Multiple VPC Networks

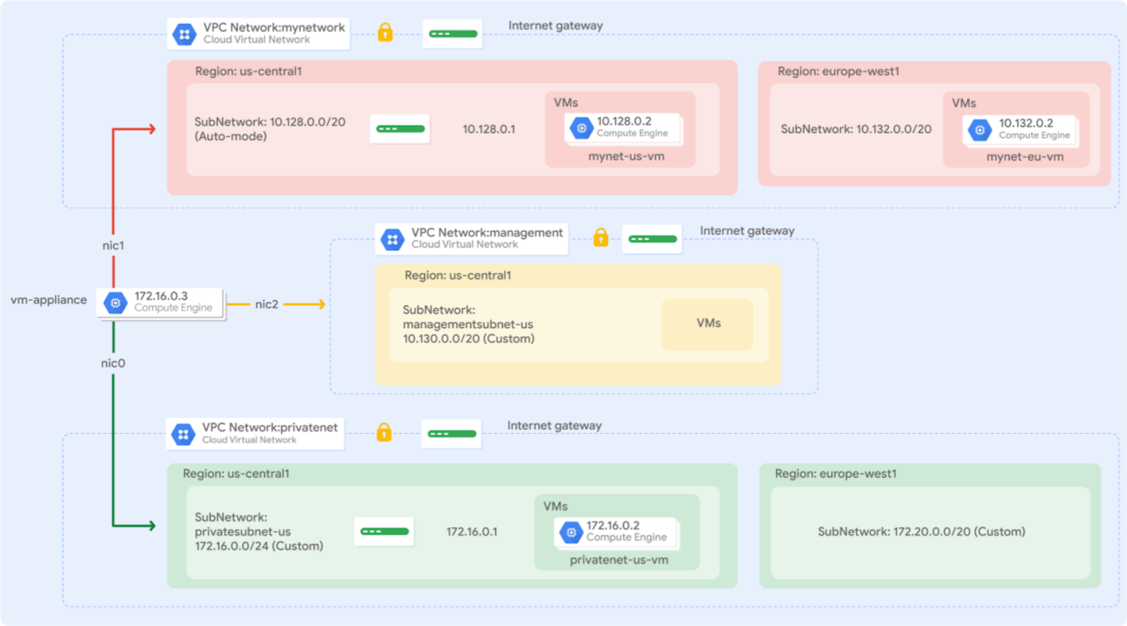
1 hour 10 minutes7 Credits
Rate Lab

GSP211

Google Cloud Self-Paced Labs

Overview

In this lab you create several VPC networks and VM instances and test connectivity across networks. Specifically, you create two custom mode networks (**managementnet** and **privatenet**) with firewall rules and VM instances as shown in this network diagram:



The **mynetwork** network with its firewall rules and two VM instances (**mynet-eu-vm** and **mynet-us-vm**) have already been created for you in this Qwiklabs project.

Objectives

In this lab, you will learn how to perform the following tasks:

- Create custom mode VPC networks with firewall rules

- Create VM instances using Compute Engine
- Explore the connectivity for VM instances across VPC networks
- Create a VM instance with multiple network interfaces

Setup and Requirements

Before you click the Start Lab button

Read these instructions. Labs are timed and you cannot pause them. The timer, which starts when you click **Start Lab**, shows how long Google Cloud resources will be made available to you.

This Qwiklabs hands-on lab lets you do the lab activities yourself in a real cloud environment, not in a simulation or demo environment. It does so by giving you new, temporary credentials that you use to sign in and access Google Cloud for the duration of the lab.

What you need

To complete this lab, you need:

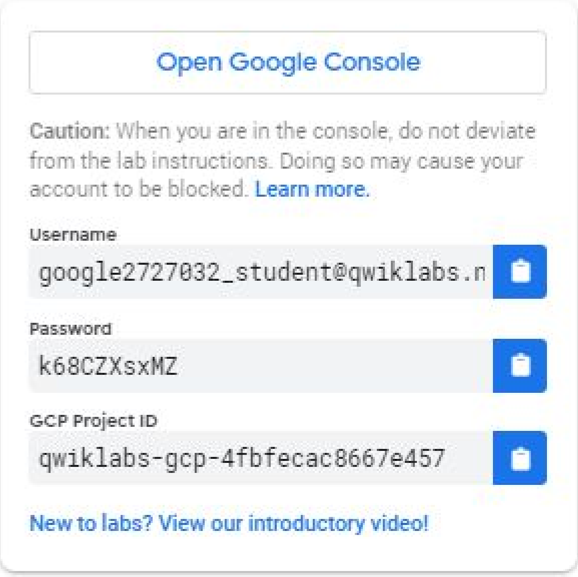
- Access to a standard internet browser (Chrome browser recommended).
- Time to complete the lab.

Note: If you already have your own personal Google Cloud account or project, do not use it for this lab.

Note: If you are using a Pixelbook, open an Incognito window to run this lab.

How to start your lab and sign in to the Google Cloud Console

1. Click the **Start Lab** button. If you need to pay for the lab, a pop-up opens for you to select your payment method. On the left is a panel populated with the temporary credentials that you must use for this lab.



Caution: When you are in the console, do not deviate from the lab instructions. Doing so may cause your account to be blocked. Learn more.

