IPv6 @ NANOG, APRICOT and other places

Philip Smith

<pfs@cisco.com>

IPv6 Summit/PhNOG3

21st-22nd May 2008

Manila

Introduction

- History:

  IPv6 transport provided by default at many Internet network operation conferences since the late 90's

- Implementation & Uptake:

  Dual stack (IPv4 and IPv6)

  IPv6 tunnel from conference to "6bone"

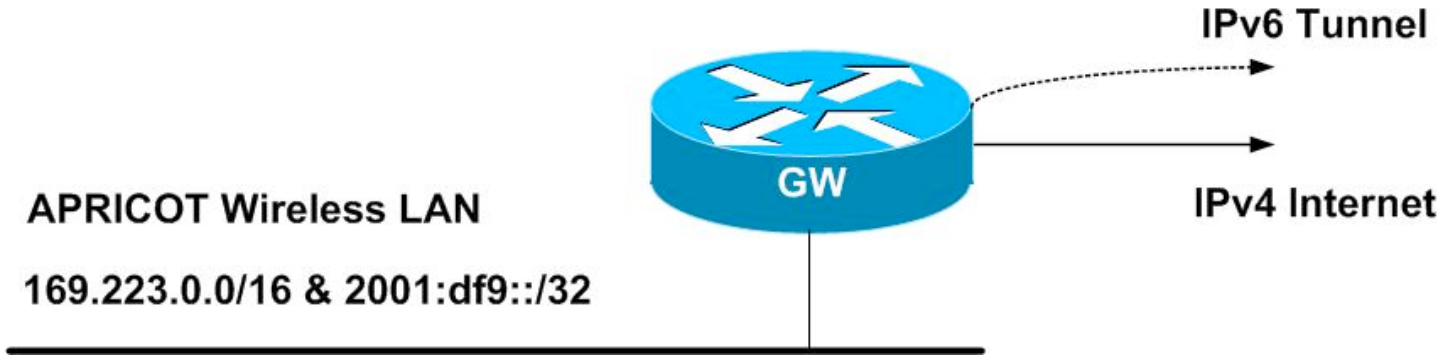
  Usage was light, mostly from *BSD/Linux users and early adopters using Win2K and latterly WinXP

  More recently Mac users joined in, with MacOS 10.2 onwards

  Launch of Windows Vista with IPv6 on by default…

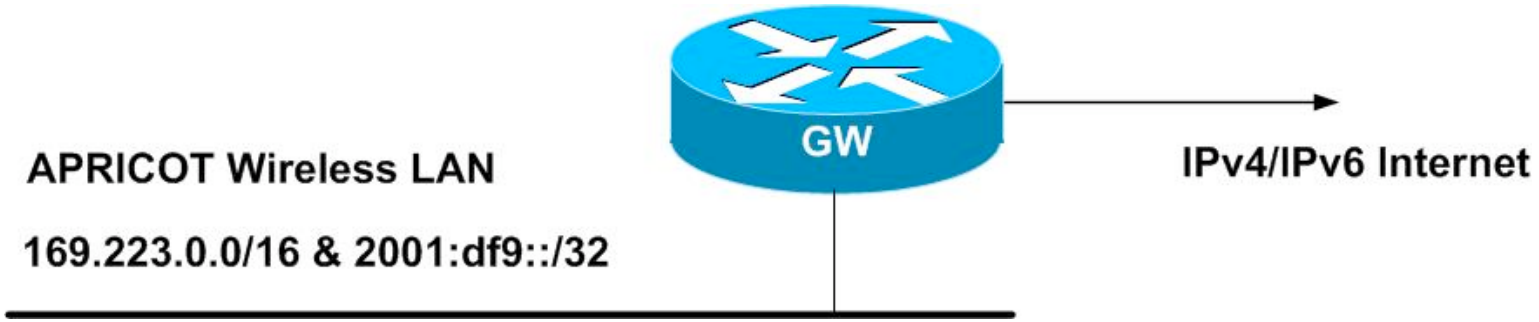
- Dual stack is fine, but what are the dependencies on IPv4??

