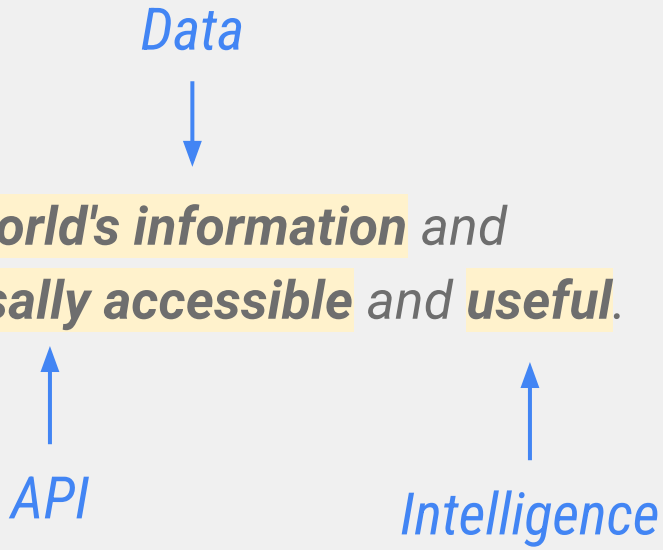

Google
Google Search
I'm Feeling Lucky

Google was born as a data company

Google's Mission Statement:

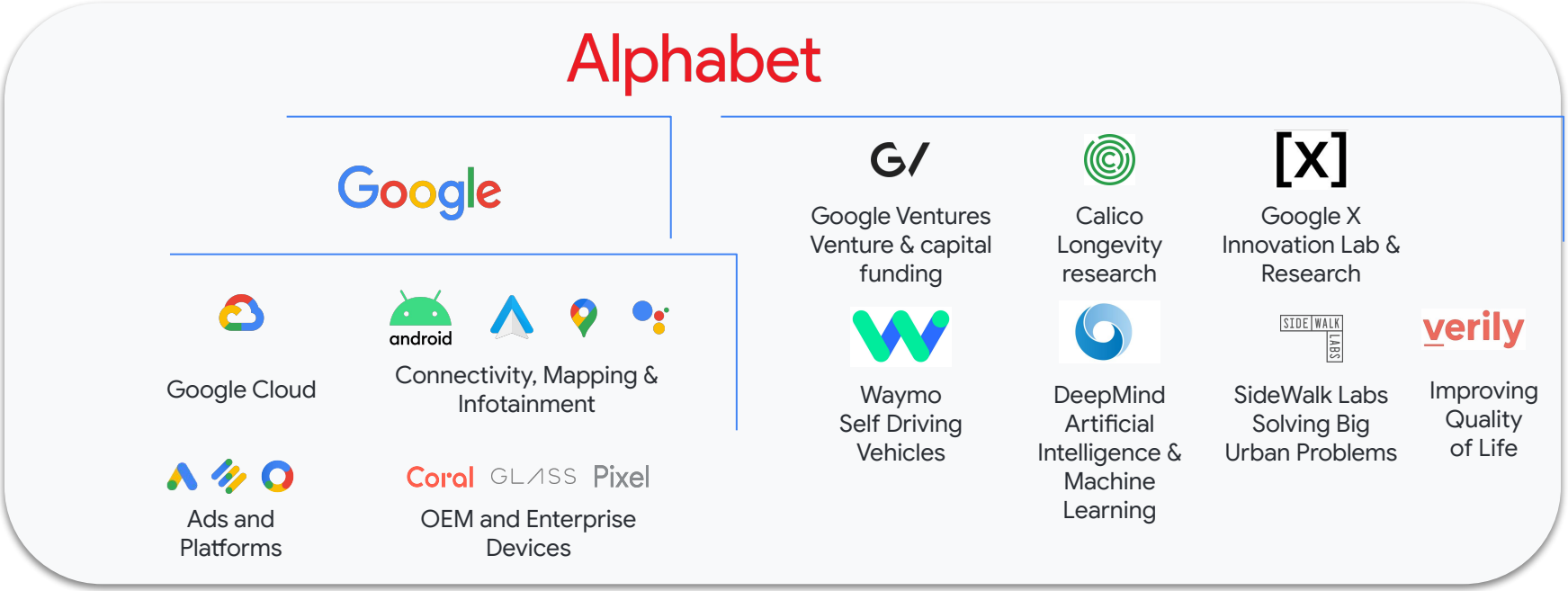
*Organize the **world's information** and make it **universally accessible** and **useful**.*



Google Cloud is part of the Alphabet family of companies

Google is one of the many interesting sister companies within Alphabet. When partnering with us, you gain access to the best of the Alphabet family.

Alphabet has a significant focus in the industries you serve, and Google is experienced in developing technologies from the ground up, designed with connected devices in mind.



Our products are how we innovate

1998 Search
Search ranking
Speech

2004 Gmail
Smart Reply
Spam classification

2005 Maps
Street View image
Popular times

2006 YouTube
Auto Caption
Better thumbnails

2008 Android
Keyboard input
Assistant

2008 Chrome
Hack detection
Translation

2012 Play
Recommendations
Developer mode

2012 Drive
Quick Access
Data Loss Prevention

2015 Photos
Photo search
Smart sharing

9
Billion User Applications

100%
Machine Learning Powered

Only Google Cloud: common infrastructure for data management

Same underlying architecture that powers YouTube, Search, Maps, and Gmail

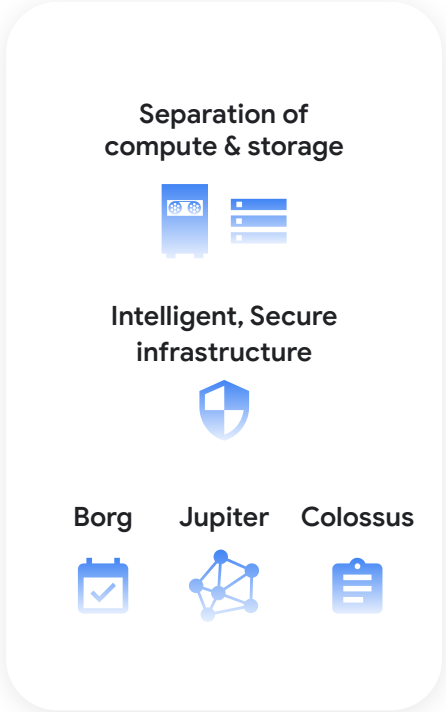
01 **Disaggregation of compute and storage:** Provides best-in-class workload isolation. Intelligent storage rebalances save time & cost.

