AutoGOLE / SENSE WG and Infrastructure

Infrastructure and Services for Domain Science Workflow Innovation

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GNA-G Community VC Q3 2025
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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

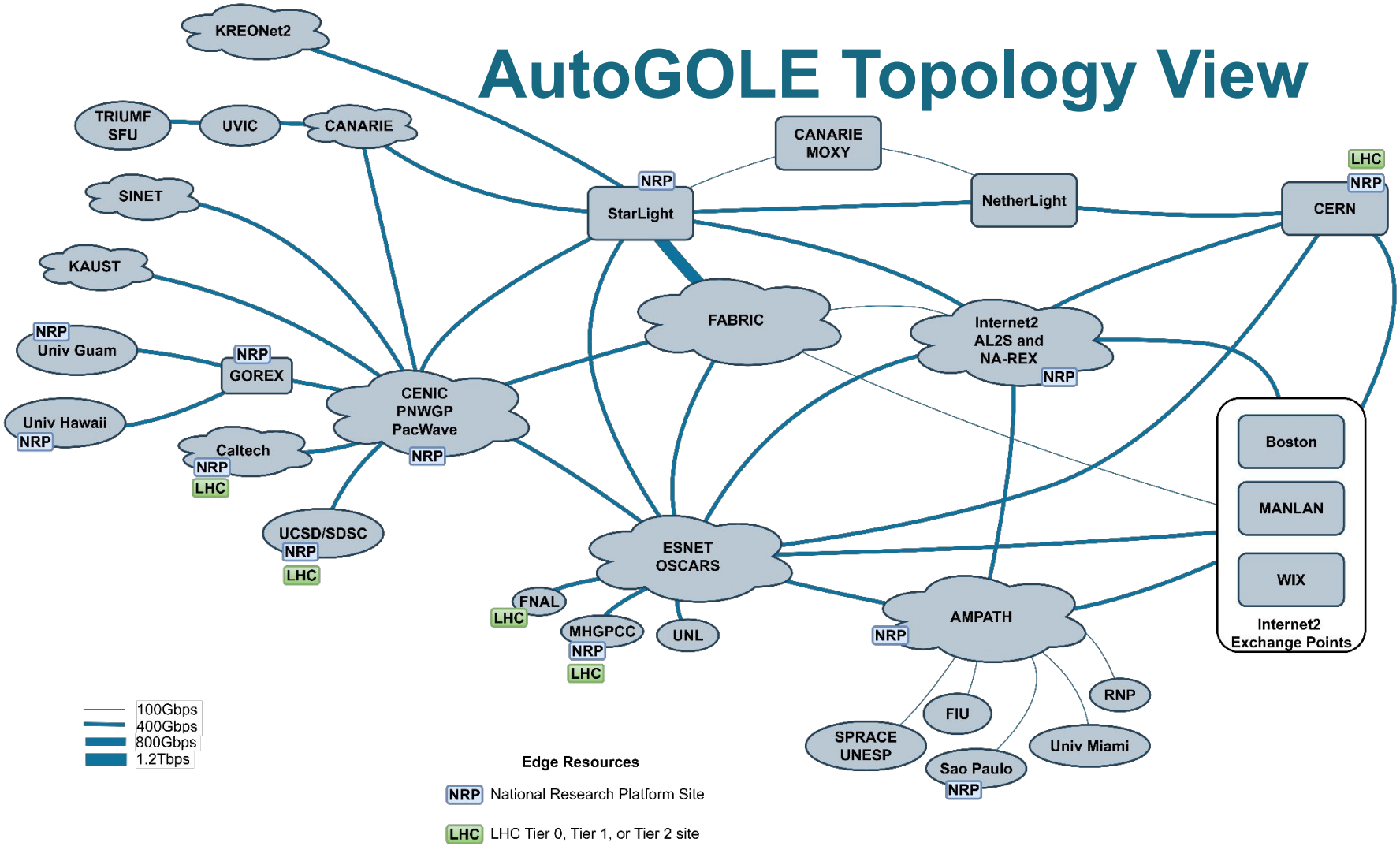
AutoGOLE / SENSE Working Group

- 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:**
  - **AutoGOLE related software:** NSI (OpenNSA, SuPA), SENSE (orchestration and site resources)
  - **Control Plan Monitoring**: Prometheus/Grafana based
  - **Data Plane Verification and Troubleshooting Service**
  - **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

