New Zealand and Ireland: IPv4 Exhaustion and IPv6 Deployment Challenges for Islands
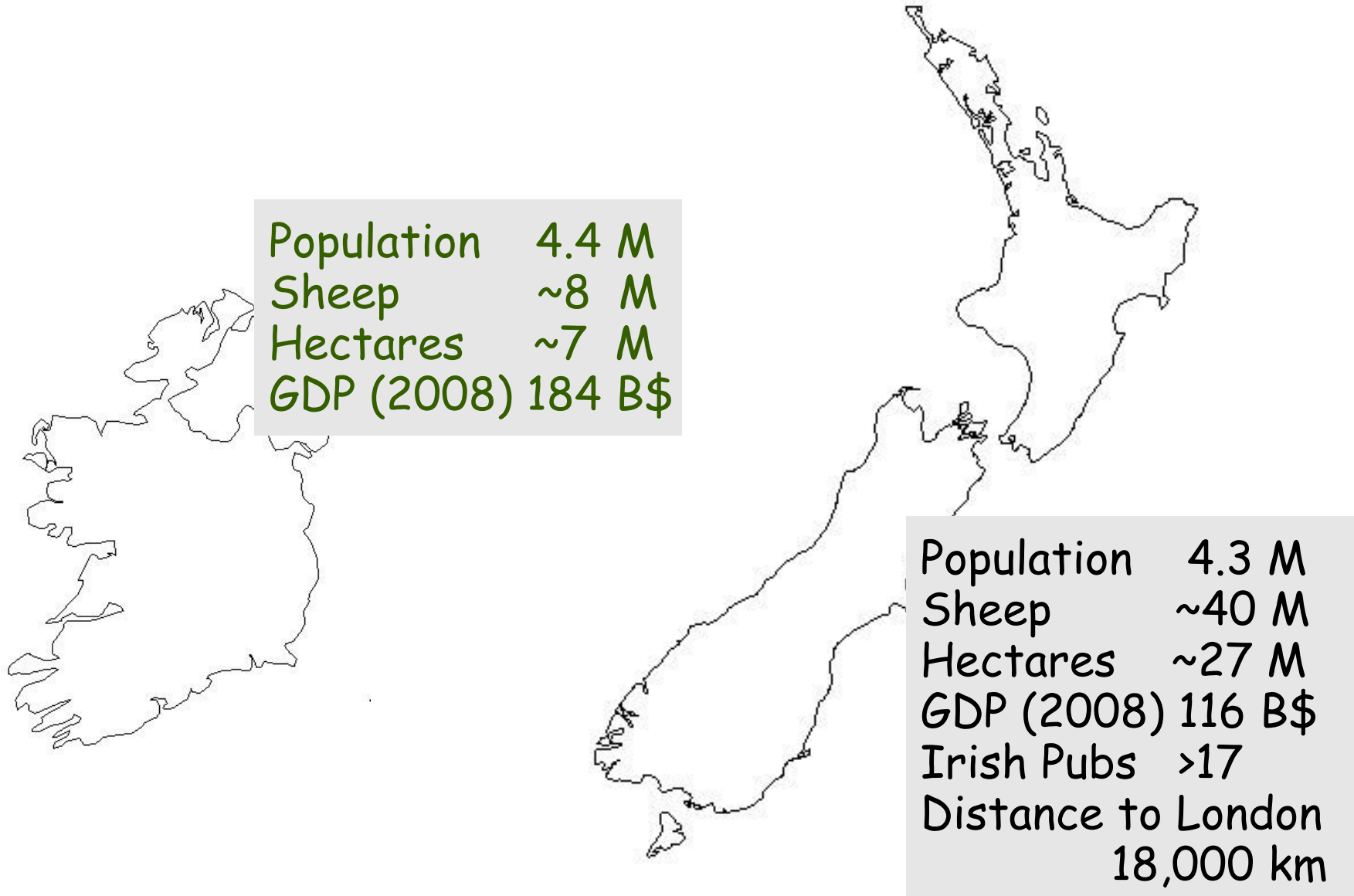
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May 2010