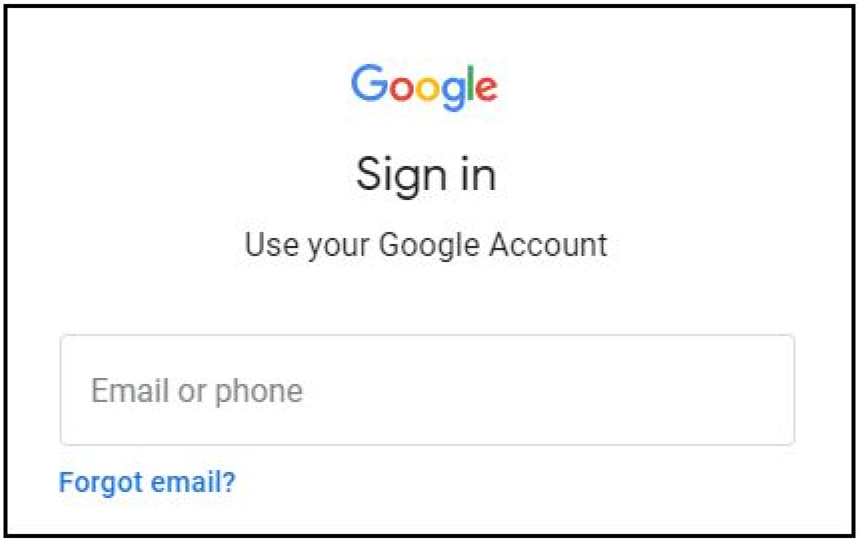
Username
google2727032_student@qwiklabs.n

Password
k68CZXsxMZ

GCP Project ID
qwiklabs-gcp-4fbfecac8667e457

New to labs? View our introductory video!

2. Copy the username, and then click **Open Google Console**. The lab spins up resources, and then opens another tab that shows the **Sign in** page.



Google

Sign in

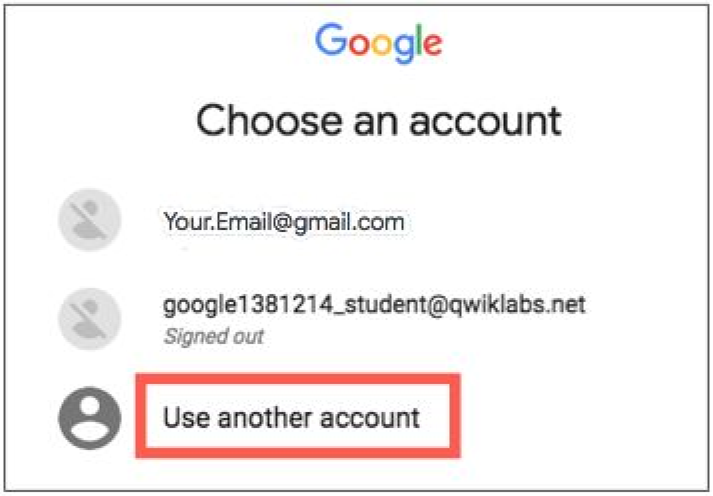
Use your Google Account

Email or phone

Forgot email?

Tip: Open the tabs in separate windows, side-by-side.

If you see the **Choose an account** page, click **Use Another Account**.



Google

Choose an account

Your.Email@gmail.com

google1381214_student@qwiklabs.net
Signed out

Use another account

3. In the **Sign in** page, paste the username that you copied from the Connection Details panel. Then copy and paste the password.

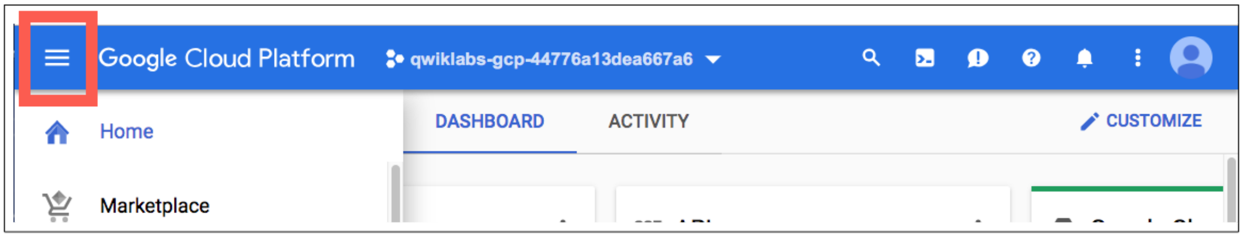
   Important: You must use the credentials from the Connection Details panel. Do not use your Qwiklabs credentials. If you have your own Google Cloud account, do not use it for this lab (avoids incurring charges).

4. Click through the subsequent pages:
   - Accept the terms and conditions.

- Do not add recovery options or two-factor authentication (because this is a temporary account).
- Do not sign up for free trials.

After a few moments, the Cloud Console opens in this tab.

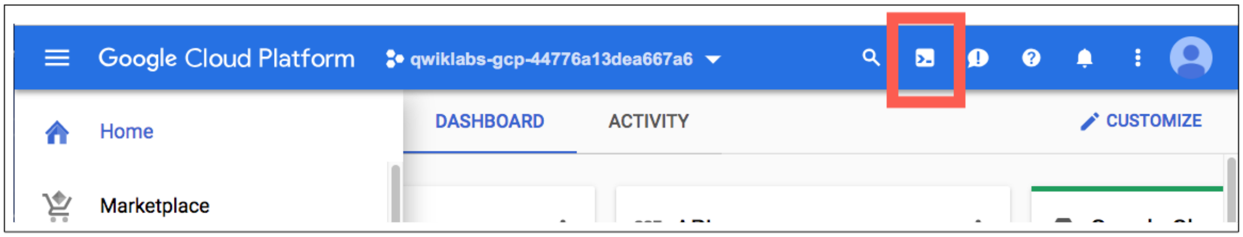
Note: You can view the menu with a list of Google Cloud Products and Services by clicking the **Navigation menu** at the top-left.



