

# GCP Certification Series: 2.4 Planning and configuring network resources



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Google is a global company and has the network all over the world. So, if you use google you can easily go global with few clicks. Even though not all companies are in the cloud all eventually they will feel the need to do so if they expand beyond their boundaries.

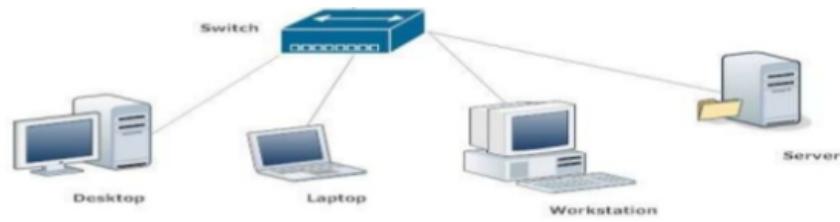
In this article, we will look at the networking aspect of the Google Cloud platform. We will see how projects are stored in the network, what resources should be placed where and what will be the good solution in this blog.

I will try to cover the concept part first then go in detail.

## Computer Network

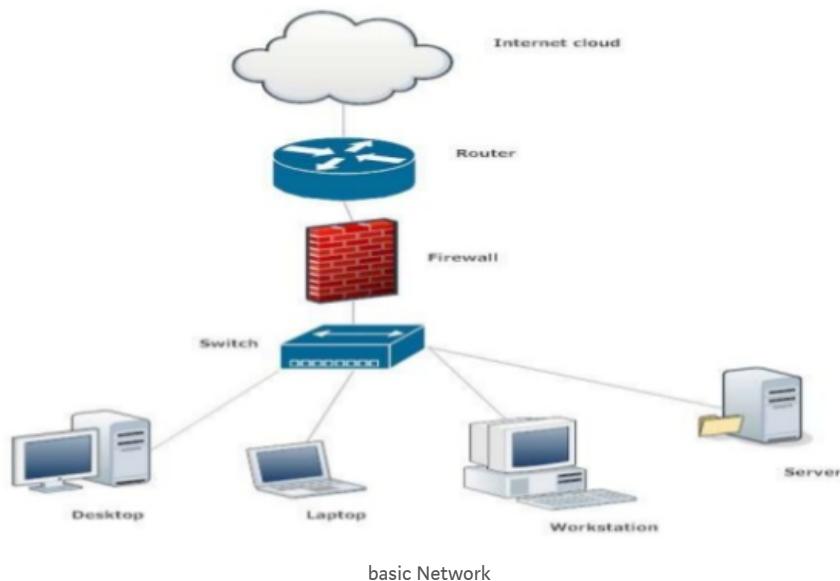
A computer network is a set of computers connected together for the purpose of sharing resources. It is often referred to as the data network. Computer network today may comprise of fiber, wireless and cable network. It is a physical layer of the OSI model. The most common resource shared today is the connection to the Internet.

In early days, a computer network used to be an interconnection between various devices within a small office or university. When computer become more and more used the network connecting them also developed. Earlier the most important device to connect to a network used to be the printer or server but now there are so many devices that hook up to a network that I cannot say this is the most important one.



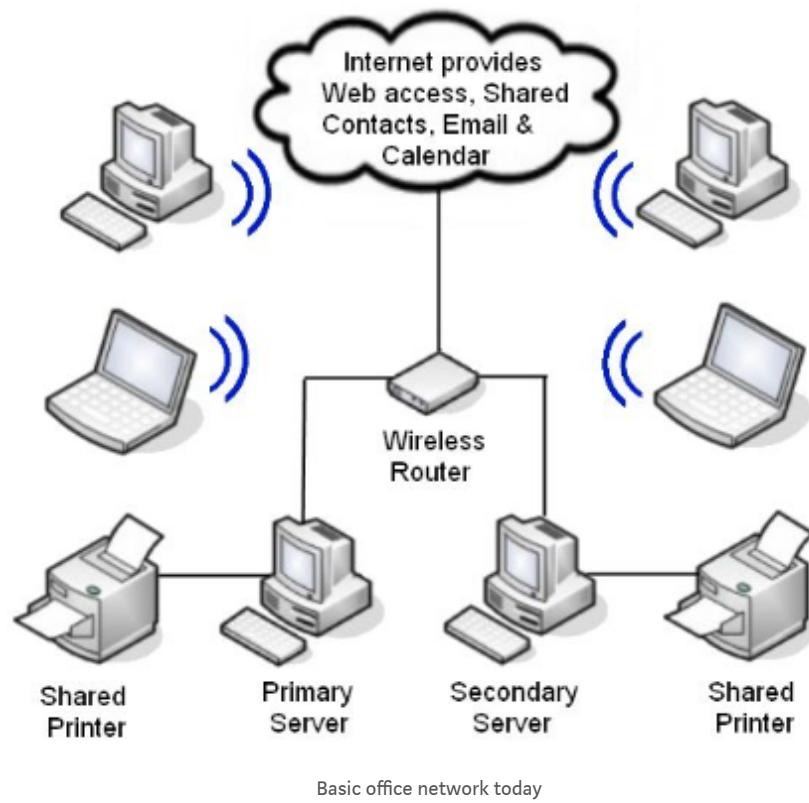
Simple network without internet—early days

After the development of the internet more and more servers and services started serving online but having a network owned far from the office location for computing purpose was not even imagined at that time. During the past 50 years, internet speed has changed from 56 kbps to 100's Gbps or more as the speed is increasing frequently.

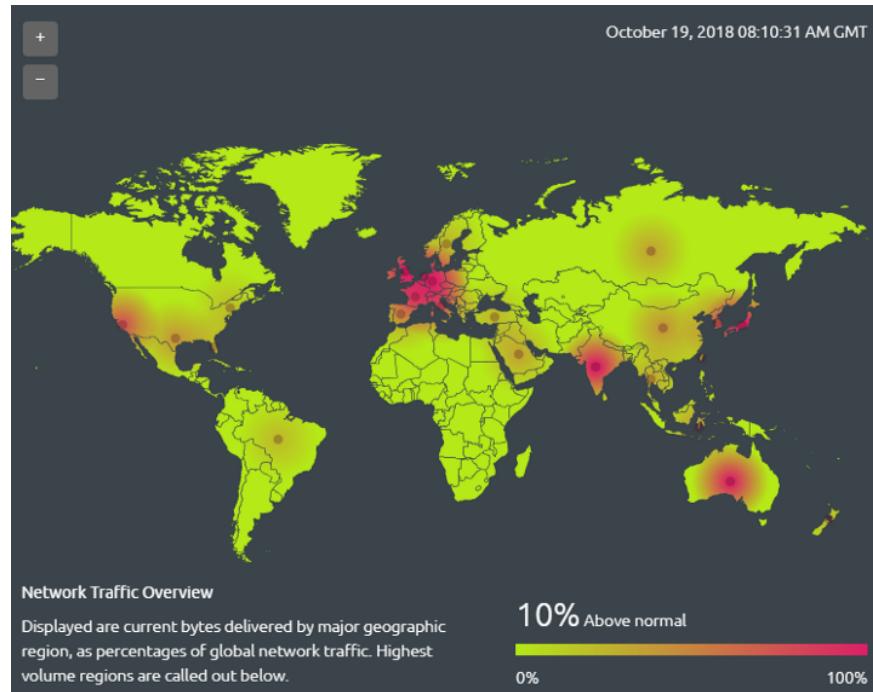


basic Network

Wireless internet and Wi-Fi became part of the lives for so many years now. 4G is available in most of the countries now and 5G is being launched now in Finland. So, network technology and speed have been developed at a fast pace.

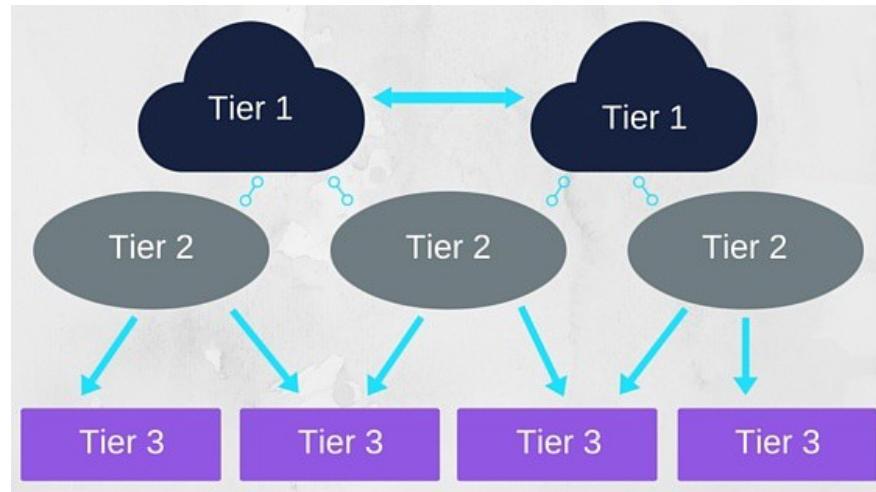


If you look at the real-time network traffic today!

