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| **Virtual Networks** | **Virtual Private Cloud** |
| **Projects, networks, and subnetworks** |
| **Expand a Subnet** |
| **IP addresses** |
| **Routes and firewall rules** |
| **Google Access and Cloud NAT** |

**Virtual Private Cloud (VPC) provides networking functionality to Compute Engine virtual machine (VM) instances, Google Kubernetes Engine (GKE) clusters, and serverless workloads. VPC provides networking for your cloud-based resources and services that is global, scalable, and flexible**.

A Virtual Private Cloud (VPC) network is a virtual version of a physical network that is implemented inside of Google's production network

A VPC network does the following:

* Provides connectivity for your [Compute Engine virtual machine (VM) instances](https://cloud.google.com/vpc/docs/vpc#vm-instances).
* Offers native internal passthrough Network Load Balancers and proxy systems for internal Application Load Balancers.
* Connects to on-premises networks by using Cloud VPN tunnels and VLAN attachments for Cloud Interconnect.
* Distributes traffic from Google Cloud external load balancers to backends.

Certainly! Let’s explore the world of **Virtual Private Cloud (VPC)** networks in the context of Google Cloud. 🌐🔒

1. **What is a VPC Network?**
   * A **Virtual Private Cloud (VPC)** network is a virtual counterpart of a physical network. It exists within Google’s production network infrastructure, powered by the Andromeda technology.
   * Key Functions:
     + Provides connectivity for your **Compute Engine virtual machine (VM) instances**.
     + Facilitates native internal communication via **Network Load Balancers** and internal **Application Load Balancers**.
     + Connects to on-premises networks using **Cloud VPN tunnels** and **VLAN attachments** for **Cloud Interconnect**.
     + Distributes traffic from Google Cloud’s external load balancers to backends.
2. **Projects and Networks:**
   * **Projects**: Google Cloud resources are organized into projects. Each project can contain multiple VPC networks.
   * **Default Network**: New projects start with a **default network** (an auto-mode VPC network). It includes one **subnet** in each region.
   * **Legacy Networks**: Legacy networks are no longer recommended for production due to limitations. You can convert them to VPC networks.
3. **Subnets and VM Instances:**
   * **Subnets**: These define ranges of IPv4 addresses within a VPC network. Subnets are regional resources.
   * **Custom Mode Subnets**: In custom mode VPC networks, subnets can also have IPv6 address ranges.
   * **VM Instances**: Compute Engine VM instances (also known as virtual machines) reside within VPC networks.
     + VM instances include Google Kubernetes Engine (GKE) clusters, App Engine flexible environment instances, and other Google Cloud products built on Compute Engine VMs.
4. **Properties of VPC Networks**:
   * **Global Resources**: VPC networks, along with their associated routes and firewall rules, are global. They aren’t tied to specific regions or zones.
   * **Controlled Traffic**: Network firewall rules control traffic to and from instances. Rules are implemented on the VMs themselves.
   * **Communication Options**:
     + Resources within a VPC network can communicate using internal IPv4 addresses, internal IPv6 addresses, or external IPv6 addresses (subject to firewall rules).
     + Instances with internal IPv4 or IPv6 addresses can also communicate with Google APIs and services.
5. **Expanding Subnets**:
   * **Expandable**: You can expand subnets without re-creating instances.
   * **CIDR Blocks**: New subnet IP ranges must be unique valid CIDR blocks.
   * **Auto Mode Expansion**: Auto-mode subnets can be expanded from /20 to /16.

In summary, VPC networks provide a secure and flexible way to manage networking within Google Cloud. [They allow you to define subnets, control traffic, and connect seamlessly across regions and projects1](https://cloud.google.com/vpc/docs/vpc)[2](https://storage.googleapis.com/cloud-training/archinfra/v2.2/trainer/02_Virtual_Networks.pdf)[3](https://cloud.google.com/vpc/docs/create-modify-vpc-networks). If you have further questions or need more details, feel free to ask! 🚀

