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

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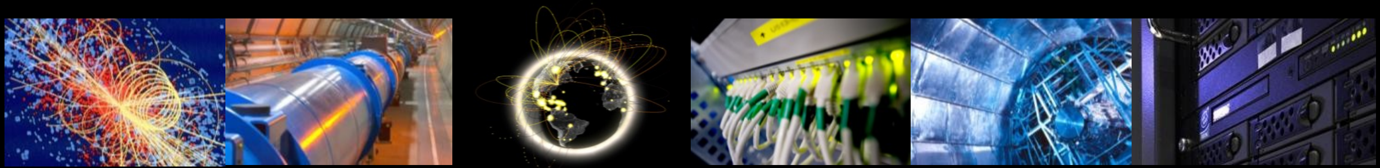
LHCOPN meetin at KIT 7th Oct 2025



Worldwide LHC Computing Grid

Open Science Grid

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)

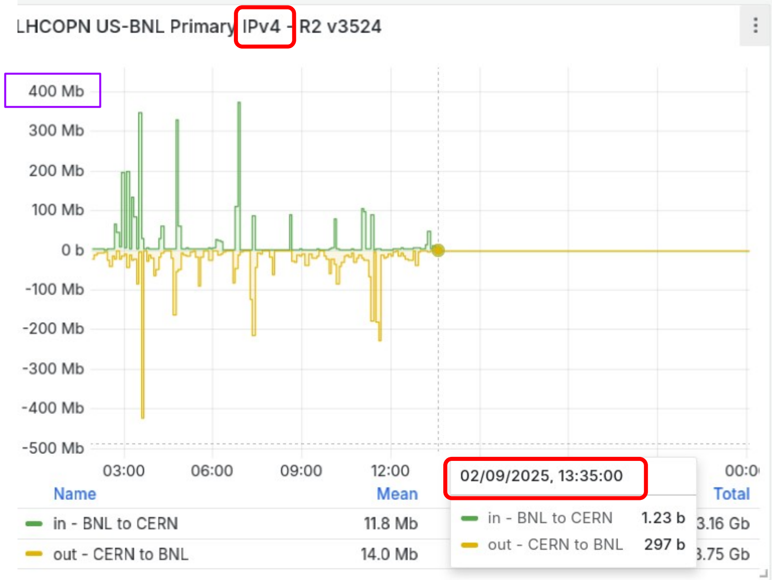
- As a consequence, the IPv4 traffic to these two sites would fall-back to LHCONE, with last resort backup over the Internet

