

Results of Removal of IPv4 Peering on LHCOPN in the U.S.

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WLCG OTF #6 (<https://indico.cern.ch/event/1562124/>)



Removal of IPv4 on US Tier1s LHCOPN links

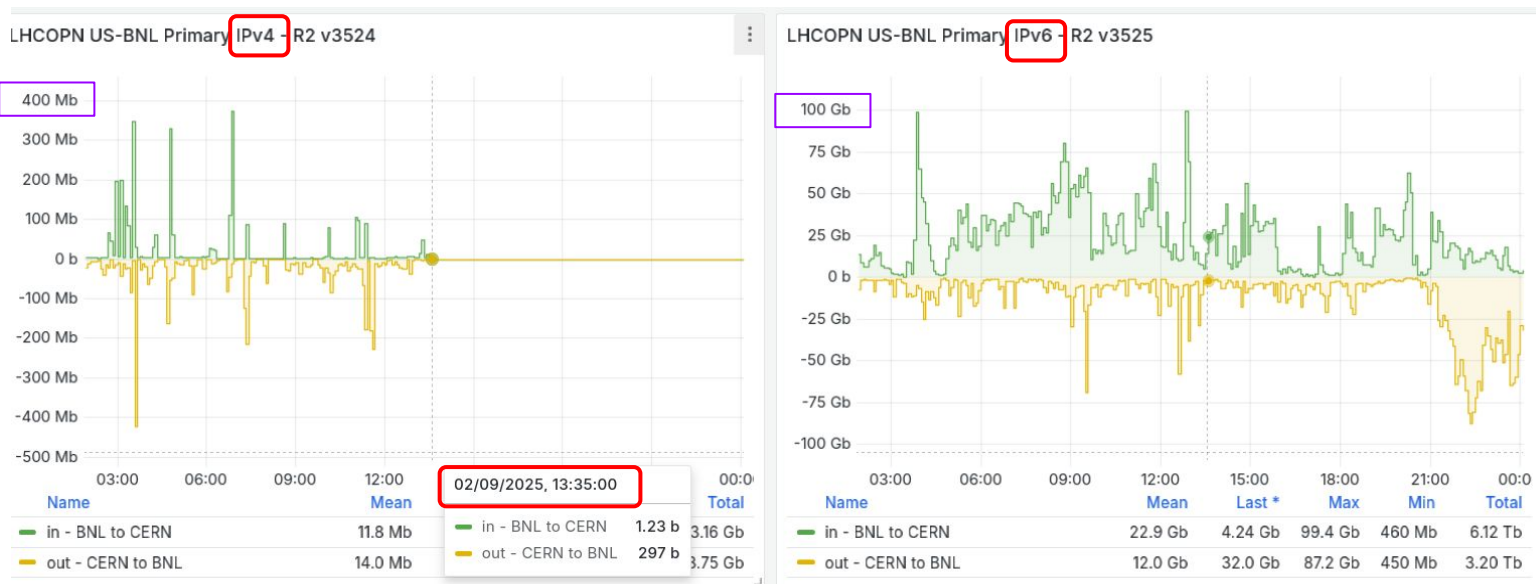
- At July WLCG Management Board it was agreed to remove IPv4 from BNL and FNAL LHCOPN links on 2nd of September 2025, during a LHC stop (machine development)
- As a consequence, the IPv4 traffic to these two sites would fall-back to LHCONE, with last resort backup over the Internet

IPv4 leftovers

- Average amount of IPv6 traffic in LHCOPN already above 90% for several months
- Last clean-up of remaining IPv4 on BNL and FNAL during August:
 - JINR: solved by JINR by preferring IPv6 over IPv4 on Linux settings
 - Still some IPv4 traffic to NLT1 and IT-INFN-CNAF for well known limitations (switch performance at NLT1 and IPv4-only Infiniband gateway at CNAF)

