



LHCONE L3VPN Updates

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Head of Research Engagement and Support

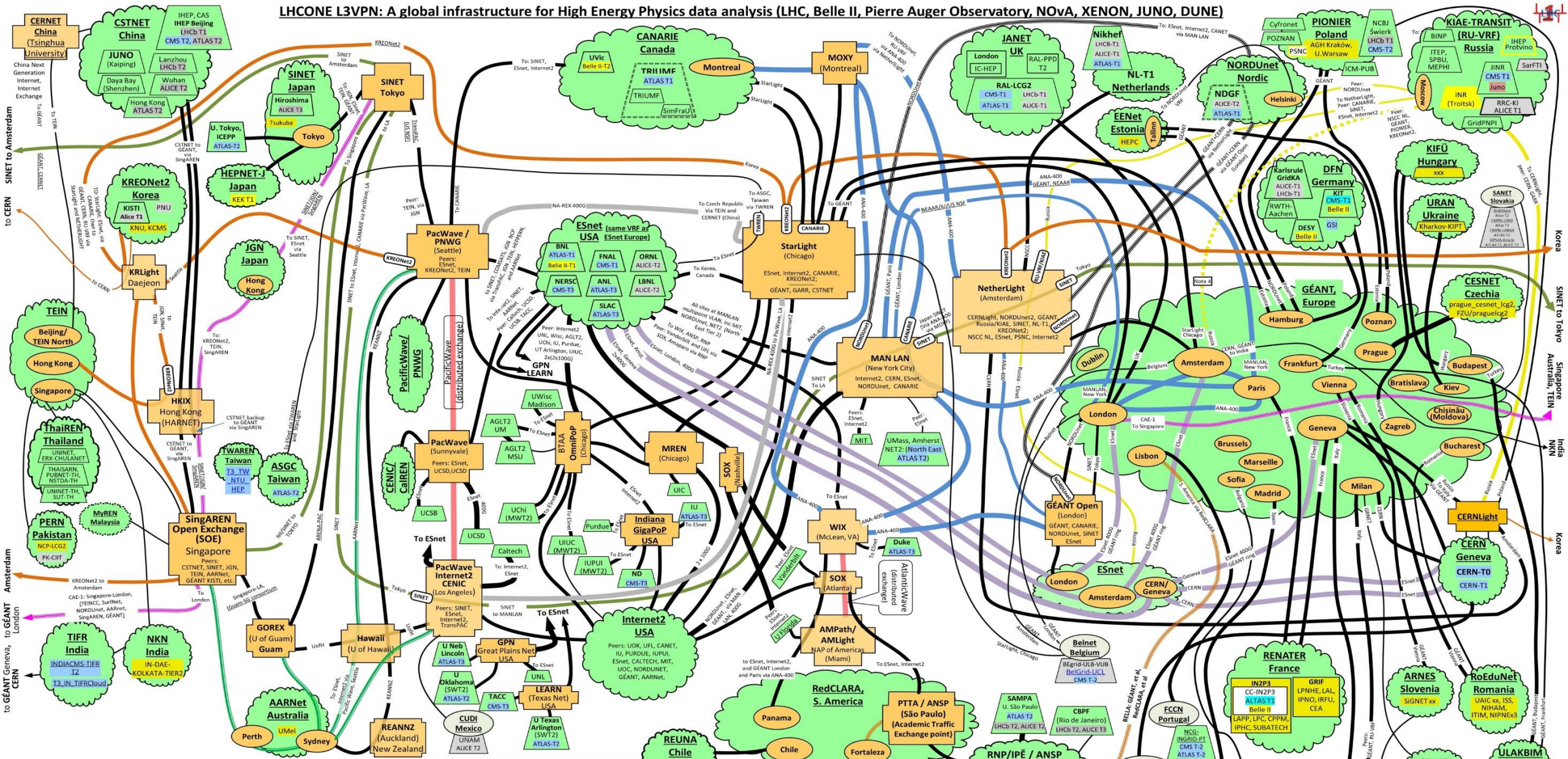
LHCOPN-LHCONE meeting – IHEP Beijing (CN)

9 October 2024

LHCONE around the world



LHCONE L3VPN: A global infrastructure for High Energy Physics data analysis (LHC, Belle II, Pierre Auger Observatory, NOVA, XENON, JUNO, DUNE)



LHCONE Map Ver. 9.0, 2024-04-03 – WEJohnston, ESnet, wej@es.net

- LHCONE VRF domain/aggregator** - A provider network
- Connector network or institution** - provides, e.g., an L2 path between VRFs.
- Provider network PoP router**
- WLCG sites that are not connected to LHCONE**
- Exchange point**

International infrastructure by provider/collaboration

- various**
- AARNet**
- GEANT**
- SINET, Japan, global ring**
- NA-REX**
- ESnet transatlantic, USA**
- SINET/JGN/ SingAREN**
- NREN/SITE router at exchange point**
- Communication links:** $100G=1.5pt, 100G=4pt, 200G=5pt, 400G=6pt, 800G=7.5pt$
- Underlined link information** - indicates link provider, not use
- Double dash outline** - indicates distributed site
- Future site**

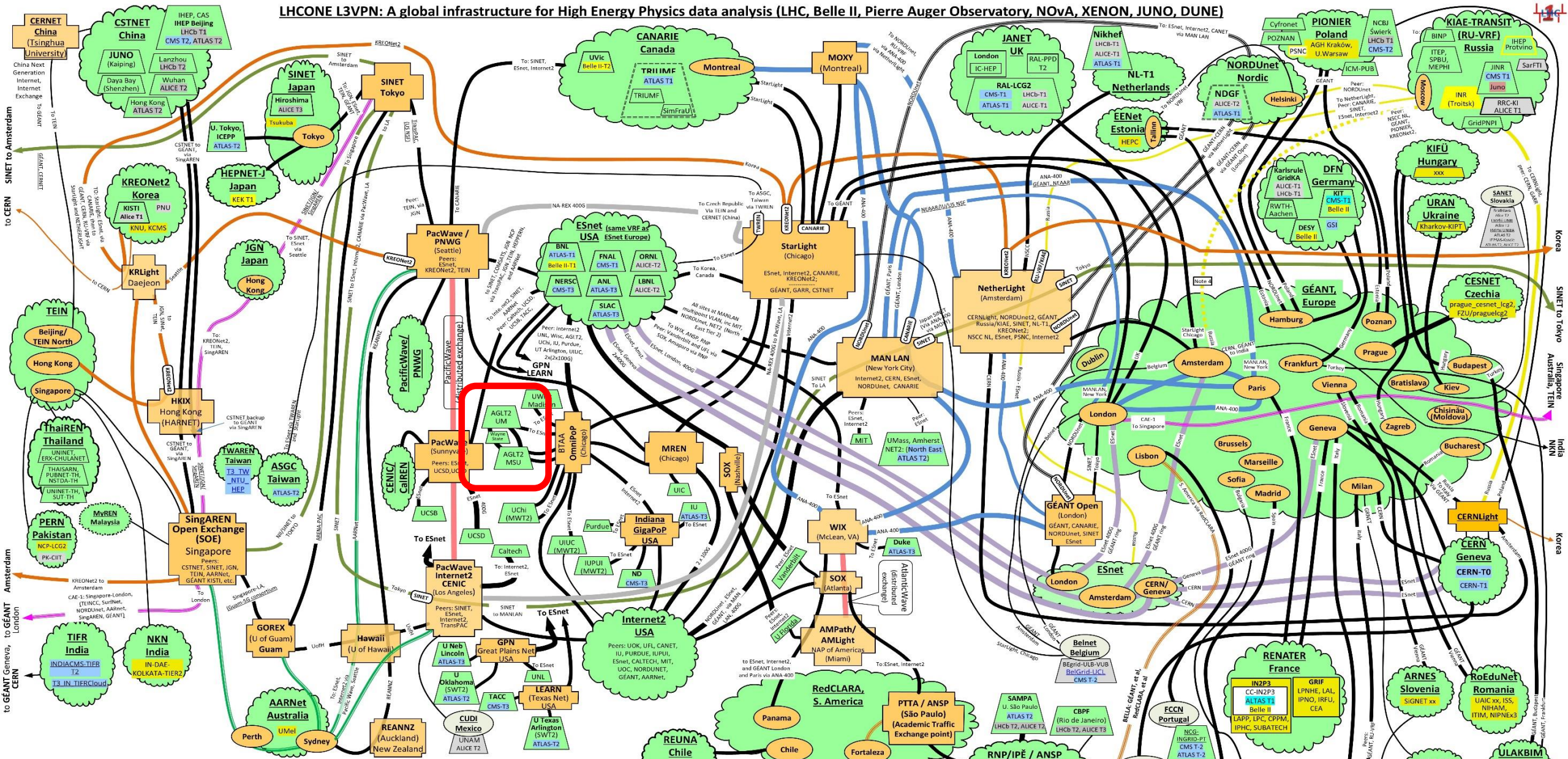
Legend for site types:

- LHCb-T1**: LHC ALICE or LHCb site
- CNAF-T1**: LHC Tier 1 ATLAS and CMS
- Uchi**: LHC Tier 2/3 ATLAS and CMS
- KEK**: Belle II Tier 1/2
- JUNO**: JUNO
- UNL**: Sites that are standalone VRFs

NOTES

- ONLY links involved in LHCONE are shown
- LHCOPN links are not shown on this diagram
- For map explanation see "Interpreting the LHCONE Map" at <https://www.dictpbx.com/sh/padof0580/1raz/AA0s8K8f8SH9fhClAe4CtozZdl=0>
- GEANT and CANARIE have shutdown the peering between their VRF and KIAE, as a result of the Ukraine war.

LHCONE L3VPN: A global infrastructure for High Energy Physics data analysis (LHC, Belle II, Pierre Auger Observatory, NOVA, XENON, JUNO, DUNE)



LHCONE Map Ver. 9.1, 2024-10-01 – WEJohnston, Esnet, wej@es.net

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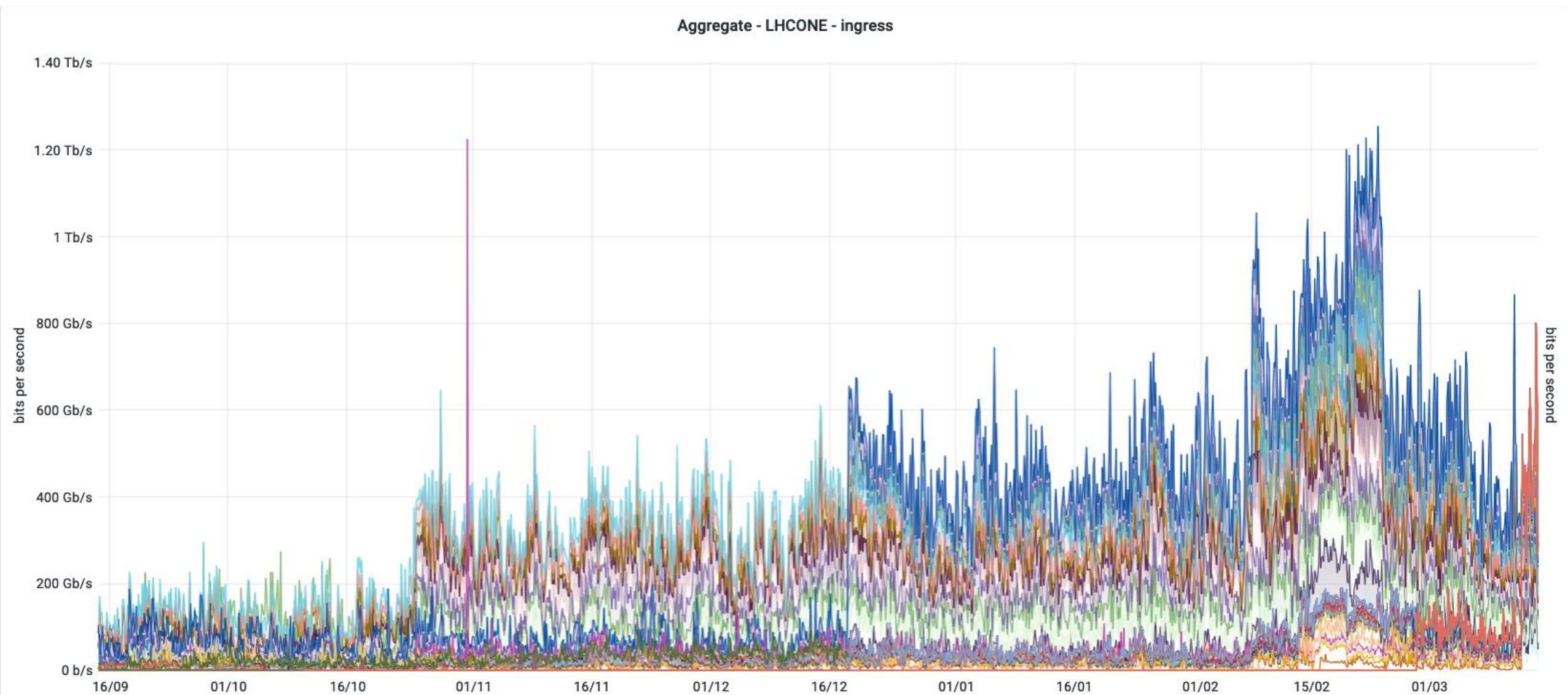
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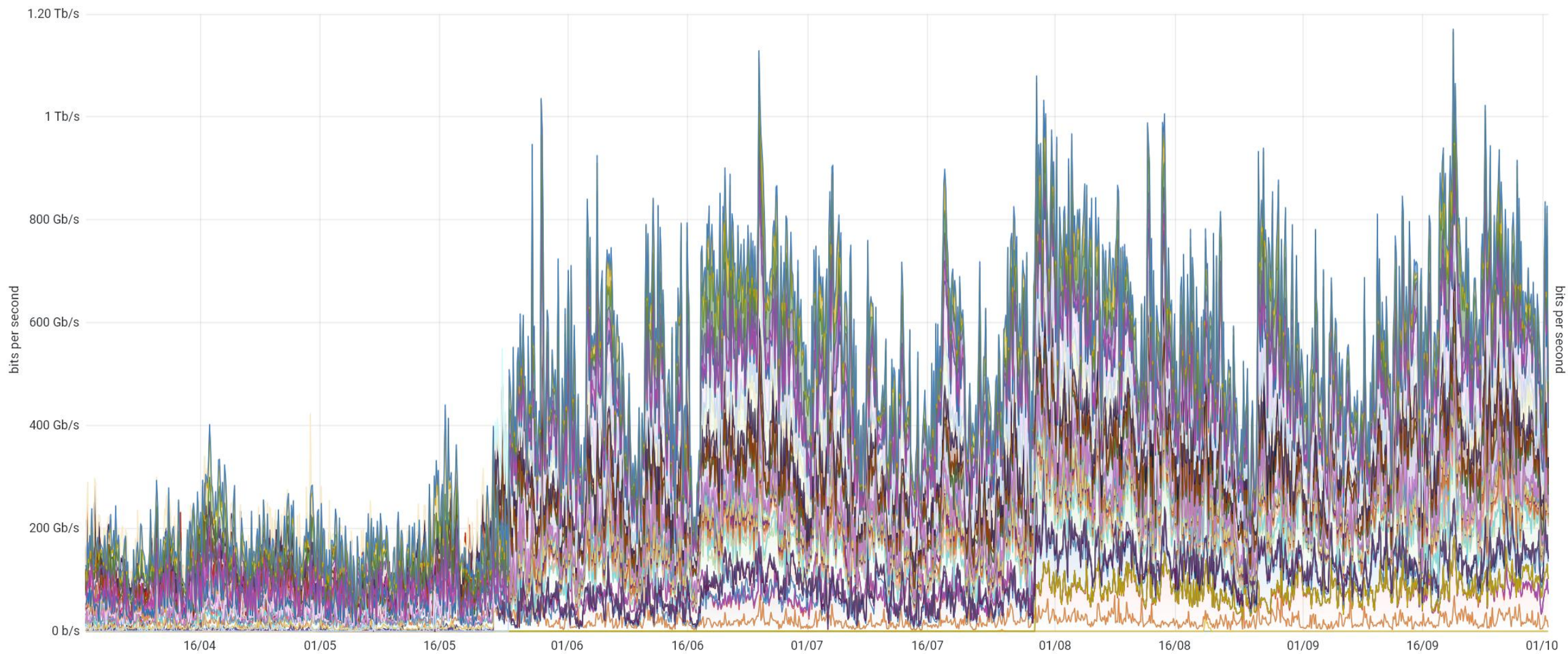
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- GÉANT and CANARIE have shutdown the peering between their VRF and KIAE, as a result of the Ukraine war.

