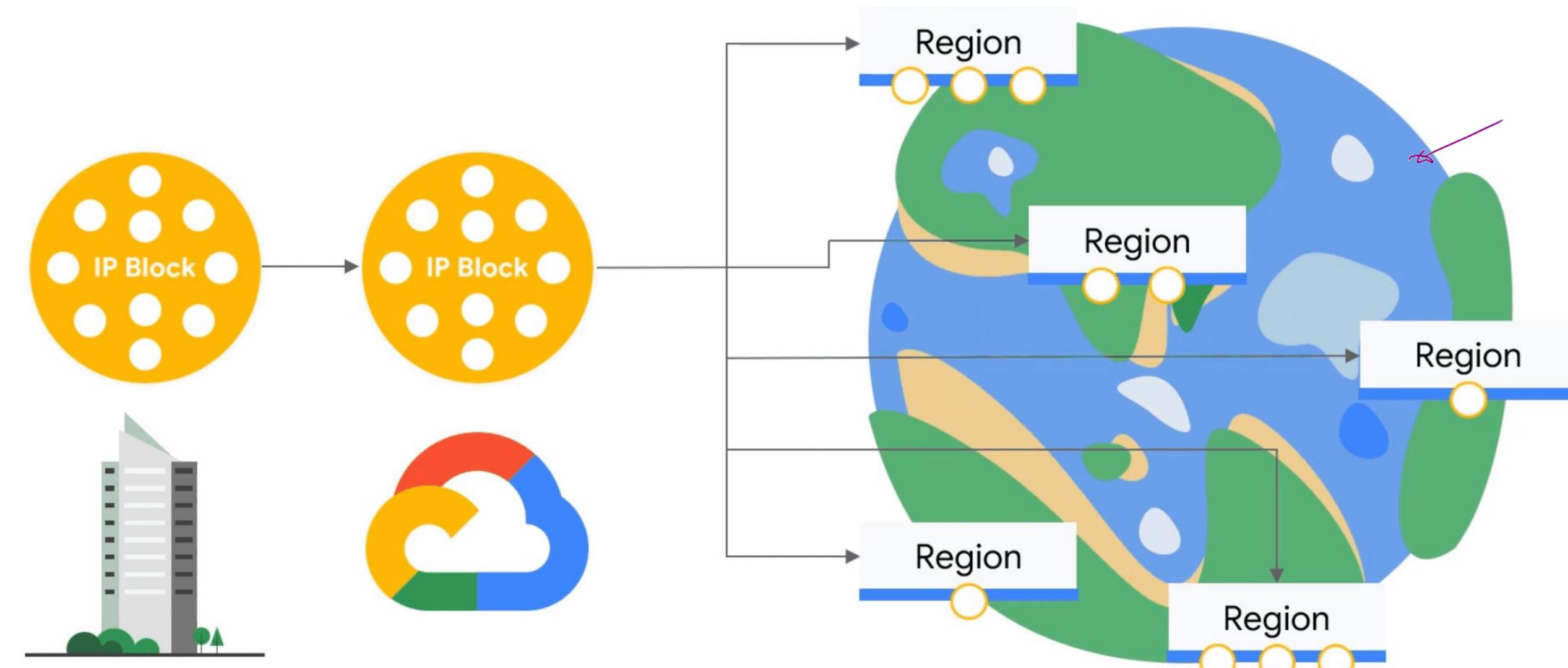
# Today's agenda

- 01 Routes and route preferences
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# Use case: Bring your own IP to Google's network

ARIN  
IP range

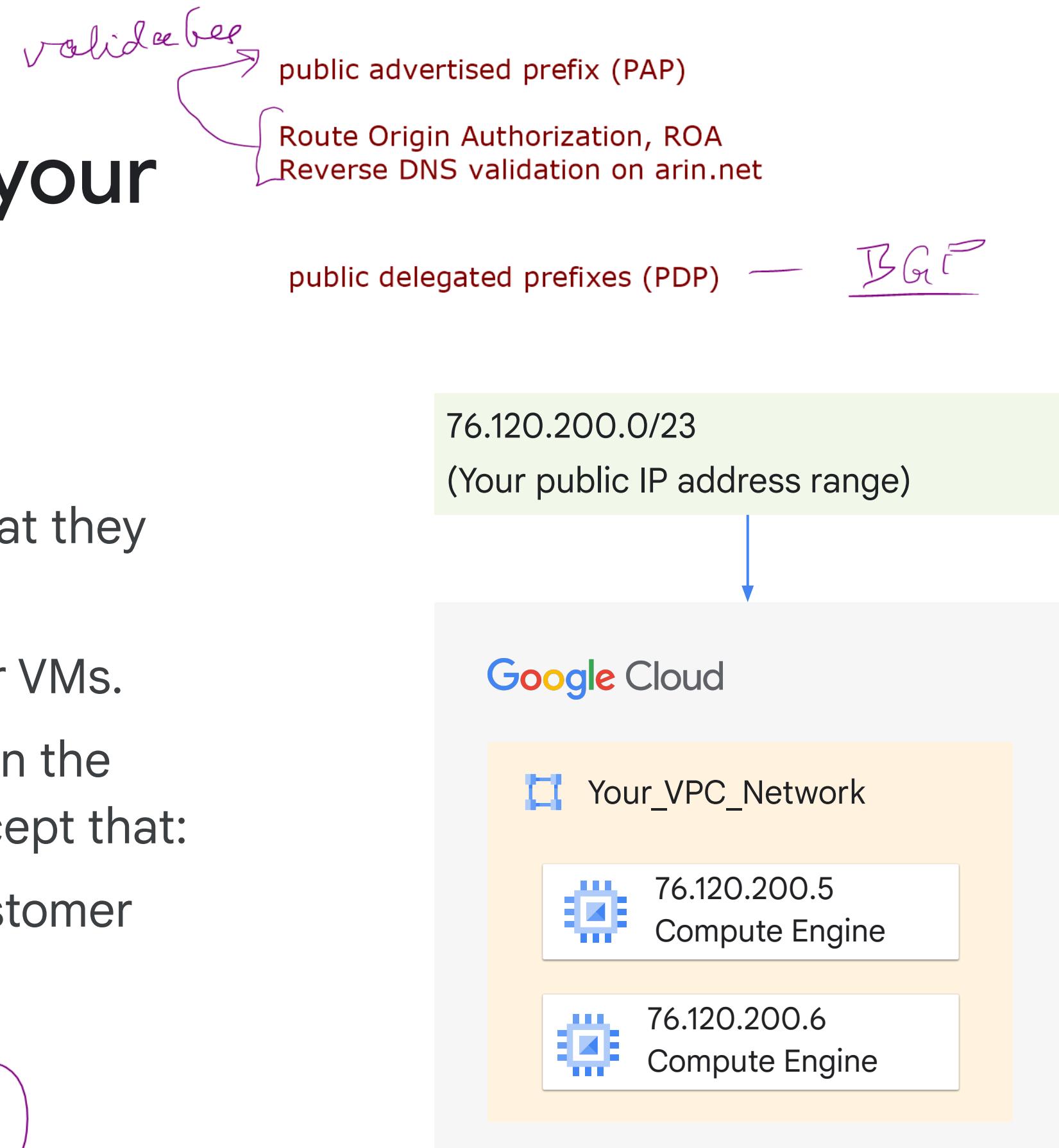
Google Advertising



# Introduction to BYOIP (bring your own IP address)

- BYOIP enables customers to:
  - Assign IP addresses from a public IP range that they own to Google Cloud resources.
  - Route traffic directly from the internet to their VMs.
- Google Cloud manages these BYOIP addresses in the same way as Google-provided IP addresses, except that:
  - The IP addresses are available only to the customer who brought them.
  - Idle or in-use IP addresses incur no charges.

pay As You Go



# BYOIP guidelines

external IP

The object that the IP address is assigned to:

- Can have a regional scope or a global scope and must support an external address type.

## BYOIP can be used

As the peer IP address of a Classic VPN gateway.

To create external forwarding rules in GKE ingress for external Application Load Balancers.

To configure static IP addresses on VM creation in a MIG.

In Shared VPC host projects and use the host project IP addresses in the service projects.

## BYOIP is not supported

As the peer IP address of a HA VPN gateway and as the external IP address of Classic VPN or HA VPN gateway.

In Google Kubernetes Engine nodes and Pods.

MIGs that automatically allocate IP addresses to VMs.

Shared VPC does not support creating BYOIP addresses in service projects.



# BYOIP caveats

01

BYOIP prefixes cannot overlap with subnet or alias ranges in the VPC.