02 **Next-generation file system:** Colossus manages, stores, and provides access to data for storage services. It enhances scalability & improves availability to handle our massive data needs.

03 **Google's global network:** Jupiter connects all of the servers in Google's data centers together, powering our distributed computing and storage systems.

04 **Scalable job scheduler:** Borg launches everything from compute to storage services to run hundreds of thousands of jobs, making computing much more efficient.

05 **Intelligent & secure infrastructure:** Secure core infrastructure designed, built, and operated to help prevent threats and help secure customer data.

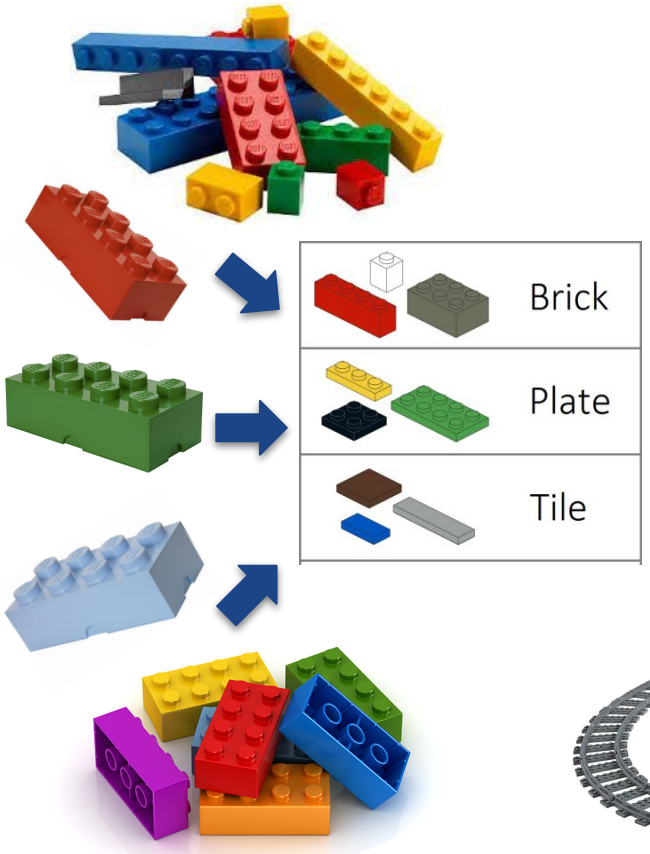


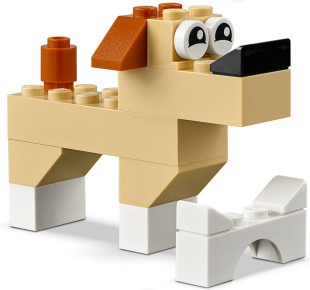
Google Cloud

Our mission

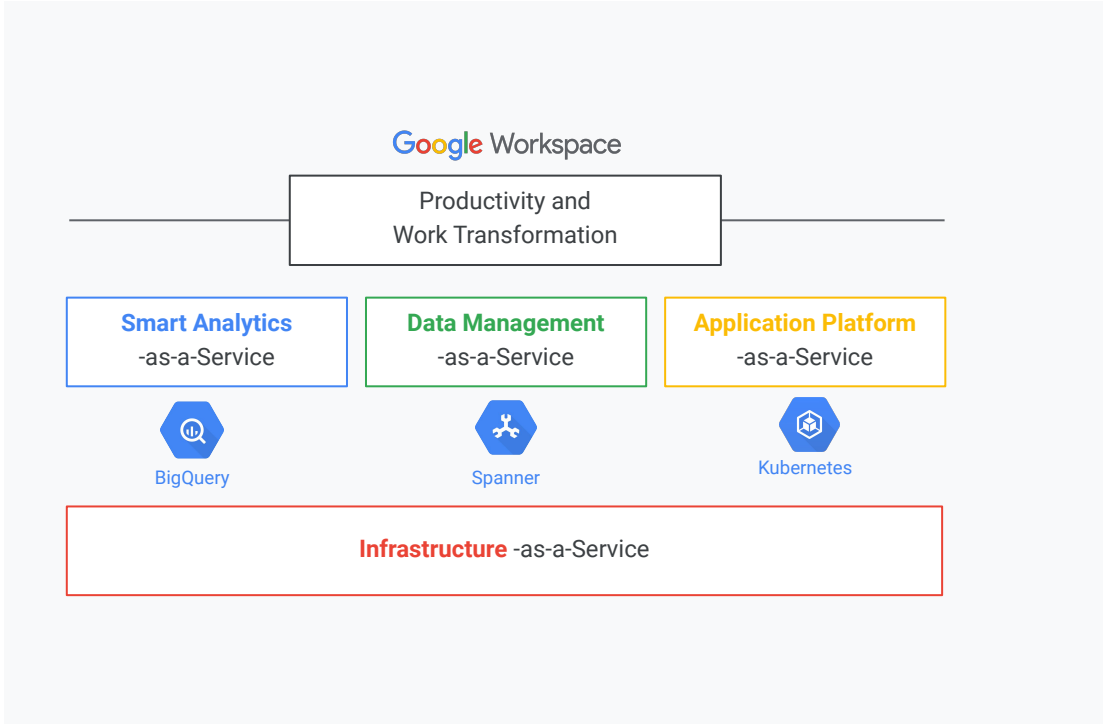
Productize Google's innovations to accelerate every organization's ability to digitally transform

From building blocks to solutions





Google Cloud provides the speed, scalability, and security to transform your day-to-day working

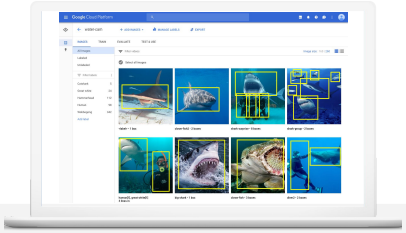


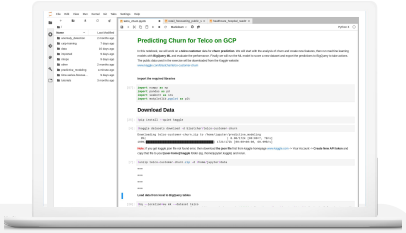
Google Cloud

Which capabilities to choose?