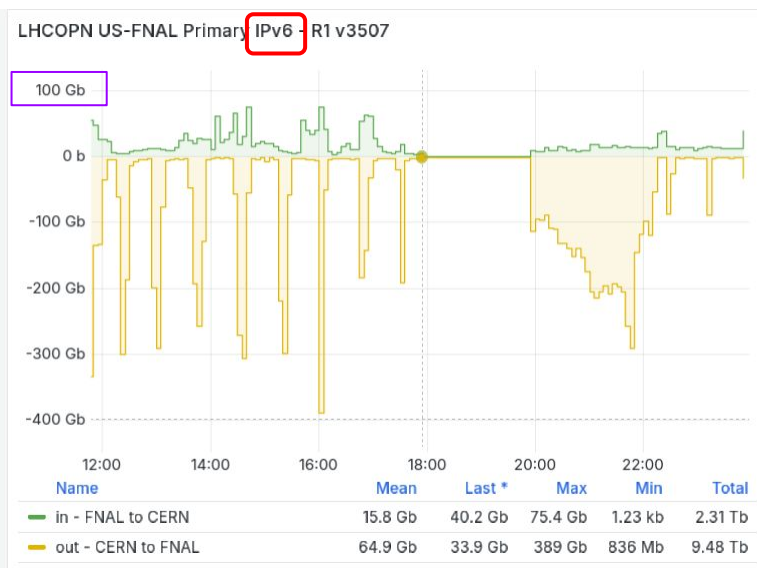
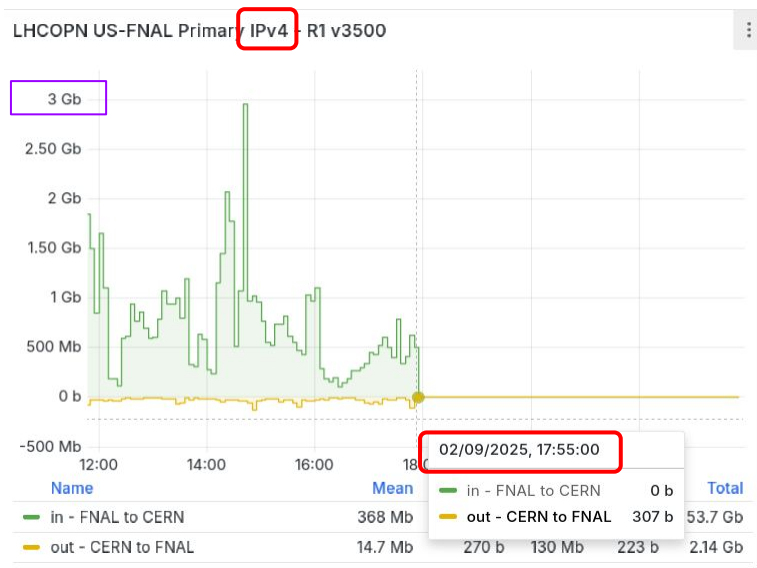


- BNL stopped all LHCOPN IPv4 peerings at 11:27 UTC (7:27 AM EDT or 13:27 CERN time where plots were copied)



<https://monit-grafana-open.cern.ch/d/Clqt0f5nk/us-bnl?orgId=16>

- FNAL stopped all LHCOPN IPv4 peerings at 15:53 UTC
- IPv6 was stopped as well by mistake, but recovered at ~17:50 UTC



<https://monit-grafana-open.cern.ch/d/JohzoB5nk/us-fnal?orgId=16>

FNAL-CERN IPv4 moves to LHCONE

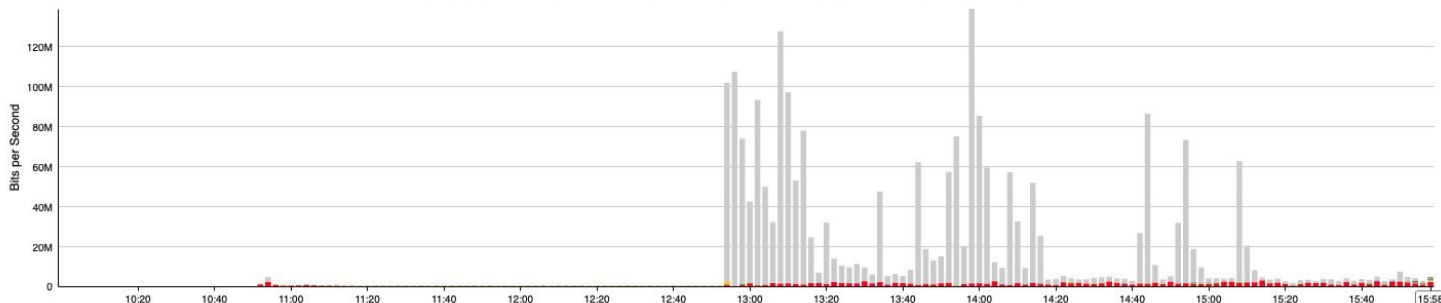
- FNAL-CERN IPv4 moves to LHCONE when the LHCOPN peerings stop

