



## SKA and LHC networks

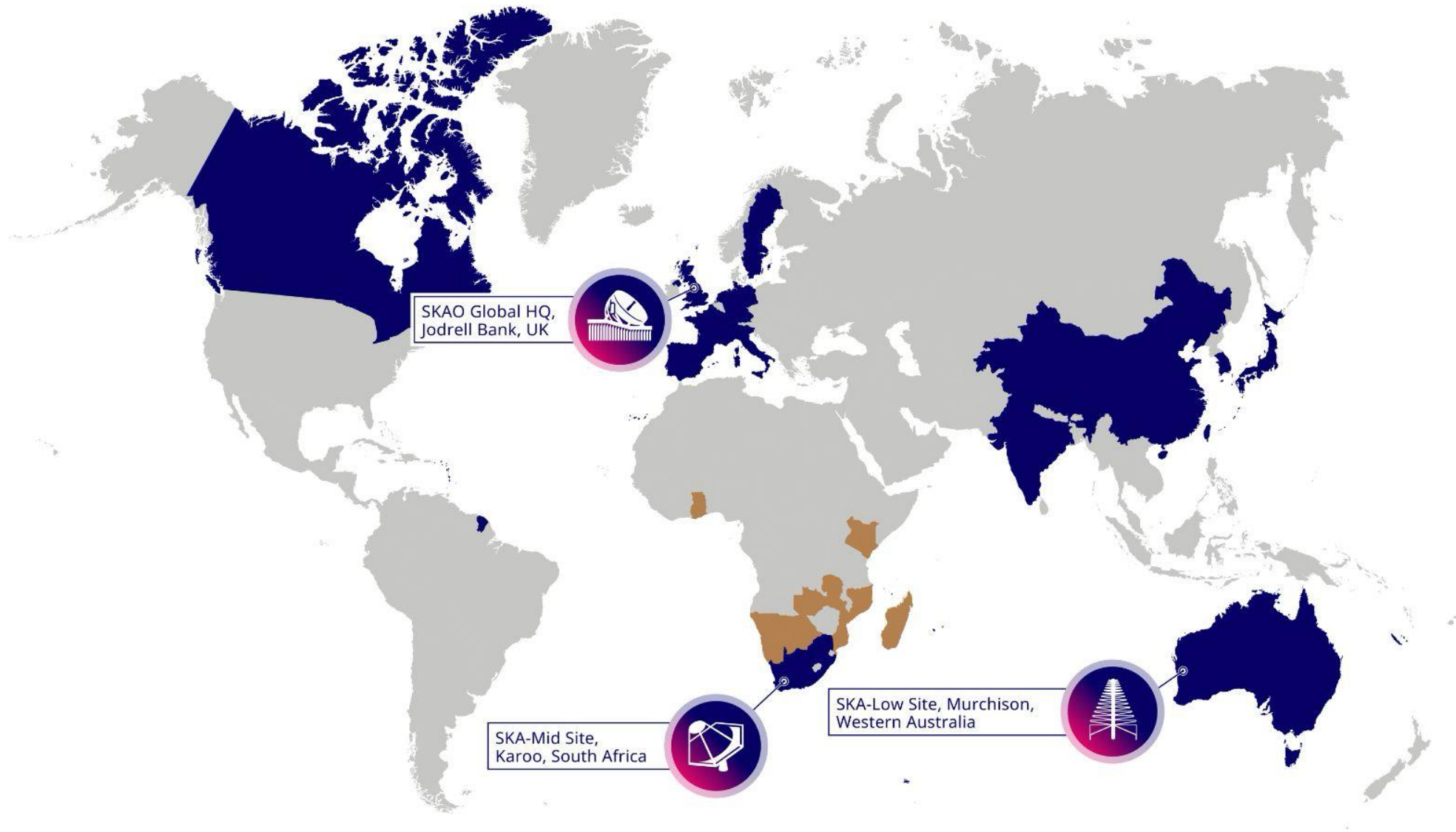
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Head of Research Engagement and Support  
GÉANT

APAN59 – GNA-G Meeting

Yokohama (JP), 4<sup>th</sup> March 2025

Public

**SKAO**



SKAO Partnership - includes SKAO Member States\* and SKAO Observers (as of April 2023)

