IPv6 at the RAL Tier 1

The long road to production IPv6
About Me

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  – wLCG Tier 1 at Rutherford Appleton Laboratory
  – Distributed Computing Infrastructure Group

• Quattor Release Manager
  – http://www.quattor.org

• Technical consultant for various projects
  – Ceph (Echo & Sirius)
  – IPv6 configuration
Real work done by

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- STFC Networking Team
  - Philip Garrad
  - Alan Clarkson
- SCD Research Infrastructure Group
  - Tim Folkes
Overview

• Goals & Motivation
• Challenges
• How did we get here
• Addressing schemes
• Future plans
• Conclusion
Goals & Motivation

• wLCG Tier 1 expected to provide IPv6
  – LHCOPN Peering
  – Need to support access by IPv6 only sites
  – Long way behind other sites — playing catch up
  – Networking team took this seriously

• Not driven by address space limitations
  – No shortage of IPv4 in Tier 1, STFC or JANET
Challenges

• IPv6 for the Tier 1 means IPv6 for STFC
  – Need a unified approach to work together
  – Networks team thinking about this since 2015

• Multiple communities
  – wLCG is not the only user of our networks

• Legacy infrastructure
  – Some not IPv6 capable at all (original OPN router)
  – Lack of hardware offload (Firewalls)
  – Broken functionality
How did we get here?

• Build test-bed along side existing networks  
  – Separate IPv6 at border routers

• Start limited testing of services using test-bed  
  – PerfSonar, GOCDB, etc.

• Upgrade and replace core infrastructure  
  – Deploy supporting services (e.g. IPv6 DNS)  
  – Replace OPN Router with new hardware  
  – All while running production work
Create two new IPv6 only VDOMs in the firewall and connect it to the external core.
Move the RAL IPv6 testbed off of the dedicated testbed firewall onto the RAL Site firewall.
Create an IPv6 internal core network and an IPv6 Subnet on Router D.
Install an IPv6 only DNS server on the core network, this should communicate with a dual stacked DNS Master.
**QUESTION** How is the TIER 1 IPv6 network going to be structured?

Create an IPv6 subnet within TIER 1 for their OPN accessible hosts.

**فئات** IPv6 في شبكة Tier 1 HOW IS THE IPv6 NETWORK GOING TO BE STRUCTURED?

Create an IPv6 subnet within TIER 1 for their OPN accessible hosts.
**QUESTION** How is the TIER 1 IPv6 network going to be structured?
CERN <-> RAL OPN LINK A
CERN <-> RAL OPN LINK B
JANET (London) <-> RAL PTP LINK
JANET (Bristol) <-> RAL PTP LINK

RAL IPv6 External Core Network
RAL IPv6 Internal Core Network
RAL IPv6 Services Network

This is a separate VLAN in the Tier 1 infrastructure
Hosts in the IPv6 OPN subnet:
* Can access the OPN using IPv6
* Can access the RAL Firewall bypass using IPv6
* Can access RAL using IPv6

This is a separate VLAN in the Tier 1 infrastructure
Hosts in the Tier1 subnet:
* Can access RAL using IPv6
* Can access the RAL OPN hosts
* Have no access to the OPNs
* Have no access to the firewall bypass

Later in 2017
Other departments / systems join the IPv6 network
Phew.

• At this point we had an IPv6 capable network
• All that remained was to:
  – Allocate subnets
  – Agree addressing schemes
  – Configure hosts
  – Configure Firewalls and ACLs
  – Expose services
  – Relax?
Addressing

• Each STFC site allocated an IPv6 /48
  – 281,474,976,710,656 addresses
  – No need to allocate sparingly
  – Try to avoid IPv4 “Stockholm Syndrome”
  – Structure address space to embed meaning
# STFC Addressing Scheme

Each project allocated one or more IPv6 /64

- 16 bits available to describe subnet

<table>
<thead>
<tr>
<th>NETWORK</th>
<th>HOST</th>
</tr>
</thead>
<tbody>
<tr>
<td>JANET</td>
<td>RAL</td>
</tr>
</tbody>
</table>

| 2001 : 0630 : 0058 : a b c d : 0000 : 0000 : 0000 : 0000 |

<table>
<thead>
<tr>
<th>JANET</th>
<th>RAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000 : 0000 : 0000 : 0000</td>
<td></td>
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</table>

- a = STFC Address plan version (0-15)
- b = Network Type
- c = Network Subtype
- d = Assigned by subnet owner (Tier 1 addressing scheme version)
## Tier 1 Addressing Scheme (v0)

- **Assumption:** All hosts will be dual-stack
- **Map all existing IPv4 address (RFC2374 style)**
  - Allocate addresses automatically with Quattor
- **DNS entries just a sed script away…**

In hex notation:
```
::82F6:B43C
```

Or mixed notation:
```
::130.246.180.60
```
• Will not implement IPv6
  – Disk storage is migrating to Echo.
  – Legacy configuration environment would make it hard.

• NB. CERN don’t intend to upgrade their CASTOR to dual stack either.
  – Intention is to make CTA (CASTOR replacement) IPv6 accessible.
Plans - Storage -

• Production endpoint currently IPv4 only
  – Focused on Echo achieving production service
• Currently testing dual stack gateways
  – One of five externally facing gateways will be made dual stack at start of May
  – If no problems will upgrade all externally facing gateways to dual stack by June
• This will meet the April 2018 Tier 1 storage requirement
Plans - Services

• By September 2017:
  – FTS (extensively tested at other sites)
  – CVMFS Stratum 1 (tested at other sites)
• By December 2017:
  – Squids (tested internally)
  – Frontier (ATLAS testing now)
  – GOCDB (ran test instance on previous test-bed)
  – SCD Private Cloud (in-use by power users now)
• By April 2018:
  – All hosts dual-stack by default
Conclusions

• RAL network ready to support IPv6 services
  – But there is still work to do
• Tier 1 running IPv6 on production network
  – Services being phased in right now
• Ready to go fully dual-stack RealSoonNow™
Thanks!

Questions?