IPv6 at the University of Southampton (ECS)

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IDEALondon, 16th October 2014

About us…

Large university, 20,000 students

Electronics and Computer Science (ECS)
www.ecs.soton.ac.uk

Top 5 in UK for both subjects

ECS has 3,000 wired Ethernet points over five buildings

Yet 80% of devices on our network are wireless BYOD, user owned

All those devices have IPv6 support, and turned on by default

Universities – what IPv4 problem?

- Established universities have ample IPv4 address space, right?
- Southampton has 152.78.0.0/16

- But we've just run out!
- New builds and some WLANs are now using Net10, and causing operational complexity

- We have a new £100m complex housing Lloyds Register. A major new project.
- But we didn't spend $10/IP to get addresses

- We need more globally unique addresses
- That means IPv6.
- Not necessarily IPv6-only though. Yet.

University deployment drivers?

- Universities increasingly driven by business cases
- Are there good arguments to make for IPv6 in universities?

- Supporting teaching and research
  - Students graduating into a world with no new IPv4 available
- Security – for all those IPv6-capable devices
- Simplify connectivity to us
  - We have campuses in China and Malaysia
- Innovation – new apps, new technology areas, e.g. sensors
- Gain experience – inform procurements
- Operational simplicity
  - Have seen recent Net10 and IPv4 NAT issues

So what are UK universities doing?

- Not as much as we might hope
- JANET has been IPv6-enabled for over 10 years
- Around 150 site /48 prefixes handed out to universities
- But only 10-15 universities doing 'big' things
- Universities are financially challenged with many priorities
- Existing deployments are dual-stack
  - May be IPv4 NAT with IPv6 globals. No ULAs.
  - Configuration by DHCPv4 + IPv6 SLAAC. No DHCPv6 - yet.
- Bite-sized deployments – not all or nothing – e.g.:
  - Enable IPv6 on *eduroam* wireless network
  - Enable public facing web sites
  - Enable connectivity to computer science labs

What have we done?

- IPv6 deployed dual-stack throughout ECS
  - Approx 25-30 subnets, including servers
- IPv6 enabled public facing services
  - Web, DNS, MX, ssh, etc
  - ECS staff can do their work from IPv6-only access networks
- IPv6 enabled campus-wide *eduroam* wireless
  - Thousands of devices, generally no problems
  - Any access to Google, Facebook etc is IPv6 native
- Applied security policies equally for both protocols
  - Though some new considerations – more in a moment…

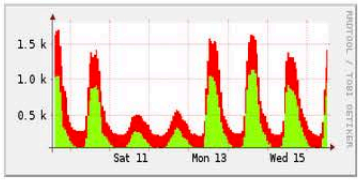
ECS Netflow example

- The next screen shows an example of using nfsen as a Netflow collector (Netflow v9 supports IPv6)
- Flow example from part of the ECS network
  - It should be representative of our general traffic
- Green is IPv6, red is IPv4

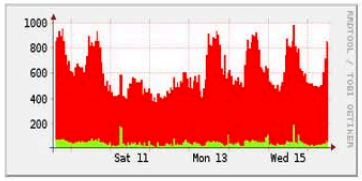
- IPv6 is 13% of traffic by MB/sec
- IPv6 is 30% of traffic by flows/sec
- IPv6 is 53% of traffic by TCP flows/sec