Chart Top Source_Destination Pairs Host All Protocol All Date 2 Sep 2025 Time 10:00 AM Interval 360 minutes Units Bits/sec.

Where ? vlan='2203' & ipversion='4' & bgpsourceas='513'

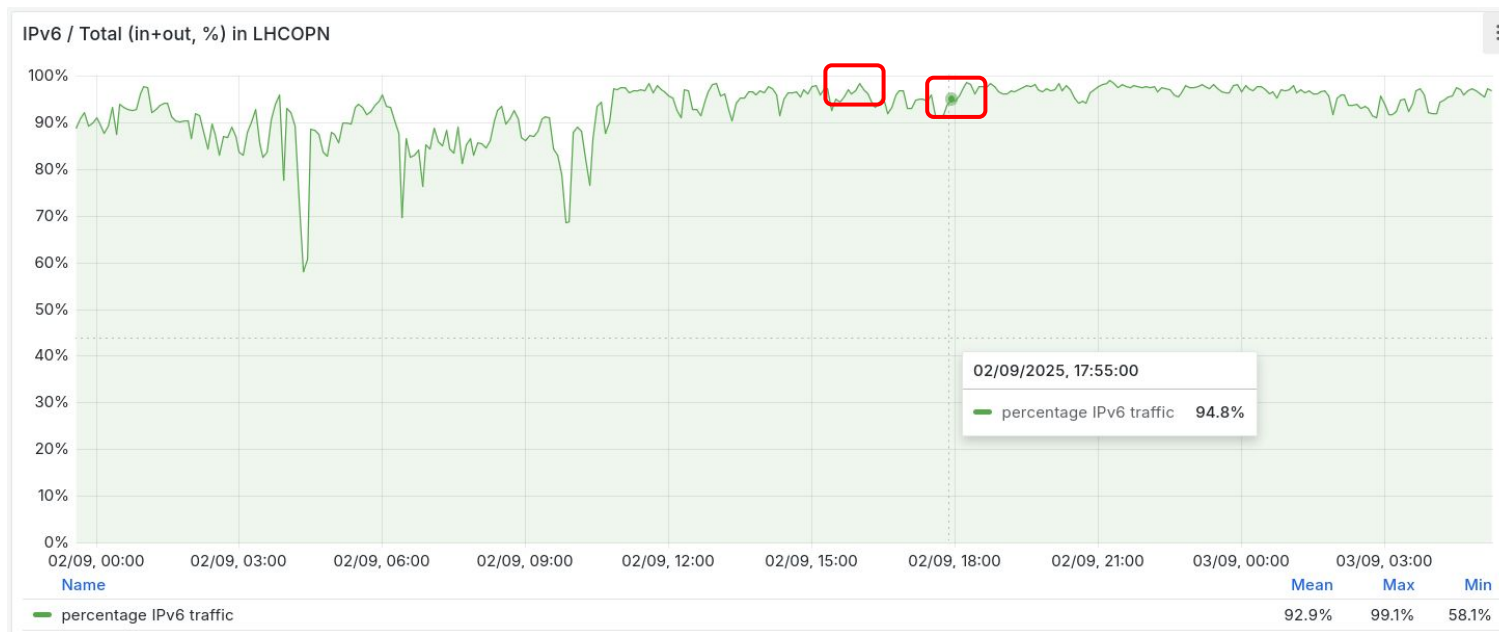
OK Edit Clear

Source Address	Destination Address	Value
srv-c2f41-26-01-lcgp5--cms.cern.ch (128.142.208.39)	cmserv2222.fnal.gov (131.225.204.59)	2.02M
vocms0294.cern.ch (128.142.194.81)	cmsrvz12.fnal.gov (131.225.189.3)	427.49K
b9p16p3622.cern.ch (188.185.196.87)	cmsstor361.fnal.gov (131.225.205.60)	417.79K
b9p05p0465.cern.ch (188.185.206.41)	cmsaos1510.fnal.gov (131.225.206.138)	373.01K
b9p13p1802.cern.ch (188.185.192.104)	cmserv2222.fnal.gov (131.225.204.59)	207.26K
b9p31p2361.cern.ch (188.185.215.15)	cmsgwms-submit14.fnal.gov (131.225.190.200)	207.26K
b9p28p3499.cern.ch (188.185.213.160)	cmsaos2312.fnal.gov (131.225.204.233)	155.10K