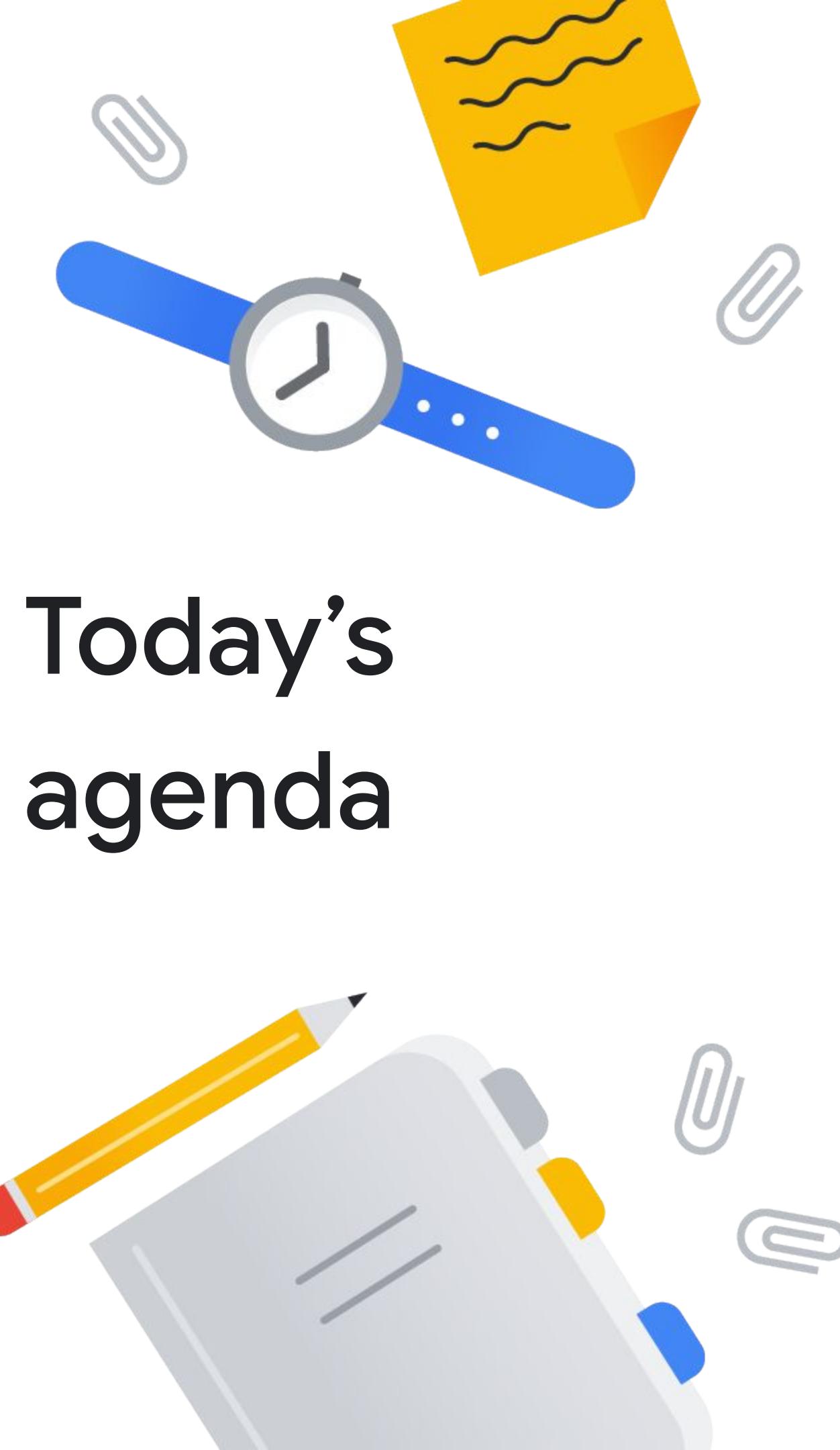
02

The IP address must be IPv4.

03

Overlapping BGP route announcements can be problematic.

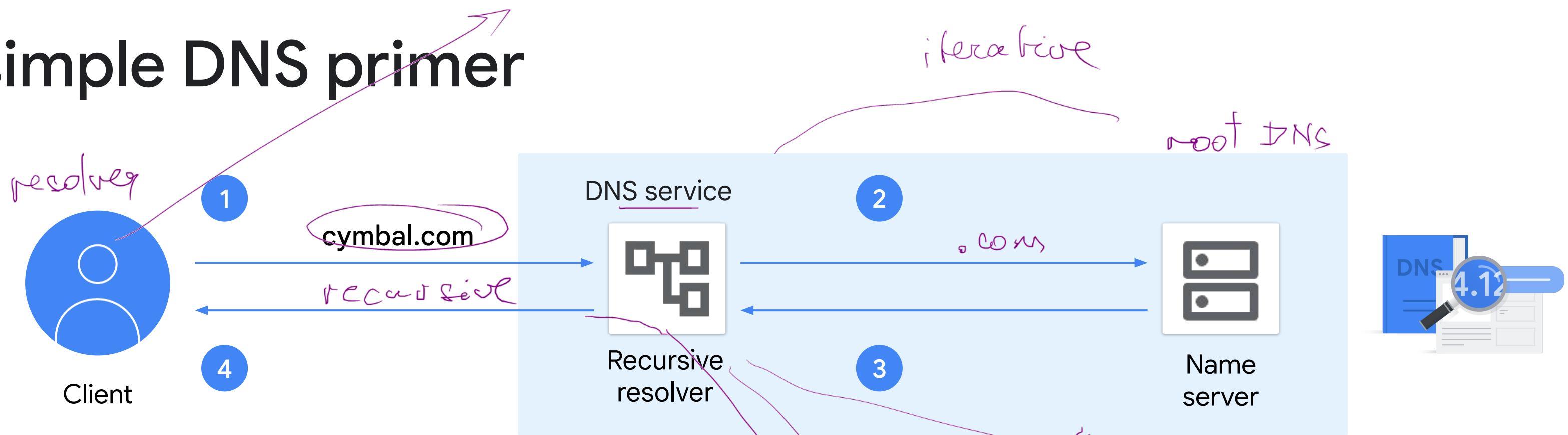




# Today's agenda

- 
- 01 Routes and route preferences
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-

# A simple DNS primer



- 1
- 2
- 3
- 4

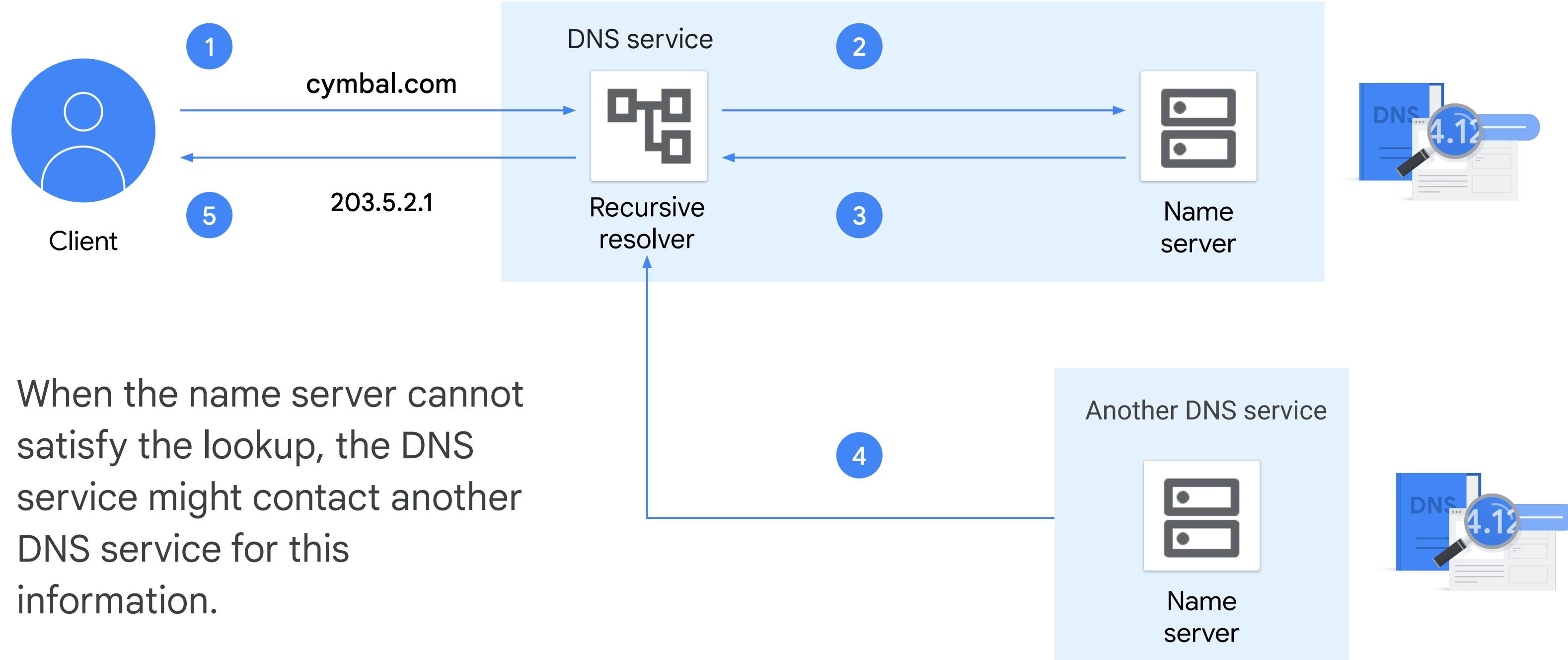
A client makes a DNS request to find the IP address; the request is sent to a recursive resolver.

