IPv6 Transition / Integration / Coexistence
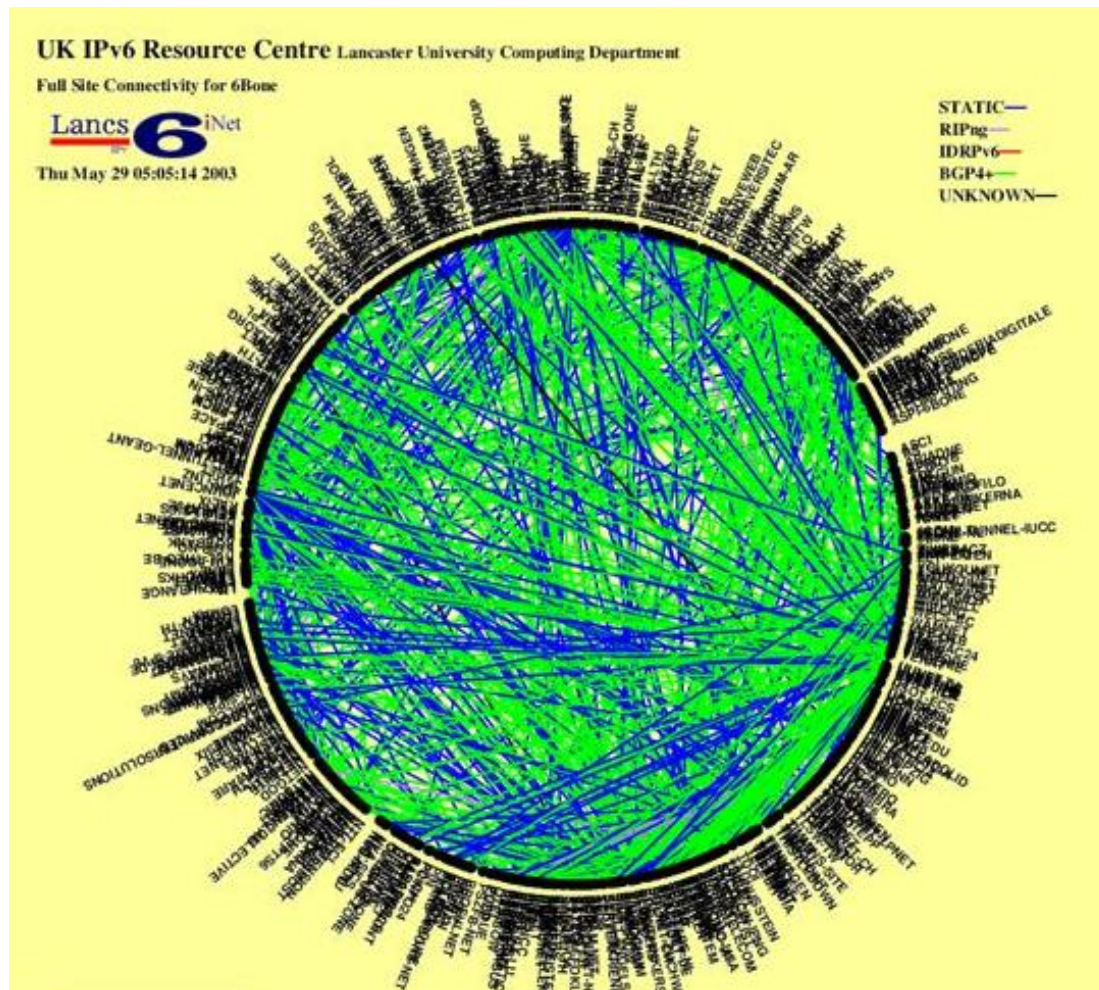## (delete as appropriate)

Tim Chown, Jisc

tim.chown@jisc.ac.uk

UK IPv6 Council Meeting

Imperial College, 25 Sep 2018

The original plan?
Based on optimistic thinking in the 1990s…

- IPv4 is everywhere

- Let's introduce IPv6 alongside IPv4

- Then we can remove IPv4

- And do all that before the IPv4 address space runs out

Early pain/gain – the 6bone years (from 1996)

UK IPv6 Resource Centre Lancaster University Computing Department

Full Site Connectivity for 6Bone

Lancs 6 iNet

Thu May 29 05:05:14 2003

STATIC—
RIPng—
IDRPv6—
BGP4+—
UNKNOWN—

A Gordian knot of IPv6-in-IPv4 tunnels, lacking routing policy.