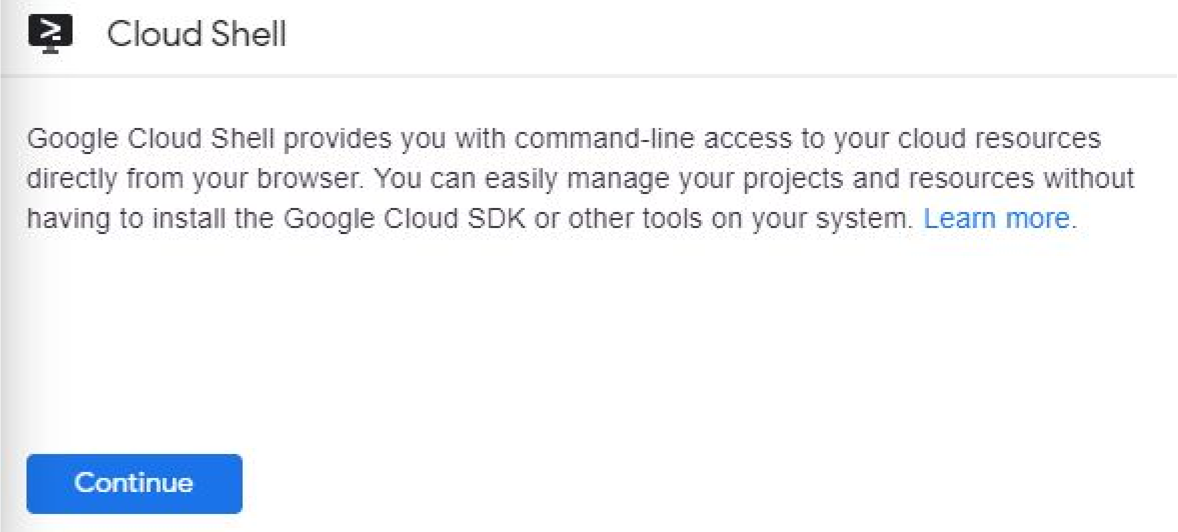
Activate Cloud Shell

Cloud Shell is a virtual machine that is loaded with development tools. It offers a persistent 5GB home directory and runs on the Google Cloud. Cloud Shell provides command-line access to your Google Cloud resources.

In the Cloud Console, in the top right toolbar, click the **Activate Cloud Shell** button.

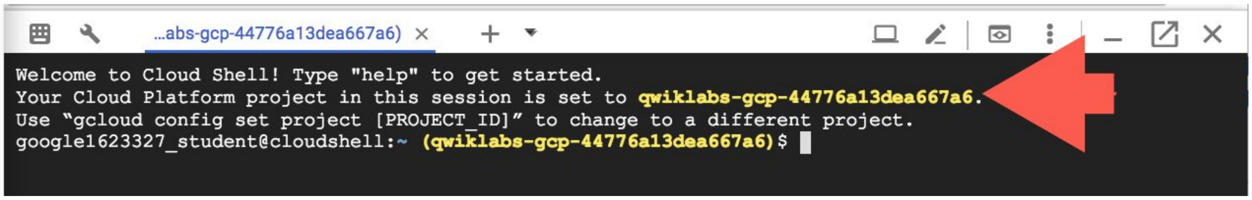


Click **Continue**.



Google Cloud Shell provides you with command-line access to your cloud resources directly from your browser. You can easily manage your projects and resources without having to install the Google Cloud SDK or other tools on your system. Learn more.

It takes a few moments to provision and connect to the environment. When you are connected, you are already authenticated, and the project is set to your *PROJECT_ID*. For example:



```
Welcome to Cloud Shell! Type "help" to get started.
Your Cloud Platform project in this session is set to qwiklabs-gcp-44776a13dea667a6.
Use “gcloud config set project [PROJECT_ID]” to change to a different project.
google1623327_student@cloudshell:~ (qwiklabs-gcp-44776a13dea667a6)$
```

`gcloud` is the command-line tool for Google Cloud. It comes pre-installed on Cloud Shell and supports tab-completion.

You can list the active account name with this command:

```
gcloud auth list
```

(Output)

```
Credentialed accounts:
 - <myaccount>@<mydomain>.com (active)
```

(Example output)

```
Credentialed accounts:
 - google1623327_student@qwiklabs.net
```

You can list the project ID with this command:

```
gcloud config list project
```

(Output)

```
[core]
project = <project_ID>
```

(Example output)

```
[core]
project = qwiklabs-gcp-44776a13dea667a6
```

For full documentation of `gcloud` see the gcloud command-line tool overview.

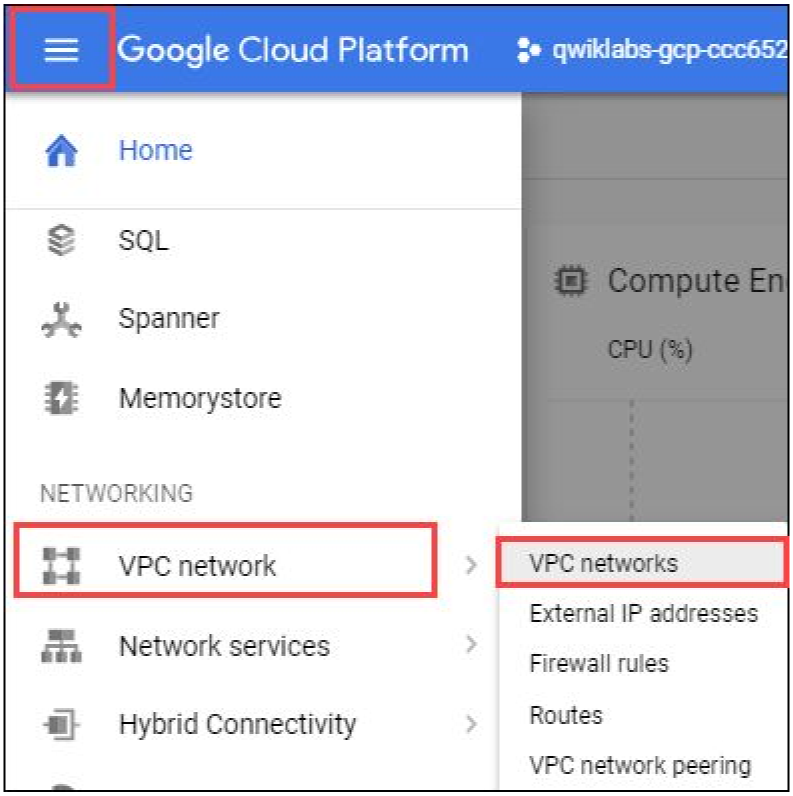
Create custom mode VPC networks with firewall rules

Create two custom networks **managementnet** and **privatenet**, along with firewall rules to allow **SSH**, **ICMP**, and **RDP** ingress traffic.

