



EIC Networking: LHCONE

An ESnet Perspective



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EICO Technical Forum
Virtual
29 September 2026

Origins of LHCONE

- Over time, the computing model of the LHC experiments outgrew the strict hierarchy of the original MONARC design for data distribution and analysis
- Increased data volumes and increased computing needs required higher data transfer rates
 - Achieving the necessary performance was difficult
 - Targeted engineering solution was explored
- The community came together and built an overlay network, running on top of the R&E/NREN infrastructure, specifically for LHC use
 - Built to support LHC data distribution and analysis
 - Only LHC sites were allowed

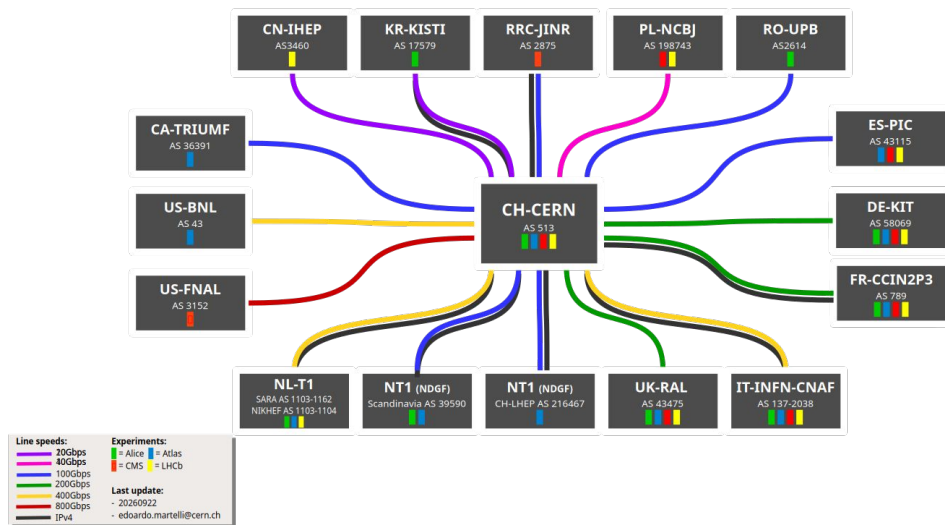
LHCOPN vs. LHCONE

- The LHC has two purpose-built networks
 - LHC Optical Private Network - LHCOPN
 - LHC Open Network Environment - LHCONE
 - Each of these has its own purpose
- LHCOPN: CERN to Tier1
 - Guaranteed bandwidth from CERN to Tier1
 - No significant resource sharing - dedicated infrastructure
- LHCONE: CERN, Tier1, Tier2
 - Purpose-built for many to many communication within LHC
 - This talk focuses on LHCONE
 - LHCOPN is described here for contrast

LHC Optical Private Network (LHCOPN)

- Deterministic
- Redundant
- Different countries implement their portion differently
- ESnet uses OSCARS circuits
 - Primary, secondary, tertiary
 - Highly reliable design
- Point to point between CERN and Tier1 sites

