AutoGOLE / SENSE WG and Infrastructure

Infrastructure and Services for Domain Science Workflow Innovation

Tom Lehman (ESnet)

GNA-G Community Meeting at SC24
November 20, 2024, 12:00-2:00 pm
Georgia World Congress Center, Atlanta, GA, USA
Room B407

AutoGOLE / SENSE WG

- GNA-G AutoGOLE/SENSE WG homepage
  - https://www.gna-g.net/join-working-group/autogole-sense
- Co-Chairs:
  - Tom Lehman (ESnet)
  - Marcos Felipe Schwarz (RNP)
  - Hans Trompert (SURF)
  - Buseung Cho (KISTI)
- AutoGOLE/SENSE Working Group mailing list
  - autogole@lists.gna-g.net
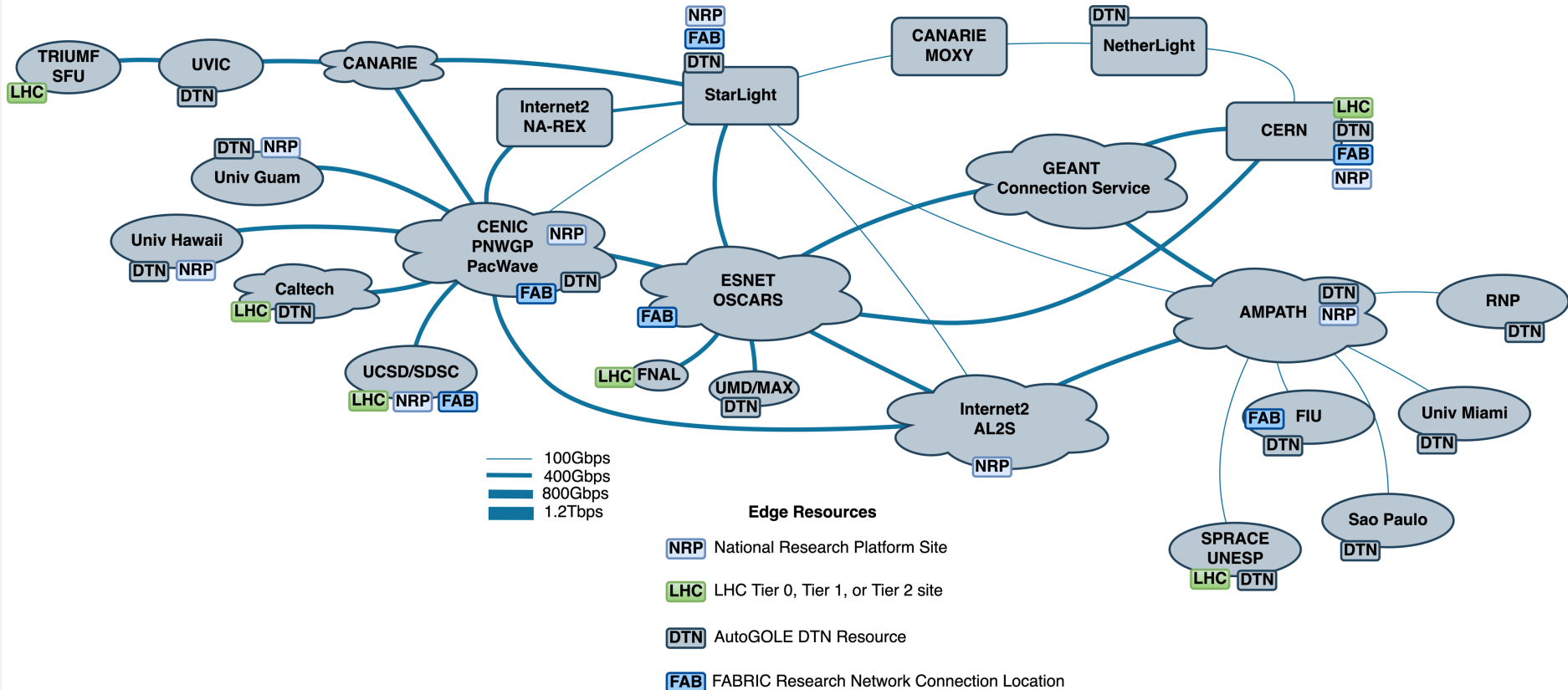- Zoom meetings
  - every two weeks on Tuesdays, 10am ET

AutoGOLE / SENSE Working Group

- Worldwide collaboration of open exchange points and R&E networks interconnected to deliver network services end-to-end in a fully automated way.   NSI for network connections, SENSE for integration of End Systems and Domain Science Workflow facing APIs.
- **Key Work areas:**
  - **Control Plan Monitoring**: Prometheus/Grafana based
  - **Data Plane Verification and Troubleshooting Service**
  - **AutoGOLE related software**: NSI (OpenNSA, SuPA), SENSE (orchestration and site resources)
  - **Experiment, Research, Use Case support**: Support for multiple activities including NOTED, Gradient Graph, P4 Topologies, Named Data Networking (NDN), Data Transfer Systems integration and testing.
- **Key Objective:**
  - The AutoGOLE Infrastructure should be persistent and reliable enough to allow most of the time to be spent on experiments and research.
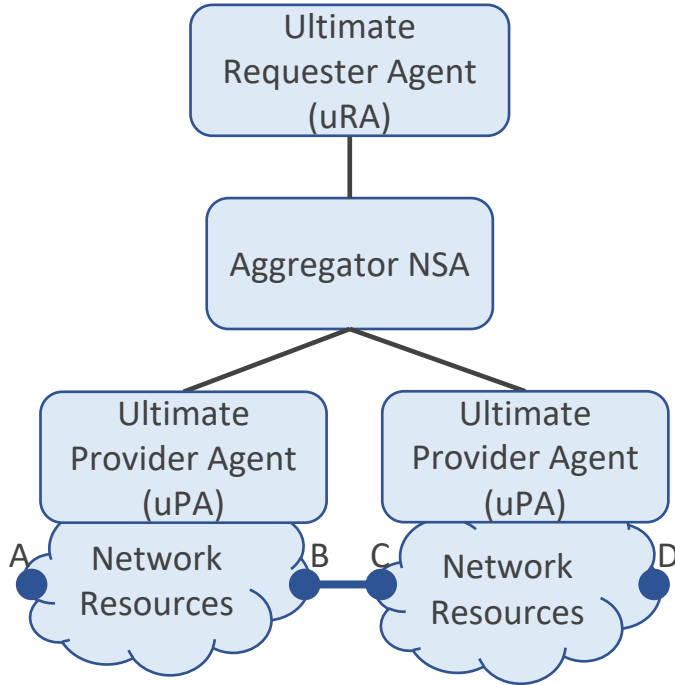
AutoGOLE / SENSE WG - Objectives and Vision

- Infrastructure which provides "end-to-end" network services in a fully automated manner

  the network elements

  the network stacks inside the attached end systems (DTNs)

- Leverages the opensource software based on:

  Network Service Interface (NSI): multidomain network provisioning

  SENSE: end-system provisioning and realtime integration with network services

- Persistent Infrastructure, somewhere in between production and a testbed

  Network Research, Experiments, Testing

  Topologies and Services for Domain Science integration and research

AutoGOLE Topology View

Edge Resources

NRP National Research Platform Site

LHC LHC Tier 0, Tier 1, or Tier 2 site

DTN AutoGOLE DTN Resource

FAB FABRIC Research Network Connection Location

- 100Gbps
- 400Gbps
- 800Gbps
- 1.2Tbps

OpenNSA
NSI based Provider (uPA)

Ultimate Requester Agent (uRA)

Aggregator NSA

Ultimate Provider Agent (uPA)

Ultimate Provider Agent (uPA)