A recursive resolver requests the IP address from a name server.

The name server responds with the IP address.

The recursive resolver sends the IP to the client.

# A simple DNS primer

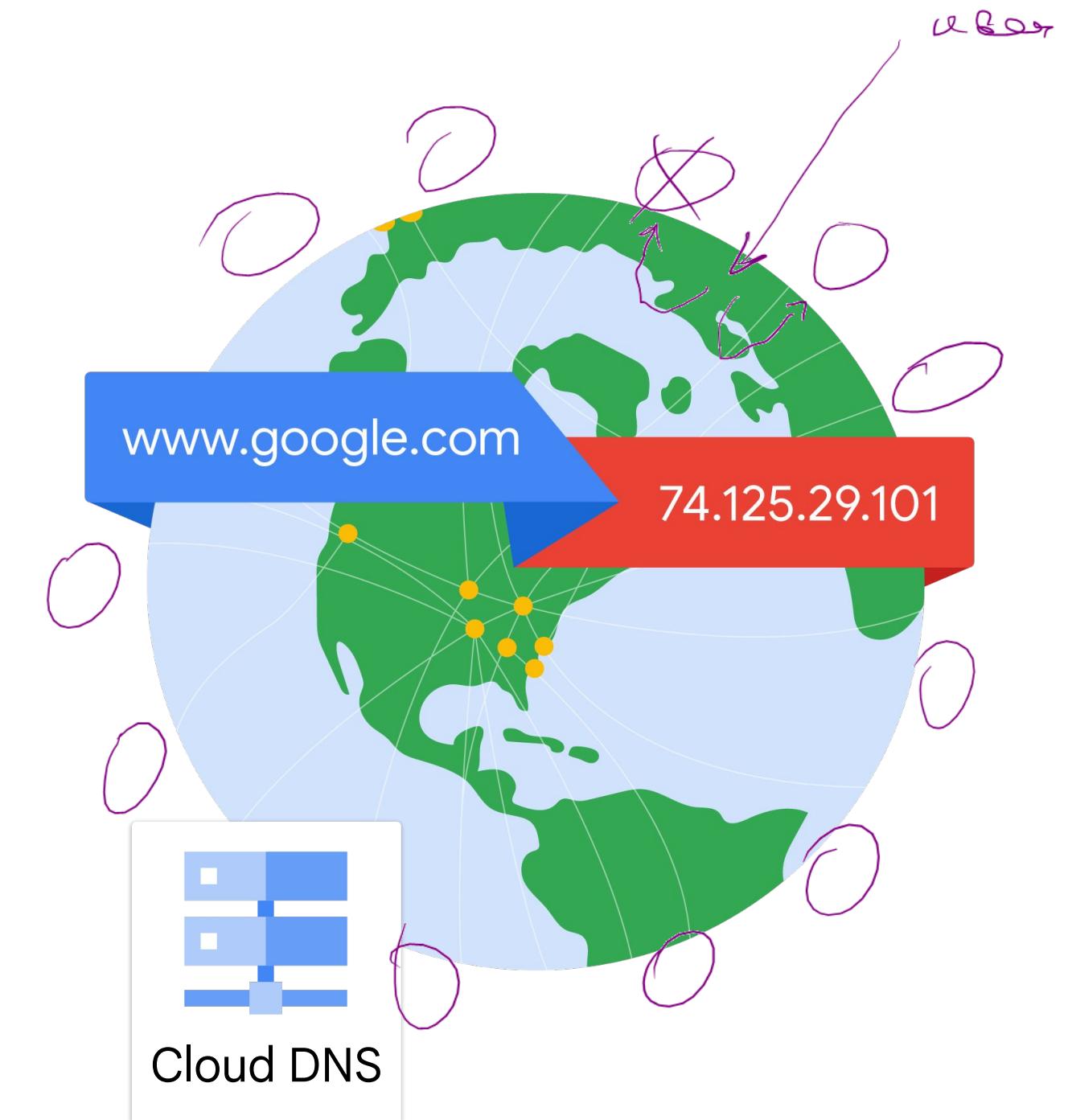


8.8.8.8  
Anycast

# Use Cloud DNS to host DNS zones

Cloud DNS can:

- ✓ Create and update millions of DNS records.
- ✓ Update by using the Google Cloud console, command line, or API.
- ✓ Google guarantees 100%\* availability of its authoritative name servers.



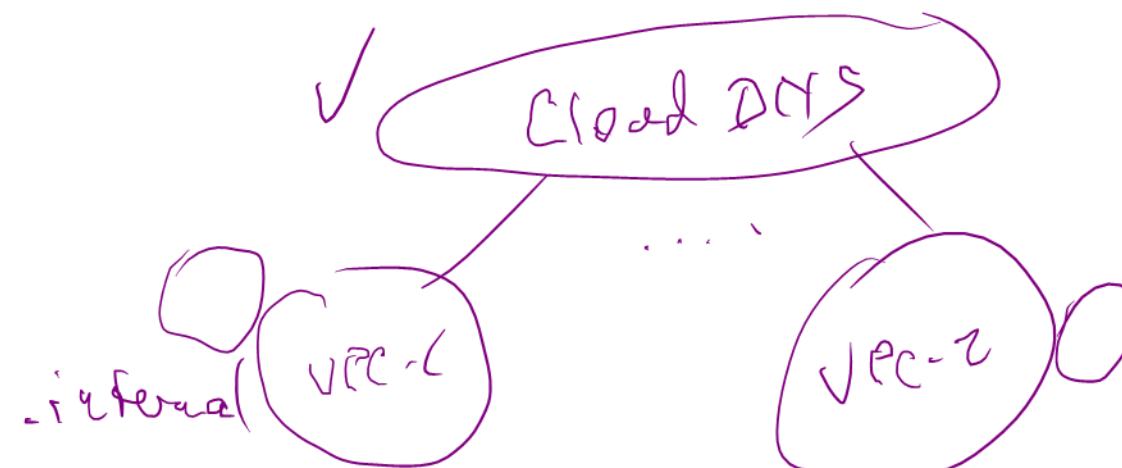
# Closed DNS

## Private and public DNS zones

### Private DNS zones

Private zones are used to provide a namespace that is visible only inside the VPC or hybrid network environment.

For example, an organization would use a private zone for a domain dev.gcp.example.com, which is reachable only from within the company intranet.



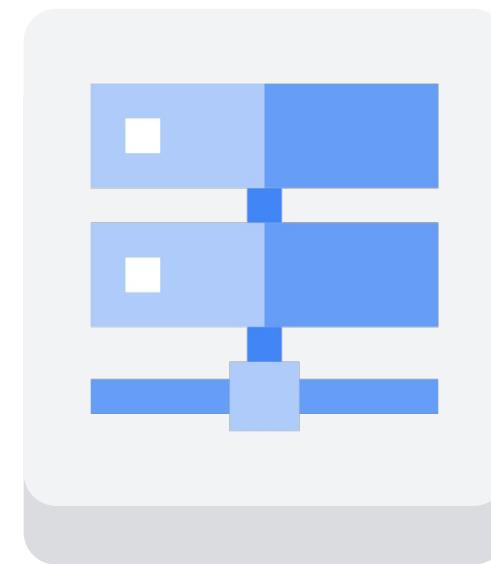
### Public DNS zones

Public zones are used to provide authoritative DNS resolution to clients on the public internet.

For example, a business would use a public zone for its external website, cymbal.com, which is directly accessible from the internet.