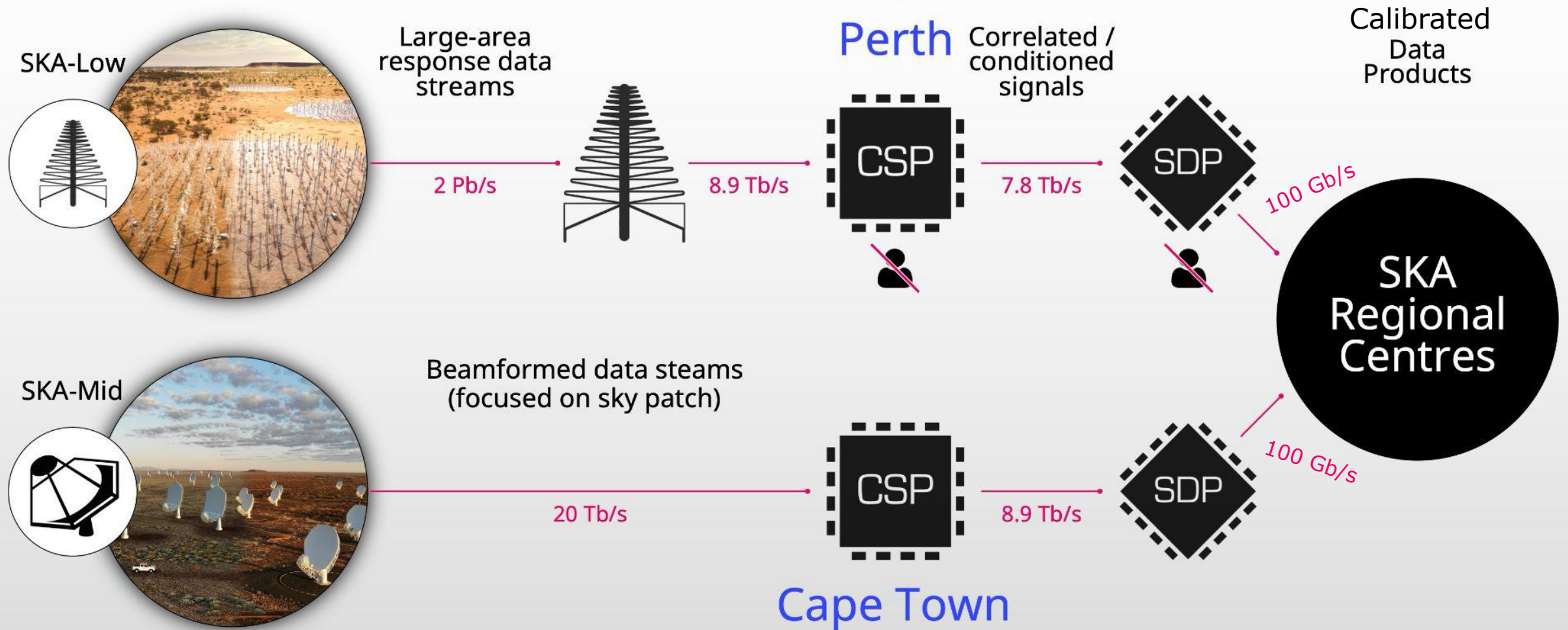


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African Partner Countries

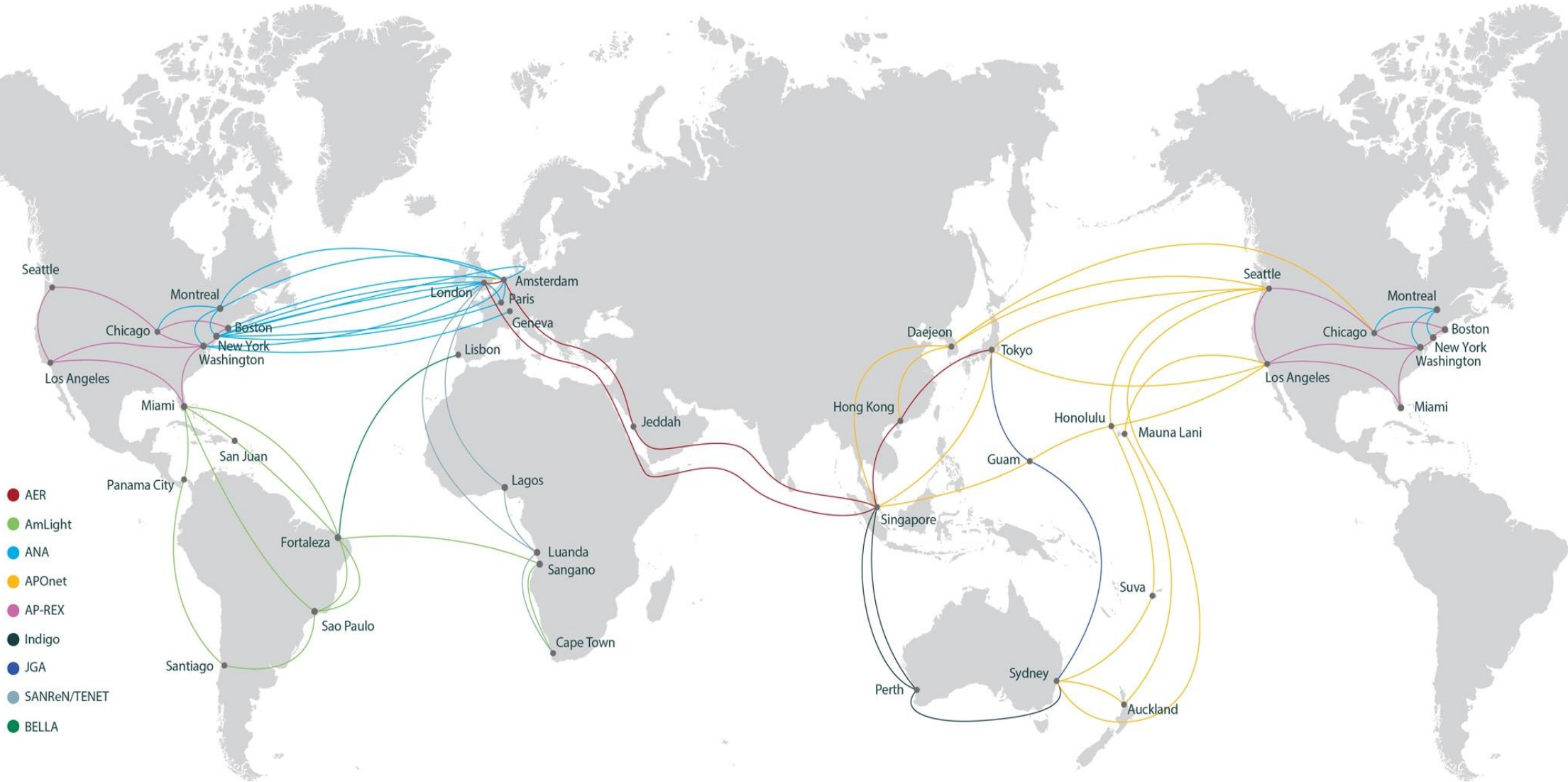


# SKA Regional Centres: SKAO data processing stages



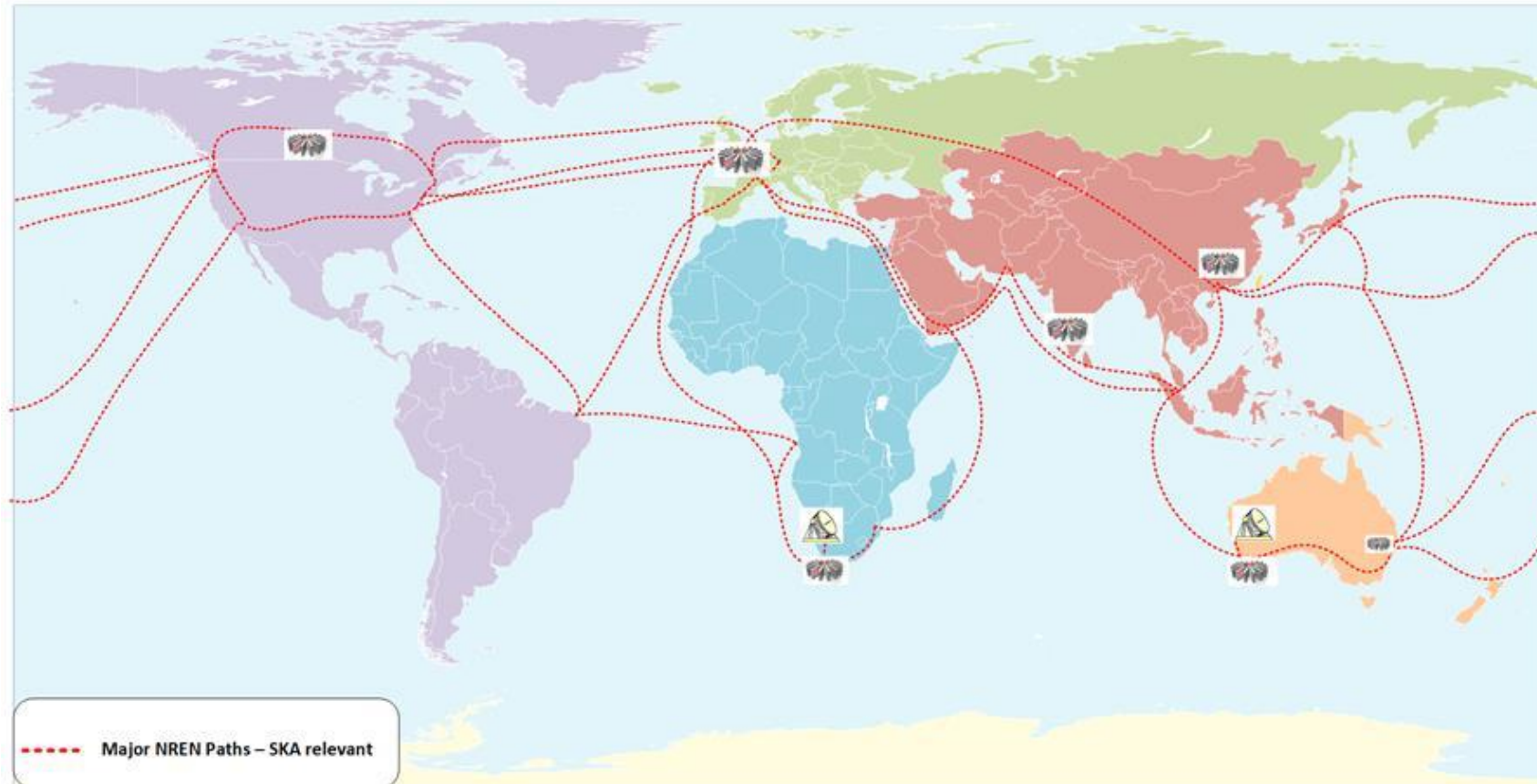


# Global Research and Education Networks



# Fibre and Cable Systems and major NREN paths

- The 2020 intercontinental fibre cable systems used by the international research and education community.
- Document produced for the SKA Regional Centres Coordination Group  
John Nicholls (AARNet) & Richard Hughes-Jones (GÉANT)



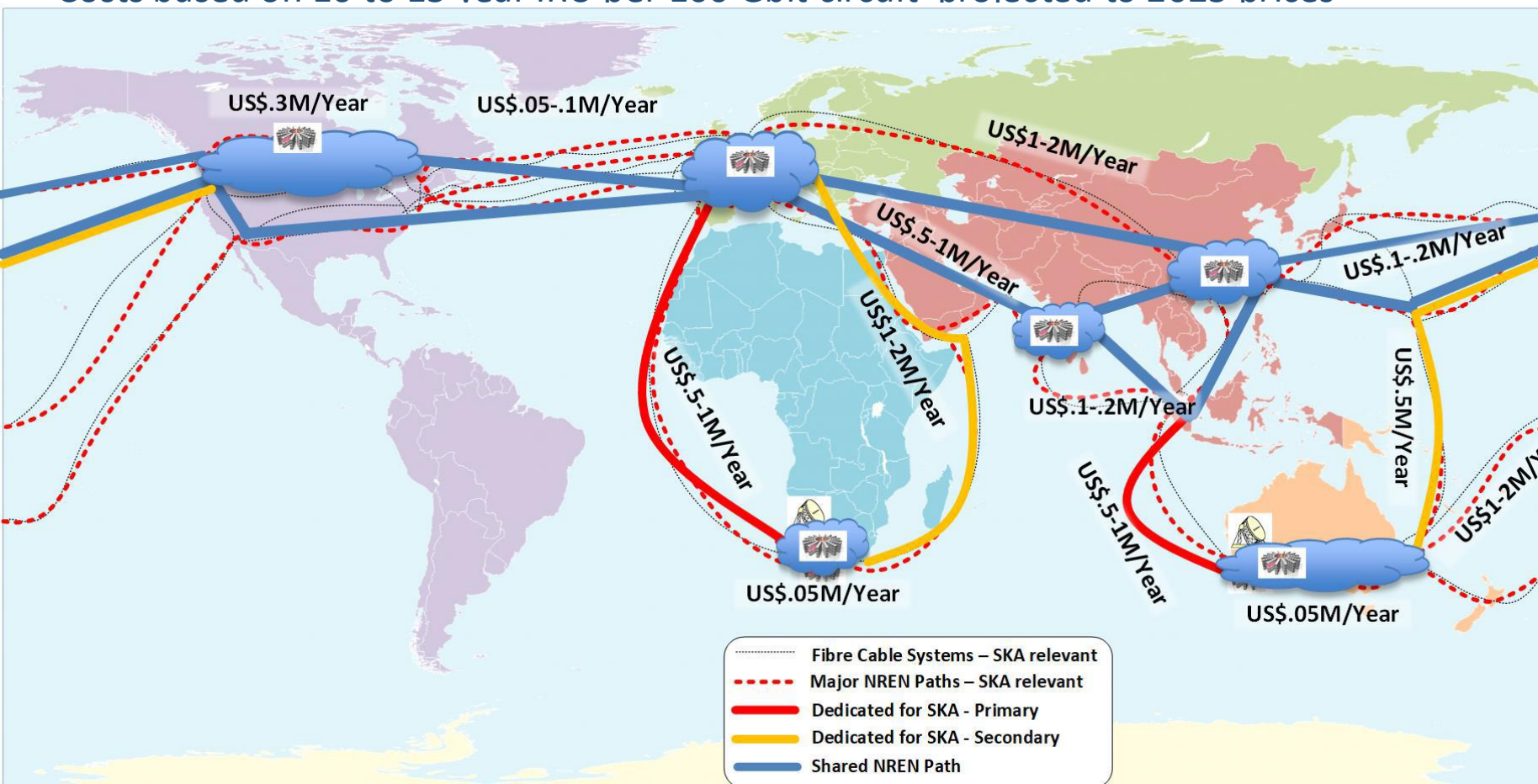
## GLOBAL AND NATIONAL NETWORK COSTS FOR SKA SCIENCE

Document Number ..... SKA-TEL-SKO-0001725  
 Document Type ..... MOD  
 Revision ..... 01  
 Author ..... Richard Hughes-Jones, John Nicholls  
 Date ..... 2020-09-22  
 Document Classification ..... UNRESTRICTED  
 Status ..... Released

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## Global Network & Paths of Interest to SKA

- Dedicated 100 Gigabit Primary paths (**red lines**) & Backup paths (**yellow lines**) from both telescopes
- Use of the academic network infrastructure shared between user communities (blue lines).
- 1 PetaByte/day pushed by SDP from each Telescope → 100 Gigabit/s for the Full Design
- Costs based on 10 to 15 year IRU per 100 Gbit circuit projected to 2025 prices



- Primary 100G bandwidth USD 1.7 – 2.3 M per year
- Backup 100G bandwidth USD 2.3 – 3.3 M per year When required
- SKAO agreed to funding the operational costs of these paths
- Funding for the shared network infrastructure follows that for other science communities (bottom-up cost model)

## Main Data Flows

- From the Telescopes to the SRCs for the 1st replica of Observatory Data Products (ODP).
  - Between SRCs to create the 2nd replica of the ODPs
  - Between SRCs to create a 2nd replica of the Advanced Data Products (ADP).
- 
- In terms of storage there will also be an archive copy of the ODPs and ADPs stored at the SRCs.