A   Network Resources   B   C   Network Resources   D

Safnari
NSI Aggregator

NSI Safnari
ESnet

Usage   Connections

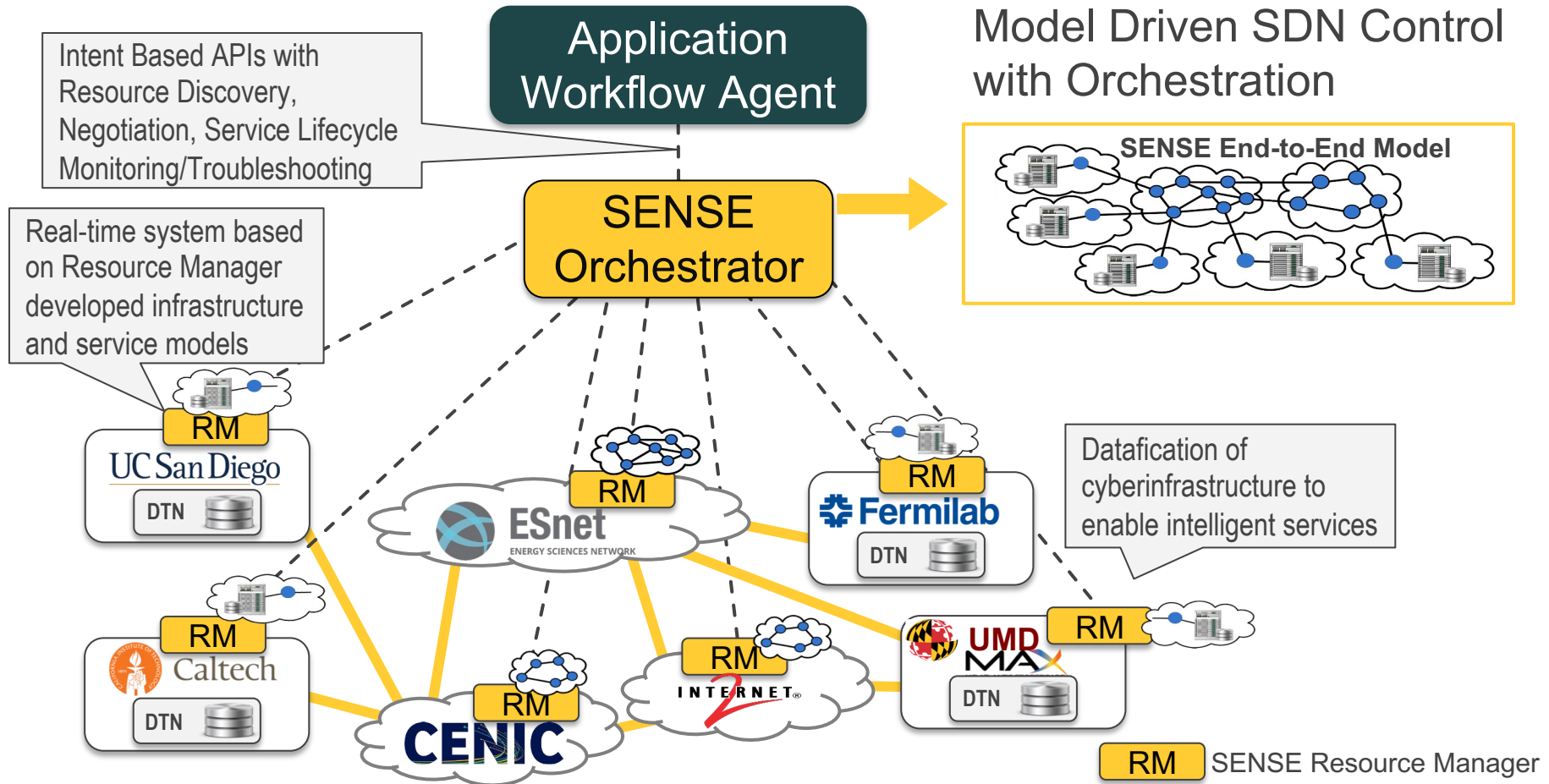**Connection 6dfa8e66-cd18-4d57-bb3a-5b17c44c267f - CERN DTN - LA DTN with ERO - VLAN3988 - jhess**

Start: 2019-12-03T21:53:44.796Z	**End:** 2019-12-04T21:48:44.796Z	
Bandwidth: 200	**Version:** 0	
Global id: -	**Requester:** urn:ogf:network:cal.bears:2019:nsa:requester	
Source: urn:ogf:network:lsanca.pacificwave.net:2016:topology:dtn0.lsanca?vlan=3988		
Destination: urn:ogf:network:netherlight.net:2013:production7:cern-1?vlan=3988		

Child connection ID	NSA	Path	Status	Error?
LS-fa09b582ce	lsanca.pacificwave.net:2016:nsa	**From** lsanca.pacificwave.net:2016:topology:dtn0.lsanca?vlan=3988 **To** lsanca.pacificwave.net:2016:topology:losa2-pw-sw-1_e1_1?vlan=3988	Released, Inactive	none
SN-740979f3c0	snvaca.pacificwave.net:2016:nsa	**From** snvaca.pacificwave.net:2016:topology:snvl2-pw-sw-1_e7_2?vlan=3988 **To** snvaca.pacificwave.net:2016:topology:snvl2-pw-sw-1_e2_2?vlan=3988	Released, Inactive	none
ST-64a9e1b353	sttlwa.pacificwave.net:2016:nsa	**From** sttlwa.pacificwave.net:2016:topology:icas-sttlwa01-03_e1_1?vlan=3988 **To** sttlwa.pacificwave.net:2016:topology:icair-grp?vlan=3988	Released, Inactive	none
IC-b47da37bc7	icair.org:2013:nsa	**From** icair.org:2013:topology:pwave-grp?vlan=3988 **To** icair.org:2013:topology:nl-cern1?vlan=3988	Released, Inactive	none
19001CS08-ANA	canarie.ca:2017:nsa	**From** canarie.ca:2017:topology:CHCG1?vlan=3988 **To** canarie.ca:2017:topology:ANA1?vlan=3988	Released, Inactive	none
890861b8-c20f-4968-aa4e-a670ef50f7c6	netherlight.net:2013:nsa:safnari	**From** netherlight.net:2013:production7:ana-1?vlan=3988 **To** netherlight.net:2013:production7:cern-1?vlan=3988	Released, Inactive	none

NSI Software

- OpenNSA
  - https://github.com/BandwidthOnDemand/opennsa
  - https://github.com/NORDUnet/opennsa
  - https://nordunet.github.io/opennsa/
- SuPA (SURF ultimate Provider Agent)
  - https://workfloworchestrator.org/SuPA/
  - https://github.com/workfloworchestrator/SuPA
  - Uses OFG defined Network Markup Language (NML)

SENSE Architecture

SENSE Software

- SENSE
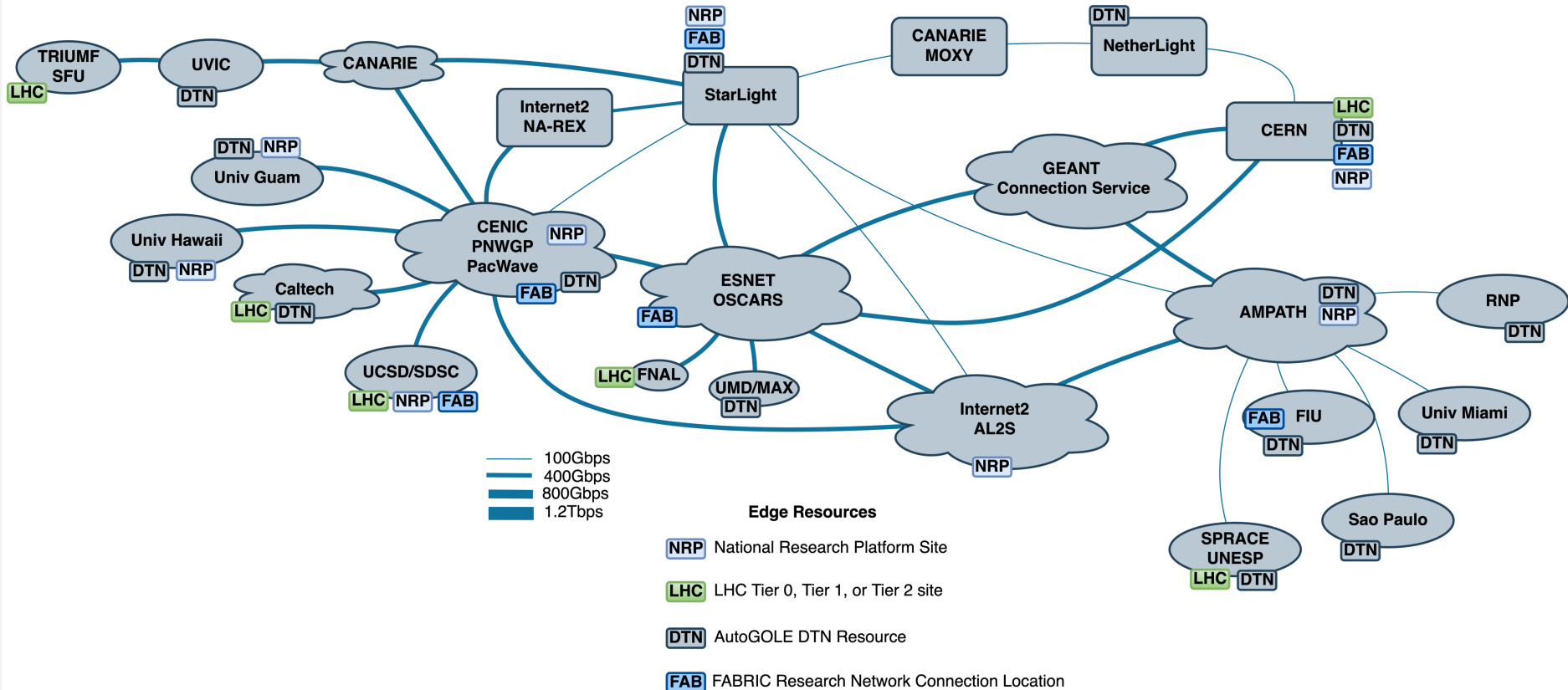 - Orchestrator
    - sense.es.net
    - Northbound API: https://app.swaggerhub.com/apis/xi-yang/SENSE-O-Intent-API/2.0.4
  - Site Resource Manager
    - https://github.com/sdn-sense
    - https://sdn-sense.github.io/
  - Network Resource Manager
    - https://github.com/esnet/sense-rm