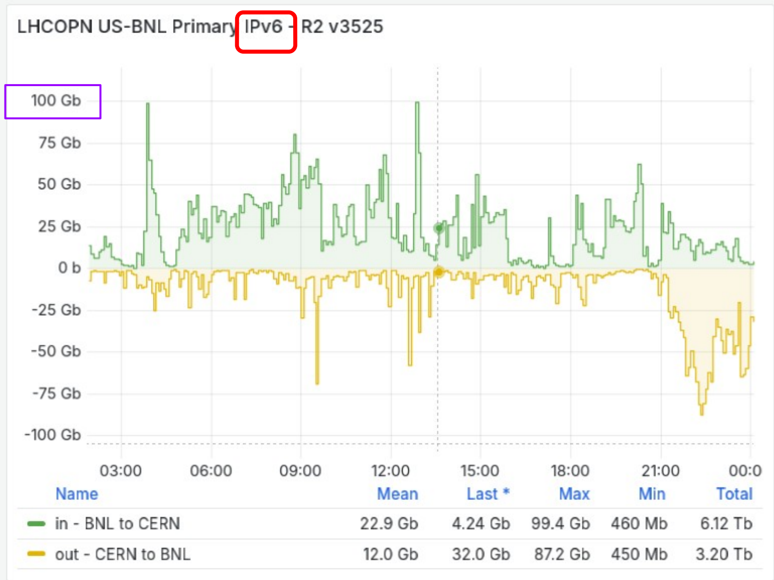
IPv4 leftovers

- 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

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

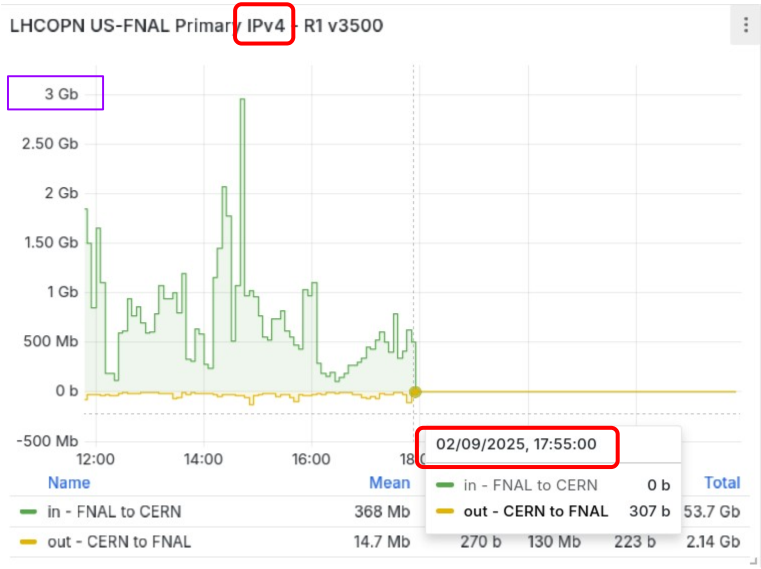


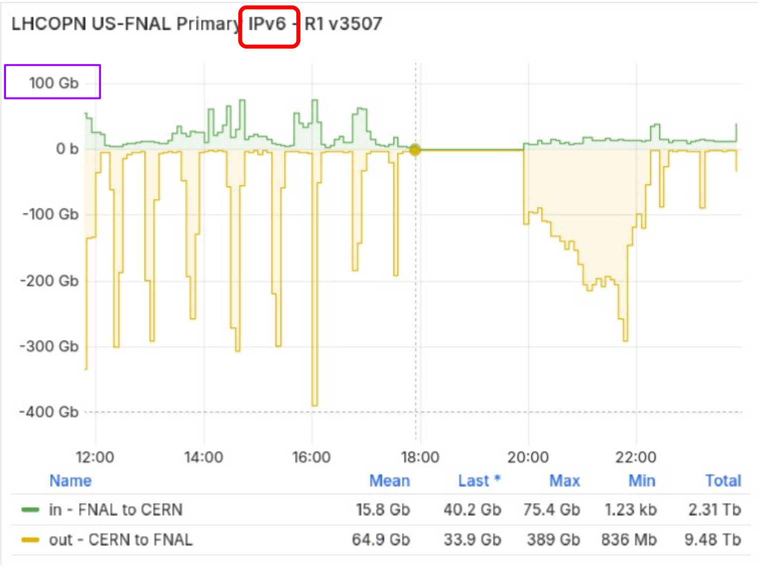


https://monit-grafana-open.cern.ch/d/CIqtof5nk/us-bnl?orgId=16

FNAL

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





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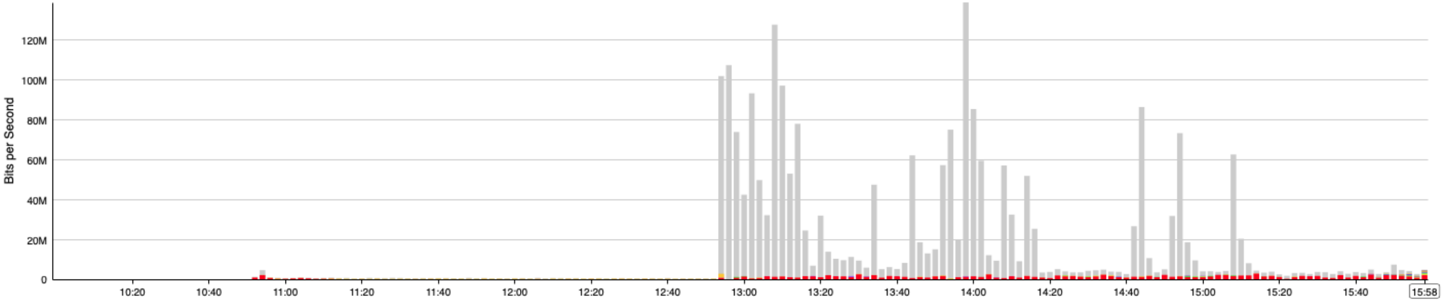
FNAL-CERN IPv4 moves to LHCONE

- 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.

