

RIPE82: Entering the post IPv4 Era

 ungleich

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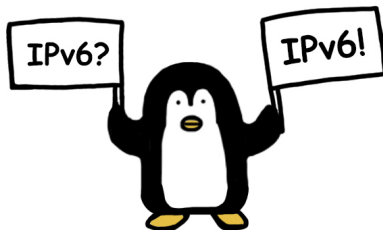
<2021-05-17 Mon>

Quote from Discord Support

BrainGamer, on the discord support:
not supporting v6 is a real bummer... being someone who has to live with a DS-Lite connection from an ISP with completely overloaded AFTR endpoints results in discord being unusable with ping spikes from 30ms to over 2000ms..why is v6 support so low on the priority list??? – from 2021-05-11

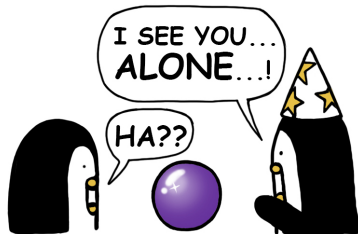
Mindset change: IPv6 first

- ▶ Before: "Do I need IPv6?"
- ▶ Now: "Why does x not do IPv6?"



Reality check

How realistic is the post IPv4 world?



WHAT WILL HAPPEN TO IPv4 PENGUIN?!

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Case study ungleich: IPv6 only and IPv6 first

- ▶ All networks at ungleich are either
 - ▶ IPv6 only (no IPv4 at all)
 - ▶ IPv6 first (IPv4 is added later)
- ▶ IPv4 has become secondary
 - ▶ In daily usage (> 90% IPv6 traffic at ungleich)
 - ▶ In planning and organisation
- ▶ More than 80% of the VPS at ungleich are IPv6 only

Mindset and workflow change

- ▶ Huge influence on projects
 - ▶ Requesting ASN+IPv6 space from ARIN/RIPE
 - ▶ Ordering IPv4 on the market is OPTIONAL
- ▶ Network design is only IPv6 by default
 - ▶ Easy separation of firewall zones
 - ▶ No conflicts with third party vendors
 - ▶ IPv4 can be treated as an IPv6 network (via NAT64)

Client network access with Covid-19

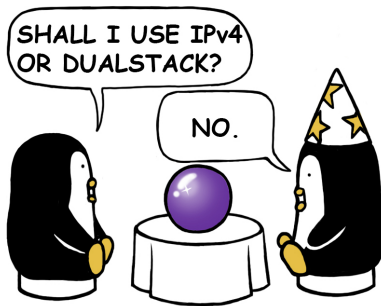
- ▶ Stronger focus on remote management of networks
- ▶ IPv6 only customer networks
- ▶ If there is no native IPv6, VPN tunnels are used
 - ▶ IPv4 has become a "layer 2.5 carrier"

Address management: no default IP address required

- ▶ Devices **always** have an IP address
- ▶ Power up, ping the all hosts multicast address
- ▶ Get the neighbour's IPv6 address
- ▶ Easier rescue, less documentation required

IPv6 only Name Servers

- ▶ IPv6 only name servers in dual stack networks
- ▶ Clients in dual stack networks need to use IPv6
- ▶ No access to DNS without IPv6



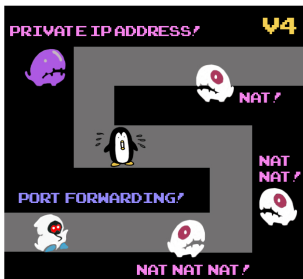
Stateless operation

- ▶ Address assignments via Router Advertisements
- ▶ No shared state required
 - ▶ Routers get significantly easier
 - ▶ No state synchronisation
- ▶ Enables multiple redundant routers
 - ▶ Network design becomes much more simple

IPv4 routing

- ▶ Using BGP Multi Protocol extensions
 - ▶ Routing of IPv4 is done via IPv6
- ▶ "Unnumbered"
 - ▶ via link local interfaces