Design your workflow- AI for every level of expertise

Out of the box → DIY





Pre-trained APIs & AI Solutions

- Pre-trained
- No training data needed
- Get started right away
- Multiple modalities

BigQuery ML

- Descriptive and predictive modeling on structured data
- Hyper-parameter tuning
- Feature engineering
- Explainability
- Simple SQL code

AutoML Models in Vertex AI

- Predictive modeling on structured & unstructured data
- Hyper-parameter tuning
- Feature engineering
- Explainability
- No code

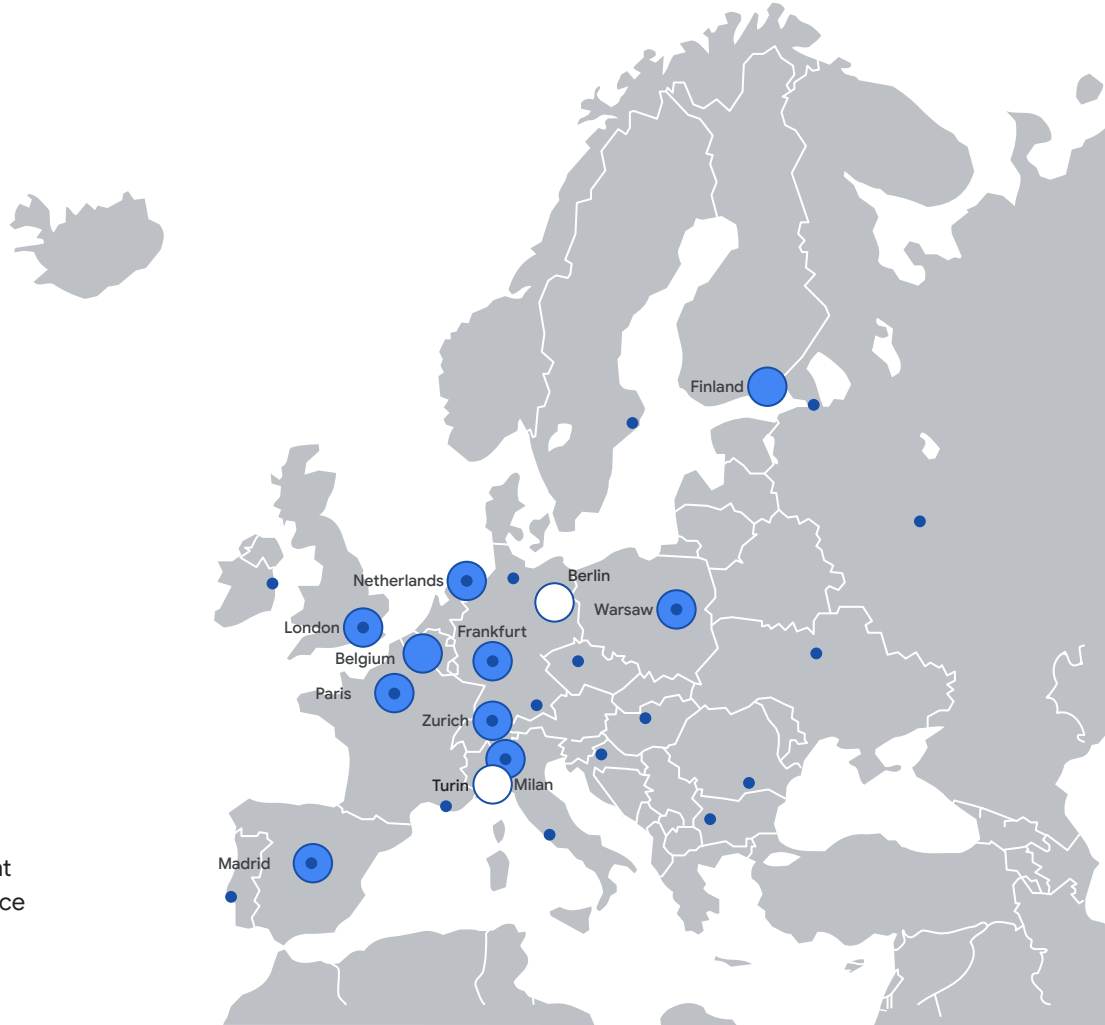
End-to-end AI with Vertex AI

- Custom models foundation
- MLops framework
- serverless training with hyperparameter tuning
- Explainability
- Custom code

Google Cloud Platform

Europe

13	39	64
Regions	Zones	PoPs



Current region with 3 zones

Future region with 3 zones

Edge point of presence

Why we can be proud of our Belgian Datacenters

15 YEAR ANNIVERSARY

- first data center outside the US;
- today we have 4 datacenters and are building a 5th and a 6th, more announcements to come soon;
- first onsite solar farm; onsite canal water treatment plant
- large offshore wind project in Belgium;
- piloting sustainable battery generators to replace diesel.

Google announces its biggest corporate purchase of renewable energy in history, including 92 MW energy deal in Belgium sealed with ENGIE

Google today announces its biggest corporate purchase of renewable energy in history. The purchase is made up of a 1,600-megawatt package of agreements and includes 18 new energy deals, of which one in Belgium together with ENGIE. Together, these deals will increase Google's worldwide portfolio of wind and solar agreements by more than 40%, to 5,500 megawatts–equivalent to the capacity of a million solar rooftops.