- ① register
- ② Cloud DNS

# Introduction to Cloud DNS policies



Cloud DNS

Cloud DNS policies provide a flexible way to refine how your organization uses DNS.

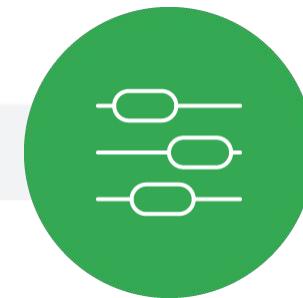
After you create the DNS zone and artifacts needed for lookups, create Cloud DNS policies.

# Supported Cloud DNS policies



Server policies apply private DNS configuration to a VPC network.

*hybrid*



Response policies enable you to modify the behavior of the DNS resolver by using rules that you define.



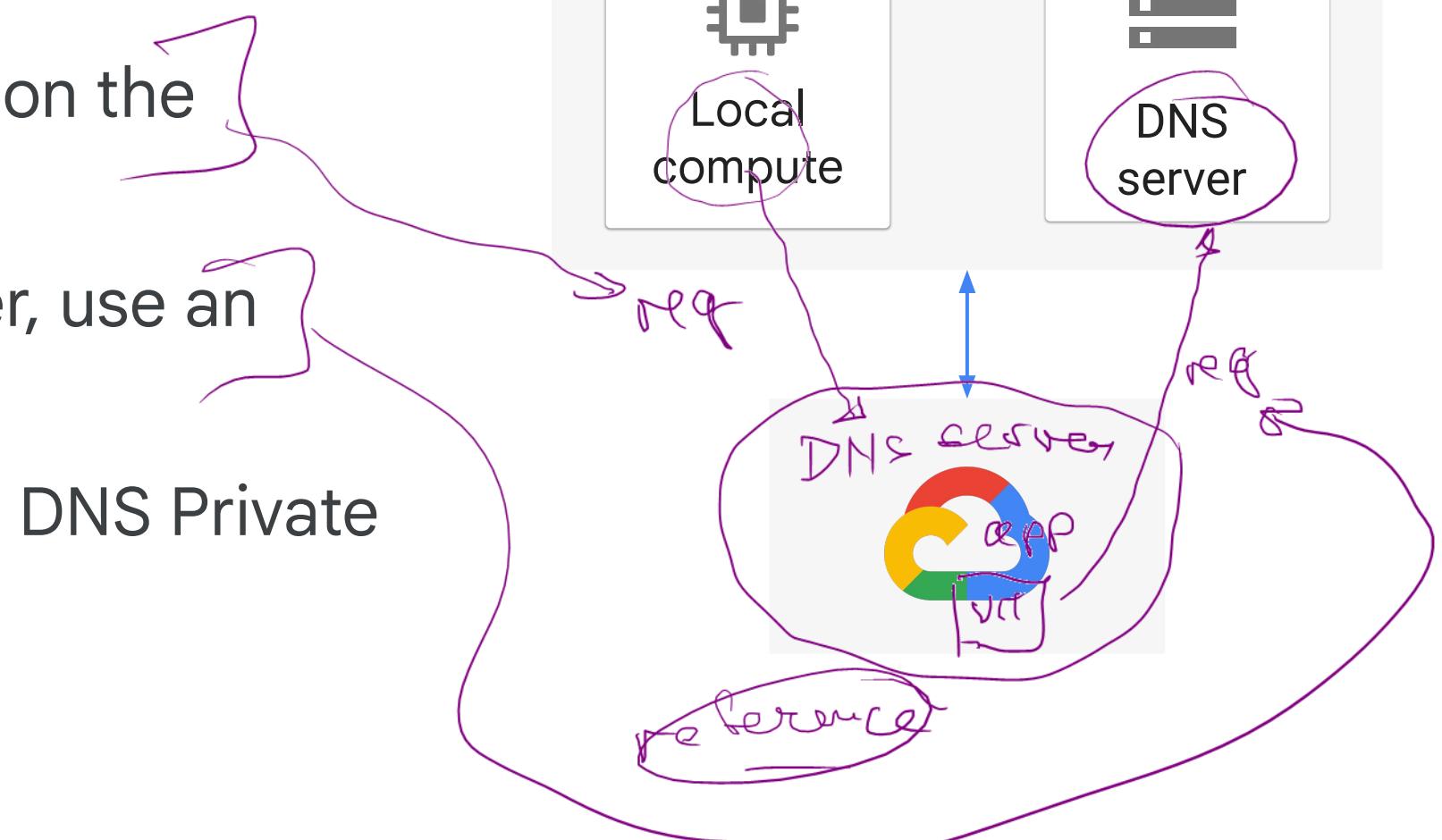
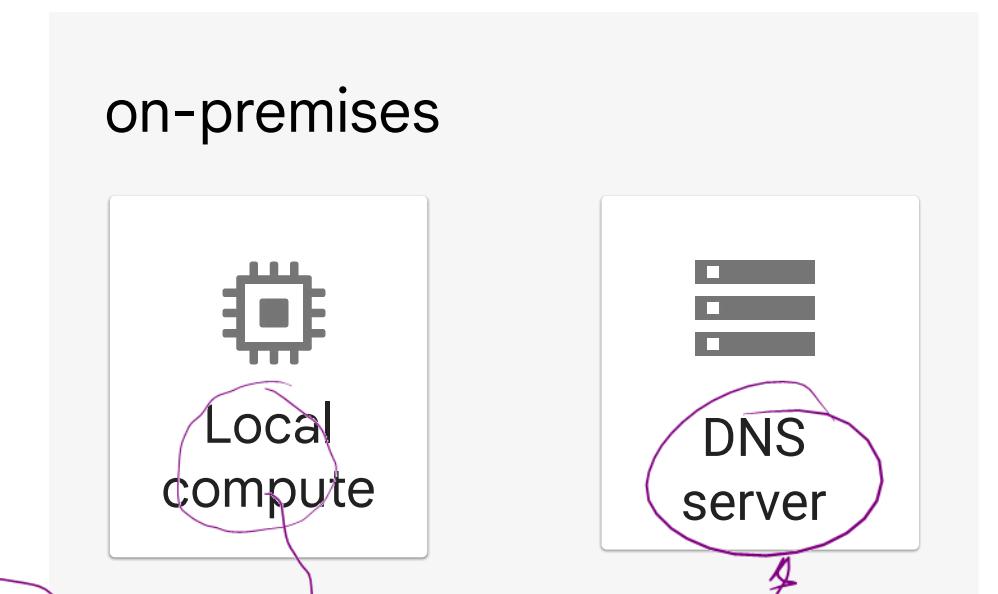
Routing policies: steer traffic based on

- geolocation or round robin.

*weighted  
geo-based  
failover*

# Server policies

- Use server policies to set up hybrid deployments for DNS resolutions.
- Each VPC network can have one DNS server policy.
- You can set up an inbound server policy depending on the direction of DNS resolutions.
- For workloads that use an on-premises DNS resolver, use an outbound server policy to set up DNS forwarding.
- If you want on-premises workloads to resolve Cloud DNS Private zones, set up an inbound server policy.

