Deployment of IPv6-only CPU on WLCG
- update from the HEPiX IPv6 WG

David Kelsey (STFC)
on behalf of the HEPiX IPv6 WG

HEPiX meeting
17 Oct 2017, KEK, Japan
Many thanks to my Colleagues

Active in HEPiX IPv6 Working Group 2017

• M Babik (CERN), M Bly (RAL), J Chudoba (Prague), C Condurache (RAL), A Dewhurst (RAL/ATLAS), D van Dok (Nikhef), T Finnern (DESY), T Froy (QMUL), C Grigoras (CERN/ALICE), K Hafeez (RAL), B Hoeft (KIT), D P Kelsey (RAL), F Lopez Munoz (PIC), E Martelli (CERN), R Nandakumar (RAL/LHCb), K Ohrenberg (DESY), F Prelz (INFN), D Rand (Imperial), A Sciaba (CERN/CMS), U Tigerstedt (CSC) & D Traynor (QMUL)

• many more in the past
• apologies to any I have missed
Outline

• History
• WLCG – support for IPv6-only CPU – timeline
• Update from the Tier-0/1 sites
• Update from Tier-2 sites & LHC experiments
• CERN Tier-0 Storage(EOS)
• IPv6-only CPU - testing
• Transition monitoring
• Current issues
• Summary
PREPARATORY WORK DURING 2011-2016
HEPiX IPv6 Working Group

• Started in April 2011
• Phase 1 – full analysis of work to be done
  – Applications, system and network tools, security etc
  – Create and operate a distributed test-bed
    • No interference with WLCG production data analysis!
  – Propose timetable and plan for transition
2012

• CERN announces predicted shortage of routable IPv4 addresses
  – explosion of virtualisation
• Active HEPiX IPv6 test-bed with ~ 12 sites
  – engagement of 4 LHC experiments
• Testing regular GridFTP IPv6 data transfers across the testbed
• Testing dual-stack services (production) at Imperial College London Tier2
• Concluded not able to support IPv6-only clients before 2014
At CHEP2013 conference

- > 2 PB data transferred over IPv6 in last 6 months
- Success rate > 87%
- Very High!

GridFTP IPv6 data transfer mesh
2013 - Data Management

• Testing the important data transfer protocols, technology and data storage/file systems
  – For IPv6-readiness

• GridFTP, DPM, dCache, xRootD, OpenAFS, FTS, CASTOR
  – Found many problems needing work
    • Worked closely with developer communities

• Concluded IPv6-only will be much later than 2014!
2015

• At CHEP conference in April 2015
  – 75% of Tier-1 sites are IPv6-ready
    • but only 20% of Tier2
  – 10% of sites now reporting lack of IPv4 addresses
• Most important IPv6-only use case
  – Sites, Clouds providing CPU (virtual machines)
  – Opportunistic resources may be IPv6-only
  – Need dual-stack federated storage services
  – And dual-stack central WLCG and Experiment services
THE IPV6 TRANSITION 2016-2020
2016

• Growing need for support of IPv6-only WN
• Continue to push for
  – deployment of production dual-stack data services
  – LHCOPN (Tier0-Tier1 private network)
    • IPv6 peering everywhere
• perfSONAR – end to end network monitoring – dual-stack
• Move central services and central monitoring to IPv6
• For CHEP2016 – October, San Francisco
  – guidance on IPv6 security for WLCG sites
  – Deployment timetable approved by WLCG Management Board
    • From April 2017
WLCG deployment plan: timeline
- approved WLCG MB Sep 2016

• By April 1\textsuperscript{st} 2017
  – Sites can provide IPv6-only CPUs if necessary
  – Tier-1’s must provide dual-stack storage access with sufficient performance and reliability
    • At least in a testbed setup
  – Stratum-1 service at CERN must be dual-stack
  – A dedicated ETF infrastructure to test IPv6 services must be available
  – ATLAS and CMS must deploy all services interacting with WNs in dual-stack
  – All the above, without disrupting normal WLCG operations

• By April 1\textsuperscript{st} 2018
  – Tier-1’s must provide dual-stack storage access in production with increased performance and reliability
  – Tier-1’s must upgrade their Stratum-1 and FTS to dual-stack
  – The official ETF infrastructure must be migrated to dual-stack
  – GOCDB, OIM, GGUS, BDII should be dual-stack

• By end of Run2
  – A large number of sites will have migrated their storage to IPv6
  – The recommendation to keep IPv4 as a backup will be dropped
Tier 0/1 status
# Tier 1 status

