

LHCONE L3VPN status update

DC 2024!

Enzo Capone

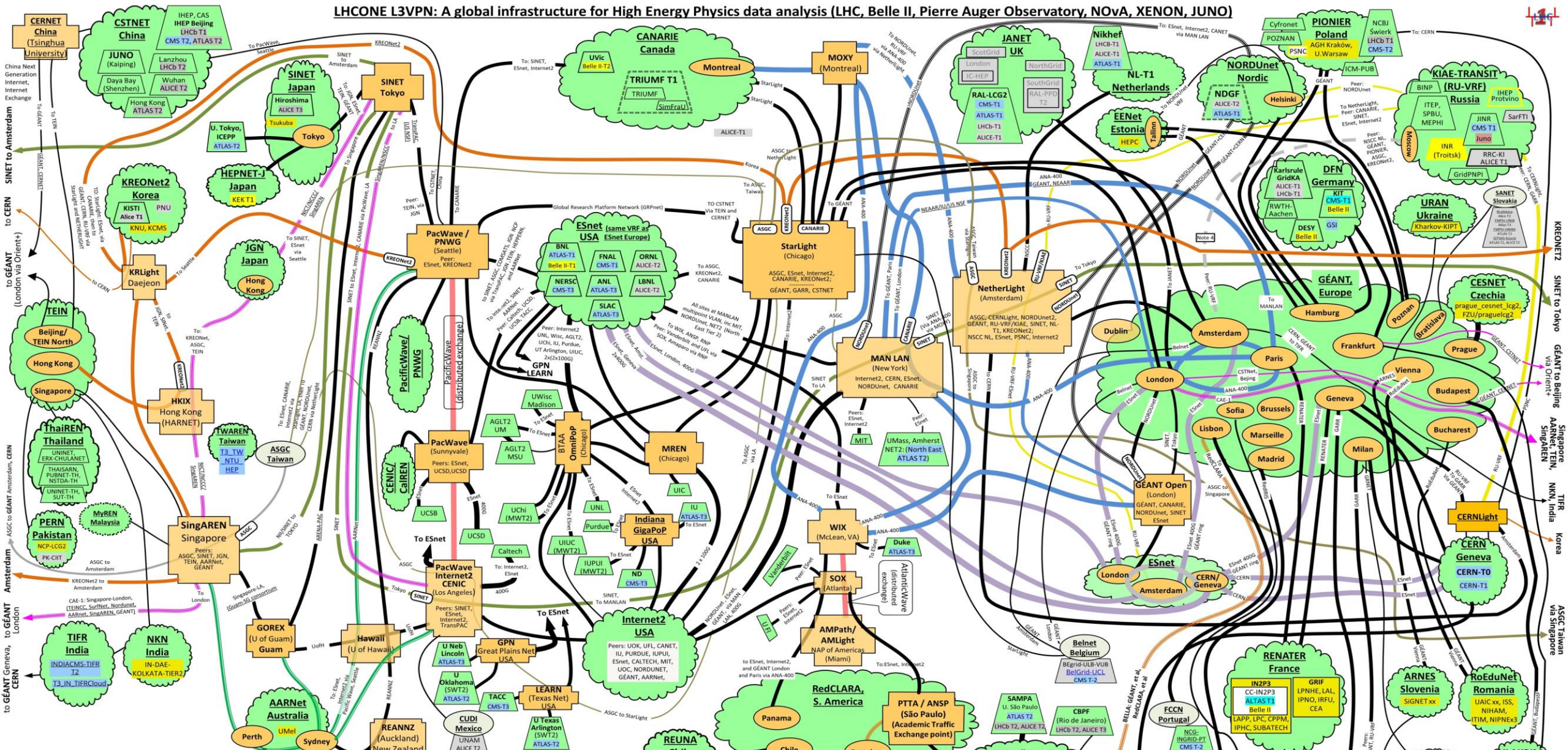
Head of Research Engagement and Support

LHCONE-OPN Meeting
Catania, 10th April 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)



LHCONE Map Ver. 8.0, 2023-10-17 – WEJohnston, ESnet, wej@es.net

LHCONE VRF domain/aggregator - A provider network
 Connector network or institution - provides, e.g., an L2 path between VRFs.
 Underlined link information indicates link provider, not use
 Double dash outline indicates distributed site
 Future site

International infrastructure by provider/collaboration

- various
- AARNet
- GEANT
- SINET, Japan, global ring
- ASGC, Taiwan
- ESnet transatlantic, USA
- NICT/NCCC/SingAREN
- SINET
- NORDUnet
- KIAE, Russia
- KREONet2, Korea
- BELLA: GEANT, et al, RedCLARA, et al

ANA-300/400 - Various links provided by CANARIE, ESnet, GEANT, Internet2, NORDUnet, SURFNet, SINET, IU/NSF

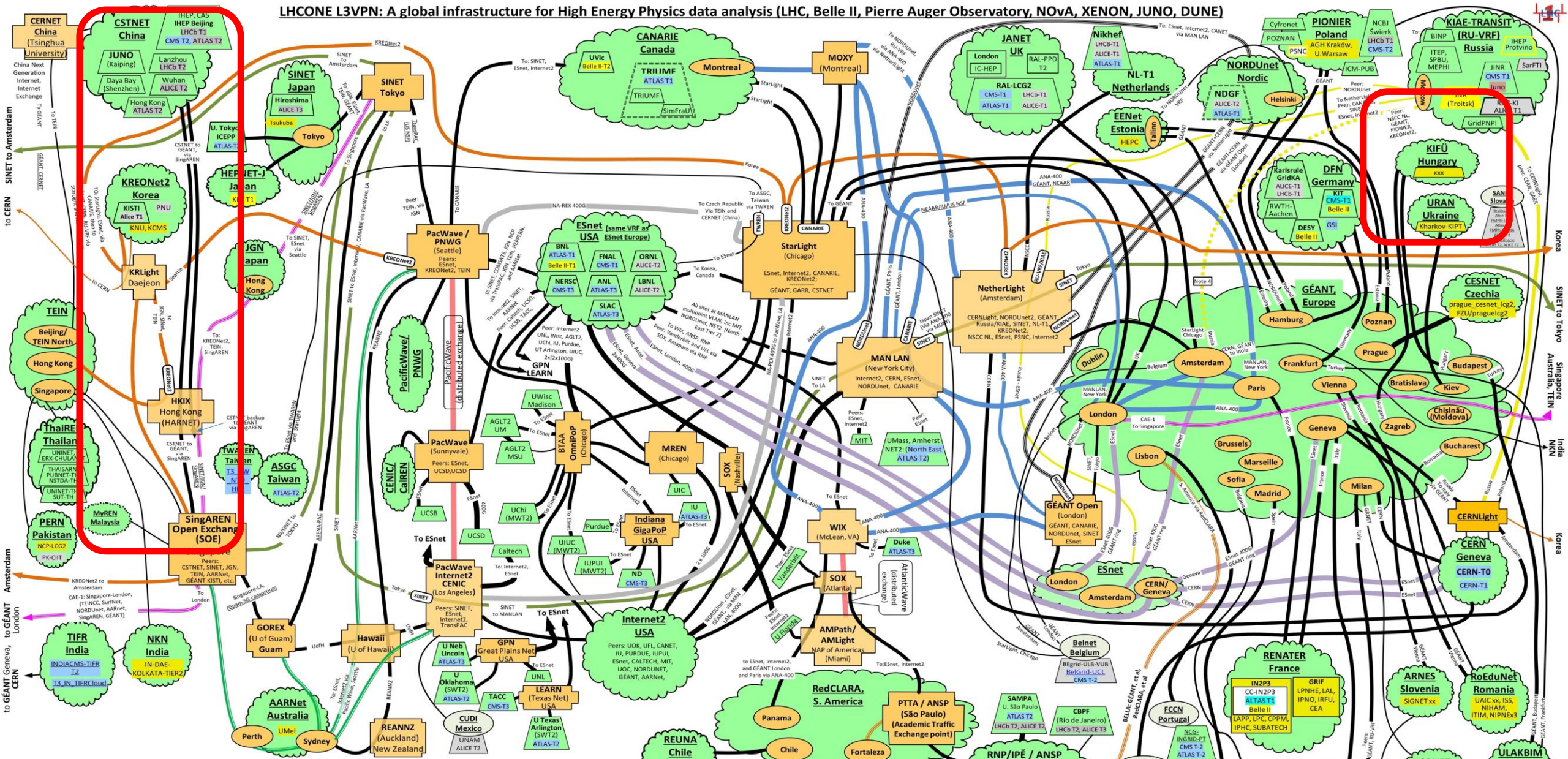
Legend for LHCONE sites:

- LHC-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.dfn.de/cnabos.com/sh/padof58/01raz/AA0s8K8t859fnc/GAeCtoq2dl=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. 9.0, 2024-04-03 - WEJohnson, ESnet, wej@es.net

GARR GARR
ANSP ANSP
London London
UNAMA UNAMA
ORNL ORNL
AARC AARC
CERN CERN

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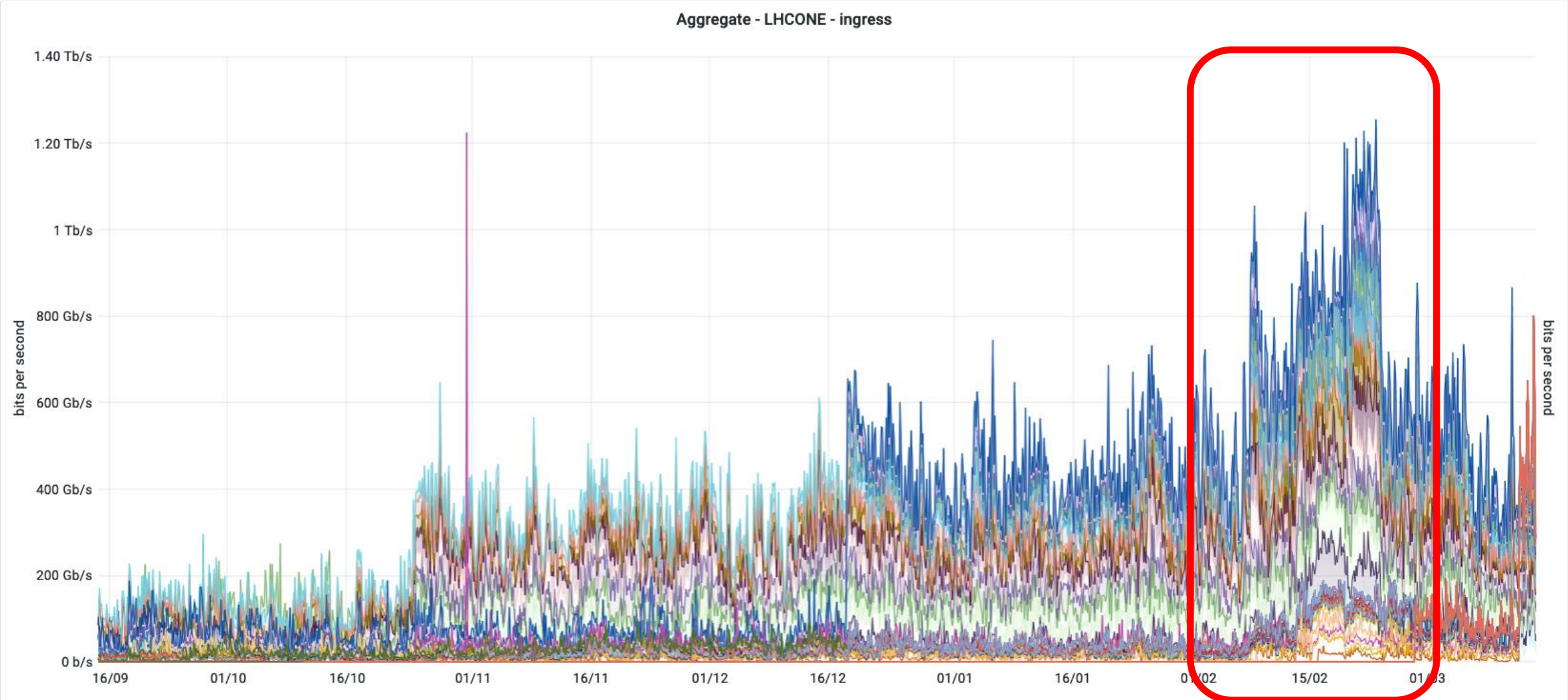
International infrastructure by provider/collaboration
— various
— AARNet
— GÉANT
— SINET, Japan, global ring
— NA-REX
— ESnet transatlantic, USA
— SINET/JGN/ SingAREN
— NREN/SITE router at exchange point
— Communication links:
— 100G=1.Spt, 100G=4pt, 200G=5pt, 400G=6pt, 800G=7.Spt
- - - Underlined link information indicates link provider, not use
- - - - - Double dash outline indicates distributed site
- - - - - Future site

— ANA-300/400 - Various links provided by CANARIE, ESnet, GÉANT, Internet2, NORDUnet, SURFnet, SINET, IU/NSF

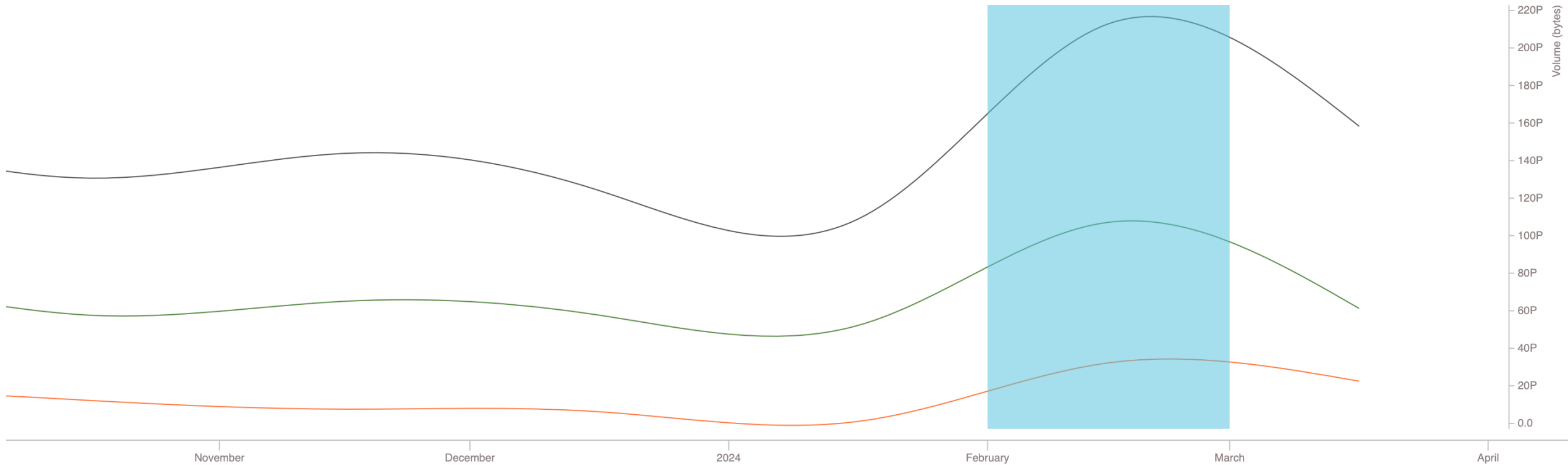
— LHC-T1	LHC ALICE or LHCb site	— UNL	Sites that are standalone VRFs
— CNAF-T1	LHC Tier 1 ATLAS and CMS	— Uchi	LHC Tier 2/3 ATLAS and CMS
— Uchi	LHC Tier 2/3 ATLAS and CMS	— KEK	Belle II Tier 1/2
— JUNO	JUNO		

