IPv4 to IPv6 transition
ALS Capacity Building
April 2014

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ICANN

Agenda

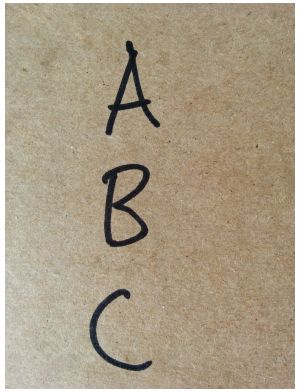
+ History of IP addressing
+ Relative sizes of IPv4 and IPv6
+ Feature equivalence
+ Transition technologies
+ Current IPv6 deployment status
+ Q&A

History of IP addressing: Vint Cerf

Vint Cerf by Joi Ito cc-by 2.0

+ Vint Cerf select the 32-bit IPv4 address space for the networking experiment he was running

History of IP addressing: 3 phases of increasing efficiency



- The initial plan was for up to 256 networks, each of which could have 16m addresses
- A year later classful addressing had been introduced
- By the mid-1990s CIDR had been developed (alongside NAT) to again increase usage efficiency

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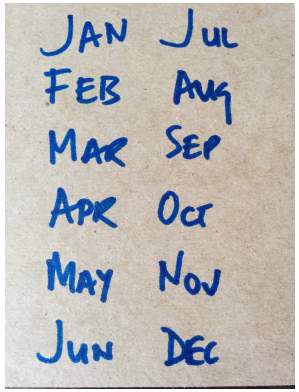
History of IP addressing: significant dates in IPv4's history



+ 1980 – the start
+ 1981 – Classes introduced
+ 1993 – CIDR introduced
+ 1997 – ARIN formed
+ 2005 – 1st Global Policy
+ 2009 – 2nd Global Policy
+ 2011 – Fully Allocated

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IPv6

IPv6 was standardized in 1996 and became available for production use in 1999

Once it became available, vendors were able to start the work needed to support it

Delegation of IPv6 address space

14 July 1999

From: IANA [iana@ISI.EDU]
Sent: Wednesday, July 14, 1999 12:32 PM
To: iana-announce@ISI.EDU
Cc: 'iana'
Subject: Delegation of IPv6 address space

Internet Community,

After much discussion concerning the policy guidelines for the deployment of IPv6 addresses, in addition to the years of technical development done throughout the Internet community, the IANA has delegated the initial IPv6 address space to the regional registries in order to begin immediate worldwide deployment of IPv6 addresses.

We would like to thank the current Regional Internet Registries (RIR) for their invaluable work in the construction of the policy guidelines, which seem to have general consensus from the Internet community. We would also like to thank the efforts of the IETF community and the support of the IAB in making this effort a reality.

If you have further questions concerning this issue, please contact your RIR, or you may also contact the IANA at iana@iana.org.

The policy guidelines can be found online at one of the Regional Internet Registries:

http://www.apnic.net
http://www.arin.net
http://www.ripe.net

This is an historic moment in the continued development of the Internet.

Thank you for your valuable support and participation in the Internet community.