More about just getting IPv6 working on early implementations.

Used IETF-managed 3ffe::/16 prefix before the RIRs did IPv6 allocations.

Visualisation by University of Lancaster.

https://slideplayer.fr/slide/1755670/

IETF ngtrans WG – designing transition tools

Charter for Working Group

1. Specify the tools and mechanisms that might be used for transition to IPv6.

2. Write documents outlining how the various transition tools and mechanisms might apply to various scenarios for a transition to IPv6.

3. Coordinate with the IPv6 6bone testbed, operating under the IPv6 Testing Address Allocation allocated in Experimental RFC 2471, to foster the development, testing, and deployment of IPv6.

4. Coordinate appropriately with other IPv6 related IETF activities and activities in other organizations.

Clear need for more than just basic IPv6-in-IPv4 tunnels.

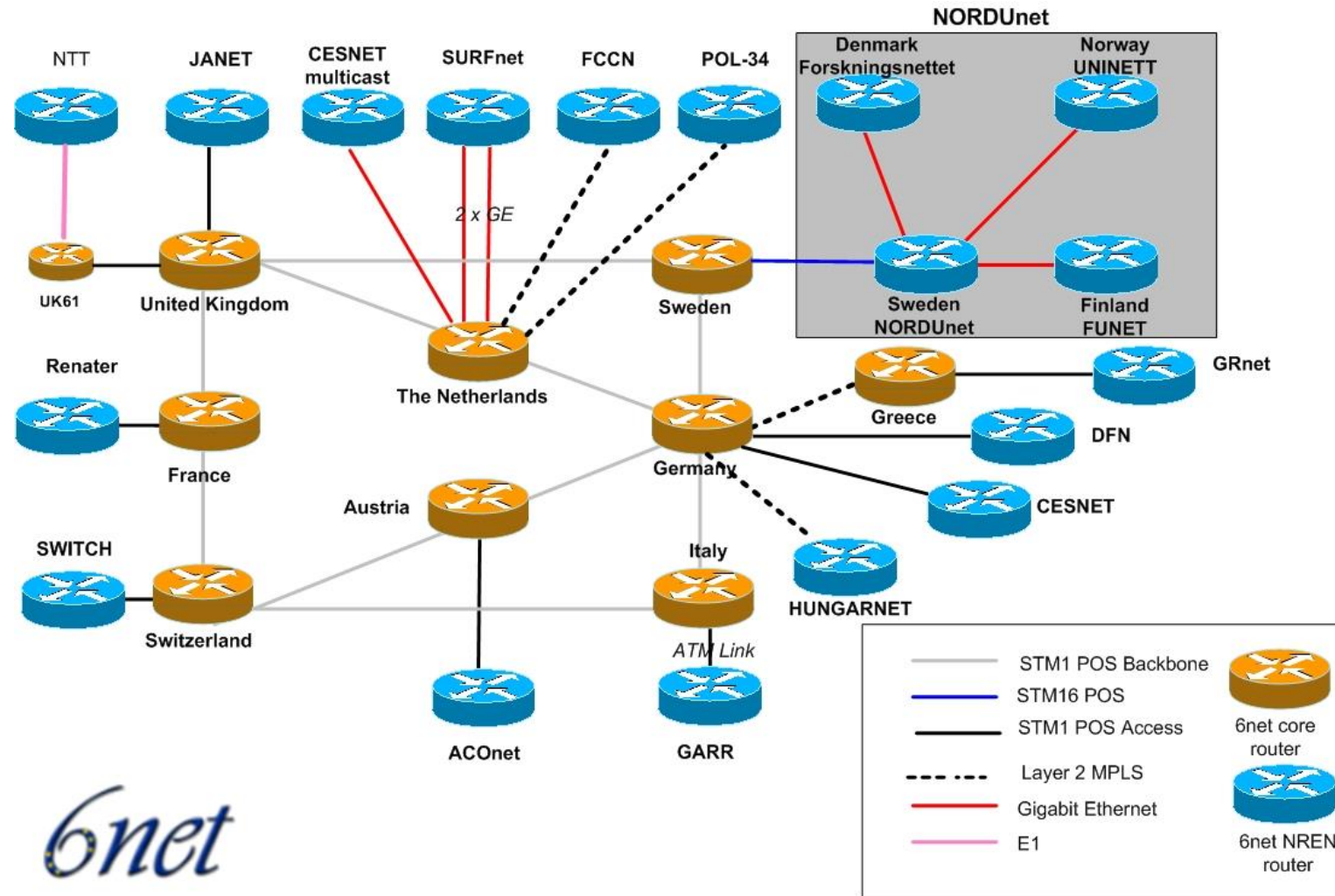WG led to the proliferation of new IPv6 transition tools.