b9p19p7705.cern.ch (188.185.193.39)	cmsaos1608.fnal.gov (131.225.188.79)	136.53K
vocms0292.cern.ch (128.142.194.123)	cmsrvz12.fnal.gov (131.225.189.3)	132.16K
vocms0294.cern.ch (128.142.194.81)	cmserv806.fnal.gov (131.225.188.243)	130.53K
b9p28p3499.cern.ch (188.185.213.160)	cmsaos2320.fnal.gov (131.225.205.131)	126.98K
vocms0292.cern.ch (128.142.194.123)	cmsrvz11.fnal.gov (131.225.189.2)	116.60K
b9g18p2454.cern.ch (128.142.192.194)	cmsaos1513.fnal.gov (131.225.206.145)	66.90K
srv-c2f41-26-01-lcgp5--cms.cern.ch (128.142.208.39)	cmserv2221.fnal.gov (131.225.204.58)	66.63K
b9g18p2454.cern.ch (128.142.192.194)	cmsaos1609.fnal.gov (131.225.188.80)	28.67K



% IPv6/total - whole LHCOPN

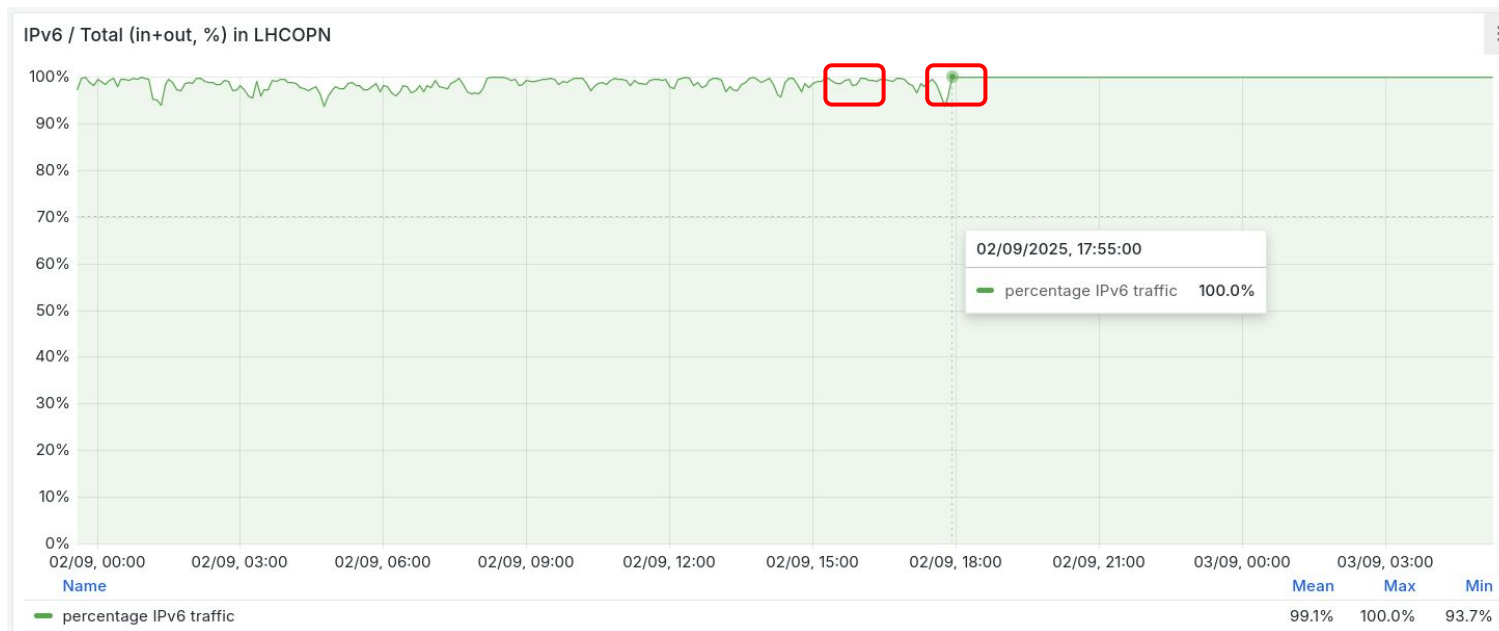
- Percentage IPv6 over total traffic considering all LHCOPN links
- Stop of BNL and FNAL not noticeable on the global stat