Profile: live

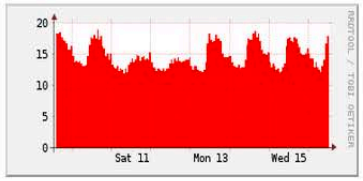
TCP



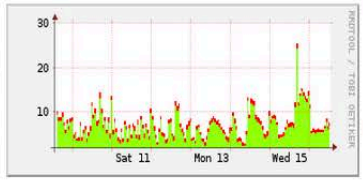
UDP



ICMP

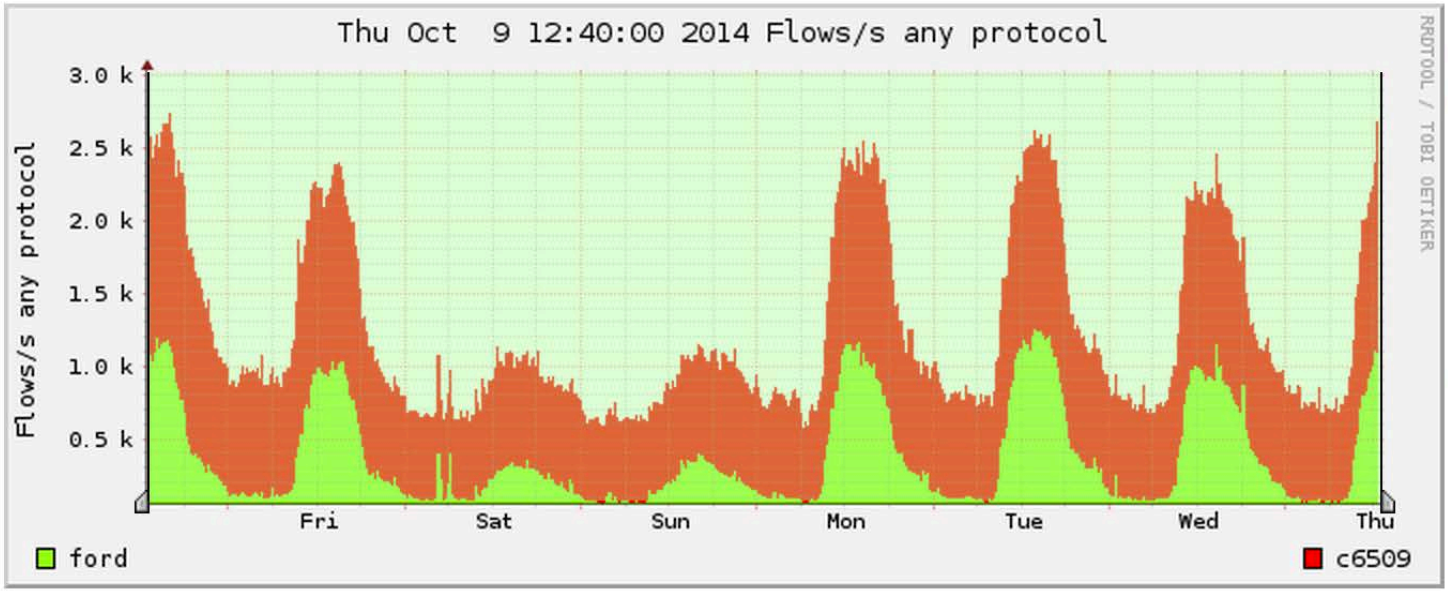


other



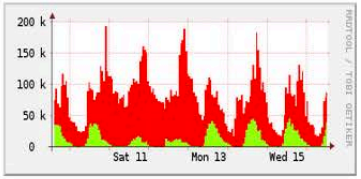
Profileinfo:

Type: live
Max: unlimited
Exp: never
Start: Jul 30 2013 - 16:03 BST
End: Oct 16 2014 - 12:50 BST

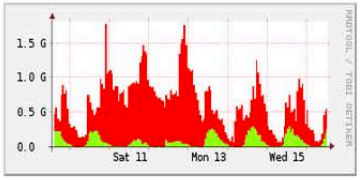


t_{start} **2014-10-09-12-40**
t_{end} **2014-10-16-12-40**

Packets



Traffic



Select Time Window Display: 1 week << < | ^ > >> >|

(•) Lin Scale (•) Stacked Graph
( ) Log Scale ( ) Line Graph

Statistics timeslot Oct 09 2014 - 12:40 - Oct 16 2014 - 12:40

Channel:	Flows:					Packets:					Traffic:				
	all:	tcp:	udp:	icmp:	other:	all:	tcp:	udp:	icmp:	other:	all:	tcp:	udp:	icmp:	other:
c6509	875.1 /s	292.5 /s	567.1 /s	14.7 /s	0.8 /s	67.2 k/s	63.5 k/s	2.0 k/s	74.7 /s	1.5 k/s	548.8 Mb/s	531.0 Mb/s	8.6 Mb/s	59.2 kb/s	9.2 Mb/s
ford	379.0 /s	319.2 /s	53.2 /s	0 /s	6.7 /s	12.7 k/s	12.5 k/s	133.4 /s	0 /s	40.6 /s	84.0 Mb/s	83.0 Mb/s	881.9 kb/s	0 b/s	123.9 kb/s

Challenges?

- Across 15 years there have been many!
  - The good news is IPv6 is increasingly hardened
- One example: IPv6 Privacy Addresses
  - Hosts can change their IPv6 (source) address over time
  - Caused interesting issue on Cisco WLC, where First Hop Security considered a host using 9+ different IPv6 addresses on the same MAC address was an attack…
  - But Cisco fixed this – people no longer thrown off ☺
  - We chose to embrace Privacy Addresses, rather than try to lock them down (even if we could)
  - Open source NAV package does SNMP scraping of network equipment to build database of IPs, MACs, physical ports, etc

IP Search | MAC Search | Switch Search

MAC search

Mac:	c8:2a:14:20:24:71
Dns:	☐
Show only active records:	☐
Days:	7
	Search

MAC Search results
1 hit

Switch	Module	Interface	Start time	End time	Mac
b32-l3-cat1.ecs.soton.ac.uk		Gi4/0/44	2013-02-06 12:23	Still active	c8:2a:14:20:24:71
1 hit					

Interface details

Please note that the MAC search results are *historic* data, while the information found at the interface details link is different points in time.