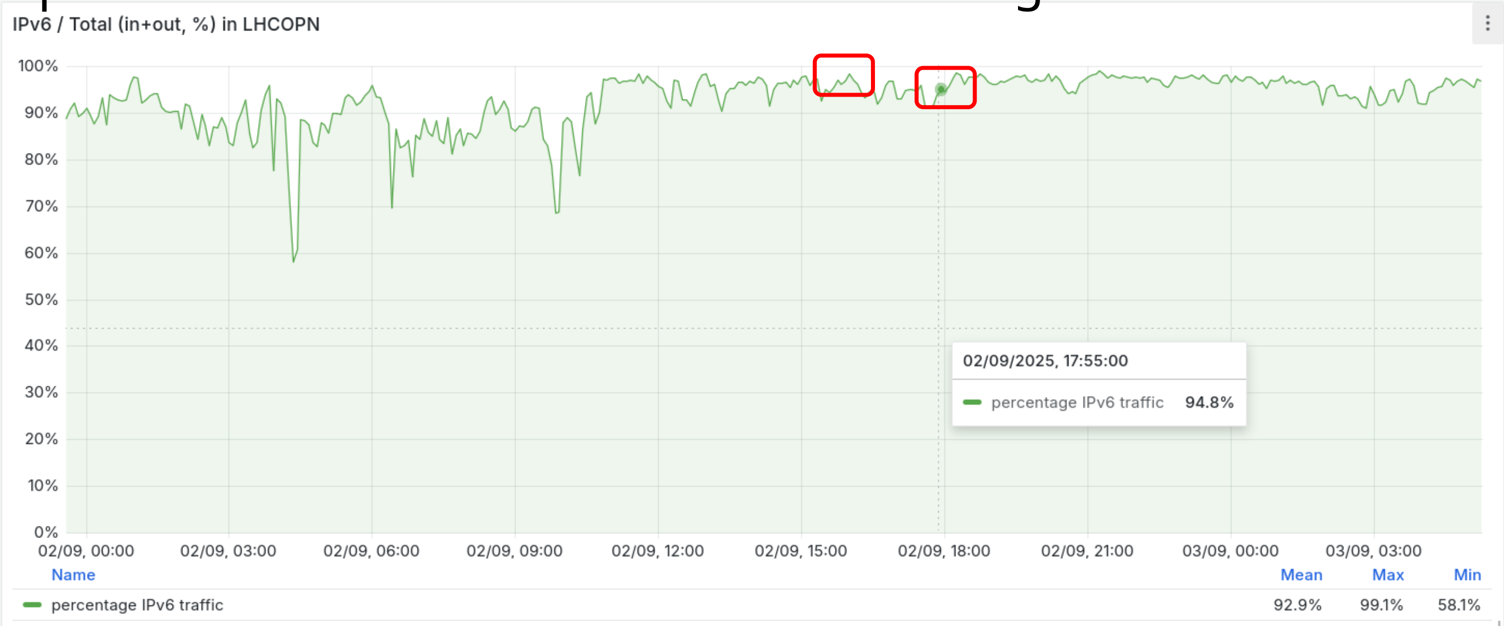
Where (?) vlan='2203' & ipversion='4' & bgpsourceas='513' OK Edit Clear

	Source Address	Destination Address	Value
	srv-c2f41-26-01-lcgp5--cms.cern.ch (128.142.208.39)	cmssrv2222.fnal.gov (131.225.204.59)	2.02M
	vocms0294.cern.ch (128.142.194.81)	cmssrvz12.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)	cmseos1510.fnal.gov (131.225.206.138)	373.01K
	b9p13p1802.cern.ch (188.185.192.104)	cmssrv2222.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)	cmseos2312.fnal.gov (131.225.204.233)	155.10K
	b9p19p7705.cern.ch (188.185.193.39)	cmseos1608.fnal.gov (131.225.188.79)	136.53K
	vocms0292.cern.ch (128.142.194.123)	cmssrvz12.fnal.gov (131.225.189.3)	132.16K
	vocms0294.cern.ch (128.142.194.81)	cmssrv806.fnal.gov (131.225.188.243)	130.53K
	b9p28p3499.cern.ch (188.185.213.160)	cmseos2320.fnal.gov (131.225.205.131)	126.98K
	vocms0292.cern.ch (128.142.194.123)	cmssrvz11.fnal.gov (131.225.189.2)	116.60K
	b9g18p2454.cern.ch (128.142.192.194)	cmseos1513.fnal.gov (131.225.206.145)	66.90K
	srv-c2f41-26-01-lcgp5--cms.cern.ch (128.142.208.39)	cmssrv2221.fnal.gov (131.225.204.58)	66.63K
	b9g18p2454.cern.ch (128.142.192.194)	cmseos1609.fnal.gov (131.225.188.80)	28.67K



