World IPv6 deployment

…and what are our options for good exit strategy.

Jan Žorž, November 2022

Who is Jan Žorž?

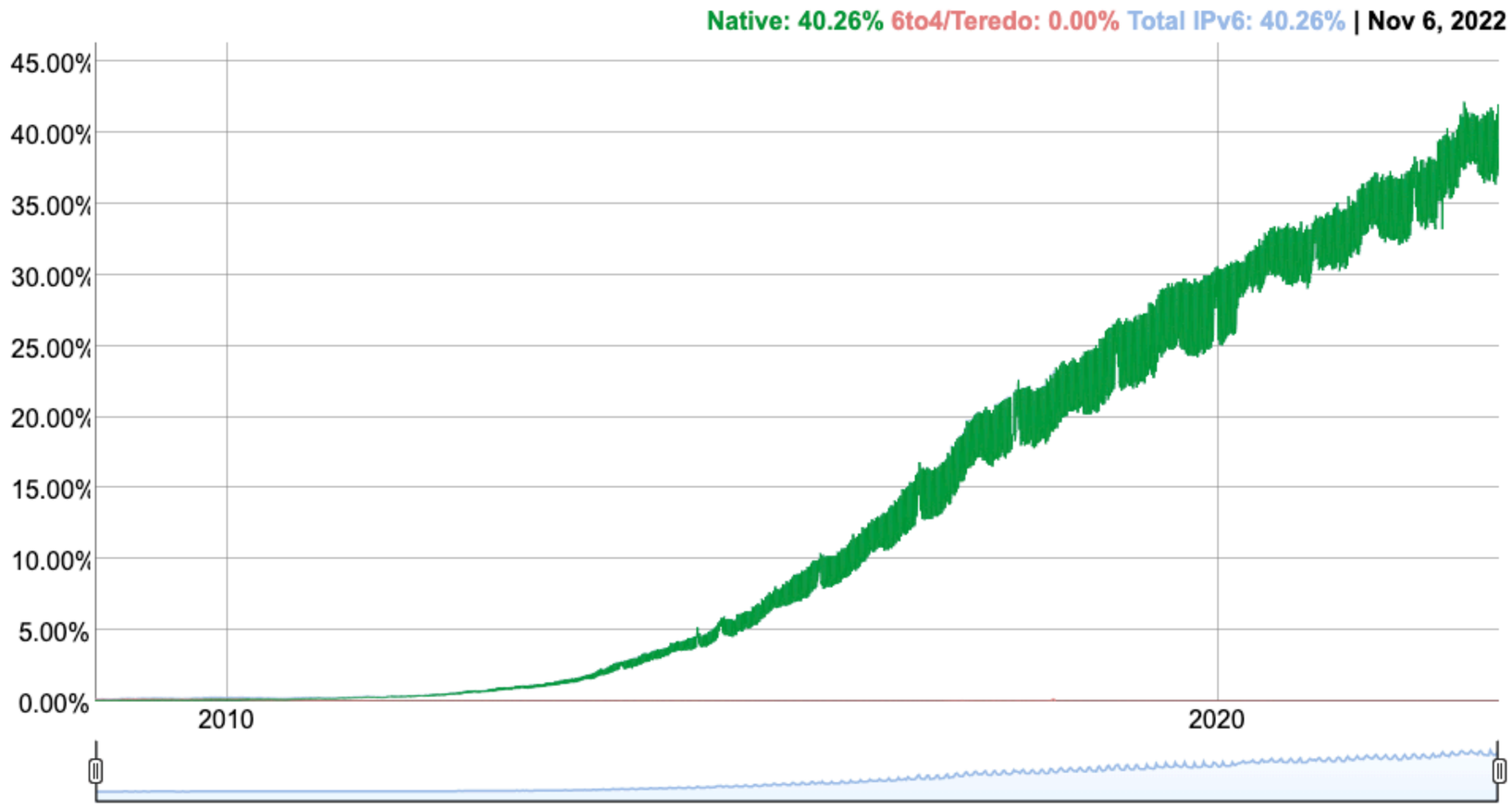
- VP of 6connect Labs, CEO at NET42 d.o.o.
- Co-founder and board member of Global NOG Alliance (GNA)
- Started building and running networks in 1992 (DECnet, RS232), first touch with IPv6 in 1998.
- **IETF Standardisation:**
  - RFC 6346 - The Address plus Port (A+P) Approach to the IPv4 Address Shortage
  - RFC 8978 - Reaction of IPv6 Stateless Address Autoconfiguration (SLAAC) to Flash-Renumbering Events
  - RFC 9096 - Improving the Reaction of Customer Edge Routers to IPv6 Renumbering Events
- **RIPE Best Current Operational Practice Documents:**
  - RIPE 501/554/772 - Requirements For IPv6 in ICT Equipment
  - RIPE 631 - IPv6 Troubleshooting for Residential ISP Helpdesks
  - RIPE 690 - IPv6 prefix assignment for end-users - persistent vs non-persistent, and what size to choose
- RIPE Program Committee, vice-chair
- SEE RIPE Regional meeting, chair
- RIPE BCOP Task Force, chair
- SINOG, chair
- Go6lab, founder
- etc…

Current state of IPv6 deployment

IPv6 Adoption | Per-Country IPv6 adoption

IPv6 Adoption

We are continuously measuring the availability of IPv6 connectivity among Google users. The graph shows the percentage of users that access Google over IPv6.



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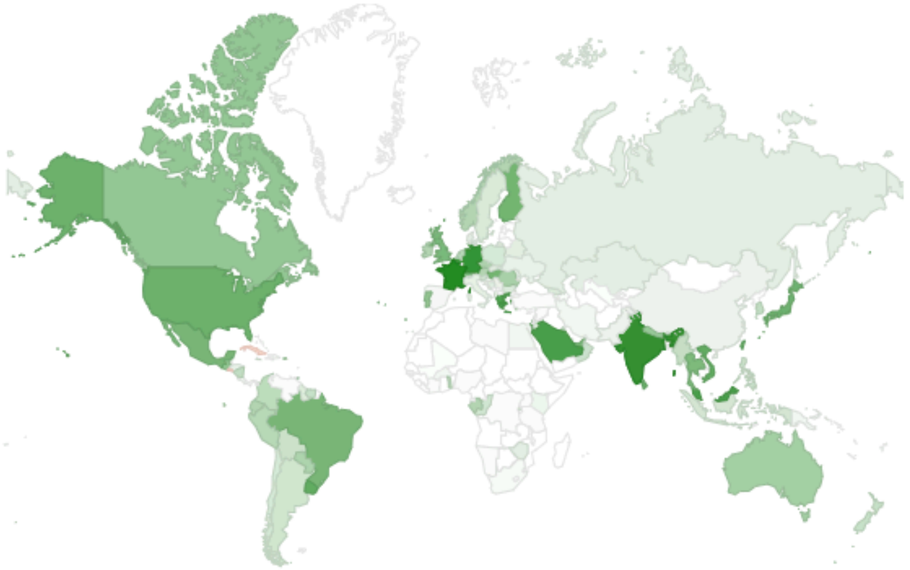
Current state of IPv6 deployment