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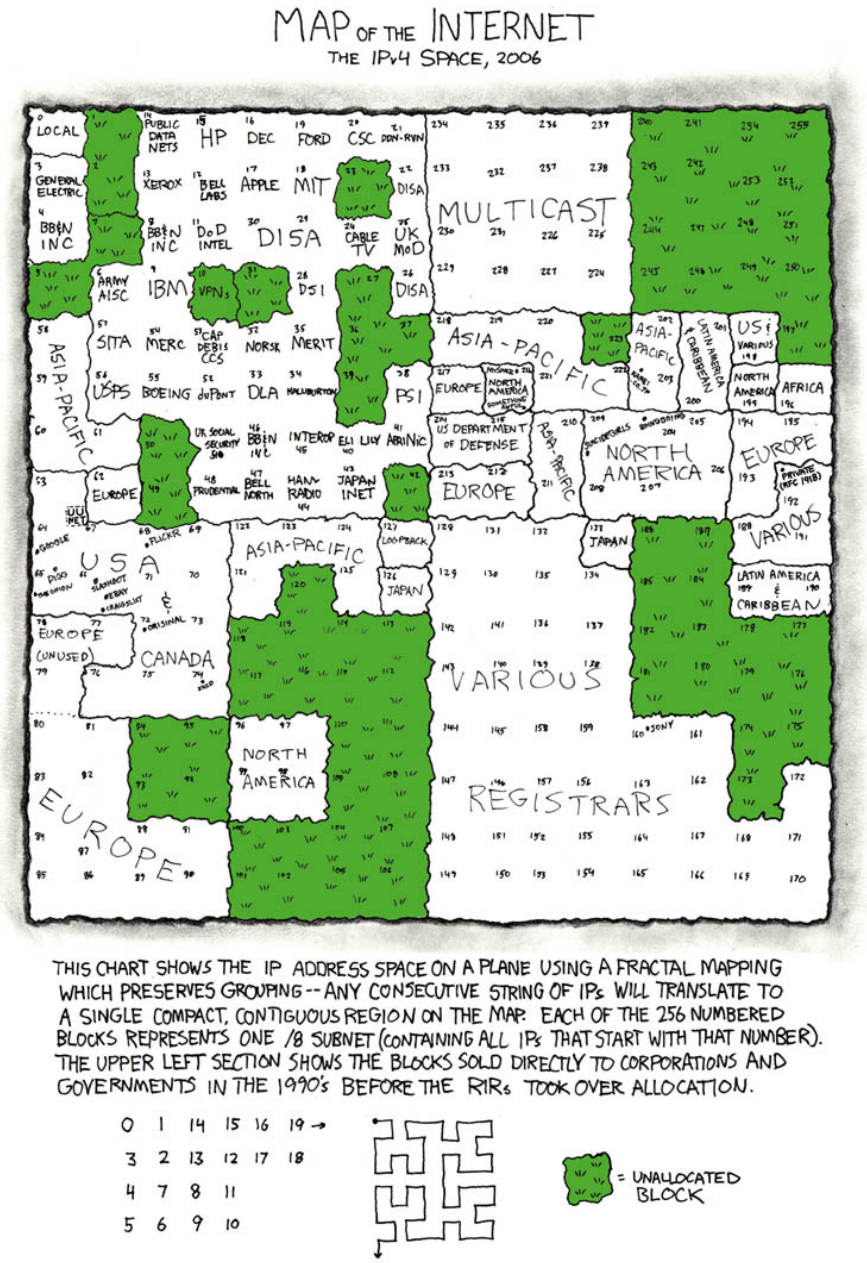
Relative size

In 2006, as we approached full allocation of IPv4 there was very little left despite a significantly smaller Internet than now



Source: xkcd.com
cc-by-nc 2.5

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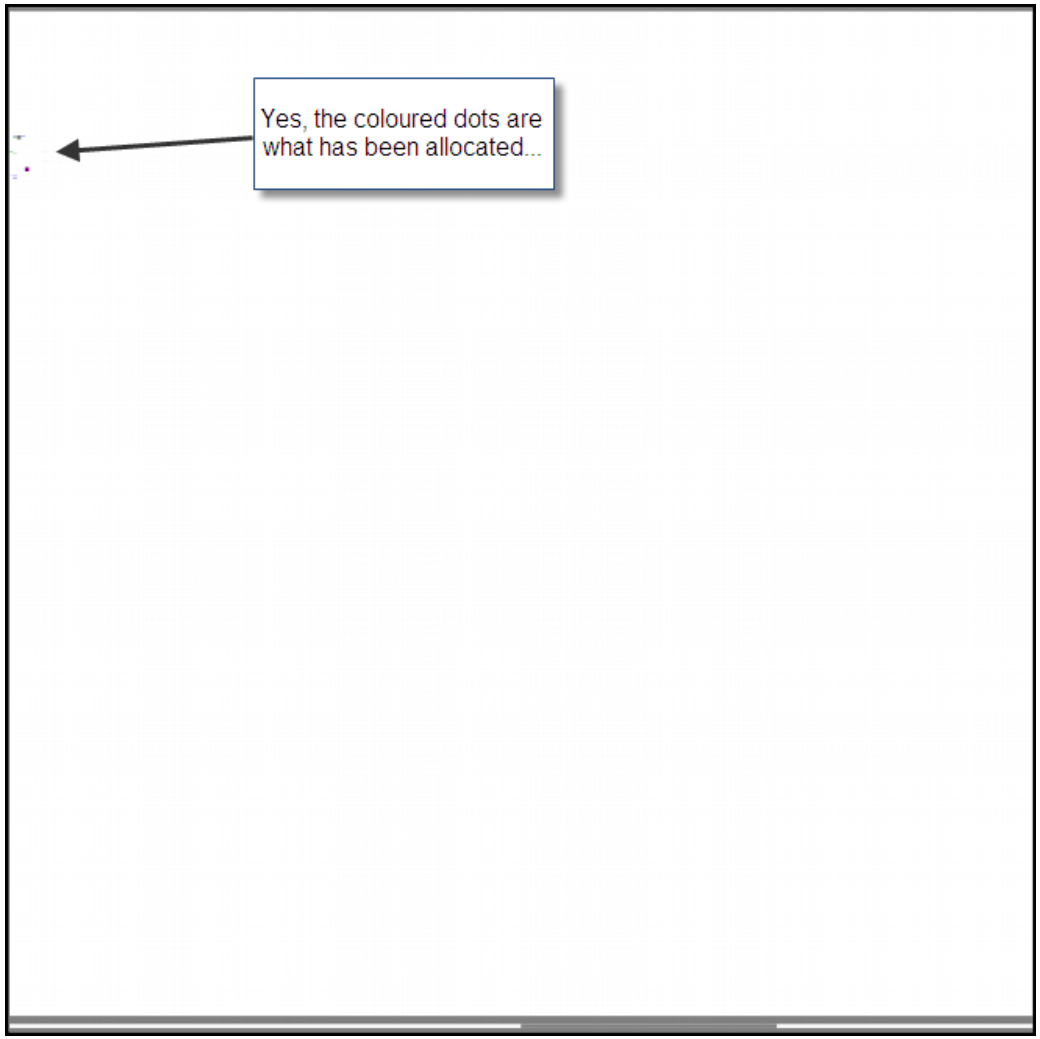
Relative size