IPv6
Irish IPv6 Task Force

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND
Te Whare Wānanga o Tāmaki Makaurau

Two island nations

Population   4.4 M
Sheep   ~8 M
Hectares   ~7 M
GDP (2008) 184 B$

Population   4.3 M
Sheep   ~40 M
Hectares   ~27 M
GDP (2008) 116 B$
Irish Pubs   >17
Distance to London
          18,000 km

Two island nations

Population 4.4 M
Sheep ~8 M
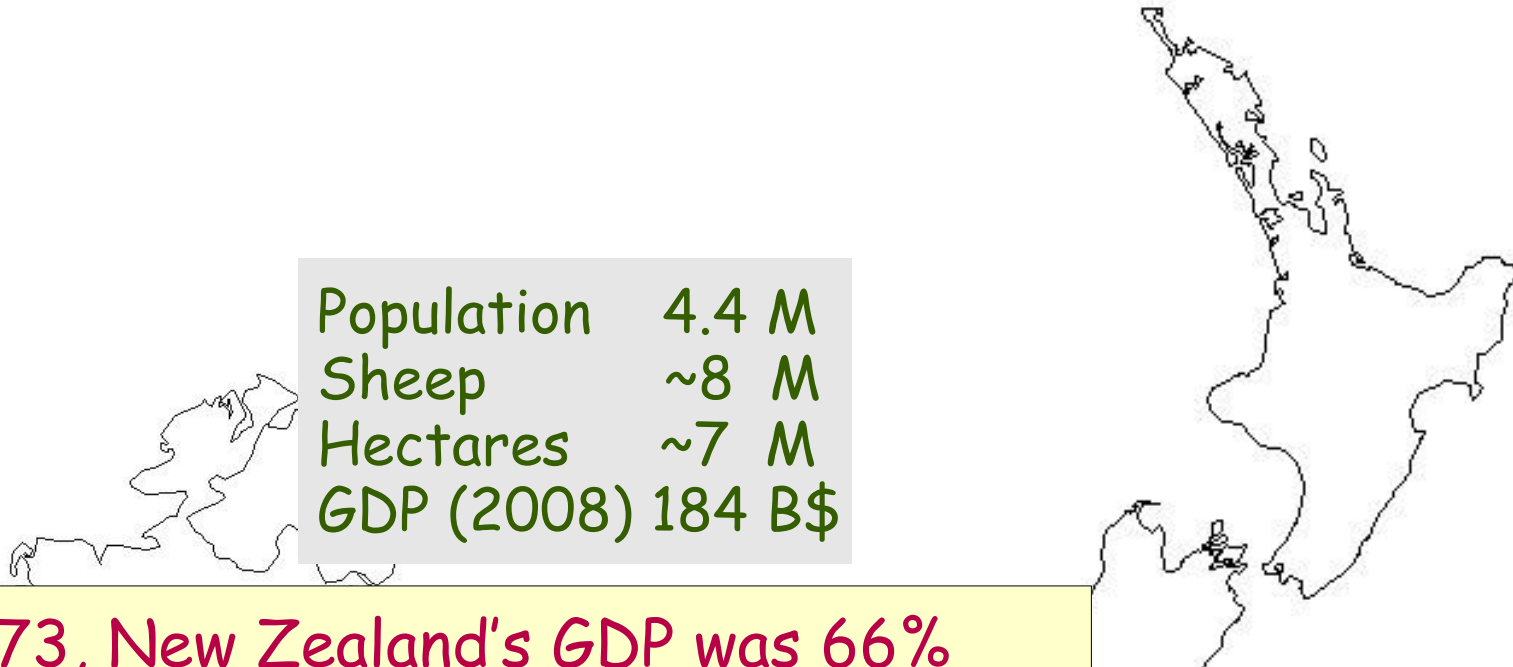Hectares ~7 M
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Something like 20% of New Zealand's wave of immigrants in the late 19th and early 20th centuries were Irish.

More than 25% of government assisted immigrants were Irish. During the 1870s, more Irish women than men migrated to New Zealand.