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

Per-Country IPv6 adoption

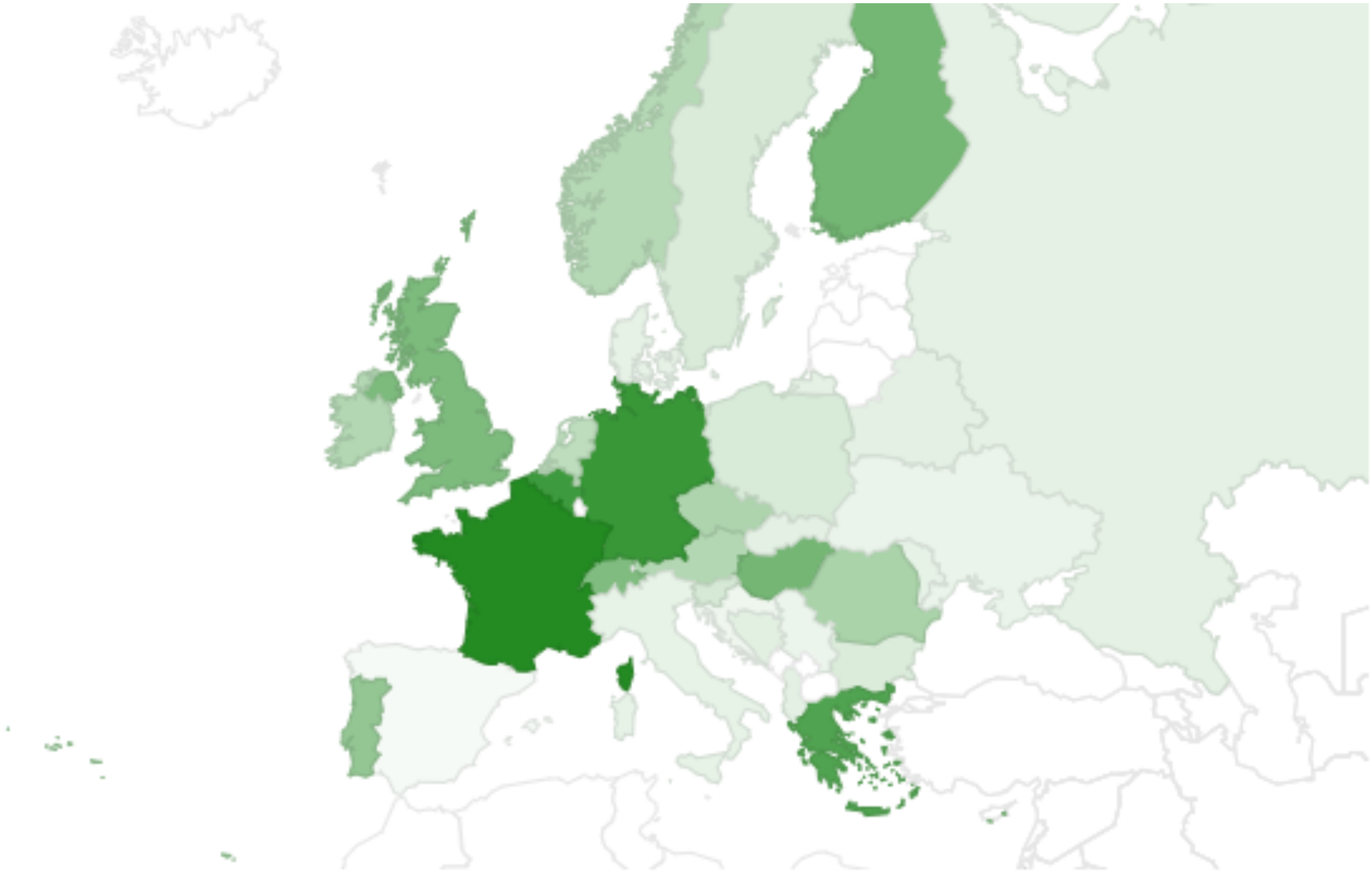


World | Africa | Asia | Europe | Oceania | North America | Central America | Caribbean | South America

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.

Current state of IPv6 deployment



World IPv6 day/launch (2011/2012)

Organisation	Country	IPv6 Page	Date joined
Free	France		16 Jan 2012
ATT	United States		16 Jan 2012
Comcast	United States		16 Jan 2012
KDDI	Japan		16 Jan 2012
Internode	Australia		16 Jan 2012
Time Warner Cable	United States		16 Jan 2012
XS4ALL	Netherlands		16 Jan 2012
Rensselaer Polytechnic Institute	United States		17 Jan 2012
Marist College	United States		17 Jan 2012
Louisiana Optical Network Initiative	United States		17 Jan 2012
Starlink	Russian Federation		18 Jan 2012
Xfone 018	Israel		18 Jan 2012
AAISP	United Kingdom		18 Jan 2012
RCS & RDS	Romania		18 Jan 2012
RedIRIS	Spain		18 Jan 2012
LITNET	Lithuania		18 Jan 2012
NFSI Telecom Lda	Portugal		18 Jan 2012
Opensvit - PEF Fenix VT	Ukraine		19 Jan 2012
Hurricane Electric	United States		22 Jan 2012
ARNES	Slovenia		26 Jan 2012
Honesty Net Solutions (I) Pvt Ltd	India		2 Feb 2012
University of Wisconsin - Madison	United States		2 Feb 2012
FCCN	Portugal		7 Feb 2012
OVH	France		10 Feb 2012
FranTech Solutions	Canada		10 Feb 2012
DreamHost	United States		13 Feb 2012
Nautile	New Caledonia		14 Feb 2012
GARR	Italy		14 Feb 2012
PoP-SP RNP	Brazil		14 Feb 2012
Claranet	United Kingdom		15 Feb 2012
Ponto de Presença da RNP na Bahia	Brazil		15 Feb 2012

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World IPv6 day/launch (2011/2012)