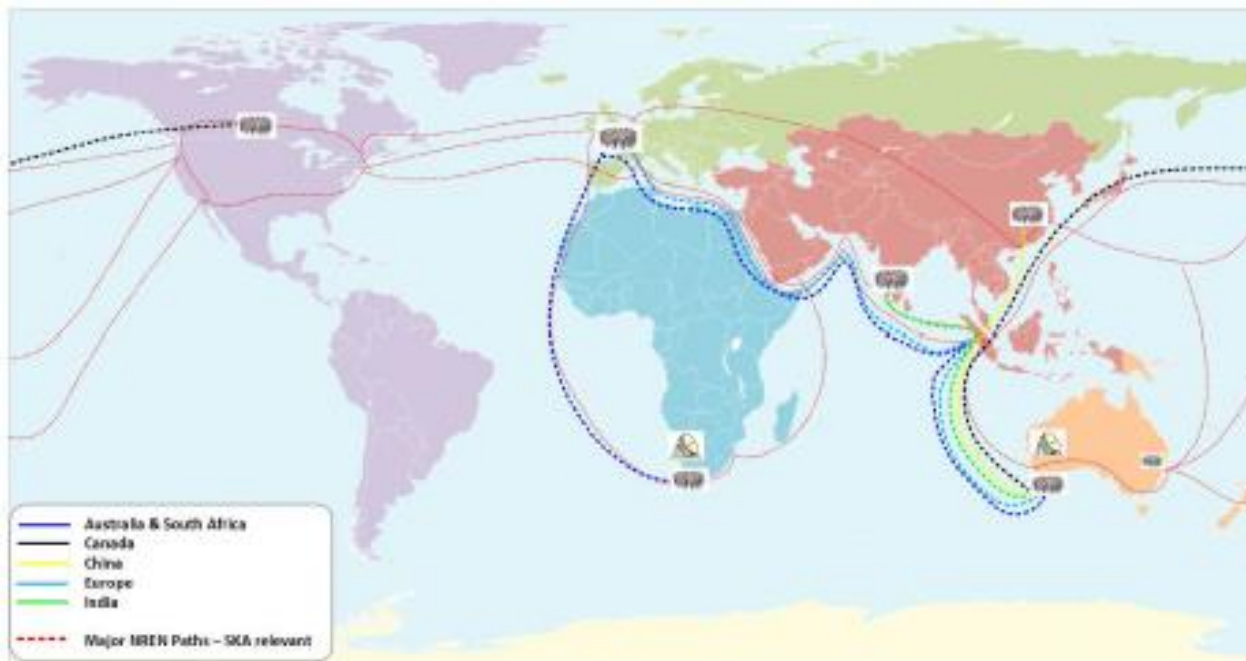


## Global Paths of the Data Flows Pushed to the SRC for the 1st Replica

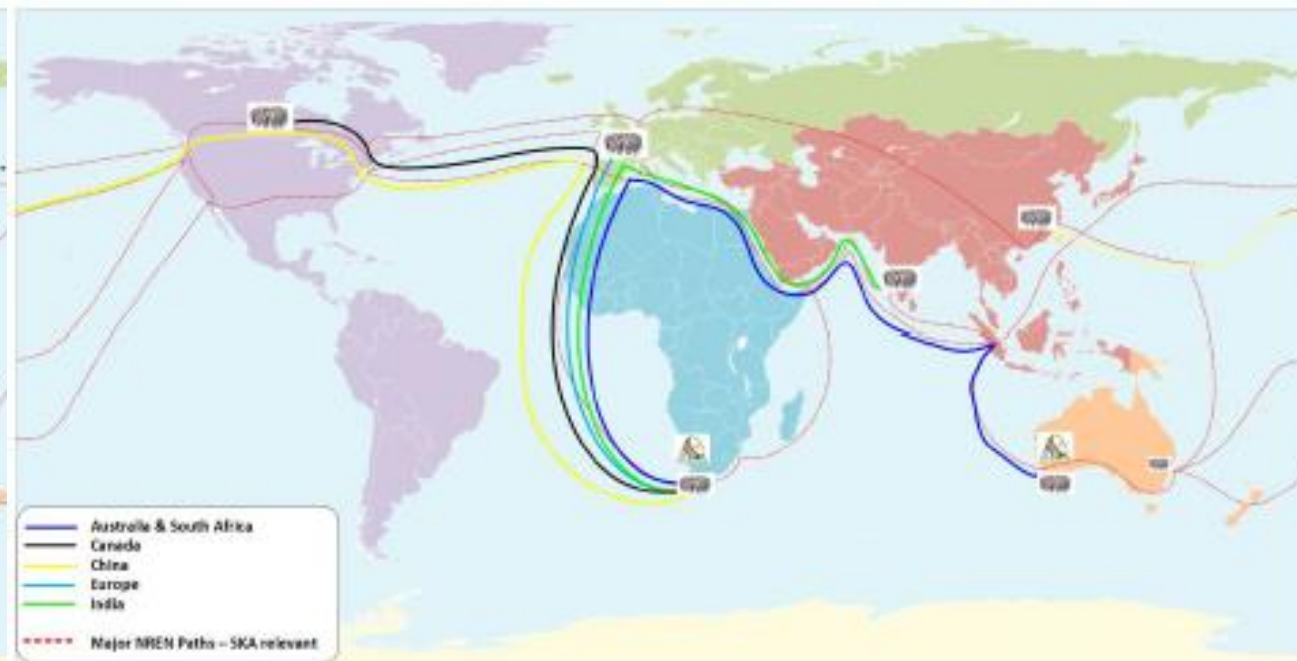
- Five flows on the submarine cable from Perth to Singapore
- Then join the general-purpose routed IP academic network
- Single flows on the routes to Canada, China and India, Australia is local, and two 20 Gbit/s flows would be carried to London to reach SRCs in Europe and South Africa

- Five flows on the submarine cable from Cape Town to London
- Then join the general-purpose routed IP academic network
- Different submarine cables used to reach India and Australia, Europe is local, and two 20 Gbit/s flows cross the Atlantic to SRC in Canada and China