Google Cloud security differentiators

Purpose-Built Infrastructure

End-to-end provenance

Hardware-based tamper protection

Private encrypted global network

Security by Default

Encryption of data at rest and in transit

DDoS Protection

Infrastructure patching - no downtime

Real Transparency

Access Transparency

Key Access Justifications

Audit & compliance

Privacy Controls Expertise

Gmail Phishing and Email Protection

BeyondCorp

User Protection Services

Training Overview

Self paced labs

Hands-on learning experiences

20 - 120 min labs

16 Quests, c. 150 self-serve stand alone labs

On-demand

On-demand course offerings

8- 10 hour courses:
Mix of slides, labs, videos, quizzes

B2B & B2C offerings:
Used to scale learning

Classroom training

Instructor Led Training (ILT)

1 day to 4 week courses

Public schedule and private classes

Google Cloud Certifications

Complete course catalog

Google Cloud

IPv6 in GCP

Pieter Leys
Customer Engineer - Networking Specialist

Google Cloud

Agenda

01. GCP Networking Concepts
02. IPv6 in GCP Today
03. Move to IPv6-only
04. Q&A

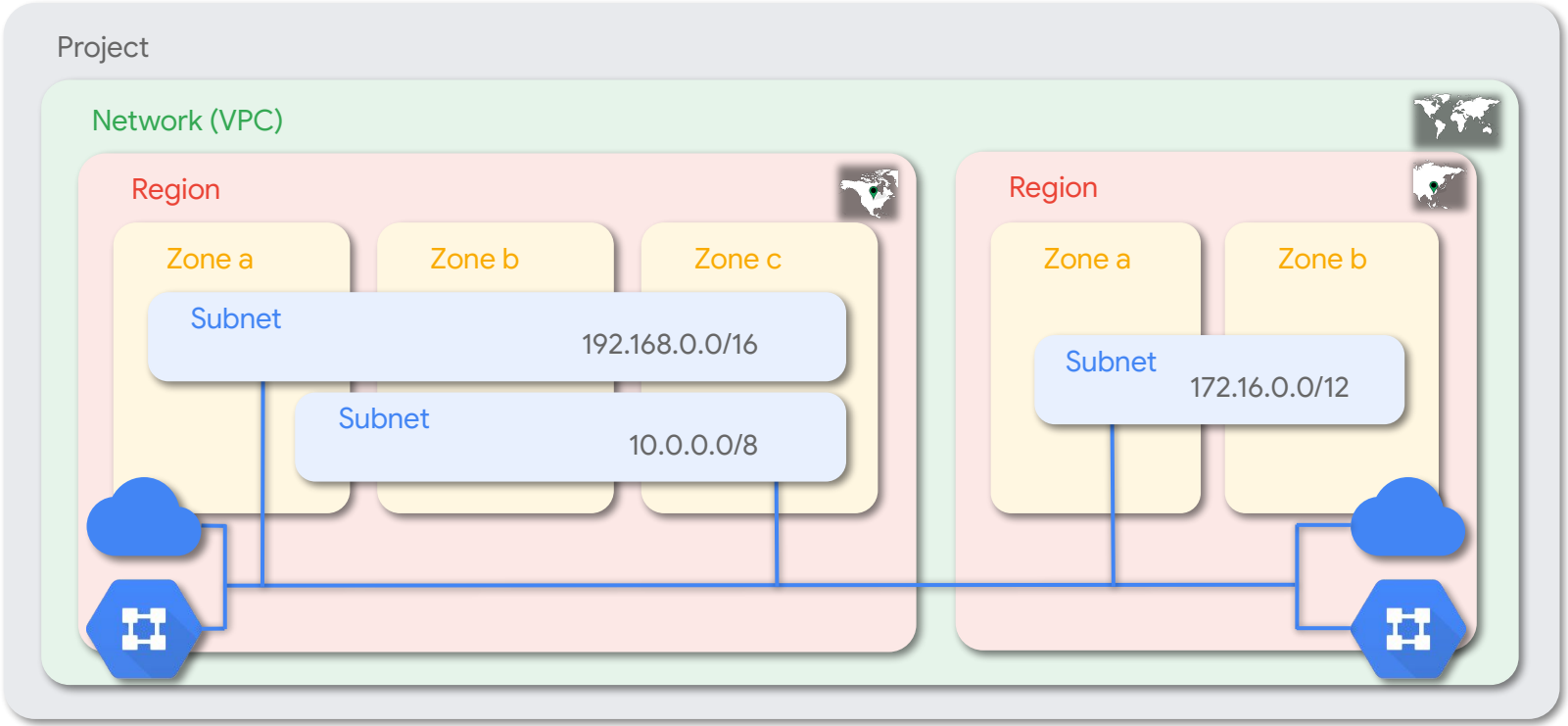
Google Cloud

GCP Networking Concepts

39 Regions,
1 Global VPC

Create workloads in any region globally, and manage them from anywhere through one Virtual Private Cloud -- with all the security and connectivity details handled for you.

VPCs and Subnets



VM Instance - IPv4 addressing

Internal IP

- Allocated from Subnet primary range
- Ephemeral (default) or static
- Multi-NIC support

plus optionally

External IP

- Allocated from Google IP ranges or BYOIP
- Ephemeral (default) or reserved
- Transparent to VM (1:1 NAT)

IPv6 in GCP Today

IPv6 addressing (Dual Stack)

Internal Connectivity

- Unique Local Address (ULA)
- Range `fd20::/20`
- Per VPC /48 (uniqueness in GCP)
- Per Subnet /64
- Per VM /96 (First /128 via DHCPv6)

