



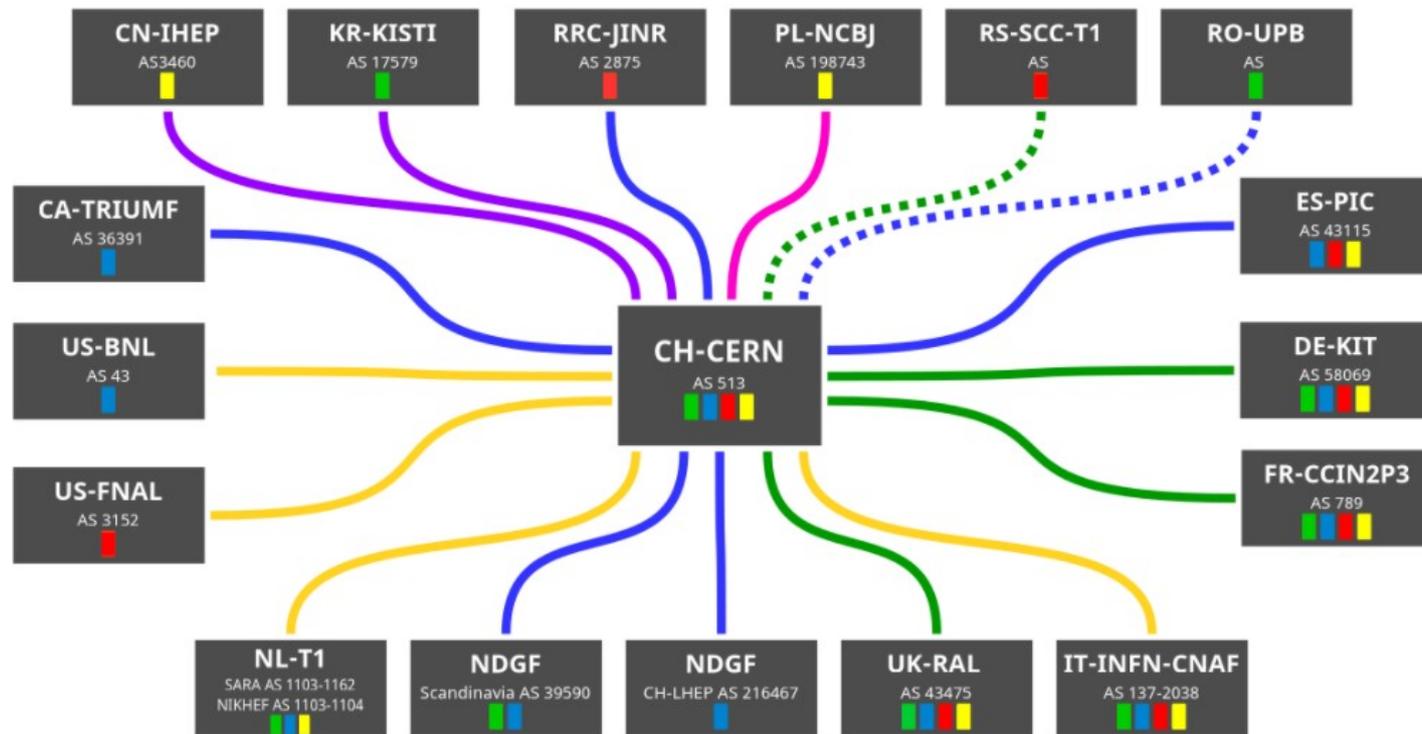
LHCOPN update

LHCOPN meeting #54, Manchester UK

18th March 2025

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LHCOPN



| Line speeds: | Experiments: |
|----------------------------|---------------------|
| 20Gbps | ■ = Alice ■ = Atlas |
| 40Gbps | ■ = CMS ■ = LHCb |
| 100Gbps | |
| 200Gbps | |
| 400Gbps | |
| 800Gbps | |
| Last update: | |
| - 20250908 | |
| - edoardo.martelli@cern.ch | |

<https://twiki.cern.ch/twiki/bin/view/LHCOPN/OverallNetworkMaps>

Numbers

- 15 sites for 14 Tier1s + 1 Tier0
- 14 countries in 3 continents
- 2.78 Tbps to the Tier0
- Soon two new Tier1s



New Tier1s

PL-NCBJ

- Started the process to become a CMS Tier1
- Will increase its LHCOPN bandwidth

New Tier1 RO-UPB Romania

- University POLITEHNICA Bucharest
- In the process to become ALICE Tier1
- RoeduNet is deploying 100G circuit from Bucharest to CERN for LHCOPN – Expected by December 2025

