ESnet
ENERGY SCIENCES NETWORK

# ESnet Status Update

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SA3CC - Virtual meeting

August 2023

U.S. DEPARTMENT OF ENERGY
Office of Science

BERKELEY LAB

# Agenda - 2023 Ideas

- **Quick overview of ESnet**
- Automation
- Monitoring
- Trans Atlantic Plans
- ESnet portion of Rubin LHN
- Questions

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# ESnet: DOE's High Performance Network (HPN) Scientific User Facility and derives its mission from Office of Science



***Mission of DOE Office of Science:***
...delivery of scientific discoveries and major scientific tools to transform our understanding of nature...

***Mission of Energy Sciences Network:***
*Science network user facility* designed to **accelerate** scientific research and discovery.

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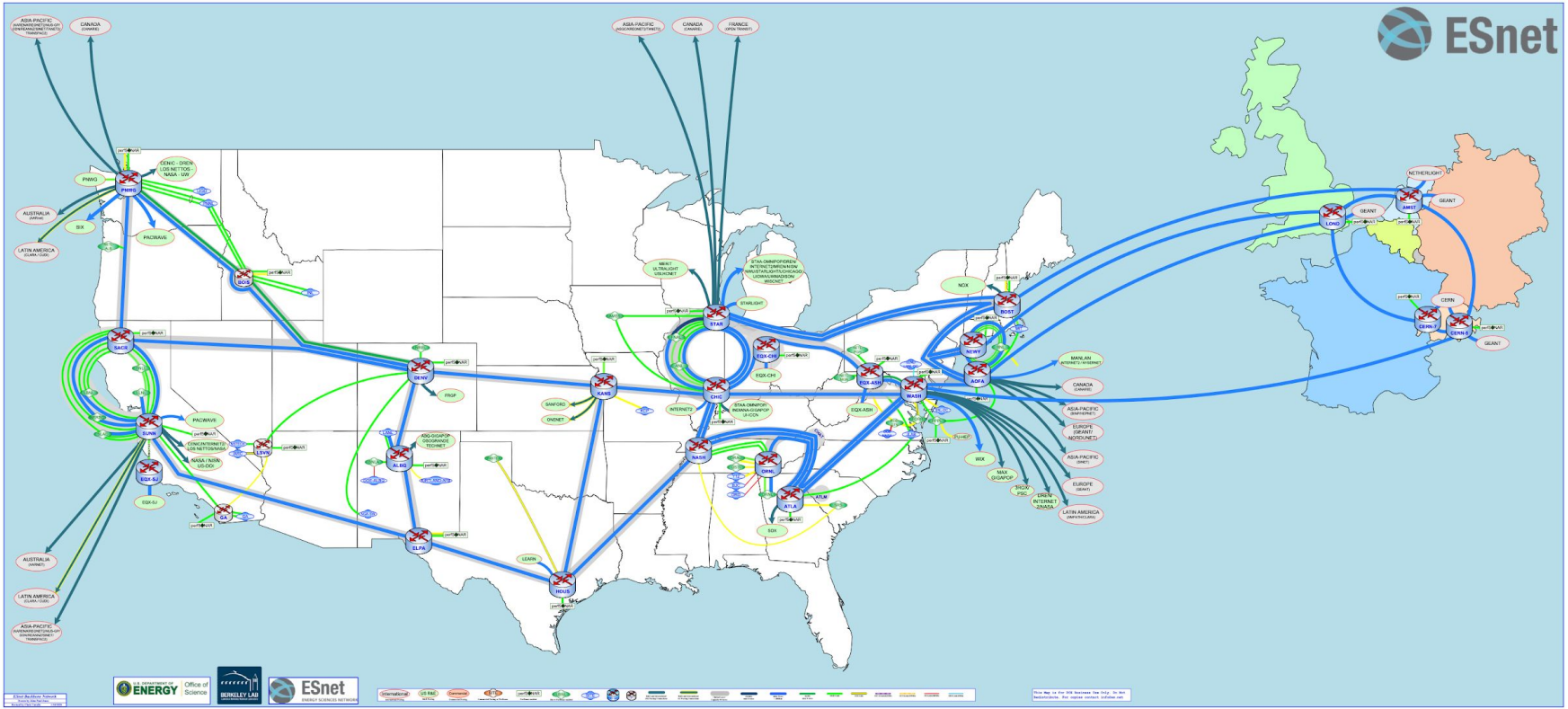
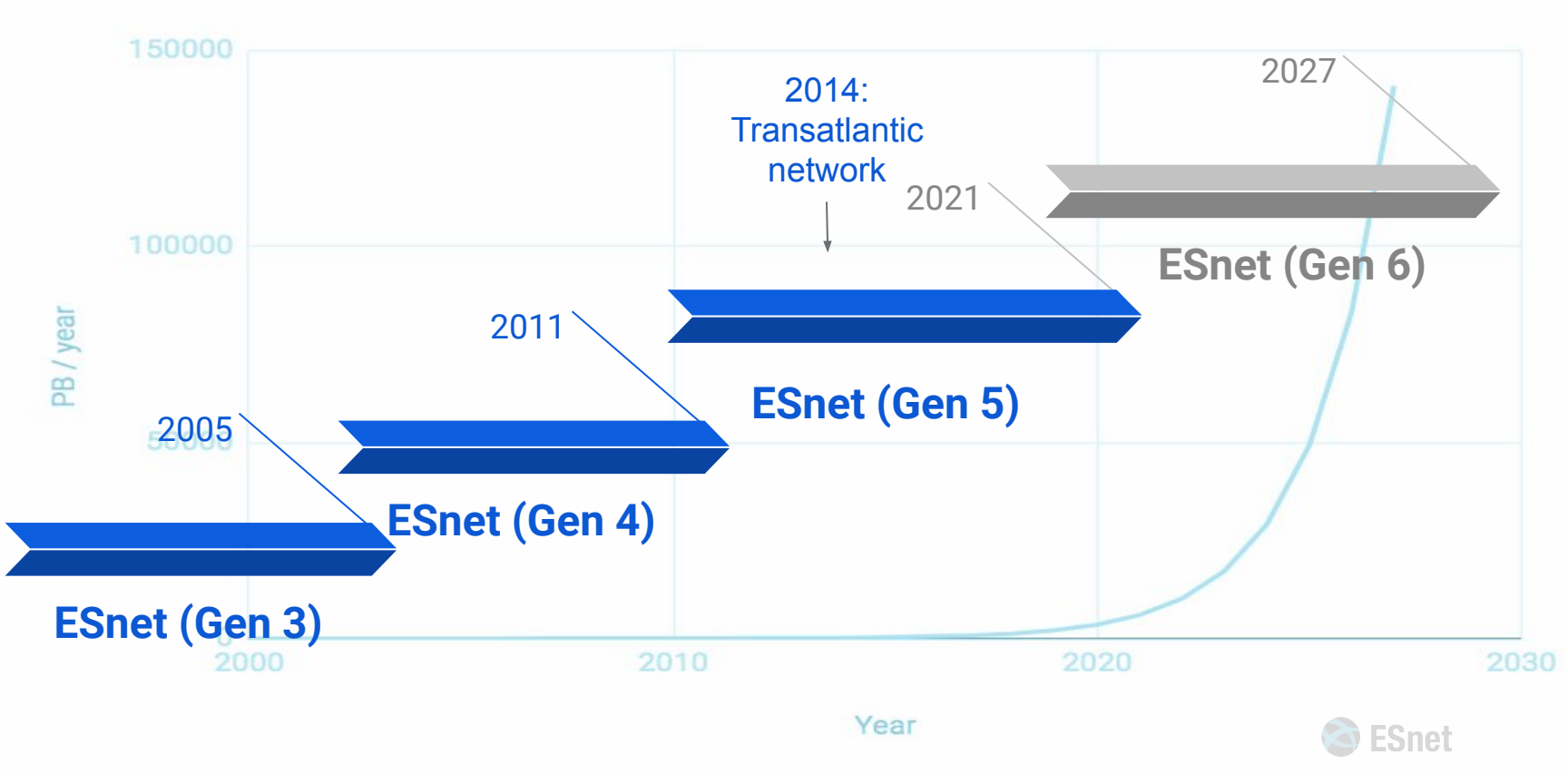
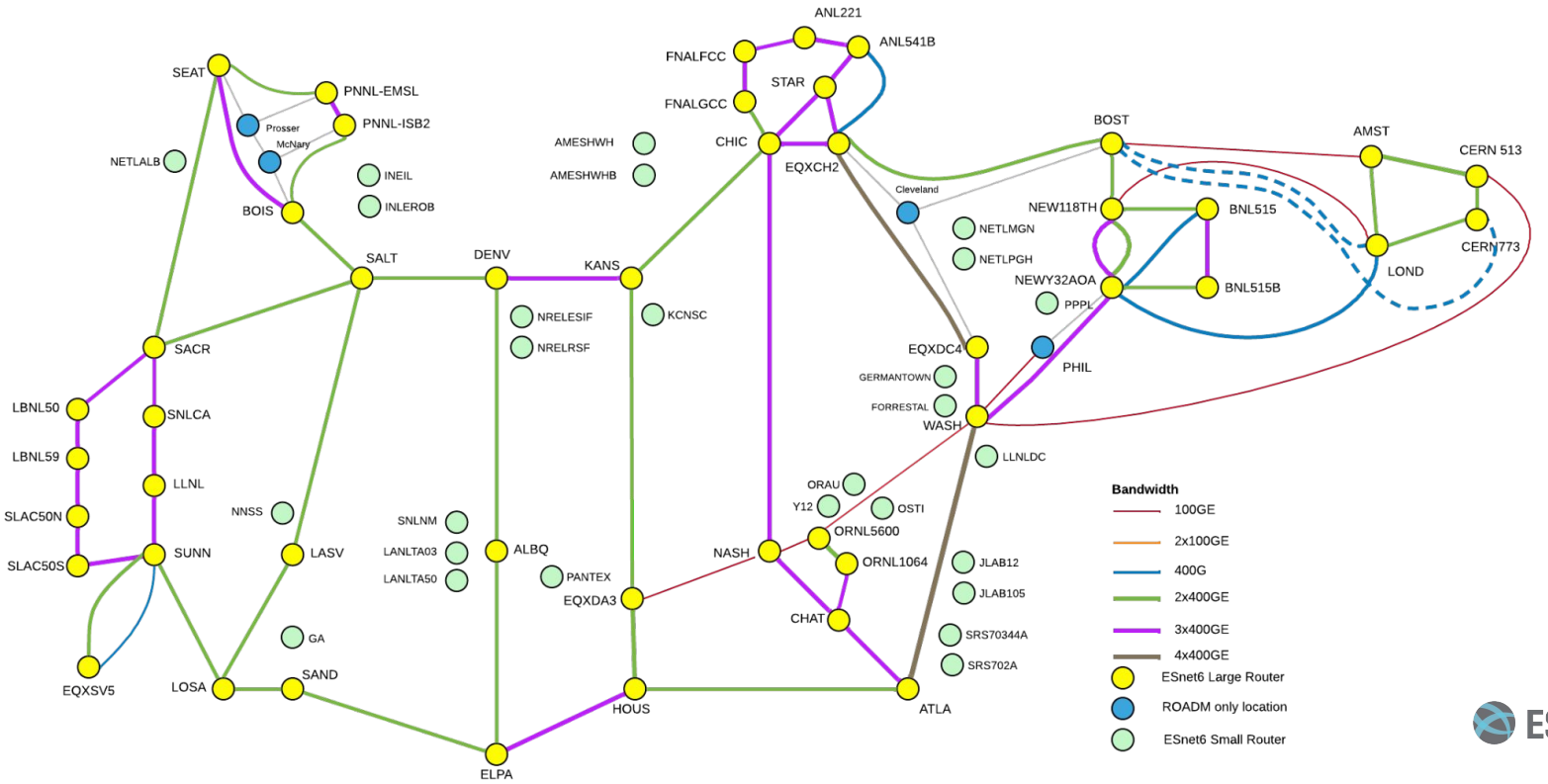
Connects all of the DOE national labs, DOE sites, and hundreds of research and commercial networks internationally.