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Two island nations

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In 1973, New Zealand's GDP was 66% higher than Ireland's. By 2008, Ireland's was 59% higher than NZ's.
[We've all had a hard time in 2009-2010.]

The UK and Ireland joined the European Community in 1973, and NZ soon lost its protected access to the UK market.

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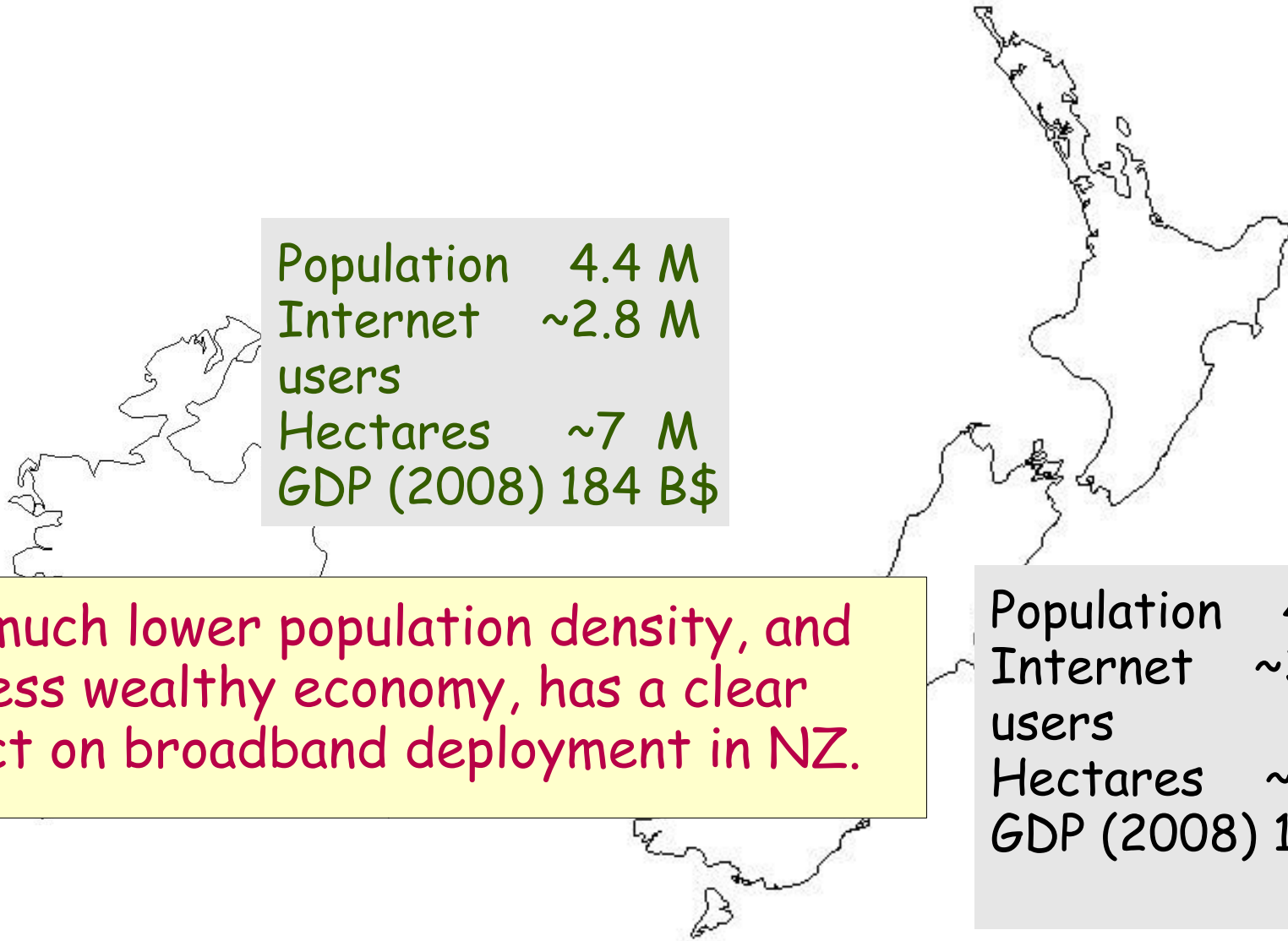
Christmas tree in New Zealand
8 Dec 2009

Crowded beach in New Zealand
13 Feb 2010

Two island nations

Population   4.4 M
Internet   ~2.8 M
users
Hectares   ~7 M
GDP (2008) 184 B$

The much lower population density, and the less wealthy economy, has a clear impact on broadband deployment in NZ.