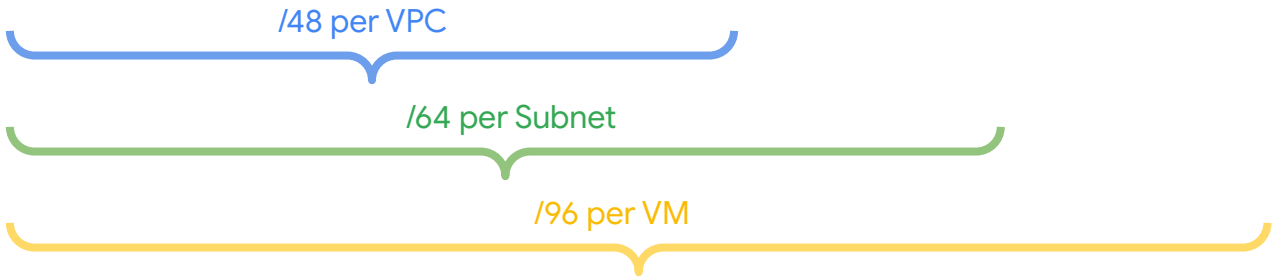
OR

External Connectivity

- Global Unicast Address (GUA)
- Range `2600:1900::/28`
- Per Subnet /64
- Per VM /96 (First /128 via DHCPv6)

VPC ULA range allocation

Bits	8	12	28	16	32	32
Field	ULA L-bit set `fd::/8`	VPC ULA `fd20::/20`	unique per VPC	Subnet range	VM range	flexible usage by VM



IPv6 addressing - Internal (ULA)

Creation of a VPC with a ULA prefix

```
gcloud compute networks create my-vpc \
   --subnet-mode=custom \
   --enable-ula-internal-ipv6 \
   --internal-ipv6-range fd20:17:1023::/48
```

Enable ULA on this VPC by allocating a /48 ULA range
A random ULA is allocated by default

(optional) Specify the /48 range yourself
This will fail if you select an already allocated range

Note: *constraints/compute.disableAllIpv6* and *constraints/compute.disableVpcExternalIpv6* in your Org Policy should be set to “false” in all examples

IPv6 addressing - Internal (ULA)

Creation of a VPC with a ULA prefix

```
admin_@cloudshell:~ (v6-council)$ gcloud compute networks describe my-vpc
autoCreateSubnetworks: false
creationTimestamp: '2023-10-14T02:56:12.775-07:00'
enableUlaInternalIpv6: true
id: '2105652430619794259'
internalIpv6Range: fd20:17:1023::/48
kind: compute#network
name: my-vpc
networkFirewallPolicyEnforcementOrder: AFTER_CLASSIC_FIREWALL
routingConfig:
  routingMode: REGIONAL
selfLink: https://www.googleapis.com/compute/v1/projects/v6-council/global/networks/my-vpc
selfLinkWithId: https://www.googleapis.com/compute/v1/projects/v6-council/global/networks/2105652430619794259
x_gcloud_bgp_routing_mode: REGIONAL
x_gcloud_subnet_mode: CUSTOM
```

IPv6 addressing - Internal (ULA)

Creation of a Subnet with Internal IPv6 access

```
gcloud compute networks subnets create subnet-1 \
  --network=my-vpc \
  --range=10.0.1.0/24 \
  --stack-type=IPV4_IPV6 \
  --ipv6-access-type=INTERNAL \
  --region=europe-west1
```

Configure subnet for Dual Stack (default IPV4)

Configure subnet for internal IPv6 access (ULA)

IPv6 addressing - Internal (ULA)

Creation of a Subnet with Internal IPv6 access

```
admin_@cloudshell:~ (v6-council)$ gcloud compute networks subnets describe subnet-1 --region=europe-west1
creationTimestamp: '2023-10-14T03:04:26.770-07:00'
fingerprint: gz46XmKagJE=
gatewayAddress: 10.0.1.1
id: '1215084987494684997'
internalIpv6Prefix: fd20:17:1023:3800:0:0:0:0/64
ipCidrRange: 10.0.1.0/24
ipv6AccessType: INTERNAL
kind: compute#subnetwork
name: subnet-1
network: https://www.googleapis.com/compute/v1/projects/v6-council/global/networks/my-vpc
privateIpGoogleAccess: false
privateIpv6GoogleAccess: DISABLE_GOOGLE_ACCESS
purpose: PRIVATE
region: https://www.googleapis.com/compute/v1/projects/v6-council/regions/europe-west1
selfLink: https://www.googleapis.com/compute/v1/projects/v6-council/regions/europe-west1/subnetworks/subnet-1
stackType: IPV4_IPV6
```

IPv6 addressing - Internal (ULA)

Creation of a VM in subnet

```
gcloud compute instances create vm-1 \
  --subnet=subnet-1 \
  --stack-type=IPV4_IPV6
```

Specify the Subnet (determines if intf gets ULA or GUA)

Configure VM Interface for Dual Stack

IPv6 addressing - Internal (ULA)

Creation of a VM in subnet

```
admin_@cloudshell:~ (v6-council)$ gcloud compute instances describe vm-1 --zone=europe-west1-b
...
- accessConfigs:
  - kind: compute#accessConfig
    name: external-nat
    natIP: 35.241.222.209
    networkTier: PREMIUM
    type: ONE_TO_ONE_NAT
  fingerprint: XCdM8miUFNo=
  internalIpv6PrefixLength: 96
  ipv6AccessType: INTERNAL
  ipv6Address: fd20:17:1023:3800:0:0:0:0
  kind: compute#networkInterface
  name: nic0
  network: https://www.googleapis.com/compute/v1/projects/v6-council/global/networks/my-vpc
  networkIP: 10.0.1.2
  stackType: IPV4_IPV6
  subnetwork: https://www.googleapis.com/compute/v1/projects/v6-council/regions/europe-west1/subnetworks/subnet-1
```

IPv6 addressing - External (GUA)

Creation of a Subnet with External IPv6 access

```
gcloud compute networks subnets create subnet-2 \
  --network=my-vpc \
  --range=10.0.2.0/24 \
  --stack-type=IPV4_IPV6 \
  --ipv6-access-type=EXTERNAL \
  --region=europe-west1
```

Configure subnet for Dual Stack (default IPV4)

Configure subnet for external IPv6 access (GUA)

IPv6 addressing - External (GUA)