Lots of tools.

Really, LOTS!

ngtrans WG was shut down and replaced by v6ops WG.

https://datatracker.ietf.org/wg/ngtrans/about/

Native dual-stack backbones – 6net (2002-05)

National Research and Education Networks generally led the early dual-stack production backbone deployments.

The UK NREN, Janet, has been dual-stack in production for 15+ years.

CERNET2 went IPv6-only.

Campus deployment is another question!

https://www.6net.org/publications/

IPv4 runs out (at IANA) - Feb 2011

https://www.nro.net/ipv4-free-pool-depleted/

IPv4 still works, but management and operations grow more complex; address trading, more NAT, use of CGN, etc.

The World IPv6 Launch – June 2012

http://www.worldipv6launch.org/

W6L focused on IPv6-enabling public-facing content.

Facebook, Google, Akamai and others got on board.

Also encouraged ISPs to enable 1% of their users.

Today, Facebook uses IPv6 internally, while its public-facing services are dual-stack.

IPv6-only to mobile handsets – Nov 2013

T-Mobile Goes IPv6 Only on Android 4.4 Devices ···T···Mobile·

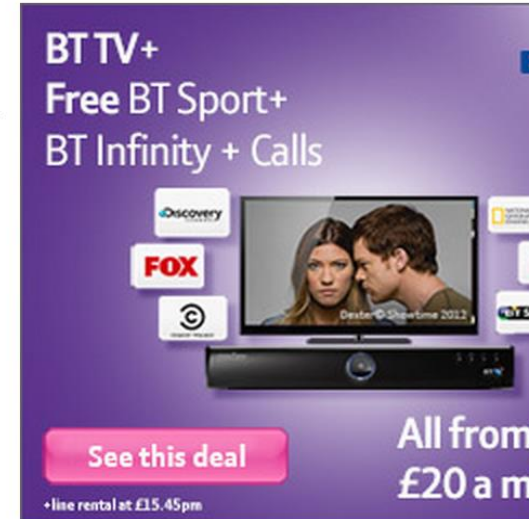by whfsdude 06:27PM Monday Nov 04 2013

T-Mobile and MetroPCS users with Android 4.4 KitKat will default to IPv6 only for connecting to the mobile network. The changes are present in Android code commit 4b3880d which changed the default access point name (APN) protocol to IPv6. IPv4 connectivity will be provided by a transition mechanism known as 464XLAT.

T-Mobile's transition to IPv6 started in 2010 when they launched a IPv6 friendly user trial (beta). The friendly user trial used a technology called DNS64/NAT64 which provided access to IPv4.