# The evolution of the ESnet network



# August 2023 ESnet Backbone

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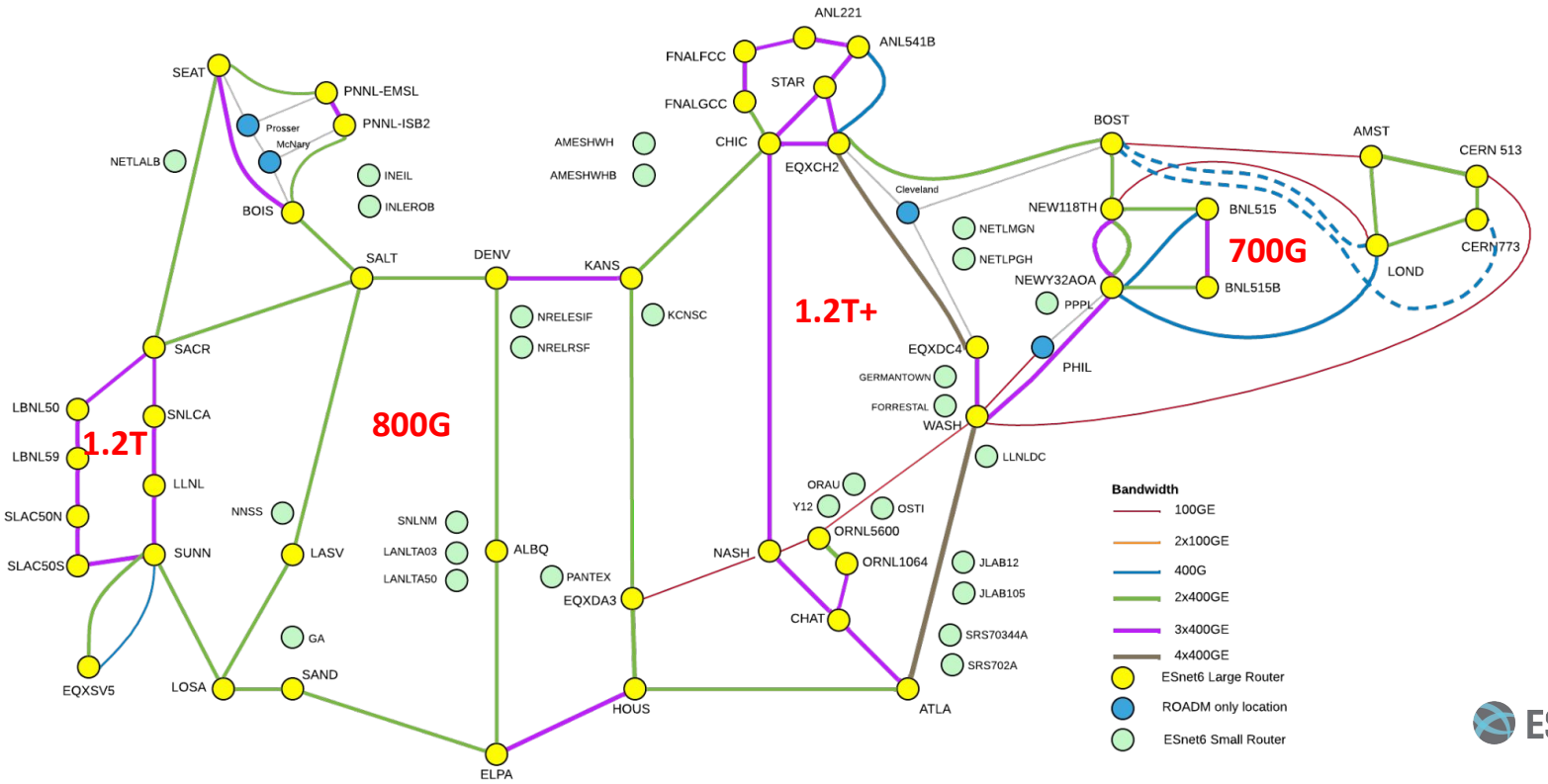
# August 2023 ESnet Backbone

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# Sites and exchange points upgrading to Nx400G

- CERN - 400G links passed testing, production turn-up scheduled for this month
