

Belle II Update

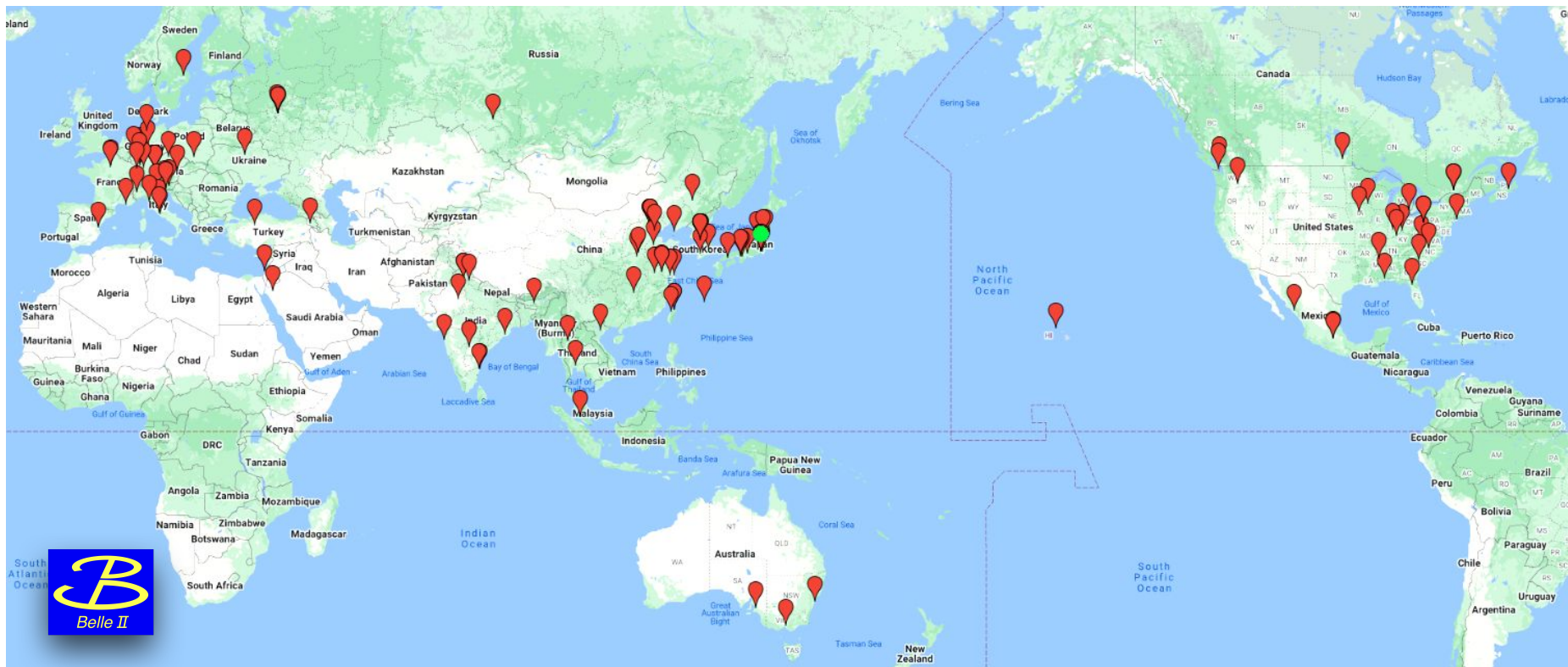
LHCONE/OPN - Prague

Dr. Silvio Pardi

18 April 2023

The Belle II Experiment

1180 members, 131 institutions, 27 countries



Belle II Status and Plan

Around 2.8PB of RAW Data collected since 2019

A full copy of RAW Data is stored at KEK Tier0. Since April 2021 the secondary copy is distributed over the following RAW Data Centers. Nominal share:

- BNL 30%
- CNAF 20%
- DESY 10%
- KIT 10%
- IN2P3CC 15%
- UVic 15%

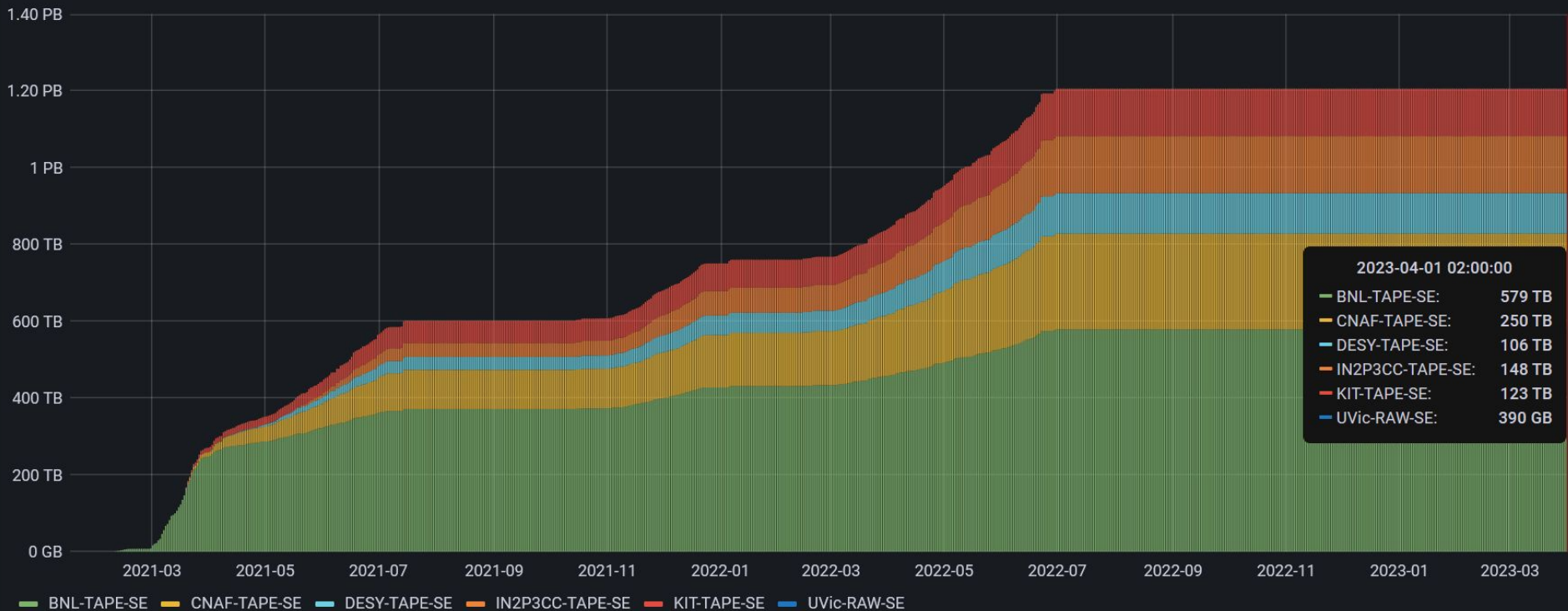
Currently in long shutdown for upgrade.

Data taking will restart after the replacement operations being performed at KEK.

Estimated restart for October 2023

Raw Data Distribution with Rucio since the 2021

Successful transfers volume per destination (aggregation) ▾

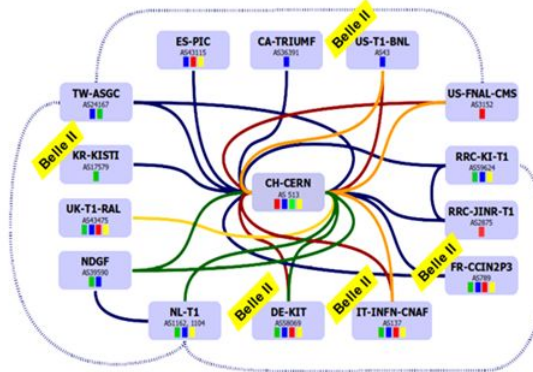


Belle II Network

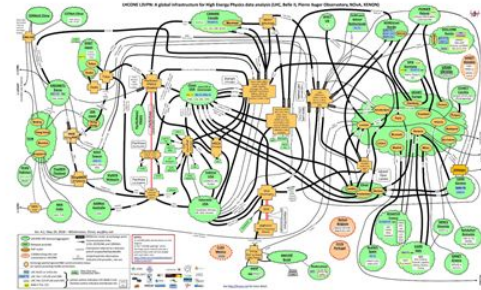
100G Global Ring via SINET



LHCOPN Optical infrastructure that can be used without jeopardizing resources



LHCONE L3 VPN Connecting all the major Data Centres



Distributed Computing Infrastructure

Storage Elements (SEs)