IP search results
25 hits

IP	MAC	Start time	End time
152.78.65.110	c8:2a:14:20:24:71	2013-02-05 16:51:57	Still active
2001:630:d0:f111:5fb:2813:ec41:2aa7	c8:2a:14:20:24:71	2013-02-21 12:22:00	2013-02-21 18:51:59
		2013-02-20 23:22:00	2013-02-21 08:51:59
2001:630:d0:f111:94f:aaea:431f:f294	c8:2a:14:20:24:71	2013-02-22 14:52:01	2013-02-22 18:51:59
		2013-02-21 20:52:00	2013-02-22 10:51:59
2001:630:d0:f111:15c2:ca97:e814:6498	c8:2a:14:20:24:71	2013-02-25 09:52:00	2013-02-25 19:22:00
		2013-02-24 15:52:02	2013-02-25 06:22:00
2001:630:d0:f111:300b:ca0b:69eb:64e7	c8:2a:14:20:24:71	2013-02-24 14:22:02	2013-02-25 18:22:01
2001:630:d0:f111:40f3:1e5f:131a:e3fb	c8:2a:14:20:24:71	2013-02-22 14:52:04	2013-02-23 18:51:59
2001:630:d0:f111:5cd3:8197:6e06:ddd3	c8:2a:14:20:24:71	2013-02-26 11:22:02	2013-02-26 17:52:04
		2013-02-25 16:52:03	2013-02-26 08:51:59
2001:630:d0:f111:60f8:8137:f58e:f3d	c8:2a:14:20:24:71	2013-02-25 14:22:03	2013-02-26 17:52:04
2001:630:d0:f111:7035:e52b:285f:6283	c8:2a:14:20:24:71	2013-02-23 05:22:00	2013-02-23 14:52:03
		2013-02-22 15:52:02	2013-02-23 02:21:59
2001:630:d0:f111:8449:f7fa:4422:736d	c8:2a:14:20:24:71	2013-02-23 20:52:00	2013-02-24 18:51:59
2001:630:d0:f111:8d64:815c:846e:c1f4	c8:2a:14:20:24:71	2013-02-27 01:22:06	2013-02-27 16:22:01
		2013-02-26 16:22:03	2013-02-26 23:22:00
		2013-02-20 14:52:11	2013-02-21 18:51:59
2001:630:d0:f111:a483:923e:384b:c396	c8:2a:14:20:24:71	2013-02-28 08:22:01	2013-02-28 12:22:00
		2013-02-27 15:52:04	2013-02-27 23:52:00
		2013-02-21 14:52:00	2013-02-22 18:21:59
2001:630:d0:f111:b01e:aac6:14c6:71c7	c8:2a:14:20:24:71	2013-02-26 14:22:11	2013-02-27 17:52:01
2001:630:d0:f111:b530:8b60:3438:82d5	c8:2a:14:20:24:71	2013-02-27 14:22:01	Still active
2001:630:d0:f111:f5df:701a:834b:afb7	c8:2a:14:20:24:71	2013-02-23 14:52:08	2013-02-24 18:22:00
fe80::ca2a:14ff:fe20:2471	c8:2a:14:20:24:71	2013-02-05 16:51:55	Still active
25 hits			

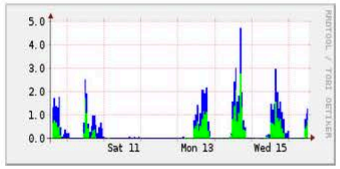
What about IPv6 only?

- Southampton has run out of global IPv4 addresses
- Should we move towards an IPv6-only deployment?
  - The win could be simplified network operations
  - The price is complexity at the edge – NAT64/DNS64

- We have just started running an IPv6-only WLAN SSID
  - Users can choose eduroamv6 rather than eduroam
  - Early days – a peak of 12 concurrent users ☺
  - Identifying application issues (see also RFC7269)
  - Can devices truly operate IPv6-only
  - e.g. can devices get IPv6 DNS resolver addresses?