GÉANT aggregate



GÉANT aggregate

Aggregate - LHCONE - ingress



CERN



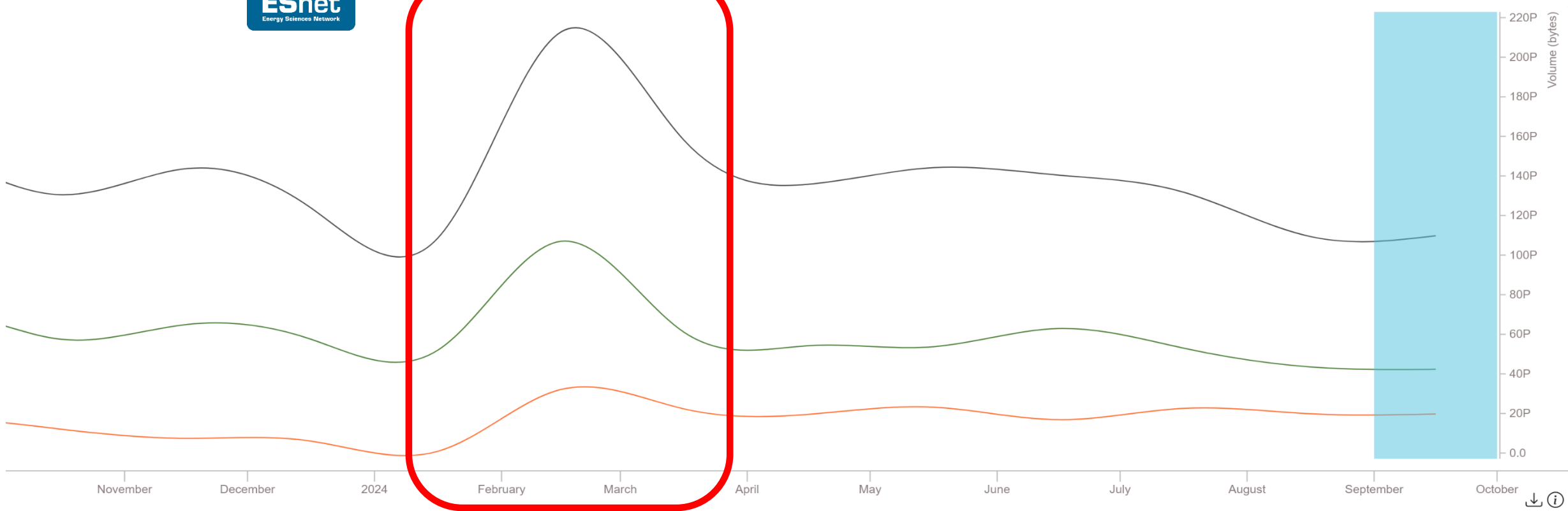
GEANT LHCONE access - 800Gbps



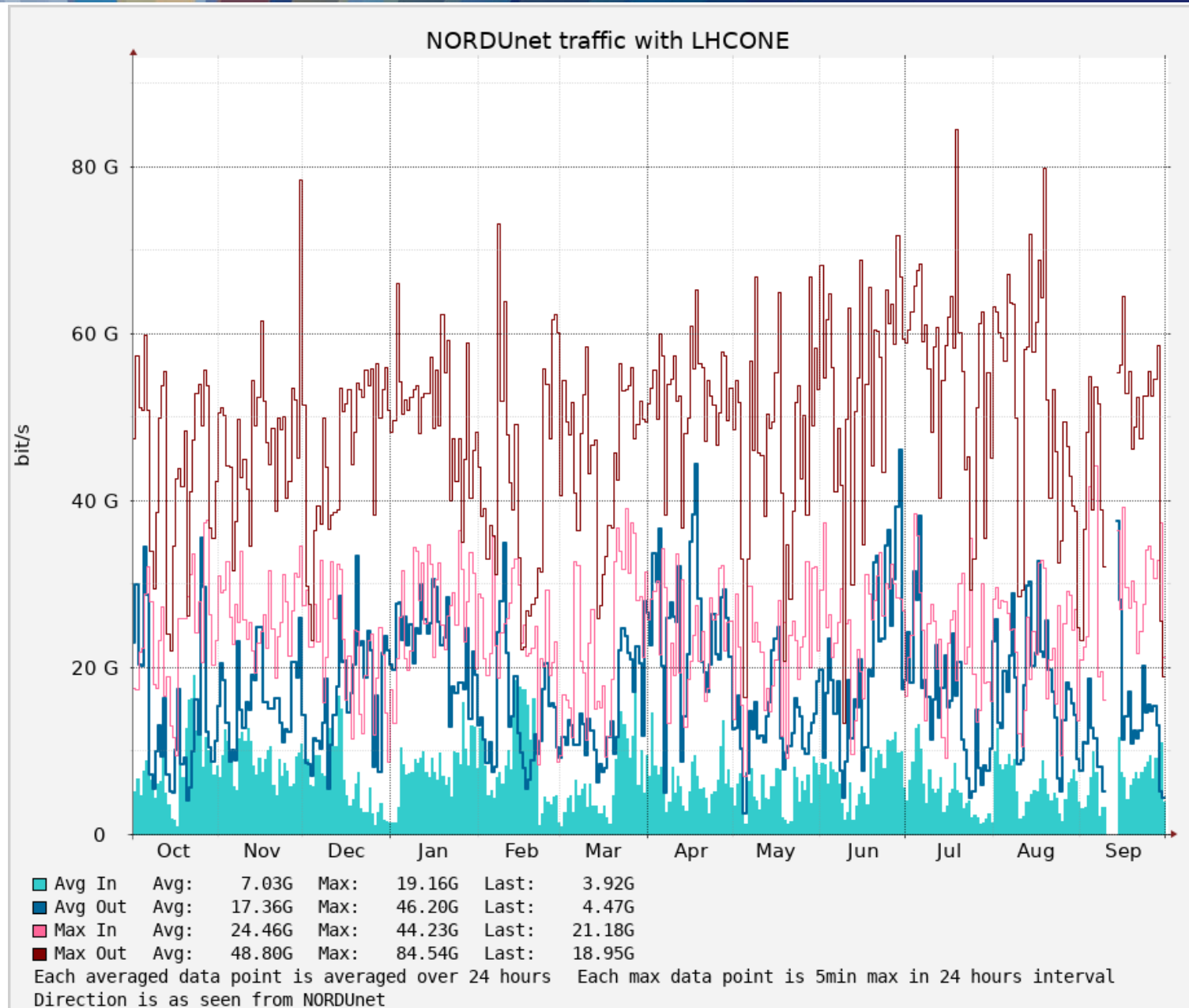
ESnet LHCONE access - 400Gbps



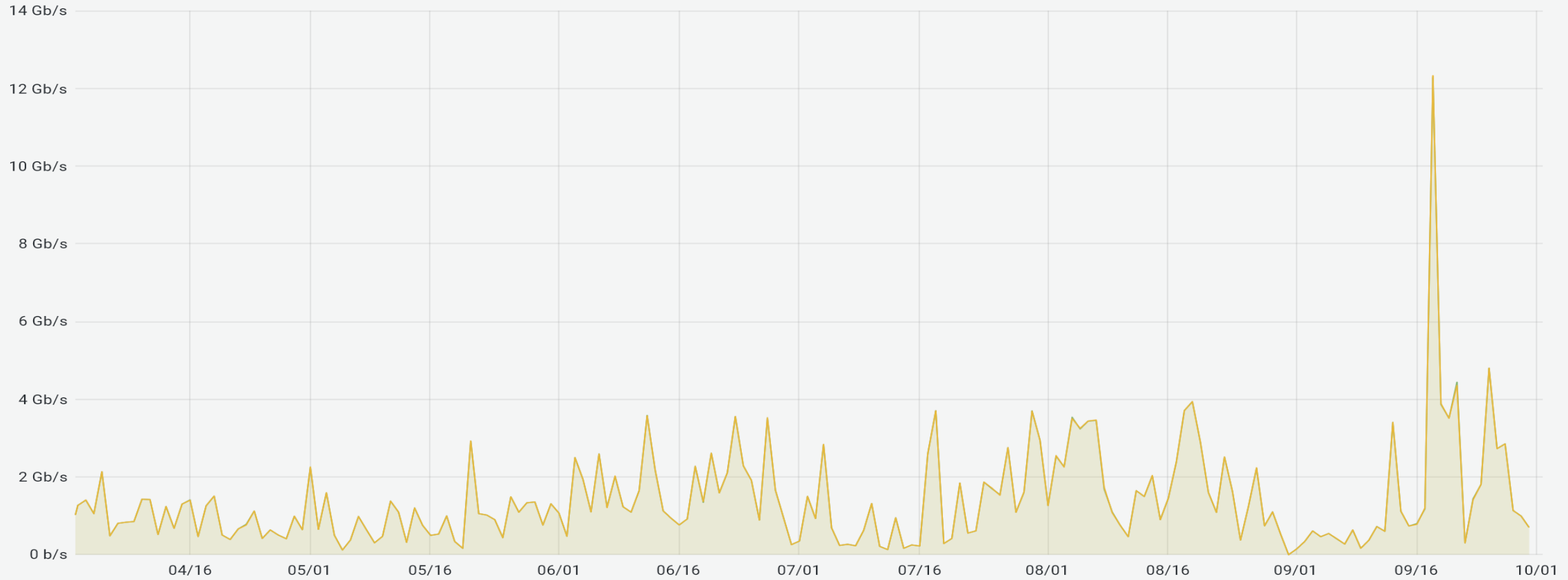
ESnet



	Bytes	Percent of Total	One Month Change	One Year Change
OSCARS	19.74PB	18.0%	-0.620%	+15.0%
LHCONE	42.35PB	38.6%	-2.60%	-39.2%
Normal traffic	47.68PB	43.4%	+3.66%	-24.3%
Total	109.76PB		+0.391%	-26.8%



Aggregate



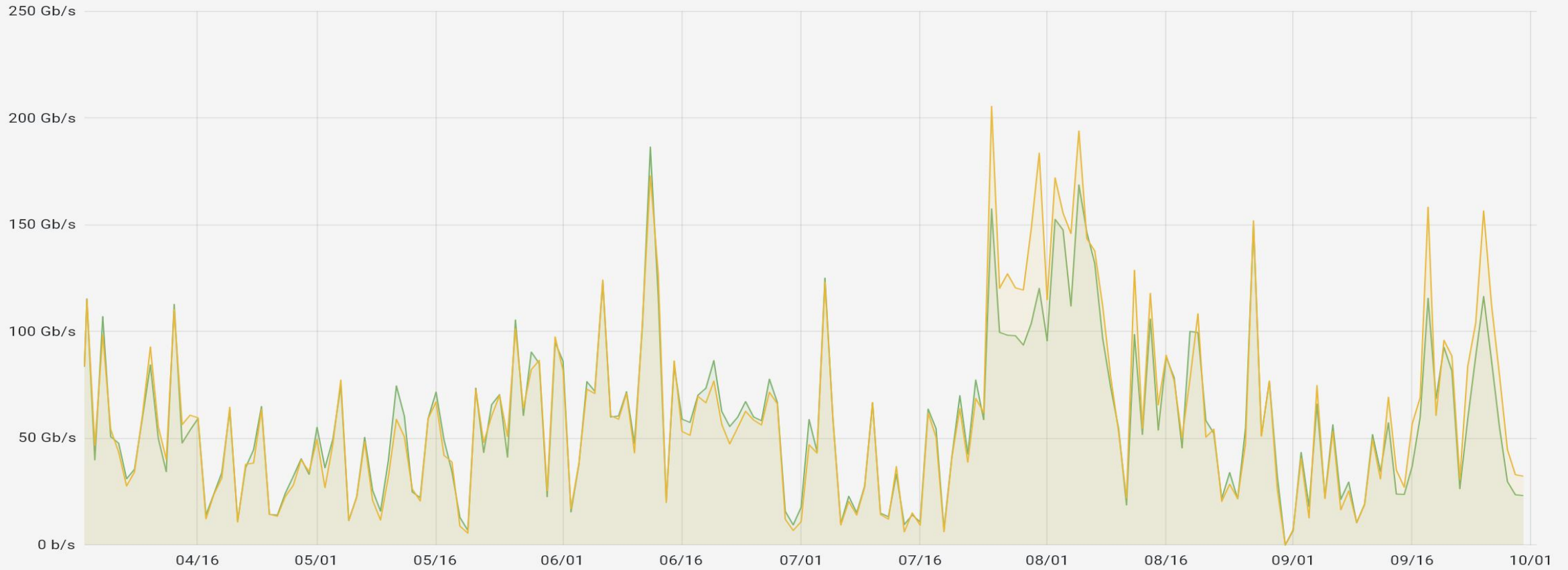
— Input [1d sums]

— Output [1d sums]

	min	max	avg
Input [1d sums]	4.69 kb/s	12.3 Gb/s	1.40 Gb/s
Output [1d sums]	134 kb/s	12.3 Gb/s	1.40 Gb/s