### SKA1-LOW Australia



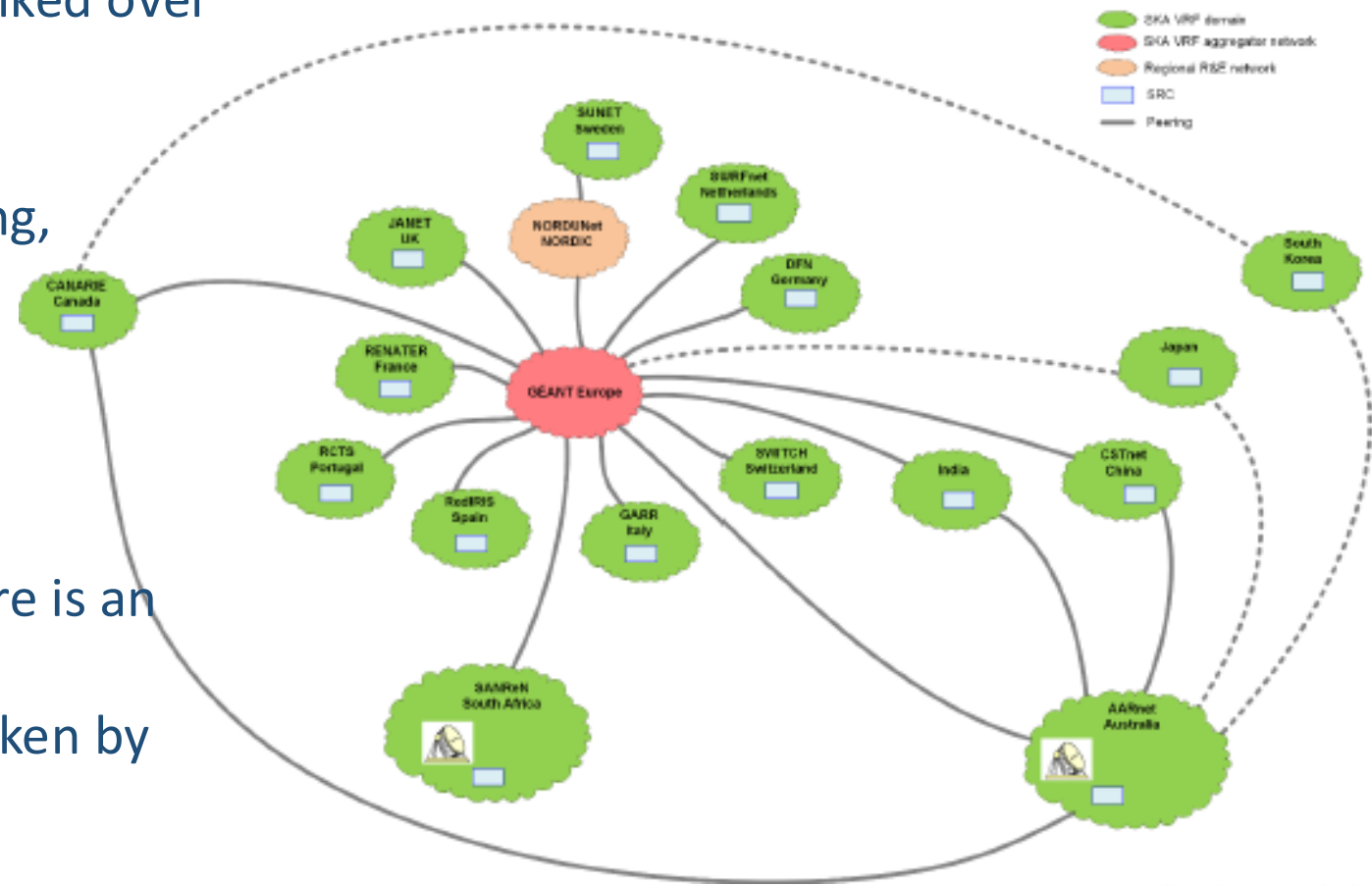
### SKA1-MID South Africa

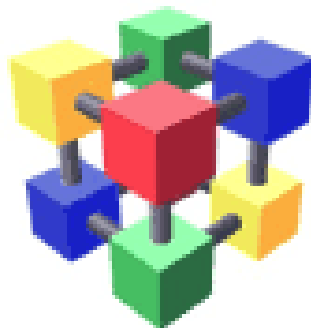




# Global Network Connectivity for SKA

- Global VRF based overlay with peering linked over the shared academic network
- Isolation of SKA traffic from other users
- Easier for NRENs to implement the routing, policies and monitoring
- SKA traffic can be engineered
- Use specific paths & routes
- Layer 3 VPN routing provides isolation
- Layer 3 will re-route traffic as long as there is an alternative network path
- Configuration actions have to be undertaken by the NREN and a Site to join the SKA VRF



