Belle II Update

LHCONE/OPN - Catania

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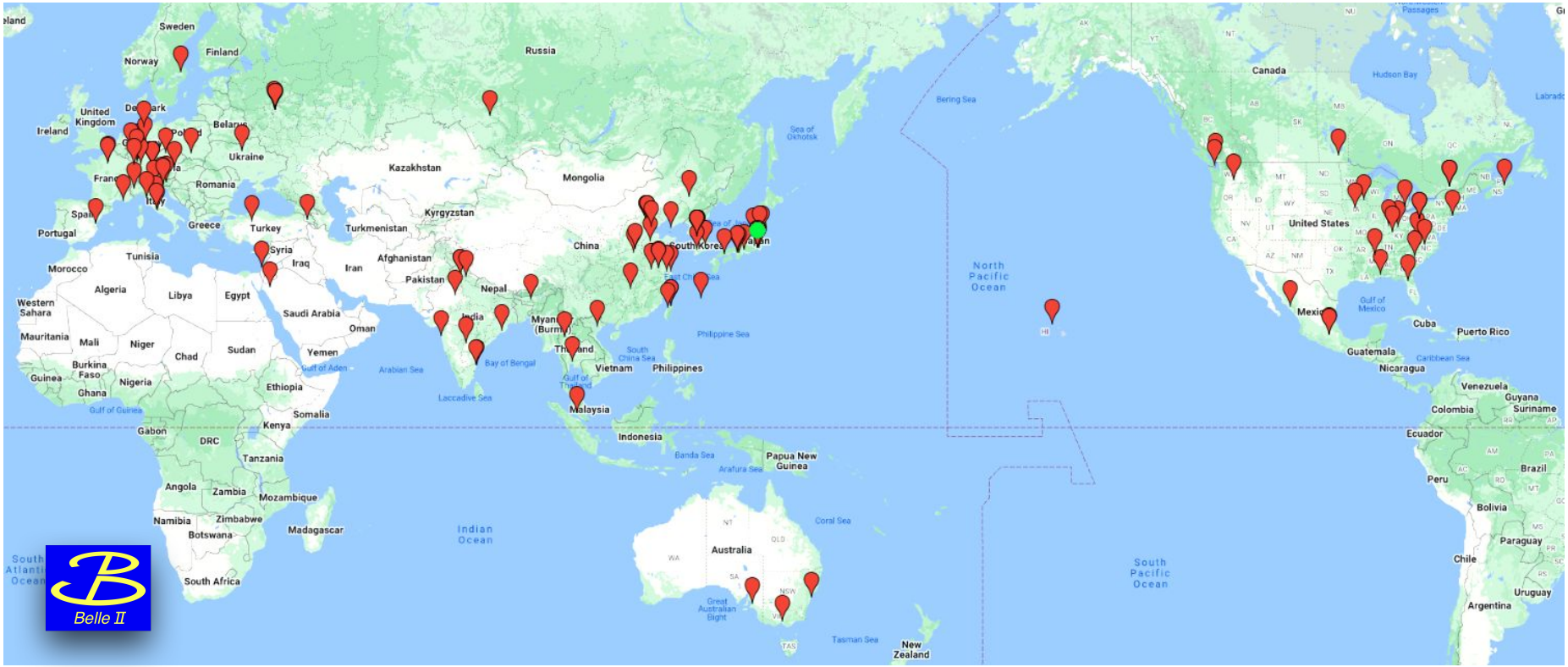
10 April 2024

The Belle II Experiment

Around 1200 members, 131 institutions, 28 countries



Belle II Status

Data taking started in 2019.