Create the managementnet network

Create the **managementnet** network using the Cloud Console.

1. In the Cloud Console, navigate to **Navigation menu** (☰) > **VPC network** > **VPC networks**.



2. Notice the **default** and **mynetwork** networks with their subnets.

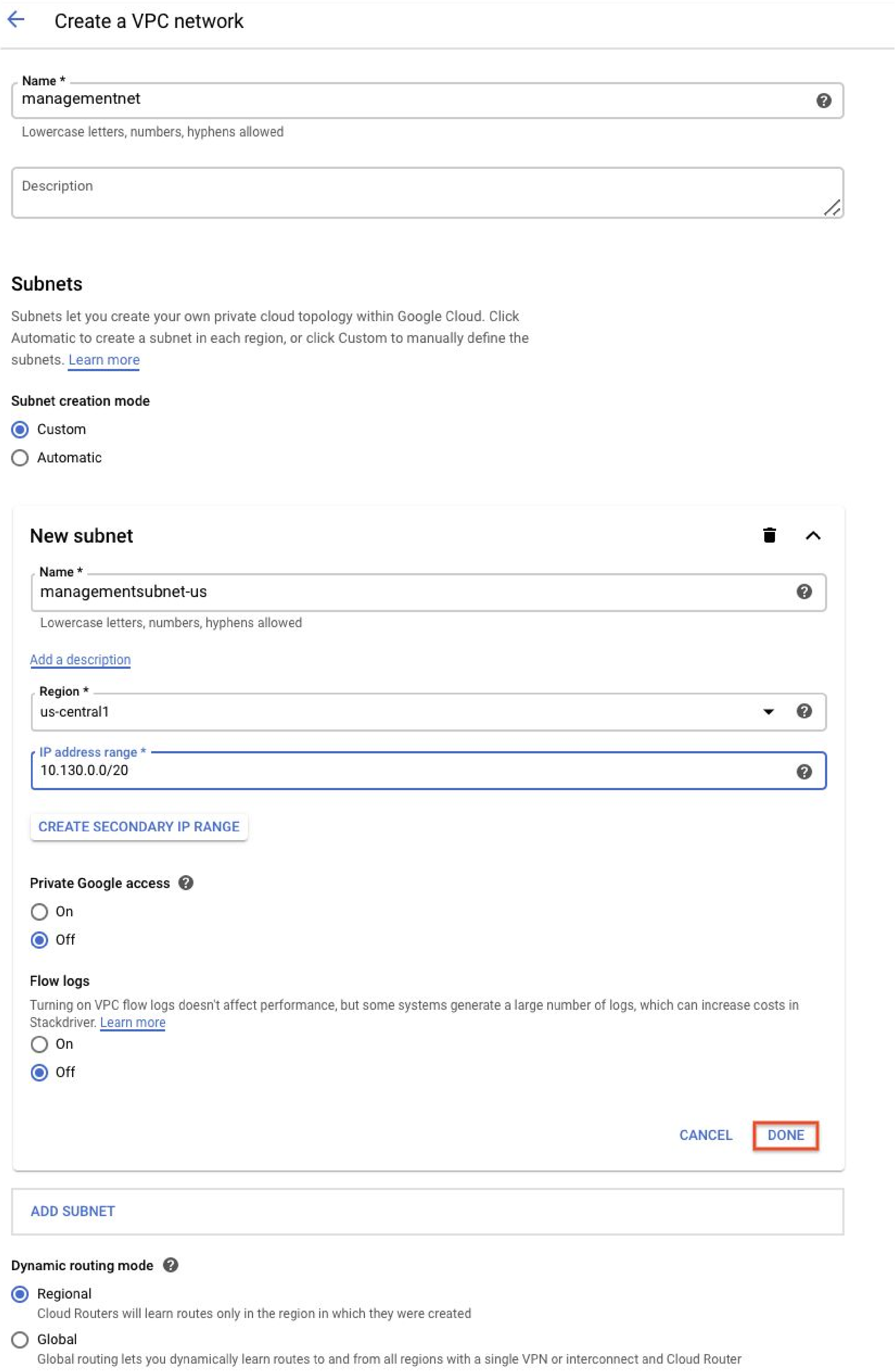
   Each Google Cloud project starts with the **default** network. In addition, the **mynetwork** network has been premade as part of your network diagram.

3. Click **Create VPC Network**.
4. Set the **Name** to `managementnet`.
5. For **Subnet creation mode**, click **Custom**.
6. Set the following values, leave all other values at their defaults:

Property	Value (type value or select option as specified)
Name	managementsubnet-us
Region	us-central1
IP address range	10.130.0.0/20

7. Click **Done**.

8. Click **command line**.



Create a VPC network

Name *
managementnet
Lowercase letters, numbers, hyphens allowed

Description

Subnets

Subnets let you create your own private cloud topology within Google Cloud. Click Automatic to create a subnet in each region, or click Custom to manually define the subnets. Learn more

Subnet creation mode

● Custom
○ Automatic

New subnet

Name *
managementsubnet-us
Lowercase letters, numbers, hyphens allowed

Add a description

Region *
us-central1

IP address range *
10.130.0.0/20

CREATE SECONDARY IP RANGE

Private Google access

○ On
● Off

Flow logs

Turning on VPC flow logs doesn't affect performance, but some systems generate a large number of logs, which can increase costs in Stackdriver. Learn more

○ On
● Off

CANCEL DONE

ADD SUBNET

Dynamic routing mode

● Regional
Cloud Routers will learn routes only in the region in which they were created

○ Global
Global routing lets you dynamically learn routes to and from all regions with a single VPN or interconnect and Cloud Router

   These commands illustrate that networks and subnets can be created using the Cloud Shell command line. You will create the **privatenet** network using these commands with similar parameters.