Based on modifications to NML to allow the things that connect to the network to also be modeled, controlled, and orchestrated.
MRML - Multi-Resource Markup Language

AutoGOLE Topology View

Edge Resources

NRP National Research Platform Site

LHC LHC Tier 0, Tier 1, or Tier 2 site

DTN AutoGOLE DTN Resource

FAB FABRIC Research Network Connection Location

Link legend:
- 100Gbps
- 400Gbps
- 800Gbps
- 1.2Tbps

Nodes:
TRIUMF SFU (LHC), UVIC (DTN), CANARIE, Univ Guam (DTN, NRP), Univ Hawaii (DTN, NRP), Caltech (LHC, DTN), UCSD/SDSC (LHC, NRP, FAB), CENIC PNWGP PacWave (NRP, FAB, DTN), Internet2 NA-REX, StarLight (NRP, FAB, DTN), CANARIE MOXY, NetherLight (DTN), CERN (LHC, DTN, FAB, NRP), GEANT Connection Service, ESNET OSCARS (FAB), FNAL (LHC), UMD/MAX (DTN), Internet2 AL2S (NRP), AMPATH (DTN, NRP), RNP (DTN), FIU (FAB, DTN), Univ Miami (DTN), Sao Paulo (DTN), SPRACE UNESP (LHC, DTN)