NOTES
 1) ONLY links involved in LHCONE are shown
 2) LHCOPN links are not shown on this diagram
 3) For map explanation see "Interpreting the LHCONE Map" at <https://www.cern.ch/doc/2024/04/13/240413.pdf>
 4) GÉANT and CANARIE have shutdown the peering between their VRF and KIAE, as a result of the Ukraine war.

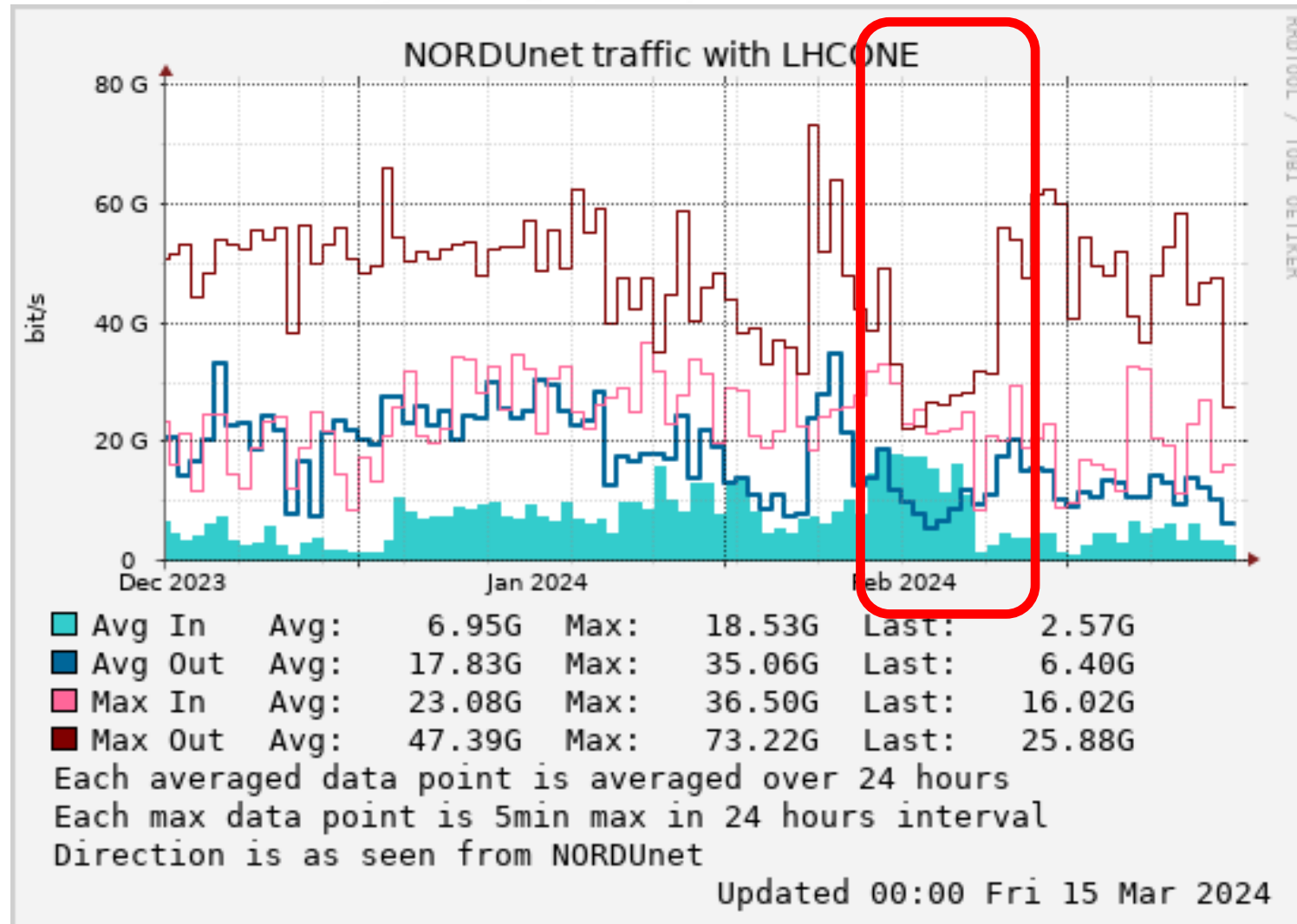
GÉANT overall



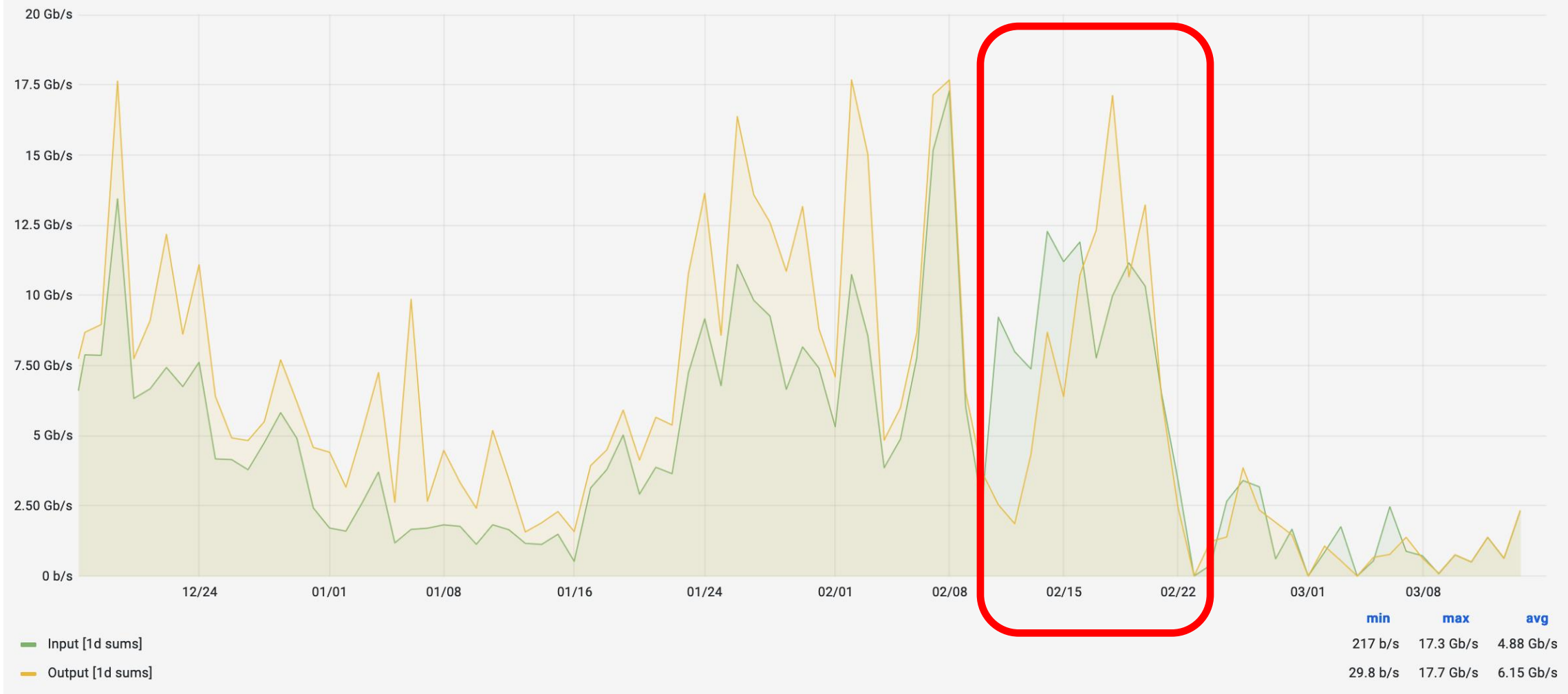




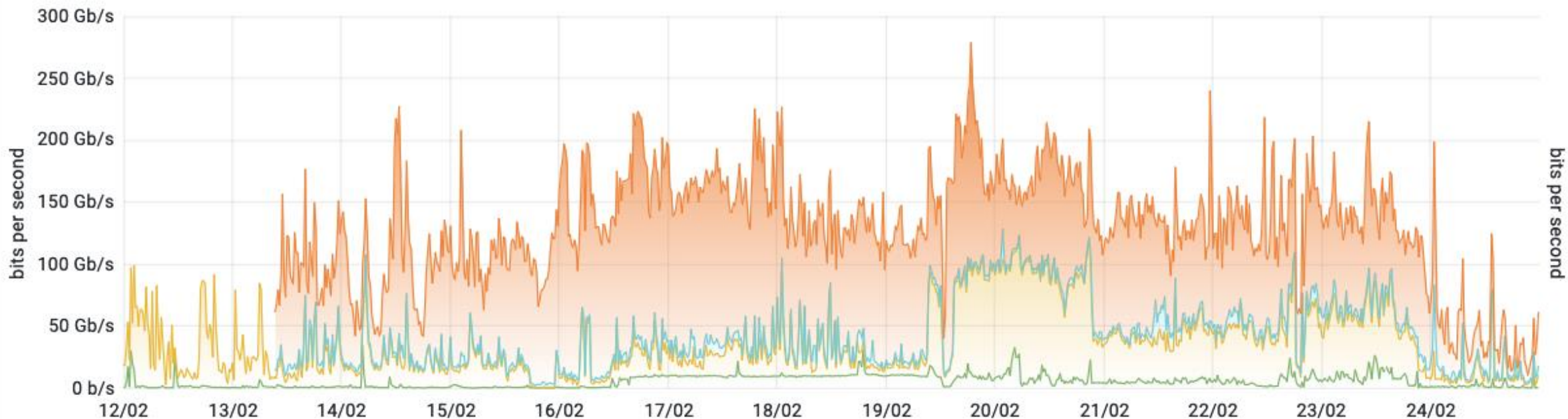
	Bytes	Percent of Total	One Month Change	One Year Change
OSCARS	32.12PB	15.1%	+3.51e+3%	+168%
LHCONE	106.99PB	50.3%	+106%	+102%
Normal traffic	73.64PB	34.6%	+32.0%	+14.7%
Total	212.75PB		+95.7%	+64.7%



