



ESnet

ENERGY SCIENCES NETWORK

ESnet Updates and Planning

Dale W. Carder

ESnet Network Engineering

Lawrence Berkeley National Laboratory

ATLAS meeting

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Agenda

- ESnet Overview
- ESnet6 project updates
- Trans-atlantic Connectivity
- Ramp up to HL-LHC
- Data Challenge 1 lessons
- Engagement & Planning Process

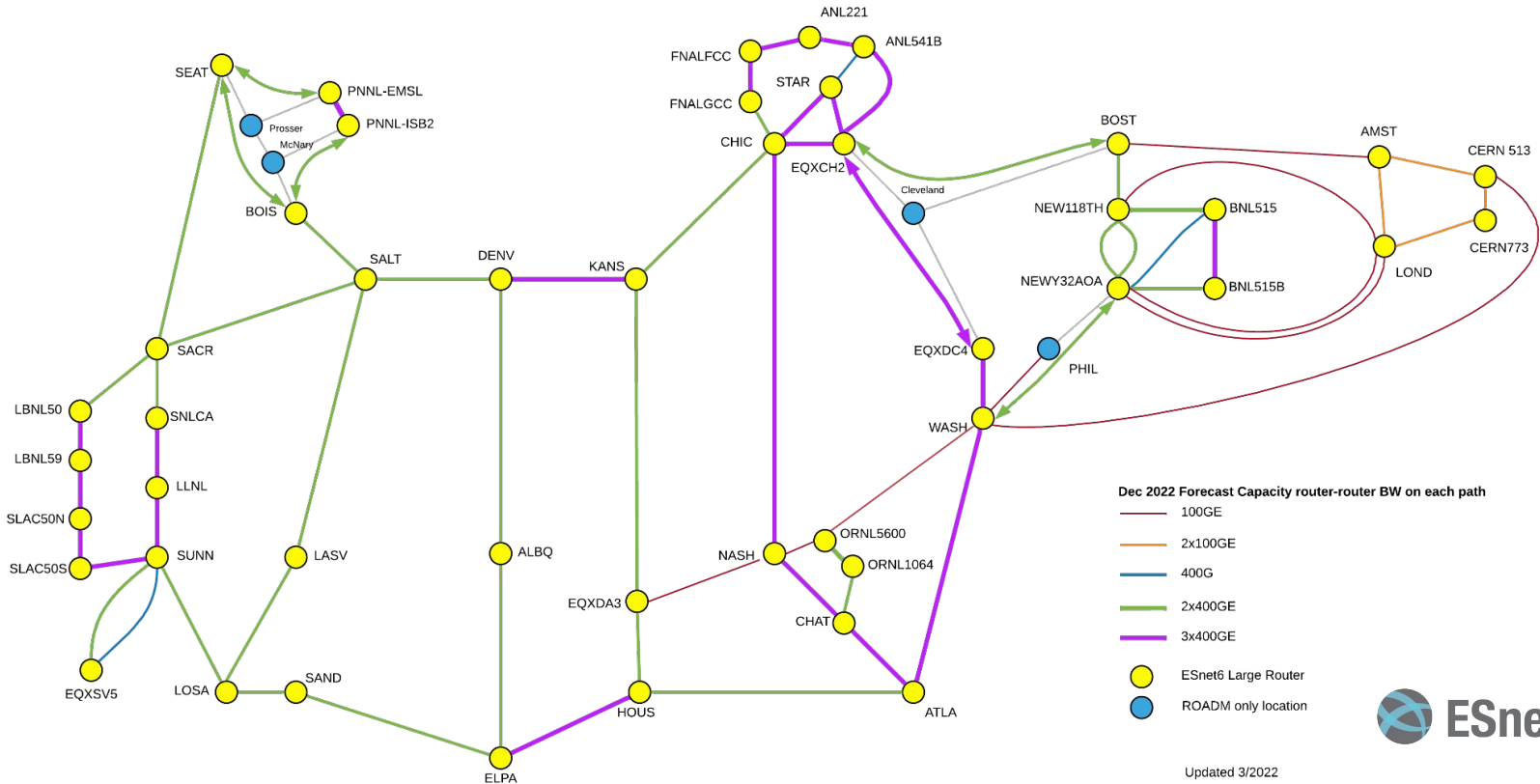
ESnet Overview & Activities

- "User Facility" charged with supporting DOE mission needs
 - ESnet6 network is the backbone of DOE and large scale science
- Engagement with HEP / ATLAS
 - LHCOPN and LHCONE networks
 - Published [2020 HEP Requirements Report](#)
 - Finishing ESnet6 project
 - Planning process for both near-term and HL-LHC programs
 - R&D activities
 - SciTags, Caching, SENSE, integration w/ RUCIO/FTS, etc
 - FABRIC and ESnet tesdbeds