SENSE - Model based Resource Descriptions
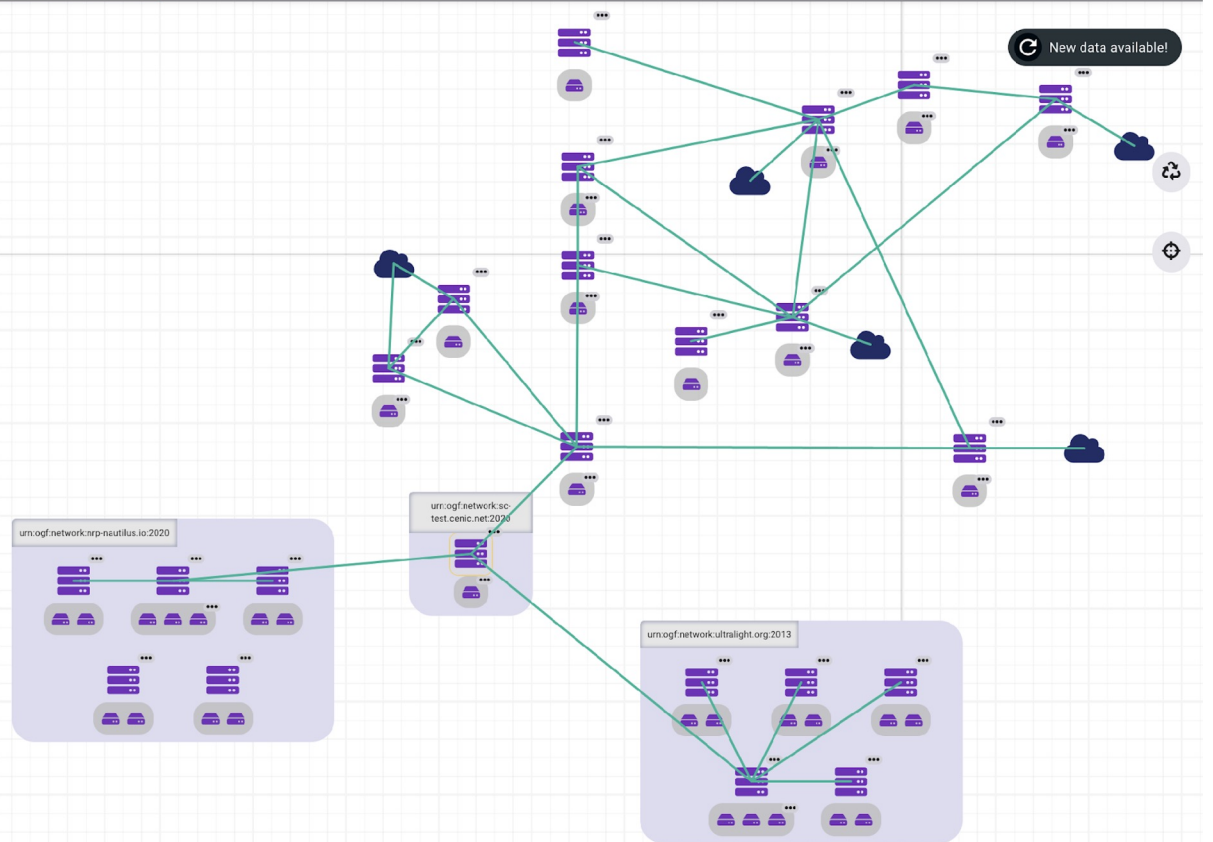
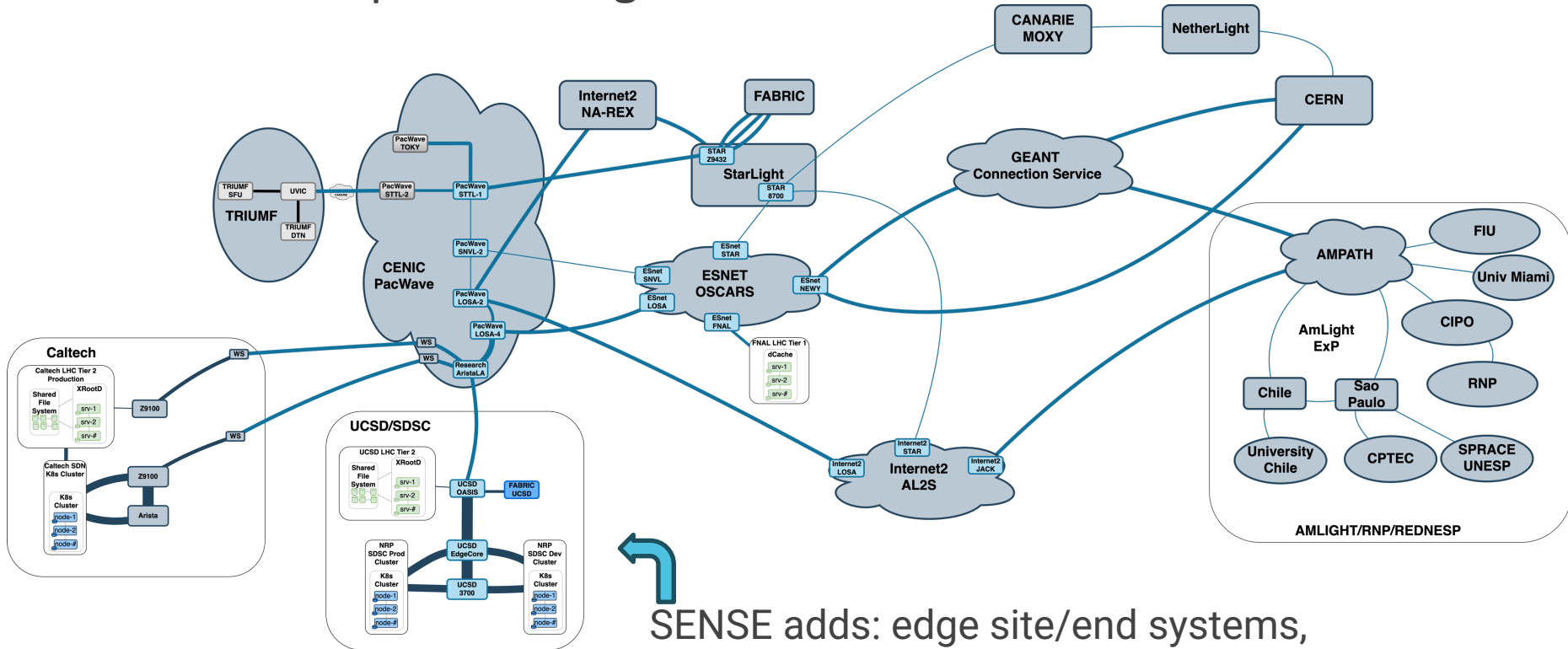# AutoGOLE/SENSE - Integrating and Orchestrating services across multiple Infrastructures
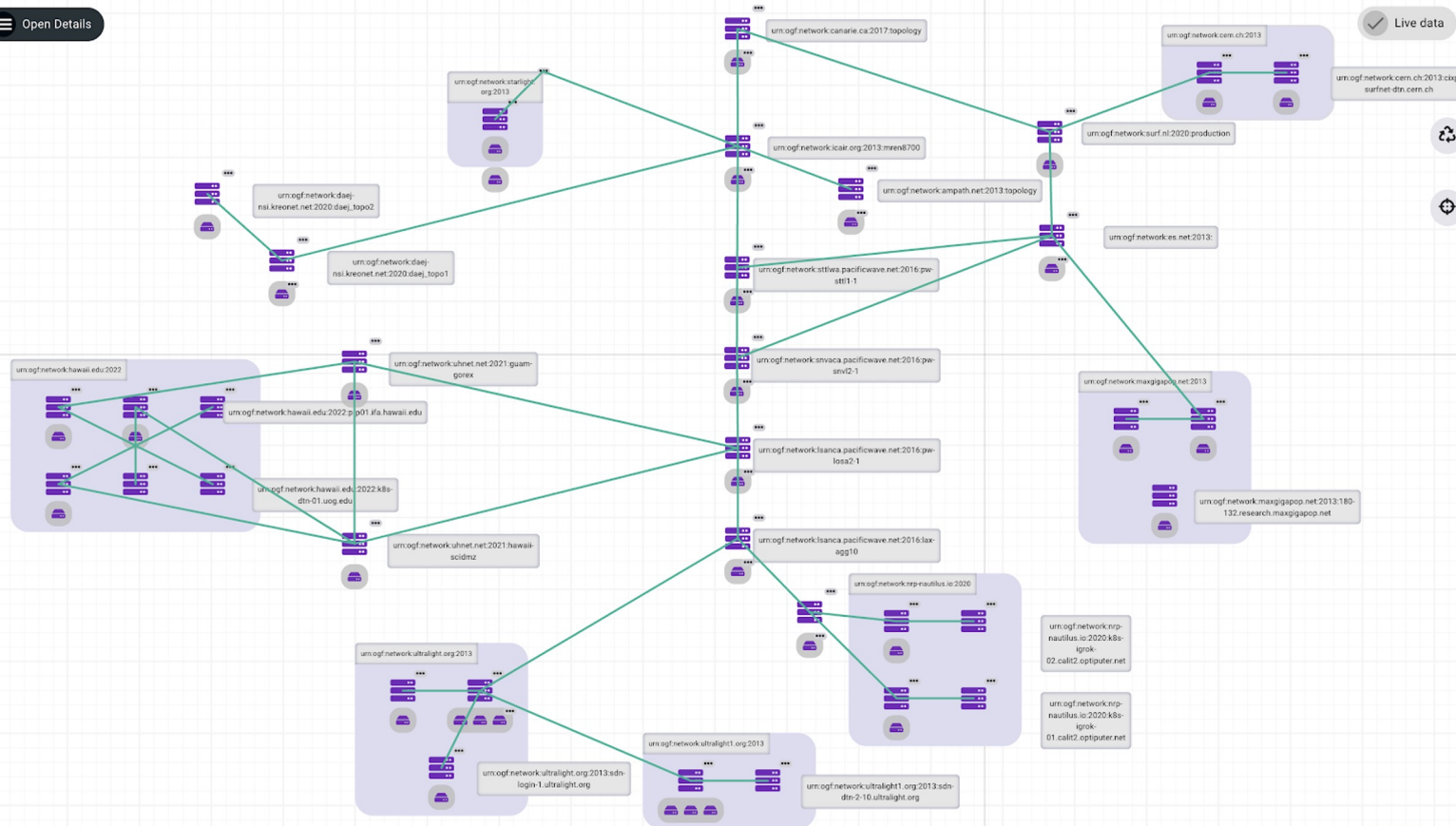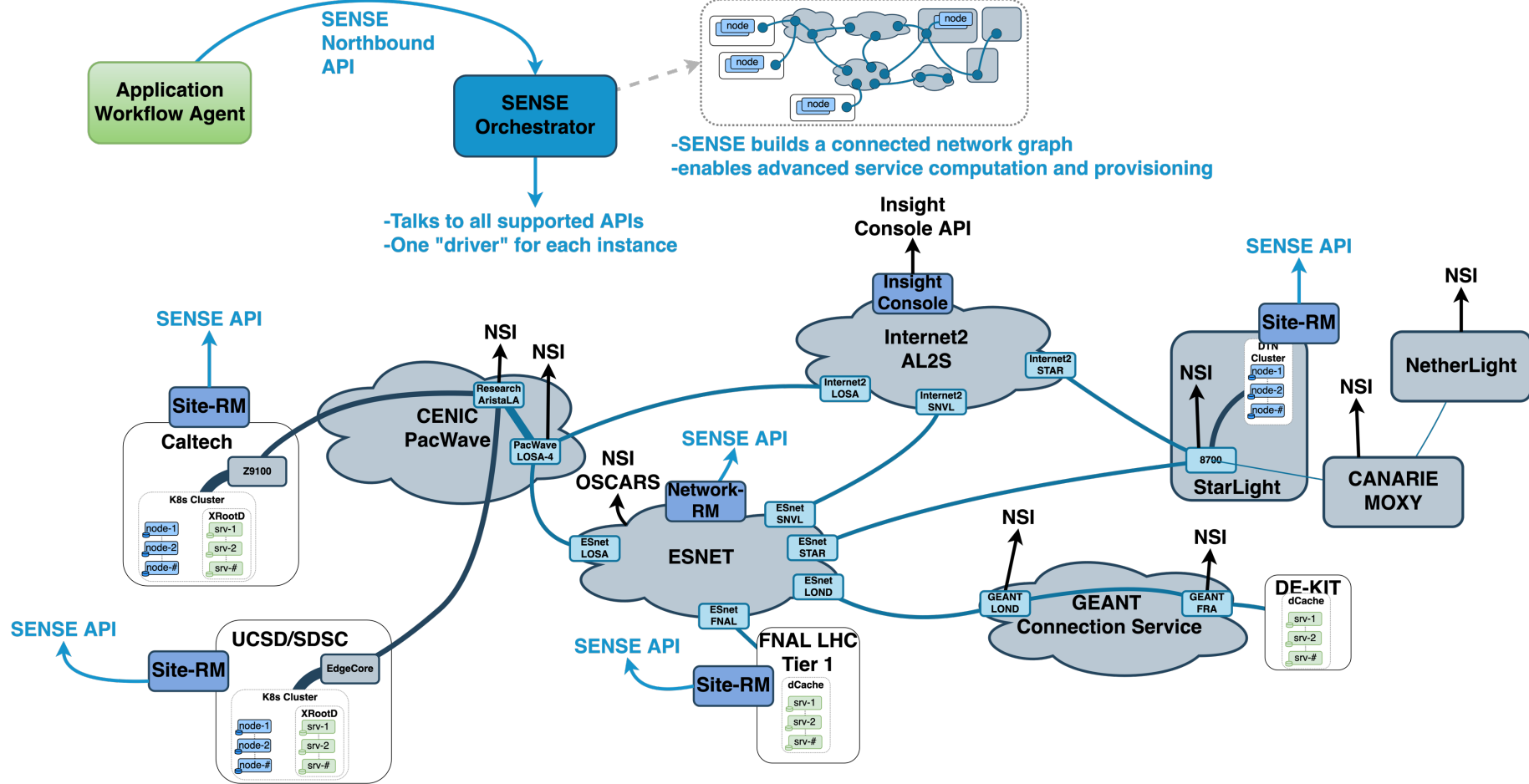
AutoGOLE Infrastructure