Aggregate

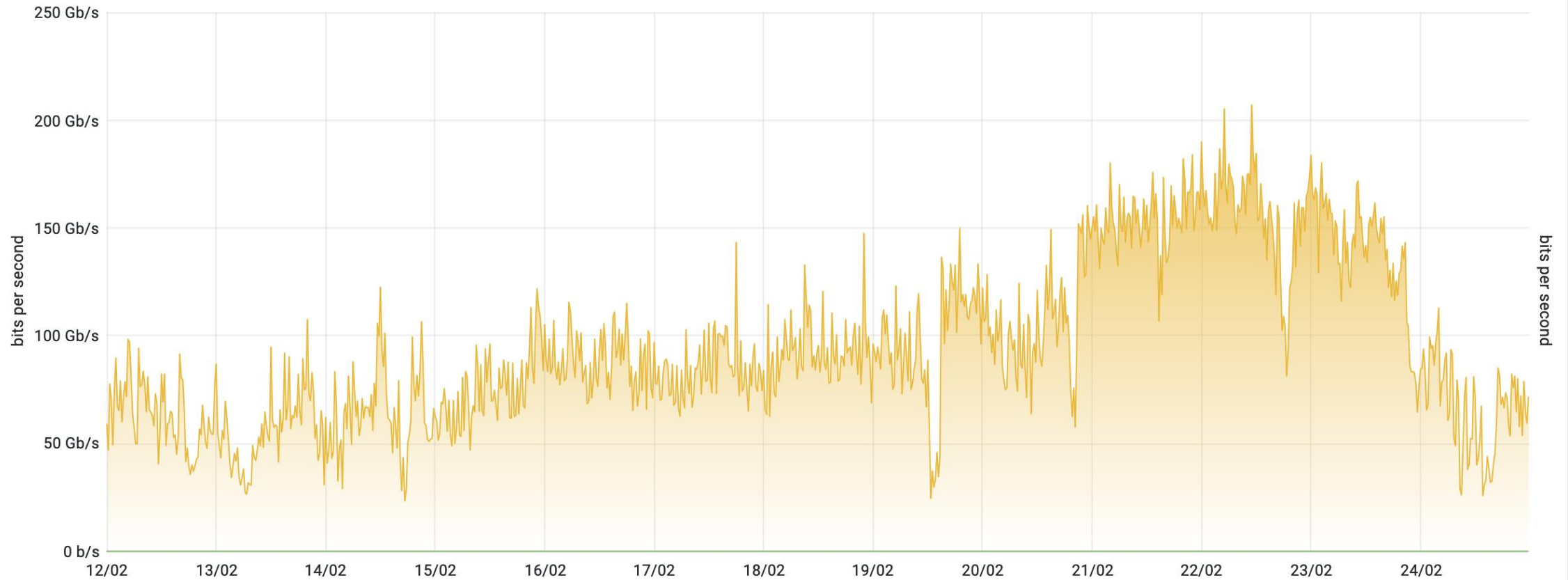


Aggregate - LHCONE - RENATER - ingress



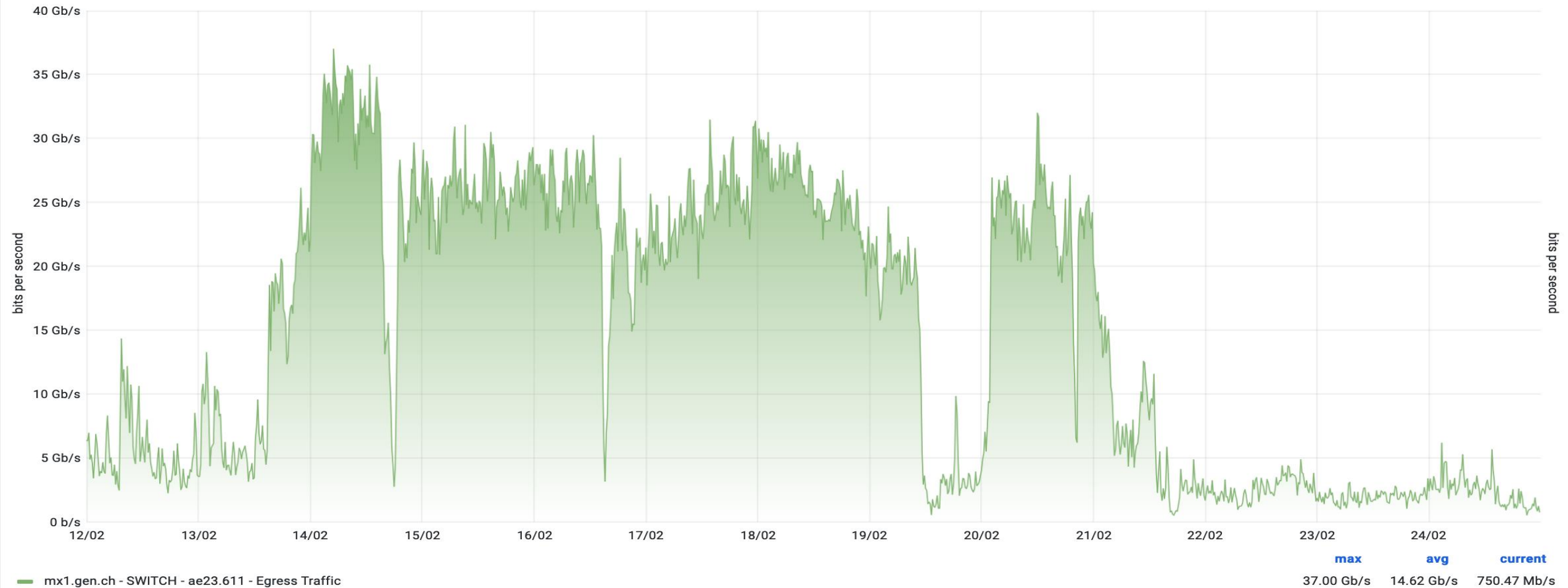
	max	avg	current
mx1.par.fr - RENATER - ae12.111 - Ingress Traffic	35.12 Gb/s	5.54 Gb/s	767.81 Mb/s
mx1.par.fr - RENATER - ae12.116 - Ingress Traffic	105.92 Gb/s	31.43 Gb/s	9.70 Gb/s
mx1.gen.ch - RENATER - ae14.111 - Ingress Traffic	53.48 Gb/s	5.48 Gb/s	7.87 Gb/s
mx1.gen.ch - RENATER - ae14.116 - Ingress Traffic	188.77 Gb/s	86.53 Gb/s	43.37 Gb/s

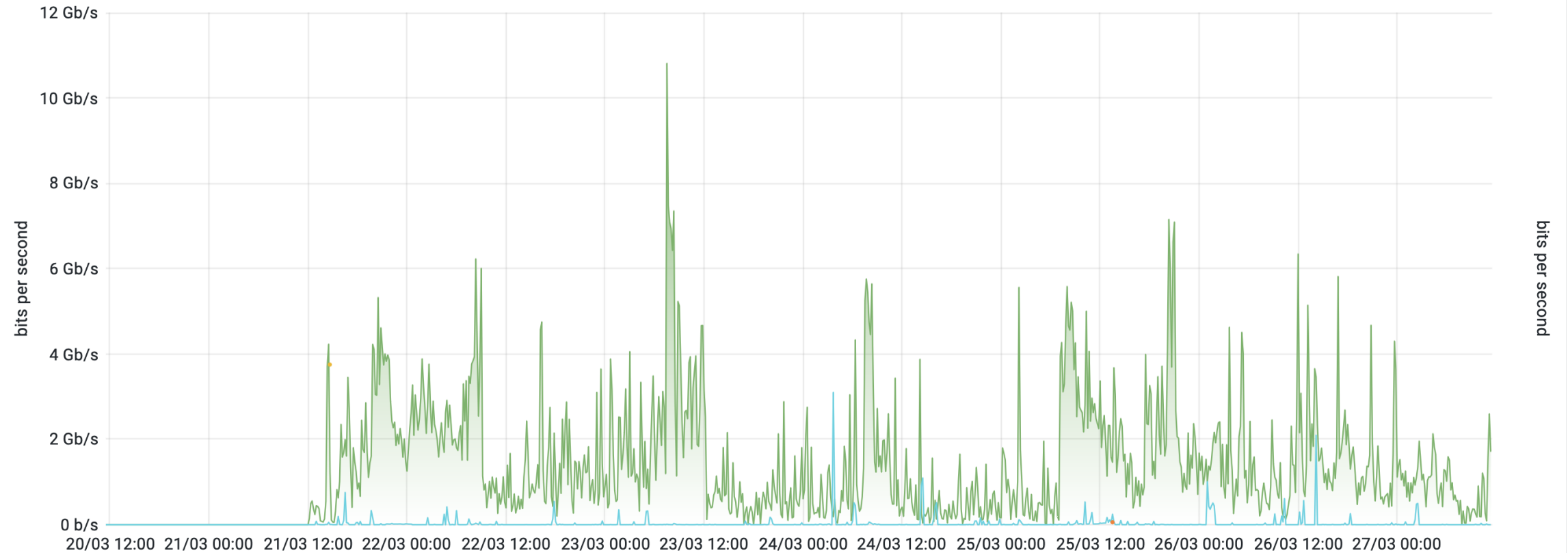
Aggregate - LHCONE - GARR - egress



	max	avg	current
rt1.mil2.it - GARR - ae10.111 - Egress Traffic	327.89 b/s	242.01 b/s	239.97 b/s
mx1.gen.ch - GARR - ae12.111 - Egress Traffic	206.94 Gb/s	95.46 Gb/s	71.82 Gb/s