We have made massive IPv6 allocations but this 2011 maps shows how tiny they are in the overall IPv6 space

A 128-bit space is much more than four times the size of 32-bit space



Source: http://v6stuff.leclanche.net/

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IPv6: count networks not addresses

- In IPv4 each address is precious as there are so few
- IPv6 we don't care about individual addresses and count network segments instead
- A /64 LAN segment has 18 trillion addresses
- A /48 has 65,536 /64s
- A /32 has 65,536 /48s
- A /12 has a million /32s

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Feature equivalence

+ All supported desktop and mobile OSs have full IPv6 support
+ All supported server OSs have full IPv6 support
+ Most supported infrastructure network equipment has full IPv6 support
+ Where's the problem?

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CPE

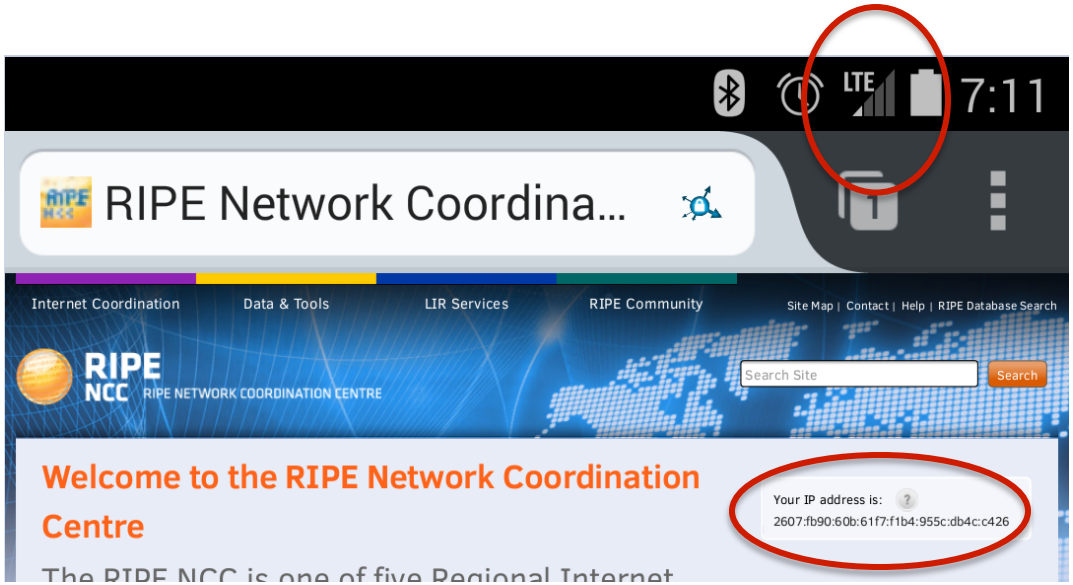
It's produced on a shoestring budget

It sits unmanaged and unloved in a dark corner until it breaks

Most of the deployed base has no IPv6 support

So where are we now?