Creation of a Subnet with External IPv6 access

```
admin_@cloudshell:~ (v6-council)$ gcloud compute networks subnets describe subnet-2 --region=europe-west1
creationTimestamp: '2023-10-14T03:09:10.711-07:00'
externalIpv6Prefix: 2600:1900:4010:3f7:0:0:0:0/64
fingerprint: jkas10eutJc=
gatewayAddress: 10.0.2.1
id: '814910467775911465'
ipCidrRange: 10.0.2.0/24
ipv6AccessType: EXTERNAL
kind: compute#subnetwork
name: subnet-2
network: https://www.googleapis.com/compute/v1/projects/v6-council/global/networks/my-vpc
privateIpGoogleAccess: false
privateIpv6GoogleAccess: DISABLE_GOOGLE_ACCESS
purpose: PRIVATE
region: https://www.googleapis.com/compute/v1/projects/v6-council/regions/europe-west1
selfLink: https://www.googleapis.com/compute/v1/projects/v6-council/regions/europe-west1/subnetworks/subnet-2
stackType: IPV4_IPV6
```

IPv6 addressing - External (GUA)

Creation of a VM in subnet

```
gcloud compute instances create vm-2 \
  --subnet=subnet-2 \
  --stack-type=IPV4_IPV6
```

Specify the Subnet (determines if intf gets ULA or GUA)

Configure VM Interface for Dual Stack

IPv6 addressing - External (GUA)

Creation of a VM in subnet

```
admin_@cloudshell:~ (v6-council)$ gcloud compute instances describe vm-2 --zone=europe-west1-b
...
  ipv6AccessConfigs:
  - externalIpv6: 2600:1900:4010:3f7:0:0:0:0
    externalIpv6PrefixLength: 96
    kind: compute#accessConfig
    name: external-ipv6
    networkTier: PREMIUM
    publicPtrDomainName: ''
    type: DIRECT_IPV6
  ipv6AccessType: EXTERNAL
  kind: compute#networkInterface
  name: nic0
  network: https://www.googleapis.com/compute/v1/projects/v6-council/global/networks/my-vpc
  networkIP: 10.0.2.2
  stackType: IPV4_IPV6
  subnetwork: https://www.googleapis.com/compute/v1/projects/v6-council/regions/europe-west1/subnetworks/subnet-2
```

Serving v6-only Internet clients

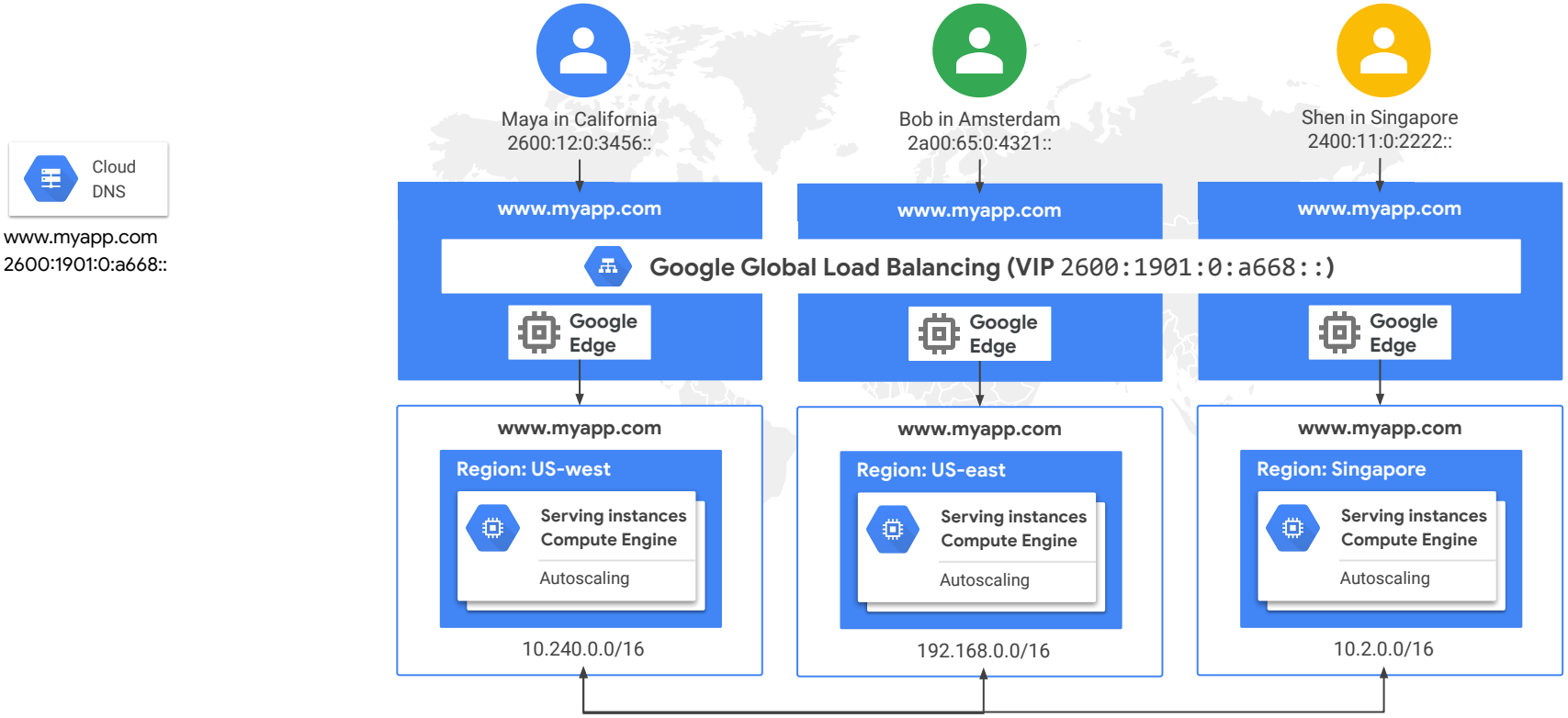
- Proxy IPv6 client connections to IPv4 backend services
- Global and regional external Load Balancers
  - Application Load Balancer
  - Proxy Network Load Balancer (SSL)
  - Proxy Network Load Balancer (TCP)

```
gcloud compute addresses create my-ipv6-vip \
  --global \
  --ip-version IPV6
```