Aggregate

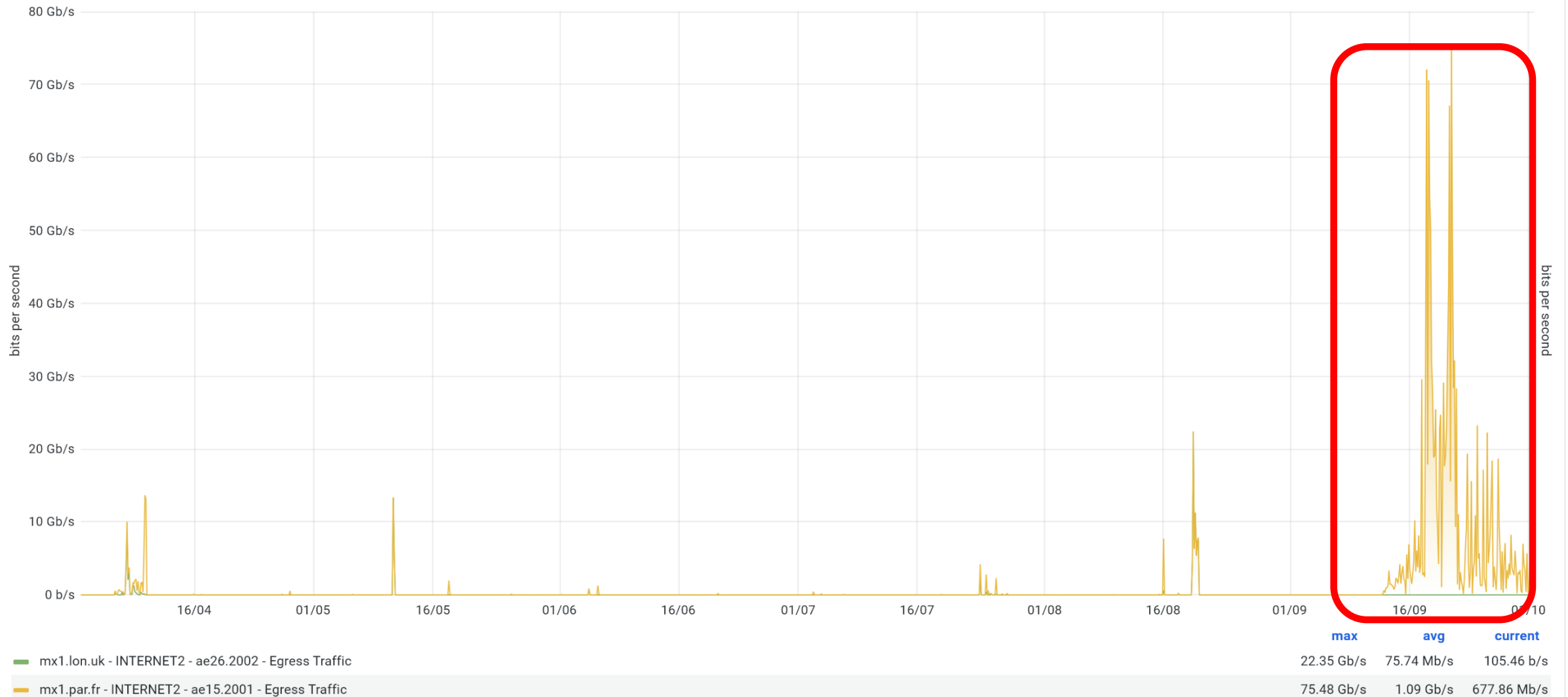


— Input [1d sums]
— Output [1d sums]

	min	max	avg
Input [1d sums]	5.56 kb/s	186 Gb/s	58.1 Gb/s
Output [1d sums]	7.21 Mb/s	205 Gb/s	60.7 Gb/s