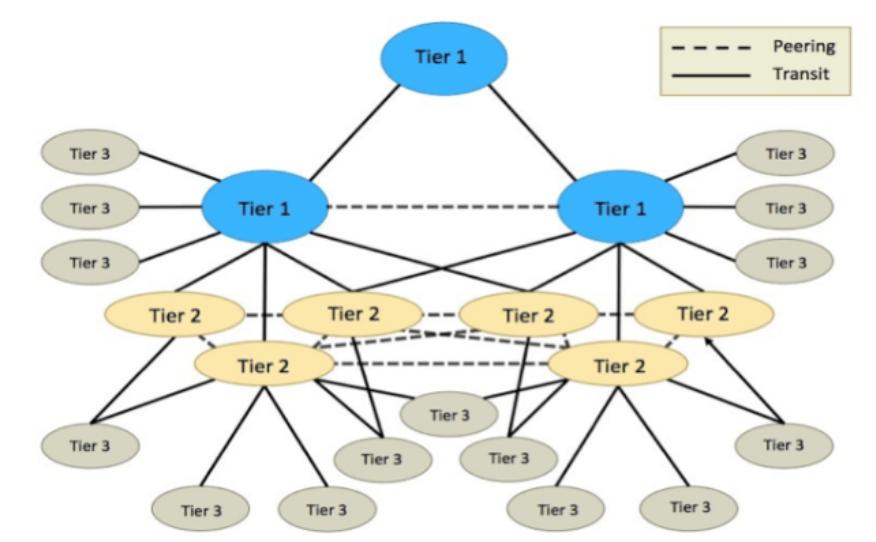


References: <https://www.akamai.com/uk/en/solutions/intelligent-platform/visualizing-akamai/real-time-web-monitor.jsp>

So, looking from top-view whole world's internet is divided into 3 tiers according to network providers



References: <https://datapath.io/resources/blog/what-is-an-internet-service-provider/>



References: <https://orhanergun.net/2017/01/tier-1-tier-2-tier-3-service-providers/>

Tier 1 can connect to each and every device in the world connected to the internet ***in a very short route***. A Tier 1 network is an Internet Protocol network that can reach every other network on the Internet solely via settlement-free interconnection, also known as settlement-free peering. In other words, Tier 1 networks can exchange traffic with other Tier 1 network without having to pay any fees. Tier 1 Internet providers are the networks that provide the backbone of the Internet. We call them backbone Internet providers. These providers build

infrastructure such as the Atlantic Internet sea cables. They provide traffic to all other Internet providers, not end users.-----  
{Connection: peering Agreement }

### List of Tier 1 network providers

Name	Headquarters	AS number	February 2018 degree <sup>[10][11]</sup>	Fiber Route Miles	Fiber Route km	Peering Policy
AT&T <sup>[12]</sup>	United States	7018	2,228	410,000	660,000 <sup>[13]</sup>	AT&T Peering policy <sup>[14]</sup>
CenturyLink (formerly Level 3, Qwest, Savvis, Global Crossing, TW Telecom and Exodus) [14] [15]	United States	209 3356 3549 4323	1,088 4,976 2,536 2,028	750,000	885,139 <sup>[16][17]</sup>	North America <sup>[18]</sup> ; International <sup>[19]</sup> Level 3 Peering Policy <sup>[20]</sup>
Deutsche Telekom AG (ICSS) <sup>[18]</sup>	Germany	3320	581	?	?	DTAG Peering Details <sup>[21]</sup>
GTT Communications, Inc. (formerly Tinet & nLayer) <sup>[19]</sup>	United States	3257 (4436)	1,576	25,000	40,000 <sup>[20]</sup>	GTT Peering Policy <sup>[22]</sup>
KPN International <sup>[21]</sup>	Netherlands	286	276	75,000	120,000 <sup>[22]</sup>	KPN Peering Policy <sup>[23]</sup>
Liberty Global <sup>[23][24]</sup>	United Kingdom <sup>[25]</sup>	6830	777	500,000	800,000 <sup>[26]</sup>	Peering Principles <sup>[27]</sup>
NTT Communications (America) (formerly Verio) <sup>[27]</sup>	Japan	2914	1,714	?	?	North America <sup>[28]</sup>
Orange (OpenTransit) <sup>[28]</sup>	France	5511	181	?	?	OTI peering policy <sup>[29]</sup>
PCCW Global	Hong Kong	3491	680	?	?	Peering policy <sup>[30]</sup>
Sprint (SoftBank Group) <sup>[29]</sup>	Japan	1239	392	26,000	42,000 <sup>[31]</sup>	Peering policy <sup>[32]</sup>
Tata Communications India Limited (Acquired Teleglobel) <sup>[31]</sup>	India	6453	724	435,000	700,000 <sup>[32]</sup>	Peering Policy <sup>[33]</sup>
Telecom Italia Sparkle (Seabone) <sup>[33]</sup>	Italy	6762	482	347,967	560,000	Peering Policy <sup>[34]</sup>
Telia <sup>[34]</sup> (Subsidiary of Telefónica) <sup>[34]</sup>	Spain	12956	304	40,000	65,000 <sup>[35]</sup>	Peering Policy <sup>[36]</sup>
Telia Carrier <sup>[38]</sup>	Sweden	1299	1,664	40,000	65,000 <sup>[37]</sup>	TeliaSonera International Carrier Global Peering Policy <sup>[38]</sup>
Verizon Enterprise Solutions (formerly UUNET and XO Communications) <sup>[42]</sup>	United States	701 702 703 2828	1,204 280 98 1,031	500,000	805,000 <sup>[43]</sup>	Verizon UUNET Peering policy 701, 702, 703 <sup>[44]</sup>
Zayo Group (formerly AboveNet) <sup>[44]</sup>	United States	6461	1,718	122,000	196,339 <sup>[45]</sup>	Zayo Peering Policy <sup>[46]</sup>

References: [https://en.wikipedia.org/wiki/Tier\\_1\\_network](https://en.wikipedia.org/wiki/Tier_1_network)

A Tier 2 network is an Internet service provider which engages in the practice of peering with other networks, but which also purchases IP transit to reach some portion of the Internet.

A tier 2 ISP is a service provider who connects between tier 1 and tier 3 Internet service providers. Tier 2 providers will exchange Internet traffic through peering agreements, as well as purchase Internet transit.

Tier 2 and tier 3 internet providers are sometimes used interchangeably. A tier 2 supplier tends to find it easier to purchase transit than to work out a peering agreement with a tier 1 provider. The reason for this is the level of transit. The tier 2 provider may not have enough transit, or capabilities, for it to make sense to peer with the tier 1 provider.