- GPN - troubleshooting some hardware issues during testing
- PNNL
- ORNL
- ANL
- NERSC
- LBNL - in progress- scheduled for late August

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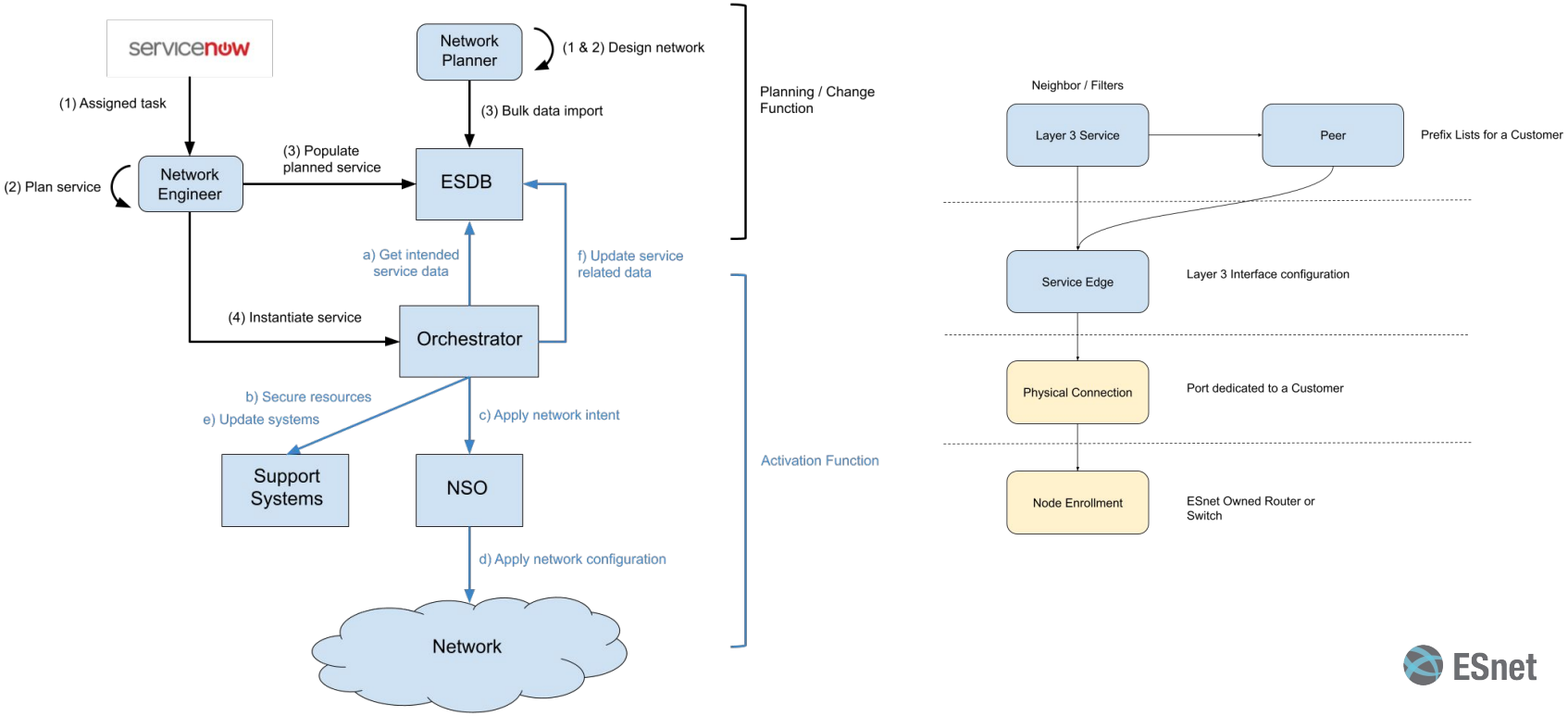
# Most of our router provisioning activities are now using the automation stack to deploy services