Aggregate - LHCONE - INTERNET2 - egress



Internet2

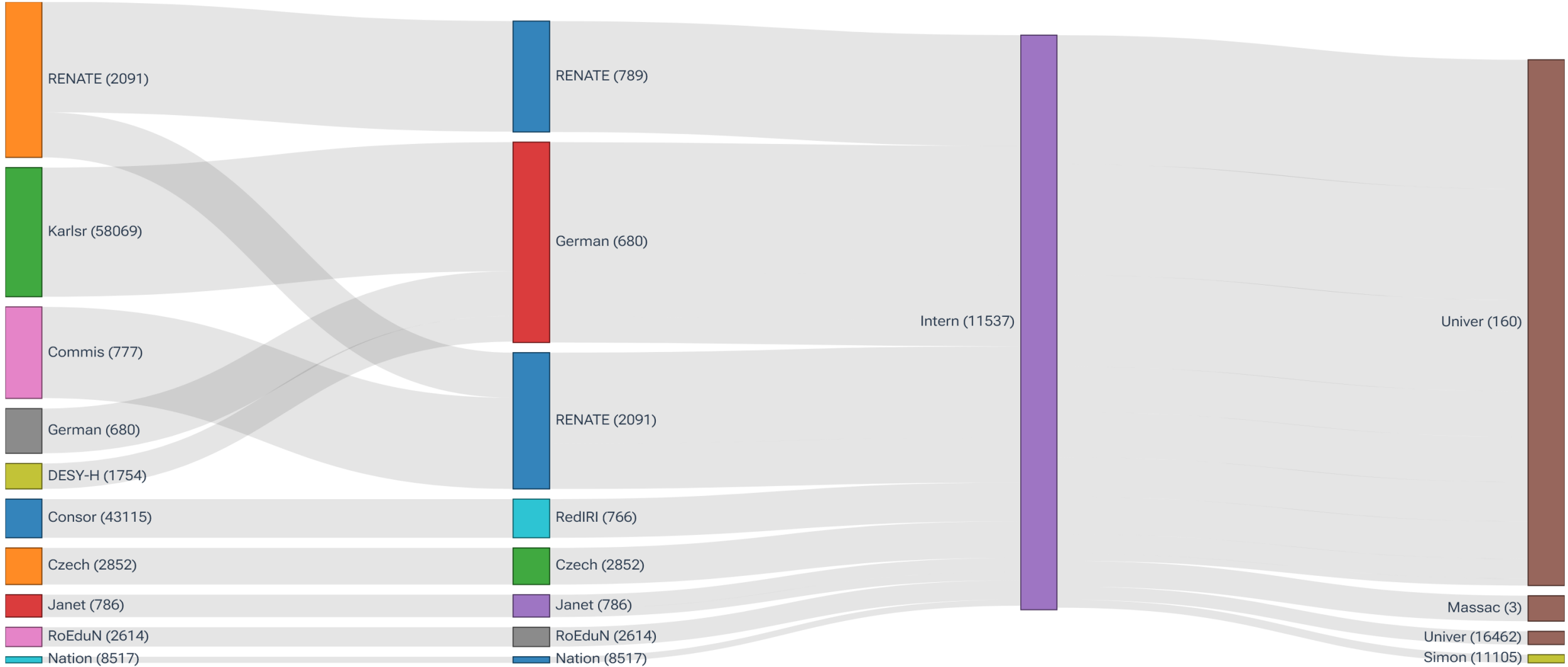


Source AS Number	Source Next Hop AS Number	Destination Next Hop AS Number	Destination AS Number	Average Mbits/s ▼	95th Percentile Mbits/s	Max Mbits/s
Total Overlay				2,681.66	10,119.89	53,723.20
Karlsruhe Institute of Technology (KIT GridKa)	German University & Research Netw	Internet2 AS11537 ▼	University of Chicago AS160 ▼	2,275.83 (84.87%)	5,195.32	18,172.61
RENATER (LHC Open Network Environment)	RENATER (IN2P3) AS789 ▼	Internet2 AS11537 ▼	University of Chicago AS160 ▼	1,953.78 (72.86%)	5,765.93	18,779.05
Commissariat a l'Energie Atomique (CEA)	RENATER (LHC Open Network Envir	Internet2 AS11537 ▼	University of Chicago AS160 ▼	1,611.10 (60.08%)	6,366.43	23,447.07
German University & Research Network (DFN)	German University & Research Netw	Internet2 AS11537 ▼	University of Chicago AS160 ▼	798.95 (29.79%)	2,848.98	4,854.81
RENATER (LHC Open Network Environment)	RENATER (LHC Open Network Envir	Internet2 AS11537 ▼	University of Chicago AS160 ▼	797.27 (29.73%)	2,753.45	9,364.65
Consorti Institut de Fisica Altes Energies (PIC)	RedIRIS / Red.es AS766 ▼	Internet2 AS11537 ▼	University of Chicago AS160 ▼	694.20 (25.89%)	2,603.76	8,342.69