In July 2022 we started the Long Shutdown 1

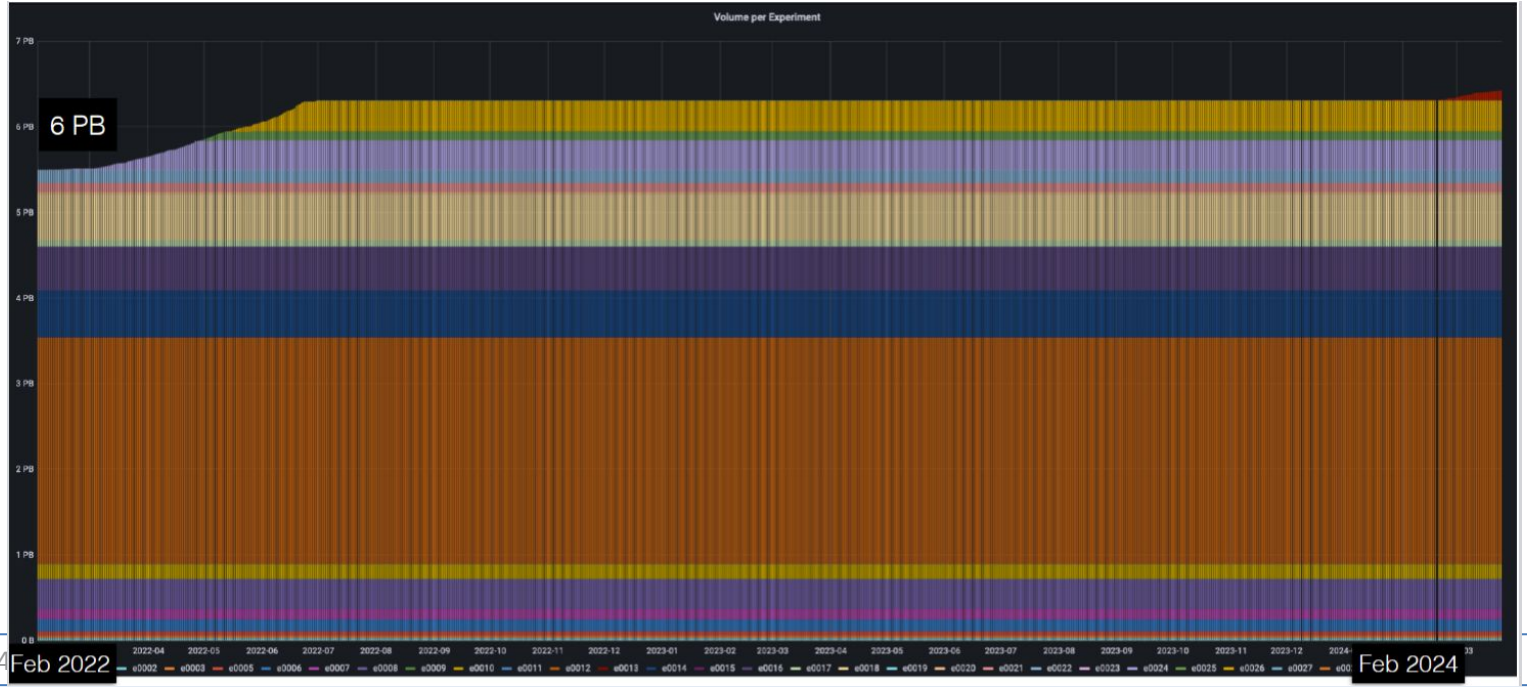
Data taking restarted early 2024, first collision 20 February 2024.

Restarted Copy of RAW Data from KEK to RAW Data Centers

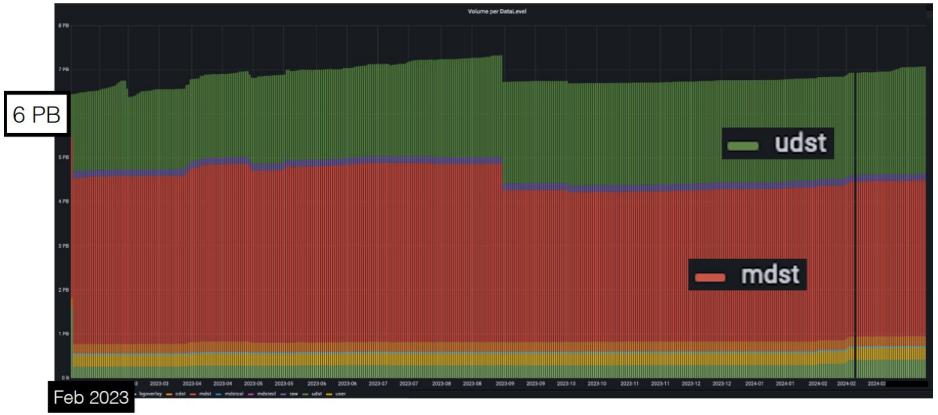
RAW Data

More than 3 PB raw data accumulated

- Incl. skimmed raw data
- Duplicated over Raw Data Centers

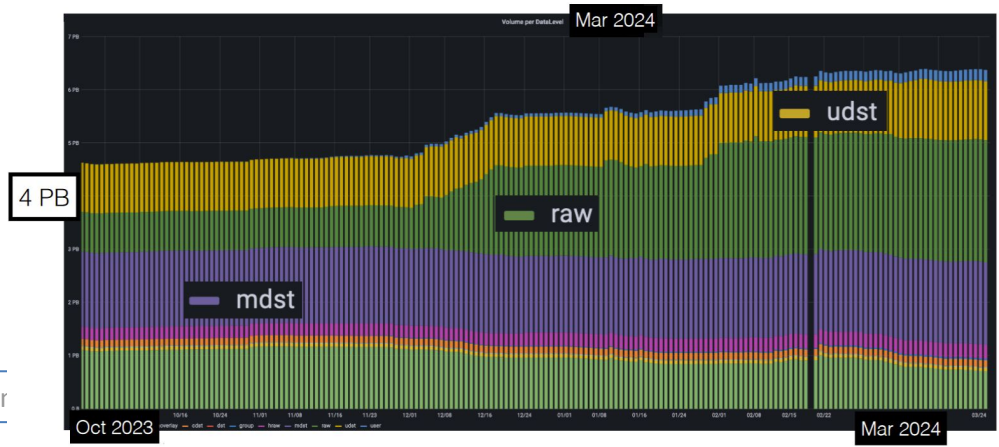


Belle II Data Volume DISK



Persistent data on DISK with life cycles based on data production/processing campaigns
mdst: reconstructed data (both real data and MC)
udst: skimmed data produced from mdst, with additional parameters for analysis

Temporary data/replicas on DISK
intermediate output, raw data staged for reprocessing, analysis output, calibration data, ...



Belle II Data Challenge 2024 within WLCG DC24

Main goal: Emulate data transfer conditions in a Belle II high-lumi scenario

Our current estimation for such scenario is 40 TB per day.