## Sites IPv6 connectivity

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>LHCOPN IPv6 peering</th>
<th>LHCONE IPv6 peering</th>
<th>HREN IPv6 peering</th>
<th>IPv6 LAAN</th>
<th>dualstack perf6@CNAR</th>
<th>dualstack storage percentage by 1st April 2017</th>
<th>dualstack storage percentage by 31st May 2017</th>
<th>dualstack storage percentage by 31st July 2017</th>
<th>Network Statistics</th>
<th>Notes</th>
<th>date last update</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH-CERN</td>
<td>Tier3</td>
<td>Yes</td>
<td>Yes</td>
<td>GEANT, EGnet, CERNlight</td>
<td>Yes</td>
<td>Yes</td>
<td>6</td>
<td>15</td>
<td>16</td>
<td><a href="https://netstat.cern.ch/monitoring/network-statistics/ext/?c=IPv6&amp;ap=EXT&amp;...">https://netstat.cern.ch/monitoring/network-statistics/ext/?c=IPv6&amp;ap=EXT&amp;...</a></td>
<td>IPv6 has been enabled on FTB since 1/2/2016. Grid submission to HTCondor is enabled via IPv6. MyProxy also runs dual stack IPv6.</td>
<td>05/11/2017</td>
</tr>
<tr>
<td>FR-CON2F3</td>
<td>Tier1</td>
<td>Yes</td>
<td>Yes</td>
<td>RENATER</td>
<td>Yes</td>
<td>Yes</td>
<td>50</td>
<td>100</td>
<td>100</td>
<td>N/A</td>
<td>03/23/2017</td>
<td></td>
</tr>
<tr>
<td>JINR-T1</td>
<td>Tier1</td>
<td>Yes</td>
<td>Yes</td>
<td>RETN</td>
<td>Yes</td>
<td>Yes</td>
<td>0</td>
<td>100</td>
<td>100</td>
<td>06/01/2017</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NL-T1 SARA- MATRIX</td>
<td>Tier1</td>
<td>Yes</td>
<td>Yes</td>
<td>GEANT</td>
<td>Yes</td>
<td>Yes</td>
<td>0</td>
<td>100</td>
<td>100</td>
<td>Production dual stack enabled May 1 2017.</td>
<td>05/04/2017</td>
<td></td>
</tr>
<tr>
<td>INFN CNAF</td>
<td>Tier1</td>
<td>Yes</td>
<td>Yes</td>
<td>GARR</td>
<td>Yes</td>
<td>Yes</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td><a href="https://gms.garr.it/Statistics/receiver.php?stroke_ipv6=on&amp;target=1%5B%5D=...">https://gms.garr.it/Statistics/receiver.php?stroke_ipv6=on&amp;target=1%5B%5D=...</a></td>
<td>All Sdrtp/WebDAV/XROOT'd doors have been dual stacked. SRM is still pending. IPv6 has been disabled for BNL instance of FTS due to issues observed between sfCache sites and plain gridftp sites for the production transfers.</td>
<td>02/16/2017</td>
</tr>
<tr>
<td>BNL</td>
<td>Tier1</td>
<td>Yes</td>
<td>Yes</td>
<td>ESNet</td>
<td>No</td>
<td>Yes</td>
<td>108</td>
<td></td>
<td></td>
<td>02/16/2017</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASGC</td>
<td>Tier1</td>
<td>Yes</td>
<td>Yes</td>
<td>GEANT, ESNet</td>
<td>GEANT, ESNet</td>
<td>Yes</td>
<td>50</td>
<td>100</td>
<td>100</td>
<td><a href="http://statas.nordu.net/stat-q/oad-map/nordi_traffic_peak">http://statas.nordu.net/stat-q/oad-map/nordi_traffic_peak</a></td>
<td>Dual stack storage will be soon available.</td>
<td>02/21/2017</td>
</tr>
<tr>
<td>NDGF</td>
<td>Tier1</td>
<td>Yes</td>
<td>Yes</td>
<td>NORDUnet</td>
<td>NORDUnet</td>
<td>Yes</td>
<td>108</td>
<td>100</td>
<td>100</td>
<td>percentage of dualstack storage to be checked</td>
<td>02/20/2017</td>
<td></td>
</tr>
</tbody>
</table>
Tier 1 (cont’d)

• All Tier 1 now have IPv6 peering with LHCOPN
  – Except KR-KISTI-GSDC
  – Should connect soon

• Dual-stack Tier1 storage slowly being deployed
  – By 31\textsuperscript{st} July 2017 - 11 Tier1’s claim some storage
  – Seems on-track for April 2018
  – But we should continue to monitor
Tier 2 status & Experiments
ALICE

• Monitoring all sites – IPv6 readiness
• http://alimonitor.cern.ch/ipv6/

• All SEs and CEs
  – Site by site

• 71 SEs in 54 sites
  – 9 have IPv6 DNS AAAA (6 sites)
  – 8 are reachable over IPv6