Czech Republic Research & Education Netwo	Czech Republic Research & Educati	Internet2 AS11537 ▼	University of Chicago AS160 ▼	660.11 (24.62%)	2,219.62	5,506.85
DESY-HAMBURG AS1754 ▼	German University & Research Netw	Internet2 AS11537 ▼	Massachusetts Institute of Technology (MIT)	449.03 (16.74%)	1,099.57	1,258.97
RoEduNet AS2614 ▼	RoEduNet AS2614 ▼	Internet2 AS11537 ▼	University of Chicago AS160 ▼	348.98 (13.01%)	1,057.88	7,455.30
Janet (JISC) AS786 ▼	Janet (JISC) AS786 ▼	Internet2 AS11537 ▼	University of Victoria AS16462 ▼	249.72 (9.31%)	1,692.64	3,535.08
Janet (JISC) AS786 ▼	Janet (JISC) AS786 ▼	Internet2 AS11537 ▼	Simon Fraser University AS11105 ▼	145.41 (5.42%)	632.75	5,025.72
National Academic Network & Information Ce	National Academic Network & Inforr	Internet2 AS11537 ▼	University of Chicago AS160 ▼	120.91 (4.51%)	298.94	2,981.95
Fundacao para a Computacao Cientifica Naci	Fundacao para a Computacao Cien	Internet2 AS11537 ▼	University of Chicago AS160 ▼	103.13 (3.85%)	325.47	1,984.17
RedIRIS / Red.es AS766 ▼	RedIRIS / Red.es AS766 ▼	Internet2 AS11537 ▼	University of Chicago AS160 ▼	69.51 (2.59%)	283.99	1,377.96

Internet2



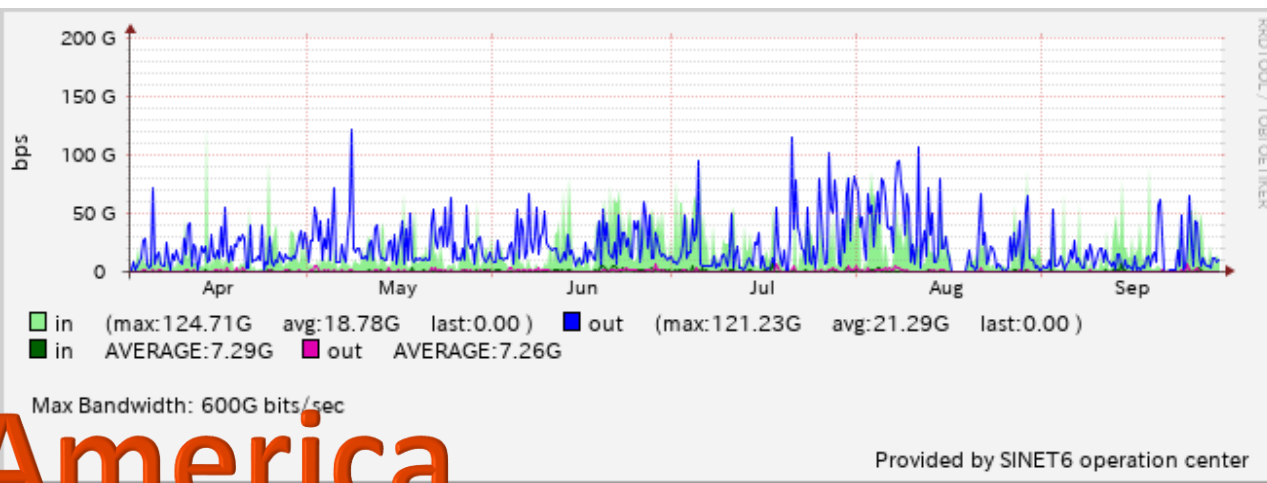
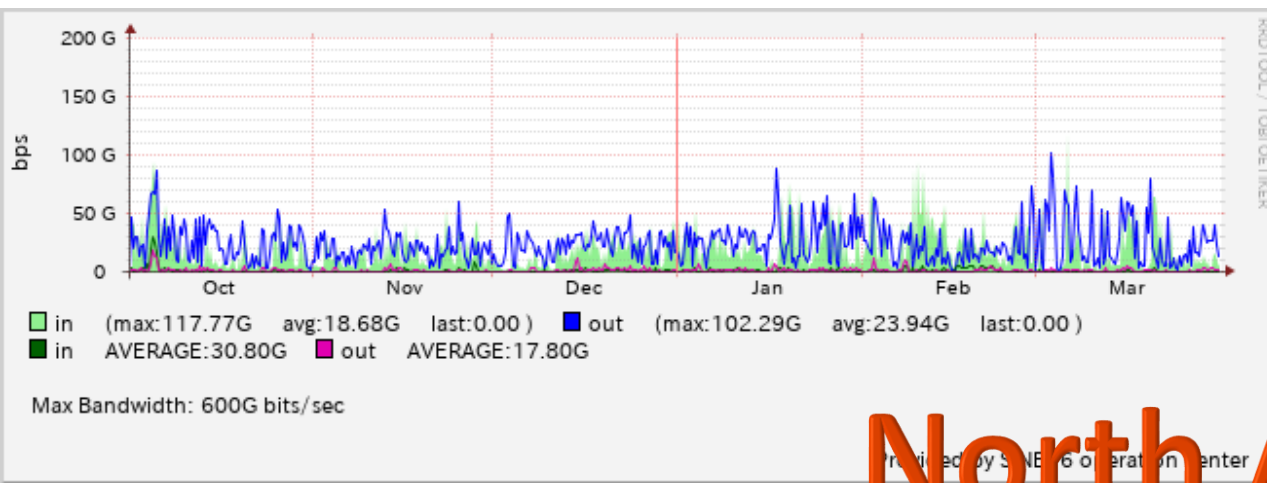
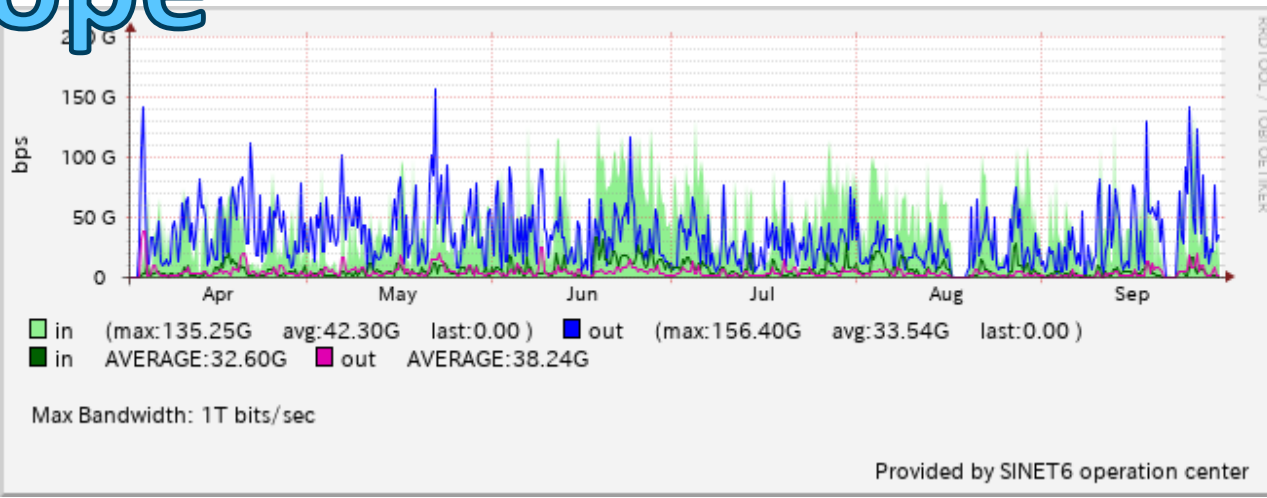
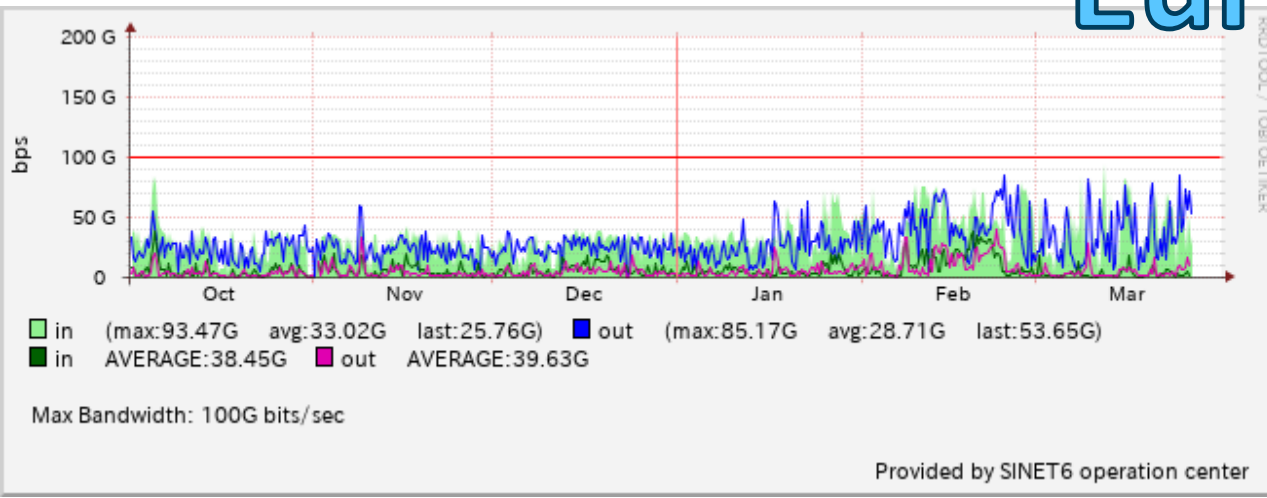
☆ LHCONE-NREN Top-talkers