Transfers from KEK to RAW Data Centers according to our distribution schema (30%BNL, 20%CNAF, 15% IN2P3CC, 15%UVic, 10%DESY, 10%KIT)

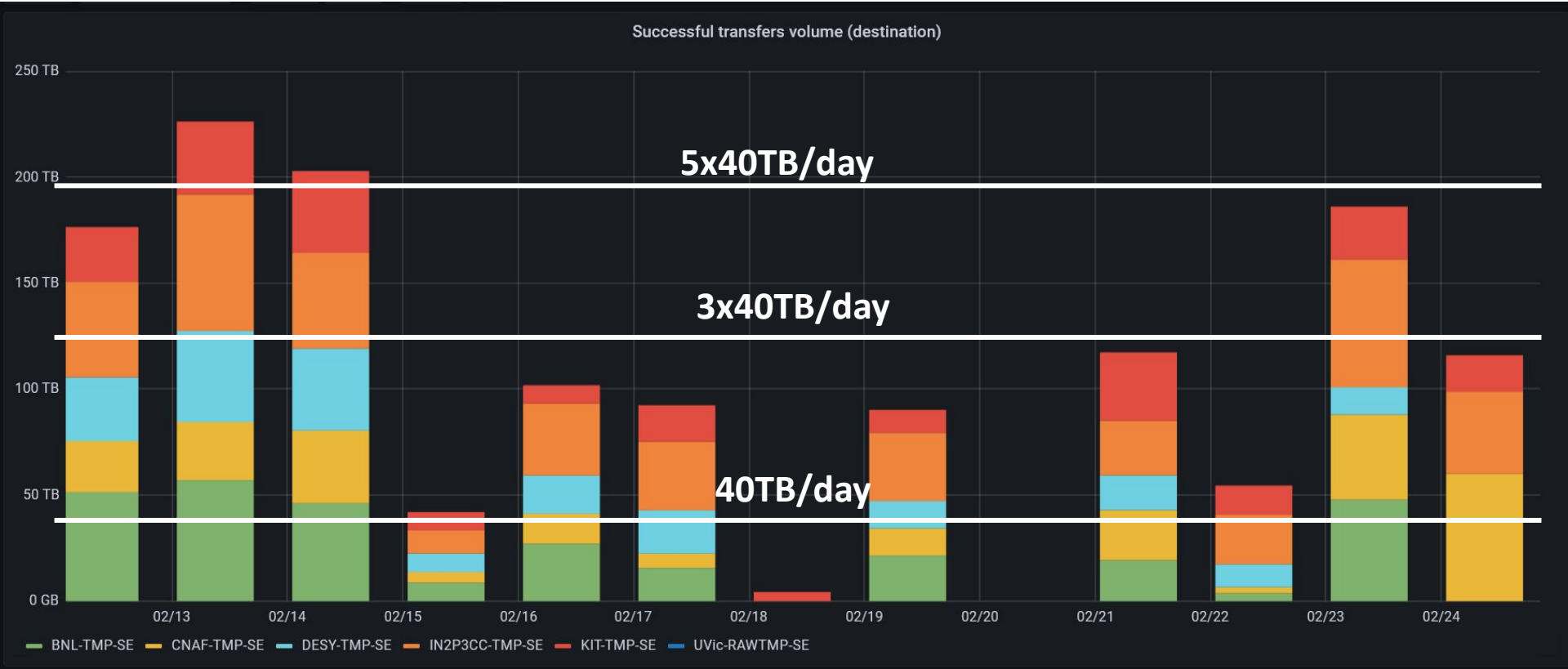
Considering that the average speed needed to transfer 40TB/day is 3.7Gbit/s in outbound at KEK vs all the Raw Data Centers.

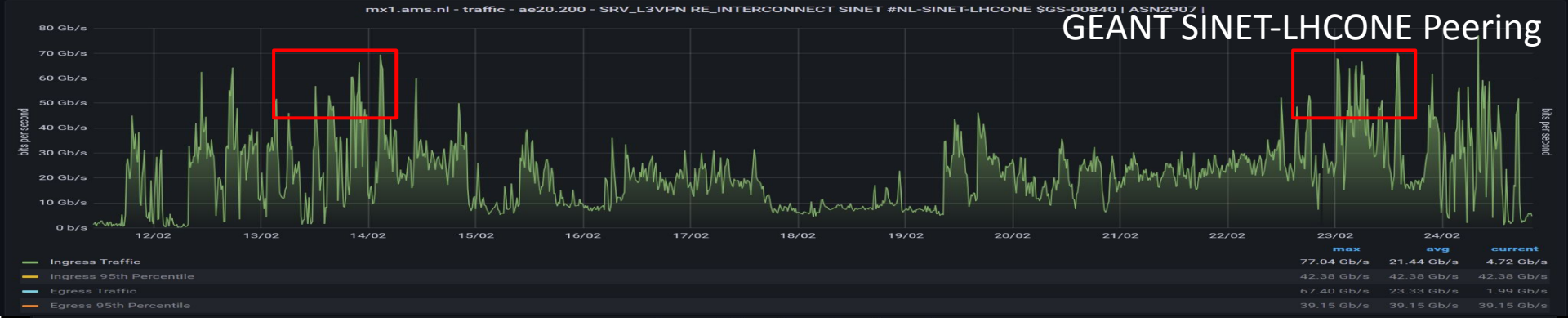
- Min - The target speed to achieve is 3x3.7Gbit/s = **11.1 Gbit/s**
- Max - The target speed to achieve is 5x3.7Gbit/s = **18.5 Gbit/s**