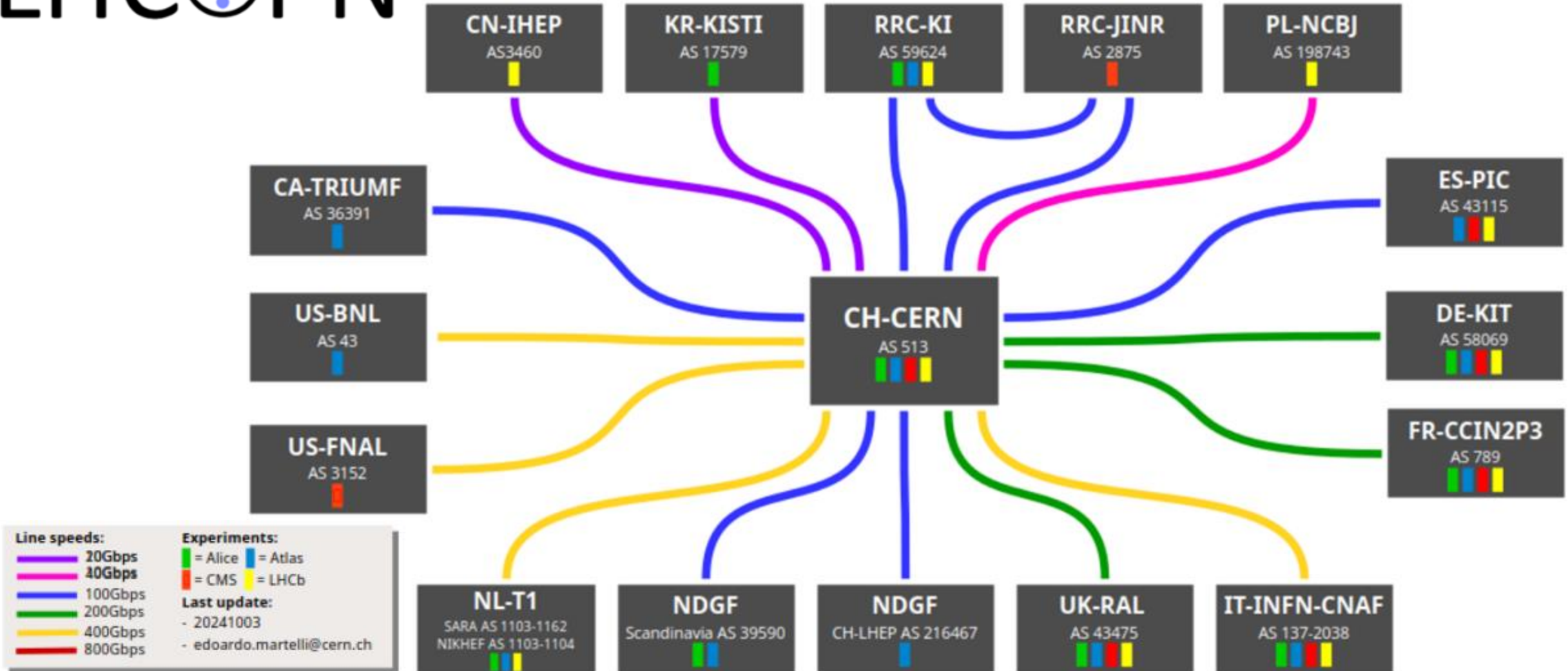


WLCG

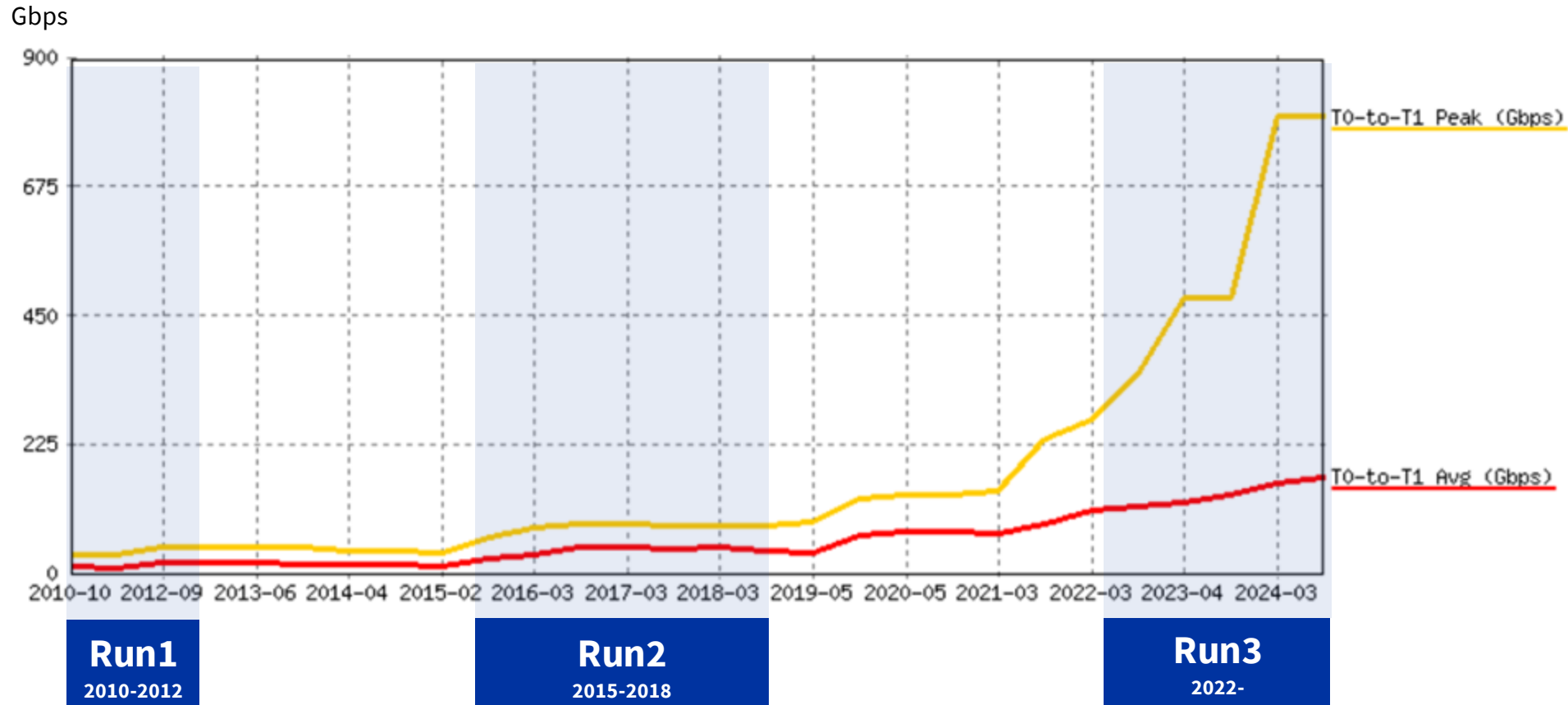
LHCOPN



# LHCOPN



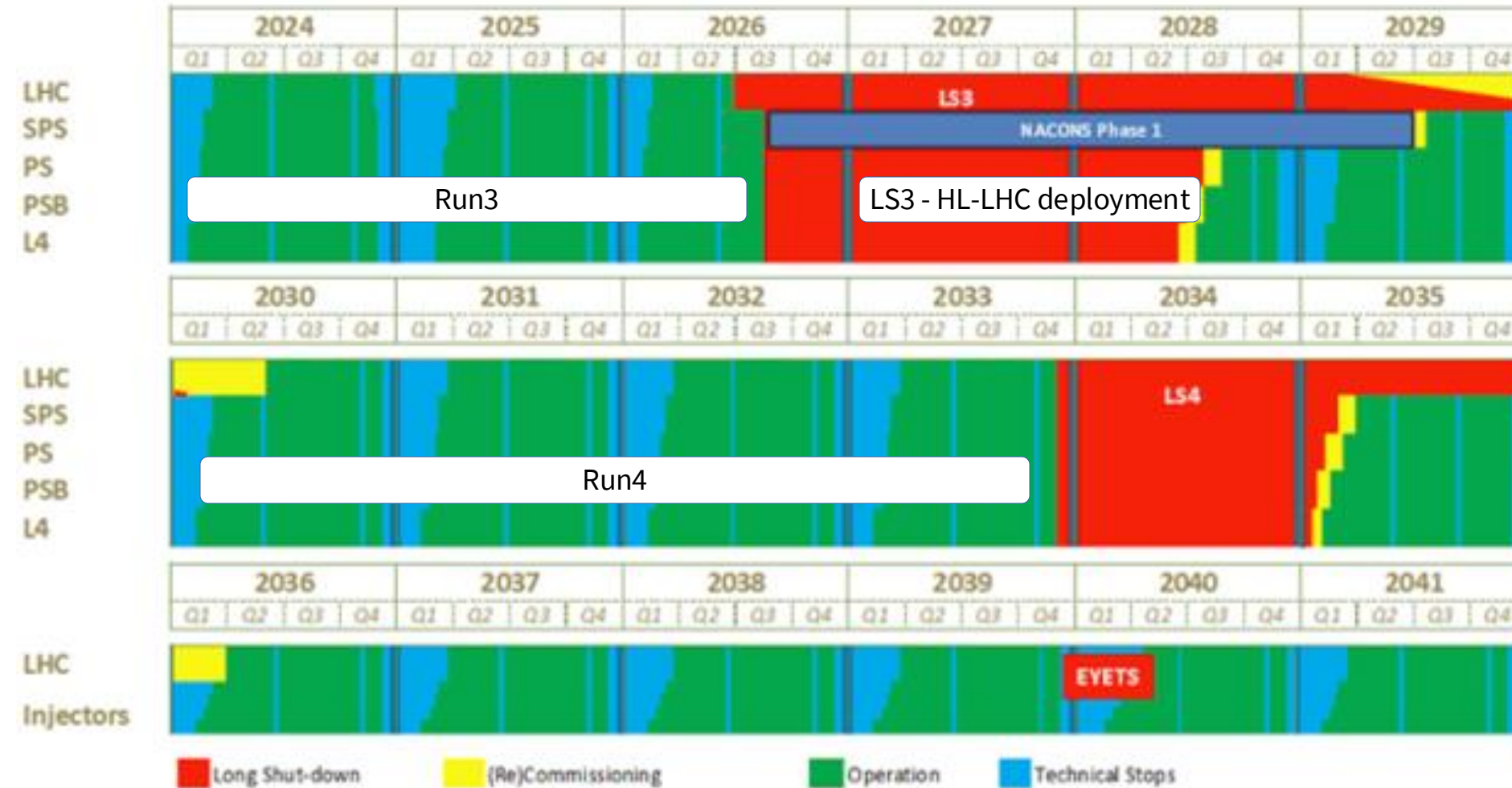
## LHCOPN: traffic growth



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



## Current LHC schedule



**LS3** now scheduled to begin July 2026, 8 months later than planned

High-Luminosity LHC (**Run4**) will start June 2030, 14 months later than planned