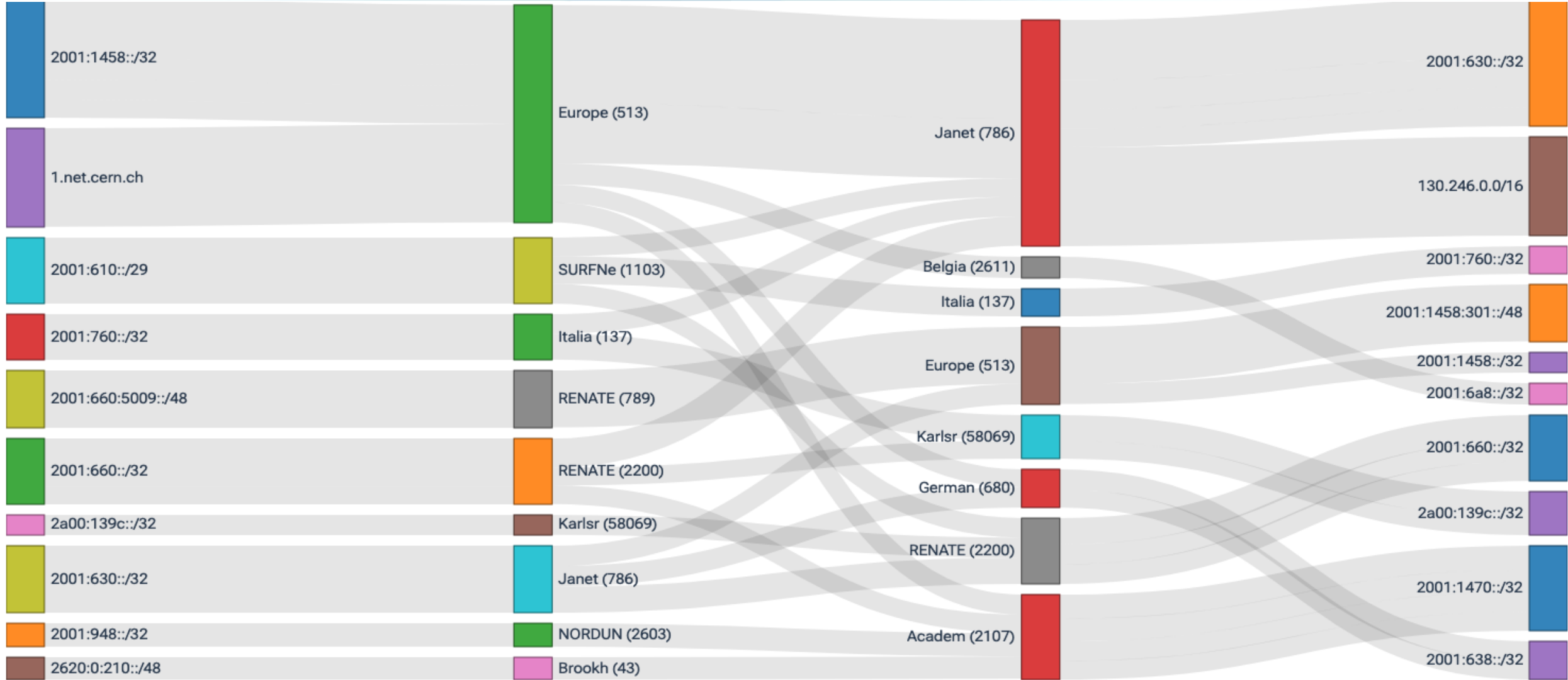
Aggregate - LHCONE - SWITCH - egress





	max	avg	current
Ingress Traffic	10.81 Gb/s	1.32 Gb/s	1.71 Gb/s
Ingress 95th Percentile	3.75 Gb/s	3.75 Gb/s	3.75 Gb/s
Egress Traffic	3.10 Gb/s	27.66 Mb/s	97.68 kb/s
Egress 95th Percentile	57.38 Mb/s	57.38 Mb/s	57.38 Mb/s