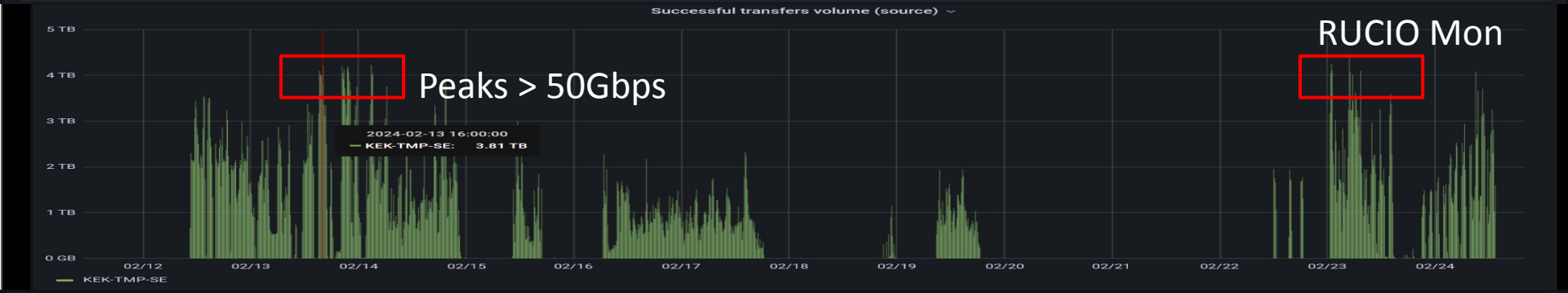
Activities

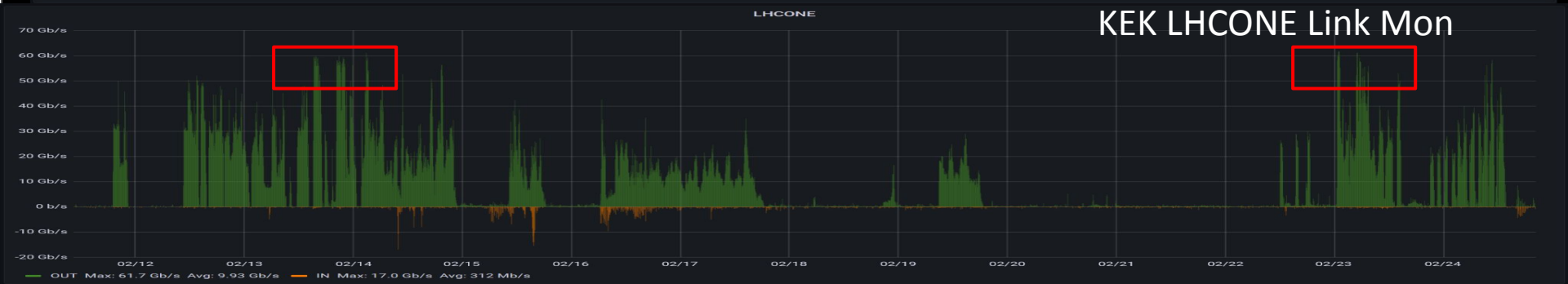
	DATE	Test	TOT	Peak (1h)	Average
1	12/02/2024 9:00 to 14/02/2004 23:00	KEK vs RAW DC (kek2-fts03 - v3.12.1)	606 TB/61h	50 Gbps	22,0 Gbps - Reached Max goal
2	15/02/2024 9:00 to 15/02/2024 16:00	KEK vs RAW DC (kek2-fts01 older)	39,9 TB/7h	25 Gbps	12,6 Gbps - Reached Min goal
3	16/02/2024 6:00 to 17/02/2024 19:00	KEK vs RAW DC (kek2-fts01)	194 TB/38h	24 Gbps	11,3 Gbps - Reached Min goal
4	19/02/2024 8:30 to 19/02/2024 21:30	KEK vs RAW DC + RAW DCs vs RAW DCs	80 TB/13h	27 Gbps	13,7 Gbps - Mixed traffic
5	21/02/2024 10:00 to 22/02/2024 9:00	RAW DCs vs RAW DCs (kek2-fts03)	141 TB/23h	46 Gbps	13,6 Gbps - Mixed traffic
6	23/02/2024 0:00 to 23/02/2024 14:00	KEK vs RAW DCs (kek2-fts03)	178 TB/15h	46 Gbps	26 Gbps - Reached Max goal