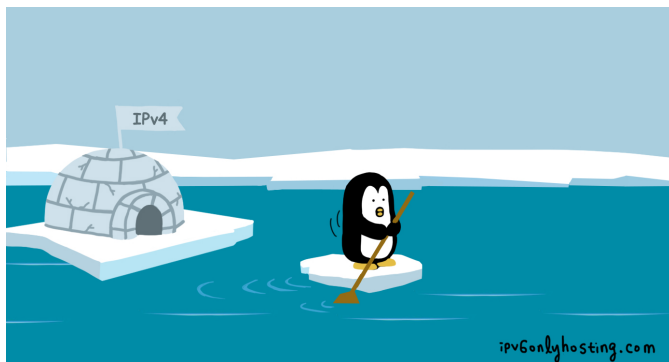
THE PENGUIN GAME



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IPv4 only islands

- ▶ IPv4 only hosts are isolated
- ▶ Access **to** the IPv6 world via NAT64-SIIT (1:1)
- ▶ Access **from** the IPv6 world via NAT64 stateful (1:n)
- ▶ Access **to** the IPv4 Internet via 464xlat (2x NAT64-SIIT)
- ▶ IPv4 networks are usually dedicated /96's (wrapped in /64's)



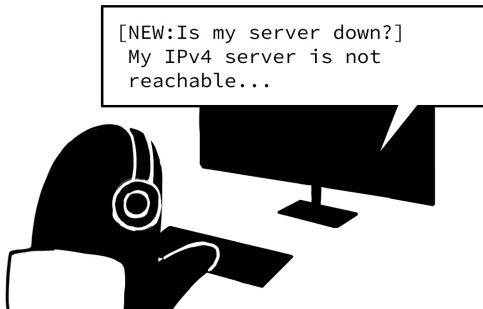
NAT64 prefixes everywhere

- ▶ Each location has their own NAT64 prefix
- ▶ Users of IPv4 only resources can build their on NAT64 service
 - ▶ Every user has at least a /48
 - ▶ Remote access to IPv4 via NAT64
- ▶ Zero configuration on the network side
 - ▶ IPv4 hosts are IPv6 hosts

Monitoring

- ▶ IPv4 is not directly reachable from IPv6 only networks
 - ▶ Requires a translator
 - ▶ Monitoring fails if the translator is failing
- ▶ Outcome: IPv6 resources are more trustworthy

PENGUIN CUSTOMER SUPPORT



The NAT64-IPSec conflict

- ▶ IPSec requires unmodified IP headers
 - ▶ Works in native IPv6 networks
- ▶ Most IPSec endpoints are IPv4 only
 - ▶ NAT64 modifies the IP headers
- ▶ Outcome: IPSec does not work in NAT64 environments



VPN technologies

- ▶ Many VPN types work fine in NAT64 environments
- ▶ OpenVPN: TLS based: works
- ▶ SSLVPN: TLS based: works
- ▶ Wireguard: custom protocol: works

Legacy network firmware

- ▶ Old firmware does not support IPv6 netboot
- ▶ ipxe to the rescue
- ▶ ipxe: an open source firmware
 - ▶ Can be flashed to the NIC rom
 - ▶ Can be booted via USB stick and chainload networking

IPv4-as-a-Service

- ▶ If IPv4 reachability is required
- ▶ Deployed via
 - ▶ NAT64
 - ▶ Routing
 - ▶ VPN ("IPv4 to go")
- ▶ Usually additional cost
 - ▶ Requires additional management
 - ▶ Requires additional resources (IPv4 addresses, memory, translators, etc.)

IPv6-as-a-service

- ▶ If missing native IPv6 connectivity
 - ▶ Or if static assignment is missing
- ▶ Often deployed via VPN

Findings

- ▶ IPv6 only networks have become practical
- ▶ IPv6 only environments take less effort to maintain
- ▶ IPv4 dependencies can be removed step-by-step

Summary

- ▶ In practical terms, IPv6 has replaced IPv4
- ▶ IPv4 is becoming a maintenance burden



Abstract

With 3 out of 5 RIRs IPv4 space being depleted and IPv6 only networks becoming the norm, it is time to look at networking in the post-IPv4 area.

Based on my work at ungleich I will show which challenges exist if your networks are IPv6 only by default and only in rare occasions IPv4 is requested or required. I'll present a number of key technologies that is about to change and discuss some of their successors.

Finally I'll give an overview of services that allow others to enter the post-IPv4 world.