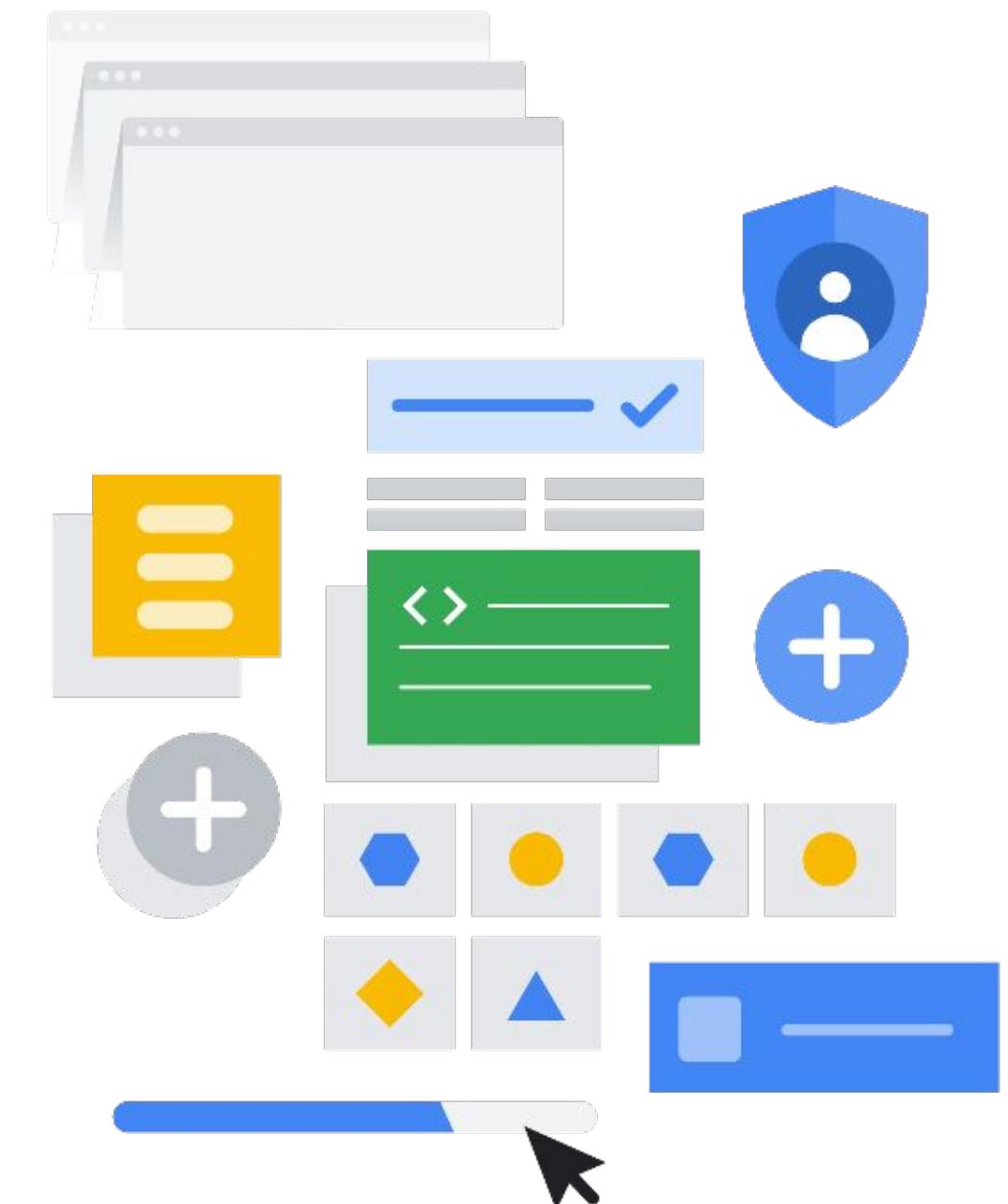


# Response policies

*Some rules → restricted IP*

- A response policy:
  - Is a Cloud DNS private zone concept that contains rules instead of records.
  - Lets you introduce customized rules in DNS servers within your network that the DNS resolver consults during lookups.
- If a rule in the response policy affects the incoming query, It's processed (otherwise, the lookup proceeds normally).
- Response policies are not DNS zones and are managed separately in the API

*Round robin*



# Routing policies



DNS routing policies steer your traffic based on specific criteria..



Google Cloud supports three types of DNS routing policies:



Weighted round robin



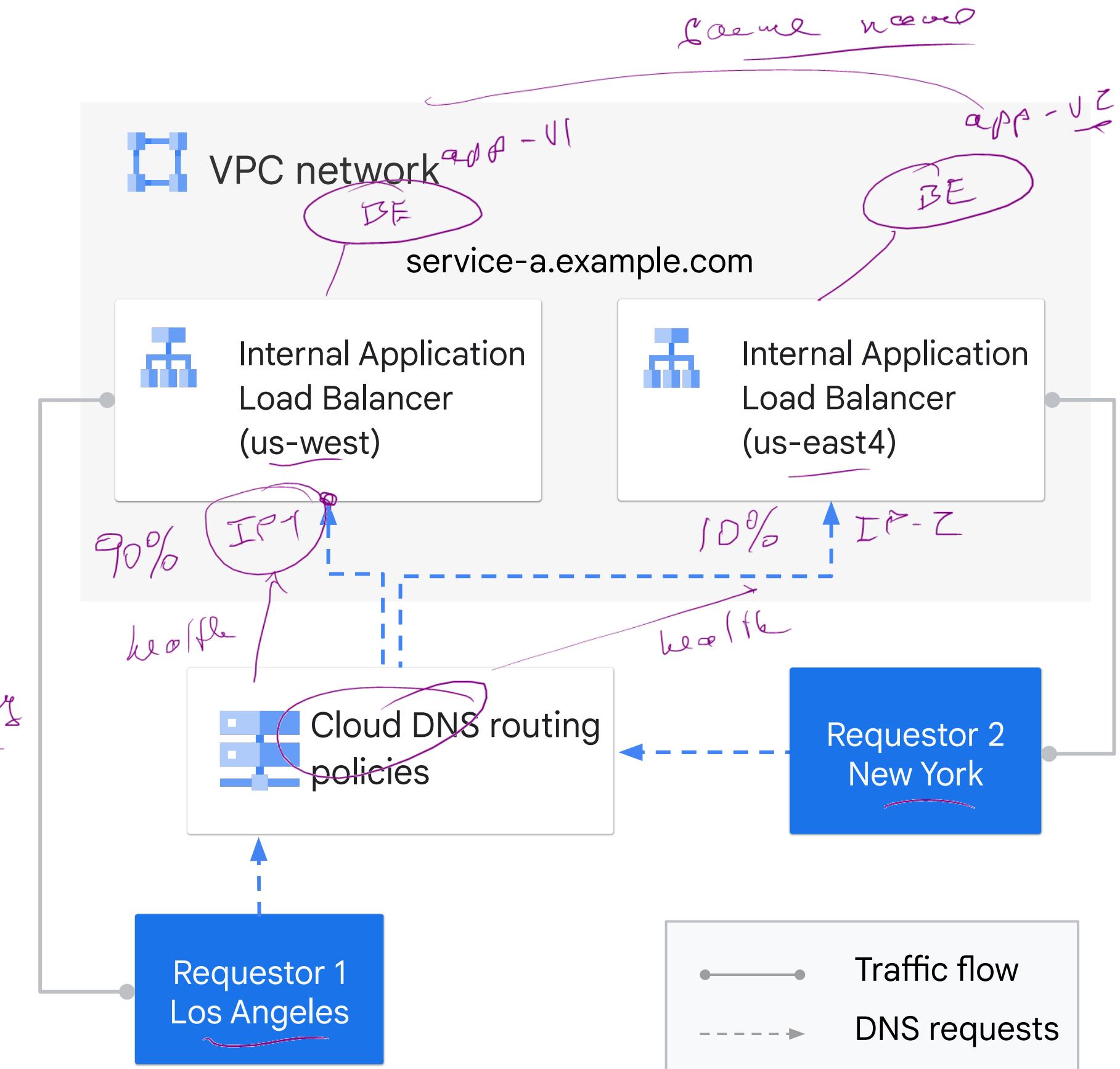
Geolocation



Failover (private zones only)