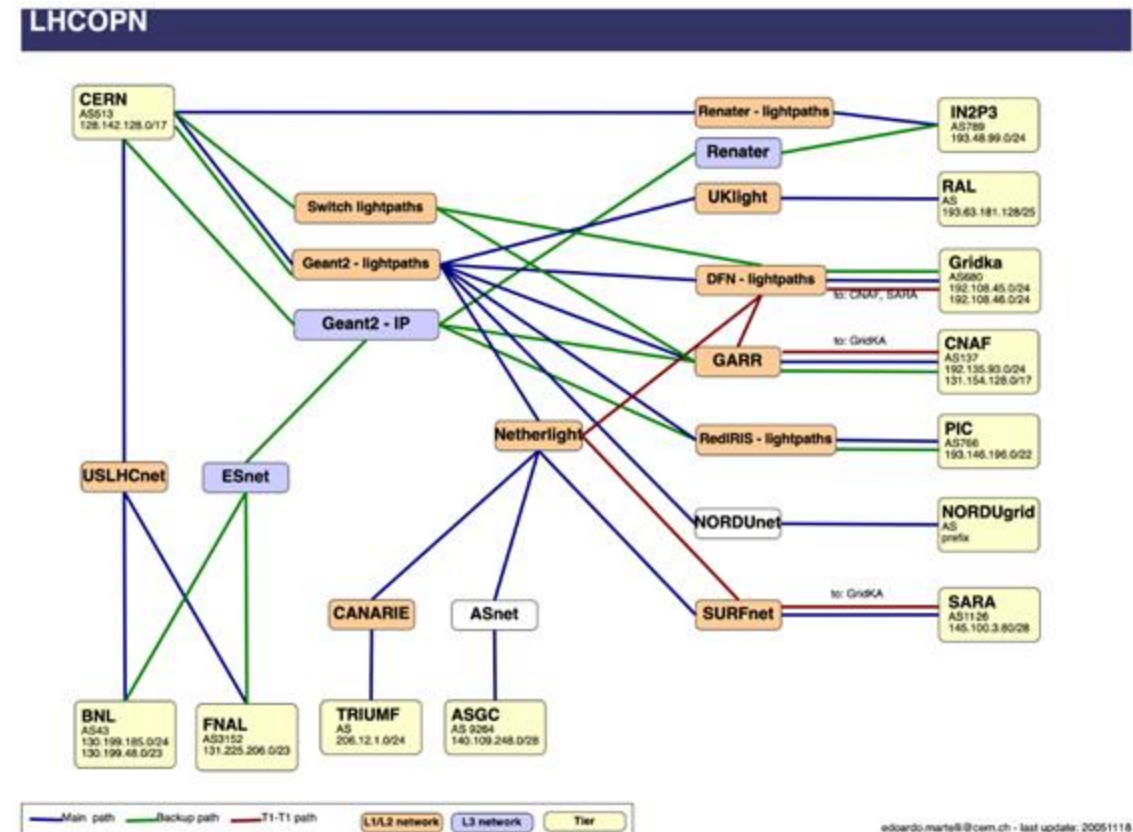
**LS4** is delayed one year



## Soon 20 years of LHCOPN

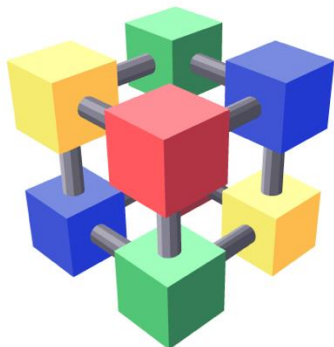
LHCOPN was started in 2005

Next year we should celebrate the  
**20<sup>th</sup> anniversary**





## Experiments supported



**WLCG**

Worldwide LHC Computing Grid



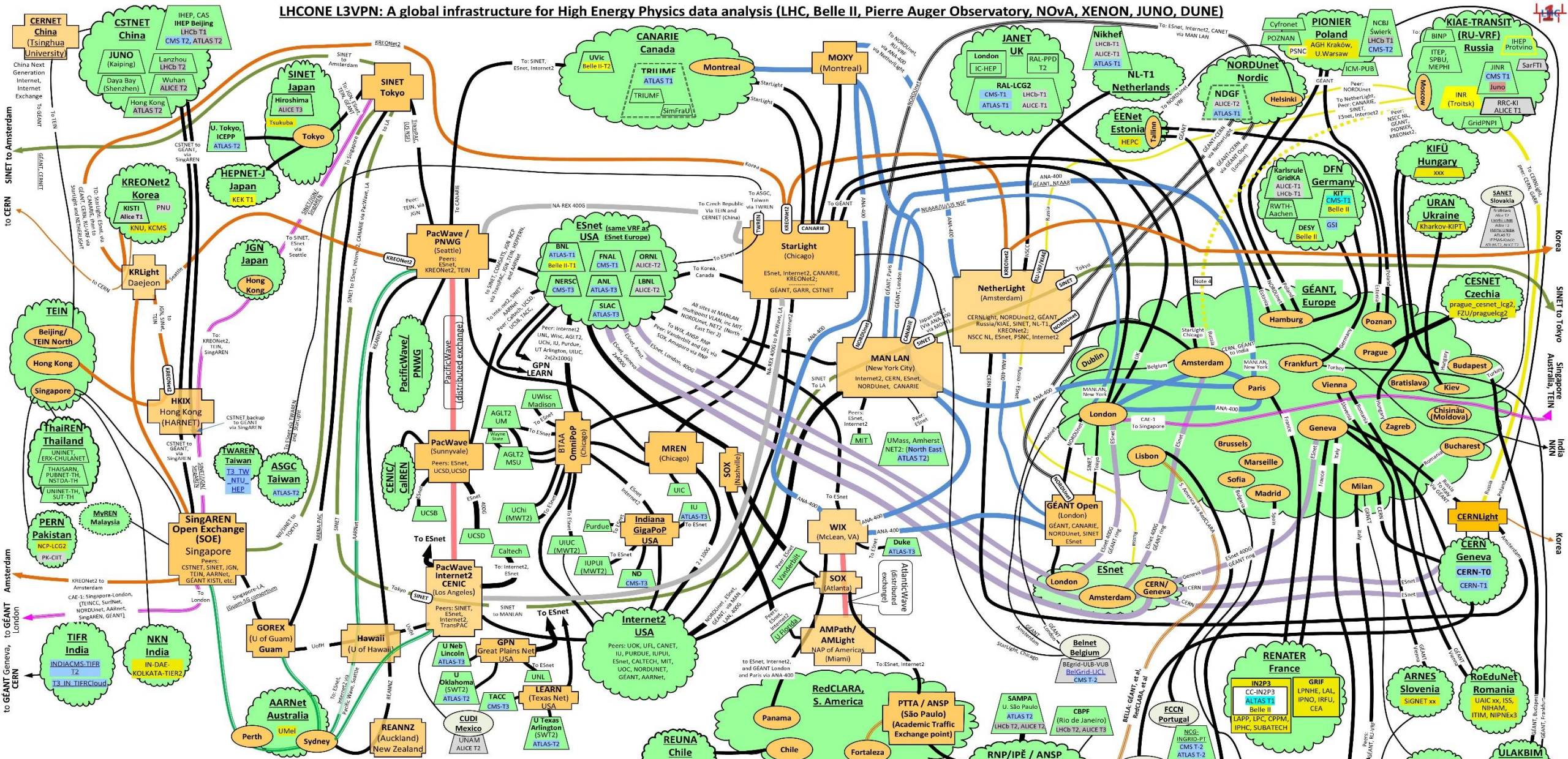
**ALICE**



# 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. 9.1, 2024-10-01 – WEJohnston, ESnet, wej@es.net**

- Exchange point** (Orange square)
- WLCG sites that are not connected to LHCONE** (Grey square)
- Provider network PoP router** (Yellow circle)
- Connector network or institution – provides, e.g., an L2 path between VRFs.** (Green circle)
- LHCONE VRF domain/aggregator – A provider network** (Green circle)
- GARR** (Green circle)

**International infrastructure by provider/collaboration**

- various** (Black line)
- AARNet** (Green line)
- GÉANT** (Blue line)
- SINET, Japan, global ring** (Purple line)
- NA-REX** (Red line)
- ESnet transatlantic, USA** (Orange line)
- SINET/JGN/ SingAREN** (Pink line)
- NREN/SITE router at exchange point** (Green line)
- Communication links: <100G=1.5pt, 100G=4pt, 200G=5pt, 400G=6pt, 800G=7.5pt** (Green line)
- NORDUnet** (Blue line)
- KIAE, Russia** (Yellow line)
- KREONet2, Korea** (Orange line)
- BELLA: GÉANT, et al** (Red line)
- REUNet, IU/NSF** (Green line)

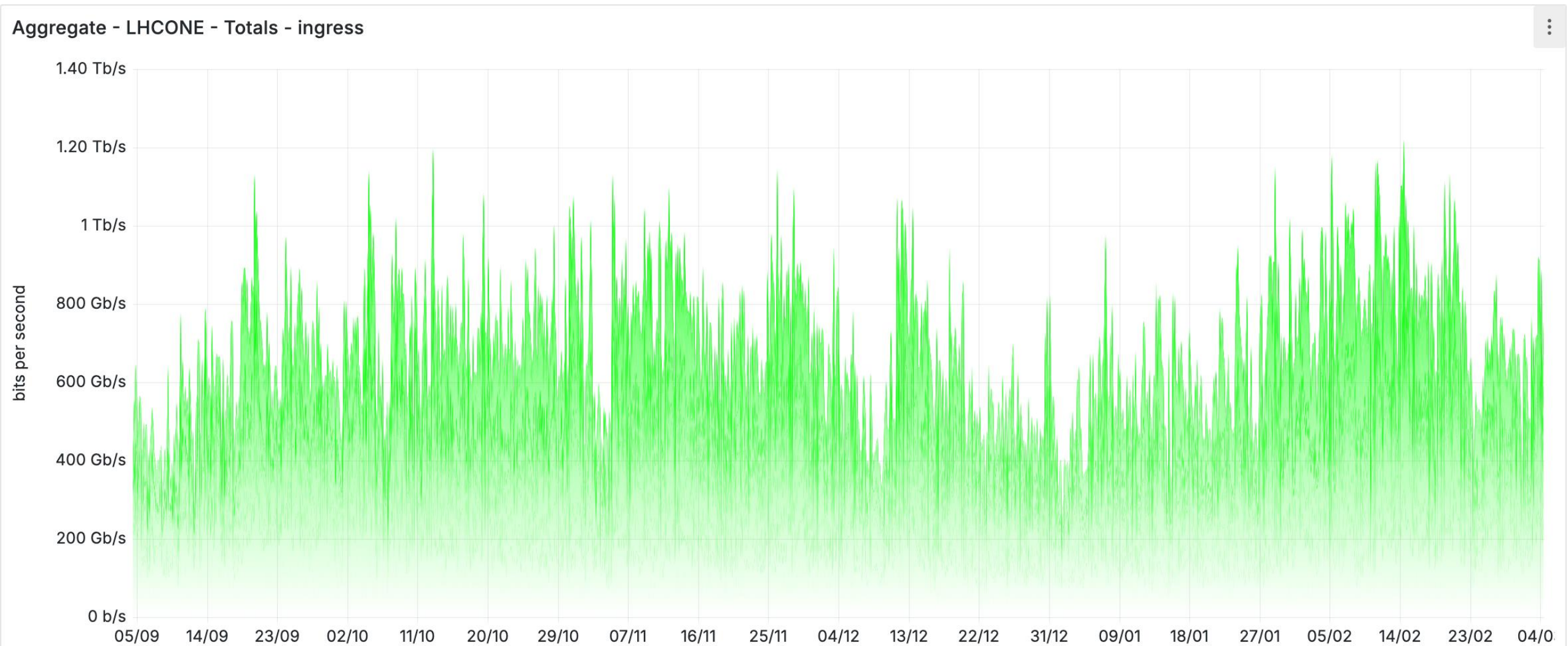
**Site types and VRFs**

- LHCb-T1** (Green circle): LHC ALICE or LHCb site
- CNAF-T1** (Blue circle): LHC Tier 1 ATLAS and CMS
- Uchi** (Green circle): LHC Tier 2/3 ATLAS and CMS
- KEK** (Yellow circle): Belle II Tier 1/2