Organisation	Country	IPv6 Page	Website URL	Date joined
Facebook	United States		http://www.facebook.com	16 Jan 2012
Google	United States		http://www.google.com	16 Jan 2012
Google	United States		http://www.youtube.com	16 Jan 2012
Yahoo!	United States		http://www.yahoo.com	16 Jan 2012
The Internet Society	United States		http://www.internetsociety.org	16 Jan 2012
Cisco	United States		http://www.cisco.com	16 Jan 2012
Time Warner Cable	United States		http://www.timewarnercable.com	16 Jan 2012
D-Link	United States		http://www.dlink.com	16 Jan 2012
Comcast	United States		http://www.comcast.net	16 Jan 2012
Comcast	United States		http://xfinitytv.comcast.net	16 Jan 2012
Comcast	United States		http://xfinity.comcast.net	16 Jan 2012
Banda Ancha	Spain		http://bandaancha.eu	17 Jan 2012
IKS GmbH	Germany		http://www.iks-jena.de/	17 Jan 2012
Entropia e.V.	Germany		https://entropia.de/	17 Jan 2012
Euphorya	Singapore		http://www.euphoryadesign.com	17 Jan 2012
Standardisation Board and Forum	Netherlands		http://www.forumstandaardisatie.nl	17 Jan 2012
The University of Reading	United Kingdom		http://www.reading.ac.uk	17 Jan 2012
LinuxTag e.V.	Germany		http://www.linuxtag.org/	17 Jan 2012
Snijders IT	Netherlands		http://snijders-it.nl/	17 Jan 2012
New York University	United States		http://www.nyu.edu	17 Jan 2012
Verket för Högskoleservice	Sweden		http://www.vhs.se	17 Jan 2012
ICT Standards Advisory Council of Canada - ISACC	Canada		http://www.isacc.ca	17 Jan 2012
ONELIFE.CZ	Czech Republic		http://www.onelife.cz	17 Jan 2012
University of North Carolina at Chapel Hill	United States		http://www.unc.edu/	17 Jan 2012
schokokeks.org GbR	Germany		http://www.schokokeks.org/	17 Jan 2012
IP for Smart Objects Alliance	United States		http://www.ipso-alliance.org	17 Jan 2012
Terra	Brazil		http://www.terra.com.br	17 Jan 2012
ChaosKreativ	Germany		http://www.bergwauwau.de	17 Jan 2012
ChaosKreativ	Germany		http://www.chaoskreativ.de	17 Jan 2012
Datapipe	United States		http://www.datapipe.net	17 Jan 2012
NederHost	Netherlands		http://www.nederhost.nl/	17 Jan 2012
Tuxis Internet Engineering	Netherlands		https://www.tuxis.nl/	17 Jan 2012
Proofpoint, Inc.	United States		http://www.proofpoint.com	17 Jan 2012
NTT America	United States		http://www.us.ntt.net	17 Jan 2012
i-pobox.net	Germany		http://www.i-pobox.net	17 Jan 2012
Go6 Institute Slovenia	Slovenia		http://go6.si	17 Jan 2012

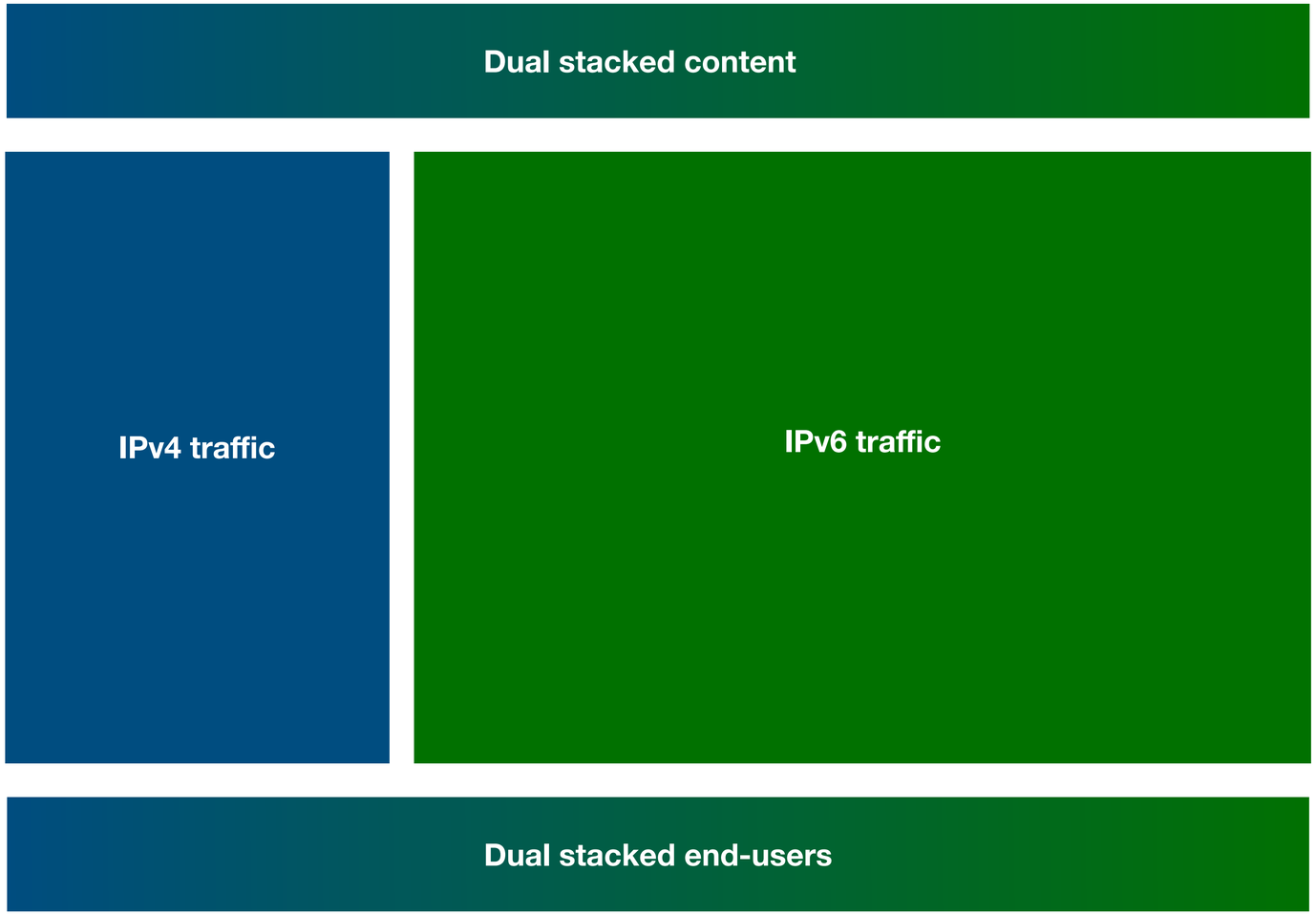
Traffic divide - mobile vs. fixed operator

Is this really happening???

- World IPv6 day/launch changed the traffic patterns a lot.
- Those who enabled dual stack after 2012 immediately saw traffic shift towards IPv6.
- Mobile operators today sees as much as 80% of traffic over IPv6
- Fixed operators around 60% and growing
- Why? Facebook, Google, Yahoo, Microsoft, Apple, Akamai, CloudFlare and many content giants and global clouds enabled dual stack on their services.