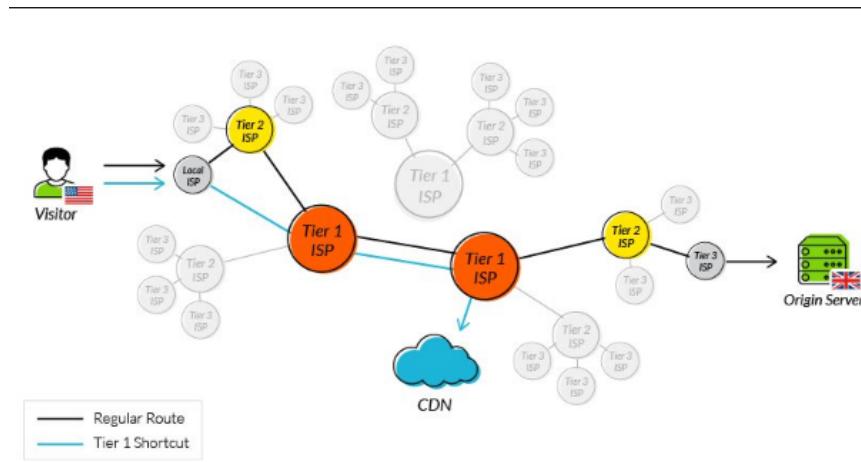
----- {Connection: peering Agreement }

## List of Tier 2 providers

Name	AS Number	September 2016 degree <sup>[1][2]</sup>	Reason
Hurricane Electric	6939	4809	IPv4: Buys transit from Telia Carrier/AS1299. <sup>[3]</sup> IPv6: Does not provide IPv6 routing/connectivity to Cogent/AS174. <sup>[4]</sup>
Cogent Communications (formerly PSINet)	174	4641	IPv6: Does not provide IPv6 routing/connectivity to Google/AS15169 or Hurricane Electric/AS6939. <sup>[4][5]</sup>
Interoute	8928	552	Uses transit from GTT/AS3257. <sup>[6]</sup>
Korea Telecom	4766	492	Buys transit from Cogent/AS174, Telia Carrier/AS1299, Tata Communications/AS6453, Hurricane Electric/AS6939, Global Telecom & Technology (GTT)/AS4436, Sprint/AS1239.
China Telecom	4134/4809	151	Buys transit from Verizon/AS701.
KDDI	2516	310	Buys transit from Level3/AS3356, Tata Communications/AS6453, Verizon/AS701, Global Telecom & Technology (GTT)/AS3257, CenturyLink/AS209.
Internet Initiative Japan	2497	307	Buys transit from NTT America/AS2914, Verizon/AS701.
SK broadband	9318	484	Buys transit from Tata Communications/AS6453, Verizon/AS701, Telia Carrier/AS1299, NTT America/AS2914, China Telecom/AS4134&AS4809.
Vodafone (formerly Cable and Wireless)	1273	296	Buys transit from Level 3 Communications/AS3356, Telia Carrier/AS1299, Verizon Enterprise Solutions (formerly UUNET)/AS701, Global Telecom & Technology (GTT)/AS3257.
Vodafone (formerly ARCOR AG Germany)	3209	166	Buys transit from Level3/AS3356, Telia Carrier/AS1299, Verizon Enterprise Solutions (formerly UUNET)/AS701, nLayer Communications/AS4436, Pacnet/AS10026. <sup>[7]</sup>
Telkom Indonesia International <sup>[8]</sup>	7713	258	Buys transit from Level3/AS3356, Cogent/AS174, Telia Carrier/AS1299, NTT America/AS2914, Telecom Italia Sparkle/AS6762, Tata Communications/AS6453.
TDC <sup>[9]</sup>	3292	221	Buys transit from Sprint/AS1239, NTT America/AS2914.
Virgin Media	5089	192	Buys transit from GTT/AS3257, Liberty Global/AS6830.
Comcast	7922	160	Buys transit from Tata Communications/AS6453, NTT America/AS2914.
PT Mora Telematika Indonesia <sup>[10]</sup>	23947	158	Buys transit from NTT America/AS2914, GTT/AS3257, Tata Communications/AS6453.
British Telecom	5400	155	Buys transit from Telia Carrier/AS1299 and NTT America/AS2914, Global Telecom & Technology (GTT)/AS4436.
Easynet <sup>[11]</sup>	4589	108	Buys transit including NTT America/AS2914, GTT/AS3257.
Tele2 (formerly SWIPNet)	1257	107	Buys transit from Sprint/AS1239, Cogent/AS174.
Fibrenoire <sup>[12]</sup>	22652	79	Buys transit from Level3/AS3356, Tata Communications/AS6453, GTT/AS3257.
Spirit Communications <sup>[13]</sup>	2711	70	Buys transit from Level3/AS3356, Cogent/AS174, Telia Carrier/AS1299, NTT America/AS2914, GTT/AS3257, Hurricane Electric/AS6939.
FiberRing <sup>[14]</sup>	38930	59	Buys transit from NTT America/AS2914, Telia Carrier/AS1299, Tata Communications/AS6453, Cogent/AS174.
Intermap	14744	43	Buys transit from Cogent/AS174, NTT America/AS2914, XO Communications/AS2828, AboveNet/AS6461, CenturyLink/AS209, AT&T/AS7018.
KCOM Group	12390	37	Buys transit from KPN/AS286, Level 3/AS3356, Cogent/AS174, NTT America/AS2914.
Stealth Communications	8002	28	Buys transit from Tata Communications/AS6453, Cogent/AS174.
RETN <sup>[15]</sup>	9002	620	Buys transit from Level 3/AS3356, NTT America/AS2914.

References: [https://en.wikipedia.org/wiki/Tier\\_2\\_network](https://en.wikipedia.org/wiki/Tier_2_network)

A tier 3 ISP is a provider who strictly purchases Internet transit. A tier 3 provider is the last mile provider who delivers Internet access to residential homes and businesses.

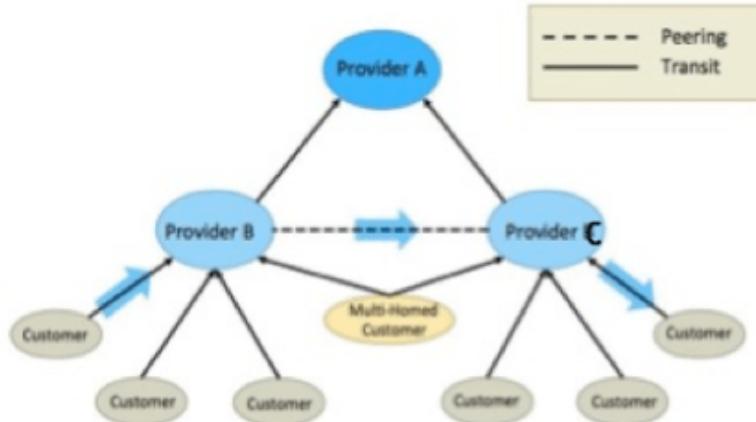


References: <https://www.incapsula.com/cdn-guide/wp-content/uploads/sites/7/2018/04/ping2.jpg>

**Downloading documents from a server in California to a user in Germany means all three levels of ISPs have to work together. This is done through a combination of peering and paid Internet transit agreements.**

### BGP Peering

BGP Peering is an agreement between different Service Providers. It is an EBGP neighborship between different Service Providers to send BGP traffic between them without paying upstream Service Provider. To understand BGP peering, first, we must understand how networks are connected to each other on the Internet. The Internet is a collection of many individual networks, which interconnect with each other under the common goal of ensuring global reachability between any two points.

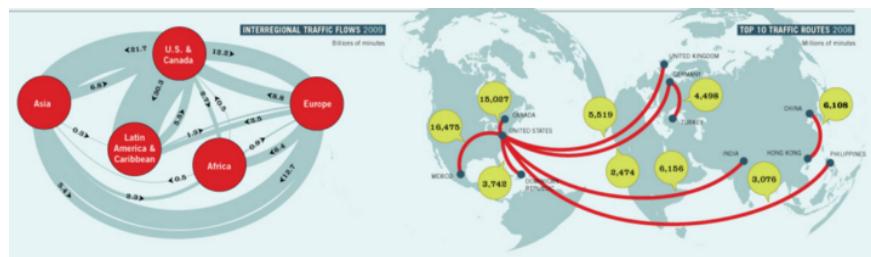


### BGP Peering and Transit Links

As in the above picture, there are three primary relationships in this interconnection:

- Provider: Typically someone who is paid and has the responsibility of routing packets to/from the entire Internet.
- Customer: Typically someone who pays a provider with the expectation that their packets will be routed to/from the entire Internet.
- Peers: Two networks that get together and agree to exchange traffic between each others' networks, typically for free. There are generally two types of peering: public and private. Both will be explained in this session.