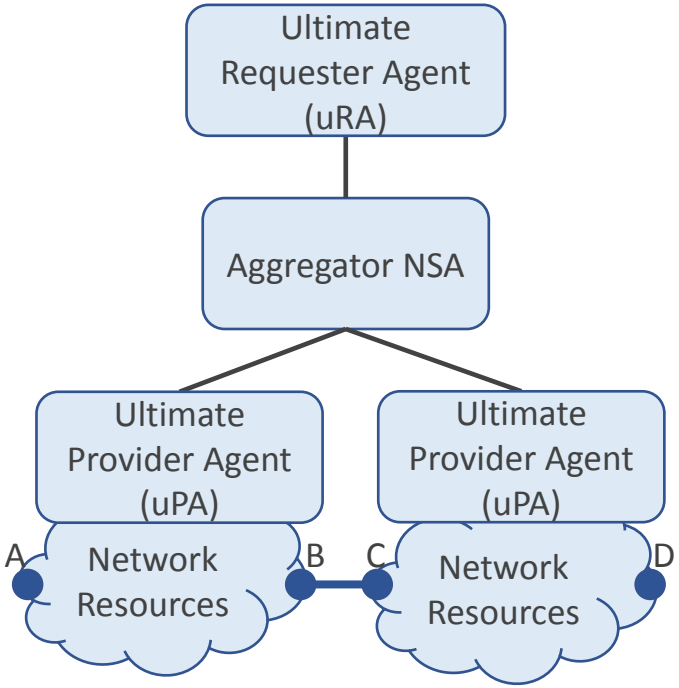
- Infrastructure which provides “end-to-end” network services in a fully automated manner
  - the network elements
  - the network stacks inside the attached end systems (DTNs)
- Leverages the open source software based on:
  - Network Service Interface (NSI): multidomain network provisioning
  - SENSE: 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



OpenNSA

NSI based Provider (uPA)



Safnari

NSI Aggregator

ESnet

NSI Safnari

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)

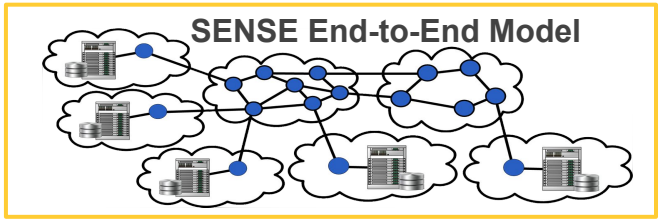
SENSE Architecture

Intent Based APIs with Resource Discovery, Negotiation, Service Lifecycle Monitoring/Troubleshooting

Application Workflow Agent

SENSE Orchestrator

Model Driven SDN Control with Orchestration



Real-time system based on Resource Manager developed infrastructure and service models