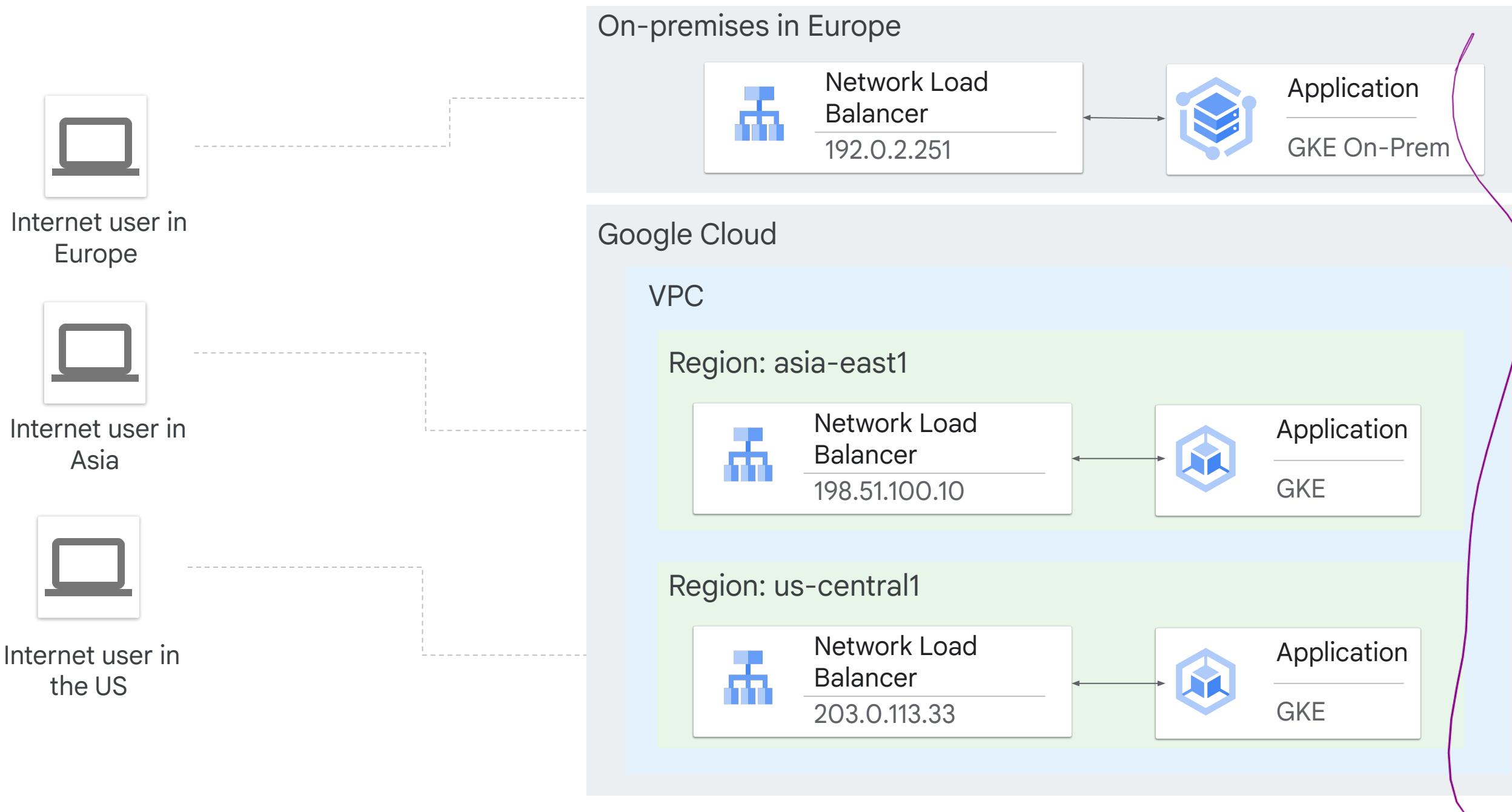
geo fenced

Cards

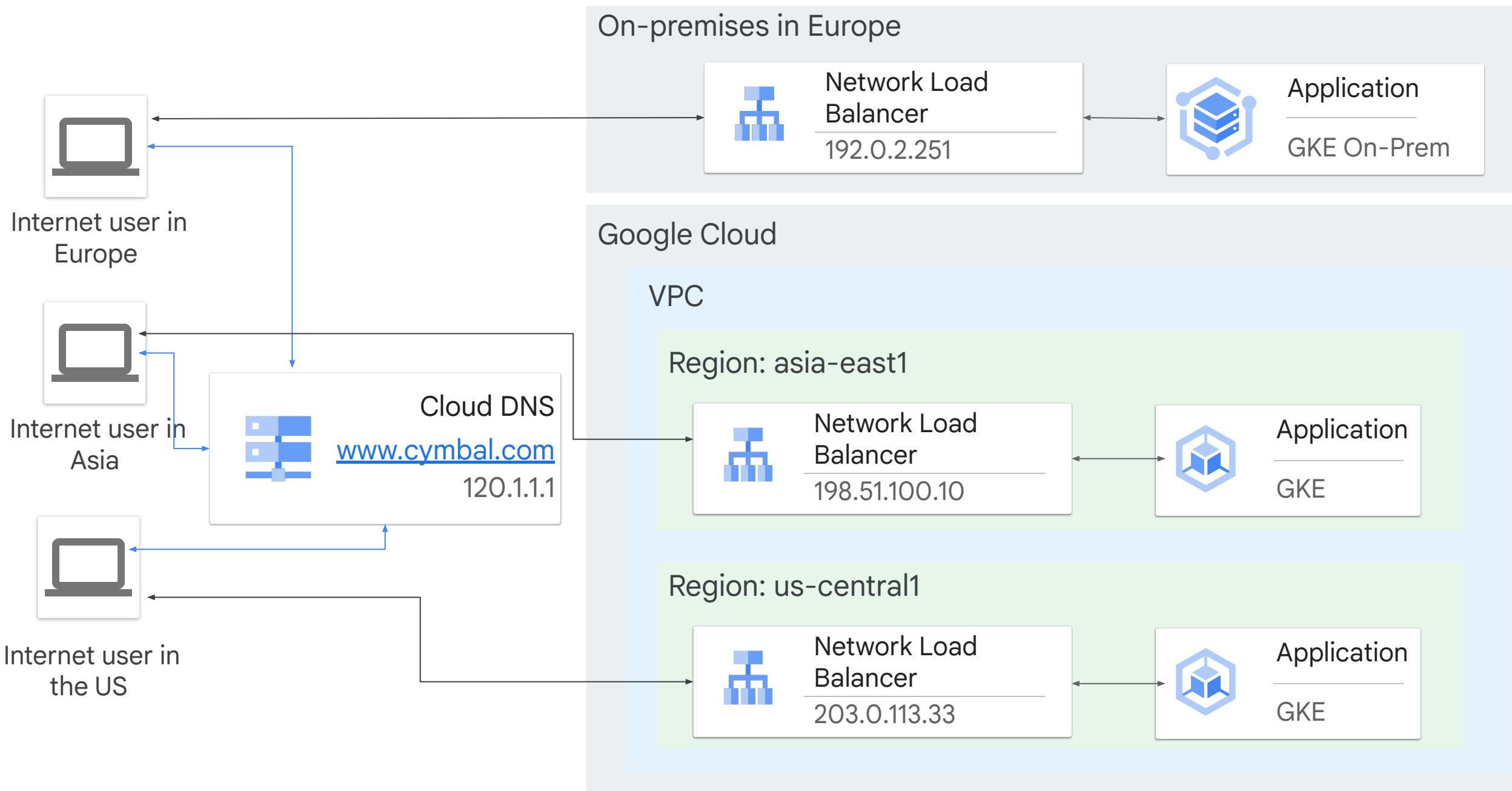


# Use case: Centralize and simplify DNS management

across multiple regions



# Use case: Carl can use Cloud DNS to centralize DNS management



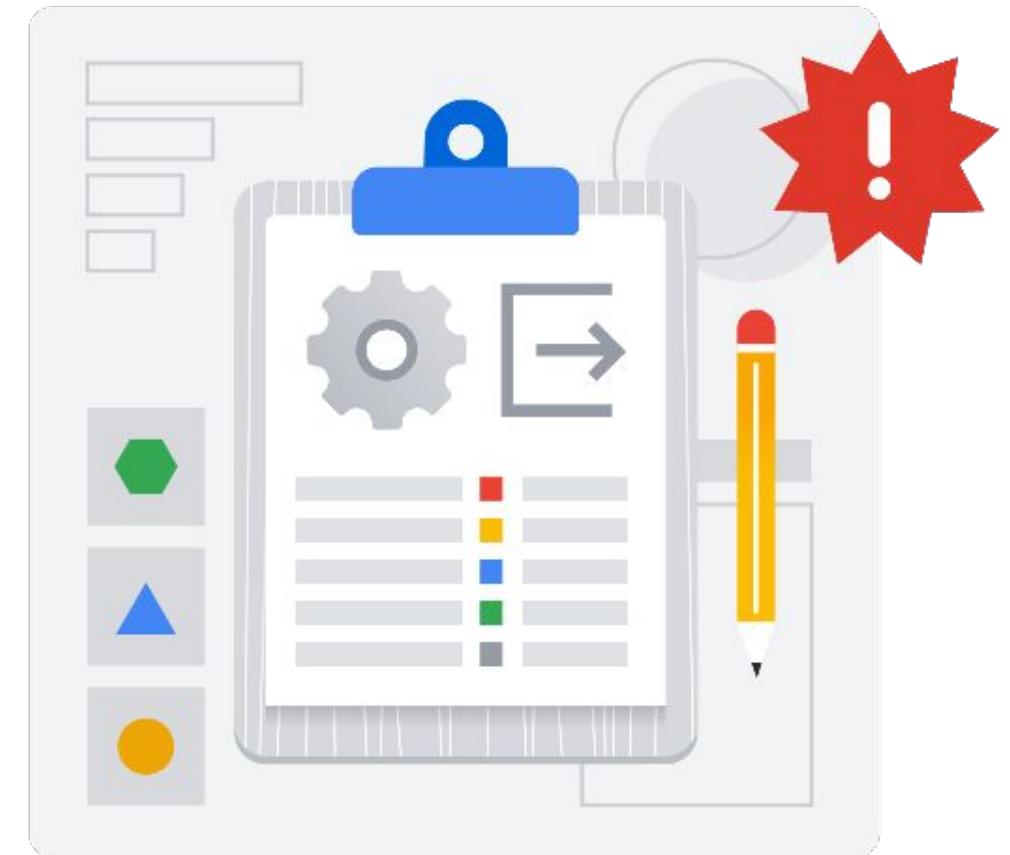