- Automated provisioning of Network services

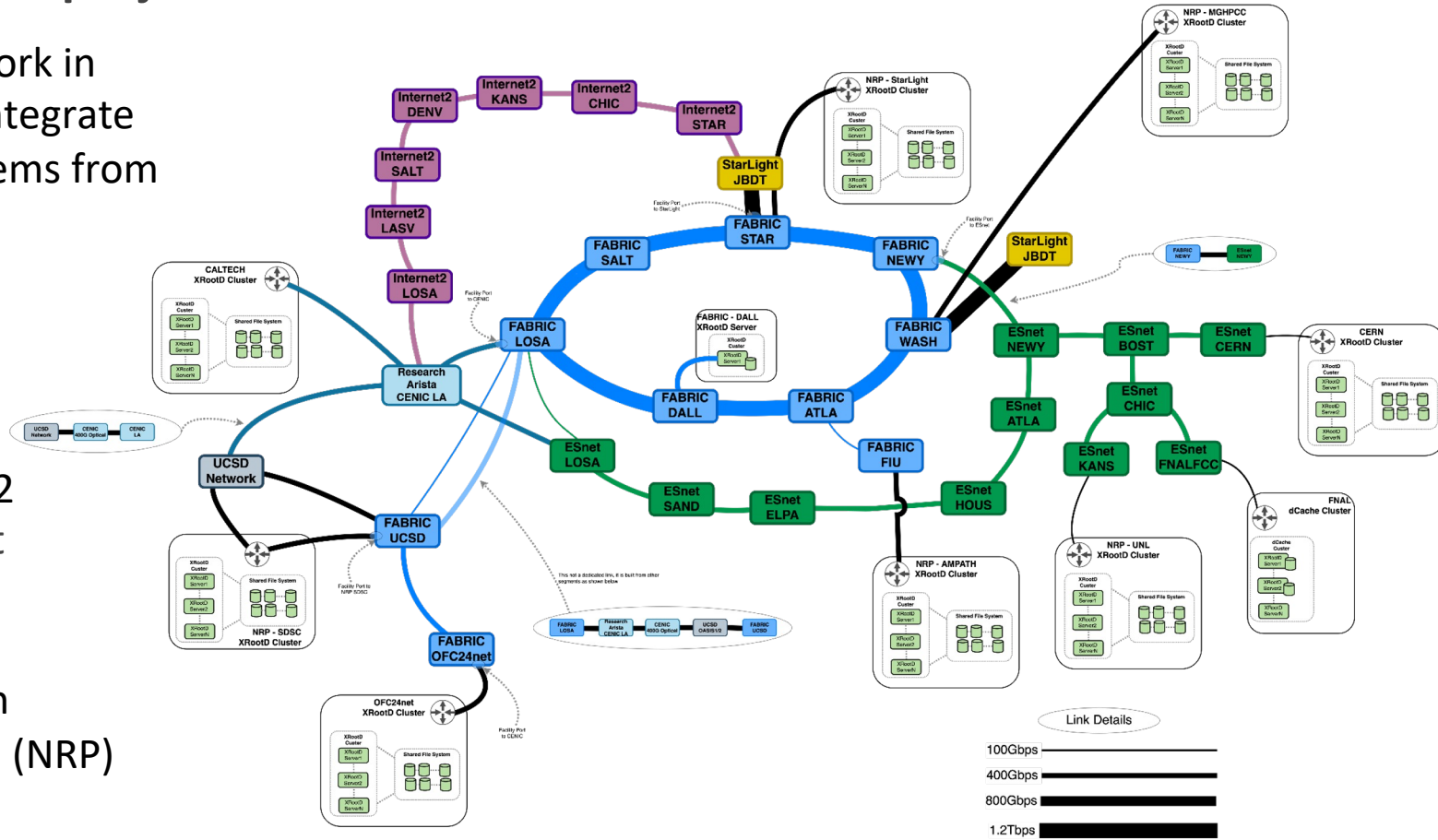SENSE adds: edge site/end systems, orchestration services, multiple API support
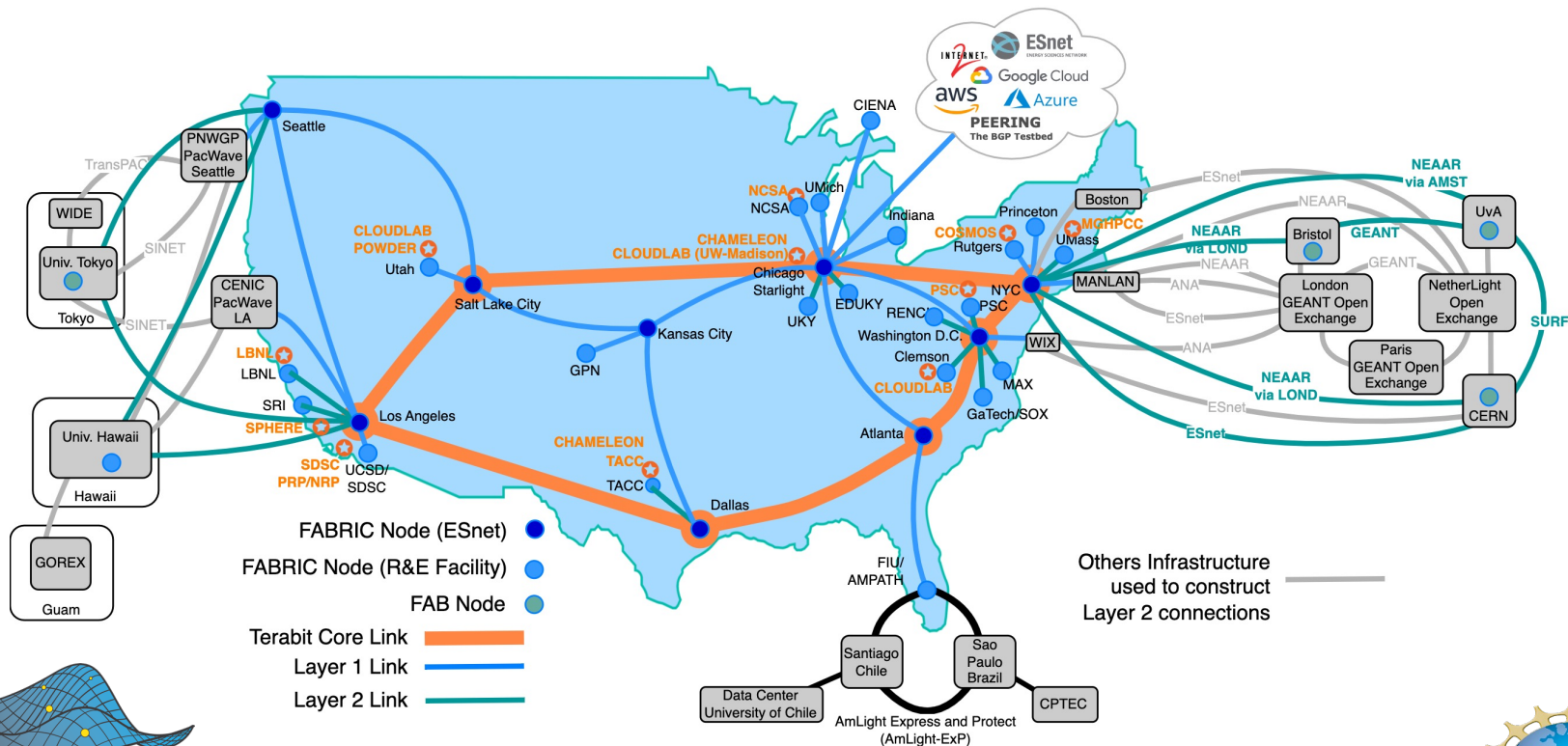
SENSE Overview