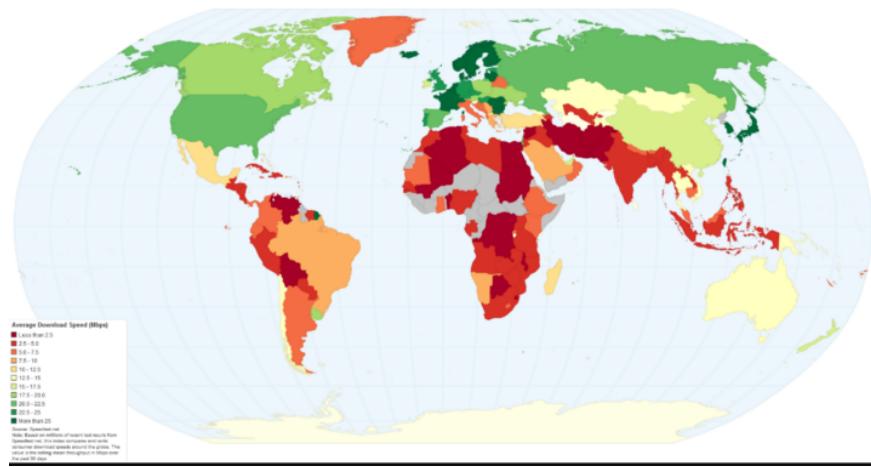




references: <https://www.telegeography.com/assets/website/images/maps/global-traffic-map-2010/global-traffic-map-2010-x.jpg>



References: <https://www.telegeography.com/assets/website/images/maps/global-traffic-map-2010/global-traffic-map-2010-x.jpg>



References: <https://cdn3.vox-cdn.com/assets/4463835/WrLYaXB.png>

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## Who controls IP addresses

For the internet to work, everyone needs a unique Internet Protocol (IP) address. To coordinate the distribution of these addresses, the internet is broken up into five zones. Each zone has been assigned hundreds of millions of IP addresses to manage. Unfortunately, the original internet architecture, called IPv4, only allows for about 4 billion addresses, and the network has nearly exhausted the supply. The problem is particularly growing in fast-growing regions like Asia. Engineers have developed a long-run solution to this problem: switching to a new internet standard called IPv6. IPv6 offers such a large number of potential addresses that the world will never run out. But adoption of IPv6 has been slow. Today, the overwhelming majority of internet traffic uses the old standard. But with few IPv4 addresses left, people joining the internet in the future will have little choice but to use IPv6.

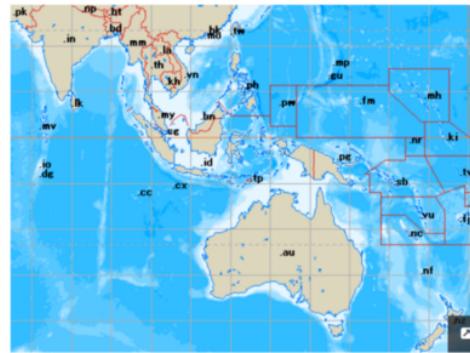


references: <https://www.vox.com/a/internet-maps>

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**Some small island nations lend their domains to internet startups**

Even very small countries get ccTLDs. Here's a close-up of the area around Australia and the many small island nations that have their own domain names. Some of these countries realized that they could make a lot of money if they opened their domains to foreigners. The result: popular websites like last.fm (.fm is the domain of the Federated States of Micronesia) and twitch.tv (.tv is the domain for the Island nation of Tuvalu). The .io domain, assigned to the British Indian Ocean Territory, has become popular among programmers. They associate the domain with the technical term input/output and use it to create "artisinal websites." Click to see a full world map.



reference: <https://www.vox.com/a/internet-maps>

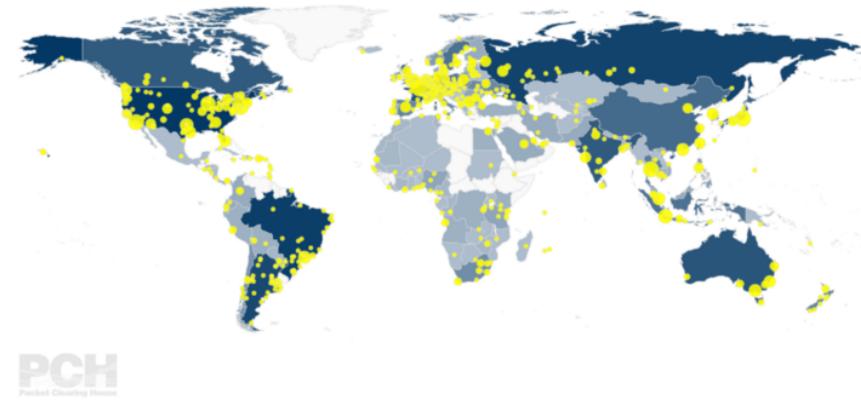
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### Most popular mobile phone brands

Right now, three companies dominate the global market for mobile phones, and they've largely divided the market by income. In wealthy countries, Apple's iPhone is popular. In middle-income countries, especially in Latin America, Eastern Europe, and the Middle East, Samsung devices have the lead. In poor countries, especially in sub-Saharan Africa, Nokia often dominates. These data are based on web browsing patterns, so it may not be a perfect reflection of the number of units sold by these companies.

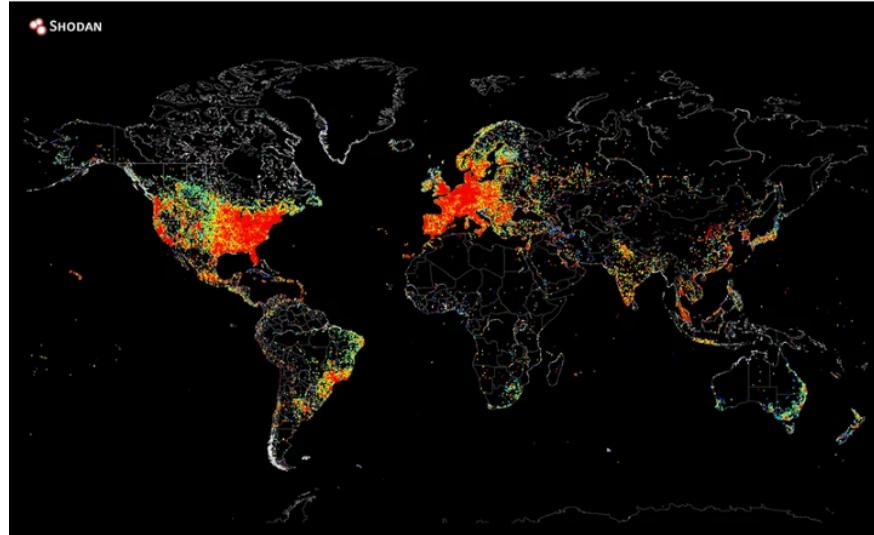


Reference: <https://www.vox.com/a/internet-maps>

**Internet Exchange Directory**

References: <https://www.pch.net/ixp/dir>

Devices connected to the internet



references: <http://time.com/3221958/internet-map/>

So, these maps will give you a holistic idea about the network traffic in the world and users in the world.

*Let's get back to google.*

Google is probably tier 1 or tier 2 network provider but as they only transfer traffic within Google's network they are not regarded as ISP. Google has a private global network connecting many data centers and POP(point of presence). They have



reference: <https://cloud.google.com/about/locations/#network-tab>

Google's private network connects their regional locations to more than 100 points of presence(POP). Google Cloud Platform uses software-defined networking and distributed systems technologies to host and deliver services around the world. Since Google has a global private network, this will help make your product global linking all the regions by the high-speed network.

1. Managing Networking for your resources
2. Worldwide Autoscaling and load balancing
3. Highly available global DNS Network
4. Fast, High availability Interconnect
5. Content Delivery Network(CDN)

## Regions and Zones

When developing your application in GCP it is very important to understand regions and zones,

Resources are also regional and zonal so you must also have an idea about which resource is what before going in detail.

A region is a geographical location that is sub-divided into zones.

While few of the resources in GCP are global, others may be restricted by region or zone.