# Routing policy caveats

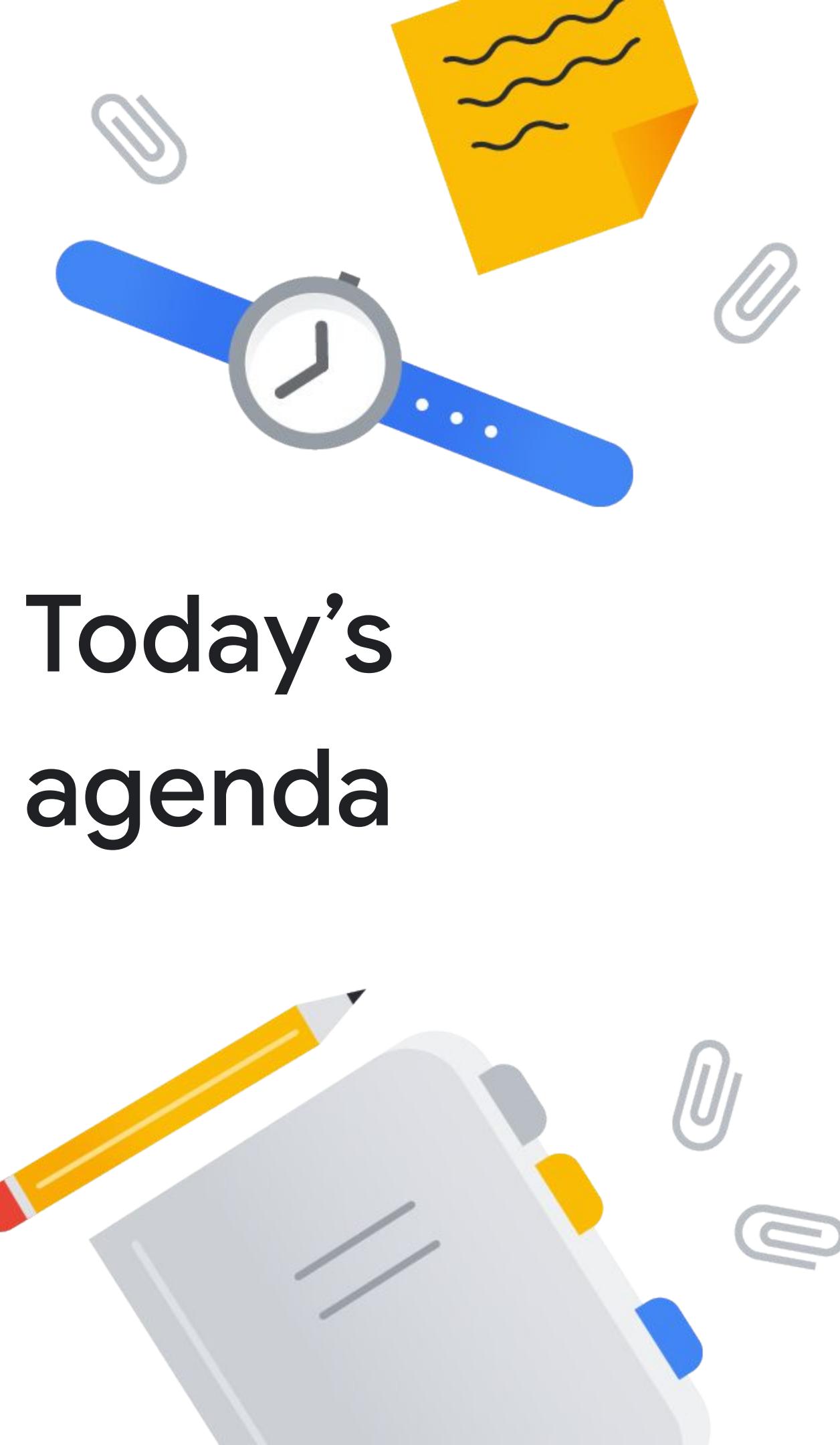
01

Only one type of routing policy can be applied to a resource record set at a time.

02

Nesting or otherwise combining routing policies is not supported.



