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Using routes

This page describes how to create and manage routes for Google Cloud (Google Cloud) VPC networks. This page assumes that you are familiar with the different types of Google Cloud routes and their characteristics as described in the [Routes Overview](https://cloud.google.com/vpc/docs/routes) (https://cloud.google.com/vpc/docs/routes).

Every new network has two types of system-generated routes: a [default route](https://cloud.google.com/vpc/docs/routes#routingpacketsinternet) (https://cloud.google.com/vpc/docs/routes#routingpacketsinternet), which you can remove or replace, and one [subnet route](https://cloud.google.com/vpc/docs/routes#subnet-routes) (https://cloud.google.com/vpc/docs/routes#subnet-routes) for each of its subnets. You cannot remove a subnet route unless you delete the corresponding subnet itself.

In addition to the system-generated routes, you can create other [custom static routes](https://cloud.google.com/vpc/docs/routes#static_routes) (https://cloud.google.com/vpc/docs/routes#static_routes).

Inspecting routes

Listing routes for VPC networks

You can view routes using either of these methods:

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To list routes for all networks:

1. Go to the Routes page in the Google Cloud Console.
[GO TO THE ROUTES PAGE](https://console.cloud.google.com/networking/routes/list) (HTTPS://CONSOLE.CLOUD.GOOGLE.COM/NETWORKING/ROUTES/LIST)
2. You can use the **Filter routes** text box to limit the routes shown. For example, you can type the name of a VPC network and press enter to show the routes for a specific network.
3. The **All** tab shows all types of routes. To view just custom [dynamic routes](https://cloud.google.com/vpc/docs/routes#dynamic_routes) (https://cloud.google.com/vpc/docs/routes#dynamic_routes), click the **Dynamic** tab.

Describing routes

To view details for *system-generated and custom static routes*, including destinations and next hops:

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1. Go to the Routes page in the Google Cloud Console.
GO TO THE ROUTES PAGE ([HTTPS://CONSOLE.CLOUD.GOOGLE.COM/NETWORKING/ROUTES/LIST](https://console.cloud.google.com/networking/routes/list))
2. Click the name of a route.


Routes for VMs

You can view applicable routes (https://cloud.google.com/vpc/docs/routes#applicable_routes) and effective routes from the perspective of a given network interface for a VM instance by following the instructions in this section. Effective routes are a subset of applicable routes that take routing order (<https://cloud.google.com/vpc/docs/routes#routeselection>) into consideration.

Applicable routes for a network interface

You can use the Cloud Console to view applicable routes for a VM's network interface. This view narrows the list of routes that could be used for egress traffic.

To view applicable routes for a specific network interface of a VM:


1. Go to the VM instances page in the Google Cloud Console.
GO TO THE VM INSTANCES PAGE ([HTTPS://CONSOLE.CLOUD.GOOGLE.COM/COMPUTE/INSTANCES](https://console.cloud.google.com/compute/instances))
2. Locate a VM instance in the list. In its **more actions** menu (), select **View network details**.
3. If an instance has multiple network interfaces, select the network interface to view in the **Network interface details** section.
4. Click the **Routes** tab to see all the routes that apply to the network interface, sorted by route name.

Route analysis and effective routes

Route analysis helps you determine effective routes, taking applicable routes and routing order into consideration. Routes are listed by destination IP range, so you can tell which applicable route will be used to send traffic to a given destination range.

For example, a network interface might use more than one applicable route. Refer to [routing order](https://cloud.google.com/vpc/docs/routes#routeselection) (https://cloud.google.com/vpc/docs/routes#routeselection) on the Routes Overview for more information.

To view the routes based on applicability and routing order, use route analysis:

1. Go to the VM instances page in the Google Cloud Console and find the instance to view.
GO TO THE VM INSTANCES PAGE (HTTPS://CONSOLE.CLOUD.GOOGLE.COM/COMPUTE/INSTANCES)
2. In the instance's **more actions** menu (), select **View network details**.
3. If an instance has multiple network interfaces, select the network interface to view in the **Network interface details** section.
4. In the **Network Analysis** section, select the **Route analysis** tab.
5. View the table, which is sorted from the most specific to least specific IP address range, to determine what route applies for a given destination range.

