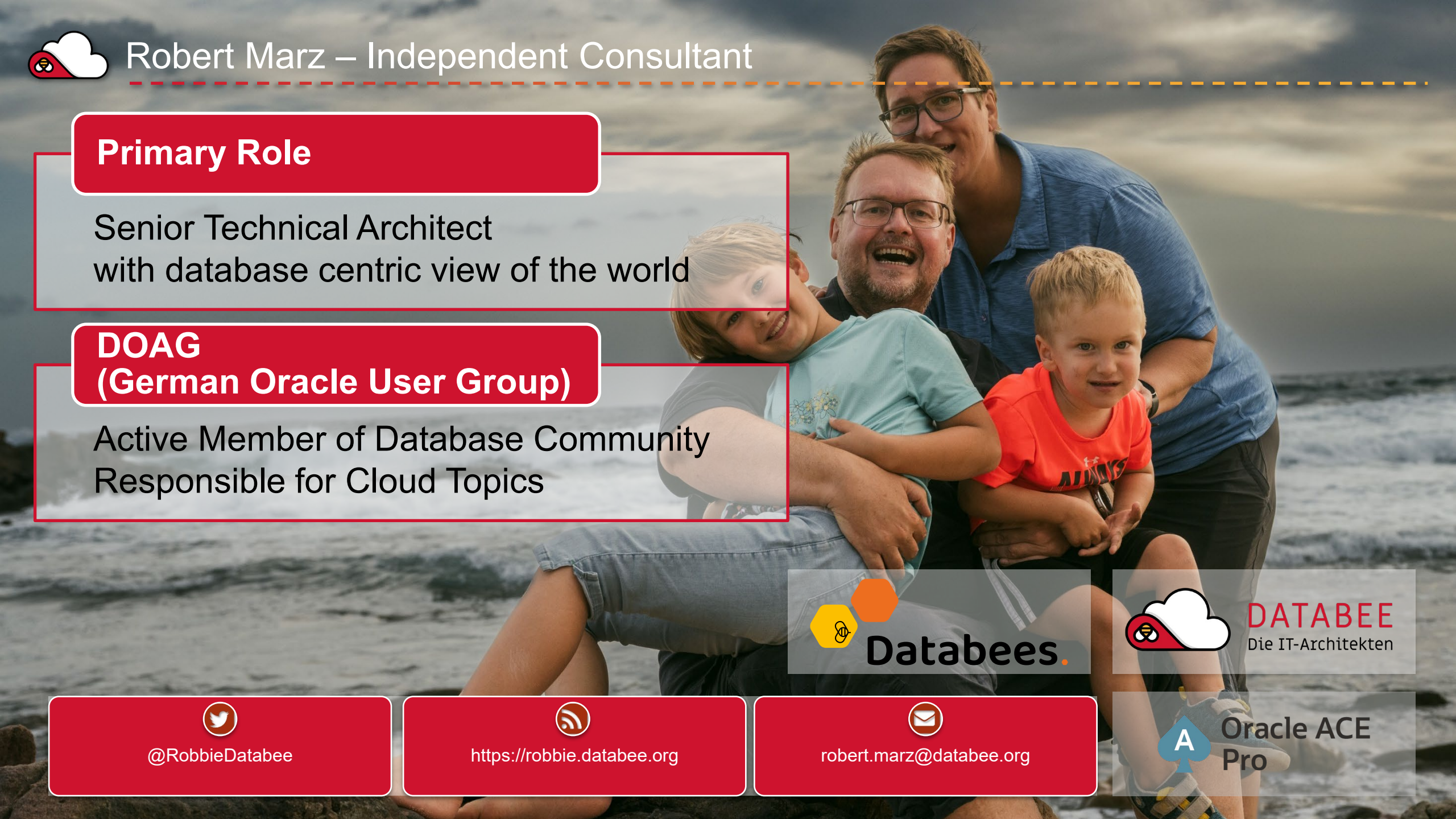
IPv6 in Public Clouds: Geht das überhaupt?

Stratus - Mittwoch, 13.12.2023 (15:00 - 15:45)

Robert Marz
DATABEE
Die IT-Architekten



Robert Marz – Independent Consultant

Primary Role

Senior Technical Architect
with database centric view of the world

DOAG (German Oracle User Group)

Active Member of Database Community
Responsible for Cloud Topics

Databees.

DATABEE
Die IT-Architekten

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IPv4 is Dead

IPv4 is dead (kindoff)

IPv4 is old

- IETF RFC 791 (September 1981)

IPv4 addresses are running out

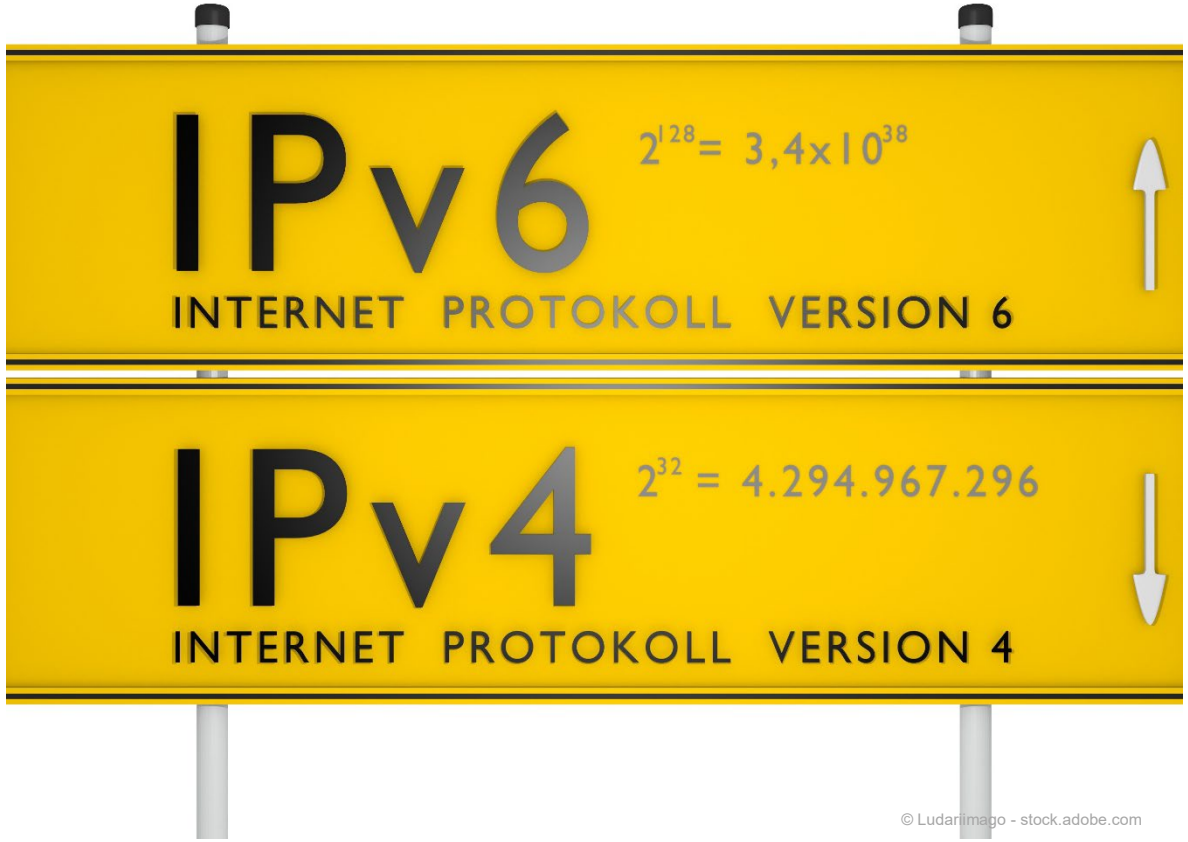
- 4 Billion unique addresses are not enough
- We know that for more than 30 years