ESnet6 Updates

- All LHCOPN and LHCONE connections in North America on new ESnet6 routers
 - EU upgrades late summer / fall
- n*400G backbone links
- Updated QOS policies
- Testing SciTags and new L2 Flow data metrics
- Fully-automated provisioning

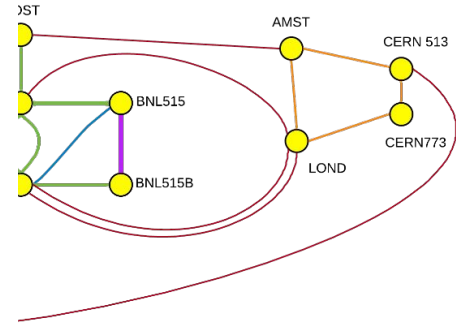
December 2022 Target Backbone Capacity



Updated 3/2022

ESnet Transatlantic paths

- Currently 4x100G
+ 100G NEA3R (NSF IRNC)
- ESnet making **significant** acquisitions of transatlantic capacity
- Unfathomable lead-times, measured in years
- Multiple paths necessary for capacity and resilience.
- Plans only made public as sensitive procurements progress.
- In most (all?) cases, partnering with other R&E networks



ESnet's first 400G Transatlantic additions

- Spectrum on Amitié cable system
- Expected initial provisioning
 - 400G Boston-London
 - 400G Boston-Bordeaux
 - early 2023 ?
- Terrestrial builds & upgrades will be required
- Internet2/CANARIE also partnering on this cable



Preparation for High-Luminosity LHC (2029)

- Current projections:
 - 400G connectivity needed per T2
 - note: there are (4) T2's connected *just in Chicago*
 - Needs likely driven by storage, w/ tradeoffs on placement.
 - ~5-12 PB typical now, possibly 20-40 PB per site in 2029?
 - in-network caches?
- Data Challenges (full software stack)
 - 10% of the target 2021 # should match Run 3
 - 30% in 2023 # 2x100 should be ok
 - 60% in 2025 # probably want 400G
 - 100% in 2027 # 400G or more
 - ... **schedule so far has not been changed to 2029**

Data Challenge 1: Huge Win

- Last LHCONe meeting described many successes of DC1
- Operational highlights going forward
 - Load balancing needs some engineering work
 - Multiple cases of saturation or close-to-saturation on paths
 - Some in ESnet
 - Some in other networks
 - ***100G Connectivity will be inadequate***
- Network upgrades are a focus of conversations for both Run 3 & 4

Distributed Networks

- Interconnection between multiple networks
 - Trans-continent, national, regional, campus,
 - LHCONe traverses many disparate parties, glued together by ESnet
- In order to prepare for increased load, multiple parties need to plan together:
 - Funding agencies
 - ESnet
 - Exchange points, like OmniPoP
 - Regional providers, like LEARN
 - Campus / Research IT
 - PI's and Staff

Exchange Points and LHCONE: By The Numbers

Aggregator	number	existing connectivity	2021 Flex	2021 Min	2023 Flex	2023 Min	2025 Flex	2025 Min	2027 Flex	2027 Min
ESnet	7	n/a								
OmniPoP	7	2x100 + 2x100	160	80	480	240	960	480	1600	800
MANLAN	1	100	40	20	120	60	240	120	400	200
LEARN	2	100	50	25	150	75	300	150	500	250
GPN	2	100	40	20	120	60	240	120	400	200
WIX	1	100	10	5	30	15	60	30	100	50
SOX	2	100	80	40	240	120	480	240	800	400
CENIC	3	100	90	45	270	135	540	270	900	450

- Significant number of exchange point interfaces need upgrades
- Multi-party effort to get this done end to end
- Huge lead times for infrastructure
- We need to start now!

ESnet Engagement Activities

- ESnet making the rounds talking to *every* T2 site
- Gathering and helping synchronize plans from
 - Individual PI's
 - Departmental Support Staff
 - Campus IT
 - Regional Networks
 - R&E Exchange points
- Near-term upgrades for Run 3
 - n*100G
- HL-LHC era
 - 400G +

Outyear planning

- Consider not just *your* components involved to meet the expectations for large scale science.
- ESnet is trying to get the word out ahead of budgeting & planning,
 - in multiple forums
 - and funding agencies
- Lead times for Infrastructure investments are large
- Give your campus CIO and Provost a heads-up now, and continuously engage for investments through 2029.
- Engage w/ NSF and DOE in support of R&D efforts