% IPv6/total - whole LHCOPN

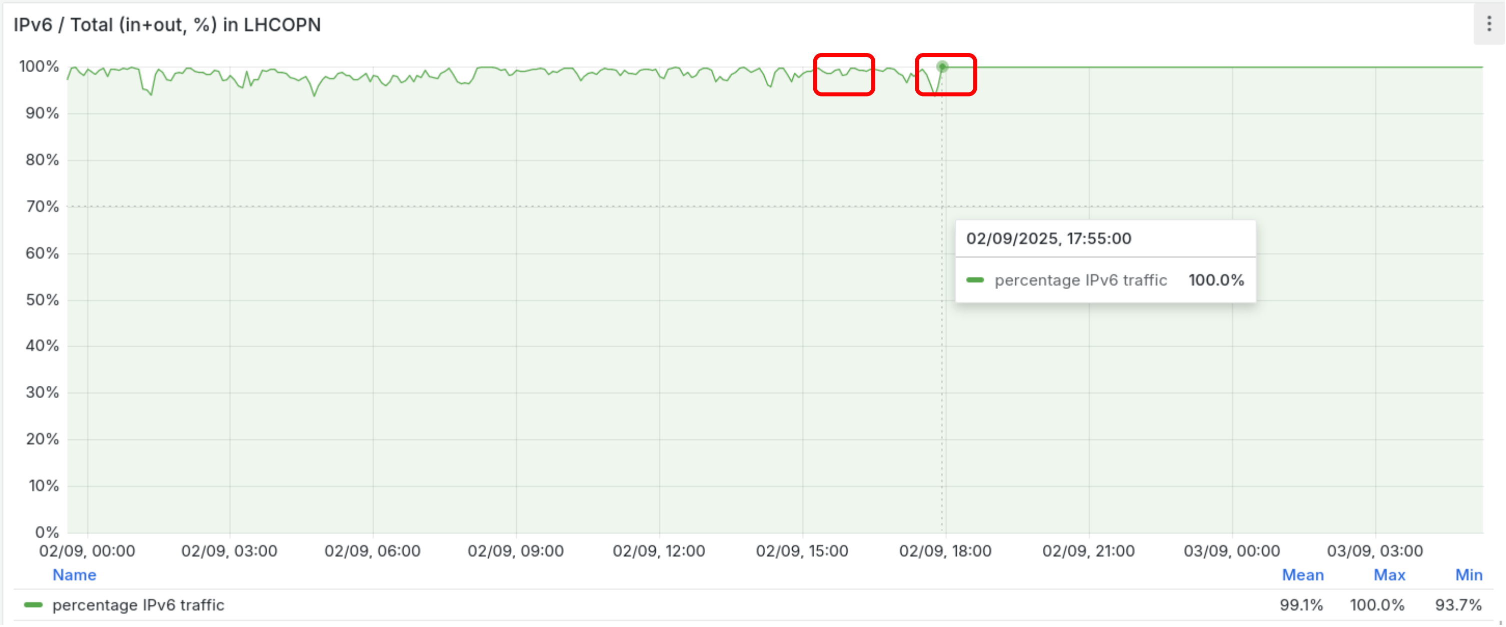
- Percentage IPv6 over total traffic considering all LHCOPN links
- Stop of BNL and FNAL not noticeable on the global stat



https://monit-grafana-open.cern.ch/d/cumEJJb4z/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/cumEJJb4z/lhcopn-one-ipv6-vs-ipv4?orgId=16

