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IPv6 Dual Stack at Imperial

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Facts and figures – Imperial

- 17,000 students
- 8,000 staff
- Main campus - South Kensington, London
- Under construction - White City, London
- 6 other large campuses (hospitals, Silwood Park)
- 10+ other sites (hospitals, halls, sports grounds)
- 2 datacentres - Slough & South Ken
- Centralised ICT

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Facts and figures – Network

- Over 65,000 unique hosts on wired network
- Over 60,000 unique hosts on wireless network
- Over 20,000 concurrent wireless clients at peak time
- 40G to Janet via two 2x10G trunks (200G planned)
- Most hosts within VRFs (MPLS L3VPNs)
- Firewalls between VRFs
- No NAT

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The journey

- 2003 - Started experimenting: 6in4 tunnel, separate infrastructure
- 2006 - Routers enabled, separate firewall, test subnets and servers
- 2010 - Upstream native IPv6, dual-stack firewalls
- 2010/11 - Most production and BYOD enabled
- 2010/11 - Some services including mail & DNS
- 2011 - World IPv6 Day: College websites enabled
- 2013 - Wireless enabled
- 2015 - AAAAs added to most load-balanced VIPs (IPv4 backends)
- … 2018 - Guest networks enabled ;-)

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Our current position

- ~30% of our Internet traffic IPv6
- Dual stack on production, guest & BYOD (including wireless)
- AAAAs on most load-balanced services
- Other services enabled:
  - Home directories (>95% IPv6!)
  - New research storage (IPv6 only)
  - Mail, DNS, Skype for Business, HEP systems
- SLAAC rather than DHCPv6
- Feature parity mandated in tenders

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Issues

- Lack of support on equipment in early days
- Feature parity on older equipment
- Additional resource overhead on routers - FIB, CPU
- Per host firewall rules without means to assign static IPv6 addresses
- Broken IPv6 prior to enabling native - RA guard lacking, AAAA filtering
- Provider AAAA blacklists
- Broken external websites - not responding, different content
- Broken SPF records
- “Works from home” - not anymore!

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What next?

- Finish renumbering exercise
- IPv6 enable remaining services
- Disable IPv4 on internal services
- DHCPv6
- RDNSS
- Retire IPv4 - NAT64 / DNS64?
- Free up IPv4 address space - $$$!

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Dual Stack pros

- Other options lacking in early days
- Negligible disruption, low risk
- Relatively easy to roll-out
- No need to introduce NAT (in our case at least)
- Transparent to incapable clients
- Stepping stone to retiring IPv4

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Dual Stack cons

- Two parallel networks to troubleshoot
- Twice the IP configuration
- Overhead in other systems - ARP & FDB tracking, IPAM, DHCP, firewall
- Consumes more hardware resources
- Doesn’t free up IPv4 address space

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