Internet providers are almost empty

- Most private Home Connections and virtual all Mobile Connections are IPv6

However Corporate / Enterprise use

- Close to 100% IPv4



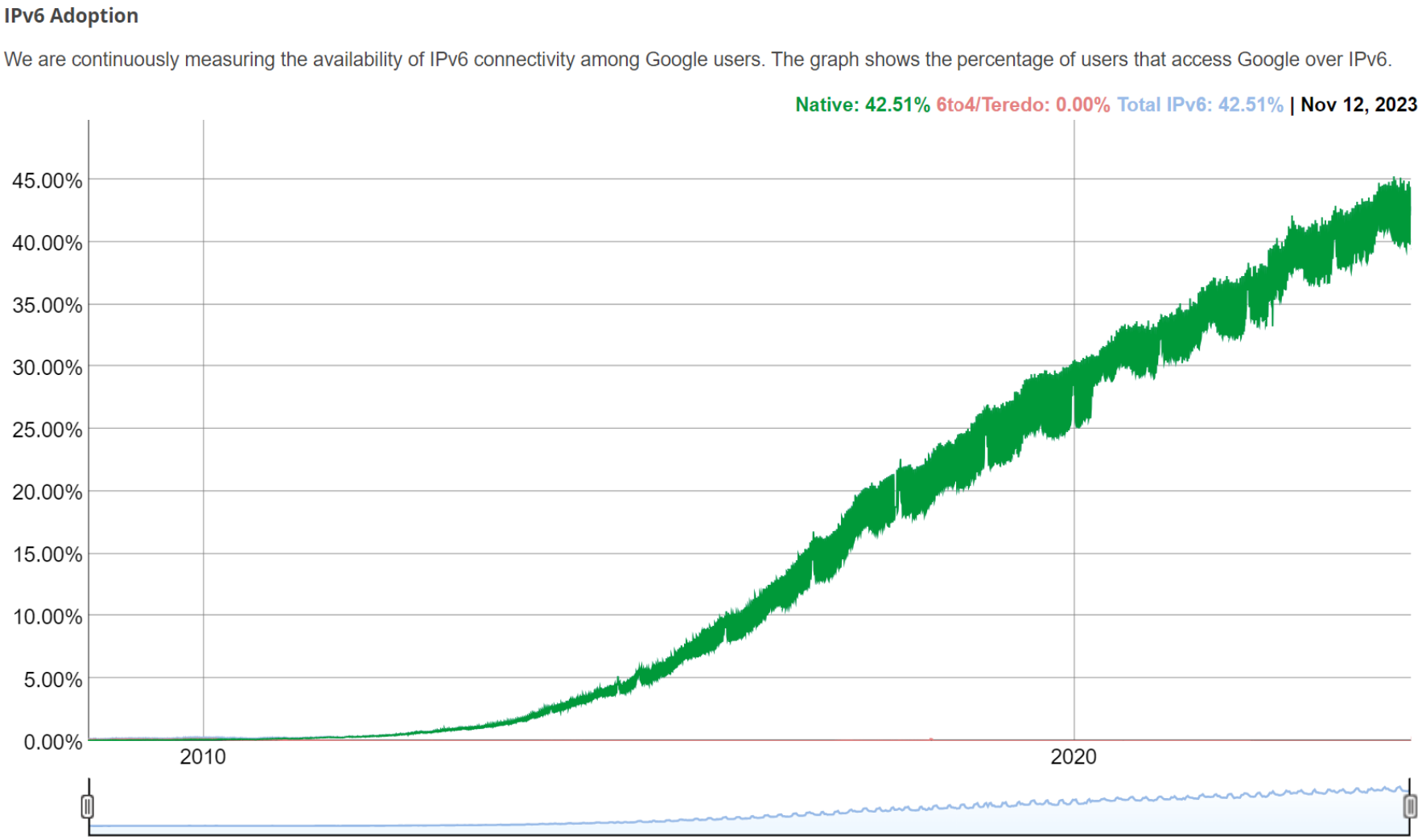
IPv4 in the Enterprise – alive by workarounds

Private IP Addresses

- 10.0.0.0/8
- 172.16.0.0/12
- 192.168.0.0/16

Network Address Translation (NAT)

IPv6 Adoption: Total

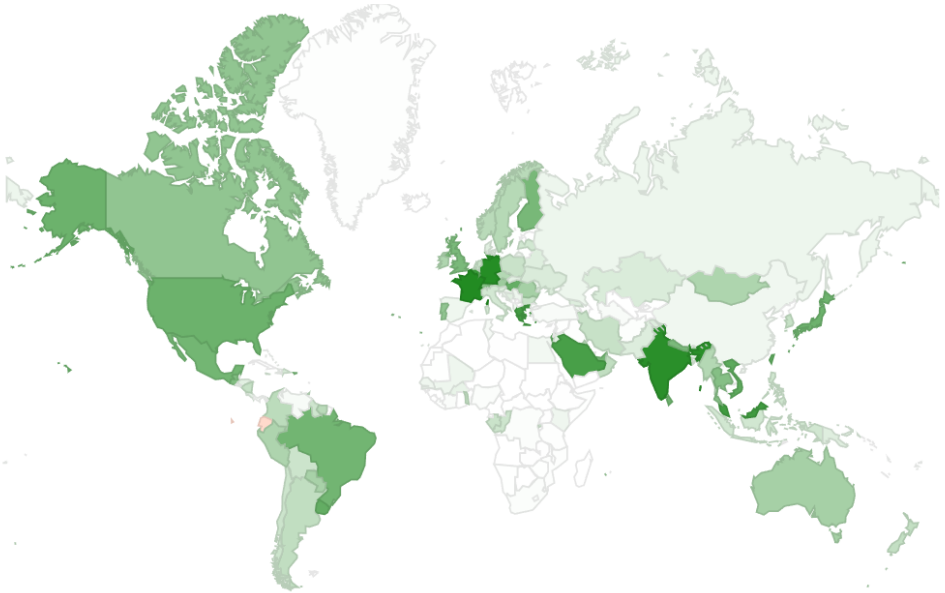


https://www.google.com/intl/en/ipv6/statistics.html#tab=ipv6-adoption (November, 15th 2023)

IPv6 Adoption: per Country - World

IPv6 Adoption | **Per-Country IPv6 adoption**

Per-Country IPv6 adoption



World | Africa | Asia | Europe | Oceania | North America | Central America | Caribbean | South America

The chart above shows the availability of IPv6 connectivity around the world.