Traffic per Day vs Goals




mx1.ams.nl - traffic - ae20.200 - SRV_L3VPN RE_INTERCONNECT SINET #NL-SINET-LHCONE $GS-00840 | ASN2907 |
GEANT SINET-LHCONE Peering
bits per second
80 Gb/s
70 Gb/s
60 Gb/s
50 Gb/s
40 Gb/s
30 Gb/s
20 Gb/s
10 Gb/s
0 b/s
12/02
13/02
14/02
15/02
16/02
17/02
18/02
19/02
20/02
21/02
22/02
23/02
24/02
max
avg
current
Ingress Traffic 77.04 Gb/s 21.44 Gb/s 4.72 Gb/s
Ingress 95th Percentile 42.38 Gb/s 42.38 Gb/s 42.38 Gb/s
Egress Traffic 67.40 Gb/s 23.33 Gb/s 1.99 Gb/s
Egress 95th Percentile 39.15 Gb/s 39.15 Gb/s 39.15 Gb/s

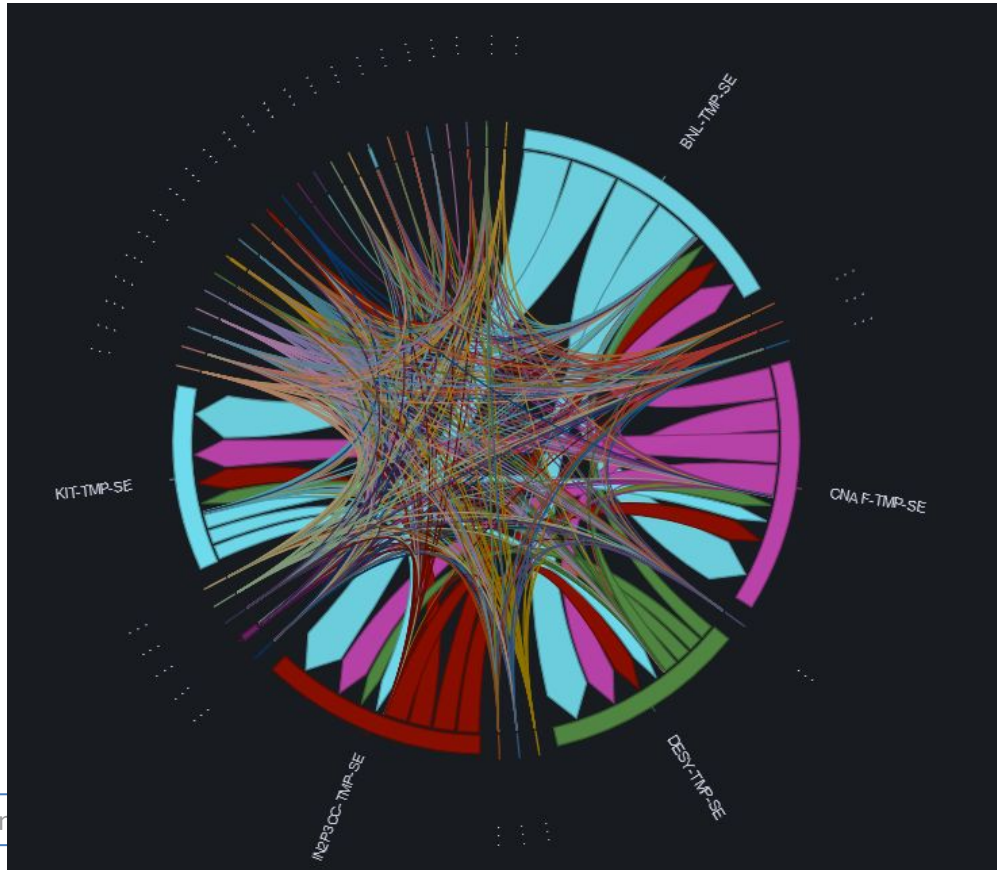

Successful transfers volume (source)
RUCIO Mon
Peaks > 50Gbps
2024-02-13 16:00:00
KEK-TMP-SE: 3.81 TB
5 TB
4 TB
3 TB
2 TB
1 TB
0 GB
02/12
02/13
02/14
02/15
02/16
02/17
02/18
02/19
02/20
02/21
02/22
02/23
02/24
KEK-TMP-SE


LHCONE
KEK LHCONE Link Mon
70 Gb/s
60 Gb/s
50 Gb/s
40 Gb/s
30 Gb/s
20 Gb/s
10 Gb/s
0 b/s
-10 Gb/s
-20 Gb/s
02/12
02/13
02/14
02/15
02/16
02/17
02/18
02/19
02/20
02/21
02/22
02/23
02/24
OUT Max: 61.7 Gb/s Avg: 9.93 Gb/s
IN Max: 17.0 Gb/s Avg: 312 Mb/s