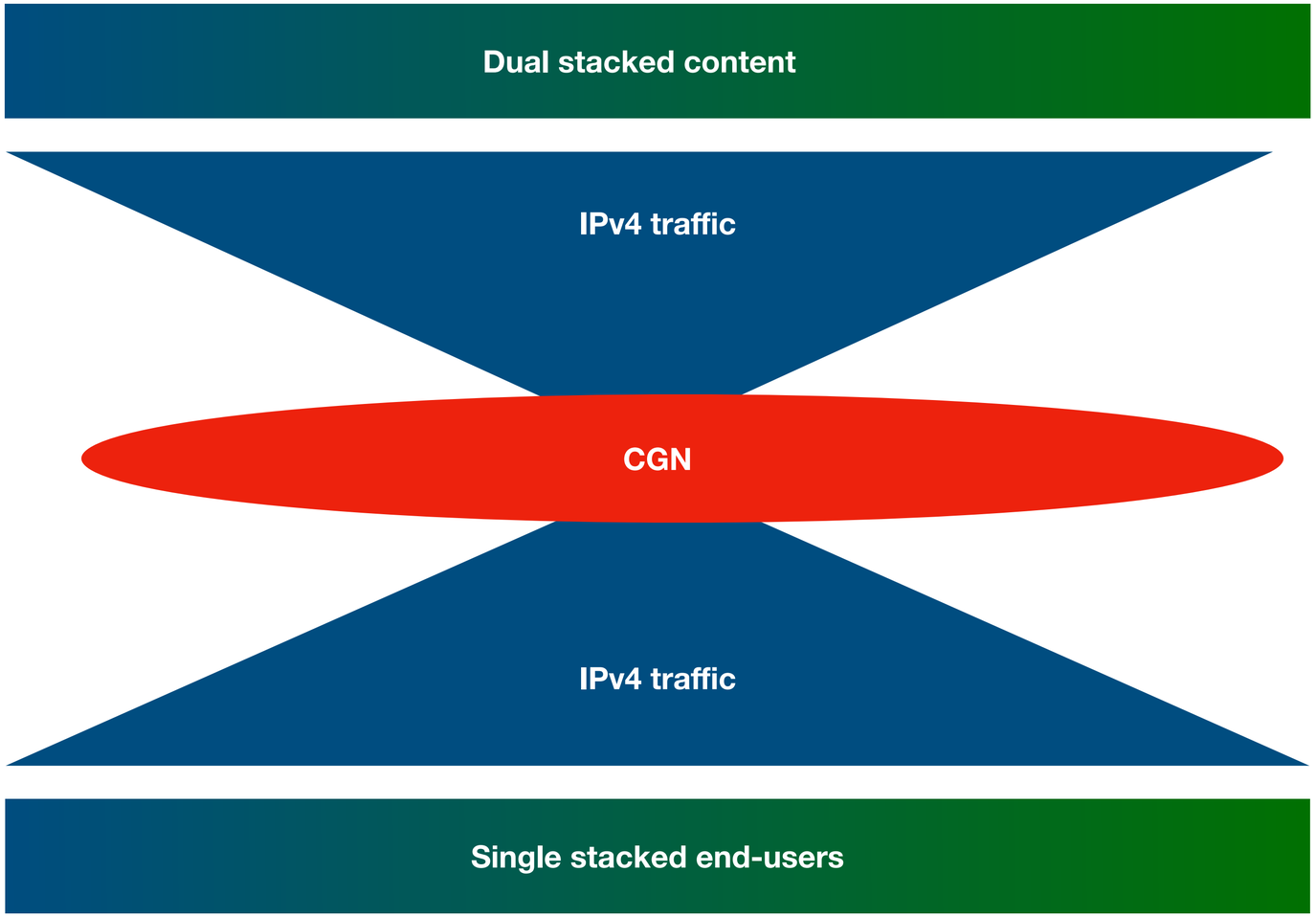
Reality of today

IPv6 vs IPv4 on dual stacked networks



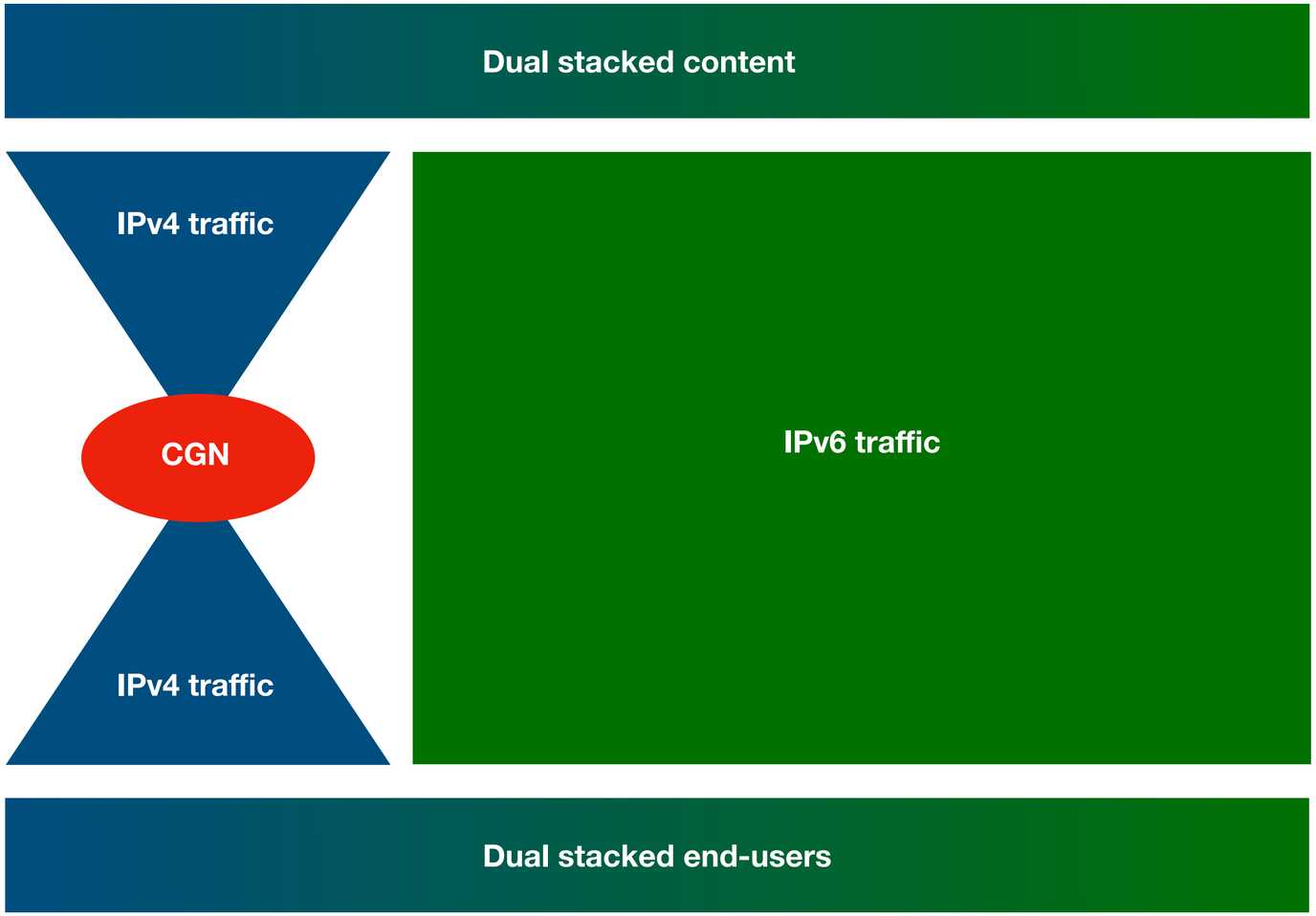
Reality of today

IPv4 CGN only???