Early APRICOT LANs



- Network was provided with IPv4 and IPv6
- Upstream ISP had no native IPv6 capability, so:
  - Tunnel to 6bone node **or**
  - Tunnel to IPv6 node somewhere
  - Usually resulted in suboptimal routing

Recent APRICOT LANs



- From around 2002, requirement was that local conference connectivity host supplied native IPv6
  - Didn't happen, usually
  - Even APRICOT 2008 in Taiwan, IPv6 was via a tunnel

IPv6 Hour Background

- With imminent IANA IPv4 free-pool depletion, idea to provide more “realistic” environment representative of post 2010/11
  - Can’t assume public IPv4, or even NAT’ed private IPv4
- NANOG & APRICOT IPv6 Hours:
  - NANOG Steering Committee: NANOG 42
  - APRICOT Management Committee: APRICOT 2008
  - Small team of cross-industry interested contributors:
    - Wiki (**www.civil-tongue.net/6and4/**) and mailing list

IPv6 Hour Design

- Plan to offer a “pure” IPv6 network
  - No IPv4 at all
- IPv6 Internet isn’t as extensive as IPv4!
  - How can IPv6-only hosts reach IPv4-only devices?
  - Only way (just now) is NAT-PT
- NAT-PT translates between IPv6 and IPv4
  - RFC2766 (Proposed Standard)
  - RFC4966 (Informational) concludes that NAT-PT should be declared historical

Design Phase Discoveries

- Windows XP cannot do DNS resolution over IPv6
  - Microsoft indicates the fix is to “upgrade” to Vista
  - Need to provision special wLAN with IPv4 resolver, just for XP
- Firefox, Thunderbird, etc
  - Ship with IPv6 support, but is turned off depending on platform
  - Need instructions on how to switch on IPv6 per client
- Only Vista has DHCPv6
  - No plans for MacOS
  - “Early” clients available for *BSD/Linux systems

Design Summary

- Original wLAN provision
  - IPv4, IPv6, DHCPv4, dual stack DNS resolver (as before)
  - Added DHCPv6 for Vista etc
- New: IPv6-only wLAN provision
  - IPv6 only, DHCPv6, NAT-PT
  - IPv6 DNS resolver (on local LAN or elsewhere)
- New: IPv6-XP wLAN provision
  - IPv6 only, IPv4 (private & non-routed) by DHCP, DHCPv6, NAT-PT
  - Dual stack DNS resolver on local LAN

Admin & Infrastructure

- Admin LAN
  - Wireless access points (supporting multiple SSIDs)
  - DNS resolver (dual stack)
  - Monitoring systems & Netflow collector
- Conference Router
  - NAT-PT and DHCPv6
- DNS Application Layer Gateway
  - Router supposedly supports
  - Use **totd** proxy fronting DNS Resolver (standalone or integrated)
    - **www.vermicelli.pasta.cs.uit.no/software/totd.html**

DNS ALG: How It works

- Client asks for address of requested end-site:

  Client is configured with **totd** proxy as resolver

- Totd function:

  IPv6 proxy address, e.g. 2001:db8::/96

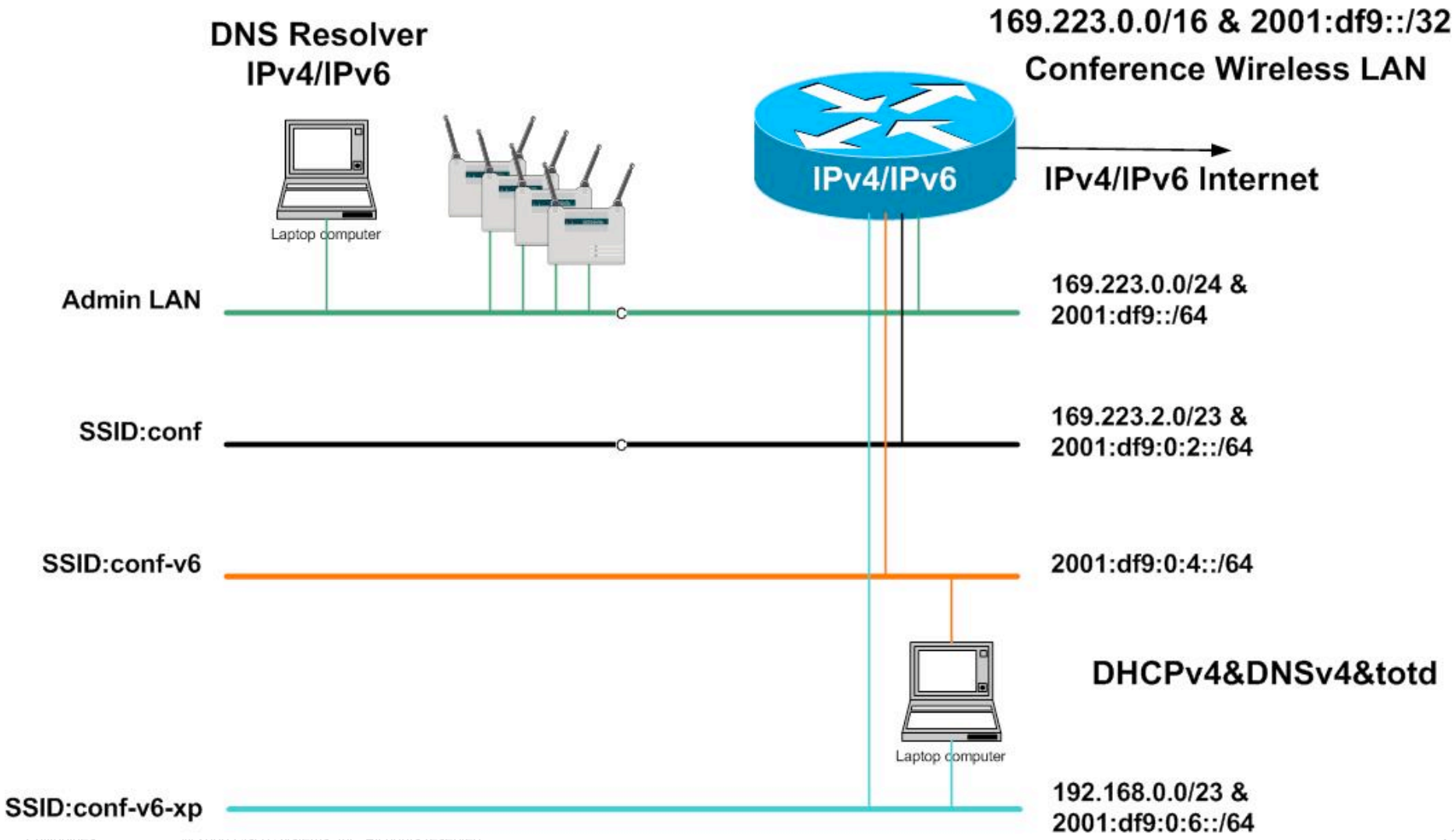
  Queries main resolver for end-site address

  IPv4 addresses in responses are mapped into IPv6 proxy address used on IPv6-only LAN

  e.g. 192.168.50.200 is mapped to 2001:db8::c0a8:32c8

- NAT-PT device translates packets from IPv6 proxy address into IPv4 address

IPv6 Hour: Network Design



SSID: conf

- IPv4 wLAN dual stack with IPv6

  Default Gateway: 169.223.2.1 & 2001:df9:0:2::1

- DHCPv4 & DHCPv6 server running on router

  169.223.2.0/23 for IPv4 LAN

  2001:df9:0:2::/64 for IPv6 LAN

- DNS resolver on Admin LAN

  169.223.0.5 & 2001:df9::5

SSID: conf-v6

- Pure IPv6 LAN
  - Default Gateway: 2001:df9:0:4::1
- DHCPv6 server running on router
  - 2001:df9:0:4::/64 for IPv6 LAN
- DNS resolver on Admin LAN
  - Fronted by **totd** on the local LAN
  - **totd** address: 2001:df9:0:4::2
- NAT-PT here
  - Stand-in address: 2001:df9:0:8::/96
  - IPv4 pool: 169.223.8.0/23