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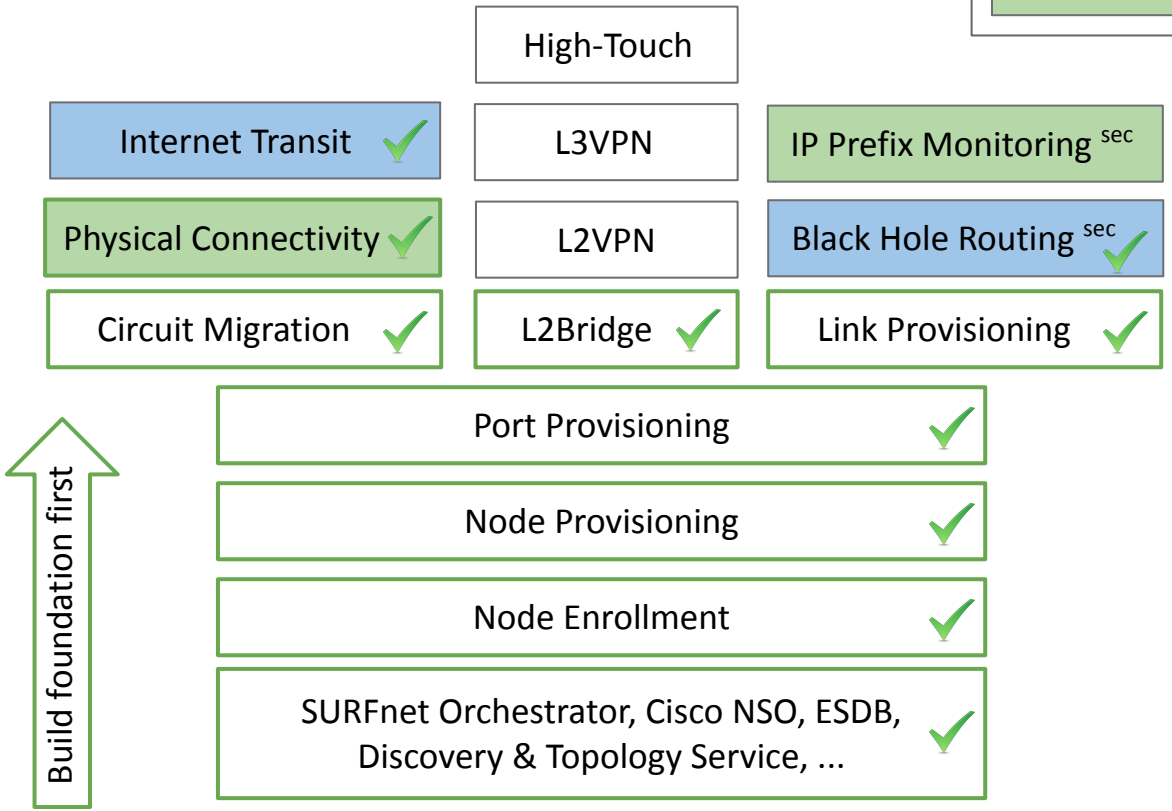
# Delivering ESnet6 Automation



# Some Statistics

Since April of 2021 (27 months) we have:

- 11 distinct ESnet6 Services developed
- 66 distinct Workflows developed
- 3144 Subscriptions to services created
- 9704 Workflows for subscriptions executed

That’s an average of 12 workflows (network changes) executed a day!