New Tier1 RS-SSC-T1 Serbia

- In the process to build a CMS Tier1
- Setting up test LHCOPN connectivity over AMRES and GEANT networks

LHCOPN latest news

CH-CERN

- Tendering for Data Centre network equipment in 2026
- Simone Campana (WLCG project director) appointed CERN IT department leader

RU-KIAE:

- Removed from the LHCOPN map

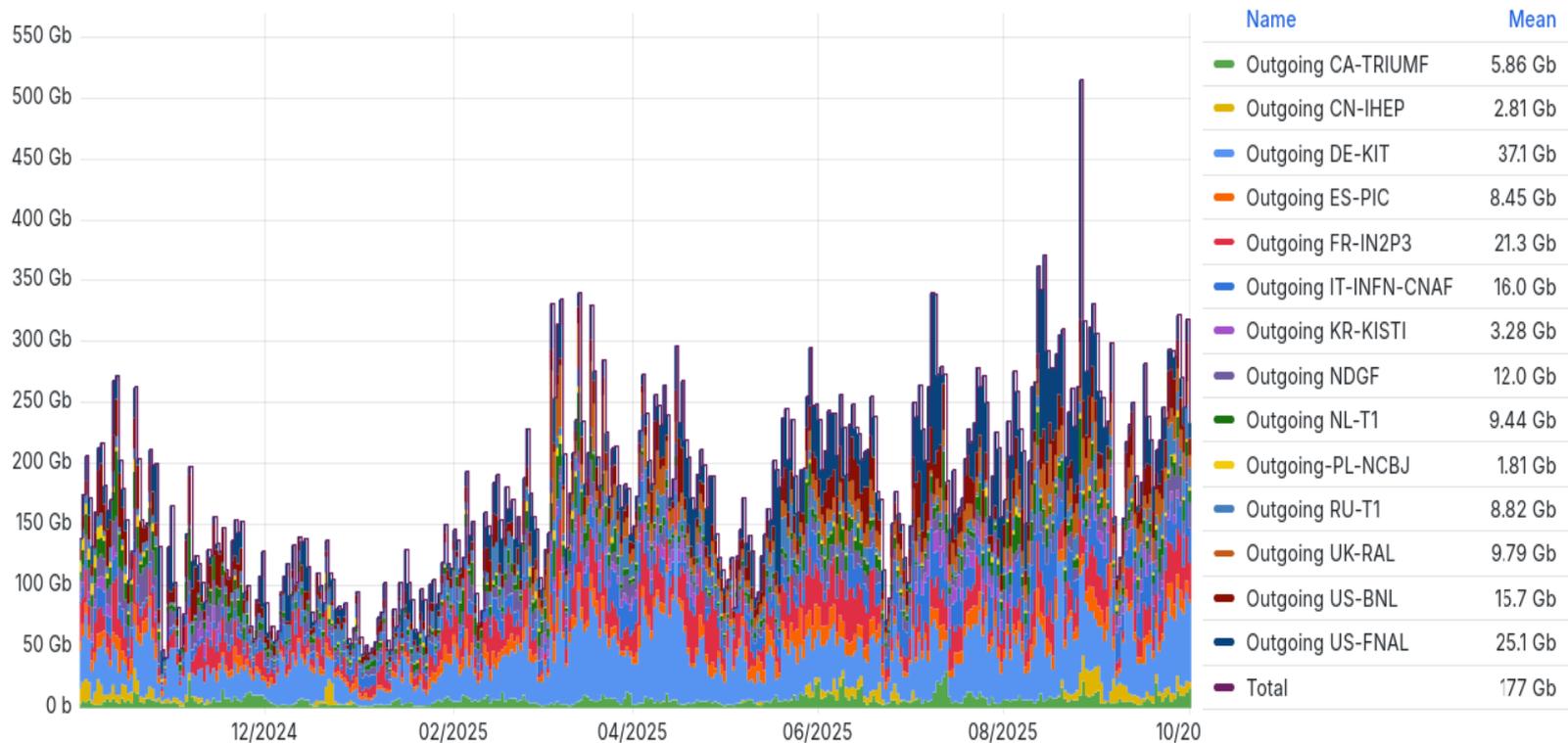
Latest news

Other Tier1s

- [input from the Tier1s in the audience]

LHCOPN Traffic – last 12 months

LHCOPN Total Traffic (CERN -> T1s) 



Numbers:

Moved ~698 PB in the last 12 months

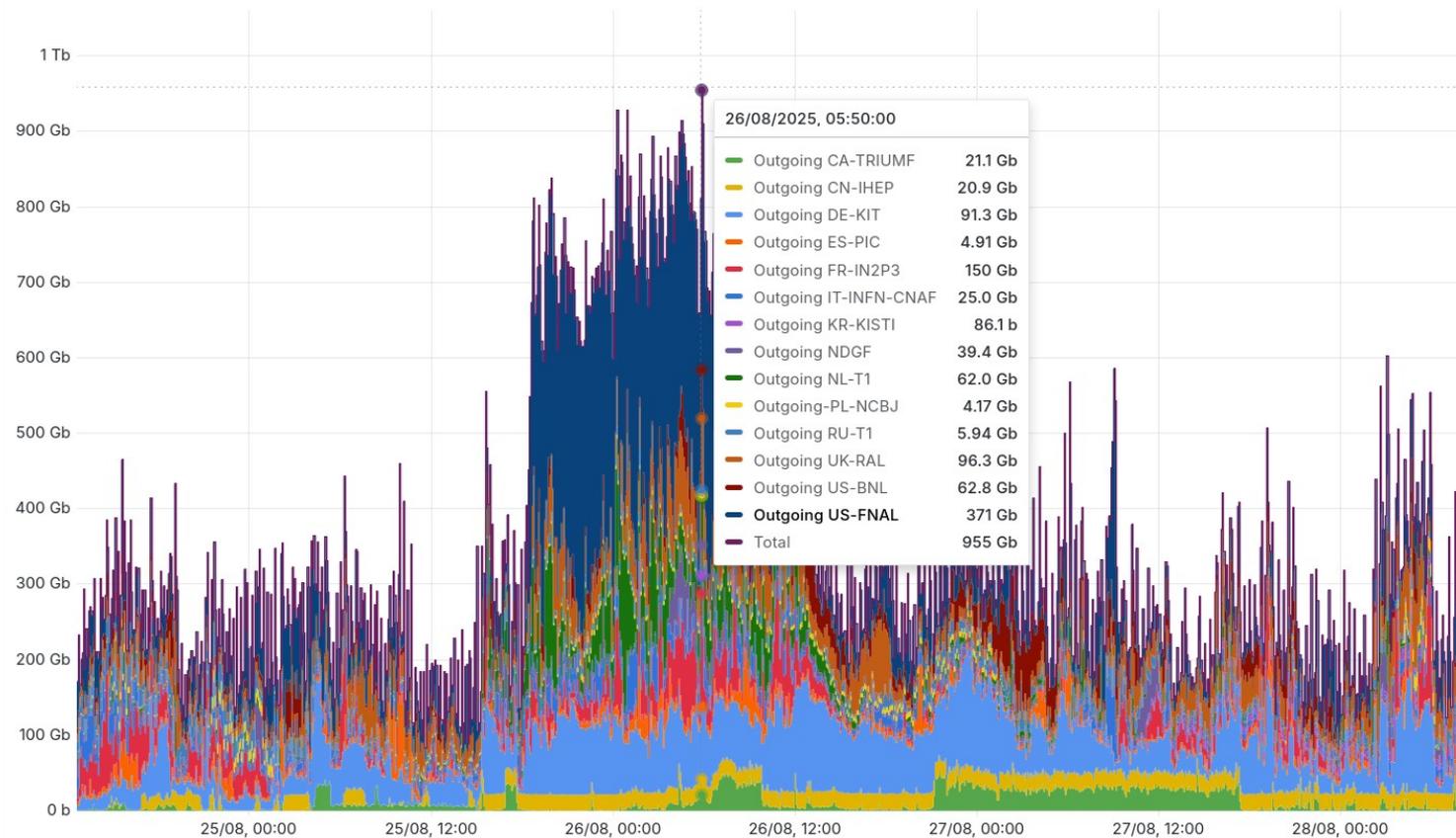
+9% compared to previous year (638PB)