*Regional resources can be used anywhere within the same region, while zonal resources can be used anywhere within the same zone.*

Some examples of this are:

Global Resources:

- Images
- Snapshots
- VPC Network
- Firewalls
- Routes

Regional Resources:

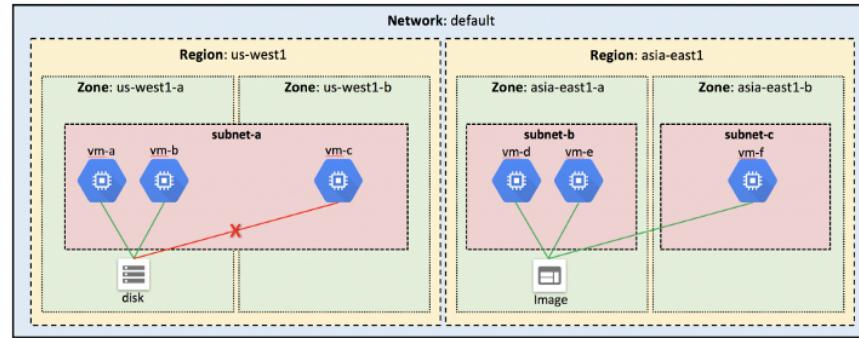
- Static external IP addresses
- Subnets

Zonal Resources:

- Instances (VMs)
- Persistent Disks

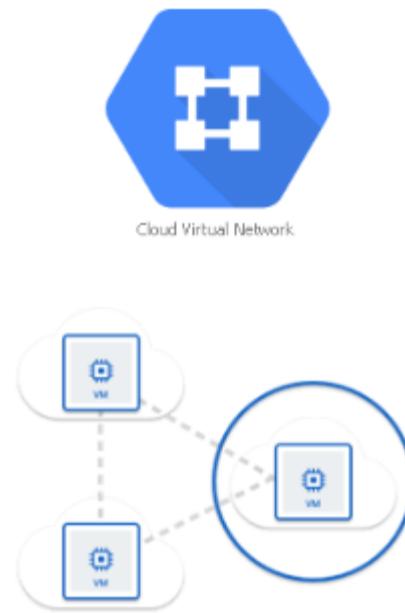
For example, I can attach a disk from one instance to another within the same zone, but I cannot do this across zones. However, since

images and snapshots are Global Resources, I can use these across zones in the same region.



reference: <https://www.networkmanagementsoftware.com/google-cloud-platform-gcp-networking-fundamentals/>

## Managing Networking for resources



With the help of Google Virtual private cloud (VPC), you can

- provision GCP resources
- connect resources
- isolate resources

- make fine-grained policies for accessing resources and network

VPC consists of

- IP Address
- firewall
- VPN
- cloud router

## VPC FEATURES

Managed networking functionality for your Cloud Platform resources

### VPC Network

VPC can automatically set up your virtual topology, configuring prefix ranges for your subnets and network policies, or you can configure your own. You can also expand CIDR ranges without downtime.

### Cloud Router

Enable dynamic Border Gateway Protocol (BGP) route updates between your VPC network and your non-Google network with our virtual router.

### VPN

Securely connect your existing network to VPC network over IPsec.

### Firewall

Segment your networks with a global distributed firewall to restrict access to instances.

### VPC Peering

Configure private communication across the same or different organizations without bandwidth bottlenecks or single points of failure.

### Shared VPC

Configure a VPC Network to be shared across several projects in your organization. Connectivity routes and firewalls associated are managed centrally. Your developers have their own projects with separate billing and quota, while they simply connect to a shared private network, where they can communicate.

### Routes

Forward traffic from one instance to another instance within the same network, even across subnets, without requiring external IP addresses.

### VPC Flow Logs

Flow logs capture information about the IP traffic going to and from network interfaces on Google Compute Engine. VPC flow logs help with network monitoring, forensics, real-time security analysis and expense optimization. GCP is unique for its near real-time visibility. Other cloud logs update every 10-minutes, while GCP logs update every 5-seconds.

References: <https://cloud.google.com/vpc/>

## USES FOR VPC

You can build simple and complex architectures using VPC, including:

- Hosting globally distributed multi-tier applications, by creating a VPC with subnets.
- Connecting GCP-hosted or externally-hosted databases to Google's unique [machine learning](#) services, by creating a VPC with subnets and VPN access.
- Disaster recovery with application replication. Create backup GCP compute capacity, then revert back once the incident is over.

References: <https://cloud.google.com/vpc/>

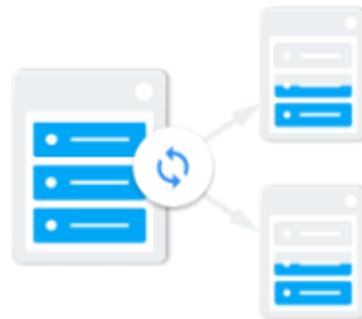
## Worldwide Autoscaling and load-balancing



Cloud Load Balancing

Autoscaling is one of the most important aspects of Cloud in general and Google has made it even easier to scale with minimum configuration. You can scale from zero to full-throttle with Google cloud load balancing with no pre-warming required.

You can select whether to make the instance regional or multi-regional while creating it and then configure the load balancing option to make it more specific.



Cloud Load balancing can put resources behind a single unicast IP and scale your resources up or down with intelligent Autoscaling.

Cloud load balancing is integrated with Google cloud CDN for optimal application and content delivery.

### Global load balancing with single Anycast IP



With cloud load balancing a single anycast IP can be used in front-end for load balancing all backend resources around the world. It provides cross-region load balancing including automatic multi-region failover which gently moves traffic infractions if backend becomes unhealthy.

## Software-defined load balancing

Cloud Load Balancing is a fully distributed, software-defined, managed service for all your traffic. It is not an instance or device based solution, so you won't be locked into physical load balancing infrastructure or face the HA, scale and management challenges inherent in instance based LBs. You can apply Cloud Load Balancing to all of your traffic: HTTP(S), TCP/SSL, and UDP. You can also terminate your SSL traffic with HTTPS Load Balancing and SSL proxy.

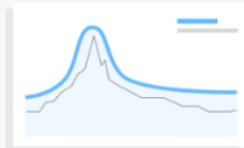


references: <https://cloud.google.com/load-balancing/>



**Over One Million Queries Per Second**

Cloud Load Balancing is built on the same front-end serving infrastructure that powers Google. It supports 1 Million+ queries per second with consistent high performance and low latency. Traffic enters Cloud Load Balancing through 80+ distinct global load balancing locations, maximizing the distance traveled on Google's fast private network backbone.



**Seamless Autoscaling**

Cloud Load Balancing can scale as your users and traffic grow, including easily handling huge, unexpected and instantaneous spikes by diverting traffic to other regions in the world that can take traffic. Autoscaling does not require pre-warming, you can scale from zero to full throttle in a matter of seconds.

references: <https://cloud.google.com/load-balancing/>



**Internal Load Balancing**

Internal Load Balancing enables you to build scalable and highly available internal services for your internal client instances without requiring your load balancers to be exposed to the internet. GCP Internal Load Balancing is architected using [Andromeda](#), Google's software-defined network virtualization platform. Internal Load Balancing also includes support for clients across VPN.

**Support for cutting edge protocols**

Cloud Load Balancer includes support for the latest application delivery protocols. It supports HTTP/2 with gRPC when connecting to Backends and also is the first major public cloud to offer QUIC support for our HTTPS load balancers to provide faster session setup to provide customers with a more responsive application experience.



references: <https://cloud.google.com/load-balancing/>

## GOOGLE CLOUD LOAD BALANCING FEATURES

High performance, scalable load balancing on Google Cloud Platform

### HTTP(S) Load Balancing

HTTP(S) load balancing can balance HTTP and HTTPS traffic across multiple backend instances, across multiple regions. Your entire app is available via a single global IP address, resulting in a simplified DNS setup. HTTP(S) load balancing is scalable, fault-tolerant, requires no pre-warming, and enables content-based load balancing. For HTTPS traffic, it provides SSL termination and load balancing.

### TCP/SSL Load Balancing

TCP load balancing can spread TCP traffic over a pool of instances within a Compute Engine region. It is scalable, does not require pre-warming, and health checks help ensure only healthy instances receive traffic. SSL proxy provides SSL termination for your non-HTTPS traffic with load balancing.

### SSL Offload

SSL offload enables you to centrally manage SSL certificates and decryption. You can enable encryption between your load balancing layer and backends to ensure the highest level of security, with some additional overhead for processing on backends.

### Advanced Feature Support

Cloud Load Balancer also includes advanced support features, such as IPv6 Global Load Balancing, WebSockets, user-defined request headers, and protocol forwarding for private VIPs.

### UDP Load Balancing

UDP load balancing can spread UDP traffic over a pool of instances within a Compute Engine region. It is scalable, does not require pre-warming, and health checks help ensure only healthy instances receive traffic.

### Stackdriver Logging

Stackdriver Logging for load balancing logs all the load balancing requests sent to your load balancer. These logs can be used for debugging as well as analyzing your user traffic. You can view request logs and export them to Google Cloud Storage, Google BigQuery, or Google Cloud Pub/Sub for analysis.

### Seamless Autoscaling

Autoscaling helps your applications gracefully handle increases in traffic and reduces cost when the need for resources is lower. You just define the [autoscaling policy](#) and the autoscaler performs automatic scaling based on the measured load. No pre warming required - go from zero to full throttle in seconds.

### High Fidelity Health Checks

Health checks ensure that new connections are only load balanced to healthy backends that are up and ready to receive them. High fidelity health checks ensure that the probes mimic actual traffic to backends.