9. Click **Close**.
10. Click **Create**.

Test Completed Task

Click **Check my progress** to verify your performed task. If you have successfully created a managementnet network, you will see an assessment score.

Create the managementnet network

Check my progress

Create the privatenet network

Create the **privatenet** network using the Cloud Shell command line.

1. Run the following command to create the **privatenet** network:

```
gcloud compute networks create privatenet --subnet-mode=custom
```

2. Run the following command to create the **privatesubnet-us** subnet:

```
gcloud compute networks subnets create privatesubnet-us --network=privatenet
--region=us-central1 --range=172.16.0.0/24
```

3. Run the following command to create the **privatesubnet-eu** subnet:

```
gcloud compute networks subnets create privatesubnet-eu --network=privatenet
--region=europe-west1 --range=172.20.0.0/20
```

Test Completed Task

Click **Check my progress** to verify your performed task. If you have successfully created a privatenet network, you will see an assessment score.

Create the privatenet network

Check my progress

4. Run the following command to list the available VPC networks:

```
gcloud compute networks list
```

The output should look like this (**do not copy; this is example output**):

```
NAME           SUBNET_MODE  BGP_ROUTING_MODE  IPV4_RANGE  GATEWAY_IPV4
default        AUTO         REGIONAL
managementnet  CUSTOM       REGIONAL
mynetwork      AUTO         REGIONAL
privatenet     CUSTOM       REGIONAL
```

default and **mynetwork** are auto mode networks, whereas, **managementnet** and **privatenet** are custom mode networks. Auto mode networks create subnets in each region automatically, while custom mode networks start with no subnets, giving you full control over subnet creation

5. Run the following command to list the available VPC subnets (sorted by VPC network):

```
gcloud compute networks subnets list --sort-by=NETWORK
```

The output should look like this (**do not copy; this is example output**):

```
NAME                REGION                   NETWORK        RANGE
```

```
default             asia-northeast1          default        10.146.0.0/20
default             us-west1                 default        10.138.0.0/20
default             southamerica-east1       default        10.158.0.0/20
default             europe-west4             default        10.164.0.0/20
default             asia-east1               default        10.140.0.0/20
default             europe-north1            default        10.166.0.0/20
default             asia-southeast1          default        10.148.0.0/20
default             us-east4                 default        10.150.0.0/20
default             europe-west1             default        10.132.0.0/20
default             europe-west2             default        10.154.0.0/20
default             europe-west3             default        10.156.0.0/20
default             australia-southeast1     default        10.152.0.0/20
default             asia-south1              default        10.160.0.0/20
default             us-east1                 default        10.142.0.0/20
default             us-central1              default        10.128.0.0/20
default             northamerica-northeast1  default        10.162.0.0/20
managementsubnet-us us-central1              managementnet  10.130.0.0/20
mynetwork           asia-northeast1          mynetwork      10.146.0.0/20
mynetwork           us-west1                 mynetwork      10.138.0.0/20
mynetwork           southamerica-east1       mynetwork      10.158.0.0/20
mynetwork           europe-west4             mynetwork      10.164.0.0/20
mynetwork           asia-east1               mynetwork      10.140.0.0/20
mynetwork           europe-north1            mynetwork      10.166.0.0/20
mynetwork           asia-southeast1          mynetwork      10.148.0.0/20
mynetwork           us-east4                 mynetwork      10.150.0.0/20
mynetwork           europe-west1             mynetwork      10.132.0.0/20
mynetwork           europe-west2             mynetwork      10.154.0.0/20
mynetwork           europe-west3             mynetwork      10.156.0.0/20
mynetwork           australia-southeast1     mynetwork      10.152.0.0/20
mynetwork           asia-south1              mynetwork      10.160.0.0/20
mynetwork           us-east1                 mynetwork      10.142.0.0/20
mynetwork           us-central1              mynetwork      10.128.0.0/20
mynetwork           northamerica-northeast1  mynetwork      10.162.0.0/20
privatesubnet-eu    europe-west1             privatenet     172.20.0.0/20
privatesubnet-us    us-central1              privatenet     172.16.0.0/24
```

As expected, the **default** and **mynetwork** networks have subnets in each region as they are auto mode networks. The **managementnet** and **privatenet** networks only have the subnets that you created as they are custom mode networks.

6. In the Cloud Console, navigate to **Navigation menu** > **VPC network** > **VPC networks**.

7. You see that the same networks and subnets are listed in the Cloud Console.

Create the firewall rules for managementnet

Create firewall rules to allow **SSH**, **ICMP**, and **RDP** ingress traffic to VM instances on the **managementnet** network.

1. In the Cloud Console, navigate to **Navigation menu** (☰) > **VPC network** > **Firewall**.
2. Click **+ Create Firewall Rule**.
3. Set the following values, leave all other values at their defaults:

Property	**Value (type value or select option as specified)**
Name	managementnet-allow-icmp-ssh-rdp
Network	managementnet
Targets	All instances in the network
Source filter	IP Ranges
Source IP ranges	0.0.0.0/0
Protocols and ports	Specified protocols and ports, and then *check* tcp, *type:* 22, 3389; and *check* Other protocols, *type:* icmp.