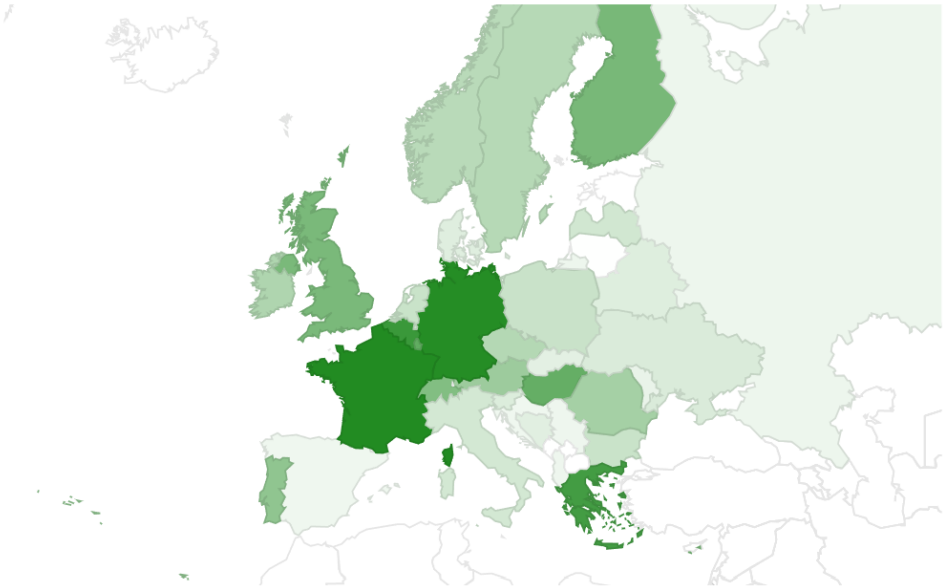
- Regions where IPv6 is more widely deployed (the darker the green, the greater the deployment) and users experience infrequent issues connecting to IPv6-enabled websites.
- Regions where IPv6 is more widely deployed but users still experience significant reliability or latency issues connecting to IPv6-enabled websites.
- Regions where IPv6 is not widely deployed and users experience significant reliability or latency issues connecting to IPv6-enabled websites.

https://www.google.com/intl/en/ipv6/statistics.html#tab=per-country-ipv6-adoption (November, 15th 2023)

IPv6 Adoption: per Country - Europe

IPv6 Adoption | **Per-Country IPv6 adoption**

Per-Country IPv6 adoption



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Why do the Cloud Hyperscaler still have enough IPv4 Addresses?

A couple of years ago

the big Cloud Provider made a lot of acquisitions

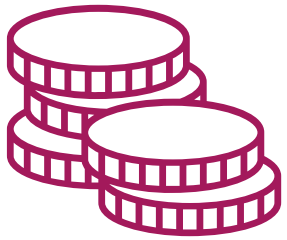
the main assets were their IPv4 Addresses

Adopt IPv6

IPv6 migration: What‘s holding you back?

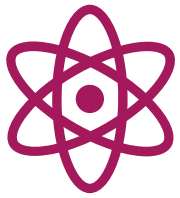
Never change a running system

IPv6 has no Killer-Feature



Learning and Training is hard and expensive

IPv6: Why start now?



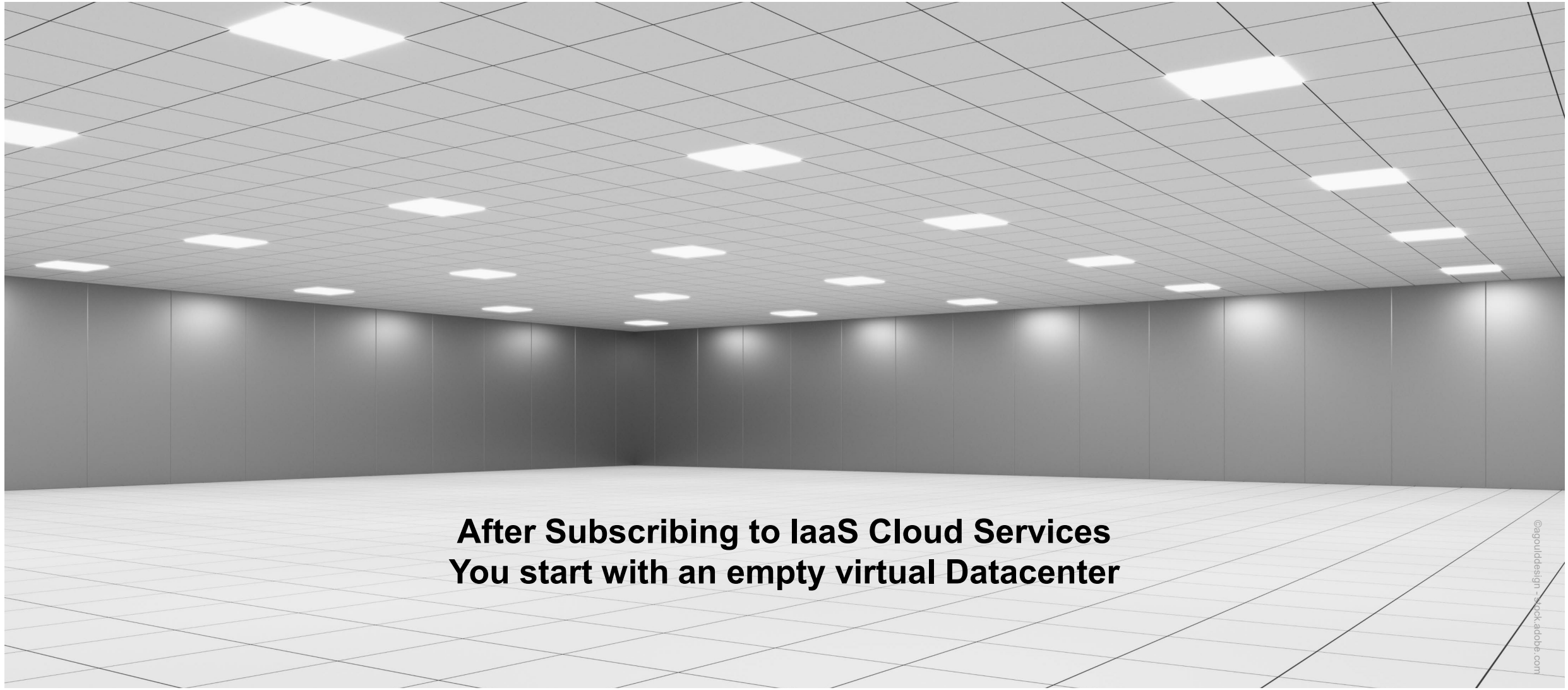
One day, you need to interface an IPv6 only service