Reality of today

IPv6 vs IPv4 CGN



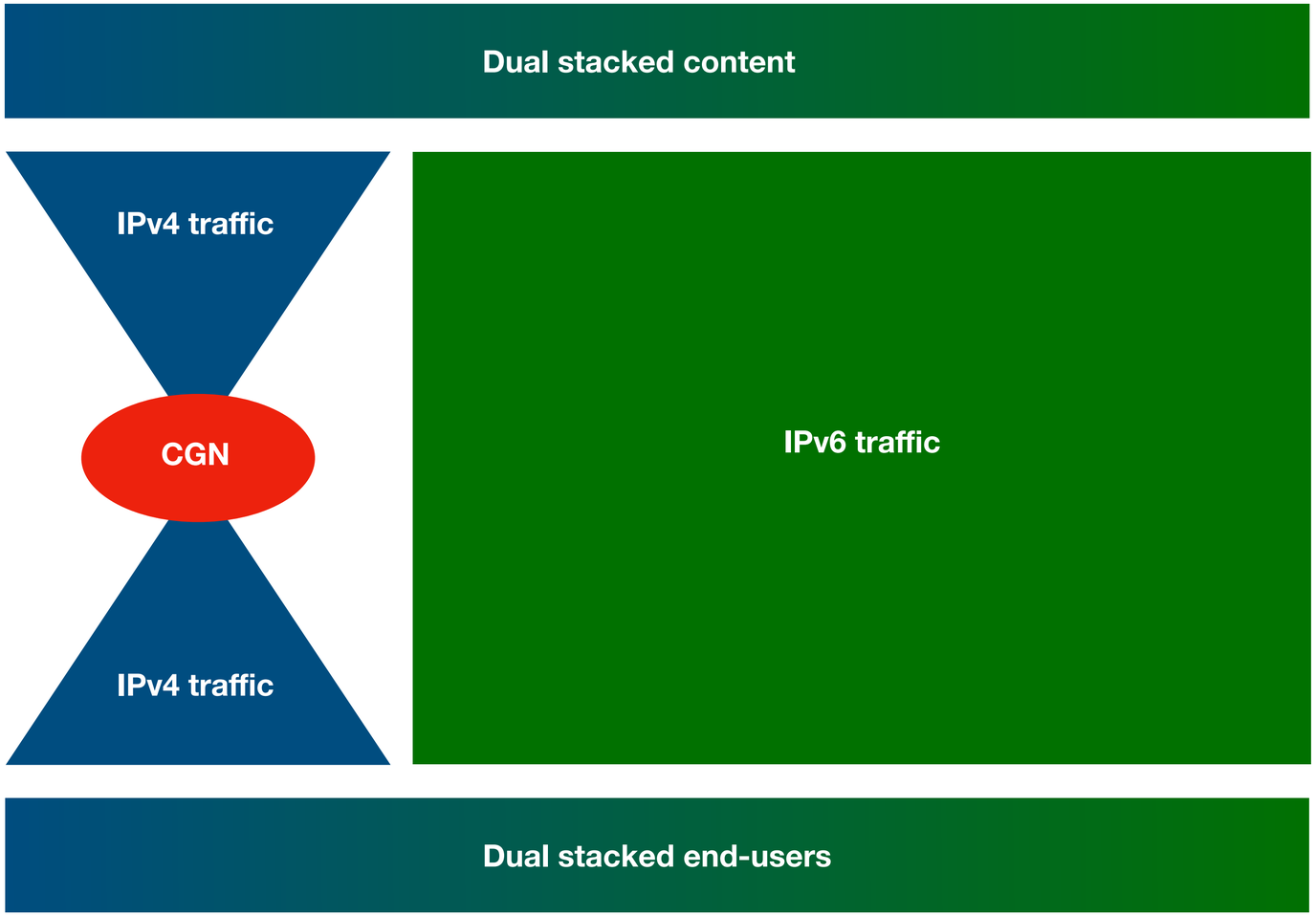
To IPv6 or not to IPv6?

Exit strategy…

- More and more content providers are enabling content on both - IPv6 and IPv4
- Deploying IPv6 to our end-users means 60% to 80% of traffic flow without translation mechanism
- CGN comes with a cost. Hardware, license, high availability, etc.
- Having all traffic today on IPv4 and through CGN is not a very wise business decision. When you grow your user base - the cost of CGN will just be bigger and bigger - there's no exit strategy.
- Transport traffic where there is no additional translation cost - over IPv6. More and more content providers will enable IPv6 and your IPv4 traffic will be smaller and smaller, reducing cost of running your network - that's a good exit strategy :)