Population   4.3 M
Internet   ~3.0 M
users
Hectares   ~27 M
GDP (2008) 116 B$

Networking scene in NZ

- Internet connectivity since 1989
- About 40 ISPs active
  - 1.6 M subscribers (25% still on dial up)
- KAREN (Kiwi Academic and REsearch Network)
  - national core 10 Gb/s
  - trans-Pacific link 622 Mb/s.
- Lively operators group (NZNOG)
- InternetNZ association
  - "Keeping the Internet open and uncapturable"

IPv6 scene in NZ

- KAREN and numerous commercial ISPs already offer IPv6 service

  - lively topic of discussion in NZNOG meetings

  - users are stymied by IPv4-only CPE

  - some usage of Teredo to bypass that problem

- We have a national IPv6 Task Force and an IPv6 technical SIG (http://www.ipv6.org.nz)

  - still seeing a very "mixed" picture of IPv6 readiness at http://www.geek.nz/ipv6/

- There's clearly a big problem getting CIOs and above to recognise that it's *their* problem.

What does the NZ Government think about that?

- "...the Minister for Communications and Information Technology does not believe that regulatory intervention is appropriate.

- Adoption of IPv6 needs to be lead by the private sector. The private sector must recognise that adopting IPv6 is in their own best interests to protect their investment in online capabilities into the future.

- ...Where the government can assist is in raising awareness." (August 2009)

IPv4 exhaustion: The Ticking Clock

- It's beyond debate, it's started.

- Estimated exhaustion of addresses at global registry (IANA): *Sept 16, 2011*

- Estimated exhaustion of addresses at regional registries (ARIN, etc.): April *29, 2012*

- Get the latest estimates at

   http://www.potaroo.net/tools/ipv4/

- Estimated exhaustion of IPv4 addresses among ISPs: *now through 2015*

What happens next?

- Hoarding and horse trading of residual IPv4 space

- Multiple layers of NAT

- Progressive deployment of IPv6
  - Millions of mobile users with **no** IPv4 address

- An indefinite period of IPv4/IPv6 interworking

  - This concerns you *especially* if you operate IPv4-only services. Users who only have IPv6 access will need to reach you.

What happens if you do nothing?

- ISPs: one day (by 2015?), you run out of addresses
  - Two choices:
    - 1. share addresses between customers, or
    - 2. no new customers.
  - Sharing addresses = more NAT = more user disconnects = more help desk calls = less money.
- Content and service providers:
  - No choices, you are at the mercy of your ISP.
  - More NAT = more user disconnects = (etc.).
  - Millions of IPv6 only customers can't reach you = more help desk calls = less money.

IPv6 - State of the Union

- The Great Disillusionment
- What the IETF has been up to in the last year
  - tunnels**++**
  - NAT**++**
- What ISPs are doing and planning

Disillusionment: Reality breaks in, as always

- When the IETF first considered deployment scenarios, the idea was that IPv6 would deploy before IPv4 ran out.

FAIL

- This failure changes the relevant transition models.
  - More need for interworking than ever expected.
  - The only commercially sane assumption is that v6 clients will need to access v4 services indefinitely.
- This has been driving IETF work for a couple of years.

Tunnels

- *Reminder:* Deploying IPv6 in parallel with IPv4 (the "dual stack" model) is by far the simplest method, in most cases.

- But some large ISPs find this operationally challenging, and prefer to tunnel v6 in v4 or conversely.

- Extra standards work is continuing in the IETF to make this easier than with the basic tunneling standards.