### Affinity

Cloud Load Balancing Affinity provides the ability to direct and stick user traffic to specific backend instances.

### Cloud CDN Integration

Enable [Cloud CDN](#) for HTTP(S) Load Balancing for optimizing application delivery for your users with a single checkbox.

references: <https://cloud.google.com/load-balancing/>

## Differentiating load balancing options

Google Cloud Platform Load Balancing enables you to do the following:

- Distribute load-balanced resources in single or multiple regions
- Meet your high availability requirements

- Put your resources behind a single anycast IP address
- Scale your resources up or down with intelligent Autoscaling
- Use Cloud CDN for optimal content delivery

By using cloud load balancing with Cloud CDN you can serve as close to your users as possible that can handle 1 million queries per second.

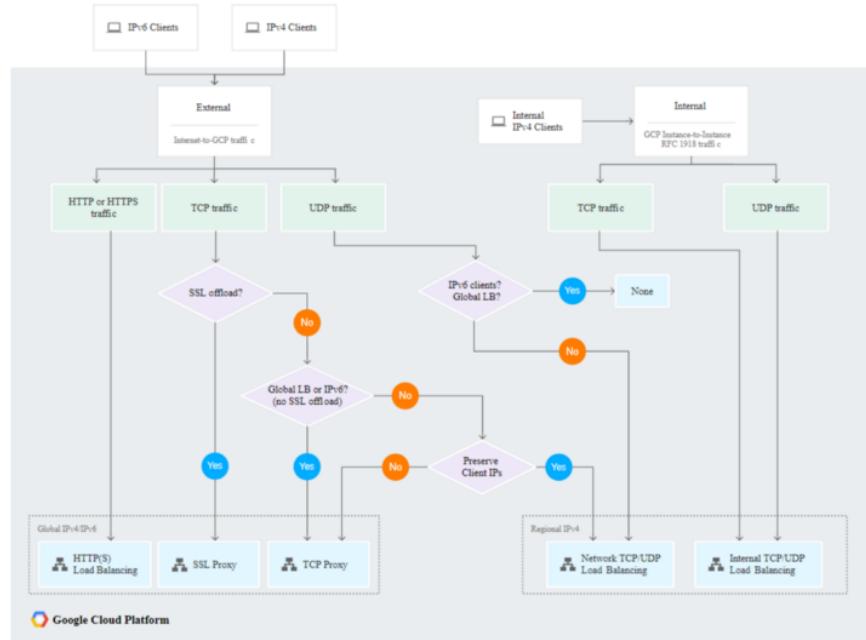
Since there are more than one load balancing options available it is very important for you to decide which one best fits your need.

***It is not an instance or device based, so you do not need to manage a physical load balancing infrastructure.***

The selection should be based on whether you want load balancing for

- Global or regional load balancing
- External or internal load balancing
- based on traffic type like HTTP, HTTPS, FTP

After you determine whether you need global or regional load balancing, external or internal load balancing, and what traffic type your load balancers must handle, use the following flowchart to determine which load balancers are available for your client, protocol, and network configuration.



reference: <https://cloud.google.com/load-balancing/images/choose-lb.svg>

Below are the types of load balances and options

Load balancer	Traffic type	Global/Regional	External/Internal	External Ports for Load Balancing
HTTP(S)	HTTP or HTTPS	Global	External	HTTP on 80 or 8080; HTTPS on 443
SSL Proxy	TCP with SSL offload	Global	External	25, 43, 110, 143, 195, 443, 465, 587, 700, 993, 995, 1883, and 5222
TCP Proxy	TCP without SSL offload. Does not preserve client IP addresses	Global	External	25, 43, 110, 143, 195, 443, 465, 587, 700, 993, 995, 1883, 5222
Network TCP/UDP	TCP/UDP without SSL offload. Preserves client IP addresses.	Regional	External	Any
Internal TCP/UDP	TCP or UDP	Regional	Internal	Any

reference: <https://cloud.google.com/load-balancing/docs/choosing-load-balancer>

## Highly Available Global DNS Network



Cloud DNS

Cloud DNS

Google Cloud DNS is scalable, reliable and managed authoritative Domain Naming System service running on the same infrastructure as Google. It has low latency, high availability and is a cost-effective way to make your application and services available to the users.

Cloud DNS translates requests for domain names like www.google.com into IP addresses like 74.125.29.101.



Cloud DNS

Cloud DNS is programmable and you can manage millions of zones and records using simple user interface, command line interface or API.

**100% Availability and Low Latency**

Use Google's infrastructure for **production quality, high volume authoritative DNS serving**. Your users will have reliable, low-latency access to Google's infrastructure from anywhere in the world using our network of Anycast name servers. Our SLA promises 100% availability of our Authoritative Name Servers.

**Automatic Scaling**

Cloud DNS can scale to large numbers of DNS zones and records. You can **reliably create and update millions of DNS records**. Our name servers automatically scale to handle query volume without any intervention from you.

**Cost Effective Pricing Tiers**

Cloud DNS is a simple, cost effective alternative to hosting your own DNS servers on premises or using other third party DNS services. For customers with more than 10,000 zones, our highest volume **pricing tier** lowers the cost of ownership for large organizations operating DNS infrastructure at scale.

reference: <https://cloud.google.com/dns/>

### CLOUD DNS FEATURES

Reliable, resilient, low latency DNS serving from Google's worldwide network

**Authoritative DNS Lookup**  
Cloud DNS translates requests for domain names like www.google.com into IP addresses like 74.125.29.101.

**Fast Anycast Name Servers**  
Cloud DNS uses our global network of [Anycast](#) name servers to serve your DNS zones from redundant locations around the world, providing high availability and lower latency for your users.

**Scalability and Availability**  
Cloud DNS can support a very large number of zones and DNS records per zone. Contact us if you need to manage millions of zones and DNS records. Our SLA promises 100% availability of our Authoritative Name Servers.

**Zone and Project Management**  
Create managed zones for your project, then add, edit and delete DNS records. You can control permissions at a project level, and monitor your changes as they propagate to DNS name servers.

**Manage through API and Web UI**  
You can manage DNS records using the Google Cloud Platform Console. Or, try our easy to use, scriptable 'gcloud' command-line tool to manage your records. You can also access the fully-featured REST API to create your own customized DNS interface.

reference: <https://cloud.google.com/dns/>

## Configuring Cloud DNS

### Before you begin

The Google Cloud DNS API requires that you create a Google Cloud DNS project and enable the Cloud DNS API.

If you are creating an application that will use the REST API, you will also need to create an OAuth 2.0 client ID.

1. If you don't already have one, sign up for a Google account.
2. Enable the Google Cloud DNS API in the GCP Console. You can choose an existing Compute Engine or App Engine project, or you can create a new project.
3. If you need to make requests to the REST API, you will need to create an OAuth 2.0 ID: Setting up OAuth 2.0.
4. Note the following information in the project that you will need to input in later steps:
  - The client ID ( `xxxxxx.apps.googleusercontent.com` ).
  - The project ID that you wish to use. You can find the ID at the top of the **Overview** page in the GCP Console. You could also ask your user to provide the project name that they want to use in your app.

If you have not run the `gcloud` command-line tool previously, you will need to run the following command to specify the project name and authenticate with the GCP Console:

```
gcloud auth login
```

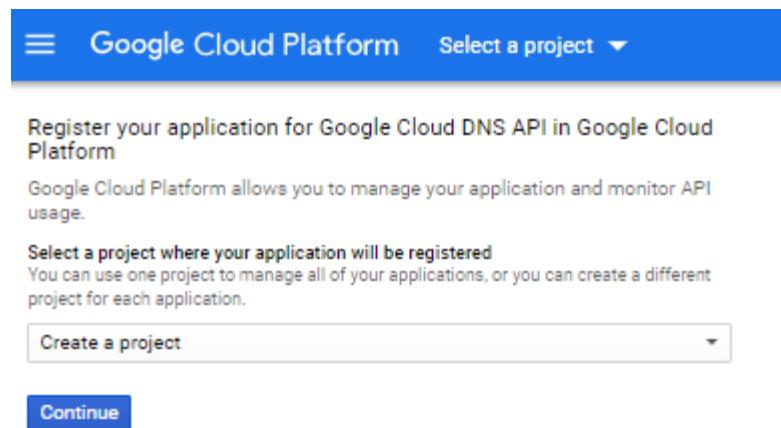
You can also specify the `--project` parameter for a command to operate against a different project for that invocation.