- 29 storages
- 5 tape systems

Storage	Space (PB)
Disk	15.5
Tape	12.4

Computing elements (CEs)

- 56 sites registered in DIRAC
 - 30 sites Providing Pledged CPUs
 - 16 Sites Pledged+Opportunistic
 - 10 Sites Opportunistic Only

CPU	kHS06	Job slots
Pledged CPU	466	32 kJS
Opportunistic CPU (Maximum)	385	32 kJS
TOTAL	852	64 kJS

N.B. annual survey with sites is ongoing. In June will have the new fully update picture.

From the latest Site Report

Network	#Sites
LHCONE	48%
GeneralIP	52%

83% of kHS06 Running on LHCONE
92% of Storage Space on LHCONE

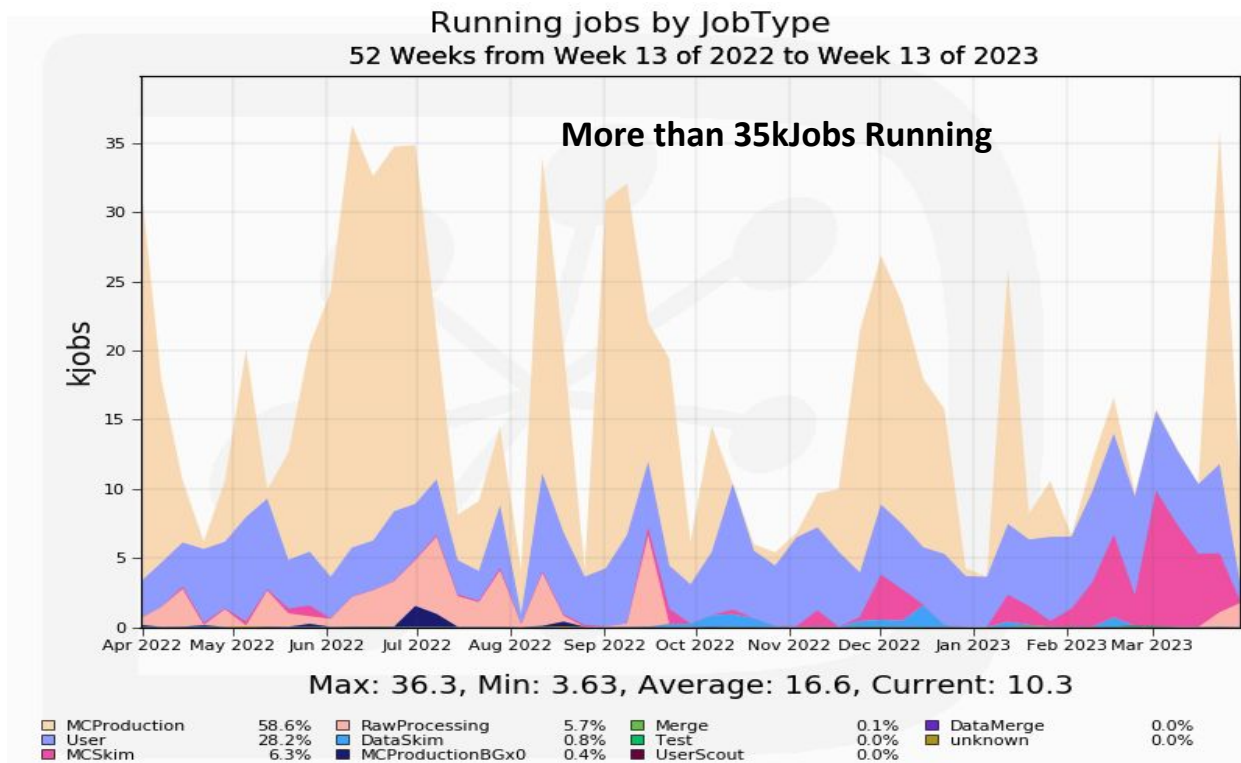
IPv6 deployment	#Sites
Storage Dual Stack	34%
Worker Node Dual Stack	13%