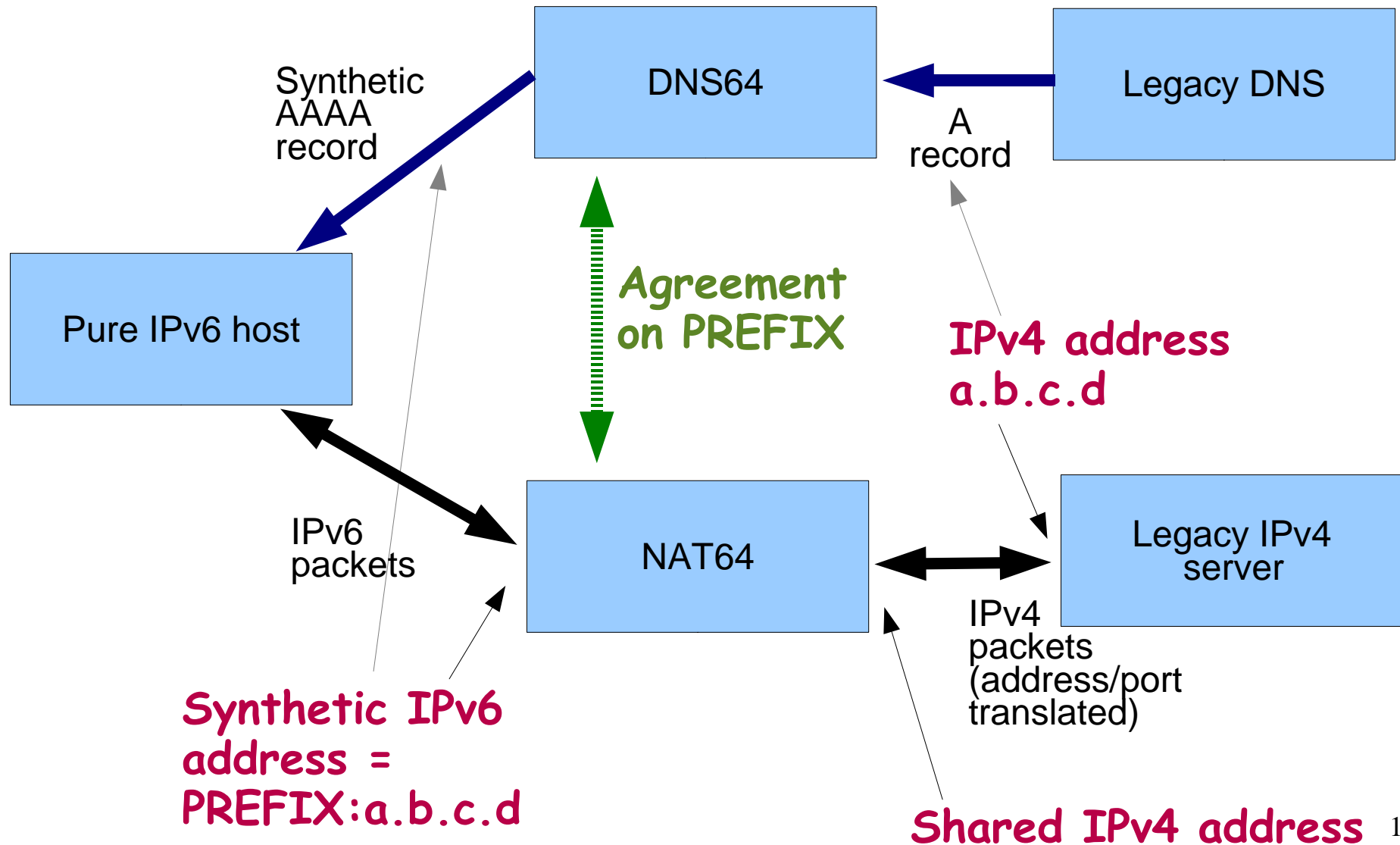- <u>Dual Stack Lite</u> and <u>6rd</u> are the buzzwords.

Translation: NAT64

- *Reminder:* IPv4 to IPv6 packet translation has always been viewed as problematic, and should only be used when neither dual stack nor tunnels can succeed.