Massac (3)
Univer (16462)
Simon (11105)



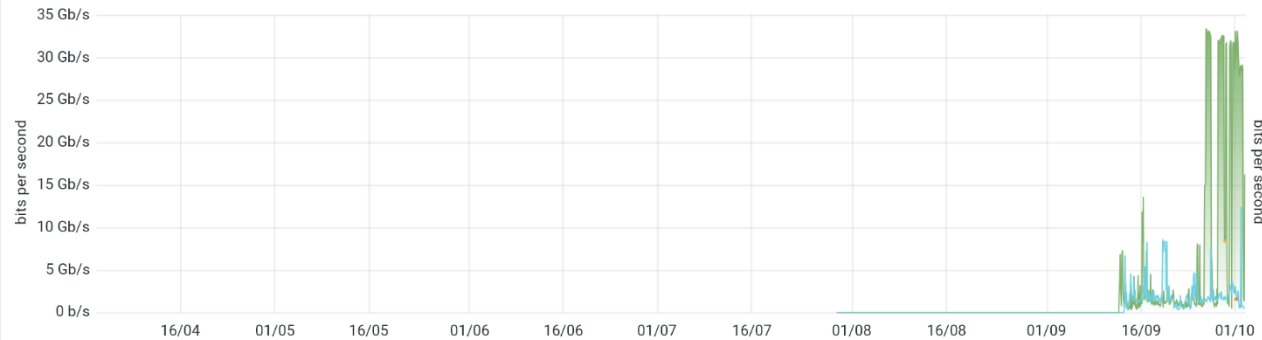
Europe



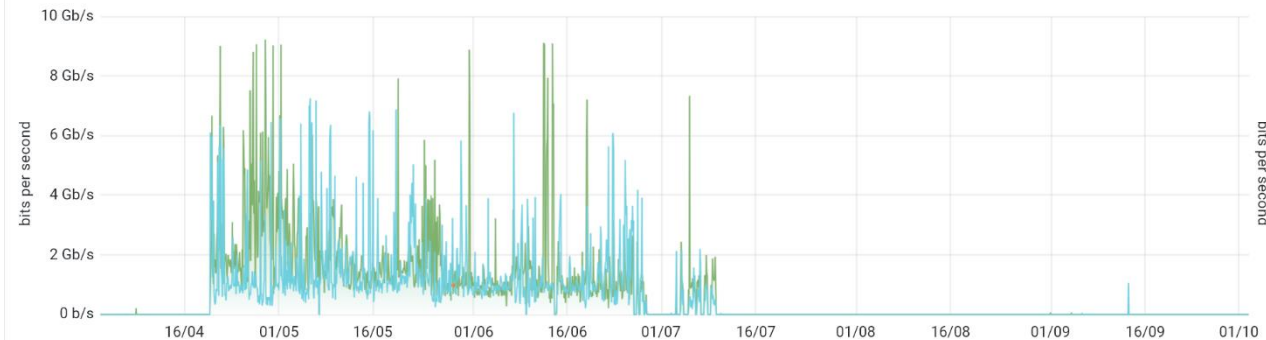
North America

CSTNET re-routing

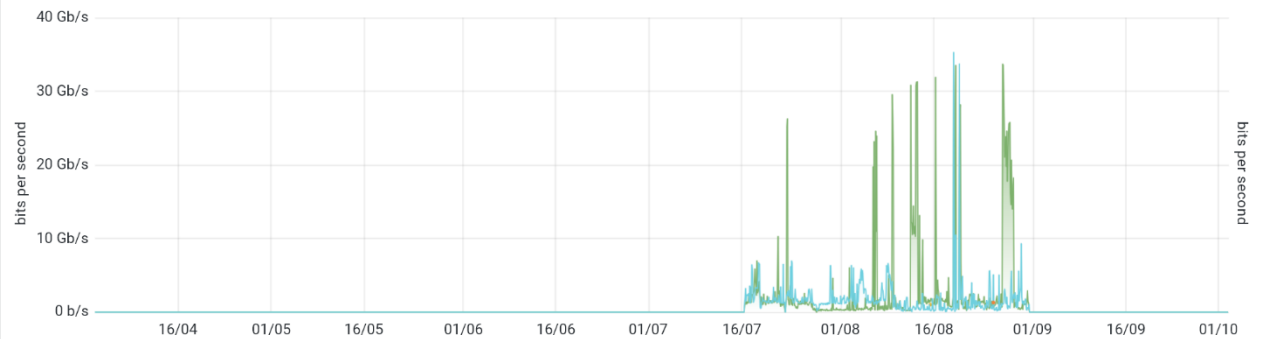
rt1.ams.nl - traffic - et-1/1/5.2000 - SRV_L3VPN RE_INTERCONNECT CSTNET #CSTNET-AMS-LHCONE \$GS-02537 | ASN7497