DC24 traffic flows

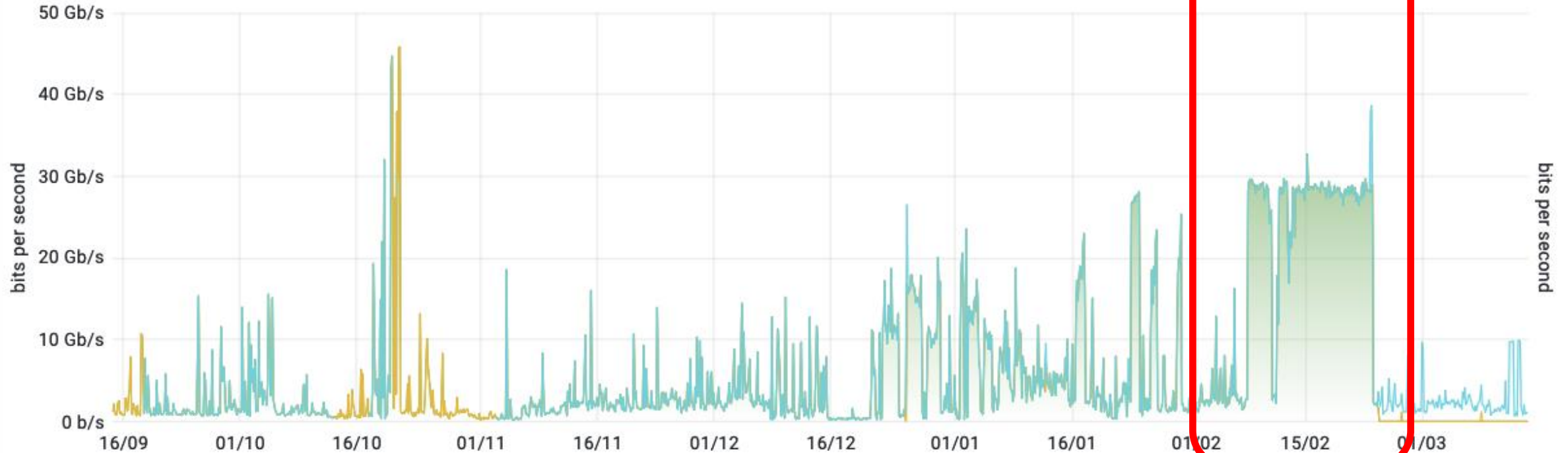


DC24 top-talkers



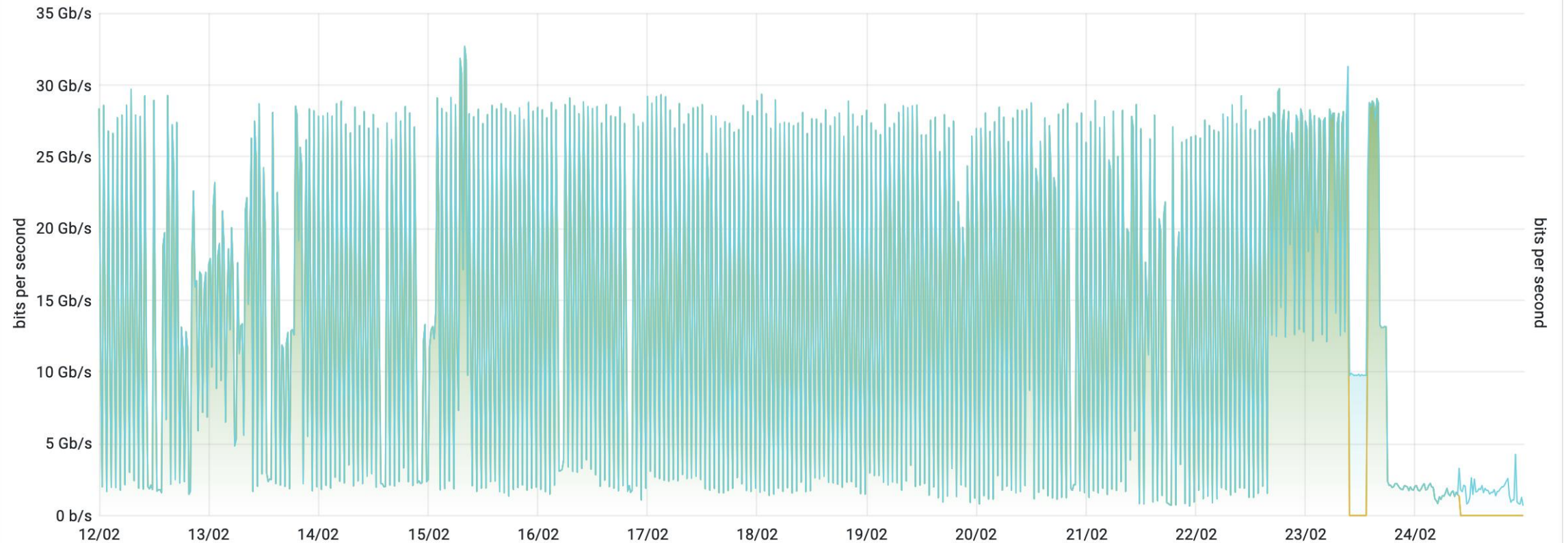
Source Route Prefix/LEN	Source AS Number	Site	Destination AS Number	Destination Route Prefix/LEN	Average Gbits/s ▼
128.142.0.0/16 (1.net.cern.ch)	European Laboratory for Particle Physics (CERN) AS513 ▼	GEN	Janet (JISC) AS786 ▼	130.246.0.0/16 (-)	127.48
2001:1458::/32 (-)	European Laboratory for Particle Physics (CERN) AS513 ▼	GEN	Janet (JISC) AS786 ▼	2001:630::/32 (-)	77.39
2001:660:5009::/48 (-)	RENATER (IN2P3) AS789 ▼	GEN	European Laboratory for Particle Physics (CERN) AS513 ▼	2001:1458:301::/48 (-)	74.01
2001:610::/29 (-)	SURFNet (Netherlands University & Research Network) AS1103 ▼	AMS	Italian Academic & Research Network (GARR) AS137 ▼	2001:760::/32 (-)	36.04
2001:760::/32 (-)	Italian Academic & Research Network (GARR) AS137 ▼	GEN	Karlsruhe Institute of Technology (KIT GridKa) AS58069 ▼	2a00:139c::/32 (-)	33.69
2001:948::/32 (-)	NORDUNet AS2603 ▼	AMS	Academic & Research Network of Slovenia (ARNES) AS2107 ▼	2001:1470::/32 (-)	31.32
2620:0:210::/48 (-)	Brookhaven National Laboratory AS43 ▼	GEN	Academic & Research Network of Slovenia (ARNES) AS2107 ▼	2001:1470::/32 (-)	29.08