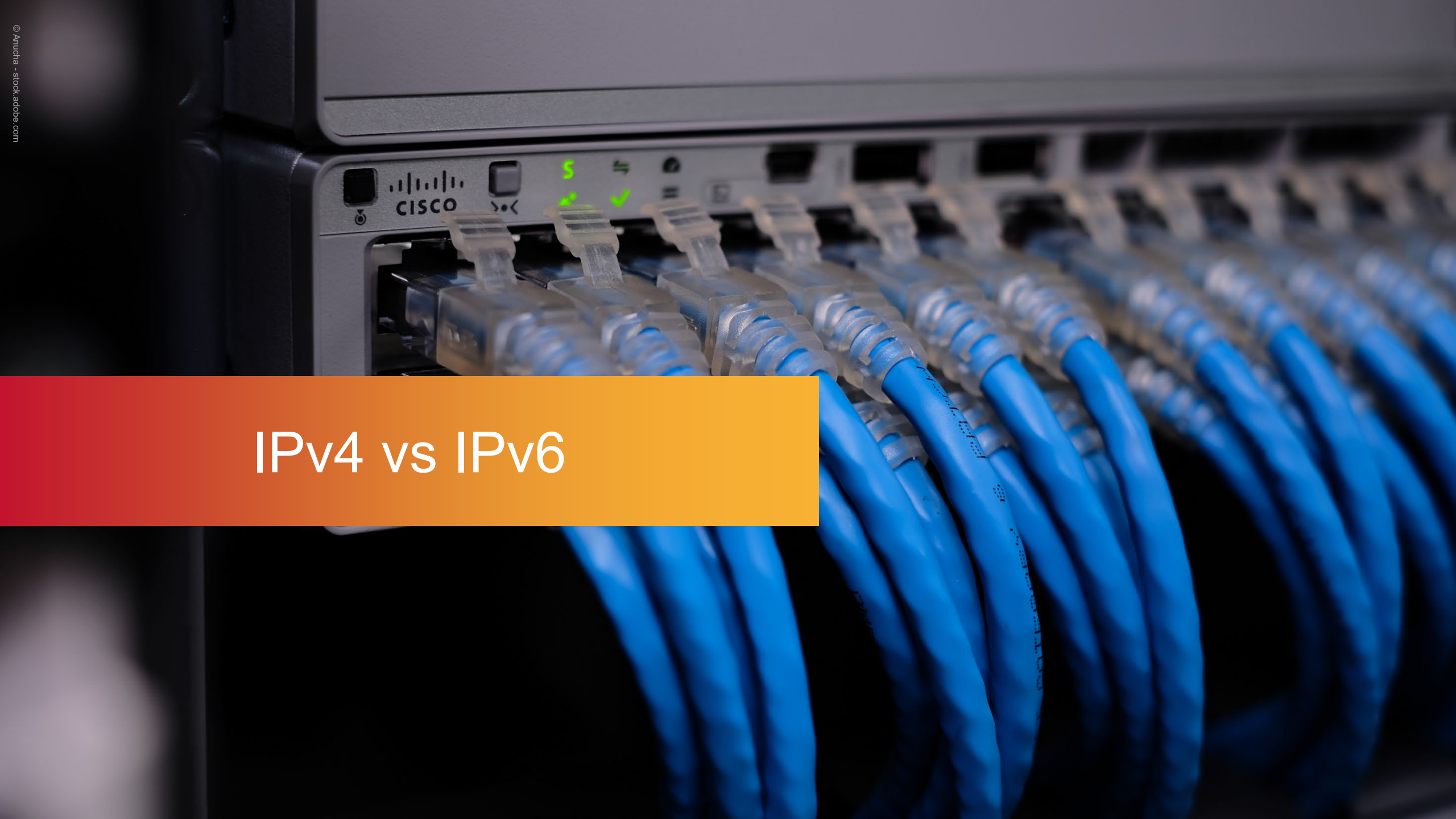
Don’t wait until the migration get urgent

IPv6 enable a small project, e.g. a guest network on premises or a cloud project

Learn and gain experience while you have time

Why start with IPv6 in the Cloud?





IPv4 vs IPv6

The OSI network reference model

http, smtp, ssh

Data encoding, encryption

Setup, auth, termination

TCP, UPD, …

Host-to-Host (IP)

Point-to-Point

Optical, Ethernet, Radio

IPv4 vs IPv6 – The Improvements I

Simplified Packet Handling

- IPv6 simplifies packet headers for more efficient processing.
- Reduces the processing load on routers, enhancing network throughput.

Improved Routing

- Enhanced addressing and routing capabilities.
- Allows for more direct and efficient routing paths.
- Reduces the size and complexity of routing tables.

Native Support for QoS (Quality of Service)

- IPv6 includes provisions for handling packets with special requirements.
- Facilitates prioritization for applications like VOIP and streaming services.

IPv4 vs IPv6 – The Improvements II

Scalability for Future Growth

- Vastly expanded address space caters to the growth of internet-enabled devices.
- Supports the expanding requirements of IoT (Internet of Things) and mobile devices.

Inherent Security Features

- Designed with security in mind, including support for IPsec (IP Security).
- Enhances data confidentiality, integrity, and authentication.

Support for Mobility and Multihoming

- Better support for mobile devices to maintain connections while moving between networks.
- Multihoming capabilities for improved resilience and redundancy.

IPv4 vs IPv6 – The Improvements III

End-to-End Connectivity

- Restores true end-to-end connectivity by eliminating NAT.
- Improves performance and reliability of peer-to-peer applications and services.