Working in a Cloud DNS may seem a bit different than traditional DNS because you have to understand behind the concept before doing anything in Cloud DNS.

### Before we begin

Google cloud DNS API requires that you create Google Cloud DNS project and enable DNS API.

To do this, go to dashboard, select Network Services and then **Cloud DNS**



Add or link Application to use in Cloud DNS

## Creating managed zones

When you get started with Cloud DNS API, you will need to create a managed zone to contain DNS record. A managed zone is always connected to your cloud project.

*Note that when you create a zone, the new zone won't be used until you update your domain registration, or explicitly point some resolver at, or directly query, one of your zone's name servers.*

```
gcloud dns managed-zones create \
    --dns-name="example.com." \
    --description="A zone" "myzonename"
```

where `[KEY] : [VALUE]` is an arbitrary key: value pair, such as `Dept:Marketing` or `Project:project1`. The `--labels` flag is not required for this command.

In the cloud console,

## ← Create a DNS zone

A DNS zone is a container of DNS records for the same DNS name suffix. In Cloud DNS, all records in a managed zone are hosted on the same set of Google-operated authoritative name servers. [Learn more](#)

If you don't have a domain yet, purchase one through [Google Domains](#).

Zone name [?](#)

DNS name [?](#)

DNSSEC [?](#)

Description (Optional)

Equivalent [REST](#) or [command line](#)

## Updating managed zones

Once you have created a managed zone to contain your DNS records, you may want to update some of its properties. Currently, you can only update the description and DNSSEC configuration.

To update a zone, you must provide the zone resource name (which cannot contain `.` —as opposed to the DNS name, which does) and the updated information associated with the zone:

```
gcloud dns managed-zones update --description="My zone"  
"myzonename"
```

You can also go to the console and tick the options to apply to the current project.

## Listing managed zones

To list all of your zones within a project:

```
gcloud dns managed-zones list
```

## Getting managed zone details

To get details about your managed zone, such as if you need to look up the associated name servers:

```
gcloud dns managed-zones describe "myzonename"
```

## Deleting managed zones

To delete a zone, provide the zone name to the delete command:

```
gcloud dns managed-zones delete "myzonename"
```

Note that only empty zones can be deleted. An empty managed-zone has only SOA and NS record-sets. You can easily empty a zone using the import command as follows:

```
touch empty-file
gcloud dns record-sets import -z "myzonename" --delete-all-existing empty-file
rm empty-file
```

## Adding and updating labels for managed zones

You can add labels to a managed zone, and you can remove existing labels.

## Add labels when you create a managed zone

```
gcloud dns managed-zones create \
--dns-name="example.com." \
--labels [KEY]:[VALUE] \
--description="A zone" "myzonename"
```

## Add labels to an existing managed zone

This command adds a label to an existing managed zone.

```
gcloud dns managed-zones update \
--labels [KEY]:[VALUE],[[KEY]:[VALUE]] \
"myzonename"
```

## Update values of label key: value pairs

This command update the `value` of an existing key:value label pair. If the `key` does not already exist, a new key: value pair is created.

```
gcloud dns managed-zones update \
--update-labels [KEY]:[VALUE],[[KEY]:[VALUE]] \
"myzonename"
```

## Remove label key: value pairs

This command removes the specified key: value label pair(s).

```
gcloud dns managed-zones update \
--remove-labels [KEY]:[VALUE],[[KEY]:[VALUE]] \
"myzonename"
```

## Clear all label key-value pairs

This command clears all labels.

```
gcloud dns managed-zones update \
--clear-labels \
"myzonename"
```

Here I will try to configure DNS server for the domain I have registered. Some of the tasks in configuring Cloud DNS are

### Managing Zones

A managed zone is the container for all of your DNS records that share the same domain name, for example, `example.com`. Managed zones are automatically assigned a set of name servers when they are created to handle responding to DNS queries for that zone. A managed zone has quotas for the number of resource records that it can include.

### Managing Records

Managing DNS records for the Google Cloud DNS API involves sending change requests to the API. These changes consist of additions and deletions to your resource record sets collection. You can easily send the desired changes to the API using the `import`, `export`, and `transaction` commands, as described below.

### Importing and exporting record-sets

You can use `import` and copy record-sets into and out of a managed zone. The formats you can import from and export to are either BIND zone file format, or YAML records format.

To import record-sets, you use the `dns record-sets import` command. The `--zone-file-format` flag tells `import` to expect a BIND zone formatted file. If you omit this flag, `import` expects a YAML formatted records file:

```
gcloud dns record-sets import -z=examplezonename \
--zone-file-format path-to-example-zone-file
```

**Note:** Some DNS implementations and providers export BIND zone files without final periods on domain name data in CNAME, MX, PTR, and other records. In zone files Google Cloud DNS follows RFC standards and interprets all domain names without a final period as relative to the DNS name of the zone, so importing the following MX records into a zone with the DNS name `example.com` results in identical (and probably undesired) records for both:

```
in.smtp          IN MX 5 gmail-smtp-in.l.google.com
in.smtp.example.com. IN MX 5 gmail-smtp-
in.l.google.com.example.com.
```

Check your zone files to ensure all names that need them to have final periods before importing them.

To export record-sets, you use the `dns record-sets export` command. Use the `--zone-file-format` flag to tell `export` to export the record-sets into a BIND zone formatted file. If you omit this flag, `export` exports the record-sets into a YAML formatted records file:

```
gcloud dns record-sets export -z=examplezonename \
--zone-file-format example.zone
```

## Migrating to Cloud DNS

Cloud DNS supports the migration of an existing DNS domain from another DNS provider to Cloud DNS. This procedure describes how to complete the necessary steps: creating a managed zone for your domain, importing your existing DNS configuration, and updating your registrar's name service records.

### Create a managed zone

To migrate an existing domain, first create a managed zone to contain your DNS records. Note that when you create a zone, the new zone won't be used until you update your domain registration, explicitly

point some resolver at it, or directly query one of your zone's name servers.

To create a zone, provide the DNS zone name, a description, and a name to identify the zone:

```
gcloud dns managed-zones create --dns-name="example.com." --  
description="A zone" "examplezonename"
```

## Export your DNS configuration from your existing provider

Consult your provider's documentation to see how to export your zone file. Cloud DNS supports the import of zone files in BIND or YAML records format.

For example:

- For Dyn, see Download Your Zone File.
- AWS Route 53 does not support export. Instead, you can use the open source cli53 tool.

## Import the record set

Once you have the exported file from your other provider, you can use the `gcloud dns record-sets import` command to import it into your managed zone.

To import record-sets, you use the `dns record-sets import` command. The `--zone-file-format` flag tells `import` to expect a BIND zone formatted file. If you omit this flag, `import` expects a YAML-formatted records file:

```
gcloud dns record-sets import -z=examplezonename --zone-  
file-format path-to-example-zone-file
```

**Caution:** When importing record sets, if your zone file contains SOA records, you must use the `--delete-all-existing` flag to replace the SOA records provided by Cloud DNS. Otherwise, the update will fail, since the imported records will conflict with the pre-existing Cloud DNS records. **Note:** Some DNS implementations and providers export BIND zone files without final periods on domain name data in CNAME, MX, PTR, and other records. In zone files Cloud DNS follows RFC standards and interprets all domain names without a final period as relative to the DNS name of the zone, so importing the following MX records into a zone with the DNS name `example.com` results in identical (and probably undesired) records for both:

```
in.smtp          IN MX 5 gmail-smtp-in.l.google.com
    in.smtp.example.com. IN MX 5 gmail-smtp-
    in.l.google.com.example.com.
```

Check your zone files to ensure all names that need them to have final periods before importing them.

## Verify DNS propagation

You can use the Linux `watch` and `dig` commands to monitor and verify that your changes have been picked up by the Cloud DNS name servers. Note that `watch` and `dig` are not `gcloud` commands and are not used with the `gcloud` prefix. On other operating systems, you might need to install the `watch` and `dig` commands.

1. Look up your zone's Cloud DNS name servers:

- `gcloud dns managed-zones describe examplezonename`

You will see output that looks something like this:

- `nameServers:—ns-cloud-a1.googledomains.com.—ns-cloud-a2.googledomains.com.—ns-cloud-a3.googledomains.com.—ns-cloud-a4.googledomains.com.`

Check if the records are available on the name servers. Replace `your_zone_nameserver` with one of the name servers returned when you ran the previous command.

- `watch dig example.com @your_zone_nameserver`

Once you see your change, press `Ctrl-C` to exit.