Example output of the routes analysis tab is:

Network analysis	
Ingress analysis	Egress analysis
	Route analysis
Destination	Active routes
172.16.1.0/24	default-route-aafb71cd183e6314, test
192.168.0.0/16	default-route-aafb71cd183e6314, default-route-19efee963cb355d1
0.0.0.0/0	default-route-aafb71cd183e6314

(https://cloud.google.com/vpc/images/routes/route-analysis.png)
Effective routes for a VM instance (click to enlarge)

Adding and removing routes

Important: You cannot edit or update a route after you create it. To modify a custom static route, you must delete it and create a replacement. When you make multiple change requests, [your changes are applied in no specific order \(#order_of_operations\)](#). If you need to make changes that depend on each other, consider making them one at a time, verifying routing behavior after each. This ensures that you do not have multiple change requests in progress whose order of implementation could affect traffic routing in unexpected or undesirable ways.

Adding a static route

Follow these steps to create a new static route. Before doing so, make sure you are familiar with the following:

- Custom static routes cannot have destination ranges that match or are more specific than the destination ranges used by any subnet route. in your VPC network.
 - When using [VPC Network Peering](https://cloud.google.com/vpc/docs/vpc-peering) (https://cloud.google.com/vpc/docs/vpc-peering) to connect two VPC networks, custom static routes in one network cannot have matching or more specific destinations than subnet routes in both of the networks. Google Cloud rejects custom static routes that would conflict with subnet routes in this way.
- To avoid conflicts when using an auto mode network, don't create static routes whose destinations fit within `10.128.0.0/9`. Review the [IP ranges reserved for auto mode networks](https://cloud.google.com/vpc/docs/vpc#ip-ranges) (https://cloud.google.com/vpc/docs/vpc#ip-ranges) for details.
- Destinations for custom static routes can't overlap with any internal [allocated range](https://cloud.google.com/vpc/docs/private-access-options) (https://cloud.google.com/vpc/docs/private-access-options).
- Make sure you're familiar with [instances as next hops](https://cloud.google.com/vpc/docs/routes#instance_next_hops) (https://cloud.google.com/vpc/docs/routes#instance_next_hops) before you create a custom static route that uses a VM as its next hop. Google Cloud only validates that a VM exists at the time when you create the route if you choose a *next hop instance*.

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1. Go to the Routes page in the Google Cloud Console.

[GO TO THE ROUTES PAGE \(HTTPS://CONSOLE.CLOUD.GOOGLE.COM/NETWORKING/ROUTES/LIST\)](https://console.cloud.google.com/networking/routes/list)

2. Click **Create route**.

3. Specify a **Name** and a **Description** for the route.
4. Select an existing **Network** where the route will apply.
5. Specify a **Destination IP range** to define the destination of the route.
6. Specify a **Priority** for the route. A priority is only used to determine routing order if routes have equivalent destinations. See [static route parameters](https://cloud.google.com/vpc/docs/routes#individualroutes) (<https://cloud.google.com/vpc/docs/routes#individualroutes>) for more details.
7. To make the route applicable only to select instances with matching network tags, specify those in the **Instance tags** field. Leave the field blank to make the route applicable to all instances in the network, or if you select an internal TCP/UDP load balancer as the route's next hop. Network tags don't apply to routes that have an internal TCP/UDP load balancer as a next hop.
8. Select a **Next hop** for the route:
 - **Default internet gateway** creates a route to the Internet.
 - **Specify an instance** allows you to select an instance by name. Traffic will be routed to that instance (or any replacement instance with the same name in the same zone) even if its IP address changes.
 - **Specify IP address** allows you to enter an IP address of an *existing instance* in the VPC network. Refer to [static route next hops](https://cloud.google.com/vpc/docs/routes#static-route-next-hops) (<https://cloud.google.com/vpc/docs/routes#static-route-next-hops>) for important restrictions on valid next hop IP addresses.
 - **Specify VPN tunnel** allows you to select an existing [Cloud VPN](https://cloud.google.com/vpn/docs/concepts/overview) (<https://cloud.google.com/vpn/docs/concepts/overview>) tunnel as a next hop. The tunnel must use [policy based routing](https://cloud.google.com/vpn/docs/concepts/choosing-networks-routing#ts-tun-routing) (<https://cloud.google.com/vpn/docs/concepts/choosing-networks-routing#ts-tun-routing>) or it must be a [route based VPN](https://cloud.google.com/vpn/docs/concepts/choosing-networks-routing#ts-tun-routing) (<https://cloud.google.com/vpn/docs/concepts/choosing-networks-routing#ts-tun-routing>).
 - **Specify a forwarding rule of internal TCP/UDP load balancer** reveals a text box that allows you to specify an existing internal TCP/UDP load balancer as a next hop.