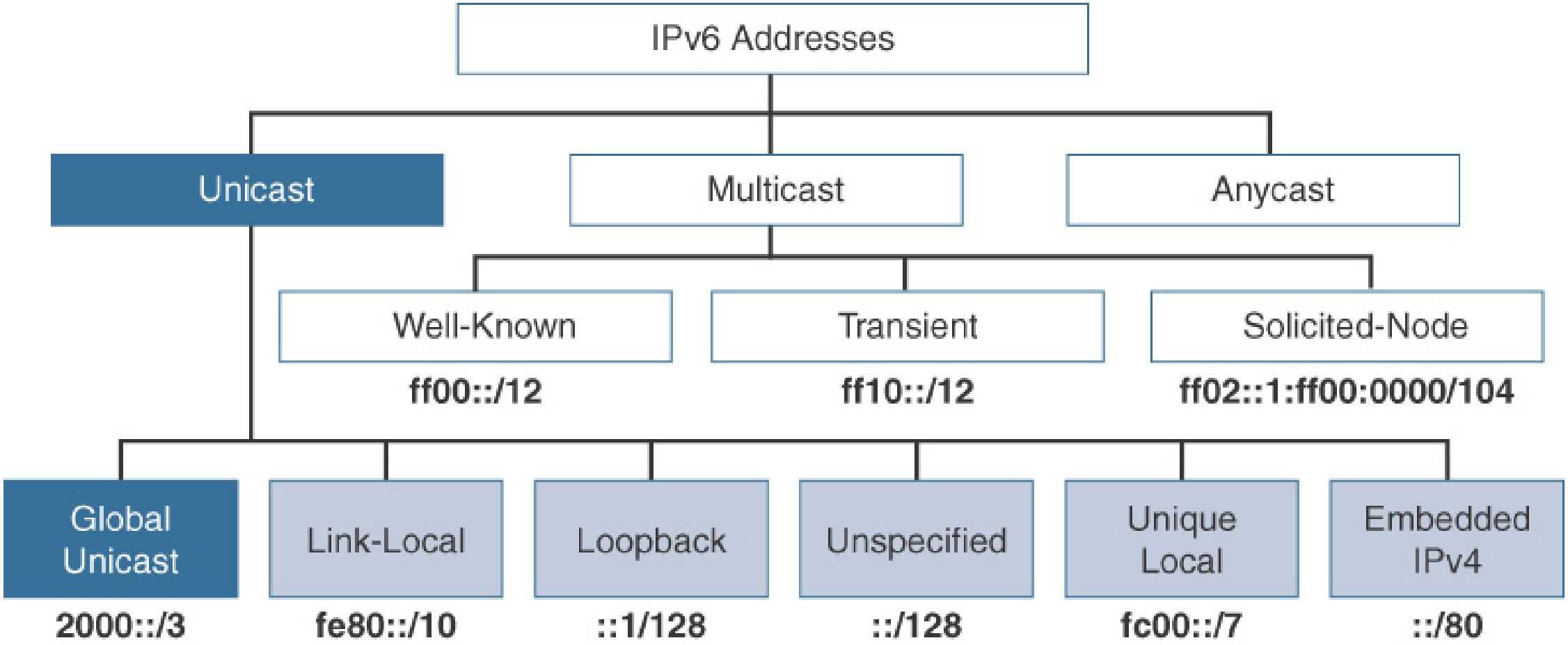
Eliminating NAT – you serious???

- Yes. I'm dead serious.
- NAT is an ugly workaround.

But NAT is a security feature

- Nope. Neither NAT nor Port-Forwarding are.
- That's the job of firewalls / security lists.

IPv6 Addresses



https://www.oreilly.com/library/view/ipv6-fundamentals-a/9780134670584/ch05.html

Recap: IPv4 IP Masking & CIDR

IP Addresses in the same Subnet are considered local

no routing required

Subnet Masking

Binary Operation “AND”

Google

“Network Calculator”
“IP Subnet Calculator”

Network	192.168.132.0 mask 255.255.255.0
CIDR	192.168.132.0/**24**

IPv4 Addresses are 4 Bytes	192	168	132	197
Each Byte has 8 Bits, 0-255	1100 0000	1010 1000	1000 0100	1100 0101
Subnet Masks	255	255	255	0
CIDR counts the 1s (3 x 8 = **24**)	1111 1111	1111 1111	1111 1111	0000 0000
Network Adress (logical AND)	192	168	132	0

IPv6 Adress Notation

8 Blocks

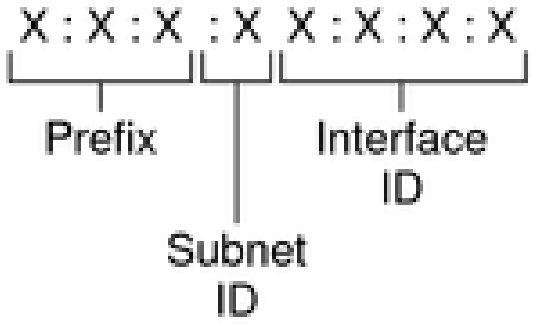
- à 16 Bits = 128 Bit
- separated by colons „:“

Each Block

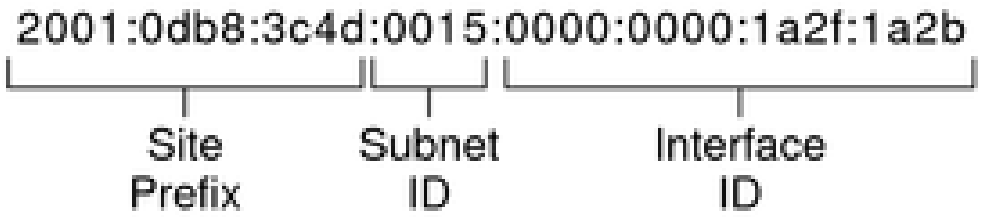
- 4 Hex Digits (0000 – FFFF)

Network and Interface Part

- have the same size
- Network 64 Bit Interface 64 Bit



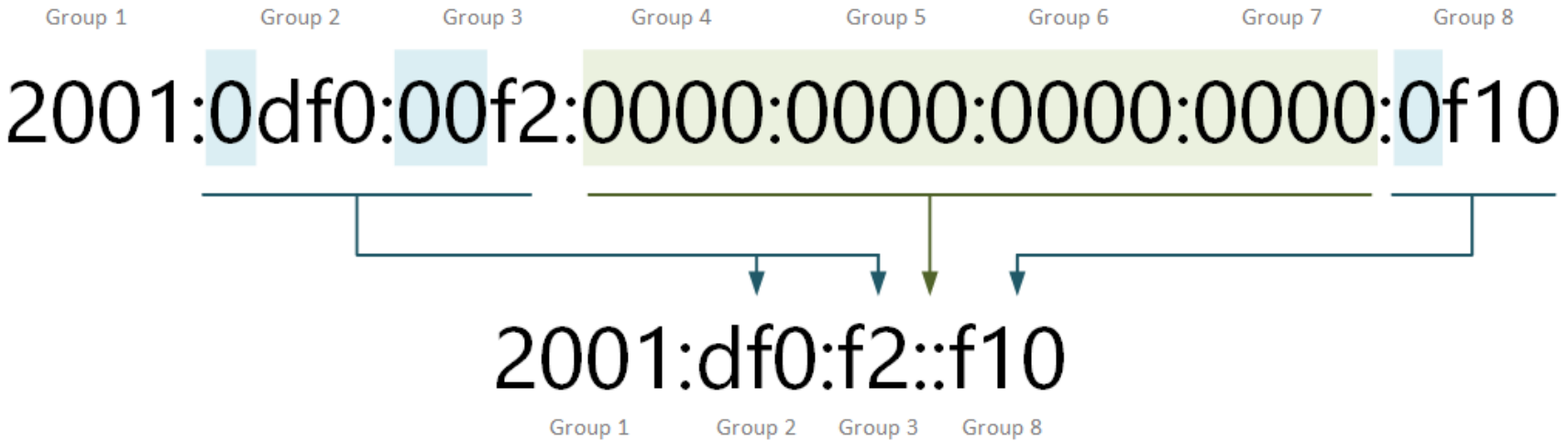
Example:



IPv6 Adress Compression

omit leading zeros per Block

replace continuous zeros blocks bei
double colons “::” – once per address



IPv6 Adress Notation, Special Cases

Sockets & URLs

- in URLs & socket colons separate protocol, address and port
- ➔use square brackets around IP address
  - http://[2001:db8:0:15::af1]:80
  - [2001:db8:0:15::af1]:1521

Microsoft UNC

- UNC (uniform naming convention)
- does not allow colons at all
- replace colons by dashes and add .ipv6-literal.net
- \\2001-db8-0-15-af1.ipv6-literal.net\pictures

IPv6 in Oracle Cloud Infrastructure

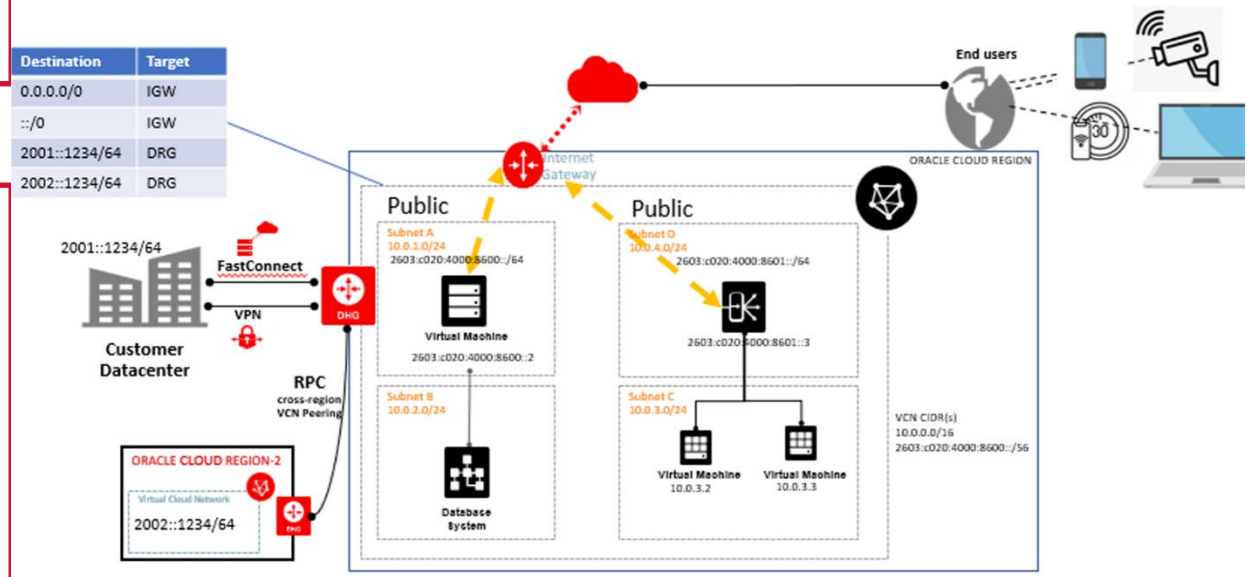
OCI IPv6 support

IPv6 general availability

- In all commercial regions
- since April 15th, 2021

Dual Stack IPv4/IPv6

- VCNs
- Subnets
- instance VNICs
- Load Balancers