Impact on ATLAS

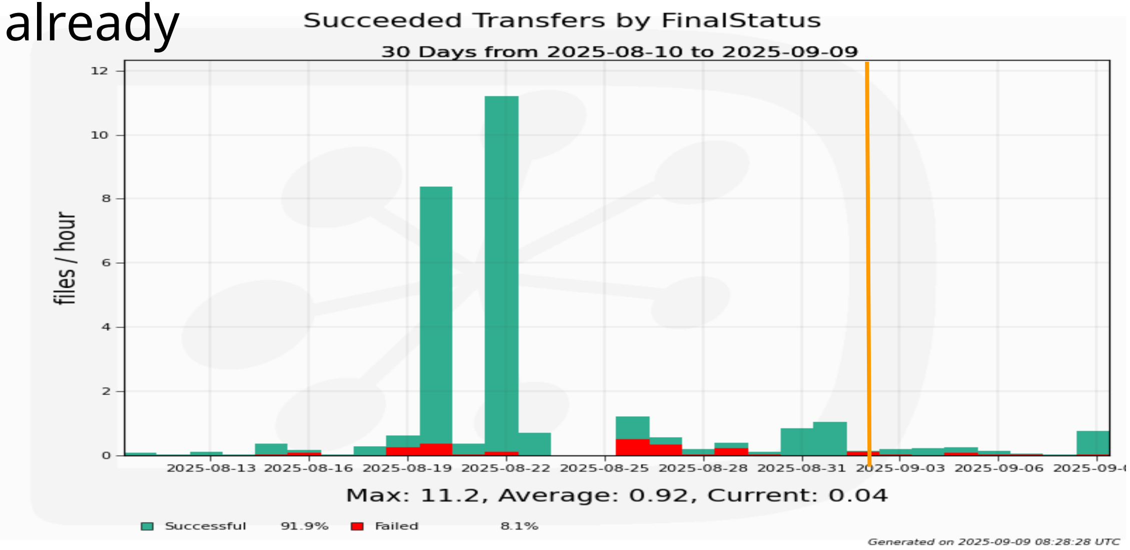
- No noticeable impact.
- Any remaining IPv4 Traffic re-routed onto LHCONE or R&E networks.
- Has a few non-WLCG experiments that were using LHCOPN and now use LHCONE

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



Next steps

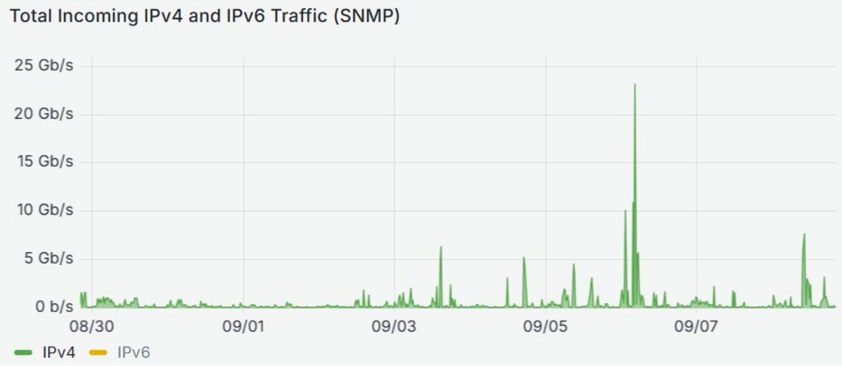
- Revert IPv4 back to FNAL and/or BNL? Or leave it off forever?
  - Still off for the time being, since no negative impact
  - Network teams in favour to keep IPv4 off

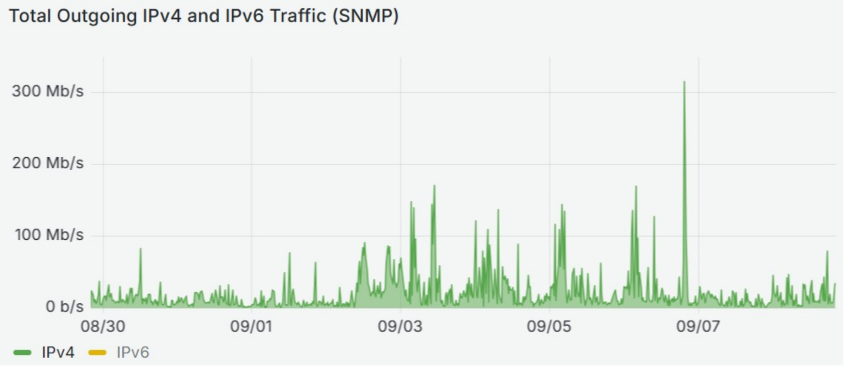
- Results and plans to be discussed at the LHCOPN/ONE meeting
  - Pushing for IPv6-only LHCOPN before DC27 (even end of 2025?)
  - Evaluating IPv6-only LHCONE before Run-4 start in 2030

