Real World IPv6

Presentation at AusNOG 01, Sydney November 2007

The Sky is falling ...

- Regional registry IPv4 address exhaustion predicted at 3 July 2011

- Getting IPv4 address space from the registries will get progressively harder and/or more expensive as that date looms.

Who is worried?

- Consumers

- Content & Enterprises

- Vendors

- ISPs

The consumers view

- There's a problem?

- It's only the plumbing but if I can't reach Google I'll just change ISPs.

Content & Enterprise

- Generally require "small" amounts of public address space

- Using NAT as a security device

- If their competitors need public address space then that's their problem.

The vendor's view

- There is no customer demand for this, we need to develop feature X instead

- But we support the RFCs required by our customers so we can "tick the box"

- Of course there are no guarantees that they are sufficient or that they will interwork but they conform to the wording in the RFC

Are ISPs playing chicken?

- If their business is to grow then they will require more address space

- There seems to be an assumption that a magic fix will appear to save us.

- Is NAT really the answer?

- IETF still clinging to the End-to-End principle

Breaking out ...

- Need to break out of this loop of negativity before it's too late

- ISP's are the key since they need the additional address space

- So irrespective of a lack of customer demand for a particular solution they need to find one that will work

- They will also need to get the bugs out of it before it's needed in anger, either through the vendors or the standards bodies.

- John Curran once said "It takes most vendors 3 to 6 months to move requirements through marketing and 1 year plus for engineering and chip design" so we don't have time to keep sitting on our hands.

Assuming that IPv6 is the solution ...

- There will be IPv4 only hosts as well as IPv6 only hosts in the future so we need to think of coexistence rather than replacement.

- List of missing pieces is extensive

- ISPs lack resources, CAPEX, OPEX, smart people, ...

- Required vendor support missing in some cases

   - hardware vendors: CPE devices, firewalls, mail appliances, ...

   - software vendors: operations support services, customer management

But we can make a start now

- Apply for an IPv6 assignment now!

- Audit equipment and software for IPv6 support but don't just believe the vendors because they can be loose with the truth

- Add IPv6 to requirements for new equipment and software, demanding equivalent functionality, line rate performance, support in hardware, IPFIX, ...

- Once you have an assignment make an assignment plan

  - /48 to each customer: just needs a flat file for management

- Try to avoid tunnels and make IPv4 & IPv6 networks as congruent as possible

Enabling the backbone

- Backbone routers should be easy to enable

  - Cisco and Juniper support IPv6 in their ISP platforms

  - Carve off first /48 for infrastructure to make filtering easier

    - Use a /64 and number loopbacks as per IPv4

      - Potentially encode IPv4 loopback if that helps the NOC

    - Hard code "external" facing interfaces, ::1, ::2, ...

    - Take advantage of EUI-64 for Ethernet addressing

IGP

- OSPFv3 seems to work OK with both Cisco and Juniper and interoperates!

- No need to learn IS-IS if OSPF is your IPv4 IGP

- Cisco have decided to change the syntax though so OSPFv3 area commands are on the interface rather than in the router block

- No MD5 though, IPv6 standard expects you to use IPSEC but vendors probably still don't support it, but that can be helpful in debugging OSPF issues. If IPv6 is up but IPv4 is down => MD5 issue :)

IOS 12.2S example

- interface loopback0
  ipv6 address 2001:db8::1/128
  ipv6 enable
  ipv6 ospf 1 area 0
  !
  interface GigabitEthernet0
  ipv6 address 2001:db8:0:8::/64 eui-64
  ipv6 enable
  ipv6 ospf 1 area 0
  !
  ipv6 router ospf 1
  log-adjacency-changes
  !

JunOS 8.x example

- interfaces {
    lo0 {
      unit 0 {
        family inet6 {
          address 2001:db8::1/128;
        }
      }
    }
    ge-0/0/0 {
      unit 0 {
        family inet6 {
          address 2001:db8:0:8::/64 {
            eui-64;
          }
        }
      }
    }
  }
  protocols {
    ospf3 {
      area 0.0.0.0 {
        interface ge-0/0/0.0;
        interface lo0.0 {
          passive;
        }
      }
    }
  }

IOS 12.2S BGP example

- router bgp 1
    bgp log-neighbor-changes
    bgp deterministic-med
    bgp graceful-restart
    neighbor INTERIOR-IPv6 peer-group
    neighbor INTERIOR-IPv6 remote-as 1
    neighbor INTERIOR-IPv6 update-source Loopback0
    neighbor 2001:db8::2 peer-group INTERIOR-IPv6
    !
    address-family ipv4
    neighbor INTERIOR-IPv6 activate
    no neighbor 2001:db8::2 activate
    exit-address-family
    !
    address-family ipv6
    neighbor INTERIOR-IPv6 activate
    neighbor INTERIOR-IPv6 next-hop-self
    neighbor INTERIOR-IPv6 send-community
    neighbor 2001:db8::2 peer-group INTERIOR-IPv6
    no synchronization
    exit-address-family
    !