2001:660::/32 (-)	RENATER AS2200 ▼	GEN	Janet (JISC) AS786 ▼	2001:630::/32 (-)	28.41
2001:1458::/32 (-)	European Laboratory for Particle Physics (CERN) AS513 ▼	GEN	Belgian National Research Network (BELNET) AS2611 ▼	2001:6a8::/32 (-)	27.79
2a00:139c::/32 (-)	Karlsruhe Institute of Technology (KIT GridKa) AS58069 ▼	FRA	RENATER AS2200 ▼	2001:660::/32 (-)	26.01
2001:1458::/32 (-)	European Laboratory for Particle Physics (CERN) AS513 ▼	GEN	Academic & Research Network of Slovenia (ARNES) AS2107 ▼	2001:1470::/32 (-)	25.75
2001:610::/29 (-)	SURFNet (Netherlands University & Research Network) AS1103 ▼	AMS	RENATER AS2200 ▼	2001:660::/32 (-)	25.39

Aggregate - LHCONE - CSTNET - ingress



	max	avg	current
rt1.mar.fr - CSTNET - ae12.111 - Ingress Traffic	45.87 Gb/s	5.66 Gb/s	0 b/s
mx1.lon.uk - CSTNET - xe-1/0/0.111 - Ingress Traffic	1.20 Gb/s	1.65 Mb/s	97.57 b/s
mx1.lon.uk - CSTNET - ae12.112 - Ingress Traffic	9.91 Gb/s	353.76 Mb/s	1.19 Gb/s

Aggregate - LHCONE - CSTNET - ingress

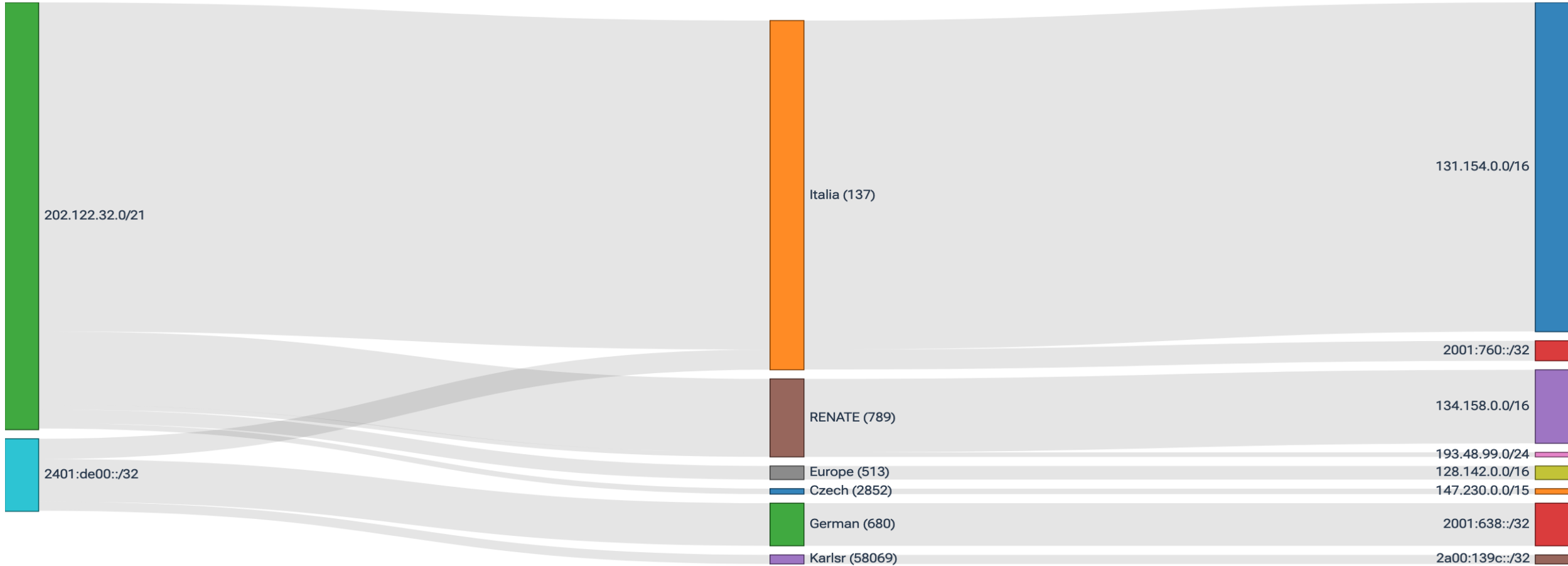


	max	avg	current
rt1.mar.fr - CSTNET - ae12.111 - Ingress Traffic	32.69 Gb/s	13.56 Gb/s	0 b/s
mx1.lon.uk - CSTNET - xe-1/0/0.111 - Ingress Traffic	3.09 kb/s	110.22 b/s	0 b/s
mx1.lon.uk - CSTNET - ae12.112 - Ingress Traffic	9.90 Gb/s	224.87 Mb/s	676.86 Mb/s