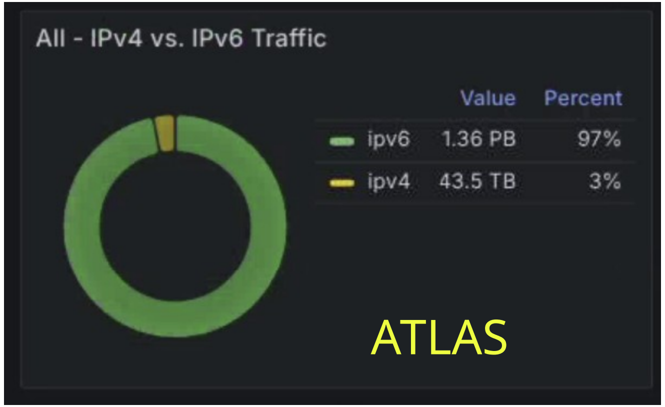
Questions?

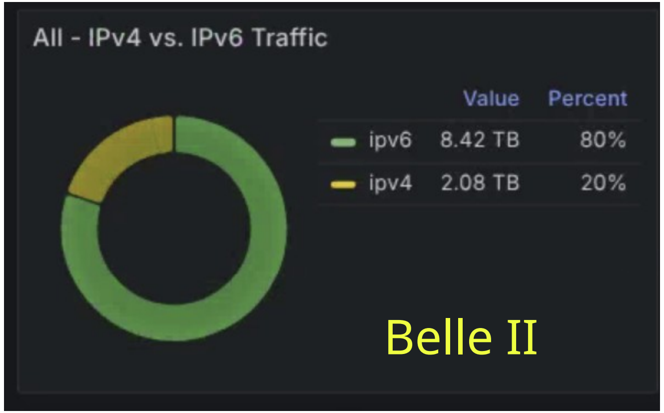
Back-up slides

BNL IPv4 and IPv6



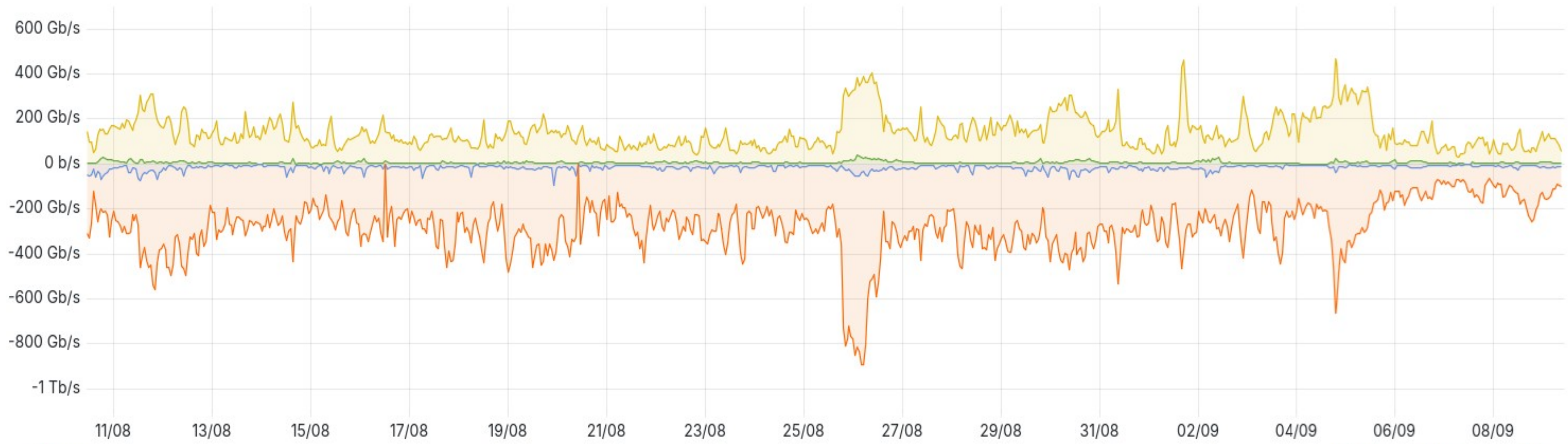






IPv4 vs IPv6 last 30 days

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