SSID: conf-v6-xp

- IPv6 LAN supporting Windows XP

  Default Gateway: 2001:df9:0:6::1

- DHCPv4 & DHCPv6 server running on router

  192.168.0.0/23 for IPv4 LAN – non-routed

  2001:df9:0:6::/64 for IPv6 LAN

- DNS resolver on Admin LAN

  Fronted by **totd** on the local LAN

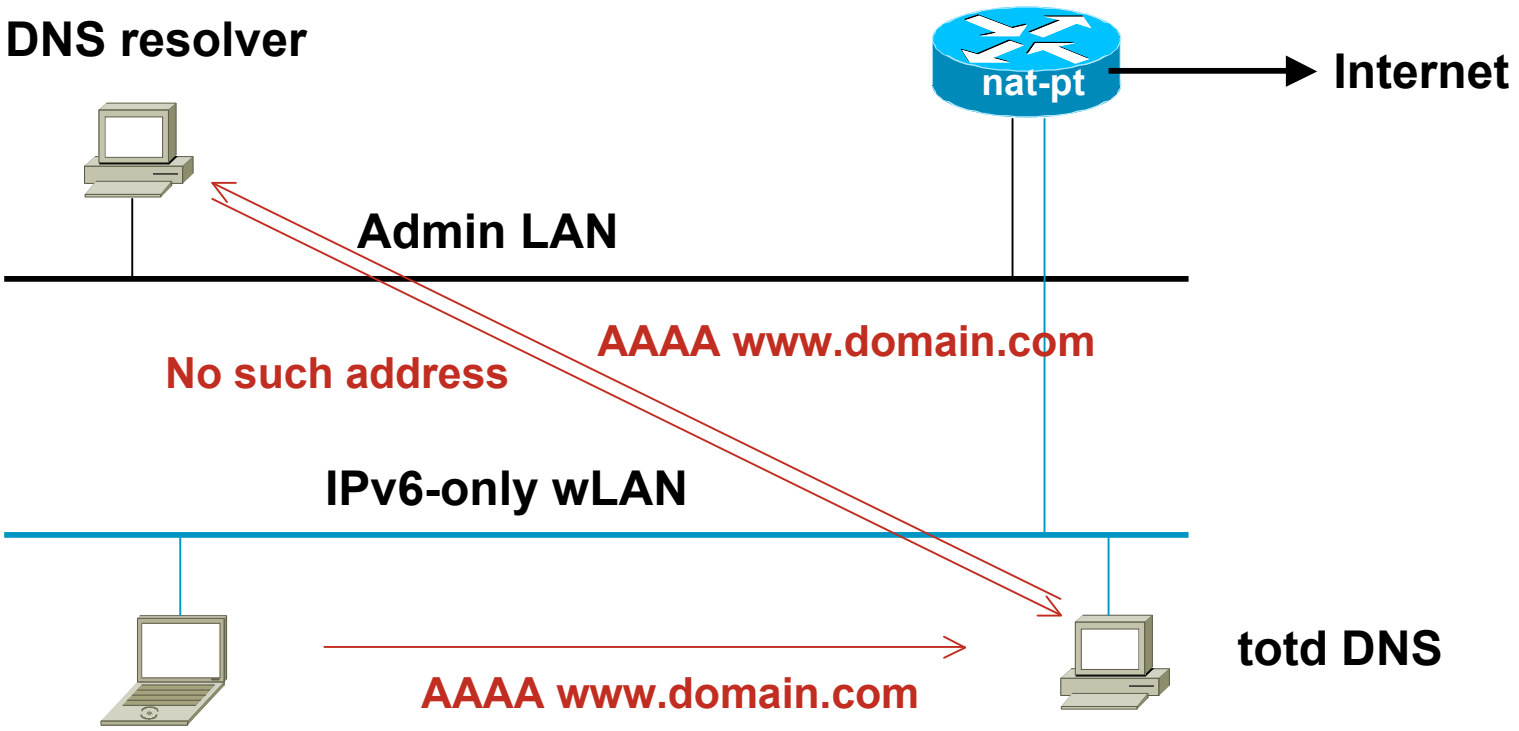
  totd address: 2001:df9:0:6::2 & 192.168.0.5