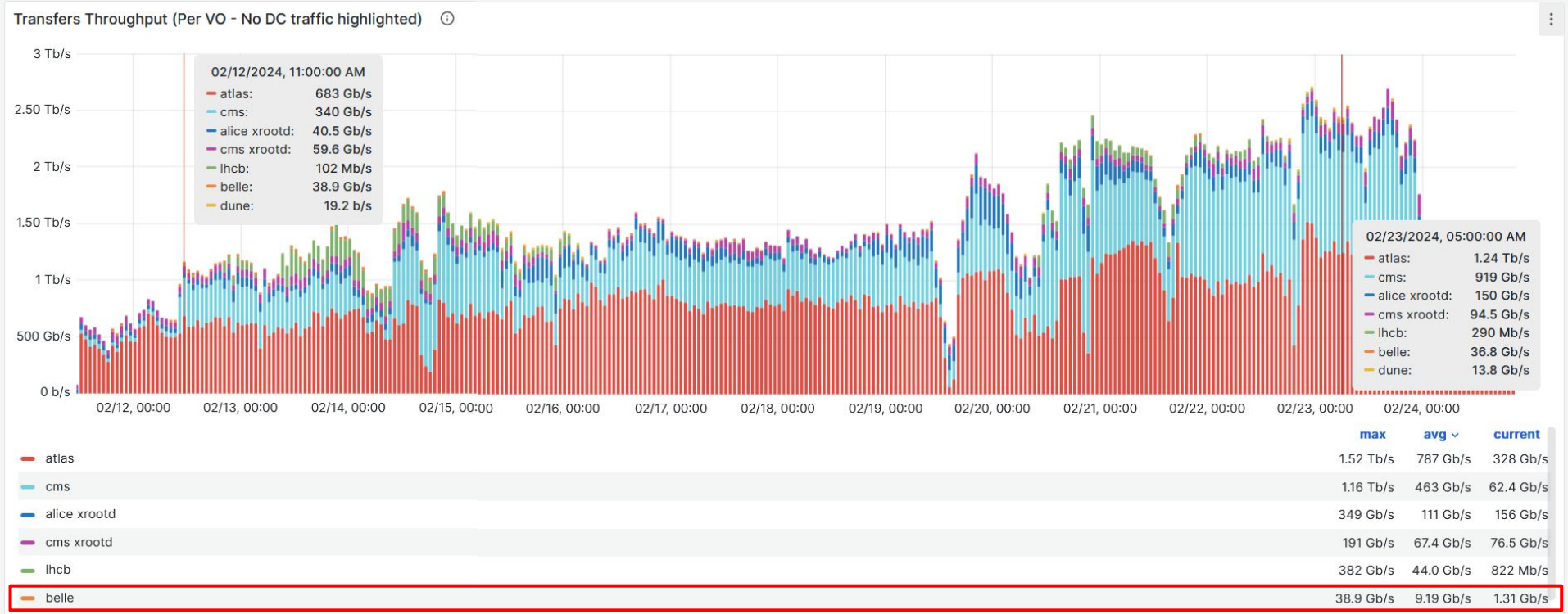
Traffic among RAW Data Centres 21/02/2024 9:00 to 22/02/2024 9:00

Expected routing table. Tentative of flow analysis ongoing.

	BNL	KIT	CNAF	DESY	IN2P3CC	Uvic
BNL		LHCOPN	LHCOPN	LHCONE	LHCONE	GeneralIP
KIT	LHCOPN		LHCONE	LHCONE	LHCONE	GeneralIP
CNAF	LHCOPN	LHCONE		LHCONE	LHCONE	GeneralIP
DESY	LHCONE	LHCONE	LHCONE		LHCONE	GeneralIP
IN2P3CC	LHCONE	LHCONE	LHCONE	LHCONE		GeneralIP
Uvic	GeneralIP	GeneralIP	GeneralIP	GeneralIP	GeneralIP	



Belle II on the WLCG Dashboard for DC24



	max	avg	current
atlas	1.52 Tb/s	787 Gb/s	328 Gb/s
cms	1.16 Tb/s	463 Gb/s	62.4 Gb/s
alice xrootd	349 Gb/s	111 Gb/s	156 Gb/s
cms xrootd	191 Gb/s	67.4 Gb/s	76.5 Gb/s
lhcb	382 Gb/s	44.0 Gb/s	822 Mb/s
belle	38.9 Gb/s	9.19 Gb/s	1.31 Gb/s

IPv6 in Belle II

A large part of Belle II traffic goes via IPv6, this because several large storages are configured in dual stack. In particular KEK and most part of RAW DCs are their storages configured in dual stack.

As regarding Computational Resources, according to the last survey conducted in April 2023, the percentage of Sites implementing IPv6 on Worker Nodes is 16%, but there are ongoing activities.

Currently, we are gathering information for the site report 2024, and by June we will have an updated status.