- However, many operators (especially in the mobile "LTE" world) are convinced that they will soon have millions of IPv6-only subscribers needing access to legacy IPv4-only services.

- Therefore, the IETF has taken up the <u>NAT64</u> challenge.

NAT64 only solves one problem

- IPv6-only client (no v4 address, no v4 connectivity) needs to initiate communication with an IPv4-only server.

  - This is a case of mutual incomprehension. The requirement cannot be met by the conventional dual stack approach or by a tunnel.

- NAT64 doesn't tackle any other cases.

- NAT64 comes with a separate DNS64 magic box.

NAT64 Components

Synthetic AAAA record

DNS64

Legacy DNS

A record

Pure IPv6 host

Agreement on PREFIX

IPv4 address a.b.c.d

IPv6 packets

NAT64

Legacy IPv4 server

IPv4 packets (address/port translated)

Synthetic IPv6 address = PREFIX:a.b.c.d

Shared IPv4 address

Recent survey of ISPs
(by Sheng Jiang (Huawei) and me)

- 31 ISPs replied
- 65% European ISPs, others from NA and AP
- Commercial ISPs operating nationally predominate
- 30 customers up to 40 million
  - some very large providers chose not to answer about the number of customers

http://tools.ietf.org/id/draft-ietf-v6ops-isp-scenarios

Bias

- Those who chose to reply were self-selected and we can make no claim of statistical significance or freedom from bias in the results.

- In particular, we assume that ISPs with a pre-existing interest in IPv6 are more likely to have replied than others.

IPv6 requirement

- 61% of ISPs report that some big customers are requesting IPv6 already
- When will 10% of your customers require IPv6?
  - 2010 to 2017
- When will 50% of your customers require IPv6?
  - 2011 to 2020
- When do *you* require IPv6 to be a standard service?
  - 2010 to 2015; most common answer = 2011

Crystal ball

- What is your planned date for regular IPv6 service?
  - *latest* date given was 2013
- When will IPv6 be 50% of traffic?
  - the most common answer is 2015

Service status

- 42% of respondents have IPv6 now as a regular service

  - in general it is used by fewer than 1% of customers

- 48% of respondents have IPv6 deployment in progress or planned

  - these all plan at least beta-test service in 2010

Equipment unable to support IPv6

- CPE, CPE, CPE, CPE, CPE, CPE, CPE, CPE, CPE

- Some of the following:

  - Handsets
  - DSLAMs
  - Routers (including several specific models)
  - Traffic management boxes; load balancers
  - VPN boxes
  - SIP boxes
  - Management interfaces & systems
  - Firewalls

- Most billing systems.

IPv4-IPv6 interworking

- 58% of ISPs don't expect IPv6-only customers
  - Mobile operators are certain they will have millions.
  - 5 ISPs report customers who explicitly refused to consider IPv6.
- How long will users run IPv4-only applications?
  - The most frequent answer is "more than ten years".
- Is IPv6-IPv4 interworking at the the IP layer needed?
  - 90% say yes
    - 30% plan NAT64
    - 23% rely (falsely) on dual stack
    - the others have no plan

Some quotes

- "Just do it, bit by bit. It is very much an 'eating the elephant' problem, but at one mouthful at a time, it appears to be surprisingly easy."

- "We are planning to move all our management addressing from IPv4 to IPv6 to free up IPv4 addresses."

- "Customer support needs to be aware that IPv6 is being started in your network, or servers. We experienced many IPv6 blocking applications, applications that do not fall back to IPv4, etc. The most difficult part may be to get engineers, sales, customer support personnel to like IPv6."

Summing up

- IPv6 is coming, after a long wait
  - Not really hard, subject to product releases
- BUT...
  - There will be many millions of IPv6-only users
  - IPv4 interworking is needed indefinitely
  - If you are running IPv4-only services, this is *not* somebody else's problem. Your revenue is at risk.
- Small countries have one distinct advantage:
  - Smaller technical and business communities communicate more efficiently, and right now spreading awareness of this risk is *the* priority.