## Subscription Counts

| | |
|---|---|
| ECMP Group (Backbone Link) | 125 |
| Management Link | 76 |
| Enroll Core Router | 77 |
| Enroll Management Router | 80 |
| Enroll Transponder | 134 |
| Physical Connection | 262 |
| Service Edge | 461 |
| Prefix List | 279 |
| Layer 3 Service (Internet Transit) | 642 |
| L2 VPN Member | 13 |
| Internal Host Connectivity | 171 |

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## Active Subscriptions

Advanced search: Search on resource types

| id | Description | Status | In Sync | Abbr. | Tag | Start date | End date | Notes |
|---|---|---|---|---|---|---|---|---|
| id | description... | | | | | | | notes... |
| 528e03b0 | Node ornl5600-cr6 Production | active | ☑ | ESNET | NodeEnrollment | 25-10-2021 | | |
| 07a82574 | Node ornl1064-cr6 Production | active | ☑ | ESNET | NodeEnrollment | 25-10-2021 | | |
| db827489 | Node lbnl59qa-cr6a Production | active | ☑ | ESNET | NodeEnrollment | 25-1-2022 | | |
| 95f51dd7 | Node frib-cr6a Production | active | ☑ | ESNET | NodeEnrollment | 26-3-2022 | | |
| ee2aa427 | Node chat-cr6 Production | active | ☑ | ESNET | NodeEnrollment | 29-9-2021 | | |

1 2 3 4 5 ... 13 Rows per page: 5

## Initial, Provisioning and Terminated Subscriptions

Advanced search: Search on resource types

| id | Description | Status | Customer | Abbr. | Product | Tag |
|---|---|---|---|---|---|---|
| id | description... | ☑ | | | | |
| 55e94d5f | Node eqxld8-mpr1 Provisioned: Ready for Backbone Link | provisioning | ESNET::Energy Sciences Network | ESNET | Enroll Management Router | NESMPR |
| 49acc9e5 | Service Edge DOENET-WAPA-PX - Base - sand-cr6:lag-20 - doenet-wapa-px_se-509 | terminated | DOENET-WAPA-PX::DOENET WAPA Phoenix Office | DOENET-WAPA-PX | Service Edge | ServiceEdge |
| d7874b3d | sacr-mpr1 to sacr-cr6 | terminated | ESNET::Energy Sciences Network | ESNET | Management Link | MgmtLink |
| afa56f63 | Service Edge DOENET-WAPA-LW - Base - denv-cr6:lag-20 - doenet-wapa-lw_se-508 | terminated | DOENET-WAPA-LW::DOENET WAPA Lakewood Office | DOENET-WAPA-LW | Service Edge | ServiceEdge |
| 5864f0c0 | sand-mpr1 to sand-cr6 | terminated | ESNET::Energy Sciences Network | ESNET | Management Link | MgmtLink |

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# Stardust

*Network Measurement and Analysis for ESnet*

## Extensible / Open Architecture

NSF NetSAGE project derived

Leverage Open Source components where we can, and innovate where it makes a difference.

## Multiple access methods

Dashboards, Indexed APIs and “Raw”

Today, we are focused on users creating and sharing visual dashboards.

In the future, we expect direct programmatic access will become increasingly common for ML work and external collaboration.

## Multi Datasource

Extensible and Open

Traffic Accounting, Link and Resource Use, Performance Testing Results, Others not yet invented.

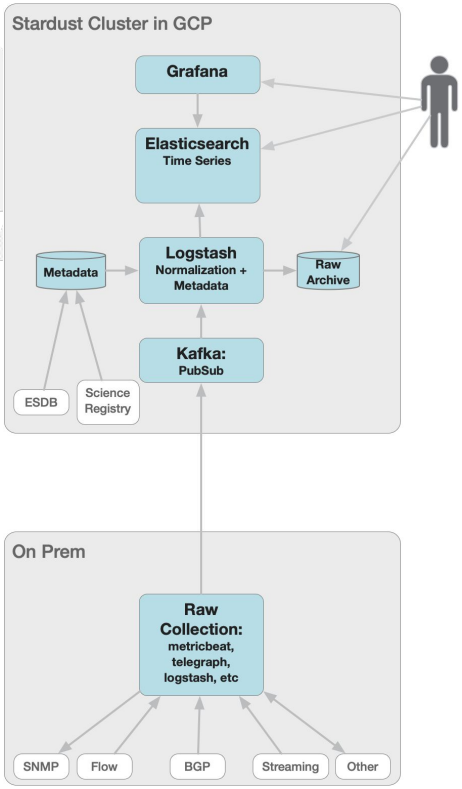
Each has its own set of measurements to which we add a common core set of metadata.

## Flexible aggregation

Time Frame and Relationships

The metadata we add to measurements is used to summarize data to tell stories, and having common metadata allows us to use multiple data sets in a story.

- How are researchers moving science data and how has that changed over the last 3 years?
- What just caused that huge spike in traffic on the links to europe in the last 15 minutes and is that likely impacting data transfers?