Make sure to include the **/0** in the **Source IP ranges** to specify all networks.

4. Click **command line**.

   These commands illustrate that firewall rules can also be created using the Cloud Shell command line. You will create the **privatenet**'s firewall rules using these commands with similar parameters.

5. Click **Close**.
6. Click **Create**.

Test Completed Task

Click **Check my progress** to verify your performed task. If you have successfully created firewall rules for managementnet network, you will see an assessment score.

Create the firewall rules for managementnet

Check my progress

Create the firewall rules for privatenet

Create the firewall rules for **privatenet** network using the Cloud Shell command line.

1. In Cloud Shell, run the following command to create the **privatenet-allow-icmp-ssh-rdp** firewall rule:

```
gcloud compute firewall-rules create privatenet-allow-icmp-ssh-rdp
--direction=INGRESS --priority=1000 --network=privatenet --action=ALLOW
--rules=icmp,tcp:22,tcp:3389 --source-ranges=0.0.0.0/0
```

The output should look like this (**do not copy; this is example output**):

```
NAME                           NETWORK     DIRECTION  PRIORITY  ALLOW
DENY
privatenet-allow-icmp-ssh-rdp  privatenet  INGRESS    1000
icmp,tcp:22,tcp:3389
```

Test Completed Task

Click **Check my progress** to verify your performed task. If you have successfully created firewall rules for privatenet network, you will see an assessment score.

Create the firewall rules for privatenet

Check my progress

2. Run the following command to list all the firewall rules (sorted by VPC network):

```
gcloud compute firewall-rules list --sort-by=NETWORK
```

The output should look like this (**do not copy; this is example output**):

```
NAME                              NETWORK        DIRECTION  PRIORITY  ALLOW
DENY
default-allow-icmp                default        INGRESS    65534     icmp
default-allow-internal            default        INGRESS    65534
tcp:0-65535,udp:0-65535,icmp
default-allow-rdp                 default        INGRESS    65534     tcp:3389
default-allow-ssh                 default        INGRESS    65534     tcp:22
managementnet-allow-icmp-ssh-rdp  managementnet  INGRESS    1000
icmp,tcp:22,tcp:3389
mynetwork-allow-icmp              mynetwork      INGRESS    1000      icmp
mynetwork-allow-rdp               mynetwork      INGRESS    1000      tcp:3389
mynetwork-allow-ssh               mynetwork      INGRESS    1000      tcp:22
privatenet-allow-icmp-ssh-rdp     privatenet     INGRESS    1000
icmp,tcp:22,tcp:3389
```

The firewall rules for **mynetwork** network have been created for you. You can define multiple protocols and ports in one firewall rule (**privatenet** and **managementnet**), or spread them across multiple rules (**default** and **mynetwork**).

3. In the Cloud Console, navigate to **Navigation menu** > **VPC network** > **Firewall**.
4. You see that the same firewall rules are listed in the Cloud Console.

Create VM instances

Create two VM instances:

- **managementnet-us-vm** in **managementsubnet-us**
- **privatenet-us-vm** in **privatesubnet-us**

Create the managementnet-us-vm instance

Create the **managementnet-us-vm** instance using the Cloud Console.

1. In the Cloud Console, navigate to **Navigation menu** > **Compute Engine** > **VM instances**.
   The **mynet-eu-vm** and **mynet-us-vm** has been created for you, as part of your network diagram.
2. Click **Create instance**.
3. Set the following values, leave all other values at their defaults:

Property	Value (type value or select option as specified)

Name	managementnet-us-vm
Region	us-central1
Zone	us-central1-c
Series	N1
Machine type	1 vCPU (f1-micro)

4. Click **Management, security, disks, networking, sole tenancy**.
5. Click **Networking**.
6. For **Network interfaces**, click the pencil icon to edit.
7. Set the following values, leave all other values at their defaults:

Property	Value (type value or select option as specified)
Network	managementnet
Subnetwork	managementsubnet-us

8. Click **Done**.
9. Click **command line**.

   This illustrate that VM instances can also be created using the Cloud Shell command line. You will create the **privatenet-us-vm** instance using these commands with similar parameters.
10. Click **Close**.
11. Click **Create**.

Test Completed Task

Click **Check my progress** to verify your performed task. If you have successfully created VM instance in managementnet network, you will see an assessment score.

Create the managementnet-us-vm instance

Check my progress

Create the privatenet-us-vm instance

Create the **privatenet-us-vm** instance using the Cloud Shell command line.

1. In Cloud Shell, run the following command to create the **privatenet-us-vm** instance:

```
gcloud compute instances create privatenet-us-vm --zone=us-central1-c
--machine-type=n1-standard-1 --subnet=privatesubnet-us
```

The output should look like this (**do not copy; this is example output**):

```
NAME              ZONE           MACHINE_TYPE   PREEMPTIBLE  INTERNAL_IP
EXTERNAL_IP    STATUS
privatenet-us-vm  us-central1-c  n1-standard-1               172.16.0.2
35.184.221.40  RUNNING
```

Test Completed Task

Click **Check my progress** to verify your performed task. If you have successfully created VM instance in privatenet network, you will see an assessment score.