RM
UC San Diego
DTN

RM
ESnet
ENERGY SCIENCES NETWORK

RM
Fermilab
DTN

Datafication of cyberinfrastructure to enable intelligent services

RM
Caltech
DTN

RM
CENIC

RM
INTERNET2

RM
UMD MAX
DTN

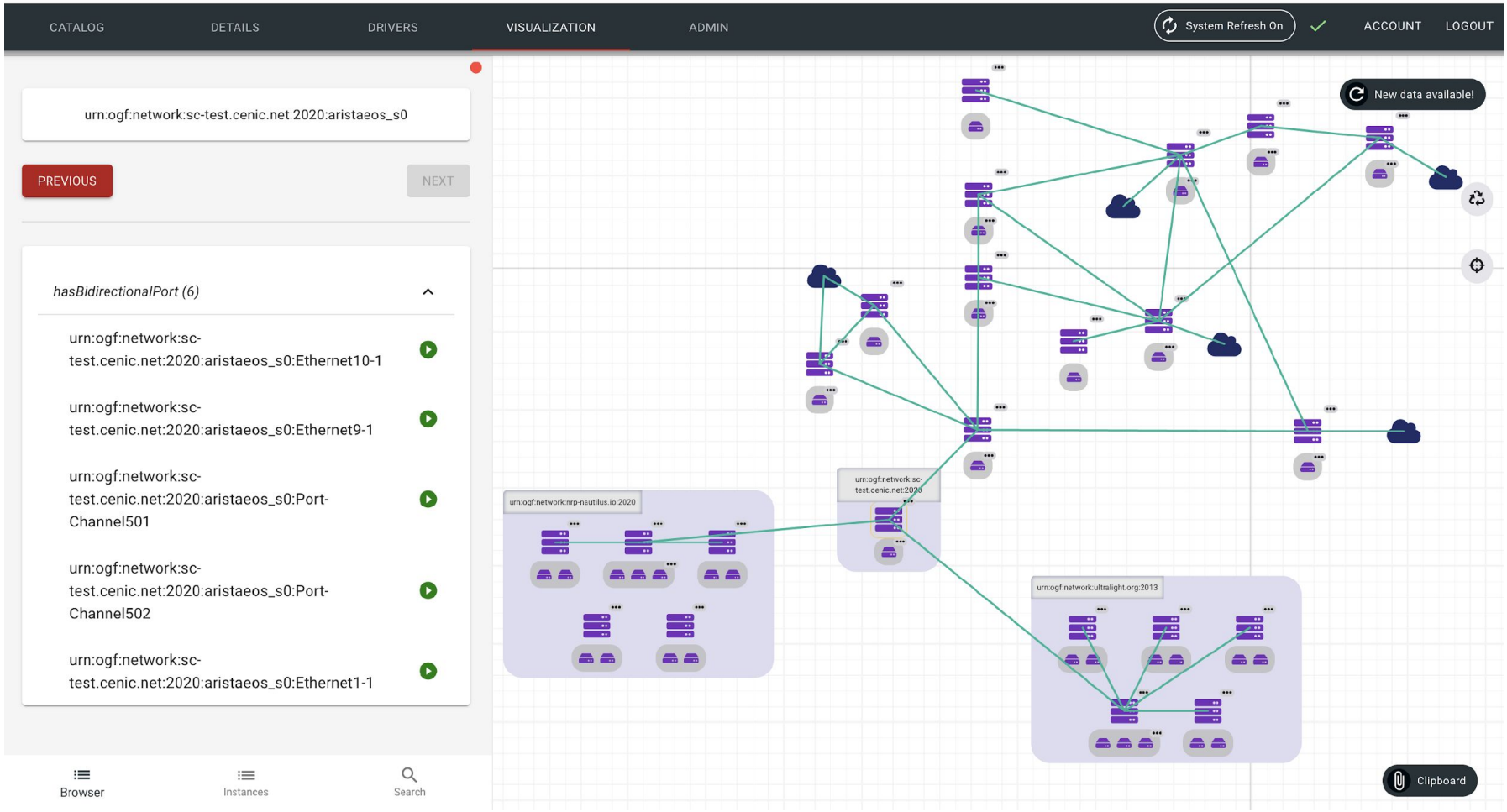
RM SENSE Resource Manager

SENSE Software

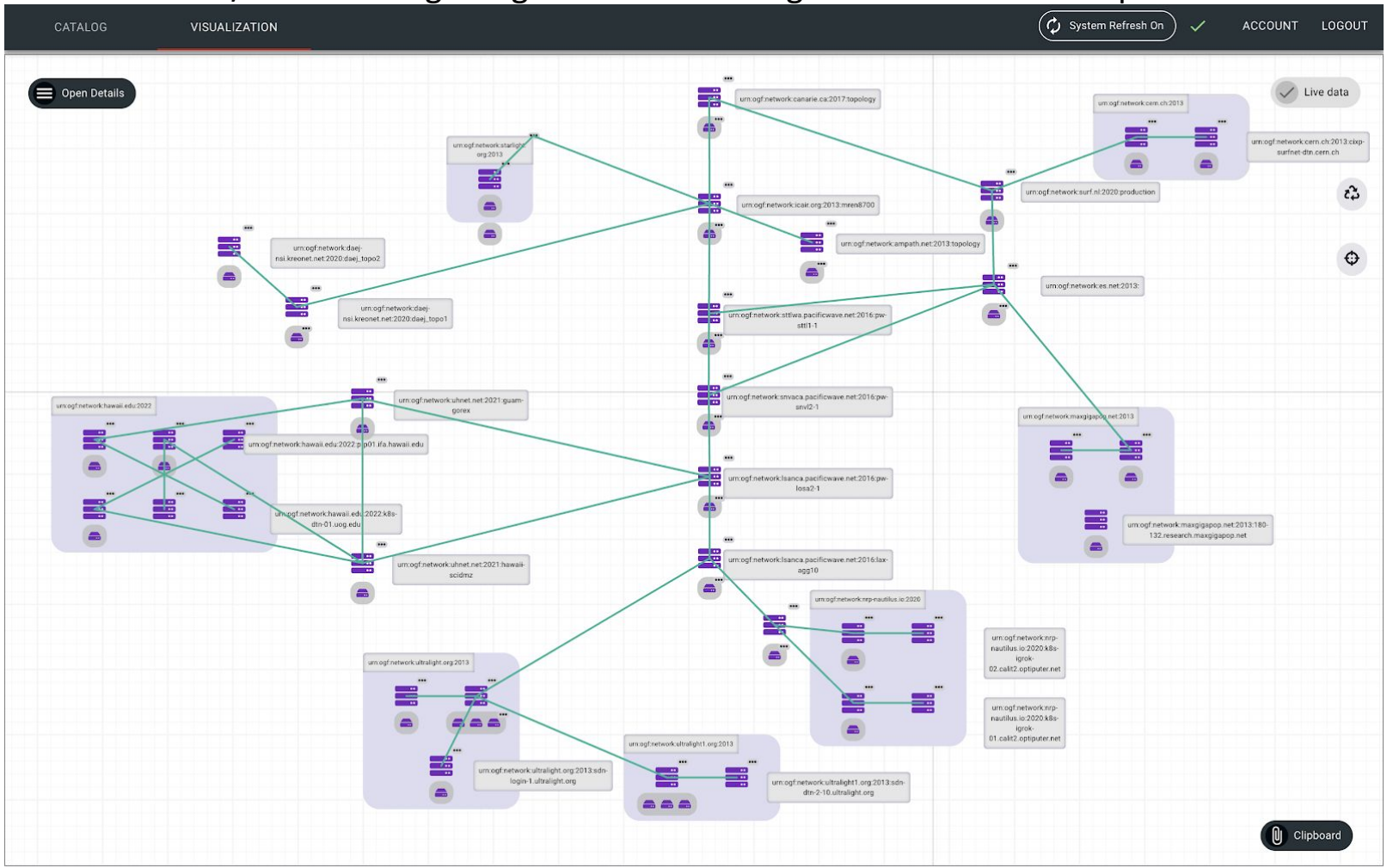
- SENSE
  - Orchestrator
    - sense.es.net
    - Northbound API: https://app.swaggerhub.com/apis/xi-yang/SENSE-O-Intent-API/2.0.4
  - Site Resource Manager
    - https://github.com/sdn-sense
    - https://sdn-sense.github.io/
  - Network Resource Manager
    - https://github.com/esnet/sense-rm