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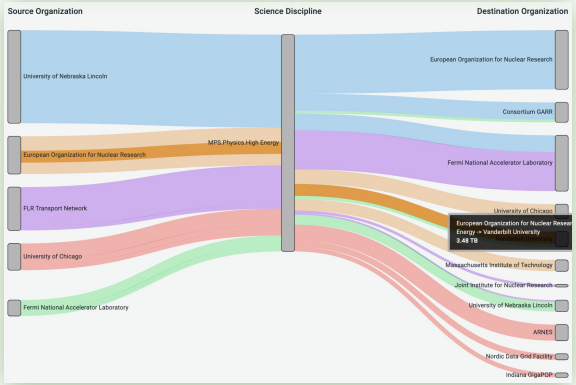
# Stardust Dashboards

- Combination of curated and custom dashboards used internally by ESnet staff to visualize and contextualize measurements

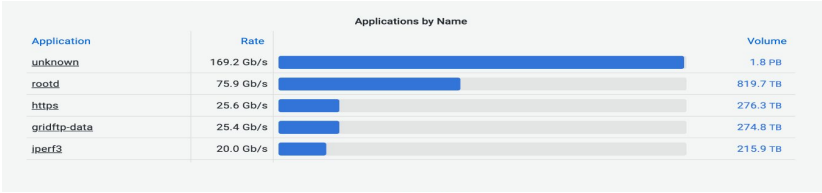
**Not This**

**This**

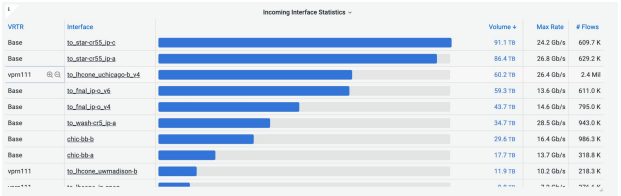




# Stardust Flow Dashboards

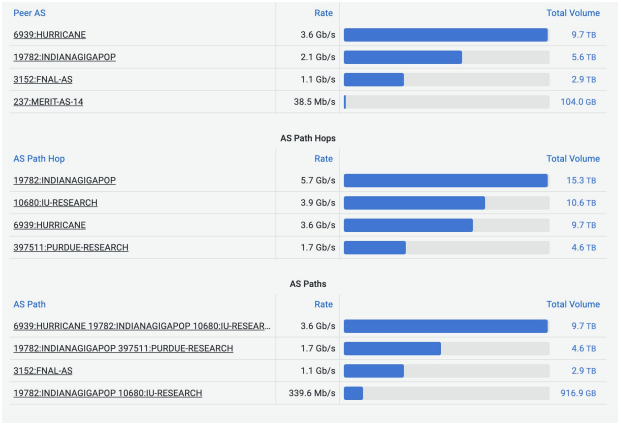
Breakdown by Application:




Breakdown by Interface:




Breakdown by Peer and AS Path:

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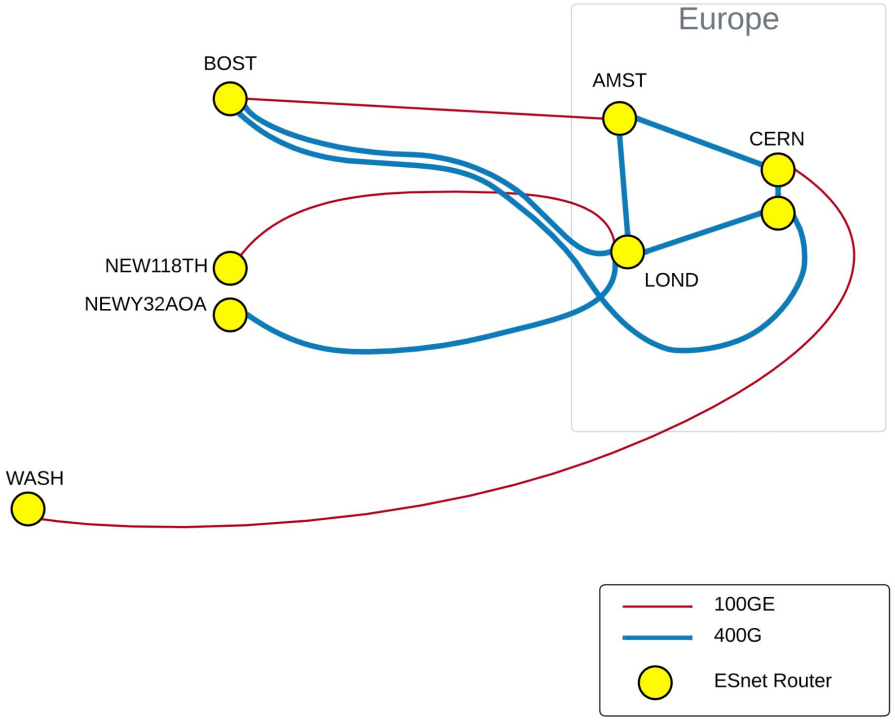
# Trans-Atlantic & EU ring upgrades