Network Services and Edge Site Integration across multiple providers and projects

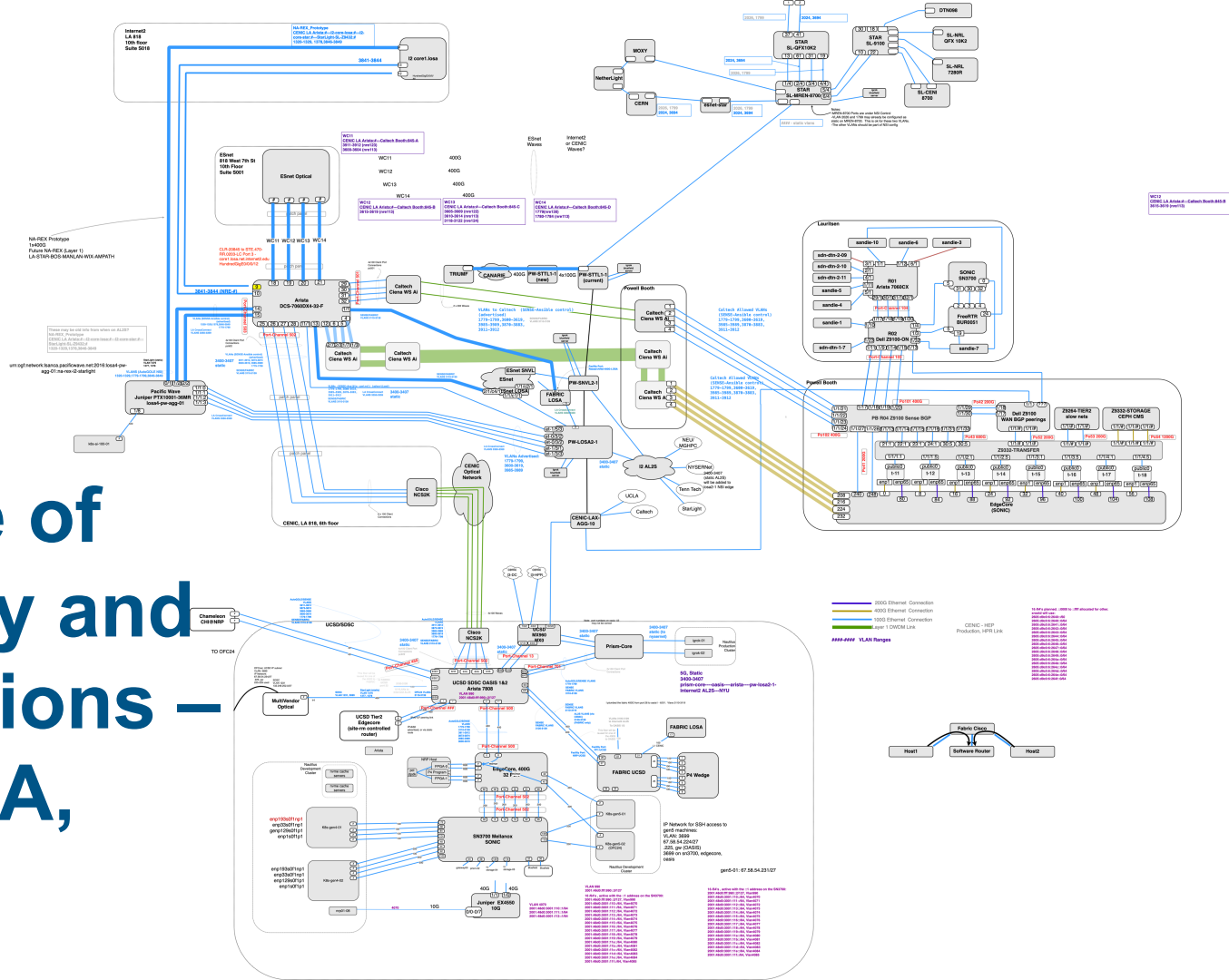This shows work in progress to integrate services/systems from the following providers:

- CENIC
- UCSD
- ESnet
- Internet2
- StarLight
- FABRIC
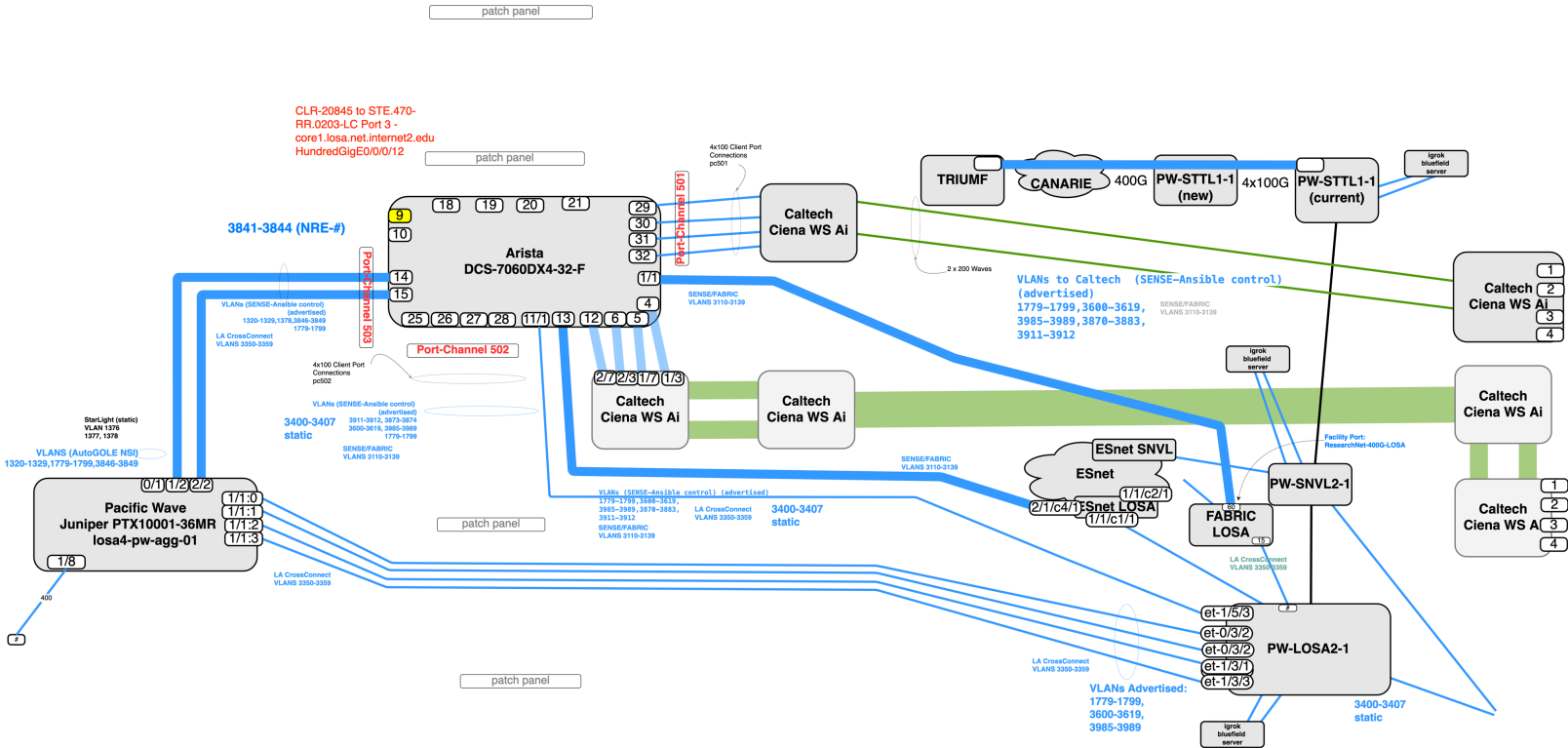- National Research Platform (NRP)