<https://monit-grafana-open.cern.ch/d/cumEJb4z/lhcopn-one-ipv6-vs-ipv4?orgId=16>

% IPv6/total - FNAL and BNL only

- Percentage IPv6 over total traffic considering only FNAL and BNL links
- 100% IPv6



<https://monit-grafana-open.cern.ch/d/cumEJb4z/lhcopn-one-ipv6-vs-ipv4?orgId=16>

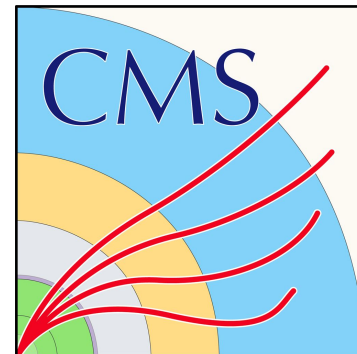
Impact on ATLAS



- No noticeable impact.
- Any remaining IPv4 Traffic re-routed onto LHCONE or R&E networks.
- Has a few non-WLCG experiments that were using LHCOPN and now use LHCONE

Impact on CMS

- No noticeable impact.
- Any remaining IPv4 Traffic re-routed onto LHCONE or R&E networks.



Impact on BelleII

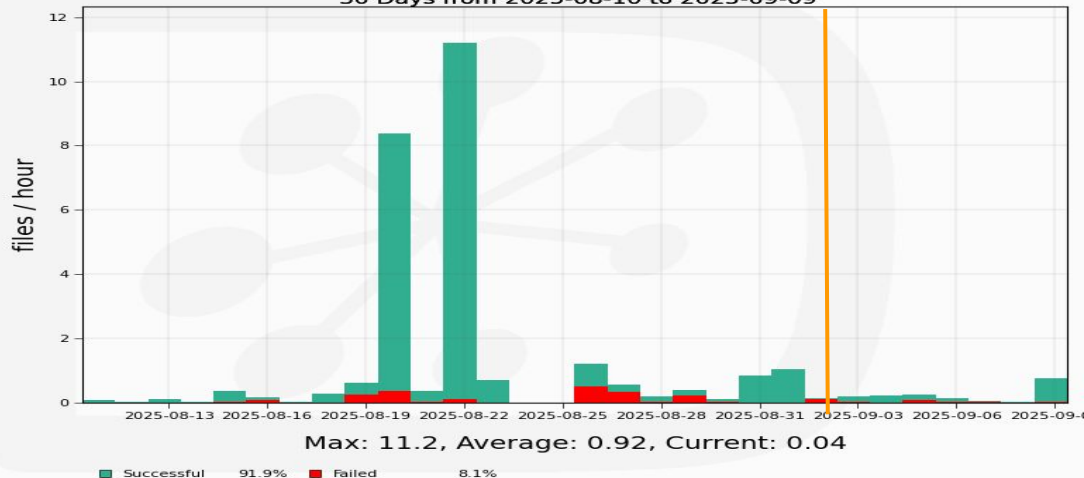


- IT-INFN-CNAF nodes are IPv4 only. Transfers to BNL moved to LHCONE OK
- All BNL services still reachable over IPv4 as before
- Some errors appeared already