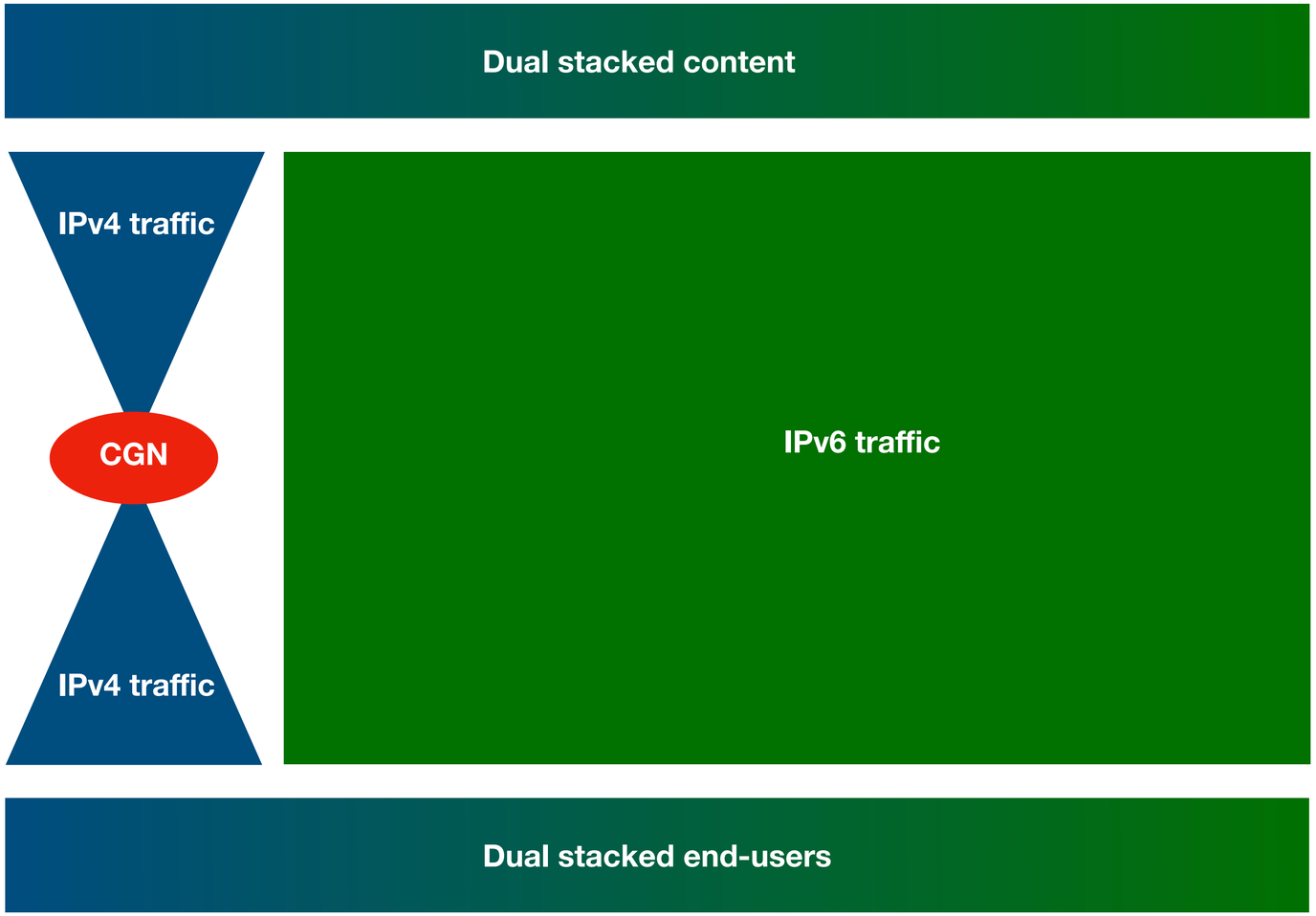
Exit strategy

IPv6 vs IPv4 CGN - 2022



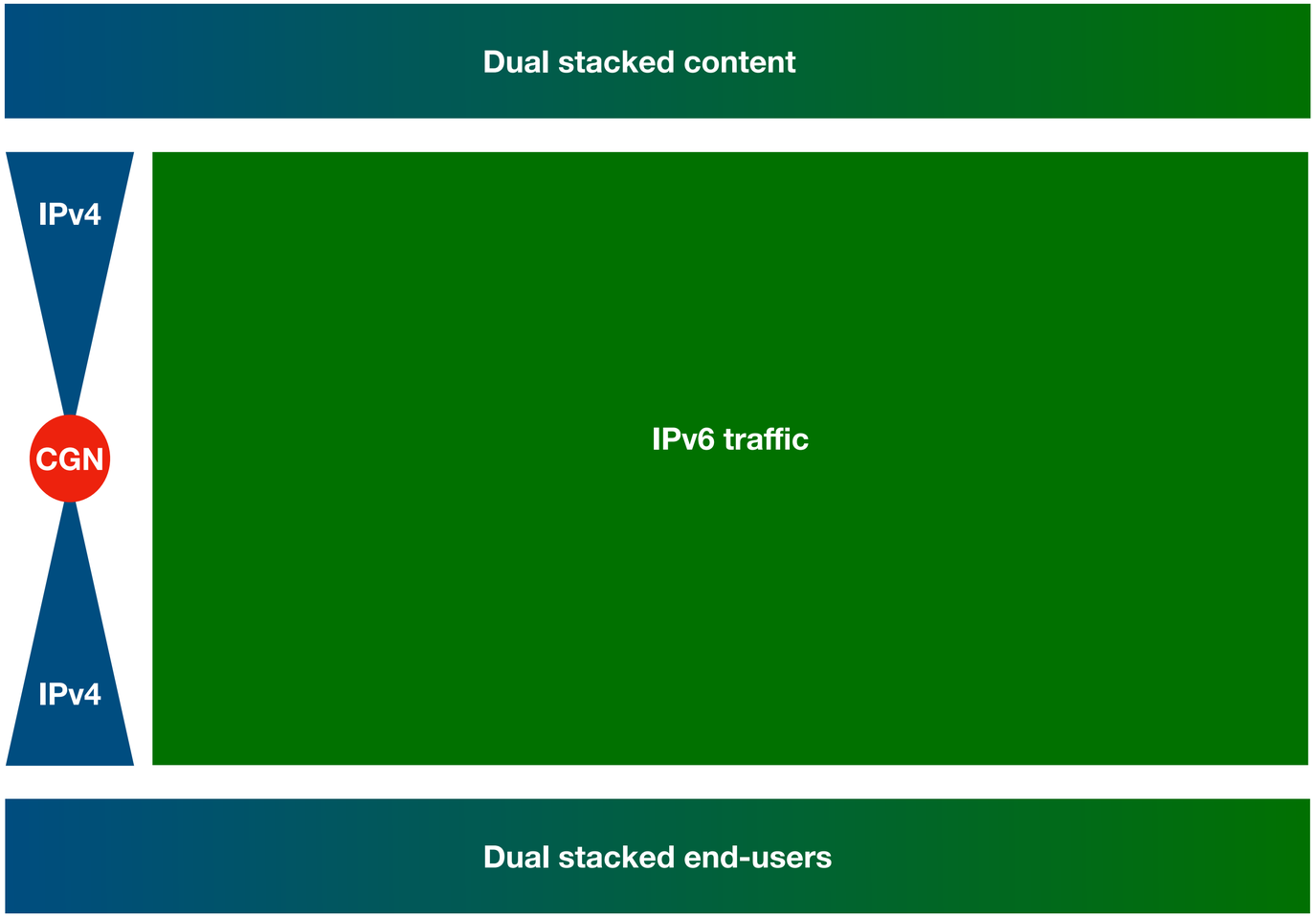
Exit strategy

IPv6 vs IPv4 CGN - 2026



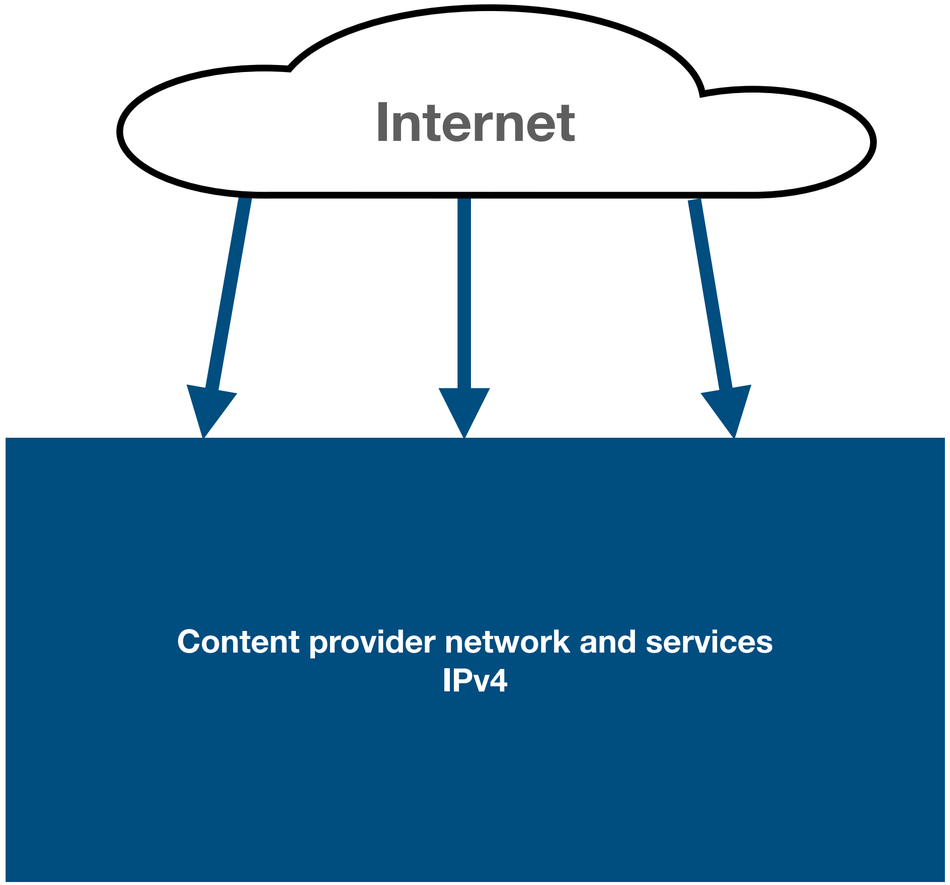
Exit strategy