FABRIC Topology

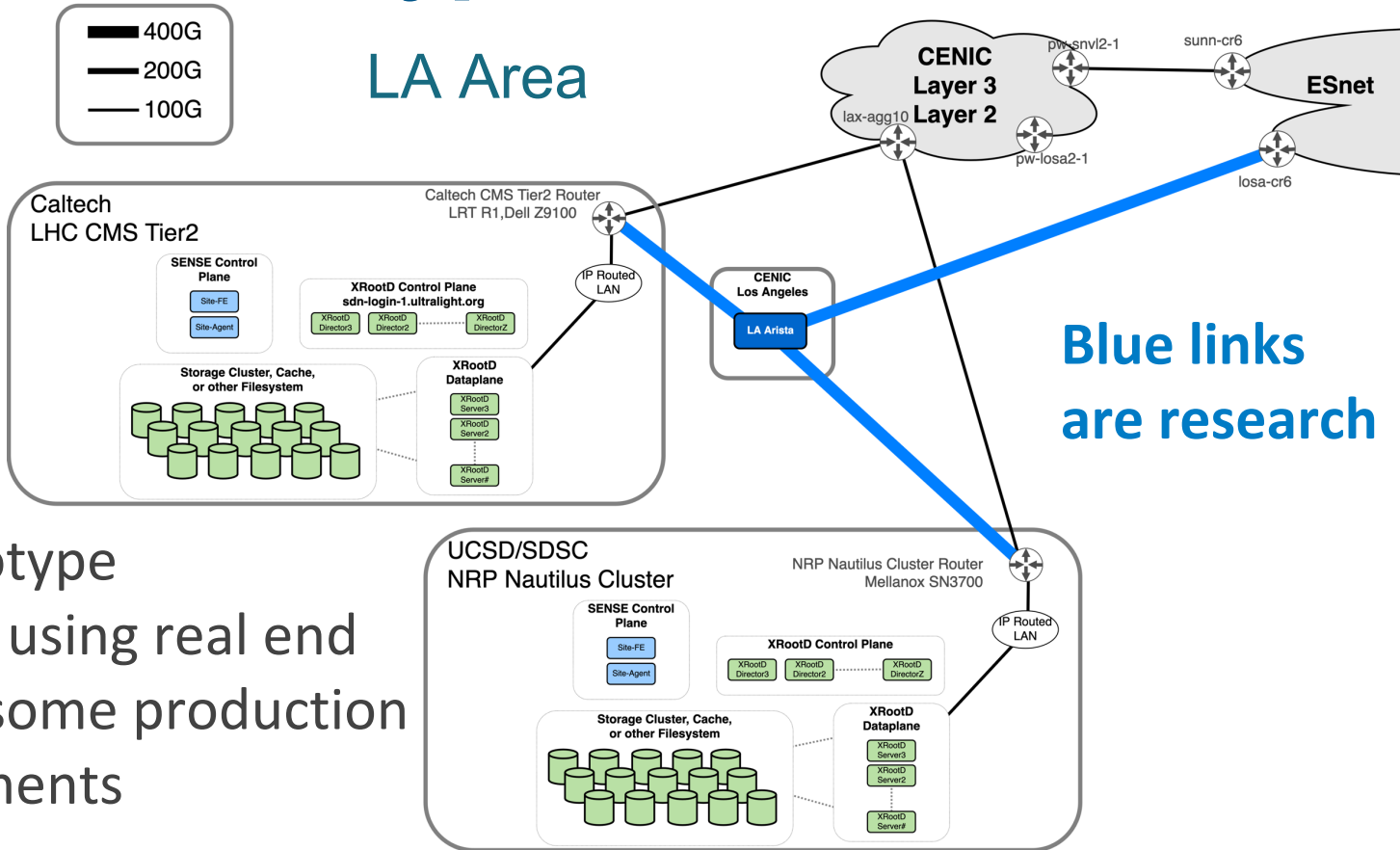# Example of Topology and Connections – UCSD, LA, Caltech

# Los Angeles Connections

Research, Prototype, and Production

Interconnects between research and production

Enables prototype development using real end systems and some production network segments
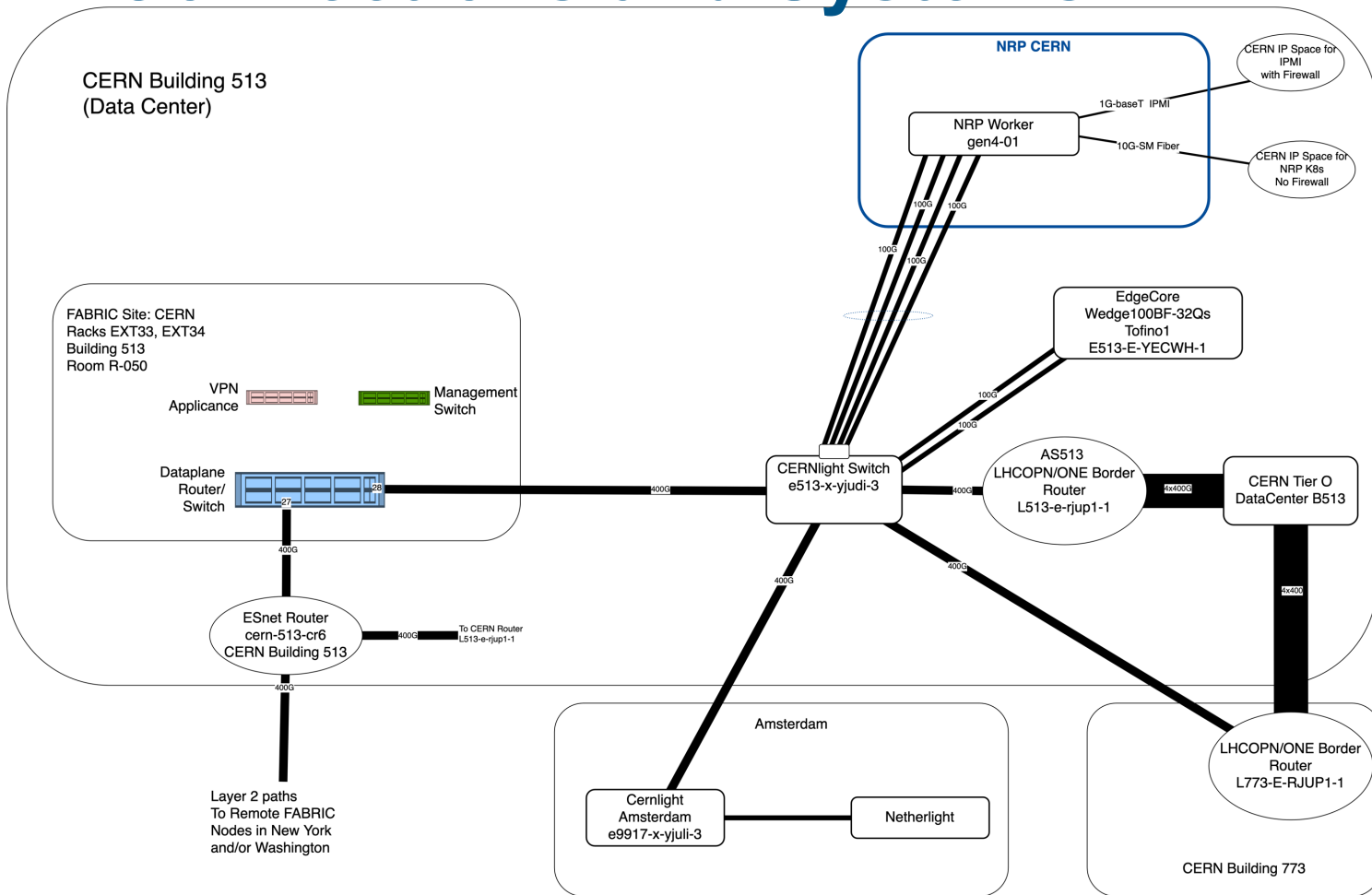

LA Area

Blue links are research

SENSE and Rucio (Caltech Production storage)