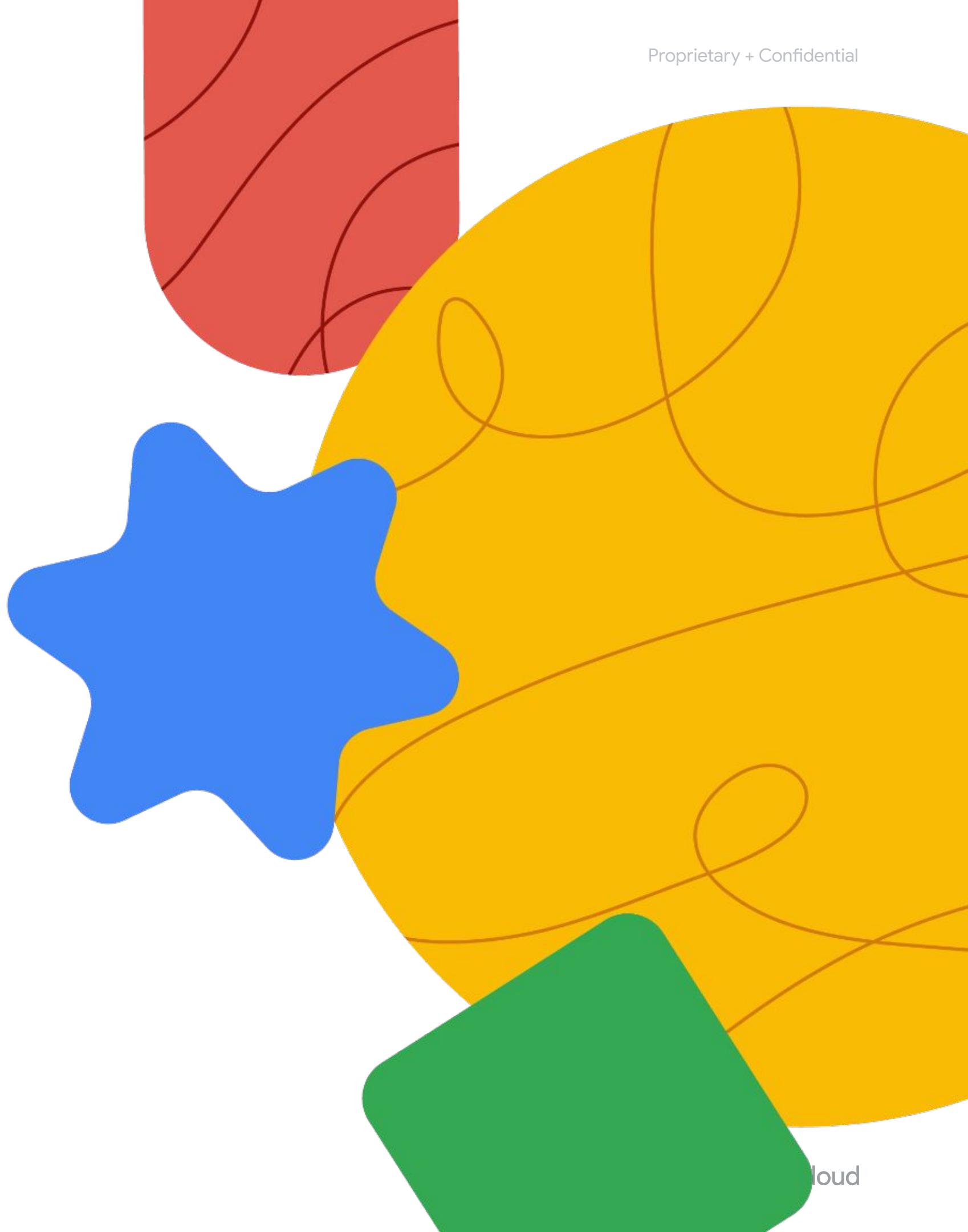


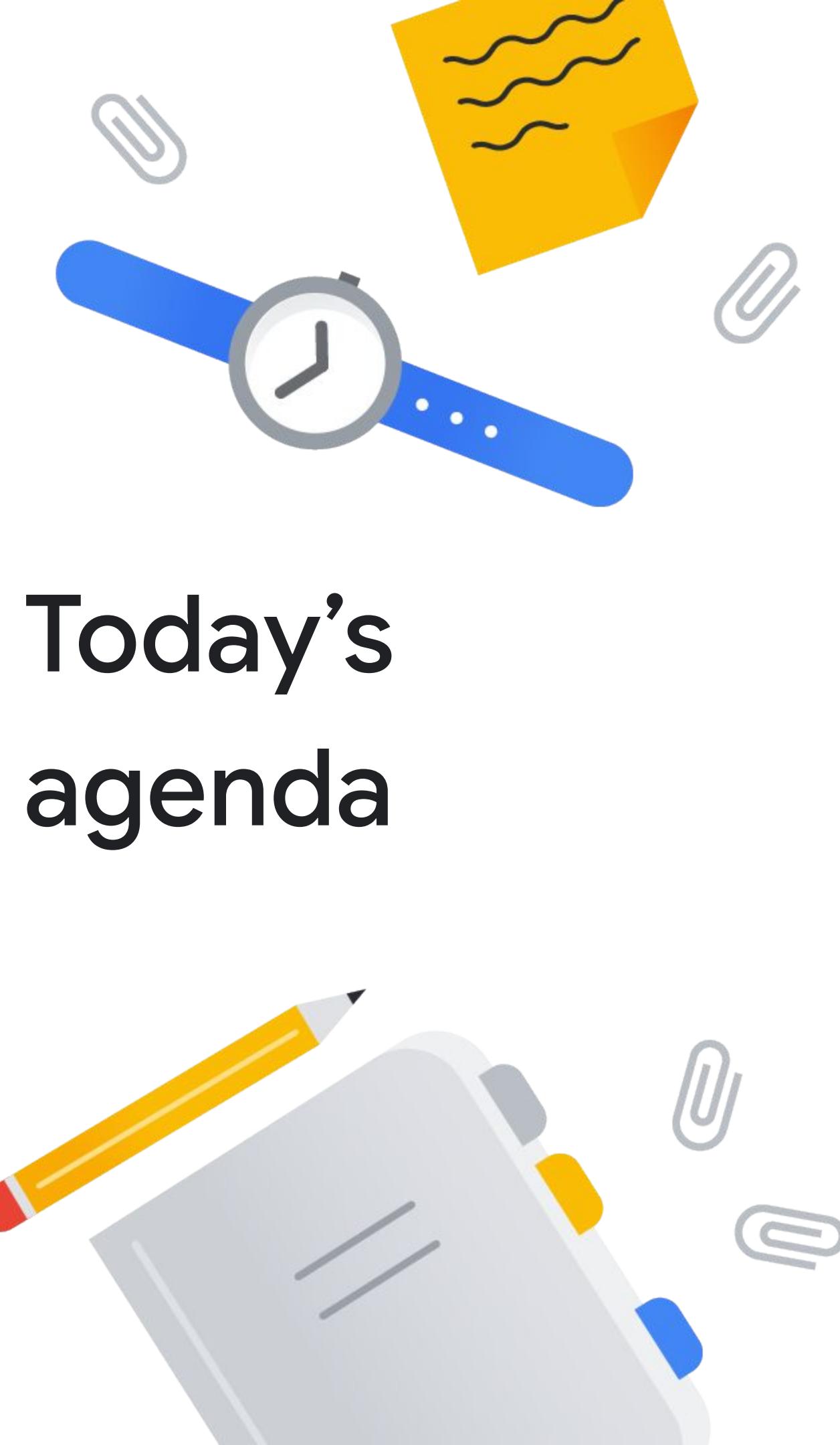
# Today's agenda

- 01 Routes and route preferences
- 02 IPv6
- 03 BYOIP (bring your own IP)
- 04 Cloud DNS
- 05 **Lab: Traffic Steering Using Geolocation**
- 06 Quiz

# Lab Intro

Traffic Steering Using Geolocation





# Today's agenda

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# Quiz | Question 1

## Question

You must create a VM that has an IPv6 address. How do you do it?

- A. Create a single-stack subnet, and create the VM with an IPv6 address.
- B. Create a dual-stack subnet, and create the VM with an IPv6 address.
- C. Create a single-stack network, and create the VM with an IPv6 address.
- D. Create a dual-stack network, and create the VM with an IPv6 address.

# Quiz | Question 1

## Answer

You must create a VM that has an IPv6 address. How do you do it?

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- C. Create a single-stack network, and create the VM with an IPv6 address.
- D. Create a dual-stack network, and create the VM with an IPv6 address.



# Quiz | Question 2

## Question

To set up hybrid deployments for DNS resolution, which type of DNS policy should you use?

- A. Routing policy
- B. Response policy
- C. Server policy
- D. Traffic policy

# Quiz | Question 2

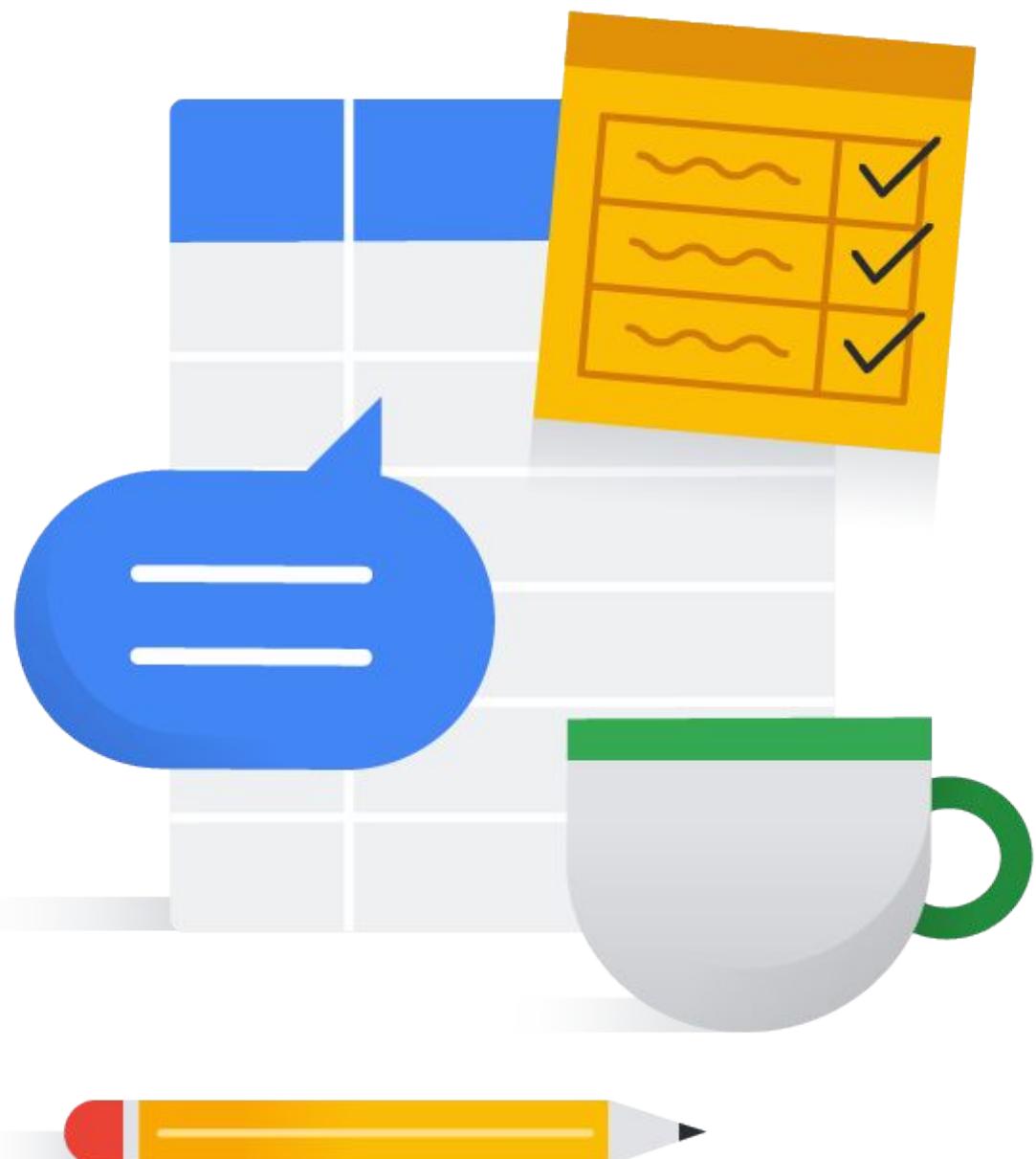
## Answer

To set up hybrid deployments for DNS resolution, which type of DNS policy should you use?

- A. Routing policy
- B. Response policy
- C. Server policy
- D. Traffic policy



# Debrief



Thank you.