Profile: live

TCP



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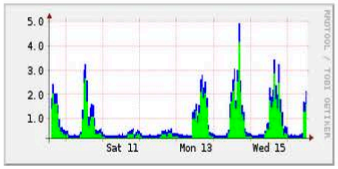

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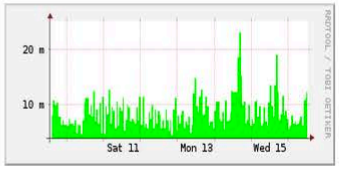
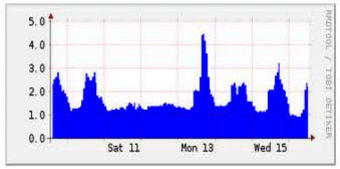


other



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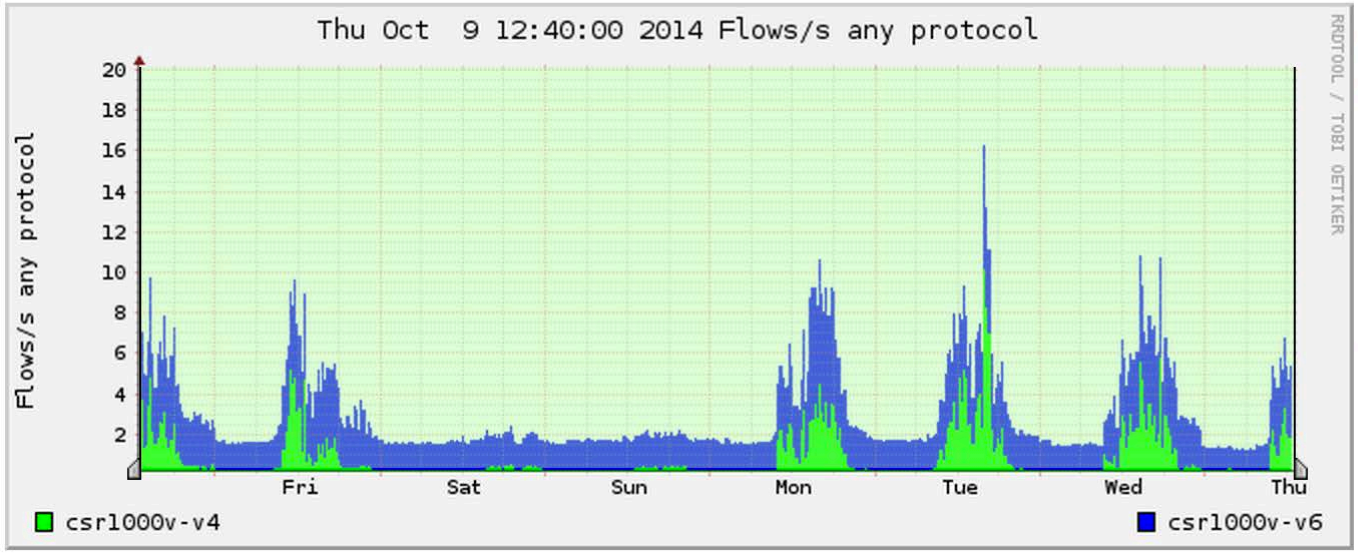
Max: unlimited
Exp: never
Start: Jul 30 2013 - 16:03 BST
End: Oct 16 2014 - 12:55 BST



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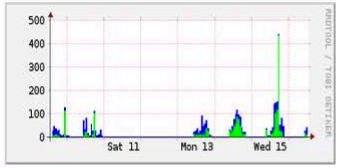
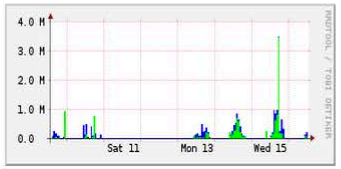


Traffic



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csr1000v-v6	2.1 /s	0.2 /s	0.2 /s	0 /s	1.7 /s	9.6 /s	6.9 /s	0.4 /s	0 /s	2.3 /s	43.6 kb/s	41.2 kb/s	850.5 b/s	0 b/s	1.6 kb/s
csr1000v-v4	0.9 /s	0.2 /s	0.7 /s	0.0 /s	0 /s	12.7 /s	10.7 /s	2.0 /s	0.0 /s	0 /s	76.0 kb/s	72.4 kb/s	3.6 kb/s	9.0 b/s	0 b/s

Summary

- IPv6 is ready for deployment
  - JANET have been exceptionally helpful as our ISP
- Universities who are doing so are going dual-stack
  - Can just do smaller projects, it's not all or nothing
  - Uptake slow, despite backbone being ready for 10+ years
  - We need a 'nudge'….
- We'll continue to investigate and deploy what is necessary to best support our teaching and research
- Questions? ☺