- JUNO** (Purple circle): JUNO
- UNL** (Green circle): 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.dicobox.com/sh/mad/0f58101raz/AA0s85K8f5H9FhCl4d4Ctes2dl=0>
- GÉANT and CANARIE have shutdown the peering between their VRF and KIAE, as a result of the Ukraine war.

## Total LHCONE traffic on GÉANT (last 6 months)




## Upcoming:



# LHCOPN-LHCONE meeting #54 - Manchester, Jodrell Bank - UK



 18 Mar 2025, 09:30 → 20 Mar 2025, 14:00 Europe/London

 Edoardo Martelli (CERN)

**Description** The meeting will be in person, with the possibility to join remotely.

Refreshments and local transportation are kindly sponsored by **JISC** and **UK SKA Regional Centre**

### Venues:

- **on Tuesday and Thursday:** [Jodrell Bank Centre for Astrophysics, The Alan Turing Building, Department of Physics and Astronomy, Oxford Road, The University of Manchester, M13 9PL, UK.](#) More information [here](#)
- **on Wednesday:** [SKA Observatory, Jodrell Bank, Lower Withington, Macclesfield, Cheshire, SK11 9FT, UK](#)

### ETAs

- The UK is transitioning to requiring Electronic Travel Authorisations (ETAs) for most visitors who do not require visas. Details of who needs and ETA and can apply - and how to apply - are available [here](#):
  - <https://www.gov.uk/guidance/check-when-you-can-get-an-electronic-travel-authorisation-eta>





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Any questions?

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As part of the GÉANT 2020 Framework Partnership Agreement (FPA), the project receives funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 856726 (GN4-3).