New peak traffic at 955Gbps, exceeding previous DC24 record



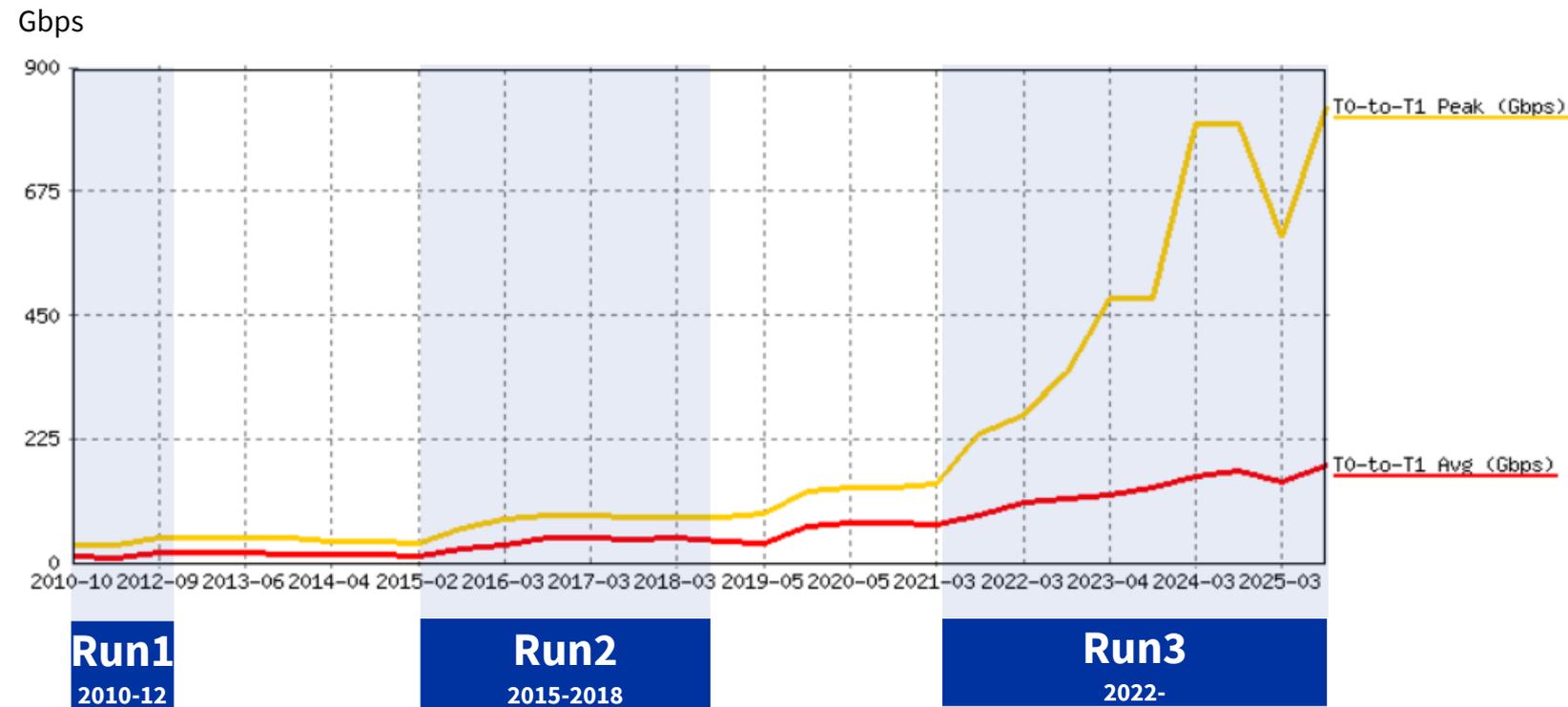
Record traffic during US-mini-challenge

LHCOPN Total Traffic (CERN -> T1s)



| Name | Mean | Max |
|-----------------------|---------|---------|
| Outgoing CA-TRIUMF | 11.8 Gb | 52.3 Gb |
| Outgoing CN-IHEP | 16.9 Gb | 26.2 Gb |
| Outgoing DE-KIT | 63.0 Gb | 159 Gb |
| Outgoing ES-PIC | 10.1 Gb | 97.7 Gb |
| Outgoing FR-IN2P3 | 24.7 Gb | 162 Gb |
| Outgoing IT-INFN-CNAF | 15.1 Gb | 96.1 Gb |
| Outgoing KR-KISTI | 1.63 Gb | 14.0 Gb |
| Outgoing NDGF | 11.1 Gb | 78.4 Gb |
| Outgoing NL-T1 | 18.3 Gb | 204 Gb |
| Outgoing-PL-NCBJ | 3.28 Gb | 25.9 Gb |
| Outgoing RU-T1 | 12.8 Gb | 64.4 Gb |
| Outgoing UK-RAL | 35.2 Gb | 97.9 Gb |
| Outgoing US-BNL | 21.3 Gb | 111 Gb |
| Outgoing US-FNAL | 99.8 Gb | 387 Gb |
| Total | 345 Gb | 955 Gb |