JunOS BGP example

- group INTERIOR-IPv6 {

    type internal;

    description "iBGP to other locations";

    local-address 2001:db8::1;

    family inet6 {

        any;

    }

    export [next-hop-self];

    neighbor 2001:db8::2;

  }

  group PEERS-IPv6 {

    type external;

    family inet6 {

        unicast;

    }

    export [peers-ipv6-export ipv6-ebgp-relaxed];

    remove-private;

    neighbor 2001:7f8::4f9:0:1 {

        import [as1273-ipv6-import no-private-asns];

        peer-as 1273;

    }

  }

Want to go somewhere?

- Enabling the backbone creates a nice Intranet but to go anywhere you'll need transit!

- Fortunately there are options in Australia

  - NTT offer a dual stack, native IPv6 solution

  - Optus can offer an IPv6 service via Singtel

  - Telstra are doing something, if I could only find out what :)

  - VSNL International/Teleglobe have a dual stack POP in Sydney

Enabling Services

- Having enabled the backbone allows you to experiment with services

- Commercial vendors may be slow to produce IPv6 enabled software but open source software has IPv6 support (probably enabled by default):

  - apache

  - bind

  - sendmail, postfix

- Don't forget to enable packet filters for IPv6 though

Learn by doing...

- Your staff will need to learn about this stuff so make sure they have access to it so they can play

- Remember the aim is not to be IPv6 only so it's OK to support some services only via IPv4

- On an Ethernet you need to consider if you need DHCPv6 or if EUI-64 is "easier". Need to consider implications for PTR records.

- Need to consider possible lack of equivalent support for IPv6 in IDS and Firewalls. The "IPv6 ready" tick doesn't mean it does all the same things as under IPv4.

Current Status

While some ISPs might argue that their networks are dual stack (and that they use IPv6 every day) I think the real proof is having public services.

Organisation (domain)			Web	Mail	DNS
45RU	2402:8000::/32	hostaway.net.au	🟥	🟥	🟥
AAPT	2001:210::/35	aapt.com.au	🟥	🟥	🟥
AARNet	2001:388::/32	aarnet.edu.au	🟥	🟥	🟧
APNIC	2001:dc0:2000::/35	apnic.net	🟩	🟥	🟧
AUDA		auda.org.au	🟥	🟥	🟥
AusRegistry	2001:dcd::/32	ausregistry.com.au	🟥	🟥	🟥
Australian Government		australia.gov.au	🟥	🟥	🟥
CSIRO		csiro.au	🟥	🟥	🟥
DataFX	2001:db0::/32	datafx.com.au	🟥	🟥	🟥
Defence Department	2401:6000::/20	defence.gov.au	🟥	🟥	🟥
iinet	2001:4478::/32	iinet.com.au	🟥	🟥	🟥
Internode	2001:44b8::/32	internode.on.net	🟥	🟥	🟥
IPv6 Forum Downunder		ipv6forum.org.au	🟥	🟥	🟥
mrp.net		mrp.net	🟩	🟩	🟧
MyTelecom	2406:c000::/32	mytelecom.com.au	🟥	🟥	🟥
NTT	2001:c78::/32	nttaus.com.au	🟥	🟥	🟥
Optus		optus.com.au	🟥	🟥	🟥
Pacific Internet	2001:e28::/32	pacific.net.au	🟥	🟥	🟥
PPS Internet	2406:a000::/32	pps.com.au	🟥	🟥	🟥
Smart Internet Technology CRC		smartinternet.com.au	🟥	🟥	🟥
Telstra	2001:8000::/20	telstra.com	🟥	🟥	🟧

Other resources

- Need to play for yourself?

  - AARNet migration broker - http://broker.aarnet.net.au

  - Provides a tunnel, even with NAT in the path, to IPv6 Internet

- A How To Guide: http://www.uknof.org.uk/uknof8/Freedman-IPv6.pdf

- http://www.arin.net/meetings/minutes/ARIN_XX/PDF/thursday/Firewalls_Piscitello.pdf

- http://www.networkworld.com/reviews/2007/111207-utm-firewall-test-ipv6.html

- Australian IPv6 Summit - http://www.ipv6.org.au/summit

Thanks

- Mark Prior

- mrp@mrp.net

- http://www.mrp.net/IPv6.html