- **Now In Production:**
  - 400G + 100G New York - London
  - 100G Boston to Amsterdam
  - 100G Washington to Geneva
- Currently underway:
  - 400G Boston - London (late fall)
  - 400G Boston - CERN (late fall)
  - 400G Europe Ring (late fall)
    - working with GEANT
    - Next phase will be 2x400G
- Planning 3+ Tbps by end of 2027
  - Capacity & resiliency primarily driven by HL-LHC

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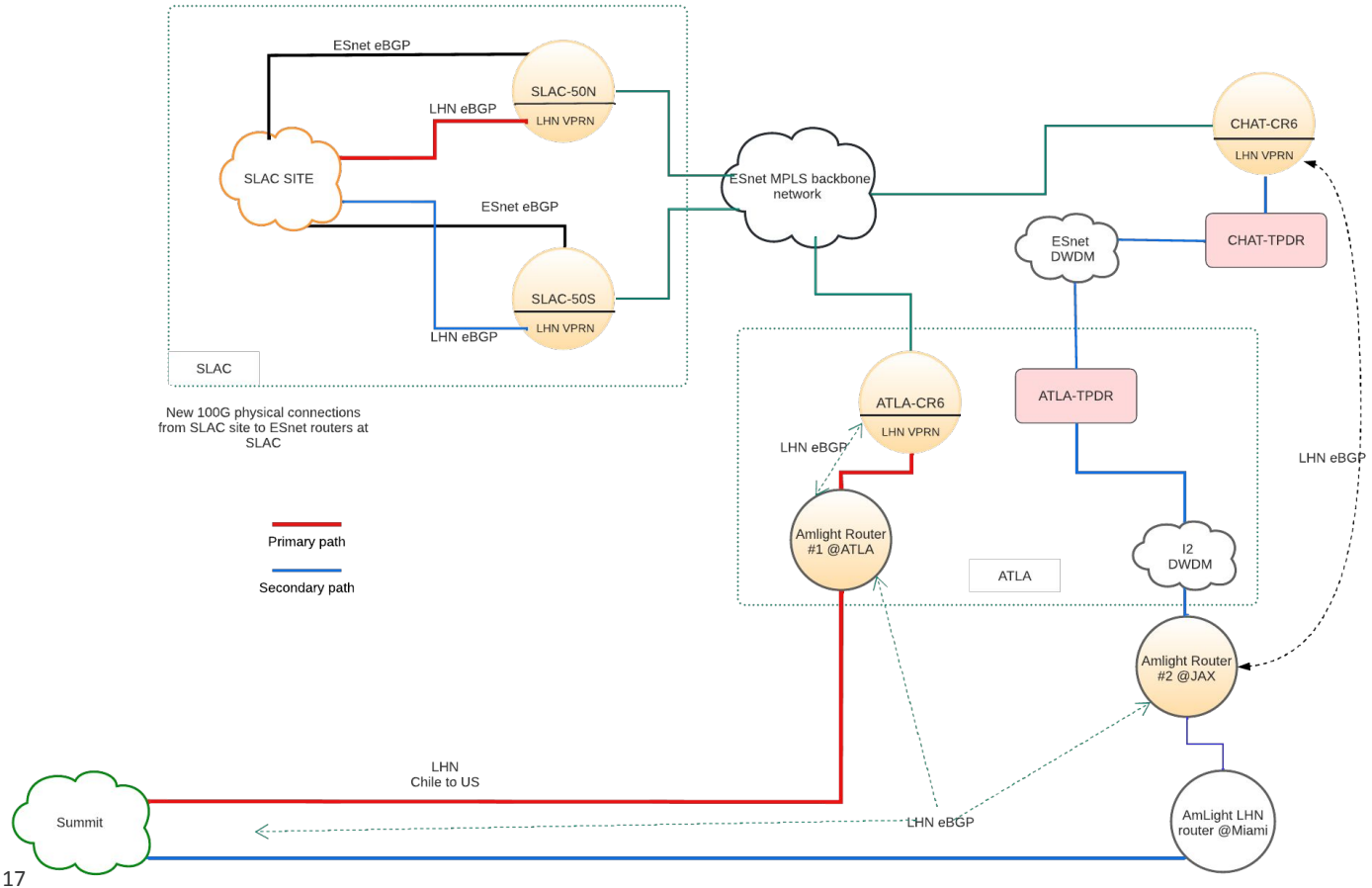
# Rubin USDF Connectivity over ESnet



# Questions...

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# ESnet6 Network Transitions