LHCOPN: traffic growth

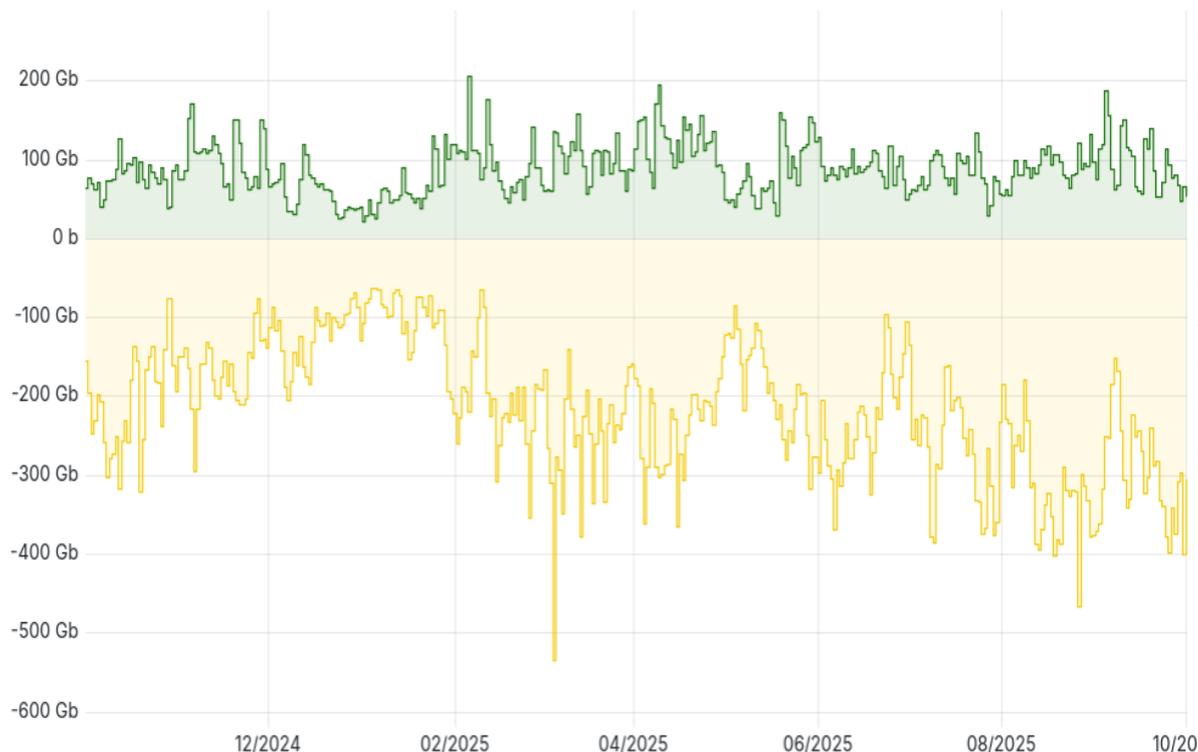


Run1: 2010-12
LS1: 2013-14
Run2: 2015-18
LS2: 2019-21
Run3: 2022-26

Y-Axis: Gbps - Average bandwidth of previous 12 months

CERN total traffic

Total Internet Traffic ⓘ



| Name | Mean |
|--------------------|---------|
| Internet IPv4 In | 5.35 Gb |
| Internet IPv4 Out | 20.4 Gb |
| Internet IPv6 In | 8.14 Gb |
| Internet IPv6 Out | 18.3 Gb |
| Internet Total In | 13.5 Gb |
| Internet Total Out | 38.7 Gb |
| WLCG IPv4+IPv6 In | 83.1 Gb |
| WLCG IPv4+IPv6 Out | 206 Gb |
| Total In | 88.0 Gb |
| Total Out | 217 Gb |

Numbers:

Sent out ~855 PB
in the last 12
months

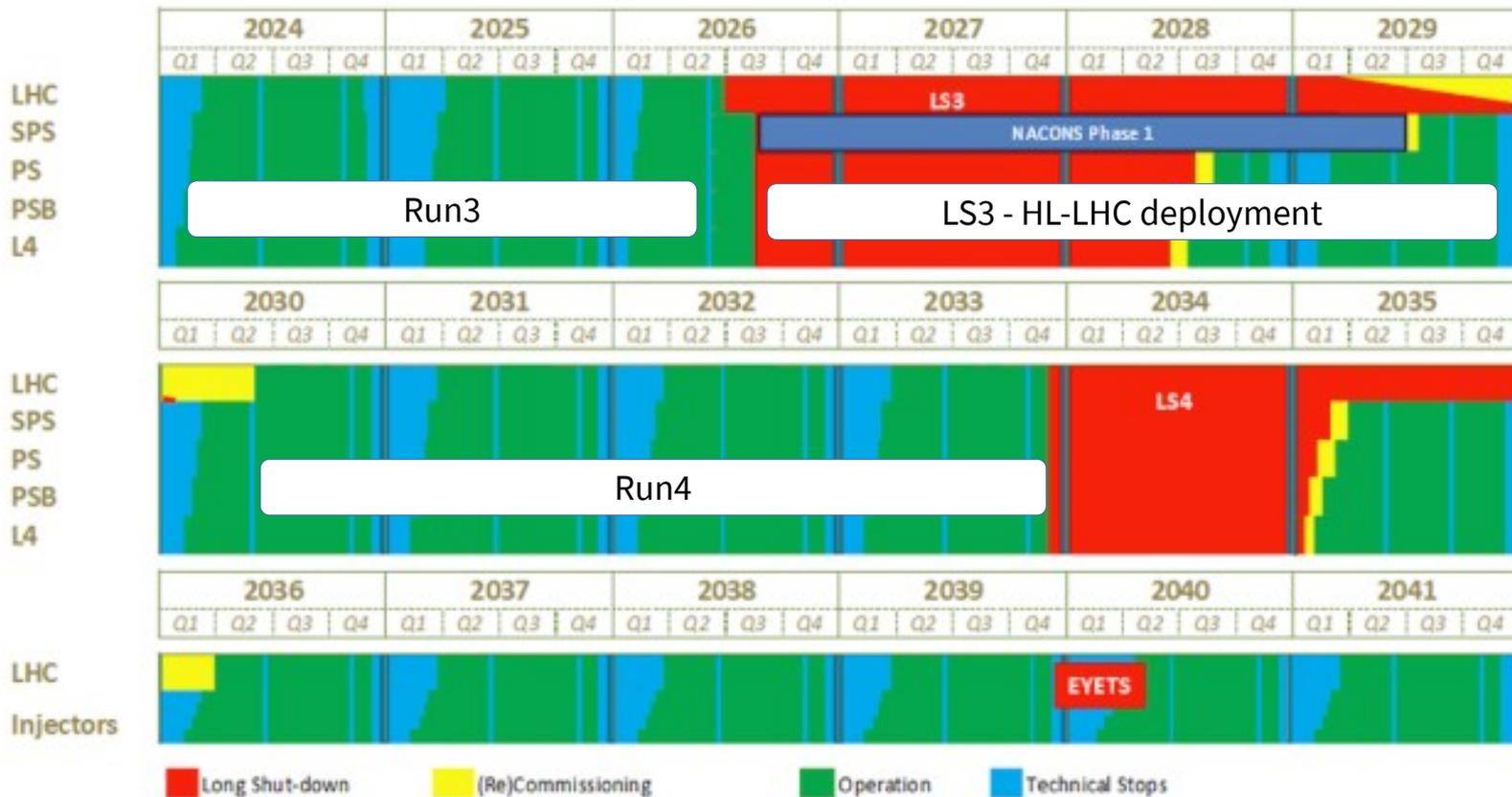
+11% compared
to previous year
(768PB)

Ref: https://monit-grafana.cern.ch/d/cScW82Tnz/00-overview?orgId=14&var-source=long_term&var-bin=1d&from=now-1y&to=now



LHC schedule

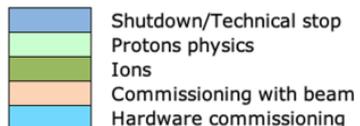
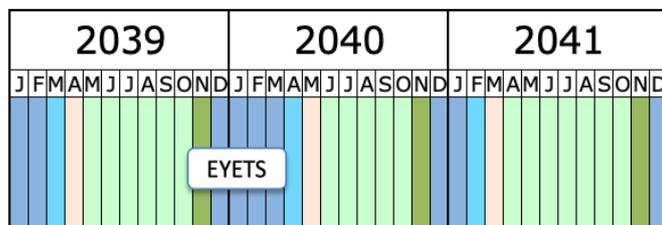
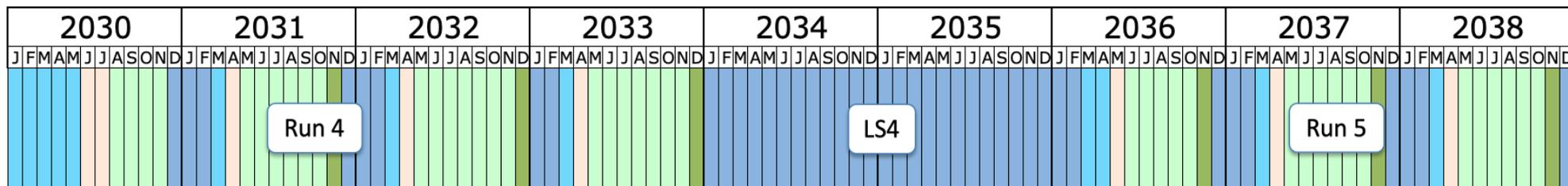
Long Term Schedule for CERN Accelerator complex