Source	Destination	VO	Submitted	Active ↓	Staging	S.Active	Archiving	Finished	Failed	Cancel	Rate (last 1h)	Thr.
➕ davs://redir-11.t2-sense.ultralight.org	davs://xrootd-sense-ucsd-redirector-112.sdsc.optiputer.net	cms	–	529	–	–	–	10472	–	–	100.00 %	32215.50 MiB/s

vlan 4071   vlan 4072   vlan 4073   vlan 4074

20

June 2024

ESnet
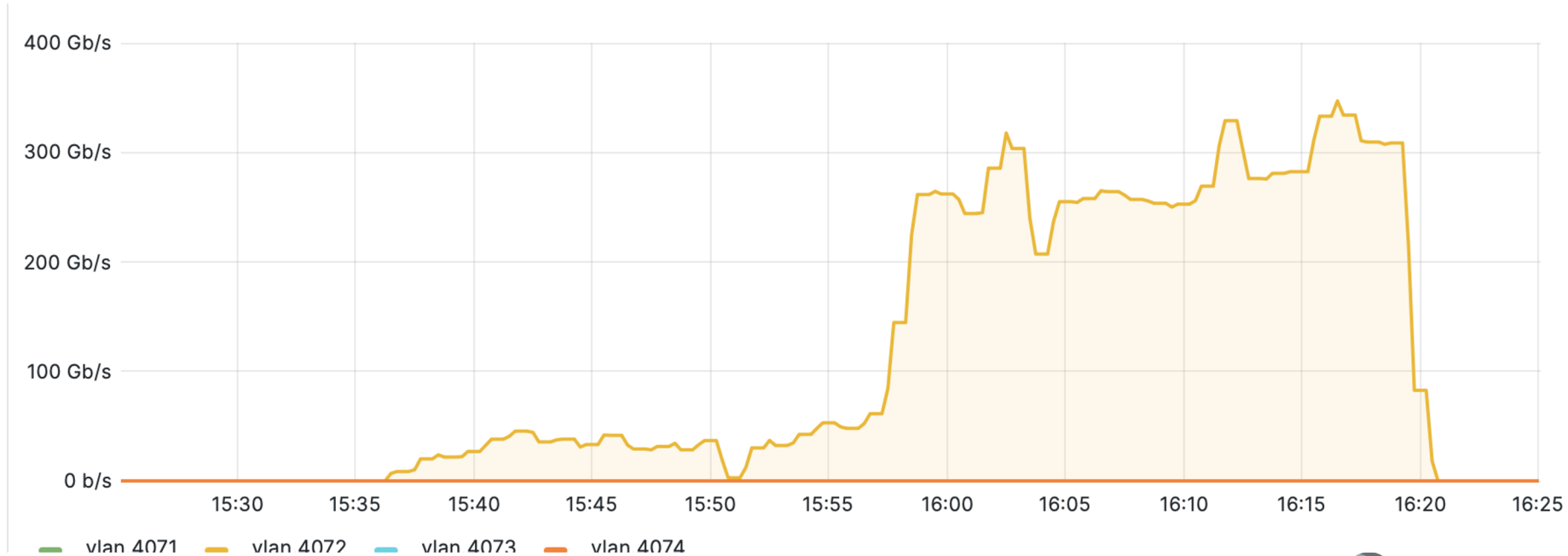
CERN Connections and Systems

SC24 Demonstrations using AutoGOLE/SENSE

- Multiple NREs using AutoGOLE/SENSE infrastructure
  - https://sc24.supercomputing.org/scinet/network-research-exhibition/accepted-nre-demos/

- SENSE/AutoGOLE integration with the Rucio, FTS and XRootD data access and management systems, Global P4 Lab, PolKA, AmLight, FABRIC, RoCE (RDMA over Converged Ethernet), among others.
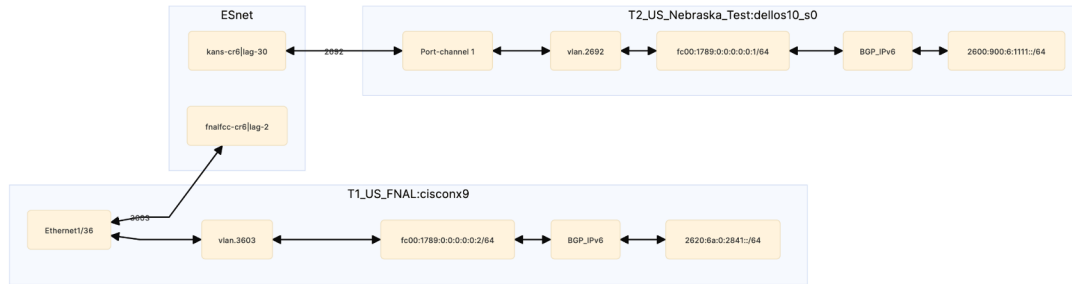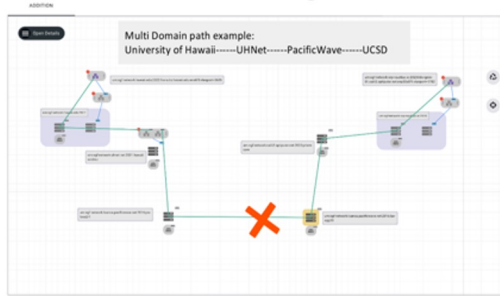
Real Time Monitoring (Nov 19)
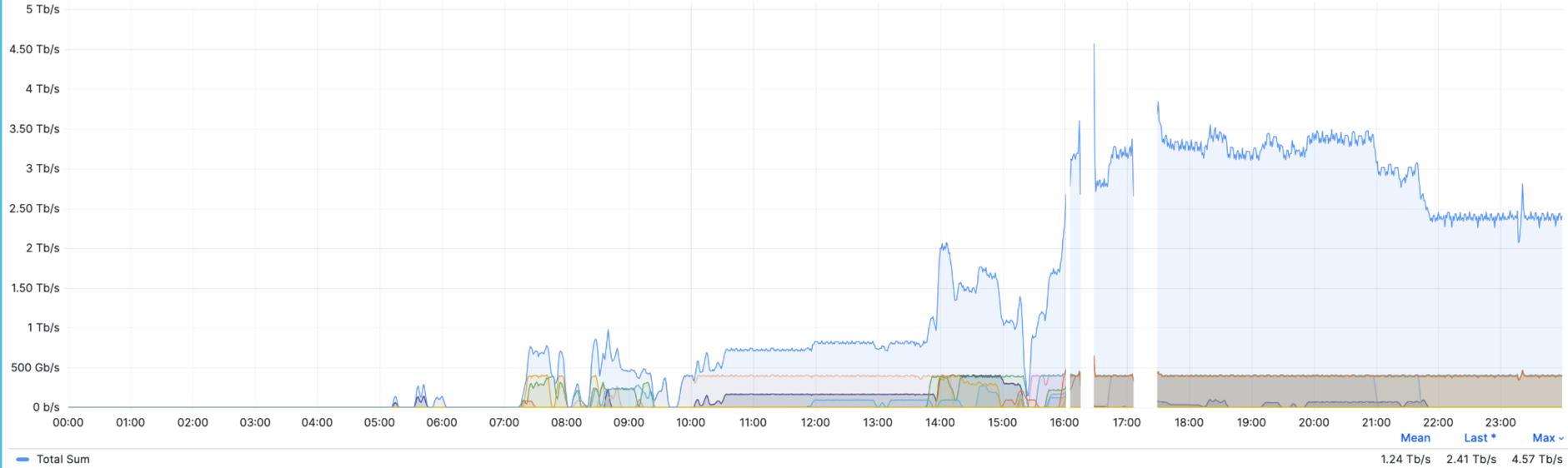
LA Arista Total Octets In, All Ports

Real Time Debugging

Imagine knowing where the network path
is broken at a glance!

Multi Domain path example:
University of Hawaii------UHNet------PacificWave------UCSD

ESnet

| kans-cr6|lag-30 | 2692 | Port-channel 1 | vlan.2692 | fc00:1789:0:0:0:0:0:1/64 | BGP_IPv6 | 2600:900:6:1111::/64 |

T2_US_Nebraska_Test:dellos10_s0

fnalfcc-cr6|lag-2

T1_US_FNAL:cisconx9

| Ethernet1/36 | 3603 | vlan.3603 | fc00:1789:0:0:0:0:0:2/64 | BGP_IPv6 | 2620:6a:0:2841::/64 |

Network Traffic by Packets (enp161s0f0|vlan.3604)

Sharks' attraction to undersea fiber-optic cables has been well-documented over the years.

Screenshot / YouTube

Thanks!