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

SENSE - Model based Resource Descriptions

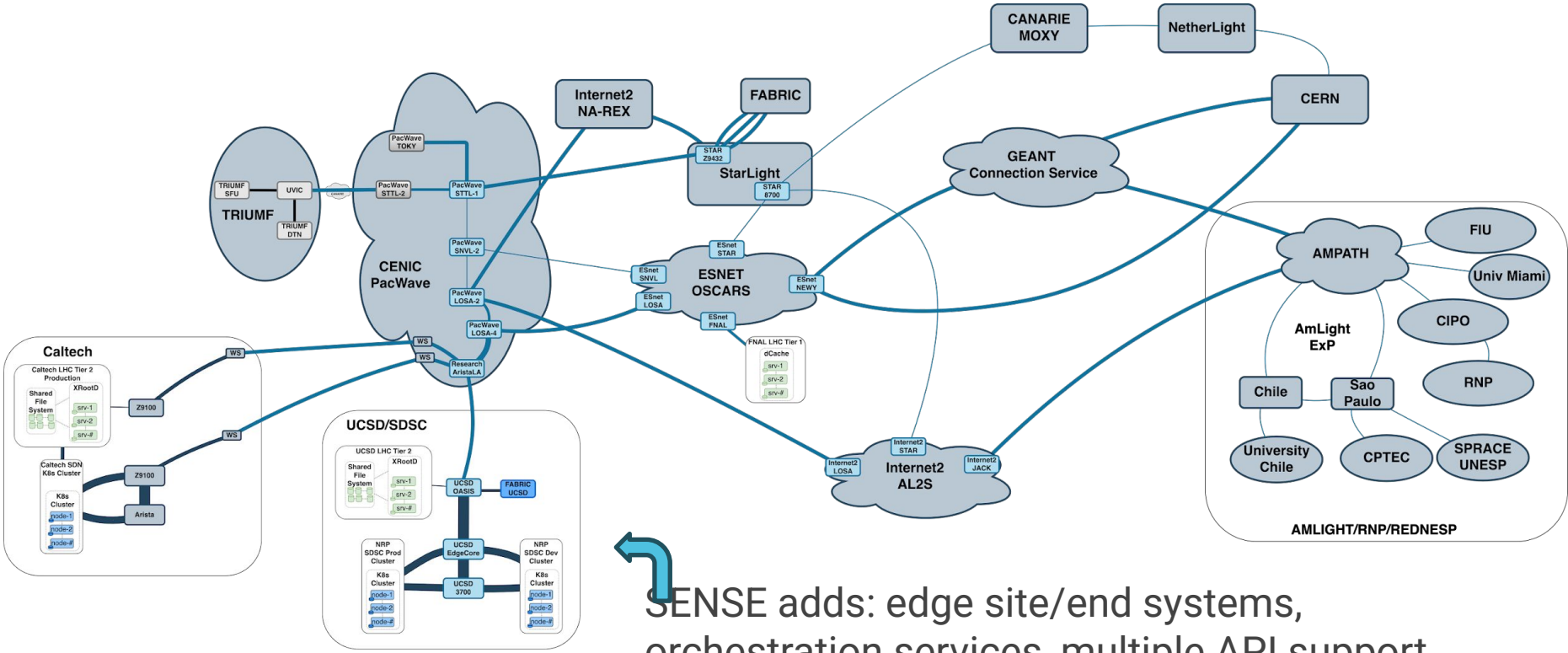


AutoGOLE/SENSE - Integrating and Orchestrating services across multiple Infrastructures