Serving v6-only Internet clients

```
admin_@cloudshell:~ (v6-council)$ gcloud compute addresses describe my-ipv6-vip --global
address: '2600:1901:0:a668::'
addressType: EXTERNAL
creationTimestamp: '2023-10-15T03:27:10.021-07:00'
description: ''
id: '909809831765213329'
ipVersion: IPV6
kind: compute#address
labelFingerprint: 42WmSpB8rSM=
name: my-ipv6-vip
networkTier: PREMIUM
selfLink: https://www.googleapis.com/compute/v1/projects/v6-council/global/addresses/my-ipv6-vip
status: RESERVED
```

Serving v6-only Internet clients



IPv6 Services

Hybrid Connectivity	Interconnect Cloud VPN Cloud Router
Security Services	VPC Firewall Rules (Hierarchical) Firewall Policies Cloud Armor
Load Balancing	Global and Regional Proxy Load Balancers Passthrough load balancers
GKE	Dual-Stack Clusters DPv2 Observability Cloud DNS FQDN Network Policies
GCE	Dual-Stack Subnets Static IP reservations VPC Peering

Move to IPv6-only

Why v6-only workloads?

Drivers

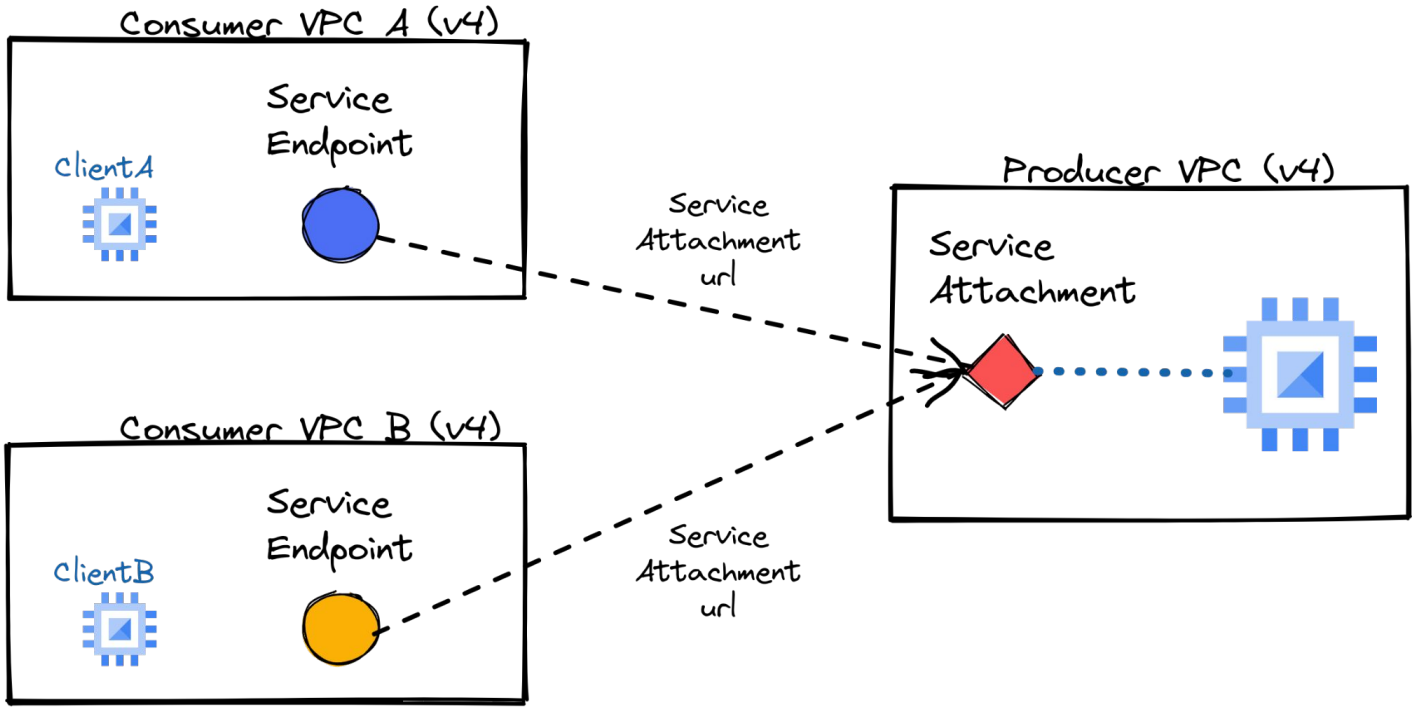
- Lack of **private** IPv4 space
  - Expanding into new (cloud) environments
  - 20+ years of fragmentation
  - Containers
  - exhausted other workarounds (non-RFC1918, CGN, Class E)
- Regulatory requirements or other policies/mandates
- Dual-stack creates two security/administrative perimeters per workload
- Avoid future problems, don't kick the can down the road..

  "*Can't run out of v4 addresses if you don't have any*"