CPE is only a problem if you rely on fixed line Internet access and that is becoming the exception rather than the norm



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Large Scale or Carrier Grade NATs (1)

- Traditionally, ISPs have given each subscriber one unique address and subscribers with multiple devices have used NAT to share that address
- PC, smartphone, tablet etc…

Large Scale or Carrier Grade NATs (2)

- CG NAT shares a single address between multiple subscribers
- There are multiple layers of NAT between a subscriber device and the Internet
- This is what telcos have done for smartphone for year, but…

Large Scale or Carrier Grade NATs (3)

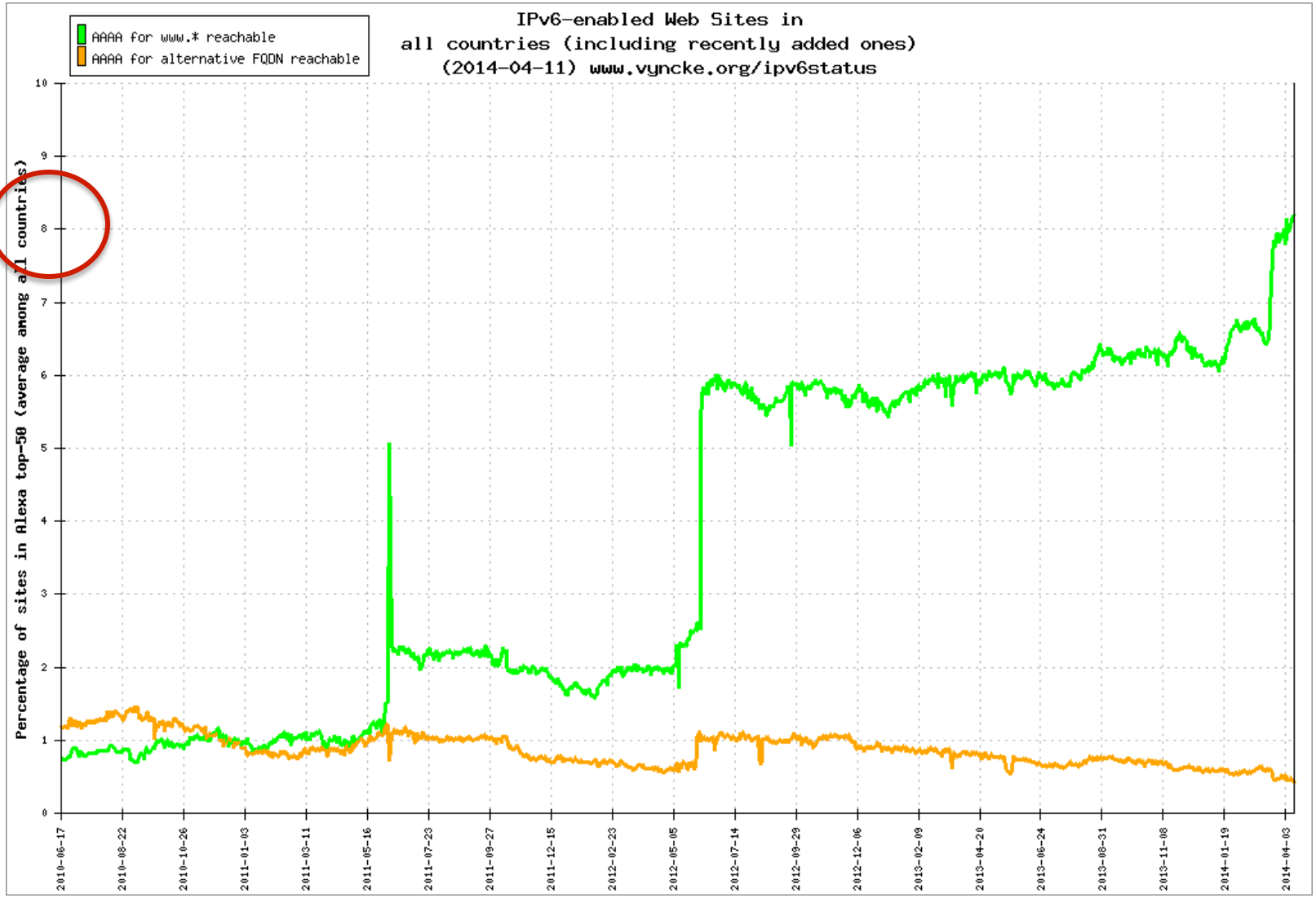
- Smartphones do not use as many connections as desktop or laptop machines
- It's the number of connections per subscriber that counts