Deep analysis

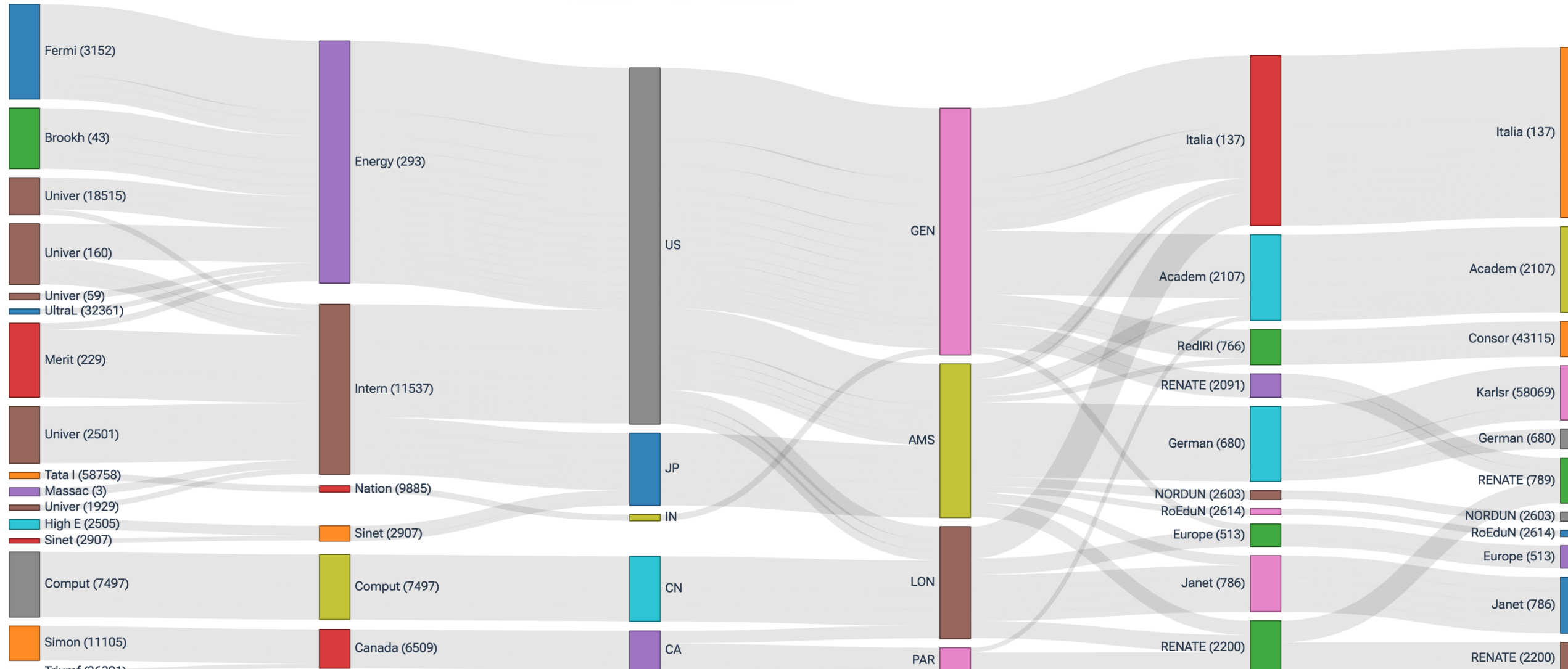


中国科技网
China Science & Technology Network

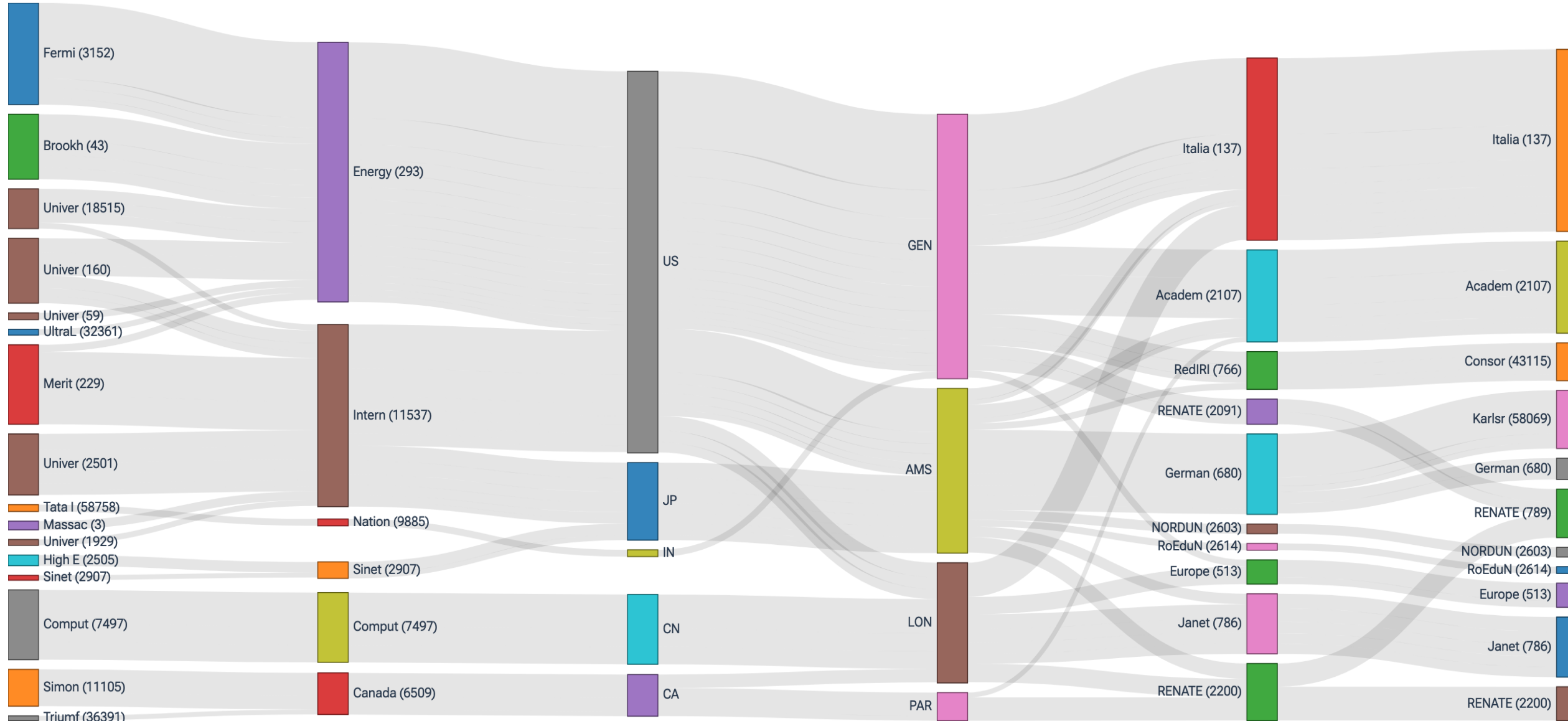


Source Route Prefix/LEN	Destination AS Number	Destination Route Prefix/LEN	Average Gbits/s	95th Percentile Gbits/s	Max Gbits/s
Total			2.33	9.23	27.00
202.122.32.0/21	Italian Academic & Research Network (GARR) AS137	131.154.0.0/16	2.73 (116.91%)	7.68	24.62
202.122.32.0/21	RENATER (IN2P3) AS789	134.158.0.0/16	0.53 (22.55%)	5.12	5.55
2401:de00::/32	German University & Research Network (DFN) AS680	2001:638::/32	0.42 (17.90%)	2.40	3.22

On demand analysis – Global to GÉANT



On demand analysis – GÉANT to Global



- New LHCONE joiners (now in operation):
 - SWITCH (University of Bern-LHEP)
 - FCCN (NCG-INGRID-PT)
- GARR access upgraded to 2 x 300G (MIL, MAR)
- RENATER access upgraded to 400G in GVA, 300G in PAR (about to become 400G)

Thank you!

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Thank you

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