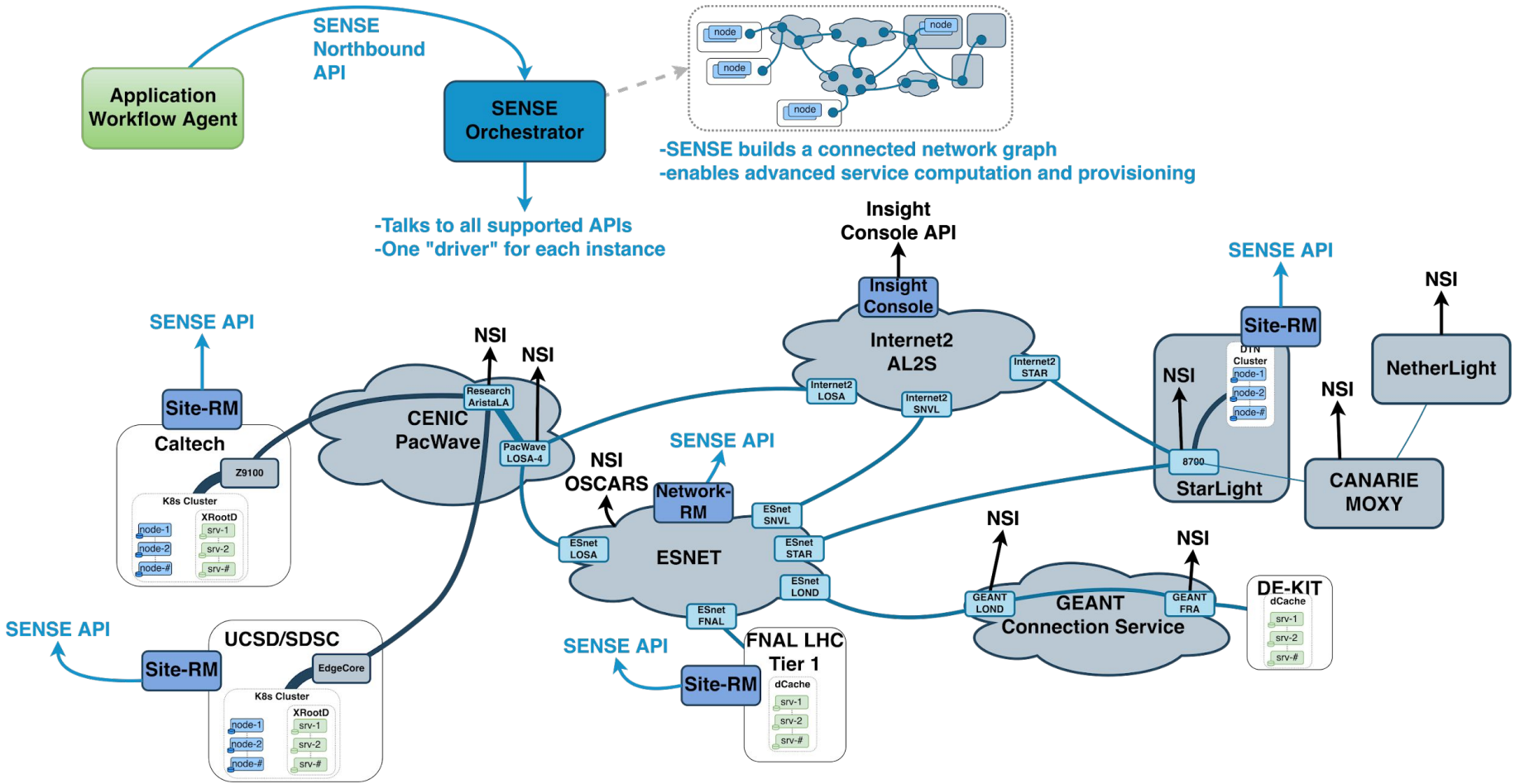
AutoGOLE Infrastructure

- Automated provisioning of Network services



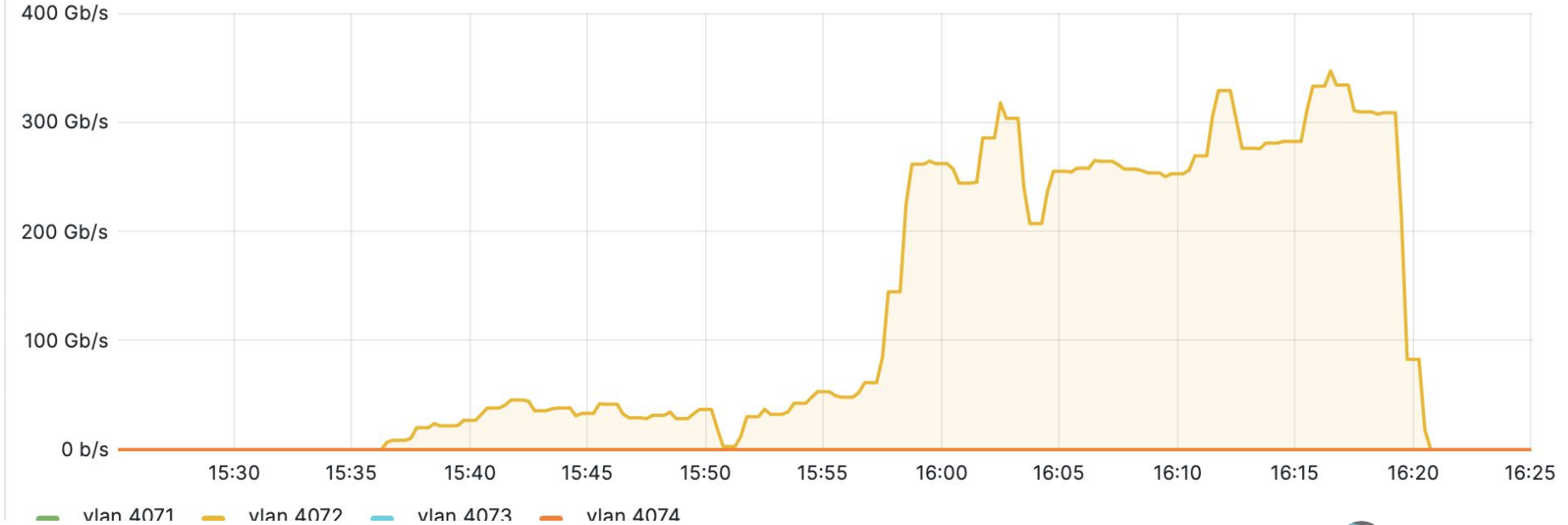
SENSE adds: edge site/end systems, orchestration services, multiple API support

SENSE Overview



SENSE and Rucio (Caltech Production storage)

