# IPv6 – just longer addresses or something different?

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# The IPv6 project

- Headed by a small technical group, looking at the various aspects of IPv6 rollout
  - Head of “Online Systems”
  - Network Manager
  - Hostmaster / IP Register Manager
- Sets up subgroups to look at individual issues and services (mail, web, traffic logging, charging, etc.)

# Senior management approval

- From the minutes: *"… proposed that the UCS policy be that it move towards IPv6 being a peer to IPv4 on the CUDN in terms of networking, services and clients. The SMT agreed the proposal."*
- Some things (e.g. www.cam.ac.uk) may require approval from higher up
- "World IPv6 Day" seems a good excuse, though!

# The Cambridge complication

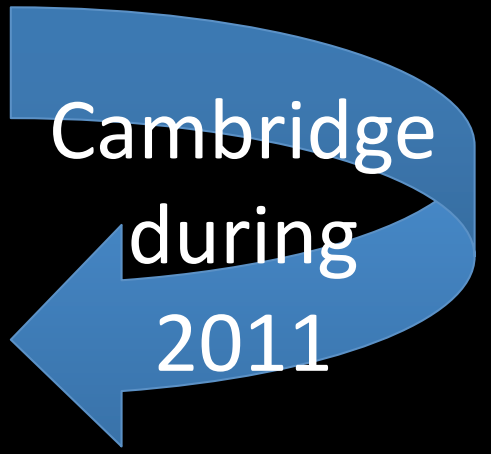
- Networking (and IT in general) is very devolved at Cambridge
- The Computing Service operates the backbone network and JANET connection
  - Functions like an ISP to ~200 institutions
  - Often allocates netblocks instead of subnets
- The Computing Service doesn't often provide the routing for an edge subnet
- Re-numbering and edge control decentralised

# Pros and Cons of this

- We have lots of IT staff in institutions, sharing the workload
  - But, IT policy is fragmented
  - … and edge networks vary wildly
- Computing Service must provide the glue to make things work
  - The interface between the central services and institutions must be clearly defined
- Before IPv6 can be promoted, many of the questions need to be answered

# The four ages of IPv6 rollout

1. IPv4 (no IPv6)
2. “A bit on the side”
   - Doing some testing
   - Delivering it to a few odd places
3. Full-scale roll-out
   - Equivalent to IPv4
   - Probably some issues remain
4. Disable IPv4
   - Resolve remaining issues



# Bend or Embrace

- Some of IPv6 seems very “unnatural” after years of IPv4
  - IPv6 was designed back in the mid-’90s
  - e.g. SLAAC and Privacy Extensions let the host choose its own address vs DHCP under IPv4
- Temptation is to bend IPv6 to work like IPv4
  - Often you can be fighting against it
- Early decision of the project was to embrace IPv6
  - Aim for the best final situation (post-IPv4) and let the natural evolution of IPv6 resolve the issues

# Why do we “register” hosts

- To record the address is ‘in use’
  - Prevent it from being re-used

- Put an entry in the DNS to locate services
  - … and provide reverse lookup
- Record who/what/where a particular address is assigned to
- To provide an entry barrier to the network
  - You need IP details to connect

# Entry control and logging

- Use 802.1X to authenticate users or machines
  - This logs MAC address + switch port → username
- Pull ND (Neighbor Discovery) entries from routers
  - Mapping of IPv6 address → MAC address
- Special handling for devices that can't do 802.1X
  - Printers, wireless APs, BMS controllers, etc.
  - MAC address authentication
- Have the potential to simplify network configuration

# 802.1X and ND logging

- Need 802.1X (RADIUS) authentication service
  - We have one of those (eduroam), but it handles users
  - Need to handle groups/institutions for shared things?
- Requires 802.1X-capable switches be configured
  - Institutional network managers
- ND logging and database
  - We can only do this for subnets we route
- Backend needs to allow MAC authentication bypass, VLAN assignment for printers, etc.
  - Complex federated interface?

# Why do we “register” hosts

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  - Prevent it from being re-used
- Put an entry in the DNS to locate services
  - And provid… …verse lookup
- Rec… …ddress is assi…
- To p… …the network
  - You need IP details to connect

Only a small number of hosts will need registering?

# Subnetting

- “64K subnets is enough for anyone”
  - Do you subnet on location, rôle, connection method?
  - What will you need space for in future?
- We are currently using BCD form of 3-digit VLAN ID (e.g. …:1230::/64 for VLAN 123)
- Expecting to renumber and compress usage
  - Sequential blocks aligned on /58 (= 64x /64s)
  - 160-200 institutions will use …:[2-4]xxx::
- Do we mark blocks for “non-Cambridge users” for journals, etc.?

# Investigations

- Prefix migration seems easy:
  1. Add the new prefix
  2. Set an expiry on the old one
  3. Auto-configuring hosts pick up new address
  4. Re-address static hosts manually (and typically have to update DNS)
  5. Retire old prefix
- Moving router addresses largely OK:
  - Picked up very quickly in normal situation
  - Crashing router takes time – HSRP/VRRP?

# Service addresses

- For **services** rather than hosts
- Hosts have their own SLAAC address
- They gain “service addresses” when they’re running a service
- Using a system: …::<service>:<id>
  - e.g. 2001:630:200:8080::d:a0 for ‘authdns0’
- We’ve been doing something similar in IPv4 for years

# Router address configuration

- With SLAAC found through Router Discovery
  - And it's link-local (not global)
- But, switching to a static address often disables discovery of routers
  - Do we need static router addresses?
  - Needs special consideration when configuring a first-hop redundancy protocol like HSRP
- Use multiple addresses on an interface and leave one in SLAAC mode?
  - Yes for Mac OS X 10.7 but not on ≤10.6

# DNS servers

- DHCPv4 didn't just provide IP addresses, subnet masks and routers
  - DNS servers
  - Boot servers for PCs, phones, printers, etc.
- DHCPv6 and RFC5006 can provide DNS information but poor support at the moment
- Not worried about this as it's only really problem when we think about turning off IPv4?
  - It will [hopefully] be solved by then!
  - You can look up AAAA using IPv4 DNS server

# Private addresses

- Not planning to using these under IPv6
- Instead will use public addresses with access control applied at the network level
  - We might need to offer this as a service
- However, RFC1918 (IPv4) addresses are NATed at the border of the university network
  - Institutions have been using these as a kind of "outbound only" firewall
  - Need to provide some sort of equivalent in IPv6?

# Traffic logging and charging

- Cambridge re-charges its JANET connection charge to institutions based on their proportion of usage of it
- Existing system doesn't handle IPv6
- Need new (in-house) system
- Requires NetFlow v9, router software upgrades, larger NetFlow tables (Cisco XL-series)

# Summary

- Need to have the essential questions answered before we deploy
  - More so than other universities?
  - Trying to smooth the enablement of IPv6 across the university – no excuses not to!
- We're bound to make mistakes
  - How easy is it to back out of them?
- IPv6 is coming
  - We might as well enjoy it

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