11.3 PB reachable via IPv6 over of 15.5 PB

Belle II Status

- Computing activities dominated by production jobs.
- User analysis continuously performed, increased to respect last year

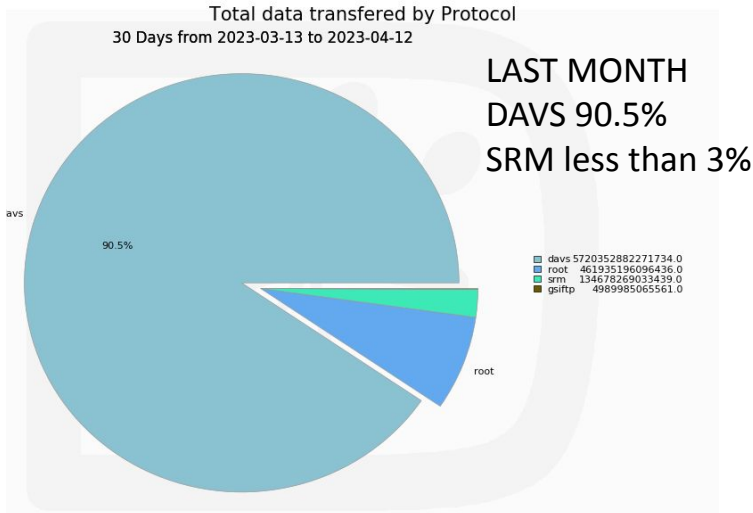
1.3M jobs per week



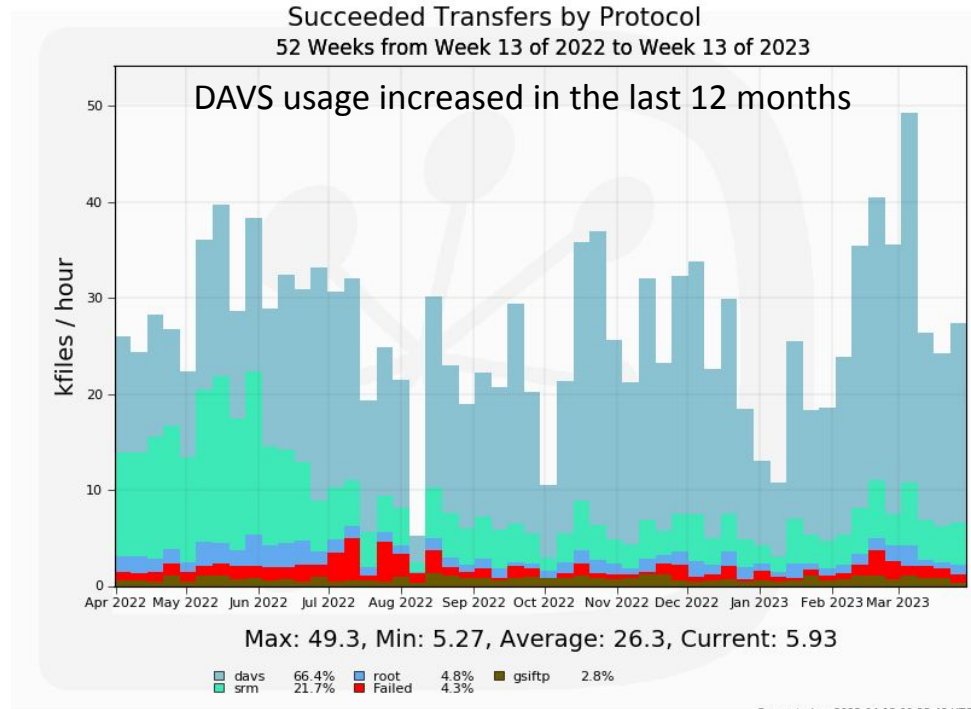
Generated on 2023-04-12 08:19:00 UTC

DAVS migration

Large effort for the extensive usage of DAVS as main protocol for data access and data transfer.