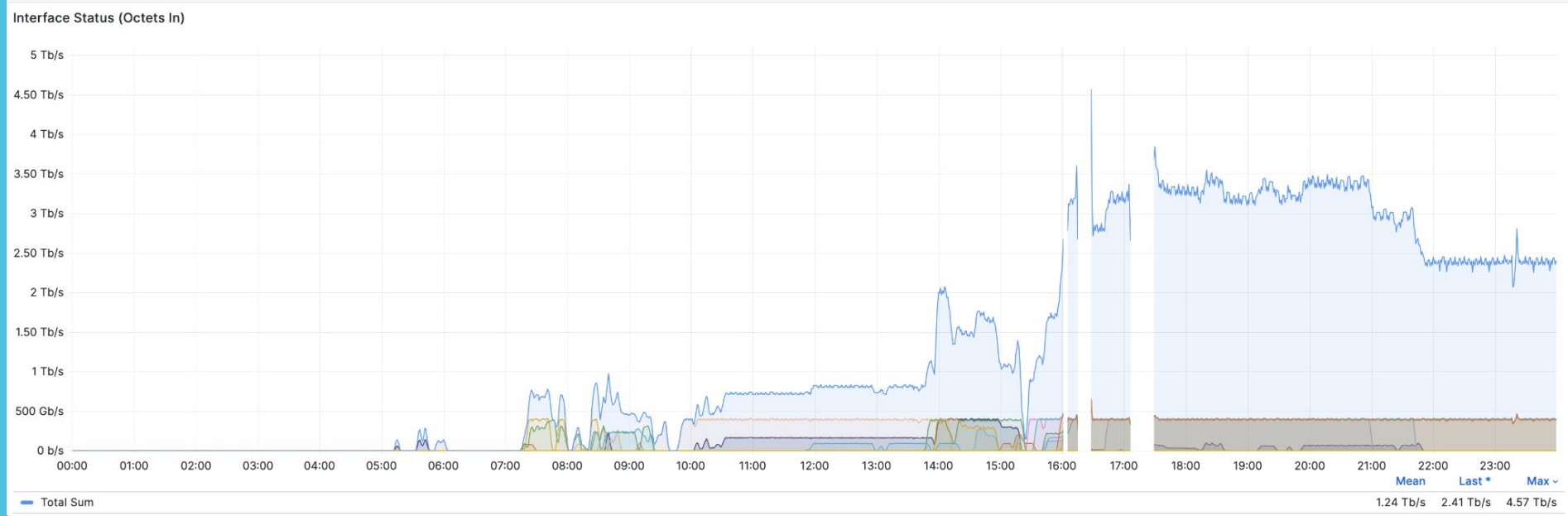
Source	Destination	VO	Submitted	Active	Staging	S.Active	Archiving	Finished	Failed	Cancel	Rate (last 1h)	Thr.
davs://redir-11.t2-sense.ultralight.org	davs://xrootd-sense-ucsd-redirector-112.sdsc.optiputer.net	cms	–	529	–	–	–	10472	–	–	100.00 %	32215.50 MiB/s