Create the privatenet-us-vm instance

Check my progress

2. Run the following command to list all the VM instances (sorted by zone):

```
gcloud compute instances list --sort-by=ZONE
```

The output should look like this (**do not copy; this is example output**):

```
NAME                 ZONE            MACHINE_TYPE   PREEMPTIBLE  INTERNAL_IP
EXTERNAL_IP     STATUS
mynet-eu-vm          europe-west1-c  n1-standard-1               10.132.0.2
35.205.124.164  RUNNING
managementnet-us-vm  us-central1-c   n1-standard-1               10.130.0.2
35.226.20.87    RUNNING
mynet-us-vm          us-central1-c   n1-standard-1               10.128.0.2
35.232.252.86   RUNNING
privatenet-us-vm     us-central1-c   n1-standard-1               172.16.0.2
35.184.221.40   RUNNING
```

3. In the Cloud Console, navigate to **Navigation menu** (☰) > **Compute Engine** > **VM instances**.
4. You see that the VM instances are listed in the Cloud Console.
5. Click on **Columns**, then select **Network**.
   There are three instances in **us-central1-c** and one instance in **europe-west1-c**. However, these instances are spread across three VPC networks (**managementnet**, **mynetwork** and **privatenet**), with no instance in the same zone and network as another. In the next section, you explore the effect this has on internal connectivity.

Explore the connectivity between VM instances

Explore the connectivity between the VM instances. Specifically, determine the effect of having VM instances in the same zone versus having instances in the same VPC network.

Ping the external IP addresses

Ping the external IP addresses of the VM instances to determine if you can reach the instances from the public internet.

1. In the Cloud Console, navigate to **Navigation menu** > **Compute Engine** > **VM instances**.
2. Note the external IP addressees for **mynet-eu-vm**, **managementnet-us-vm**, and **privatenet-us-vm**.
3. For **mynet-us-vm**, click **SSH** to launch a terminal and connect.
4. To test connectivity to **mynet-eu-vm**'s external IP, run the following command, replacing **mynet-eu-vm**'s external IP:

```
ping -c 3 <Enter mynet-eu-vm's external IP here>
```

This should work!

5. To test connectivity to **managementnet-us-vm**'s external IP, run the following command, replacing **managementnet-us-vm**'s external IP:

```
ping -c 3 <Enter managementnet-us-vm's external IP here>
```

This should work!

6. To test connectivity to **privatenet-us-vm**'s external IP, run the following command, replacing **privatenet-us-vm**'s external IP:

```
ping -c 3 <Enter privatenet-us-vm's external IP here>
```

This should work!

You are able to ping the external IP address of all VM instances, even though they are either in a different zone or VPC network. This confirms public access to those instances is only controlled by the **ICMP** firewall rules that you established earlier.

Ping the internal IP addresses

Ping the internal IP addresses of the VM instances to determine if you can reach the instances from within a VPC network.

1. In the Cloud Console, navigate to **Navigation menu** > **Compute Engine** > **VM instances**.
2. Note the internal IP addressees for **mynet-eu-vm**, **managementnet-us-vm**, and **privatenet-us-vm**.
3. Return to the **SSH** terminal for **mynet-us-vm**.
4. To test connectivity to **mynet-eu-vm**'s internal IP, run the following command, replacing **mynet-eu-vm**'s internal IP:

```
ping -c 3 <Enter mynet-eu-vm's internal IP here>
```

You are able to ping the internal IP address of **mynet-eu-vm** because it is on the same VPC network as the source of the ping (**mynet-us-vm**), even though both VM instances are in separate zones, regions and continents!

5. To test connectivity to **managementnet-us-vm**'s internal IP, run the following command, replacing **managementnet-us-vm**'s internal IP:

```
ping -c 3 <Enter managementnet-us-vm's internal IP here>
```

This should not work as indicated by a 100% packet loss!

6. To test connectivity to **privatenet-us-vm**'s internal IP, run the following command, replacing **privatenet-us-vm**'s internal IP:

```
ping -c 3 <Enter privatenet-us-vm's internal IP here>
```

This should not work either as indicated by a 100% packet loss! You are unable to ping the internal IP address of **managementnet-us-vm** and **privatenet-us-vm** because they are in separate VPC networks from the source of the ping (**mynet-us-vm**), even though they are all in the same zone **us-central1**.

VPC networks are by default isolated private networking domains. However, no internal IP address communication is allowed between networks, unless you set up mechanisms such as VPC peering or VPN.

Which instance(s) should you be able to ping from mynet-us-vm using internal IP addresses?

privatenet-us-vm

mynet-eu-vm

managementnet-us-vm

Submit

Create a VM instance with multiple network interfaces

Every instance in a VPC network has a default network interface. You can create additional network interfaces attached to your VMs. Multiple network interfaces enable you to create configurations in which an instance connects directly to several VPC networks (up to 8 interfaces, depending on the instance's type).

Create the VM instance with multiple network interfaces

Create the **vm-appliance** instance with network interfaces in **privatesubnet-us**, **managementsubnet-us** and **mynetwork**. The CIDR ranges of these subnets do not overlap, which is a requirement for creating a VM with multiple network interface controllers (NICs).

1. In the Cloud Console, navigate to **Navigation menu** > **Compute Engine** > **VM instances**.
2. Click **Create instance**.
3. Set the following values, leave all other values at their defaults:

Property	**Value (type value or select option as specified)**
Name	vm-appliance
Region	us-central1
Zone	us-central1-c
Series	N1

Machine type	4 vCPUs (n1-standard-4)

The number of interfaces allowed in an instance is dependent on the instance's machine type and the number of vCPUs. The n1-standard-4 allows up to 4 network interfaces. Refer here for more information.

4. Click **Management, security, disks, networking, sole tenancy**.
5. Click **Networking**.
6. For **Network interfaces**, click the pencil icon to edit.
7. Set the following values, leave all other values at their defaults:

Property	Value (type value or select option as specified)
Network	privatenet
Subnetwork	privatesubnet-us

8. Click **Done**.
9. Click **Add network interface**.
10. Set the following values, leave all other values at their defaults:

Property	Value (type value or select option as specified)
Network	managementnet
Subnetwork	managementsubnet-us

11. Click **Done**.
12. Click **Add network interface**.
13. Set the following values, leave all other values at their defaults:

Property	Value (type value or select option as specified)
Network	mynetwork
Subnetwork	mynetwork

14. Click **Done**.

15. Click **Create**.

Test Completed Task

Click **Check my progress** to verify your performed task. If you have successfully created VM instance with multiple network interfaces, you will see an assessment score.