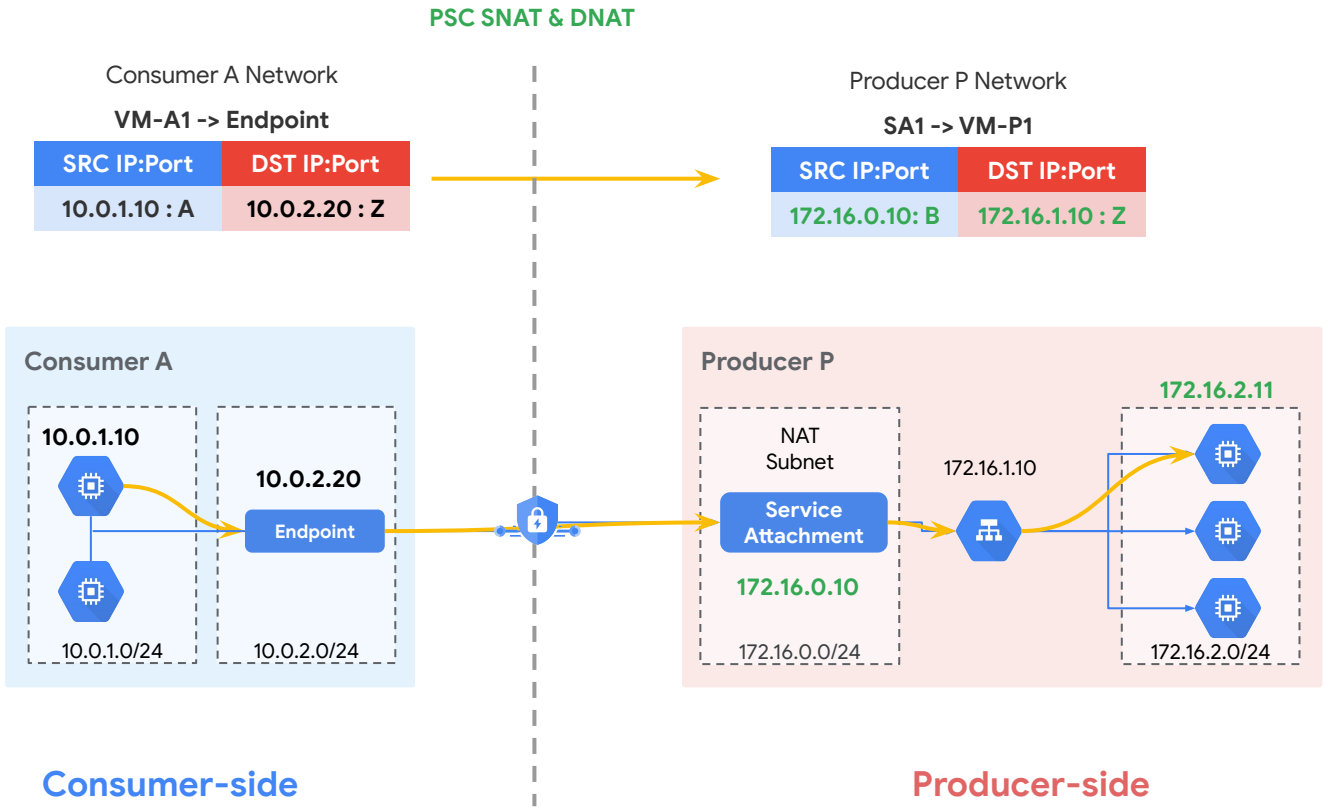
Transition Services for v6-only workloads

- Provide communication to public and private v4 workloads via a Gateway64 service
  - NAT64
  - DNS64
- Provide private communication to IPv4 managed services deployed in cloud and on-prem
  - PSC64 (Private Service Connect)

Private Service Connect (PSC44)

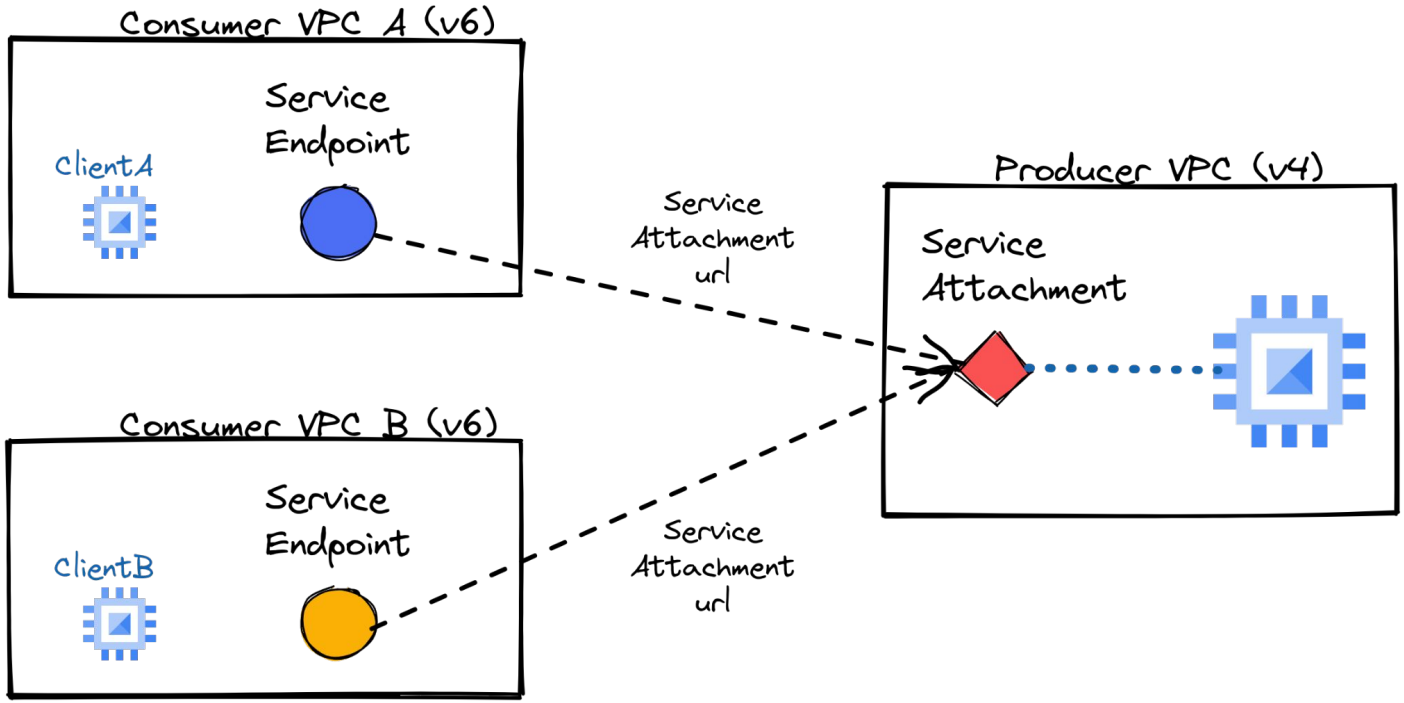


PSC - Life of a Packet



PSC64

Roadmap



Any Questions?