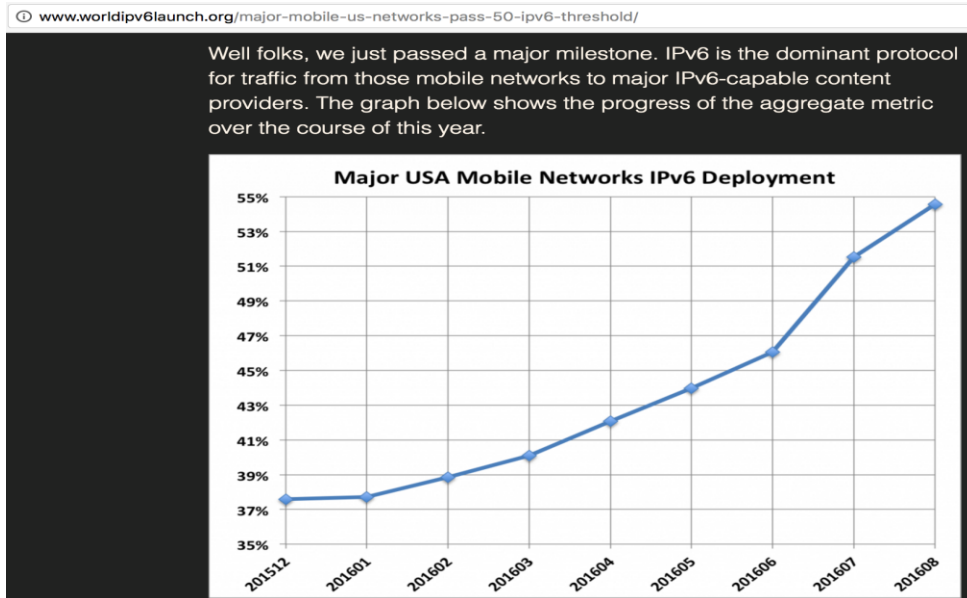However, DNS64 does not work with IPv4 literals. The friendly user trial revealed lots of breakage with popular apps such as Skype and Netflix which use IPv4 literals in their applications.

To address the IPv4 literal problem with DNS64 and NAT64, T-Mobile's Cameron Byrne co-authored a new standard known as 464XLAT. 464XLAT calls for a CLAT daemon to provide local IPv4 connectivity to the smartphone.

IPv6 on US mobile handsets - 2016

www.worldipv6launch.org/major-mobile-us-networks-pass-50-ipv6-threshold/

Well folks, we just passed a major milestone. IPv6 is the dominant protocol for traffic from those mobile networks to major IPv6-capable content providers. The graph below shows the progress of the aggregate metric over the course of this year.

Major USA Mobile Networks IPv6 Deployment

IPv6-only to the handset
Simplicity for the operator
EE has done the same in the UK

https://www.facebook.com/ps/posts/10157221242360858

Paul Saab
17 August at 07:08

Today marks the first day that more people used IPv6 to access Facebook than IPv4 from the 4 major USA mobile networks. This is a huge milestone in just 4 short years since World IPv6 Launch in 2012.

You, Steve Simlo, Dan York and 1.5k others

146 shares   14 comments

Dave Lloyd It's pretty awesome to be at the front of such a huge shift in technology
Like · Reply · 3 · 17 August at 12:52

Over 50% of traffic to Facebook
from big four US mobile operators
was native IPv6 as of summer 2016

IPv6 - up and to the right - 2009 to today

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.

