IPv6 for Everyone

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What Is IPv6?

- A new version of IP (Internet Protocol)
- Able to address 2^{128} things
  - more atoms than on the planet
- Has in-built IPSec (IP Security)
- Multicast and Anycast is easy

Reasons for IPv6

- We were running out of address space in IPv4 (2^{32})
- CIDR (Classless Inter-Domain Routing) helped
- Then we began to run out of routing table entries
- Now large ISPs limit announcements to /19 (some well known /24s also accepted)

Changes in IPv6

- 128 bit address space
  - E.g. 3ffe:8001:c::6/64
- Autoconfiguration
  - Configure router and you are done!
- Everyone has to learn hexadecimal

128-bit Addresses

- Address are broken into components
  - Network and Host
- Designers (Deering et al.) have allocated a fixed 48 bits for network portion.
- Realised that IPv4 Class A (/8) is too large; IPv4 Class B (/16) is almost okay; multiple IPv4 Class C (/24) is just right.
- Have allocated 16 bits for site local network
- Thus the network portion ends up being 64 bits

128-bit Addresses (cont'd)

- <net><site><host>
- <48><16><64>
- First 48 bits determined by ISP
- Next 16 bits determined by you
- Next 64 bits determined
  - Either via stateless autoconfiguration
  - Or via DHCPv6
  - Or manually configured

IPv6 Addressing

- Textual representation is 8 sections of 4 hexadecimal blocks
  - E.g. 2001:2abc:3def:00e4:0000:0000:0065:4321
    3ffe:8001:000c:0006:0000:0000:0000:0014
- Some simplifications
  - Leading 0s are not required
  - Consecutive zeros can be merged ‘::’ (once only!)
- So we get
  - 2001:2abc:3def:e4::65:4321
  - 3ffe:8001:c:6::14

IPv6 Address Types

- Unicast, Multicast, Anycast, site-local and link-local address types
- Unicast and Anycast indistinguishable
- Multicast
  - FFxy::/16
  - x is either 0 (for global) or 1 for local unique
  - y can be E (global), 8 (org.), 5 (site), 2 (link), 1(node).
  - E.g. FF0E::/16 is a global multicast prefix

IPv6 Address Types (cont'd)

- FEC0::/8 is site-local
- FE80::/8 is link-local
  - Link-local addresses are used when no routers are found
  - With appropriate setup, is like Zeroconf (see Brad Hards talk)

Automatic Addressing

- While you can have almost any address.
  - ::dead:beef.
  - ::b00b:babe.
  - ::c0ca:c01a (obligatory product placement).
- Much simpler to just configure the router.
- Router is configured to broadcast, periodically, the assigned prefix on an interface.

Automatic Addressing (cont'd)

- On Linux based routers the package radvd (Router ADVertisement Daemon) is used.
- Sample configuration is

```
interface eth0 {
        AdvSendAdvert on;
        prefix  3ffe:8001:c:6::/64
        {
        };
};
```

- That's it!

Automatic Addressing (cont'd)

- On Zebra / Cisco, just as simple

```
interface eth0
 no ipv6 nd suppress-ra
 ipv6 nd ra-interval 30
 ipv6 nd ra-lifetime 3600
 ipv6 nd prefix-advertisement 3ffe:8001:c:6::/64
  2592000 604800 onlink autoconfig
```

- That's it

Automatic Addressing (cont'd)

- The gory details
  - Routers send out RAs (router advertisements)
  - Hosts send out RSs (router solicitations)
- Hosts listen for RAs and if they don't hear anything send RSs.
- Prefix learned and local MAC address are munged together to form global IPv6 address

Automatic Addressing (cont'd)

- Hardware address (MAC) of 00:50:BA:61:78:2A
- Prefix broadcast is 3ffe:8001:c:6::/64
- Becomes 3ffe:8001:c:6:250:baff:fe61:782a/64
- 48 bit MAC is turned into 64 bits

Automatic Addressing

Demonstration

Getting Connected!

- Two methods.
  - Ask your upstream ISP.
    - In Australia: Telstra, NTT and AARNet have production IPv6 (2001::/3) addresses.
  - Connect using a tunnel broker.
    - In Australia: Trumpet or ProgSoc. Both provide 6bone IPv6 (3ffe::/16) addresses. ProgSoc obtains transit from Trumpet.
    - Other notable tunnel brokers are: Hurricane Electric, BT Exact, XS26. All overseas with high latency.

Tunnelled Connection

- Different distributions use different methods
  - Command line

```
ip tunnel add sit1 mode sit remote <tunnel broker IPv4address>
ip link set sit1 up
ip addr add <your end of tunnel>/<tunnel netmask> dev sit1
ip route add 2000::0/3 via <their end of tunnel>
```

  - Debian - /etc/network/interfaces

```
iface sit1 inet6 v4tunnel
address <your end of tunnel>
netmask <tunnel netmask>
endpoint <tunnel broker IPv4 address>
up ip route add 2000::0/3 via <their end of tunnel>
```

Native Connection

- Remember, only required on routers
- For Debian

```
iface <device> inet6 static
    address <your address>
    netmask <your netmask>
    gateway <ISPs gateway>
```

- Others distributions I’m not familiar with

Getting Connected!

Demonstation

Debian IPv6 Packages

- A lot of things in Debian 3.0 (woody) already IPv6 ready
- For things that are not (e.g. inetd, X, apache 1) are available at

```
deb http://debian.fabbione.net/ woody
deb http://debian.fabbione.net/ sid
```

- Goal is to have sarge (3.1) ready with IPv6 packages in main

References / Resources

- The 6bone – http://www.6bone.org/
- IPv6 News – http://www.hs247.com/
- USAGI Linux IPv6
  - http://www.linux-ipv6.org/
- DeepSpace6 – Linux IPv6 News
  - http://www.deepspace6.net/
- FreeNode IRC network #ipv6

Questions?