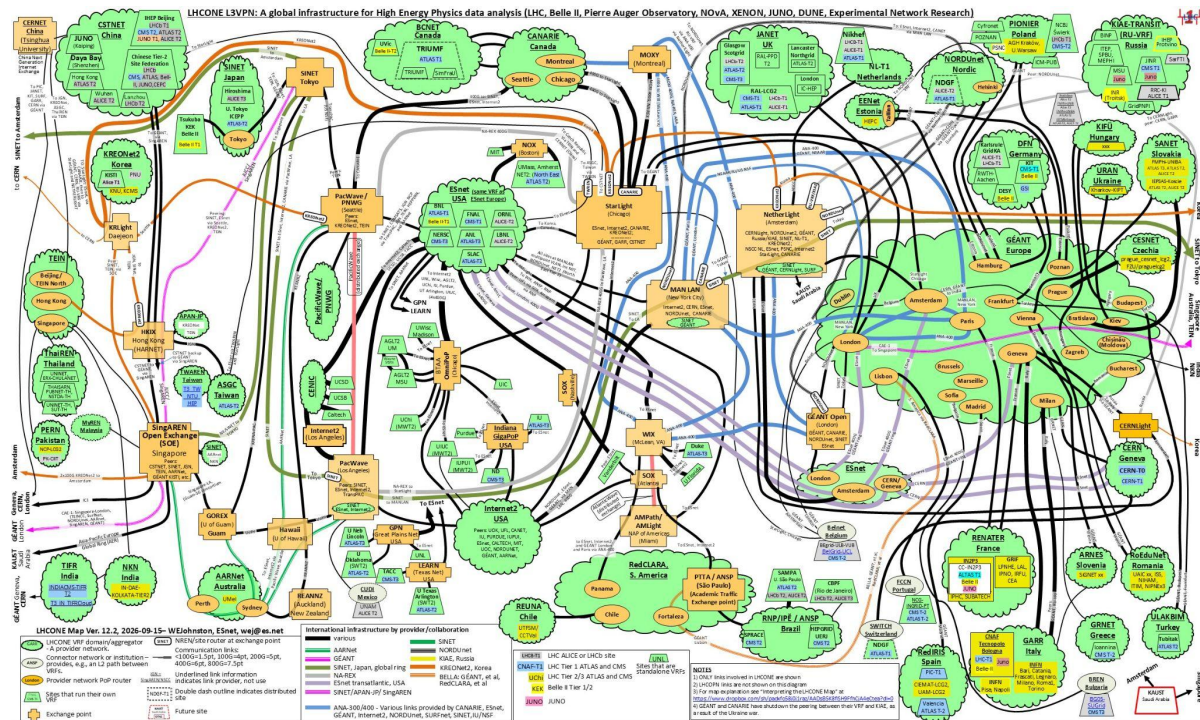
LHCOPN



Map: Edoardo Martelli, CERN

LHC Open Network Environment (LHCONE)

- Tier1 to Tier2 connectivity, including CERN
- Implemented as a Layer3 overlay network
- Many to many connectivity
- Important for the community in several ways



Map: William Johnston, ESnet

Value of LHCONE

- LHCONE is valuable in several ways
 - Performance
 - Security
 - Sociology and Collaboration
 - Funding
 - Different sites find different aspects valuable, but all are valuable within the collaboration as a whole
- Performance
 - LHCONE connection is specifically configured at the site
 - Dedicated network path for WLCG resources
 - Effectively moves the site into the Science DMZ model*

Value of LHCONE (2)

- Security
 - Only LHC/WLCG sites are present in the network overlay
 - Reduces cybersecurity risk aperture
 - Filter based on LHCONE prefixes
 - Reduces exposure to other LHC sites rather than whole Internet
- Sociology and Collaboration
 - Many WLCG groups are small compared to their institution, and have limited control over how “Central IT” operates
 - LHCONE provides a large, significant, international entity that the site can join, with benefits to the site
 - This gives physics groups improved ability to negotiate with IT staff for resources
- Funding
 - In some cases, specific network circuits, paths, or bandwidth is funded with physics-specific money
 - Some NRENs use LHCONE for traffic engineering to place physics traffic on network paths paid for by physics money

Value of LHCONE (3)

- Each of the aspects of LHCONE is valuable to at least some of the LHC sites
- As a whole, LHCONE benefits the LHC experiments as a whole, even though individual sites may only benefit from some aspects of the whole
- This is not without cost - it took a lot of effort to put LHCONE together, and maintaining it takes ongoing effort
 - LHC community gets out more than they put in
 - Difficult to get benefits any other way

LHCONE Evolution: Adding Collaborations

- LHCONE functions as a “mini-Internet” for LHC sites
 - IP address space of LHC sites in the LHCONE routing table
 - No other addresses in the LHCONE routing table
 - **LHCONE path is preferred by LHC computing resources**
- Many LHC sites also support non-LHC collaborations on the same computing resources
 - Grid allows resource sharing
 - Job schedulers are not aware of routing policy
 - All computing resources in LHCONE address space exchange data via LHCONE, regardless of which collaboration “owns” the job
- Early example: Belle-II
- Far easier to formally add these collaborations to LHCONE than to exclude them, or build another overlay for them

Many EIC Sites Already On LHCONE

<u>EIC Site (some errors/omissions in this list)</u>	<u>LHCONE Connected?</u>
ASGC (TW)	Yes
BNL (US)	Yes
Digital Research Alliance Canada (CA)	Yes?
IN2P3 (FR)	Yes
INFN-CNAF (IT)	Yes
JLAB (US)	No (*)
Osaka University (JP)	Yes
RIKEN (JP)	???
University of Manitoba (CA)	No
University of Tokyo (JP)	Yes



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Thanks!



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