- Fast Connect
- VPN connect



OCI IPv6 enabling

Enable IPv6

- on existing IPv4-only resources
- while creating new resources

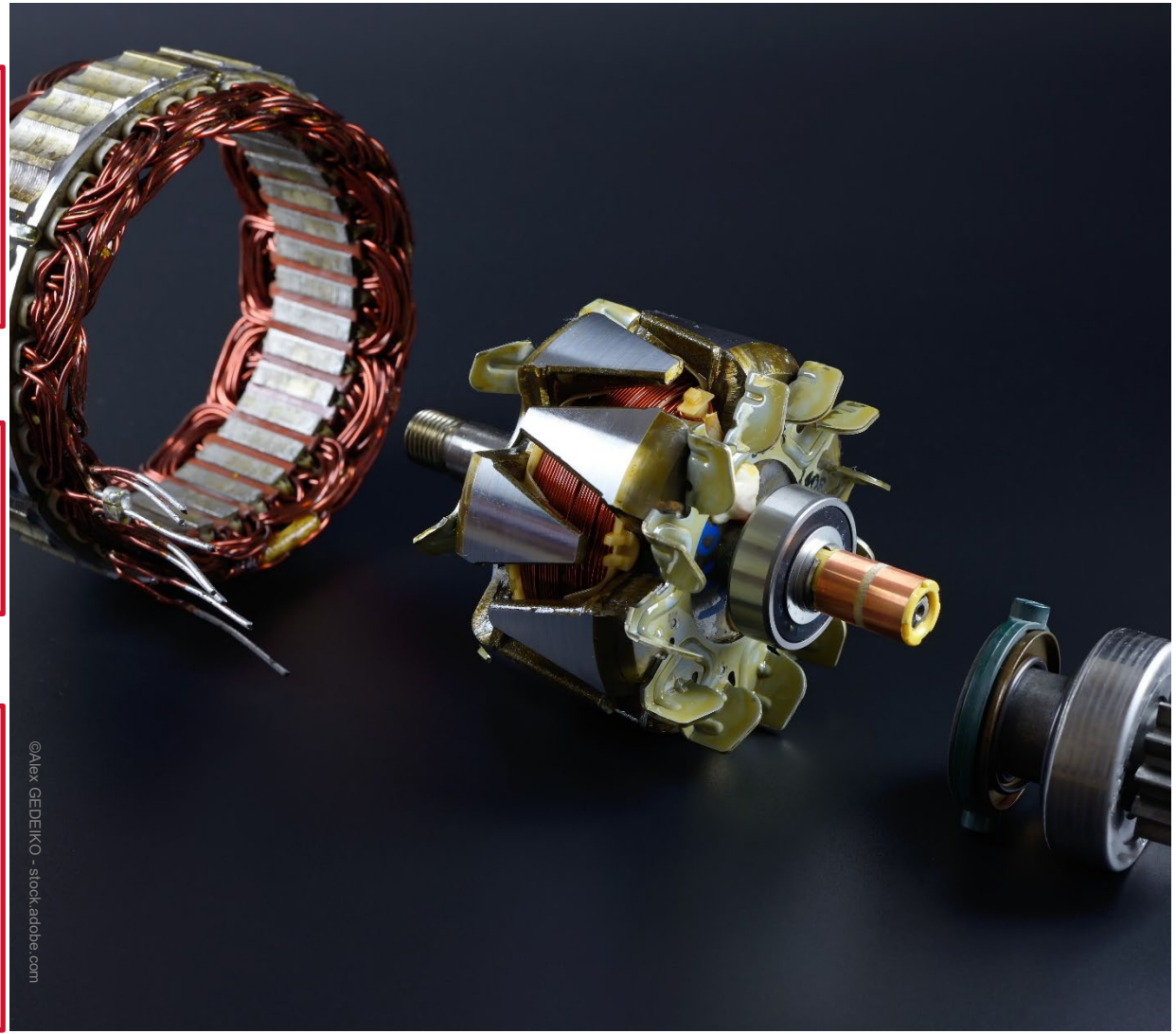
IPv4

remains mandatory default

Attention

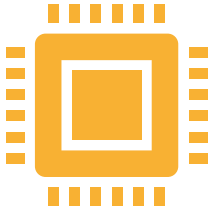
assigned IPv6 blocks cannot be removed from a VCN

→ recreate VCN



OCI IPv6 address allocation

OCI allows Multiple IPv6 Prefixes per VCN (since April 13th, 2023, with BYOIP)



Oracle IPv6 addresses

are allocated from oracle owned addess space

/56 GUA (Global Unicast Address) CIDR range per VCN

are internet routable

prohibit routing by specify subnet as private

BYOIP

Must be imported via BYOIP verification process

BYOIP prefixes must be /48 or larger

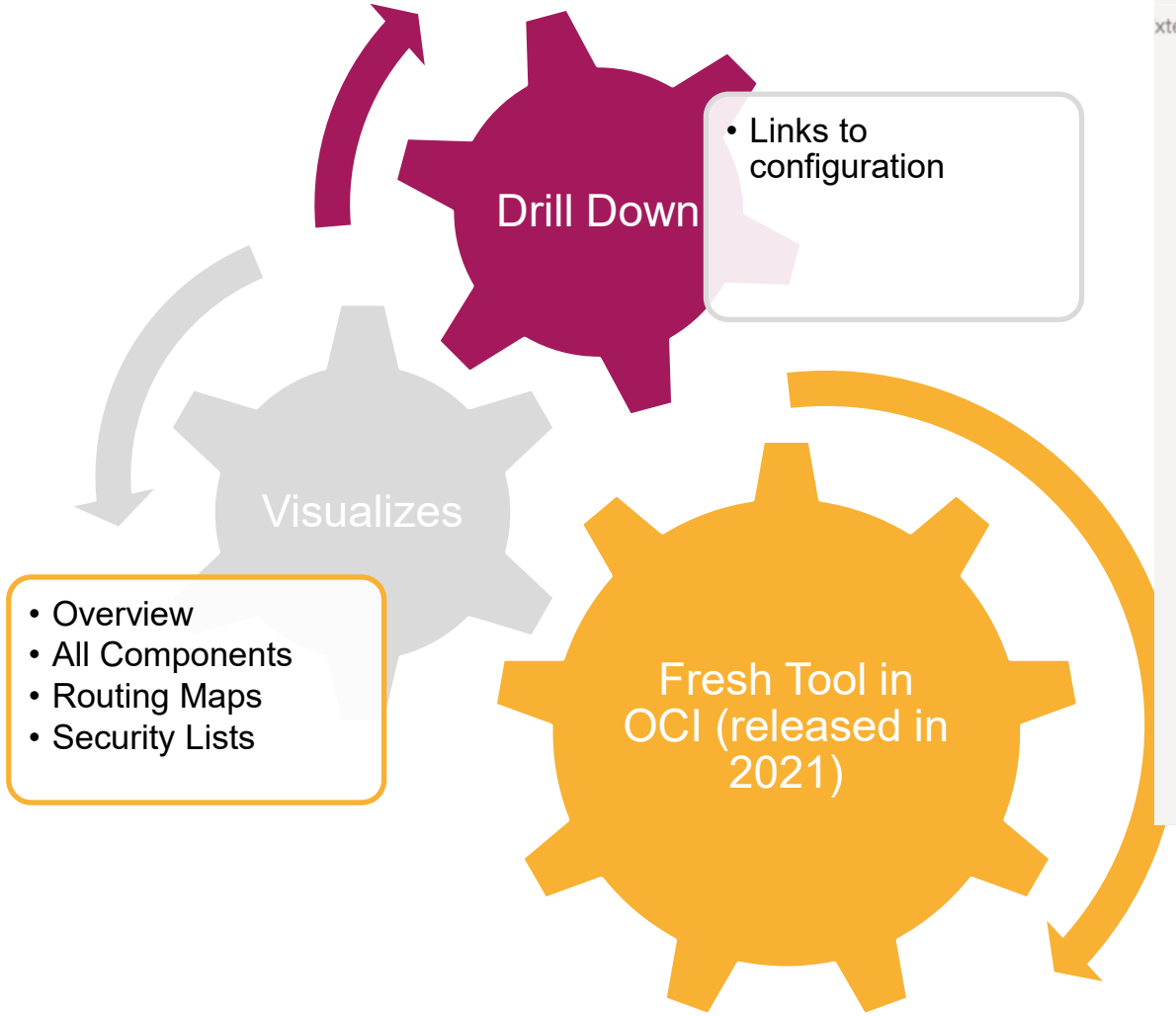
Unique Local Addresses (ULA)