Issues

- Regulatory requirements for logging address usage
- Potentially degrading Internet access experience
- Competition between vertically integrated media owners and telcos and start-up OTT providers

When Cloudflare switched on IPv6

Source: https://www.vyncke.org/ipv6status



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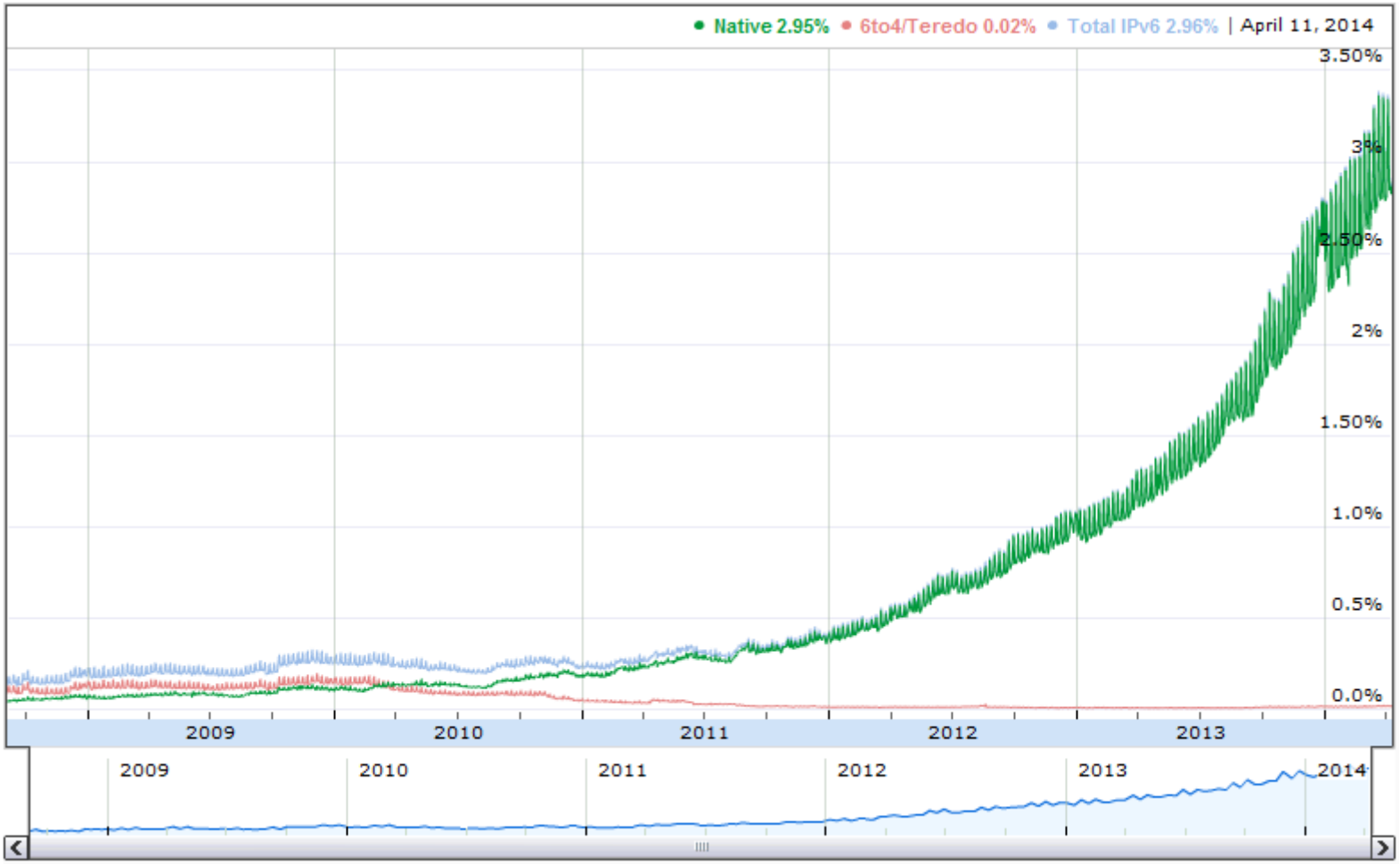
Google's view