June 2024

ESnet

Real Time Monitoring (Nov 19)

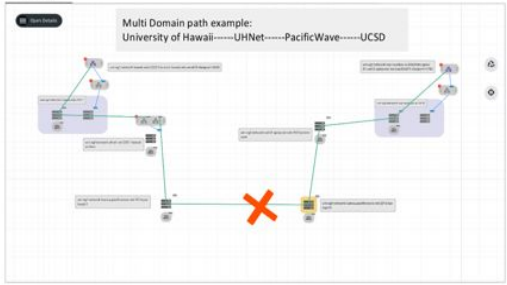


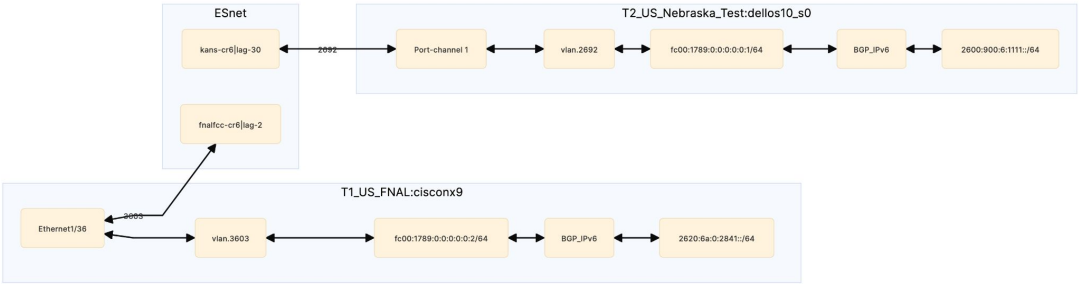
LA Arista Total Octets In, All Ports

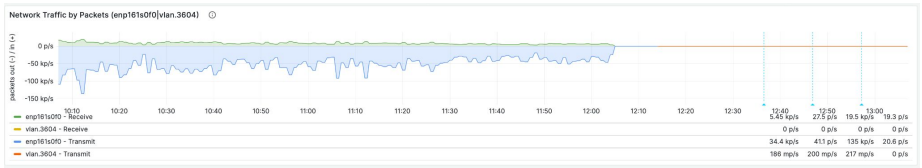
ESnet

Real Time Debugging

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







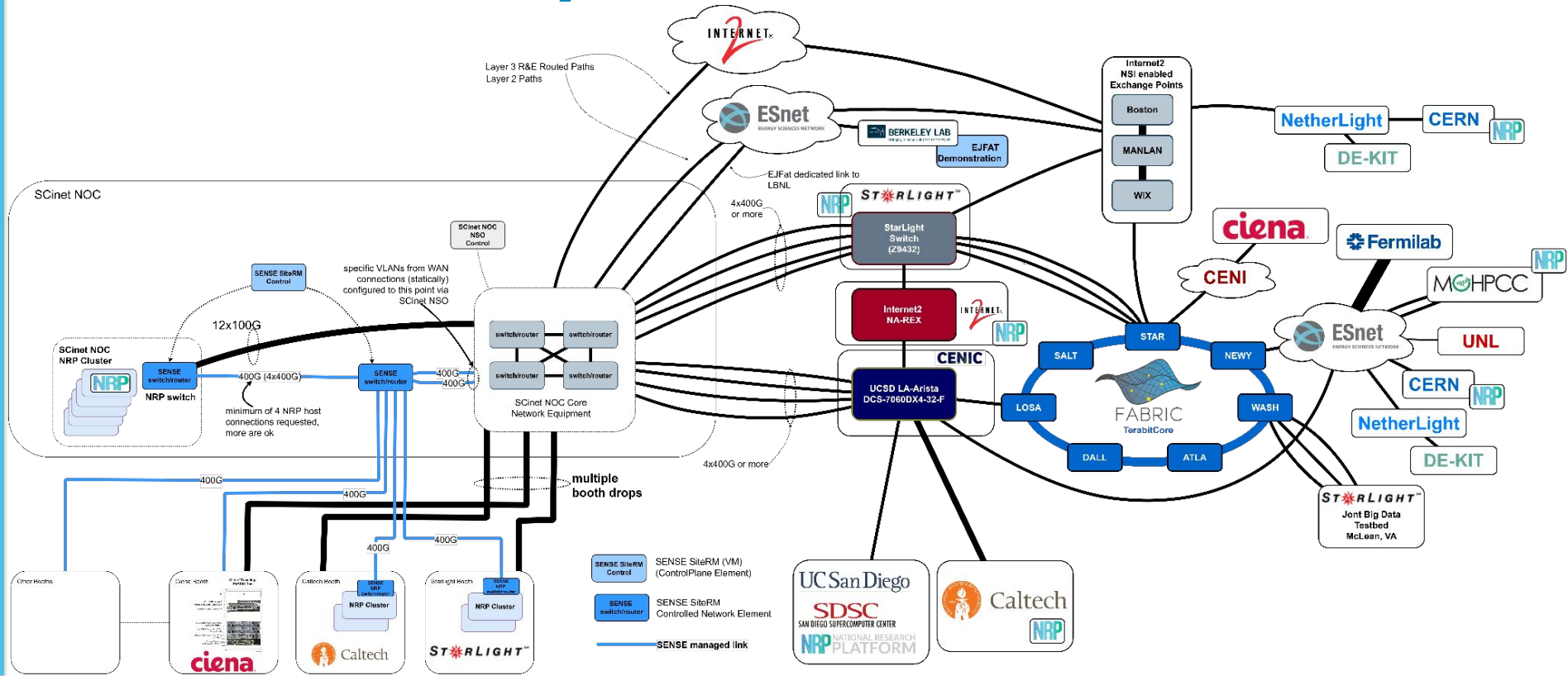
Sharks' attraction to undersea fiber-optic cables has been well-documented over the years.

Screenshot / YouTube

SC25 Demonstrations using AutoGOLE/SENSE

- Multiple NREs using AutoGOLE/SENSE infrastructure
  - Official list to be published (november)
- SENSE/AutoGOLE integration with the Rucio, FTS and XRootD data access and management systems, Global P4 Lab, PolKA, AmLight, FABRIC, NRP, RoCE (RDMA over Converged Ethernet), among others.

SC25 Demonstrations using AutoGOLE/SENSE



NREs using AutoGOLE / SENSE infrastructure

NRE	POC Name	Title
nre106	Tom Lehman	Multi-Resource Cyberinfrastructure Services for Science Domain Workflows via SENSE
nre107	Joe Mambretti	Software Defined Exchange (SDX) Multi-Services for Petascale Science
nre111	Joe Mambretti	Global Research Platform (GRP)
nre116	Justas Balcas	IRI Compute Job Portability
nre117	Tom Lehman	FABRIC
nre119	Mohammad Firas Sada	The National Research Platform and SCinet: Enabling Live, Multi-Institutional Scientific AI/ML and HPC Workflows
nre120	Mohammad Firas Sada	Live High-Precision Per-Packet Kubernetes Data Telemetry from NRP to StarLight via ESnet SENSE
nre121	Mohammad Firas Sada	Real-Time In-Network Machine Learning and P4 Testbed Deployment on FPGA SmartNICs, DPUs, and Switches
nre122	Mohammad Firas Sada	Agentic AI with Qualcomm Cloud AI 100 Ultra Cards for HPC Cluster Management and Resource Provisioning
nre124	Rafael Coelho Lopes de Sa	Advanced capabilities in high-bandwidth research networks
nre125	Harvey Newman	A Next Generation Multi-Terabit/sec Campus and Global Network System for Data Intensive Sciences// The Global Network Advancement Group Data Intensive Science and AutoGOLE/SENSE Working Groups
nre126	Marcos Schwarz	GP4L - Global Platform For Labs
nre128	Carlos A. Ruggiero	High Performance Networking with The Sao Paulo Backbone SP Linking 8 Universities and The Bella Link
nre129	Carlos A. Ruggiero	University of Sao Paulo (USP) High Performance Dark Fiber Infrastructure
nre130	Everson Borges	A Case Study for Data-Intensive Traffic from Vera Rubin Observatory Supported by Path Aware PolKA Network
nre132	Jeronimo Berezza	AmLight 2.0: Flexible control, deep visibility and programmability @ Tbps!

Thanks!