Native: **24.19%** 6to4/Teredo: **0.00%** Total IPv6: **24.19%** | **23 Sep 2018**
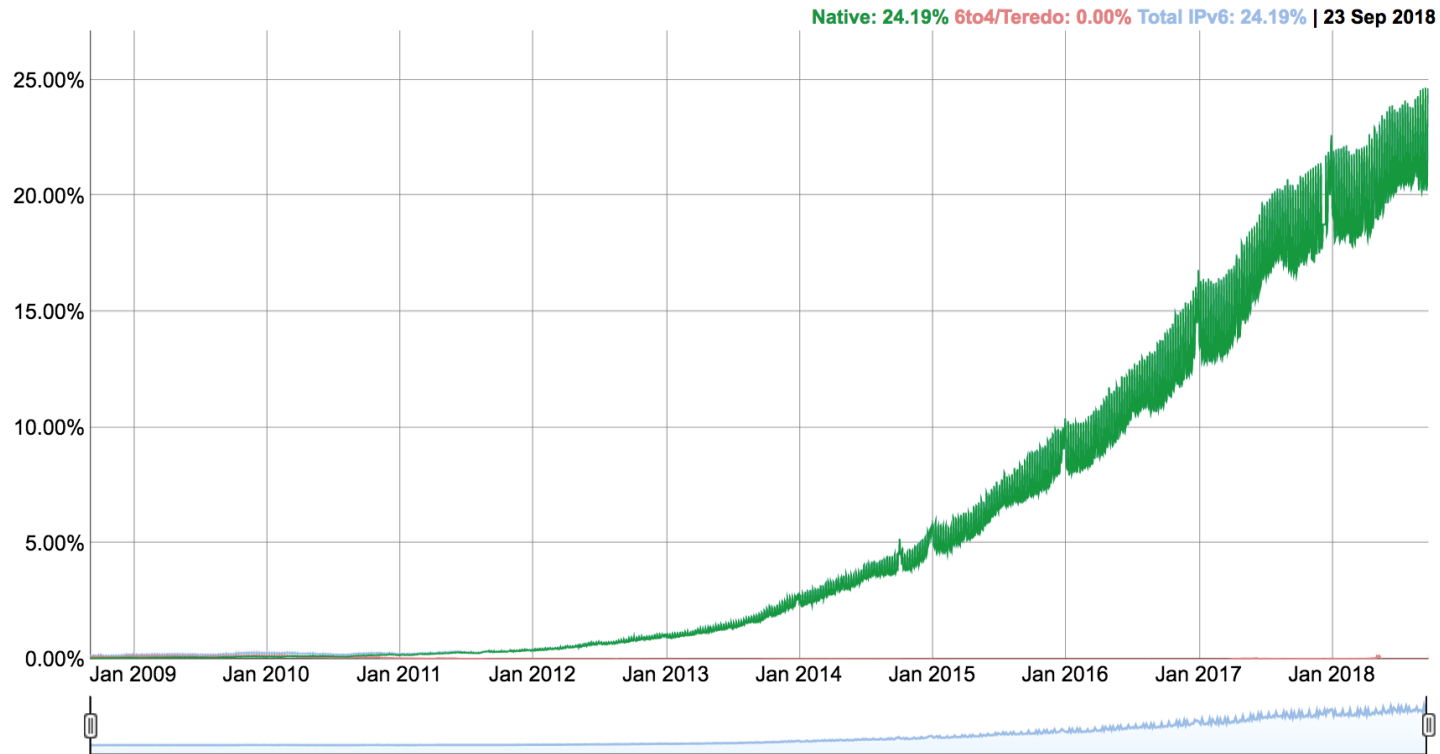
All the work before 2012 was important, but negligible IPv6 growth before 2012.

Doesn't show whether devices are in dual-stack or IPv6-only environments. Or mobile vs enterprise.

Growing desire to explore IPv6-only beyond just mobile. How realistic is this today?

https://www.google.com/intl/en/ipv6/statistics.html

Wading in the sea of IETF transition tools…

6over4

6PE

464XLAT

LISP

DSTM

ISATAP

MAP T/E

Tunnel broker

RFC 4213

Dual stack

GRE

LW4o6

6rd

NAT-PT

DS Lite

6to4

SIIT

dIVI

NAT64 / DNS64

Teredo

There is no shortage of choice in transition tools.

Some older tools are still applicable, others not so.

The question is which tool(s) are appropriate for your own scenario. There is no grand plan.

That's what we'll be looking at and discussing today.

(Note: this is NOT a complete list!)