Source: https://www.google.com/ipv6



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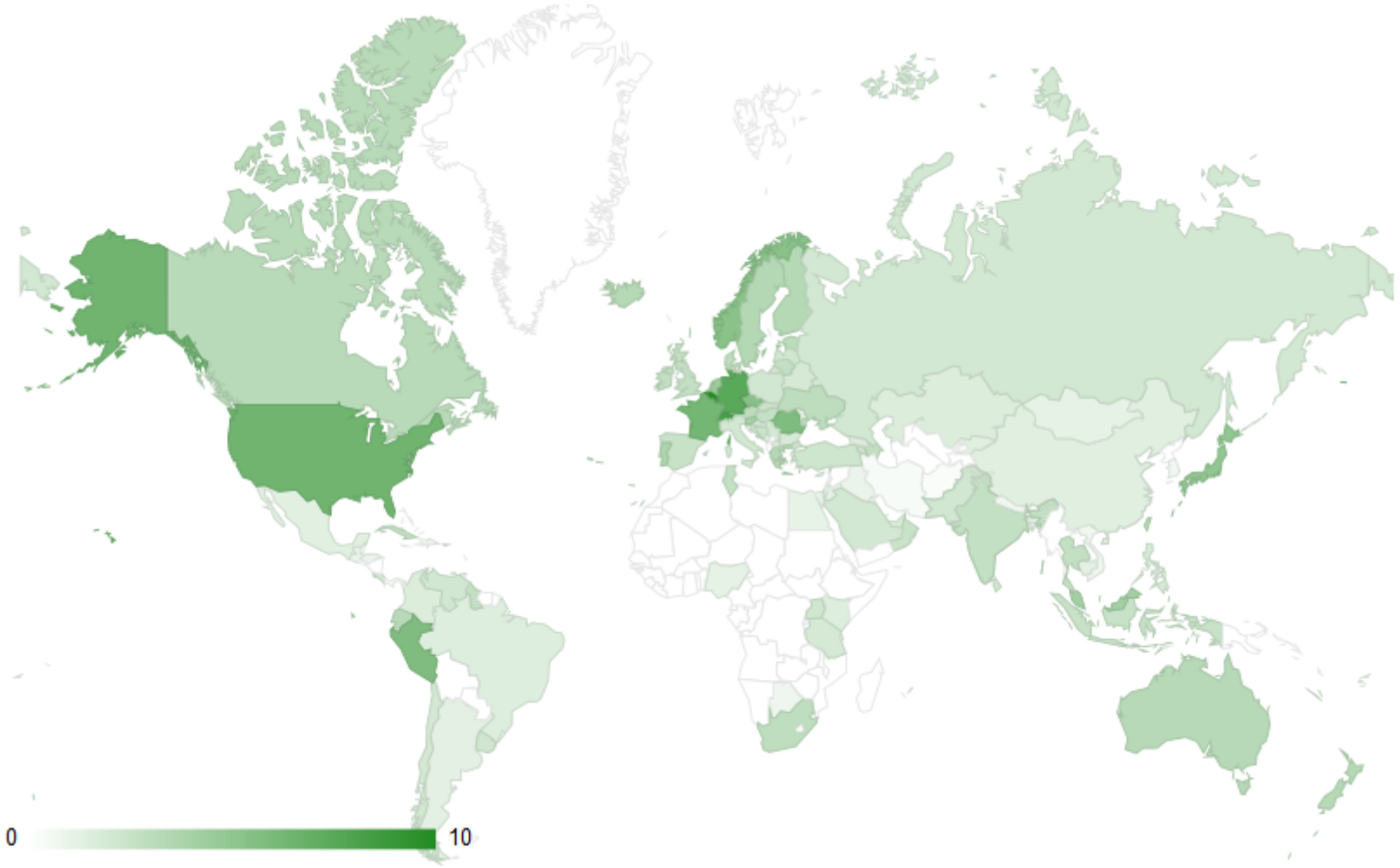
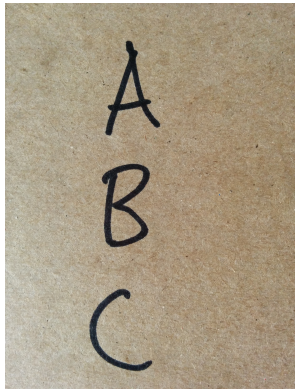
Cisco’s analysis

Source: https://6lab.cisco.com



What was the initial plan again?



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Thank You & Questions?