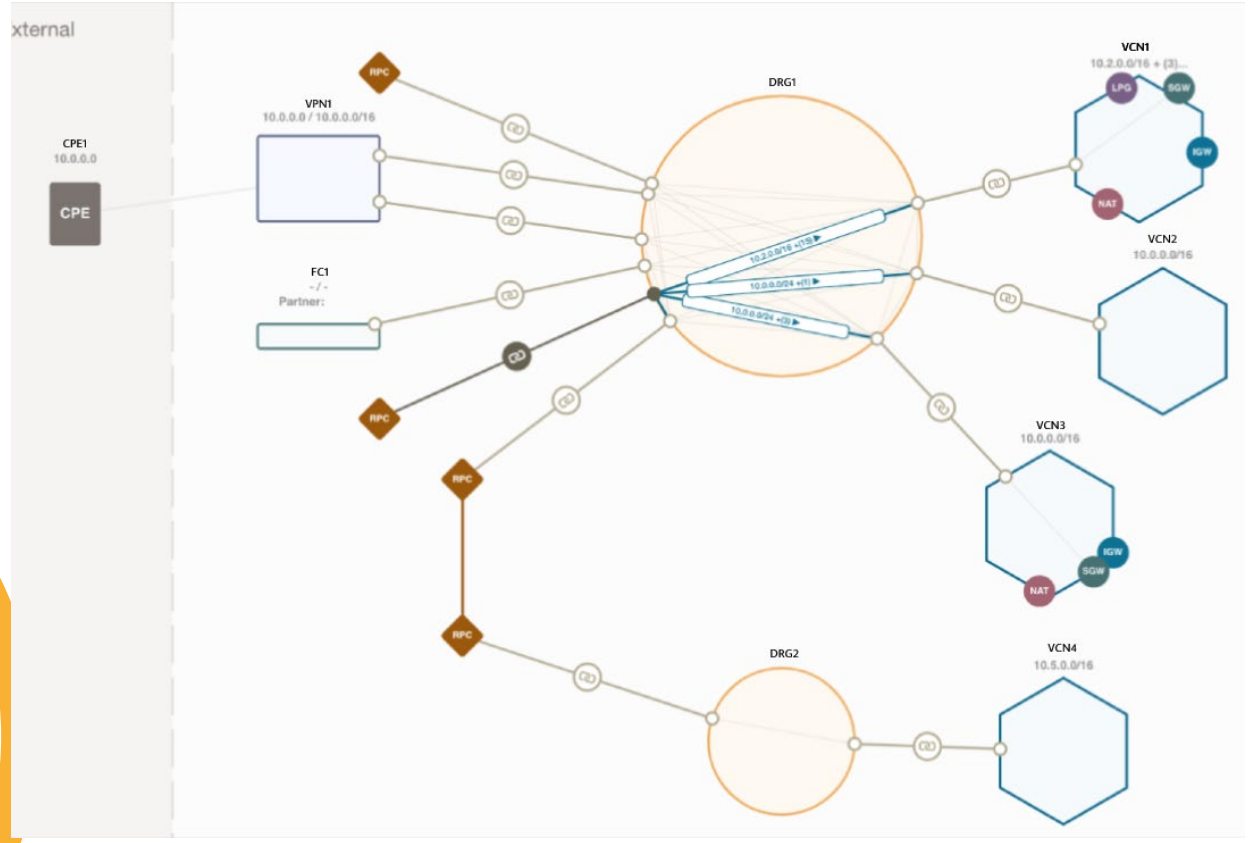
ULA Prefix /64 or larger

Not recommended (by me)

ULA is Broken (in Dual-stack Networks) (infoblox.com)

OCI: Network Visualizer





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Azure IPv6 support

IPv6 general availability

- In all commercial regions
- since April 1st, 2020

Dual Stack IPv4/IPv6

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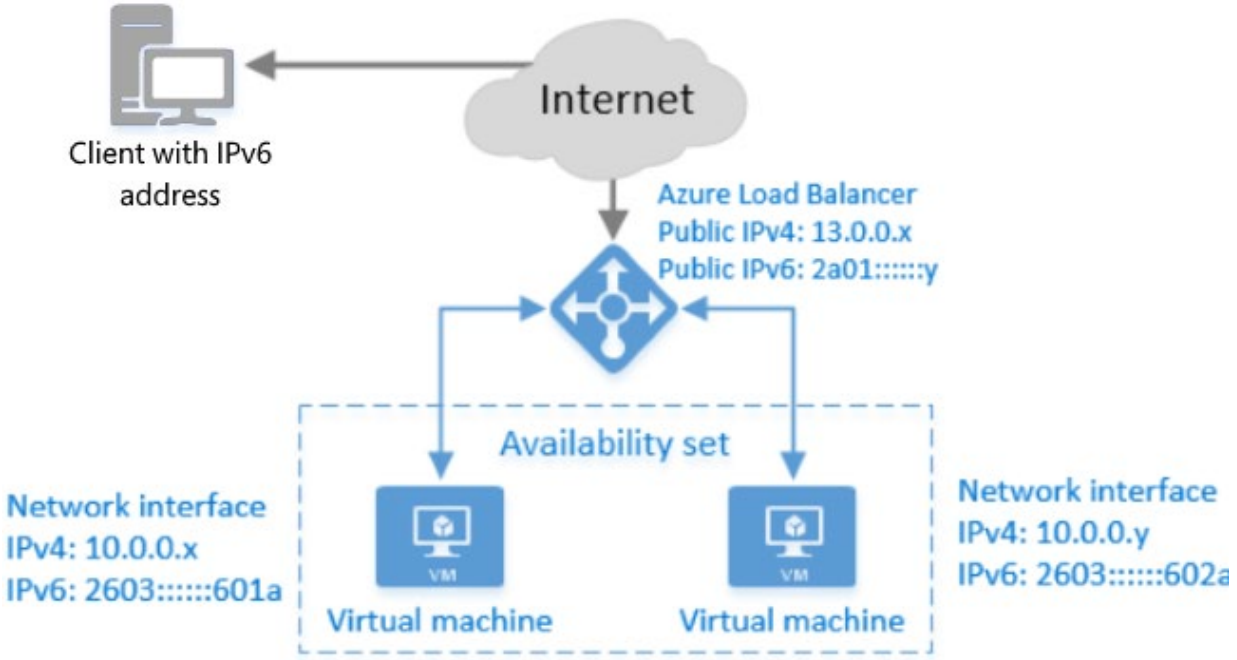
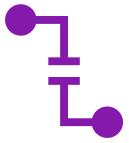


OCI IPv6: Demo

OCI IPv6: Caveats, Pitfalls & Best Practices

Keep in mind: IPv4 is mandatory

You are always using dual stack



Once IPv6 is enabled

Double Route Tables for IPv6

IPv6 enable Gateways as well

Double Security Lists (firewall rules)

Carefully check your configuration

Do NOT use ULA

ULA is broken in dual Stack networks

In IPv6, there is no need for NAT anymore

Use VCN Visualization

Perfect for getting an overview

Helps finding quirks faster

IPv6 is the future, and the future is now! (or at least close)

- IPv6 is inevitable
- Learn and train with small projects while there is time
- Public Cloud Tenants are virtual Datacenter – use them as training environments
- OCI, Azure, AWS & Co are now all IPv6 capable
- Keep in mind you must double all network resources when using IPv4 and IPv6 in parallel