IPv6 vs IPv4 CGN - 2030



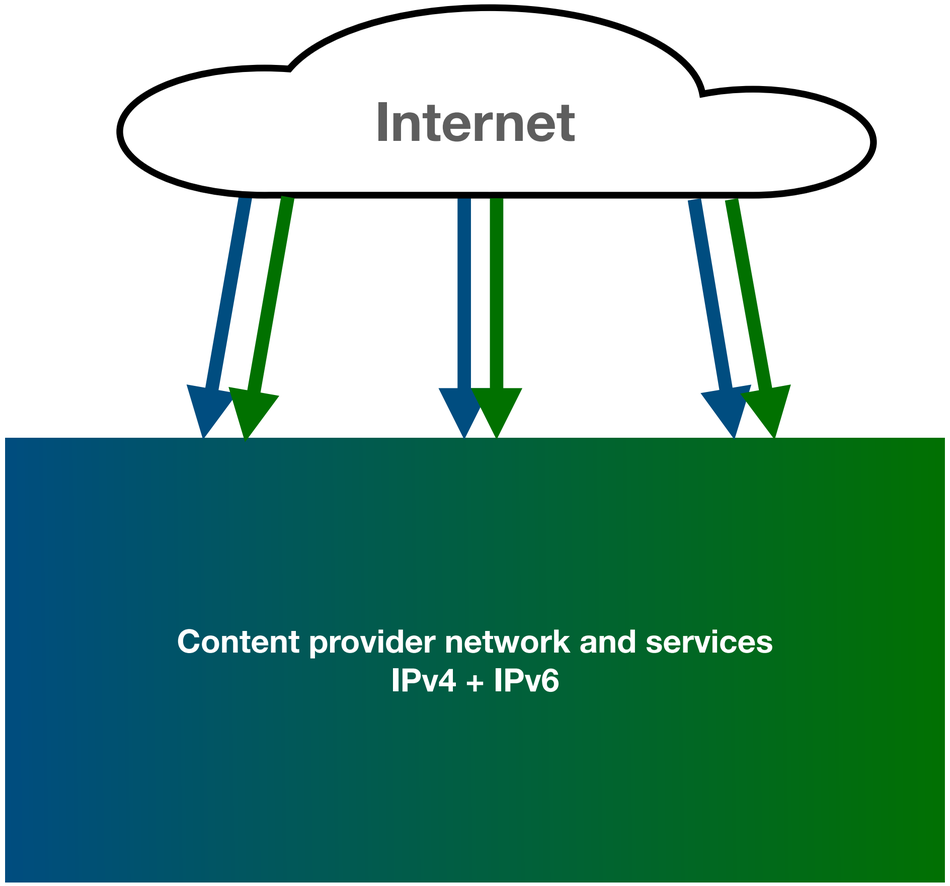
What content providers are doing today?

Going back to single stack… pre 2012



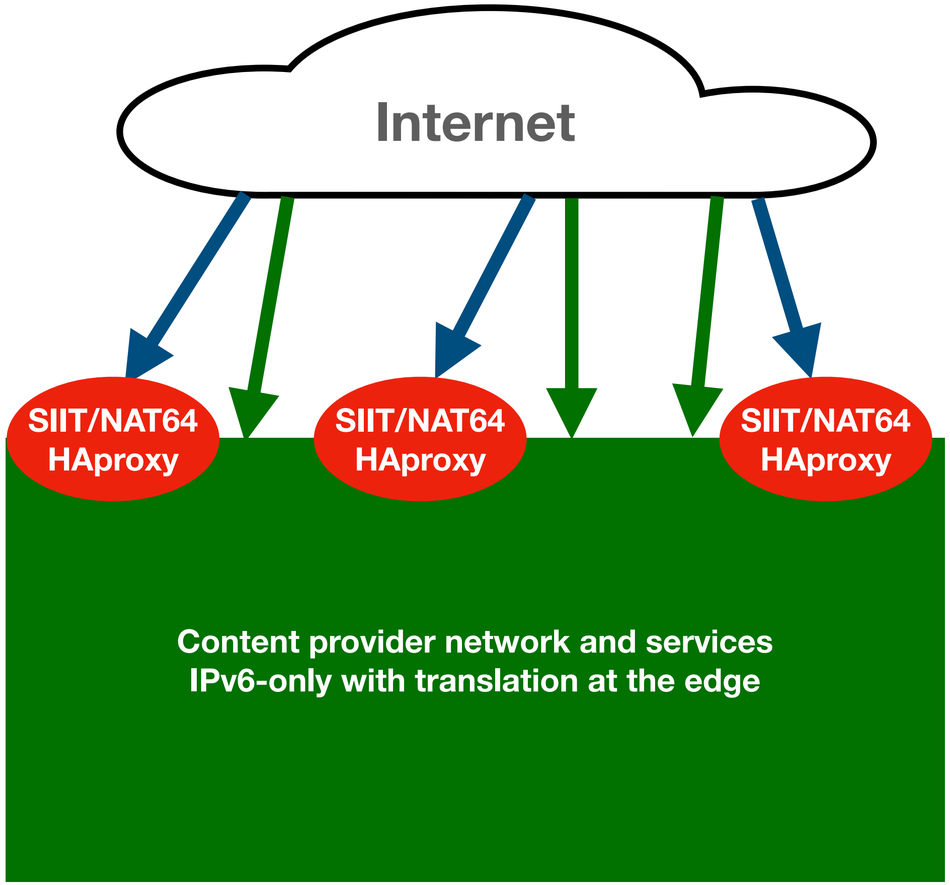
What content providers are doing today?