For more information about the different types of next hops, see [Static route next hops](https://cloud.google.com/vpc/docs/routes#static-route-next-hops) (<https://cloud.google.com/vpc/docs/routes#static-route-next-hops>) in the Routes overview.

9. Click **Create**.

Deleting routes

You can delete a system-generated default route or any custom static route. For other types of routes:

- You **cannot** delete a [subnet route](https://cloud.google.com/vpc/docs/routes#subnet-routes) (<https://cloud.google.com/vpc/docs/routes#subnet-routes>) unless you delete the corresponding subnet.

- To delete a dynamic route (https://cloud.google.com/vpc/docs/routes#dynamic_routes) learned by a Cloud Router, you need to configure its BGP peer router to stop advertising the route.

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1. Go to the Routes page in the Google Cloud Console.

[GO TO THE ROUTES PAGE \(HTTPS://CONSOLE.CLOUD.GOOGLE.COM/NETWORKING/ROUTES/LIST](https://console.cloud.google.com/networking/routes/list)

2. Select the checkbox next to the rule you want to delete.

3. Click **Delete**.

4. Click **Delete** again to confirm.

Order of operations

When you make a request to add or delete a route, your changes are staged then propagated to instances in your network using an eventually consistent design. Change requests with either **PENDING** or **RUNNING** status indicate that the request has not yet been processed. After processing, the status of the change request is **DONE**.

Important: It can take an **additional** thirty seconds before instances in your network recognize route changes after the change request is **DONE**.

If you make a sequence of change requests, the changes can be applied in any order. There is no guarantee that the order in which you submit change requests will be the order in which they are processed. Further, different instances might become aware of the changes at different times.

Enabling IP forwarding for instances

By default, Google Cloud performs strict source and destination checking for packets so that:

- VM instances can only send packets whose sources are set to match an internal IP address of its interface in the network.
- Packets are only delivered to an instance if their destinations match the IP address of the instance's interface in the network.

So by default, a VM cannot forward a packet originated by another VM.

To use a VM as a next hop for a route, the VM necessarily needs to receive packets having destinations other than itself. Because it forwards those packets, their sources will be different from its own internal IP. To accomplish this, you must enable IP forwarding for the VM. When IP forwarding is enabled, Google Cloud does not enforce packet source and destination checking.

Important: You can **only** enable IP forwarding when you create an instance, and enabling IP forwarding alone is **not** sufficient to cause the instance to forward packets. Its guest operating system must be configured as well. For an example, see [Configuring an Instance as a NAT Gateway](https://cloud.google.com/vpc/docs/special-configurations#natgateway) (<https://cloud.google.com/vpc/docs/special-configurations#natgateway>).

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1. Go to the VM instances page.

GO TO THE VM INSTANCES PAGE ([HTTPS://CONSOLE.CLOUD.GOOGLE.COM/COMPUTE/INSTANCES](https://console.cloud.google.com/compute/instances))

2. Click **Create instance**.

3. Click **Management, disks, networking, SSH keys**.

4. Click **Networking**.

5. Select a network interface by clicking the edit button.

6. For the network interface, choose **On** from the **IP forwarding** menu.

7. Specify any other instance parameters.

8. Click **Create**.

What's next

- See [Routes Overview](https://cloud.google.com/vpc/docs/routes) (<https://cloud.google.com/vpc/docs/routes>) for information on routes.
- See the [VPC Overview](https://cloud.google.com/vpc/index) (<https://cloud.google.com/vpc/index>) for information on GCP VPC networks.
- See [Using VPC](https://cloud.google.com/vpc/docs/using-vpc) (<https://cloud.google.com/vpc/docs/using-vpc>) for instructions on creating and modifying VPC networks.

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