before Sept 2nd: not related to the routing change

Succeeded Transfers by FinalStatus

30 Days from 2025-08-10 to 2025-09-09



Generated on 2025-09-09 08:28:28 UTC

Next steps

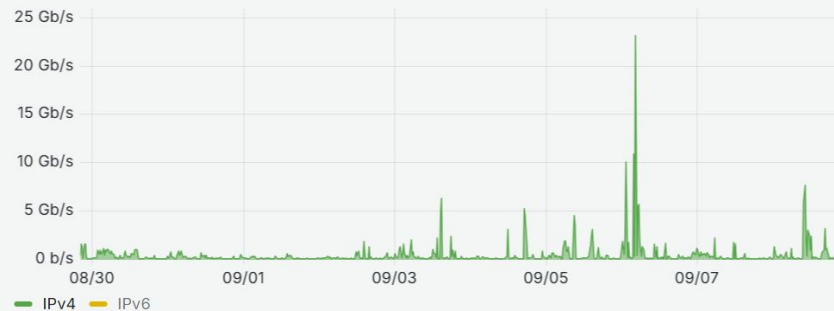
- Revert IPv4 back to FNAL and/or BNL? Or leave it off forever?
 - Still off for the time being, since no negative impact
 - Network teams in favour to keep IPv4 off
- Results and plans will be discussed at the upcoming [LHCOPN/ONE meeting](#)
 - Pushing for IPv6-only LHCOPN before DC27 (even end of 2025?)
 - Evaluating IPv6-only LHCONE before Run-4 start in 2030

Questions?

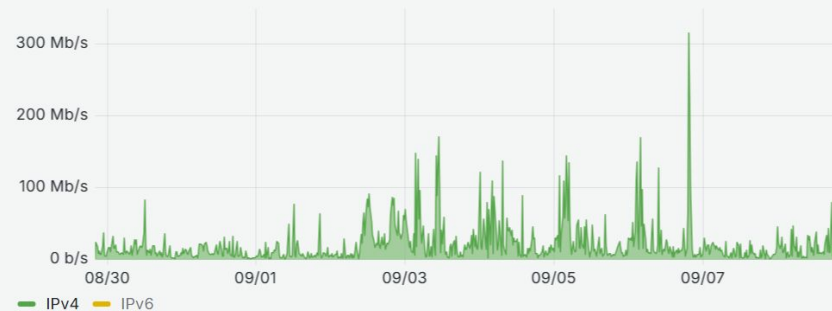
Back-up slides

BNL IPv4 and IPv6

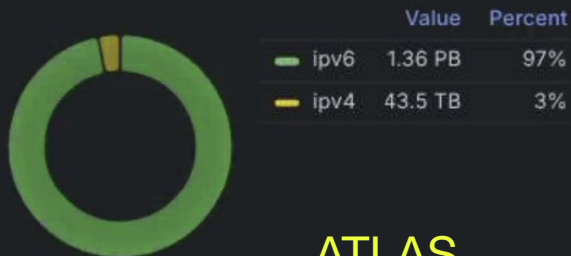
Total Incoming IPv4 and IPv6 Traffic (SNMP)



Total Outgoing IPv4 and IPv6 Traffic (SNMP)

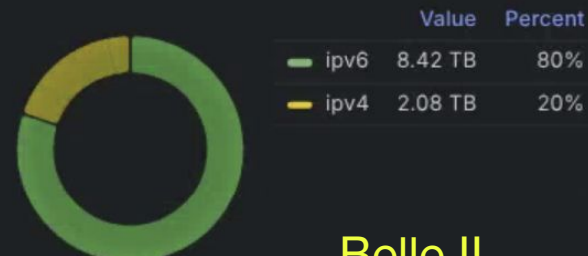


All - IPv4 vs. IPv6 Traffic



ATLAS

All - IPv4 vs. IPv6 Traffic



Belle II

IPv4 vs IPv6 last 30 days

IPv4 vs IPv6 in LHCOPN



Name	Mean	Max	Min
In IPv4 to CERN	7.17 Gb/s	39.0 Gb/s	576 Mb/s
In IPv6 to CERN	141 Gb/s	470 Gb/s	32.6 Gb/s
Out IPv4 from CERN	15.7 Gb/s	93.9 Gb/s	0 b/s
Out IPv6 from CERN	281 Gb/s	893 Gb/s	0 b/s

% IPv6/Total last 30 days

IPv6 / Total (in+out, %) in LHCOPN