Going back to single stack… after 2012

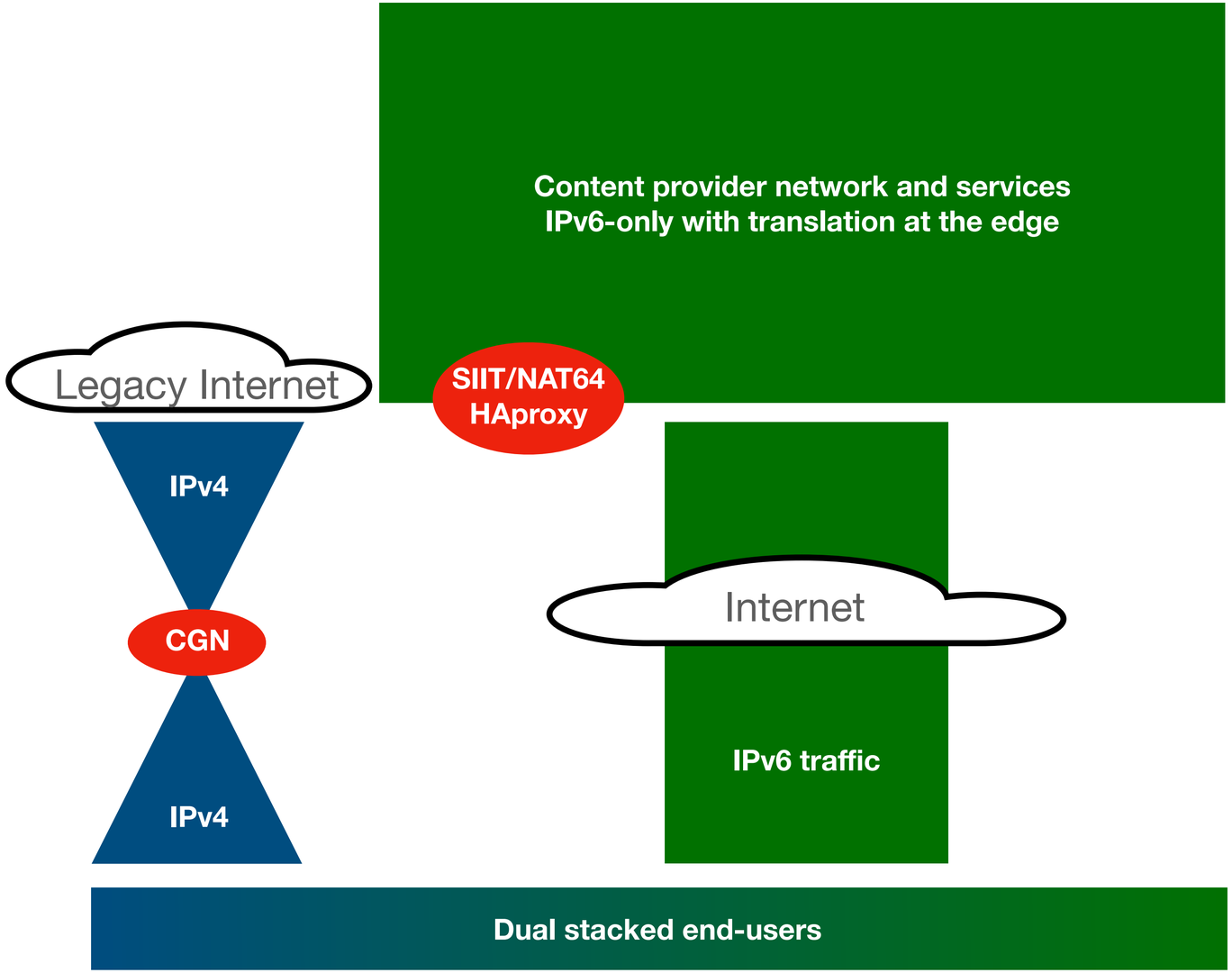


What content providers are doing today?

Going back to single stack… after 2014 and slowly getting there.

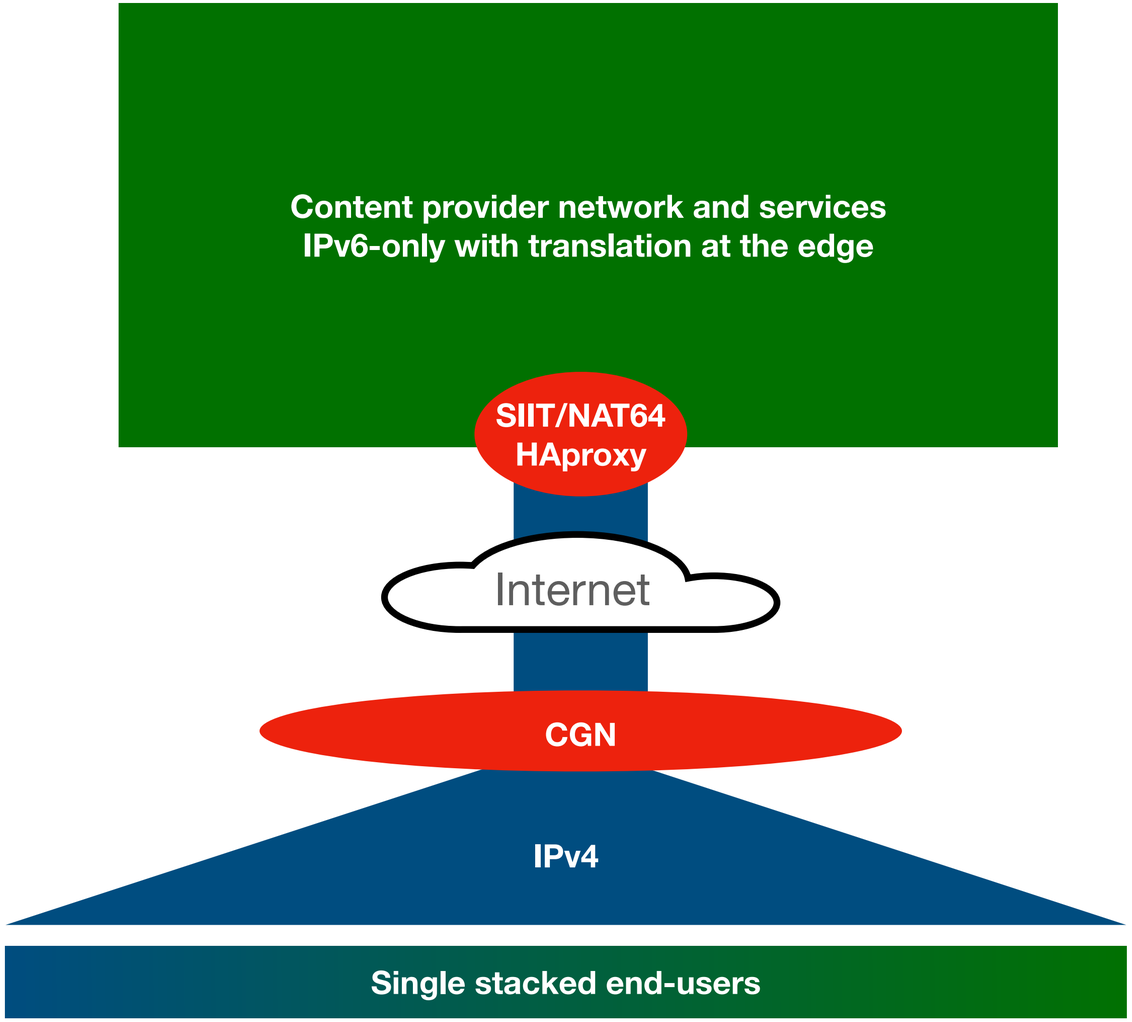


Reality of today
Dual stacked access networks



Reality of today

IPv4 CGN only access network???



Conclusions

To IPv6 or not to IPv6?

- Implementing IPv6 in access and content provider networks makes running and expanding networks cheaper
- Make an initial assessment of your network hardware and software, then make a firm plan of deployment with realistic timeline…
- There may be initial investment in hardware upgrades (if needed at all) and staff training
- Some organisations deploy IPv6 in couple of weeks, some in couple of years. It depends… :)
- Facebook and LinkedIN measured between 10% and 40% better user experience (page loads) over IPv6 compared to IPv4

Q&A

Any doubts?

- Jan Žorž <jan@6connect.com>