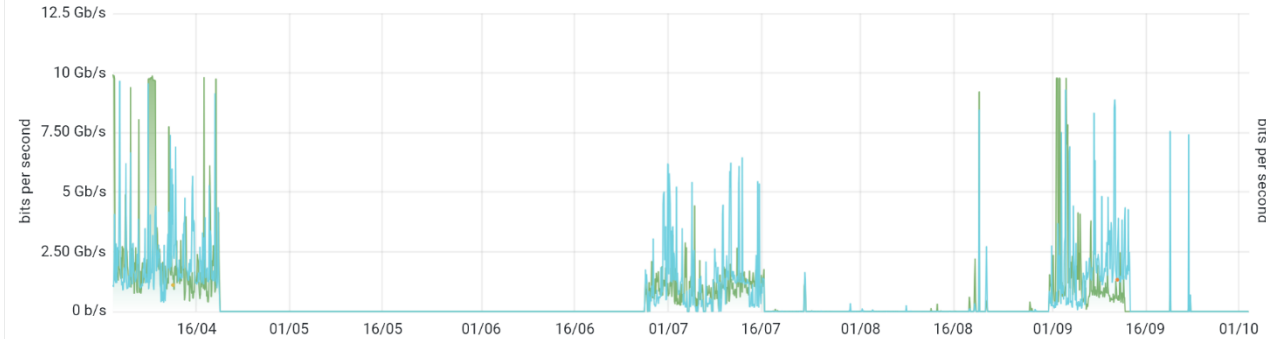
mx1.lon.uk - traffic - xe-1/0/0.111 - SRV_L3VPN RE_INTERCONNECT CSTNET #CSTNET-LON-LHCONE \$GS-00815 | ASN23911



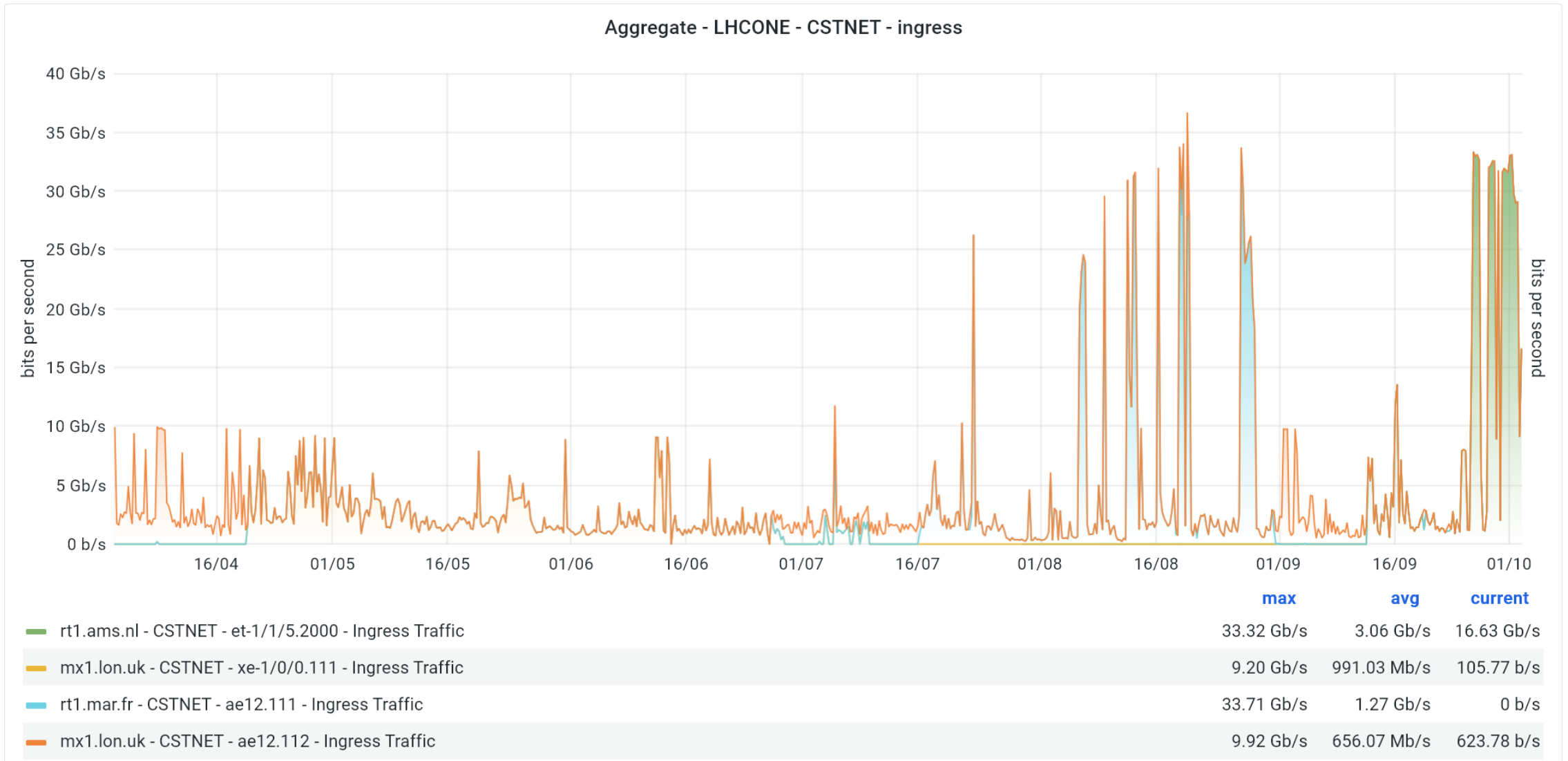
rt1.mar.fr - traffic - ae12.111 - SRV_L3VPN RE_INTERCONNECT CSTNET #CSTNET-MAR-LHCONE-PRIMARY \$GS-00814 | ASN7497



mx1.lon.uk - traffic - ae12.112 - SRV_L3VPN RE_INTERCONNECT CSTNET #CSTNET-LON-LHCONE-SECONDARY \$GS-02380 | ASN7497



CSTNET re-routing



Site news (new prefixes)

- KREONET/KISTI (AS17579)
 - IPv4: 134.75.123.0/24
 - IPv4: 134.75.124.0/24
 - IPv4: 134.75.125.0/24
 - IPv4: 134.75.126.0/24
 - IPv4: 134.75.127.0/24
 - IPv6: 2001:320:15:124::/64
 - IPv6: 2001:320:15:125::/64
- ASGC (AS18217)
 - IPv4: 140.109.225.64/26
 - IPv6: 2001:0c08:ffff:ffff:ffff:ffff:ffa:940/122
- KEK (AS2505)
 - IPv4: 202.13.202.124/30
 - IPv4: 202.13.202.128/25
 - IPv6: 2001:2f8:3e:cc26::/112

Summary

- Little or no changes in the service topology
- A general increase in the overall global traffic
- More evident to/from Europe, starting in May
- Mutual backup arrangement have proved to be very effective in keeping LHCONE up-and-running despite fibre cuts



Thank You

Any questions?

www.geant.org



Co-funded by
the European Union