- NAT-PT here

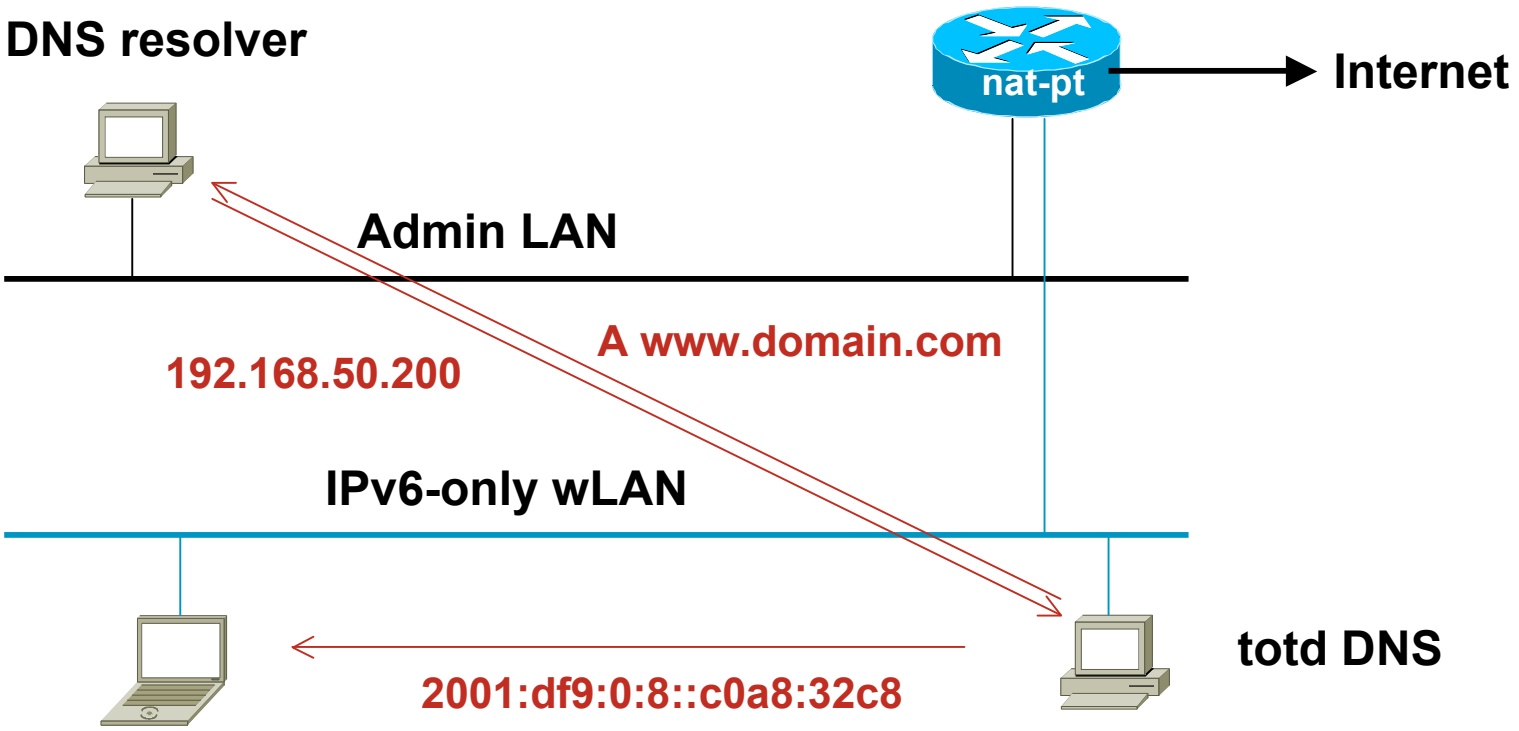
  Stand-in address: 2001:df9:0:8::/96

  IPv4 pool: 169.223.8.0/23

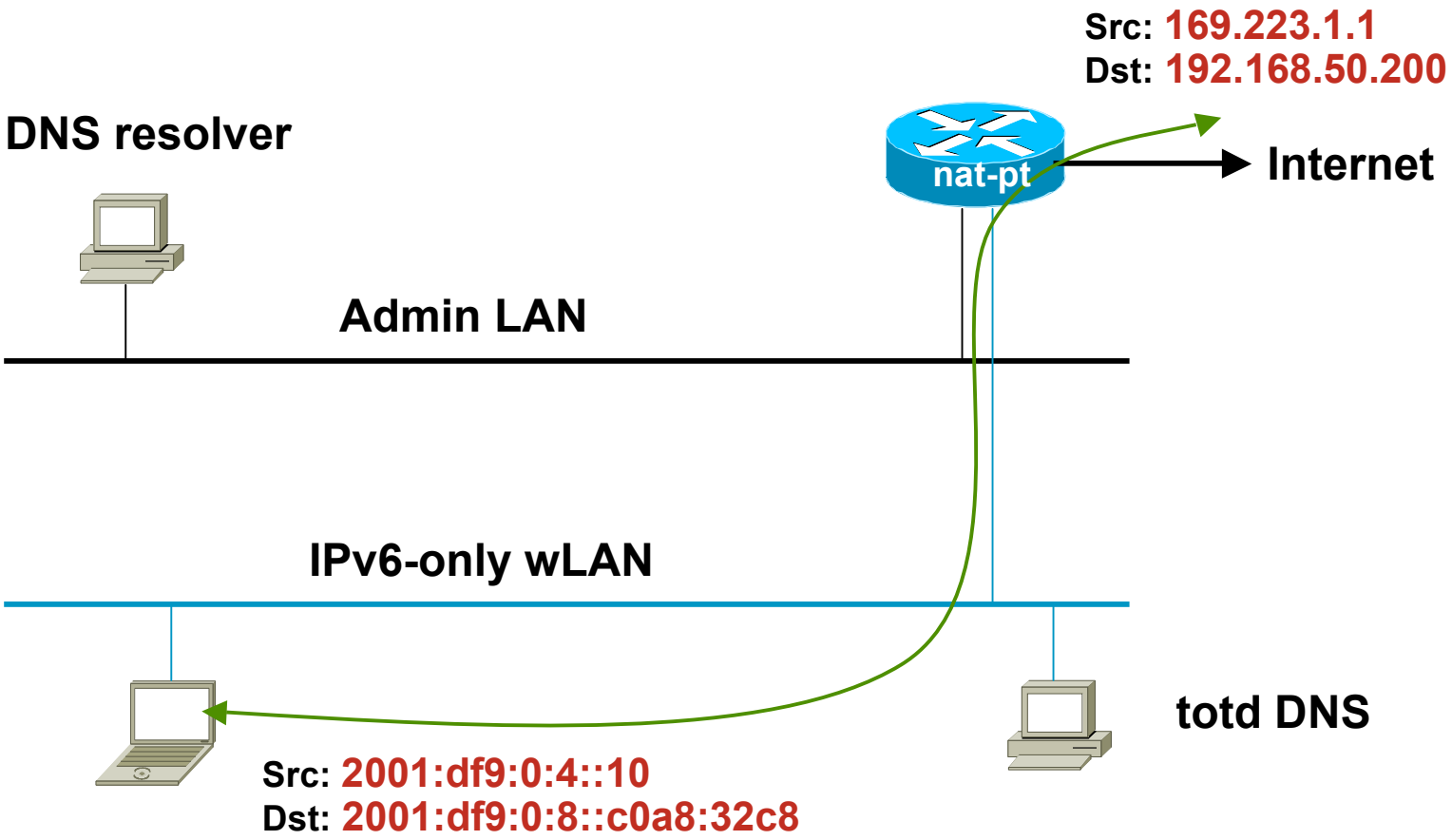
IPv6 Hour: DNS ALG



IPv6 Hour: DNS ALG



IPv6 Hour: DNS ALG



What happened: NANOG

- Switched off IPv4 wireless during “IPv6 Hour”
  - Just kept nanog-v6 and nanog-v6-xp wLANs
- Couldn’t get Cisco IOS NAT-PT to work
  - Using IOS release 12.4(11)T3
- Used NAT-PT on Linux instead
  - Chose Tomicki **natptd**
  - Was relatively unreliable, falling over every few minutes

What happened: NANOG

- User experiences:
  - Some didn't care – they had 3G cards in laptops
  - Reasonable percentage used alternative LANs
  - A few whined
- Highlights of problems we found:
  - Clearing browser caches necessary
  - MacOS wouldn't accept "A" in IPv6 addresses – "a" was fine
    - **www.civil-tongue.net/6and4/wiki/NANOG42-Lessons**
- Positives:
  - Dual stack sites were fully accessible
  - MacOS, *BSD/Linux & Vista "just worked"

What happened: APRICOT

- Network design wasn't implemented quite as described earlier
- Switched off IPv4 wireless during "IPv6 Hour"
  - Just kept apricot-v6 and apricot-v6-xp wLANs
  - IPv4 switched off before explanation complete – users couldn't get to website to find out what to do
- Cisco IOS NAT-PT worked well
  - Used IOS release 12.4(15)T3 on 7206VXR-G2
  - About 12000 simultaneous mappings
  - Surprising level of CPU consumption – 25%
  - Default interface in-queue of 75 spots not enough!!