Create a VM instance with multiple network interfaces

Check my progress

Explore the network interface details

Explore the network interface details of **vm-appliance** within the Cloud Console and within the VM's terminal.

1. In the Cloud Console, navigate to **Navigation menu** (☰) > **Compute Engine** > **VM instances**.
2. Click **nic0** within the **Internal IP** address of **vm-appliance** to open the **Network interface details** page.
3. Verify that **nic0** is attached to **privatesubnet-us**, is assigned an internal IP address within that subnet (172.16.0.0/24), and has applicable firewall rules.
4. Click **nic0** and select **nic1**.
5. Verify that **nic1** is attached to **managementsubnet-us**, is assigned an internal IP address within that subnet (10.130.0.0/20), and has applicable firewall rules.

6. Click **nic1** and select **nic2**.
7. Verify that **nic2** is attached to **mynetwork**, is assigned an internal IP address within that subnet (10.128.0.0/20), and has applicable firewall rules.

Each network interface has its own internal IP address so that the VM instance can communicate with those networks.

8. In the Cloud Console, navigate to **Navigation menu** > **Compute Engine** > **VM instances**.
9. For **vm-appliance**, click **SSH** to launch a terminal and connect.
10. Run the following, to list the network interfaces within the VM instance:

```
sudo ifconfig
```

The output should look like this (**do not copy; this is example output**):

```
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1460
        inet 172.16.0.3  netmask 255.255.255.255  broadcast 172.16.0.3
        inet6 fe80::4001:acff:fe10:3  prefixlen 64  scopeid 0x20<link>
        ether 42:01:ac:10:00:03  txqueuelen 1000  (Ethernet)
        RX packets 626  bytes 171556 (167.5 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 568  bytes 62294 (60.8 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1460
        inet 10.130.0.3  netmask 255.255.255.255  broadcast 10.130.0.3
        inet6 fe80::4001:aff:fe82:3  prefixlen 64  scopeid 0x20<link>
        ether 42:01:0a:82:00:03  txqueuelen 1000  (Ethernet)
        RX packets 7  bytes 1222 (1.1 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 17  bytes 1842 (1.7 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
eth2: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1460
        inet 10.128.0.3  netmask 255.255.255.255  broadcast 10.128.0.3
        inet6 fe80::4001:aff:fe80:3  prefixlen 64  scopeid 0x20<link>
        ether 42:01:0a:80:00:03  txqueuelen 1000  (Ethernet)
        RX packets 17  bytes 2014 (1.9 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 17  bytes 1862 (1.8 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

The **sudo ifconfig** command lists a Linux VM's network interfaces along with the internal IP addresses for each interface.

Explore the network interface connectivity

Demonstrate that the **vm-appliance** instance is connected to **privatesubnet-us**, **managementsubnet-us** and **mynetwork** by pinging VM instances on those subnets.

1. In the Cloud Console, navigate to **Navigation menu** > **Compute Engine** > **VM instances**.
2. Note the internal IP addressees for **privatenet-us-vm**, **managementnet-us-vm**, **mynet-us-vm**, and **mynet-eu-vm**.
3. Return to the **SSH** terminal for **vm-appliance**.
4. To test connectivity to **privatenet-us-vm**'s internal IP, run the following command, replacing **privatenet-us-vm**'s internal IP:

```
ping -c 3 <Enter privatenet-us-vm's internal IP here>
```

This works!

5. Repeat the same test by running the following:

```
ping -c 3 privatenet-us-vm
```

You are able to ping **privatenet-us-vm** by its name because VPC networks have an internal DNS service that allows you to address instances by their DNS names rather than their internal IP addresses. When an internal DNS query is made with the instance hostname, it resolves to the primary interface (nic0) of the instance. Therefore, this only works for **privatenet-us-vm** in this case.

6. To test connectivity to **managementnet-us-vm**'s internal IP, run the following command, replacing **managementnet-us-vm**'s internal IP:

```
ping -c 3 <Enter managementnet-us-vm's internal IP here>
```

This works!

7. To test connectivity to **mynet-us-vm**'s internal IP, run the following command, replacing **mynet-us-vm**'s internal IP:

```
ping -c 3 <Enter mynet-us-vm's internal IP here>
```

This works!

8. To test connectivity to **mynet-eu-vm**'s internal IP, run the following command, replacing **mynet-eu-vm**'s internal IP:

```
ping -c 3 <Enter mynet-eu-vm's internal IP here>
```

This does not work! In a multiple interface instance, every interface gets a route for the subnet that it is in. In addition, the instance gets a single default route that is associated with the primary interface eth0. Unless manually configured otherwise, any traffic leaving an instance for any destination other than a directly connected subnet will leave the instance via the default route on eth0.

9. To list the routes for **vm-appliance** instance, run the following command:

```
ip route
```

The output should look like this (**do not copy; this is example output**):

```
default via 172.16.0.1 dev eth0
10.128.0.0/20 via 10.128.0.1 dev eth2
10.128.0.1 dev eth2 scope link
10.130.0.0/20 via 10.130.0.1 dev eth1
10.130.0.1 dev eth1 scope link
172.16.0.0/24 via 172.16.0.1 dev eth0
172.16.0.1 dev eth0 scope link
```

The primary interface eth0 gets the default route (default via 172.16.0.1 dev eth0), and all three interfaces eth0, eth1 and eth2 get routes for their respective subnets. Since, the subnet of **mynet-eu-vm** (**10.132.0.0/20**) is not included in this routing table, the ping to that instance leaves **vm-appliance** on eth0 (which is on a different VPC network). You could change this behavior by configuring policy routing as documented here.