Generated on 2023-04-12 09:36:20 UTC



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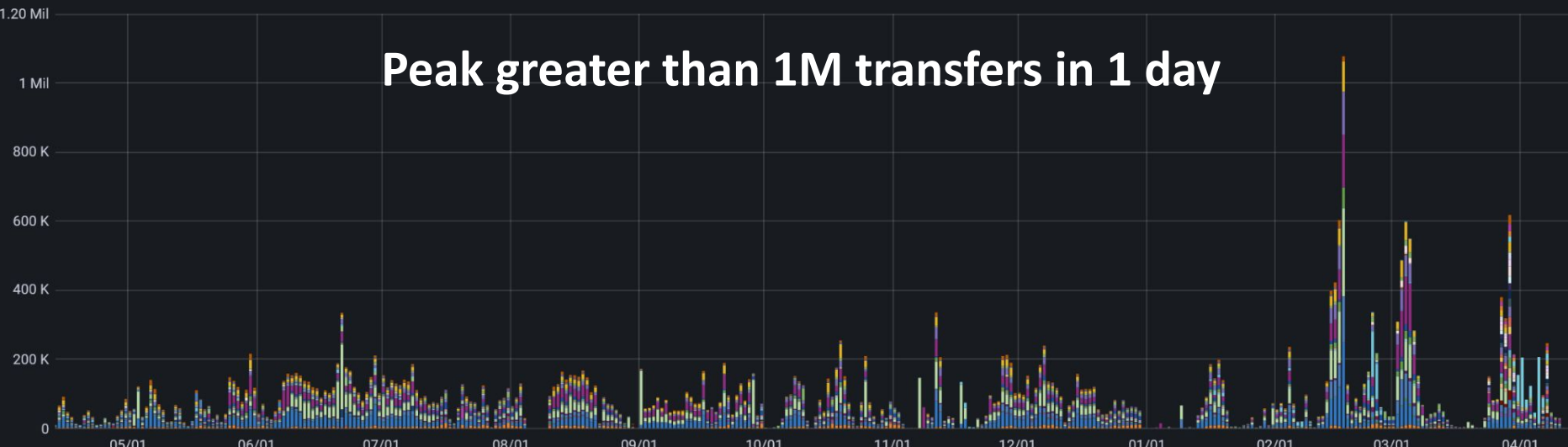
Token Based Authentication

- IAM service in pre-production available at KEK + 2 testing IAM services: one at KEK and one at CNAF
- Tested for job submission and storage operation with success with several endpoints.
- Upgrading the DIRAC infrastructure step-by-step to support Token Based Authentication as soon as possible.
- DDM based on RUCIO has the internal capability to work with Token.

Rucio monitoring system

Successful transfers (destination)