• Concern – not changing
ALICE (part of list)
• Adding a DNS IPv6 test to production ETF instance
  – Can be done from an IPv4-only system!
• A storage test for xRootD is being prepared
  – To automatically test all SEs (from IPv6 ETF/SAM3)
• Other experiments can request same ETF DNS test
• CMS also tracking all storage@sites with their IPv6 readiness
  – 17 Sites “Tested” (11 OK, 4 problems, 2 not connected)
  – 26 Sites “Not ready yet”
  – 7 “Unknown status”
• Also updating the old WLCG survey
  – [https://www.gridpp.ac.uk/wiki/2014_IPv6_WLCG_Site_Survey](https://www.gridpp.ac.uk/wiki/2014_IPv6_WLCG_Site_Survey)
LHCb

• Agreed that they will monitor in same way as ALICE (using same table and columns)
• Analysis after the September 2017 meeting
  – 21 SEs (6 IPv6 capable)
  – 163 CEs at 76 Sites (15 IPv6 at 6 sites)
    • Here just standard WLCG CE
    • exclude VAC, Vcycle, DIRAC (none is IPv6 capable)
ATLAS

• Machines that need to be IPv6 (to allow jobs to run on IPv6-only WN) done for some time
  – Very few operational problems
  – A problem at one site with WebDav deletes
    • IPv6 firewall problem - now fixed

• Starting to move the Frontier service to dual stack

• Plans to make more services dual stack
  – but still to happen
CERN Storage
EOS
Enable IPv6 in EOS

1. Give IPv6 connectivity to the nodes
2. Restart the daemons (FST\textsuperscript{a} or MGM\textsuperscript{b})
3. Welcome to the 21\textsuperscript{st} century

\textsuperscript{a}storage node
\textsuperscript{b}management node
Numbers about IPv6 on EOS

- 59% of all EOS traffic is IPv6\(^a\)
- \(\approx 9\%\) of “users” come via IPv6

\(^a\)Boosted by internal replication
IPv6-only CPU testing

• By several members of the WG, including
  – Tier 1: PIC
  – Tier 2: Brunel, QMUL

• Test jobs run by ATLAS, CMS, LHCb at various times
• In general works, but still some issues to solve

• QMUL has been running some IPv6-only nodes behind NAT64
  – Good way of listing which services are contacted by a particular job
Transition monitoring
FTS transfers (During 6 hrs) total

https://monit.cern.ch/
IPv6: ~3% “successes”; ~5% “throughput”; failure spike is IPv4!
PerfSONAR Dual-stack mesh

IPv6 Bandwidth test

ETF IPv6

- ETF IPv6 instance provides dual-stack testing support for SAM
- Works for all experiments – they can now request their own IPv6 instance
- Using experiment production topologies
  - it parses a list of CEs/SEs from the experiments feeds

https://etf-ipv6.cern.ch/etf/check_mk/index.py
Current IPv6 issues

- IPv6 – ongoing intermittent problems between SARA and Imperial London
  - LHCONE link? Vendor? Now solved!
    - GGUS #129946
- X.509 CA CRLs (being chased with IGTF)
  - 37 IPv6, 51 IPv4-only
- CERN Agile Infrastructure
  - plan to turn on IPv6 on VMs by default
    - delayed (until Jan 2018) because of a router bug
- Docker containers and IPv6-only support? (issue 25407)
  - In general works, but some bridging problems (CERN EOS)
- IPv6-only WN tests at PIC
  - HTcondor instability
HEPiX IPv6 WG meetings

• Meetings held monthly (and 3 F2F per year)
  • Last F2F at CERN 11/12 Sep 2017
  • Next F2F at CERN 11/12 Jan 2018
• Participation of all LHC experiments, Tier-0/1 sites and some Tier-2 sites
  • Participation from more sites warmly welcome
  • Write to ipv6@hepix.org to join
• Discuss technical issues, progress reports
  • Best way to get involved and contribute
Summary

• Dual-stack storage at Tier-1 is coming slowly
• Some issues still to be solved for IPv6-only WN
• ~10% of services dual-stack; ~3 to 5% of FTS data throughput is IPv6
• A number of Tier 2s run dual-stack storage
  – But still a small minority
• **WLCG Tier 2s please start planning for IPv6 now**
• Automatic endpoint transition monitoring being worked on
• How best to track/urge/encourage/support the Tier 2’s?
  – Documentation & training
  – Responsible for deployment: WLCG Operations and its IPv6 Task Force
• Tracking/monitoring best done Experiment by Experiment
  – given different timescales & requirements
Links

• HEPiX IPv6 web
  http://hepix-ipv6.web.cern.ch

• Working group meetings
  http://indico.cern.ch/categoryDisplay.py?categId=3538

• WLCG Operations IPv6 Task Force
  http://hepix-ipv6.web.cern.ch/content/wlcg-ipv6-task-force-0
Questions?