The `watch` command runs the `dig` command every 2 seconds by default. You can use this command to determine when your authoritative name server picks up your change, which should happen within 120 seconds.

## Update your registrar's name server records

Log into your registrar provider and change the name server records to point to the name servers you saw in the prior step. At the same time, make a note of the time to live (TTL) your registrar has set on the records. That will tell you how long you have to wait before the new name servers will begin to be used.

## Wait for changes, then verify

To see the authoritative name servers for your domain on the Internet, run the following:

```
dig +short NS example.com
```

If the output shows that all changes have propagated, you're done. If not, you can check intermittently or you can automatically run the command every 2 seconds while you wait for the nameservers to change. To do that, run the following:

```
watch dig +short NS example.com
```

`Ctrl-C` exits the command.

## Fast, High Availability Interconnect



Cloud Interconnect

**Google Cloud Interconnect** allows Cloud platform customers to connect to Google via enterprise-grade connections with higher availability and/or lower latency than their existing Internet connections. Connections are offered by Carrier Interconnect service provider partners and may offer higher SLAs than standard Internet connections. Google also supports direct connections to its network through direct peering. Customers who cannot meet Google at its peering locations, or do not meet peering requirements, may benefit from Carrier Interconnect.

Choosing a network connection option	INTERCONNECT	PEERING
Different applications and workloads require different network connectivity solutions. Google supports multiple ways to connect your infrastructure to Google Cloud Platform.	Direct access to RFC1918 IPs in your VPC – with SLA	Access to Google public IPs only – without SLA
	Includes: <ul style="list-style-type: none"><li>• Dedicated Interconnect</li><li>• Partner Interconnect</li><li>• IPsec VPN</li></ul>	Includes: <ul style="list-style-type: none"><li>• Direct Peering</li><li>• Carrier Peering</li></ul>

reference: <https://cloud.google.com/interconnect/>

## Interconnect Options



### Dedicated Interconnect

If you would like to extend your data center network into your Google Cloud projects, Dedicated Interconnect offers enterprise-grade connections to GCP. This solution allows you to directly connect your on-premises network to your GCP VPC. You must meet Google at one of our supported locations.

Useful to connect to your VPC, and in hybrid environments, to extend your corporate data center's IP space into the Google cloud, or for high-bandwidth traffic (greater than 2Gbps), for example when transferring large data sets.

Dedicated Interconnect can be configured to offer a 99.9% or a 99.99% uptime SLA. Please see the [Dedicated Interconnect documentation](#) for details on how to achieve these SLAs.



### Partner Interconnect

You can also extend your data center network into your Google Cloud projects through the service providers you know and love, Partner Interconnect offers enterprise-grade connections similar to Dedicated Interconnect. This solution allows you to add connectivity from your on-premises network to your GCP VPC through one of Google Cloud's many [service provider partners](#).

Partner Interconnect gives you bandwidth options from 50Mbps - 100Gbps allowing you to connect to your VPC and to extend your corporate data center's IP space into the Google cloud by choosing the bandwidth that works best for your needs. This allows you to work with our partners to get similar SLA options as provided by Dedicated Interconnect when you are not able to meet us at one of our dedicated interconnect locations.

Please see the [Partner Interconnect documentation](#) for details on how to create a Partner Interconnect in your GCP Project.



### IPsec VPN

Google Cloud VPN securely connects your on-premises network to your GCP Virtual Private Cloud (VPC) network through an [IPsec VPN](#) connection. Traffic traveling between the two networks is encrypted by one VPN gateway, then decrypted by the other VPN gateway. This protects your data as it travels over the Internet.

Useful to connect to your VPC over the public internet for low volume data connections.

reference: <https://cloud.google.com/interconnect/>

## Peering Connection Options



### Direct Peering

If you require access to Google and Google Cloud properties and can satisfy Google's [peering requirements](#), Direct Peering is the solution. Direct peering does not have an SLA.

Useful to connect directly to Google, and to save up to 67% on egress fees compared to VPN or public access over the Internet.



### Carrier Peering

If you require access to Google public infrastructure and cannot satisfy Google's peering requirements, you can connect via a [Carrier Peering partner](#). Carrier Peering does not have an SLA.

Useful if you like the benefits of Direct Peering, but are unable to meet the peering requirements without a partner.

reference: <https://cloud.google.com/interconnect/>

Here is a side by side comparison of the Interconnect options.

CONNECTION	ACCESS TYPE	CAPACITY	COST	OTHER CONSIDERATIONS
<b>Dedicated Interconnect</b>				
Dedicated, direct connection to VPC networks	Internal IP addresses in RFC 1918 address space	10 Gbps for each link	Reduced egress costs, fee for each link and VLAN	Requires you to have a connection in a Google supported colocation facility, either directly or through a carrier
<b>Partner Interconnect</b>				
Dedicated Bandwidth, connection to VPC Network through a service provider	Internal IP Addresses in RFC 1918 address space	50Mbps - 10Gbps per connection	Reduced egress costs, fee for each VLAN attachment. For additional costs, contact your service provider	Service providers might have specific restrictions or requirements.
<b>IPsec VPN tunnel</b>				
Encrypted tunnel to VPC networks through the public Internet	Internal IP addresses in RFC 1918 address space	1.5-3 Gbps for each tunnel	Egress is billed the same as general network pricing + a fee for each tunnel	Requires a VPN device on your on-premises network

Here is a side by side comparison of the Peering options.

CONNECTION	ACCESS TYPE	CAPACITY	COST	OTHER CONSIDERATIONS
<b>Direct Peering</b>				
Dedicated, direct connection to Google's network	Public IP addresses	10 Gbps for each link	Settlement free peering, reduced cost for egress	Requires you to have a connection in a colocation facility, either directly or through a carrier provided wave service
<b>Carrier Peering</b>				
Peering through service provider to Google's public network ( <a href="#">list of partners</a> )	Public IP Addresses	Varies based on partner offering	Cost based on partner offering, reduced cost for egress	Requirements vary by partner

reference: <https://cloud.google.com/interconnect/>

## Content Delivery Network



Google Cloud CDN leverages Google's globally distributed edge caches to accelerate content delivery for websites and applications served out of Google Compute Engine. Cloud CDN lowers network latency, offloads origins, and reduces serving costs. Once you've set up HTTP(S) Load Balancing, simply enable Cloud CDN with a single checkbox.

### Content Delivery Network for Cloud Platform

Google Cloud CDN leverages Google's globally distributed edge points of presence to accelerate content delivery for websites and applications served out of Google Compute Engine and Google Cloud Storage. Cloud CDN lowers network latency, offloads origins, and reduces serving costs. Once you've set up HTTP(S) Load Balancing, simply enable Cloud CDN with a single checkbox.



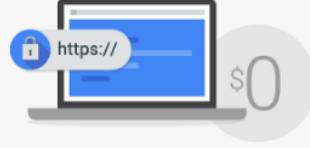
#### Global Reach



With caches at more than 90 sites around the world, Cloud CDN is always close to your users. That means faster page loads and increased engagement. And, unlike most CDNs, your site gets a single IP address that works everywhere, combining global performance with easy management — no regional DNS required.

**SSL Shouldn't Cost Extra**

The web is moving to HTTPS, and your cacheable content should, too. With Cloud CDN, you can secure your content using SSL/TLS for no additional charge.





Enable Cloud CDN

**Seamless Integration**

Cloud CDN is tightly integrated with the Google Cloud Platform. Enable Cloud CDN with a single checkbox and use the Google Cloud Platform Console and Stackdriver Logging for full visibility into the operation of your site.



**Media CDN Support**

Cloud CDN includes support for large objects (up to 5 TB) making it the ideal platform to deliver media and gaming to customers around the globe.

reference: <https://cloud.google.com/cdn/>

## CLOUD CDN FEATURES

<b>Anycast</b> Serve all your content from a single IP address with low latency worldwide.	<b>Invalidation</b> Take down cached content in minutes.
<b>HTTP/2</b> Supports the new, more efficient HTTP/2 protocol in addition to HTTP/1.0 and HTTP/1.1.	<b>Logging</b> Integrates with Stackdriver Logging to give you detailed information about each cache hit and miss.
<b>HTTPS</b> Provide your own SSL/TLS certificate to secure your content using a domain name of your choice.	<b>Origins</b> Serves content originating from Compute Engine VMs and Cloud Storage buckets. You can even mix and match multiple origins behind a single domain. External origin servers are not supported.

<https://cloud.google.com/cdn/>