LS3 scheduled to begin July 2026

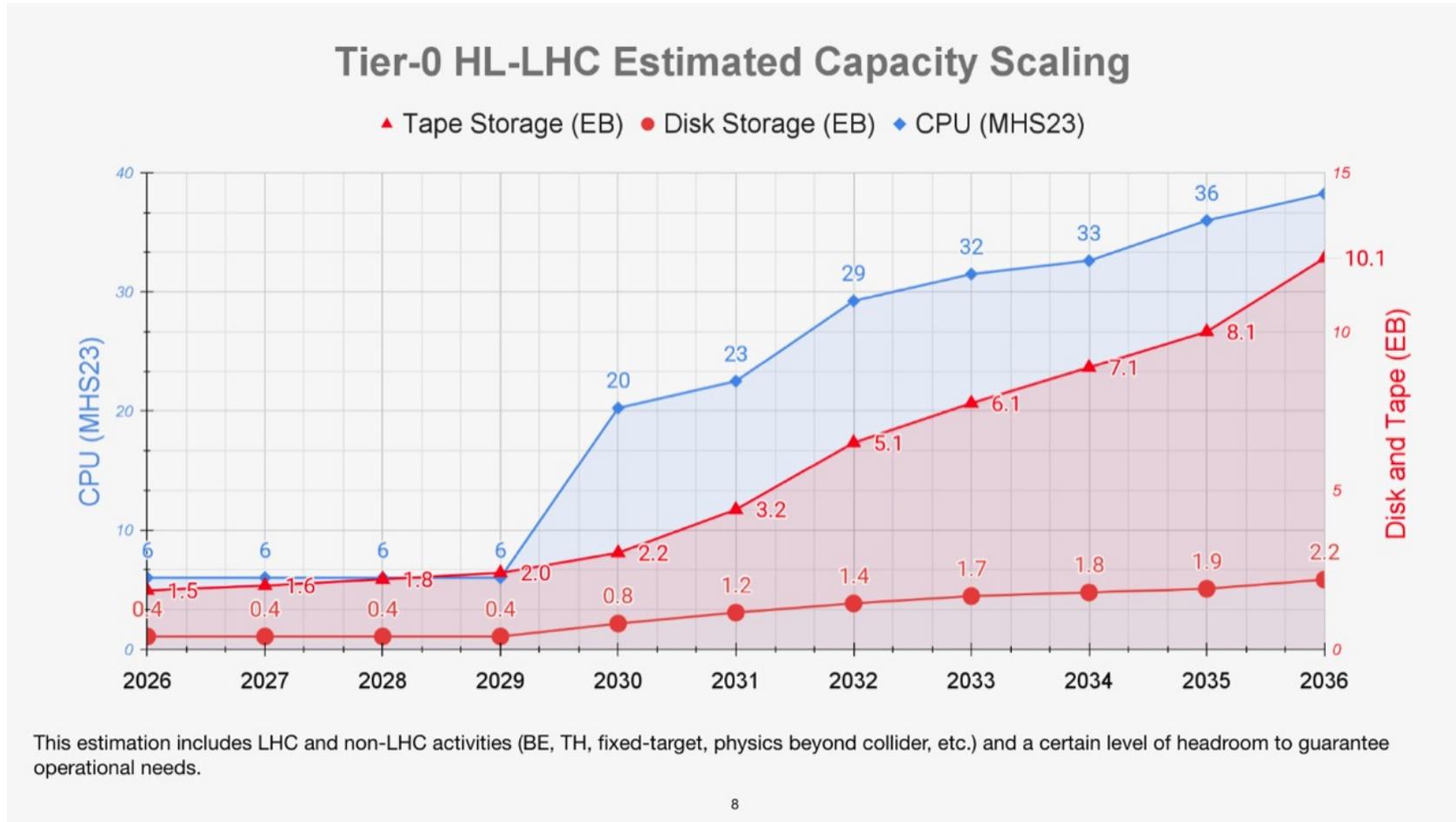
High-Luminosity LHC (Run4) will start June 2030

LHC schedule



Last update: November 24

Tier0 capacity plan (estimated)



Issue: Impact of LHCOPN links outages

In case of a LHCOPN link failure, for most of the Tier1s their traffic move to LHCONE.