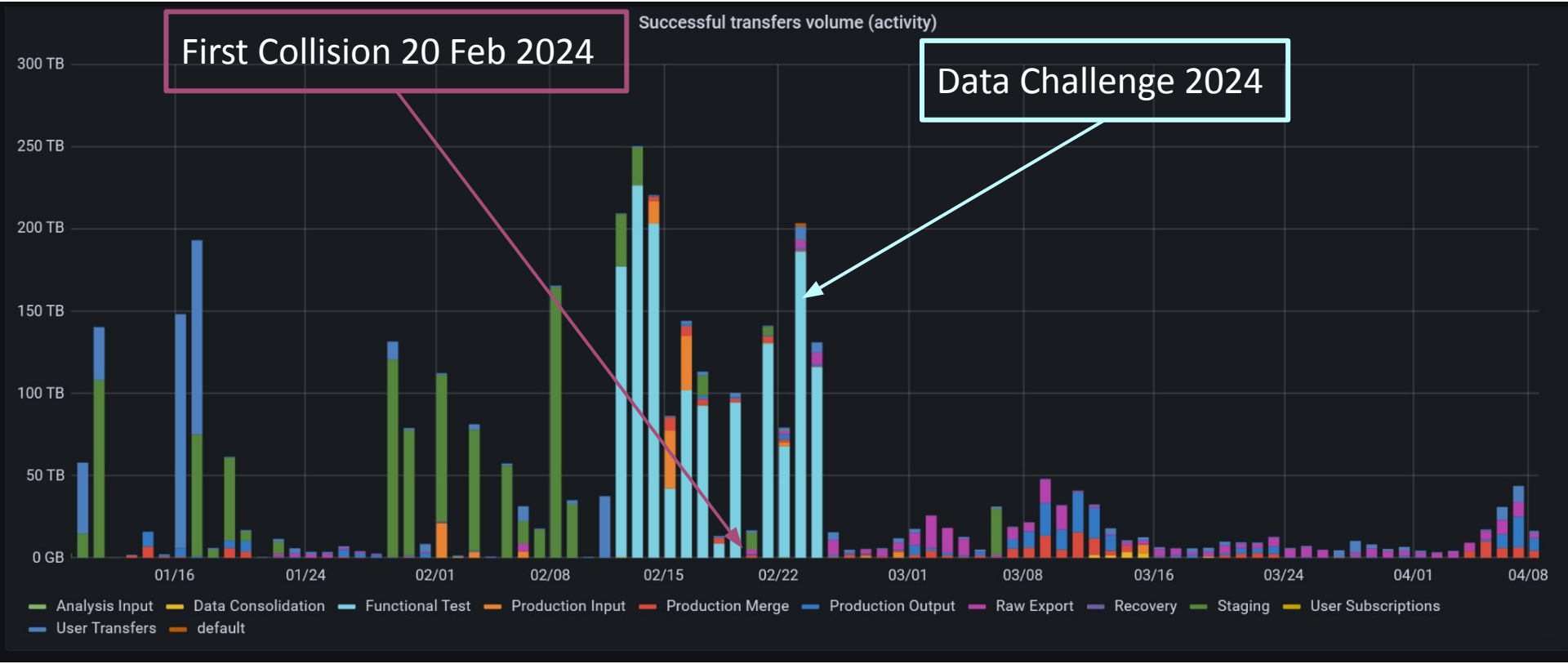
SITE REPORT 2023	
IPv6 deployment	**#Sites**
Storage Dual Stack	43% (was 34%)
WorkerNode Dual Stack	16% (was 13%)

IPv6 in Belle II

As for the Central Services of Belle II (DIRAC, Rucio, Condition DB, etc.), IPv6 is not configured for all of them, and compliance should be double-checked service by service.

The activity requires a process to be started, and currently, we don’t have a plan in place to implement an IPv6-Only infrastructure.

Successful Transfer Volume since January 2024



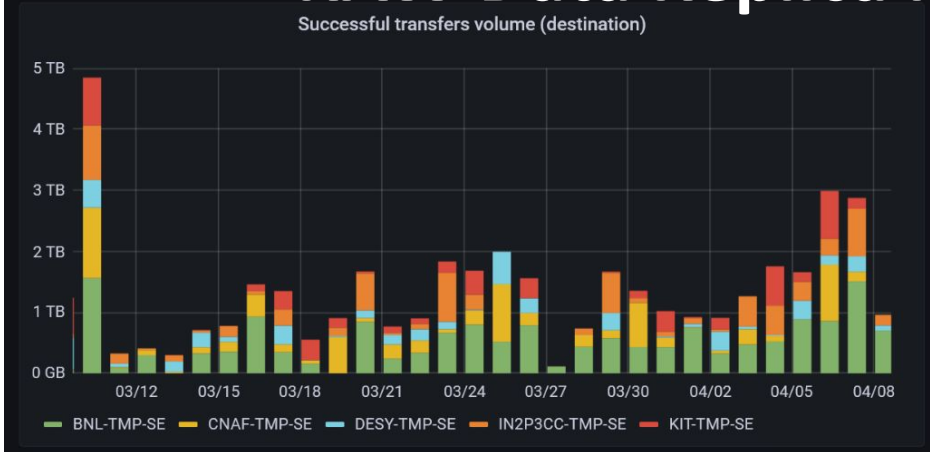
Belle II DDM / Belle II Transfers and Deletions

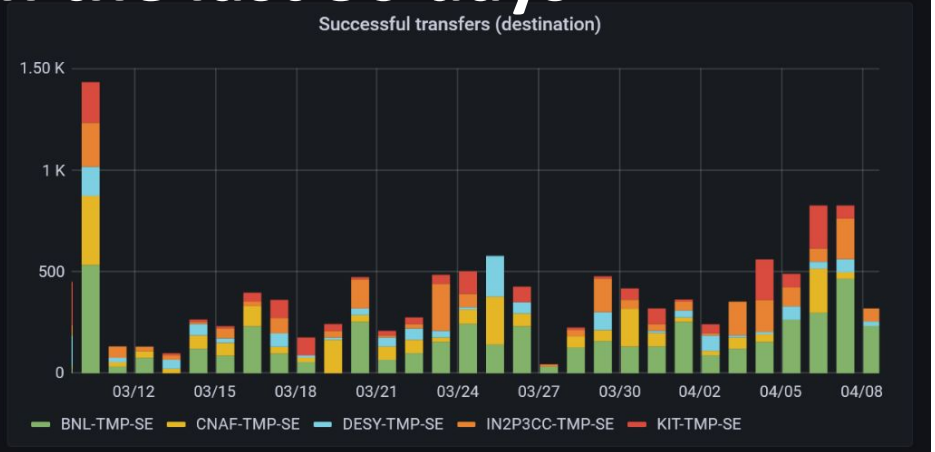
Last 30 days

Source: KEK-TMP-SE | Destination: BNL-TMP-SE + CNAF-TMP-SE + IN2P3CC-TMP-SE + KIT-TMP-SE + DESY... | Activity: Raw Export | Binning: 1d | Filters: +