Peak greater than 1M transfers in 1 day



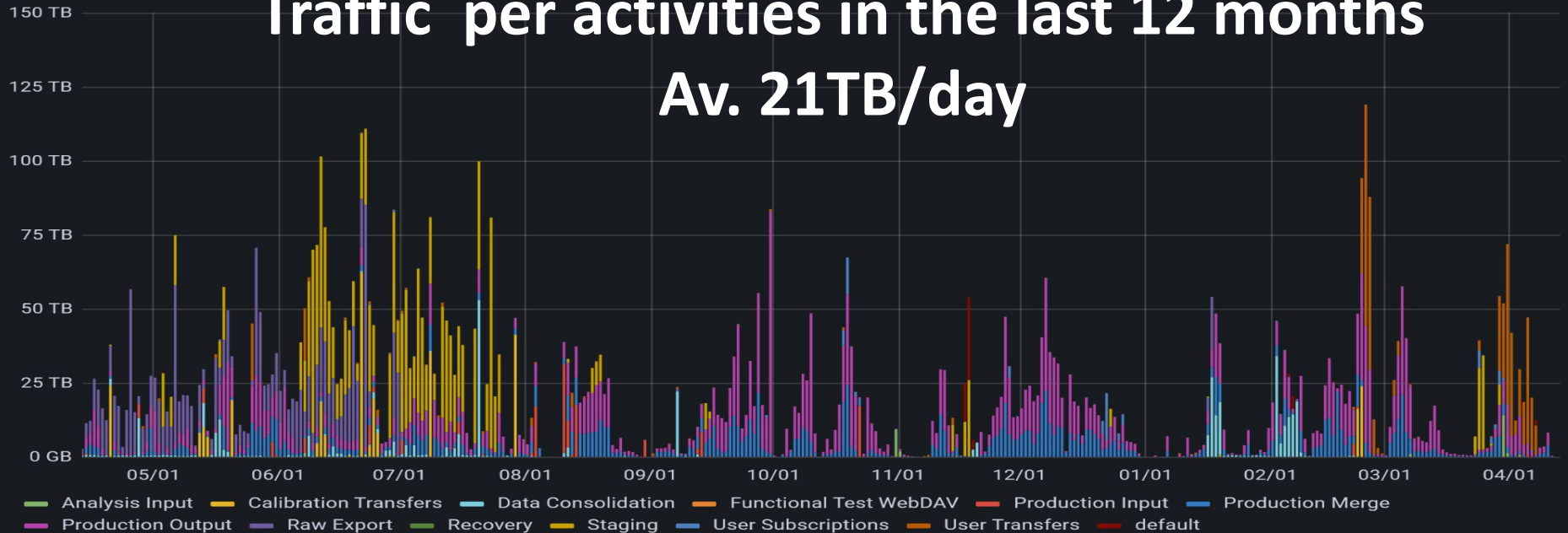
- Australia-DATA-SE — Australia-TMP-SE — BNL-CALIB-SE — BNL-DATA-SE — BNL-TAPE-SE — BNL-TMP-SE — CESNET-DATA-SE — CESNET-TMP-SE — CNAF-DATA-SE — CNAF-TAPE-SE — CNAF-TMP-SE
- CYFRONET-DATA-SE — CYFRONET-TMP-SE — DESY-CALIB-SE — DESY-DATA-SE — DESY-TAPE-SE — DESY-TMP-SE — Frascati-DATA-SE — HEPHY-DATA-SE — HEPHY-TMP-SE — IHEP-DATA-SE — IHEP-TMP-SE
- IN2P3CC-DATA-SE — IN2P3CC-TAPE-SE — IN2P3CC-TMP-SE — IPHC-DATA-SE — IPHC-TMP-SE — KEK-DEV-SE — KEK-DEV-TMP-SE — KEK-DISK-DATA-SE — KEK-DISK-TMP-SE — KEK-RAW-SE — KEK-TAPE-SE
- KEK-TMP-SE — KEK2-Archive-SE — KISTI-DATA-SE — KISTI-TMP-SE — KIT-DATA-SE — KIT-TAPE-SE — KIT-TMP-SE — KMI-TMP-SE — LAL-DATA-SE — LAL-TMP-SE — LMU-LOCAL-SE — MPPMU-DATA-SE
- MPPMU-TMP-SE — NDU-DATA-SE — NDU-TMP-SE — NTU-TMP-SE — NTUCC-DATA-SE — NTUCC-TMP-SE — Napoli-DATA-SE — Napoli-TMP-SE — Pisa-DATA-SE — Pisa-TMP-SE — Roma3-TMP-SE
- SIGNET-DATA-SE — SIGNET-TMP-SE — Torino-DATA-SE — Torino-TMP-SE — UBonn-LOCAL-SE — ULAKBIM-DATA-SE — ULAKBIM-TMP-SE — UVic-DATA-SE — UVic-OBJ-TMP-SE — UVic-ObjectStorage-SE
- UVic-RAW-SE — UVic-TMP-SE

Rucio monitoring system

Successful transfers volume (activity)