LHCONE is a virtual network built on top of the R&E networks, so the LHCOPN backup traffic has an impact on the R&E traffic of the country hosting the Tier1

NRENs are getting worried that given the capacity of the LHCOPN links for HL-LHC (1Tbps for major T1s), any of their failure may have heavy consequences for the R&E users

Is it something we should look into?

LHCOPN routing (a)symmetry

| From \ To | CA-T | CH-C | CH-L | CN-I | DE-K | ES-P | FR-I | IT-C | KR-K | NDGF | NLT1 | PL-N | RO-U | RRC-J | RS-S | UK-R | US-F | US-B | last update |
|--------------|------|------|-------|------|------|------|------|------|---------|------|------|------|------|-------|------|------|------|------|-------------|
| CA-TRIUMF | - | OPN | OPN | 1 | OPN | OPN | OPN | OPN | 1 | OPN | OPN | 1 | | OPN | | OPN | 1 | 1 | 20250822 |
| CH-CERN | OPN | - | OPN | OPN | OPN | OPN | OPN | OPN | OPN | OPN | OPN | OPN | | OPN | | OPN | OPN | OPN | 20250820 |
| CH-LHEP | OPN | OPN | - | OPN | OPN | 1 | OPN | 1 | OPN tbc | OPN | 1 | OPN | | OPN | | 1 | OPN | OPN | 20250821 |
| CN-IHEP | OPN | OPN | 1 | - | 1 | 1 | 1 | 1 | OPN | 1 | 1 | OPN | | OPN | | 1 | 1 | 1 | 20250901 |
| DE-KIT | OPN | OPN | OPN | OPN | - | OPN | OPN | 1 | OPNtbc | OPN | OPN | OPN | | OPN | | OPN | 1 | OPN | 20250821 |
| ES-PIC | OPN | OPN | OPN | OPN | OPN | - | OPN | OPN | OPN | OPN | OPN | OPN | | OPN | | OPN | OPN | OPN | 20250903 |
| FR-CCIN2P3 | OPN | OPN | OPN | OPN | 1 | OPN | - | 1 | OPN | OPN | OPN | OPN | | OPN | | OPN | OPN | OPN | 20250822 |
| IT-INFN-CNAF | OPN | OPN | OPN | OPN | OPN | OPN | OPN | - | OPN | OPN | OPN | OPN | | OPN | | OPN | OPN | OPN | 20250929 |
| KR-KISTI | OPN | OPN | OPN | OPN | OPN | OPN | OPN | OPN | - | OPN | OPN | OPN | | OPN | | OPN | OPN | OPN | 20250905 |
| NDGF | OPN | OPN | OPN | OPN | OPN | OPN | OPN | OPN | OPN | - | OPN | OPN | | OPN | | OPN | OPN | OPN | 20250903 |
| NL-T1 | OPN | OPN | 1 | OPN | OPN | 1 | OPN | 1 | out | OPN | - | OPN | | out | | 1 | OPN | OPN | 20250829 |
| PL-NCBJ | OPN | OPN | OPN | OPN | OPN | OPN | OPN | OPN | OPNtbc | OPN | OPN | - | | OPN | | OPN | OPN | OPN | 20250821 |
| RO-UPB | | | | | | | | | | | | | - | | | | | | |
| RRC-JINR-T1 | OPN | OPN | OPN | OPN | OPN | OPN | OPN | OPN | OPNtbc | OPN | OPN | OPN | | - | | OPN | OPN | OPN | 20250822 |
| RS-SSC-T1 | | | | | | | | | | | | | | | - | | | | |
| UK-T1-RAL | OPN | OPN | OPN | OPN | OPN | OPN | OPN | OPN | OPNtbc | OPN | OPN | OPN | | OPN | | - | OPN | OPN | 20250821 |
| US-FNAL-CMS | 1 | OPN | 1 | OPN | OPN | 1 | OPN | OPN | out | 1 | OPN | No | | OPN | | OPN | - | 1 | 20250825 |
| US-T1-BNL | OPN | OPN | 1 tbc | OPN | OPN | OPN | OPN | OPN | tbc | OPN | OPN | OPN | | OPN | | OPN | OPN | - | 20250822 |

Questions?

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