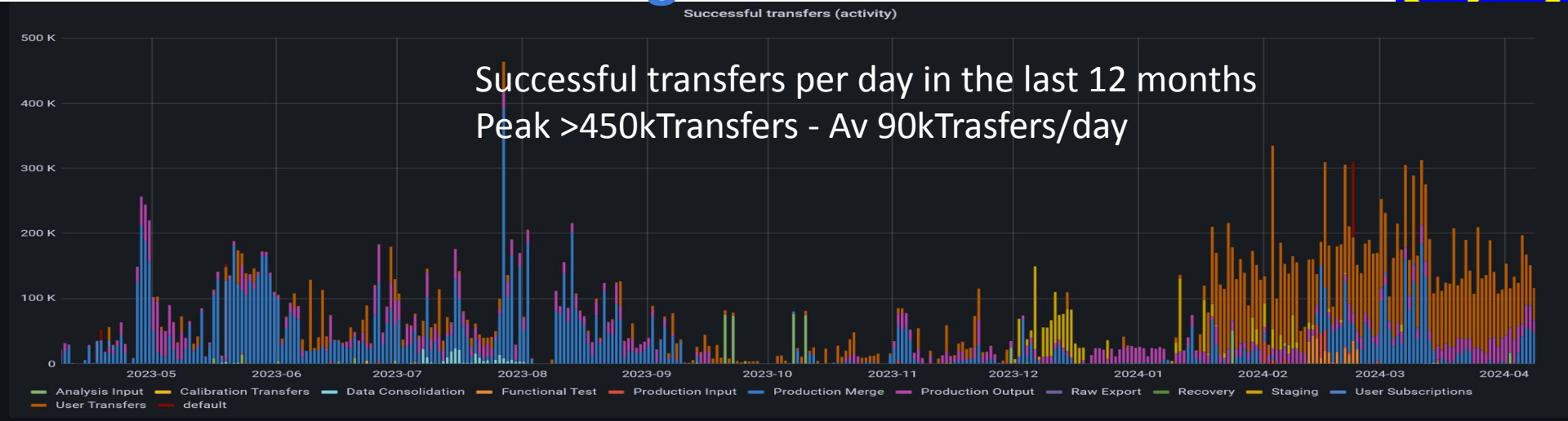
Transfers overview

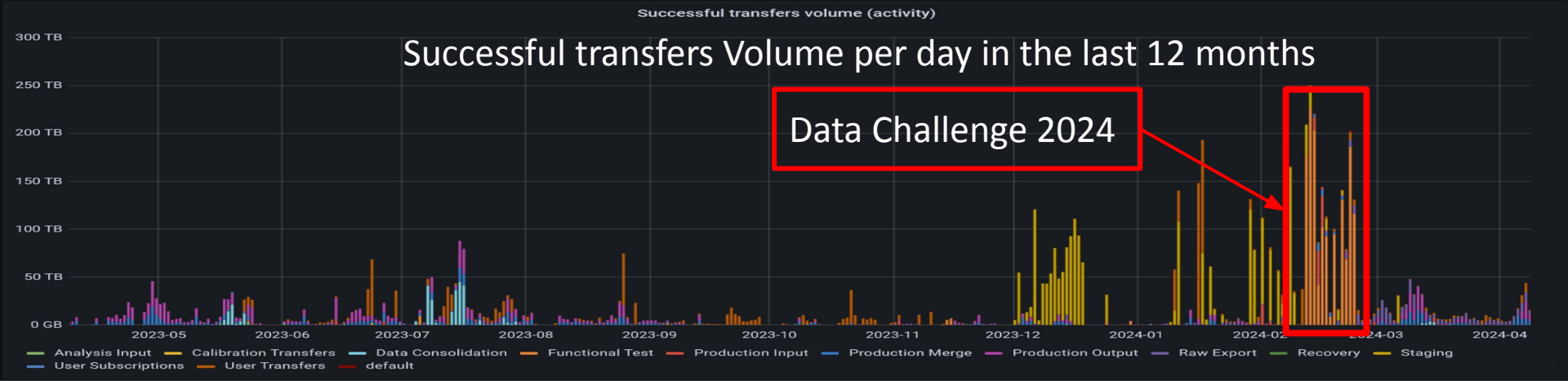
RAW Data Replica in the last 30 days





From Rucio Monitoring





Conclusions

Belle II resumed data taking in early 2024.

The Data Challenge 2024 has been successfully completed, achieving the maximum target of 18.5Gbps outbound from KEK to RAW DCs.

Although IPv6 traffic is already significant, the entire computing infrastructure is currently not optimized for IPv6-only resources.

Data transfer activities are functioning correctly over the research network and are monitored via Rucio.

BACKUP