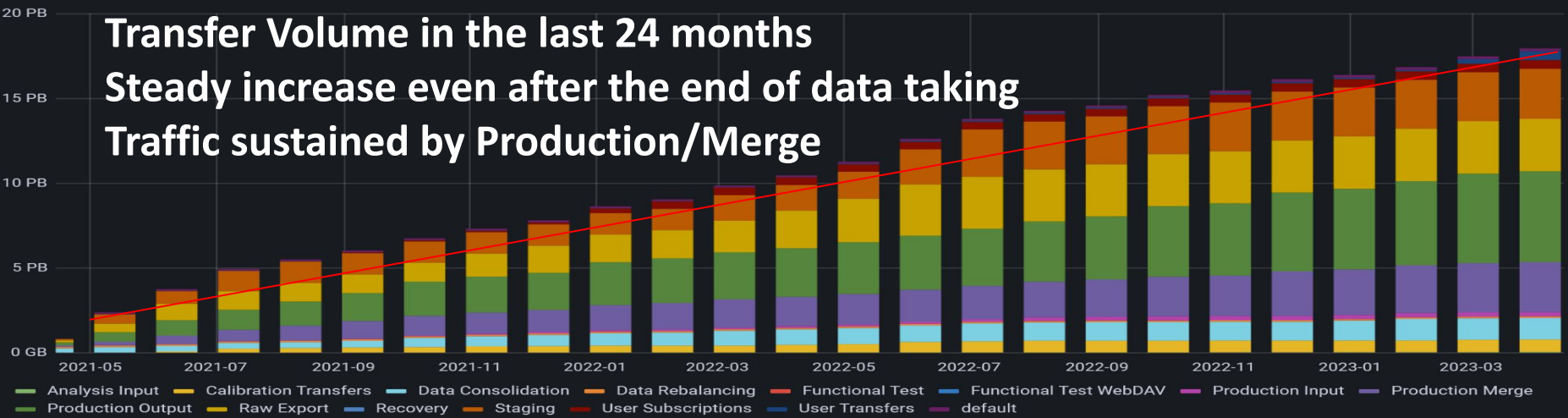
Traffic per activities in the last 12 months

Av. 21TB/day



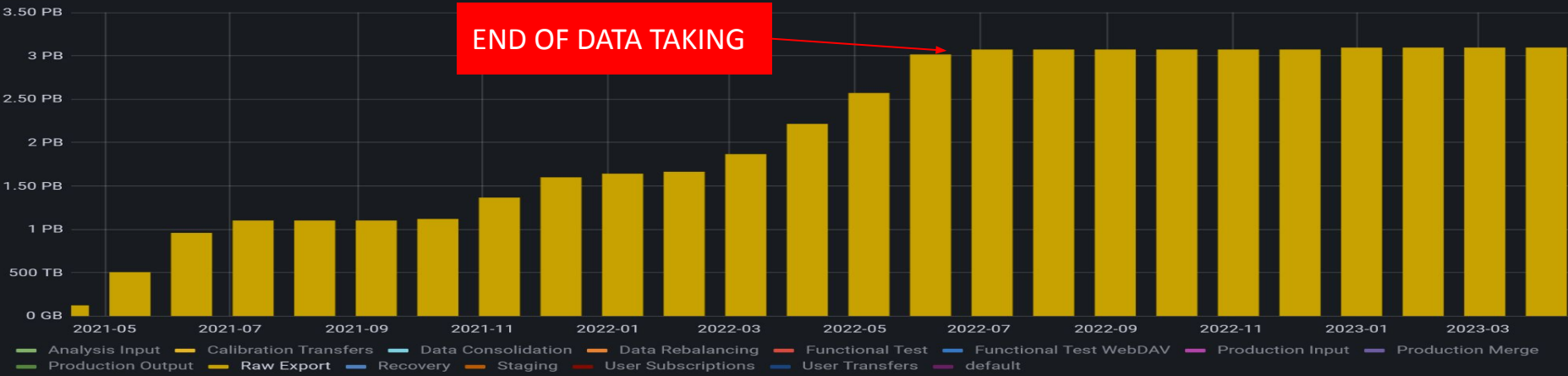
Successful transfers volume per activity (aggregation)

Transfer Volume in the last 24 months
Steady increase even after the end of data taking
Traffic sustained by Production/Merge



Successful transfers volume per activity (aggregation)