APRICOT: NAT-PT statistics

```
NAT-PT#sh ipv6 nat statistics
Total active translations: 12086 (0 static, 12086 dynamic; 1162 extended)
NAT-PT interfaces:
  GigabitEthernet0/1.1, GigabitEthernet0/1.2, GigabitEthernet0/1.3, NVI0
Hits: 0  Misses: 0
Expired translations: 40212
NAT-PT#sh proc cpu
CPU utilization for five seconds: 27%/16%; one minute: 24%; five minutes: 21%
NAT-PT#sh proc cpu | i IPv6
 237       95928   2077589         46  2.03%  2.61%  2.07%   0 IPv6 Input
 239         176    123780          1  0.00%  0.05%  0.07%   0 IPv6 ND
 243          48     34936          1  0.00%  0.02%  0.00%   0 IPv6 NAT-PT
  Ager
NAT-PT#sh int gig 0/1
GigabitEthernet0/1 is up, line protocol is up
  Input queue: 0/2000/0/0 (size/max/drops/flushes); Total output drops: 0
  30 second input rate 2143000 bits/sec, 604 packets/sec
  30 second output rate 1276000 bits/sec, 345 packets/sec
```

What happened: APRICOT

- User experiences:
  - Some used alternative LANs
  - Many whined because of the lack of coordination
- Problems as NANOG plus:
  - Mozilla.org and google.com seemed to break
  - Cisco NAT-PT docs need to be much better
  - iChat, Gizmo and Skype all hang at login or thereabouts
  - Chicken of VNC can't use IPv6
  - Only jabber worked in Adium
  - **www.civil-tongue.net/6and4/wiki/APRICOT2008-Lessons**

What happened: MENOG

- Left IPv4 wireless running
  - Other networks available throughout conference
- Couldn’t get Cisco IOS NAT-PT to work
  - IOS release 12.4(8a) suffering from same problems as at NANOG
  - Didn’t try upgrading
- IPv6 tunnel to PSG.com as no native IPv6 available
- IPv4 tunnel to PSG.com as well, as IPv4 available was single public IPv4 address from hotel LAN

What happened: MENOG

- User experiences:

  Some participated – IPv6 worked fine

- Problems we found:

  IOS NAT-PT – seems as though 12.4(15)T3 is minimum working release now

  On-site DNS server (RHEL3) paused for 30 seconds when doing IPv6 lookups

- Positives:

  As NANOG & APRICOT

  Gained experience at setting up vlan mapped SSIDs

What happened: RIPE 56

- Switched off IPv4 for one hour in the conference hall
  - As for NANOG and APRICOT
  - IPv6 and IPv6-XP LANs available for duration of the week's meeting
- Cisco IOS NAT-PT worked, but not as predicted
  - Used IOS 12.4(15)T5
  - IPv4 pool for NAT-PT didn't work
  - Overload on single interface (NAPT-PT) did
  - IOS DNS ALG still didn't work – used **totd** as before

What happened: RIPE 56

- Issues:

  Wireless access points crashed when IPv4 SSID was disabled (or removed?)

  v6 and v6-xp network performance was very poor during IPv6 hour, restored when the IPv4 SSID was restored

- Summary:

  Utilisation of network lower than expected (perhaps due to AP issues)

  Full report from RIPE 56 by James Aldridge:

  www.civil-tongue.net/6and4/wiki/RIPE56-Lessons

Others

- Other events trying this:

  ARIN tried the APRICOT configuration – failed to make it function

  IETF held their own IPv6 Hour

  LACNIC and AfNOG will be doing this too next week

- Hints:

  Use the collected hints/tips and configurations on our wiki:

  www.civil-tongue.net/6and4/wiki/

Summary

- Pure IPv6 isn't as ready as we like to think it is
  - Still lots of IPv4 dependencies even to make IPv6 connectivity
- NAT-PT isn't the magic bullet – but it helps for basic needs
  - Published "how to" documentation is woeful
  - OS support is woeful (development stopped in early 2000s)
- OSes need work
  - Windows XP in general (upgrading to Vista is not solution)
  - MacOS 10.5 seems backward step from 10.4
  - DHCPv6 client support needed across the board

Conclusion

- IPv6 Hours have helped with awareness
- More operators now seriously looking at IPv6
- Everything needs work:
  - Operating Systems
  - Applications & Servers
  - Network infrastructure devices
- There is a difference between “IPv6 is supported” and “IPv6 is usable”