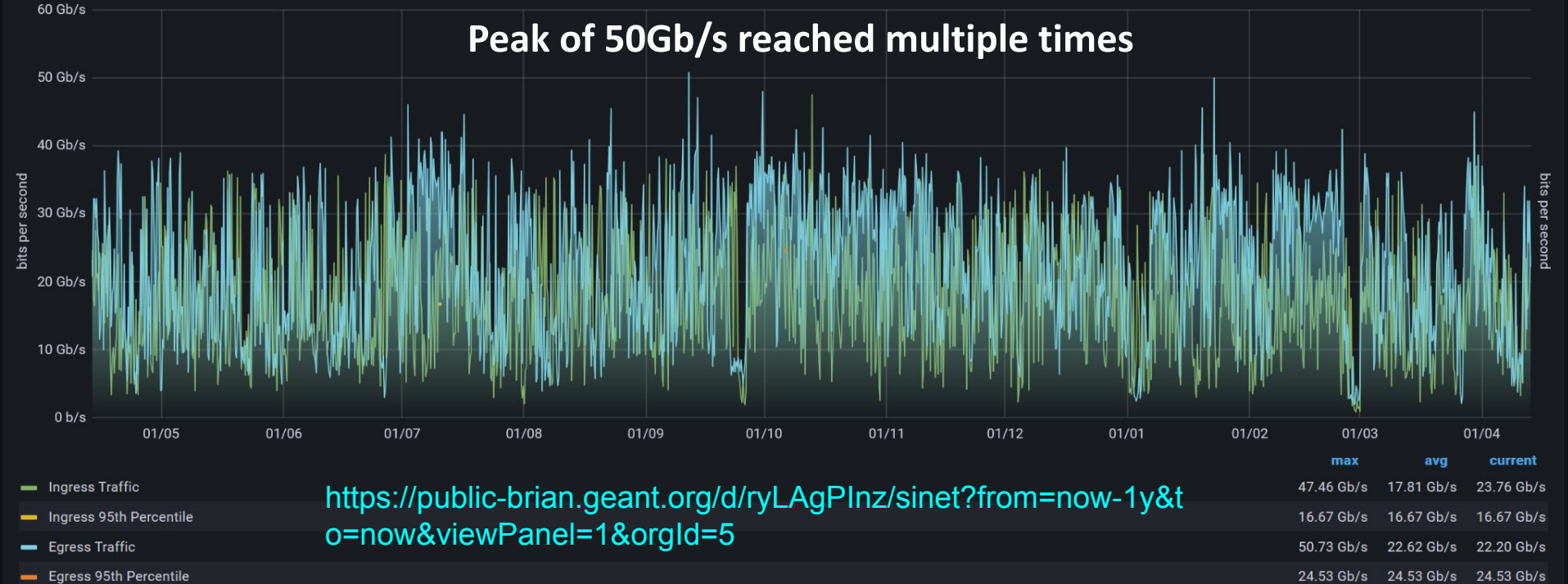
END OF DATA TAKING



SINET - GEANT Peering - last 12 months

mx1.ams.nl - traffic - ae20 - LAG RE_INTERCONNECT SINET SRF9946517 \$GA-01916 |

Peak of 50Gb/s reached multiple times



<https://public-brian.geant.org/d/ryLAGPlnz/sinet?from=now-1y&to=now&viewPanel=1&orgId=5>

Belle II Data Challenge 2024

What should be exercised during DC24:

Technology that can be stressed: Network, DDM, FTS, Storages, Monitoring System, Protocols, IAM

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)

Possible dates: We can be ready for March 2024. Let's coordinate how much we want to overlap HL-LHC test with Belle II.

Belle II ramp-up and constraint

Timeline for ramp-up challenges during 2023:

September/October - Early Tests

To Do: Prepare data set, setup DDM, Prepare Monitoring Tools

Conclusion

Belle II activities are going smoothly through the LHCONE and General-IP network.

Davs is now extensively used in our infrastructure for both data access and data transfers

Effort Token based authentication in testing.

Rucio Monitoring system allow a fine grain analysis of data flow.

Steady increase of transfer volume in the last 2 years. An additional speed-up is expected after the restart of data taking.

Preparation for Network Data Challenge 2024

BACKUP

Belle II Activities for packet marking

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Data Consolidation
 Data Rebalancing
 Functional Test
 Functional Test WebDAV
 Recovery
 Production Input
 Production Output
 Production Merge
 Analysis Input
 Analysis Output
 Staging
 Raw Export
 Upload/Download (Job)
 Upload/Download (User)
 User Merge
 User Transfers
 User Subscription
 T0 Tape
 T0 Export

We are interested to participate at packet marking activities (some of them used for test) activities.

Preliminary set of activities collected in the Draft of packet marking.

- Analysis Input
- Calibration Transfers
- Data Consolidation
- Data Rebalancing
- Functional Test
- Production Input
- Production Merge
- Production Output
- Raw Export
- Recovery
- Staging
- T0 Export
- T0 Tape
- User Merge
- User Subscriptions
- User Transfers
- default