SC26 Network Research Exhibition Abstract

Customized End-to-End Services for Science Workflows via SENSE, NRE 122

Tom Lehman, ESnet, tlehman@es.net
Xi Yang, ESnet, xiyang@es.net
Justas Balcas, ESnet, jbalcas@es.net

Abstract

Domain science workflows often require integration across a heterogeneous set of data, compute, storage, and instruments which are located at different facilities. Operation within this distributed Cyberinfrastructure context is rapidly increasing due to the emergence of new Artificial Intelligence (AI) motivated workflows, the Department of Energy focus on building a virtual "SuperFacility" based on seamless integration across its many facilities, and general technology trends which require dynamic and configurable access to many different types of resources. SENSE is an Orchestration system which enables the instantiation of end-to-end network services which can be customized and presented to workflow agents in application specific context, and includes full lifecycle service modifications, monitoring, and troubleshooting. Figure 1 shows how SENSE fits into the overall science domain workflow ecosystem.

The SENSE Orchestration focus is to enable the construction of topologies which integrate distributed Compute, Storage, Instrument, and Network resources for domain science workflows. These types of topologies requires integration across disparate technology domains, administrative boundaries, identity verification, and resource access authorization.

In this context, the SENSE system focuses primarily on the network domain. While all of the technology domains need to know enough about the other integrated domains to access their services, the network component is the "glue" that can bring all of the components together in a functional manner. As a result, SENSE typically has a more detailed understanding and feature sets which extend into the other technology domains. Figure 2 shows how SENSE enables workflow agents to consider network services as part of overall resource planning and scheduling activities

For instance, SENSE can build an end-to-end guaranteed bandwidth network service which connects Data Transfer Nodes (DTN) or Kubernetes clusters at different sites. In this context end-to-end includes the networks between these two sites, and the network stacks inside the end-systems.

This NRE demonstration will show the SENSE system in action on integrated topologies which include external facilities and also on the SCinet National Research Platform (NRP) Kubernetes Cluster in SCinet NOC. The demonstrated functionality will include:

- Rucio's use of SENSE services spanning production and prototype systems for LHC CMS and ATLAS facilities at NET2 MGHPCC/UMass, FermiLab, CERN, SCinet NRP Cluster, and others.
- SENSE managed fine grained traffic engineering to adjust bandwidth guarantees in realtime.
- SENSE services integration with prototype LHC site data movement end systems including the site XRootD/dCache clusters.
- Show the SENSE Priority Network service which can be used as part of the LHC Rucio driven data management and movement workflows. Figure 3 below provides an overview of this service.
- SENSE Service Specific end-to-end data flow monitoring and troubleshooting dashboard.

Goals

1. Demonstrate the value of end-to-end multi-resource orchestration for domain science workflows along with SENSE functions and deployment status.

2. Show prototype and production architectures for future site data movement clusters based on Kubernetes and SENSE integration and end-to-end QoS features. A namespace on the SCinet NRP cluster with an LHC XRootD deployment will be used for this.
3. Support for other demonstrations using SENSE services for connections to external systems, SCinet National Research Platform (NRP) Cluster, local SC26 Exhibit floor booths, and external resources.

Resources

- Wide area connections from ESnet and Internet2 Chicago area production networks to the SCinet NRP cluster.
- SENSE enabled switch/router next to the SCinet NRP cluster for Multus based SENSE network services integration.
- Figure 4 shows an overview of the SENSE enabled SC26 Exhibit and NRE demonstration support infrastructure.

Involved Parties

- Tom Lehman, ESnet, tlehman@es.net
- Xi Yang, ESnet, xiyang@es.net
- Justas Balcas, ESnet, jbalcas@es.net
- Mohammad Sada , mfsada@es.net
- Alberto Jimenez, ESnet, ajimenez@es.net
- Kiran Vasu, ESNet, kvasu@es.net
- Chin Guok, ESnet, chin@es.net
- Inder Monga, ESnet, inder@es.net
- John Graham, UCSD, jjgraham@ucsd.edu
- Frank Würthwein, UCSD, fkw@ucsd.edu
- Tom Hutton, UCSD, hutton@sdsc.edu
- Chris Hughes, UCSD, crhughes@sdsc.edu
- Aashay Arora, UCSD, aaarora@ucsd.edu
- Diego Davila, UCSD, didavila@ucsd.edu
- Harvey Newman, Caltech, newman@hep.caltech.edu
- Preeti Bhat, Caltech, preeti@caltech.edu
- Andres Moya, Caltech, amoya@caltech.edu
- Marcos Felipe Schwarz, RNP, marcos.schwarz@rnp.br
- Everson Scherrer Borges, IFES, everson@ifes.edu.br
- Phil Demar, FNAL, demar@fnal.gov
- Asif Shah, FNAL, sshah@fnal.gov
- Dmitry Litvintsev, FNAL, litvinse@fnal.gov
- Eduardo Bach, UMASS, eduardobach@umass.edu
- Rafael Coelho Lopes de Sa, UMASS, rclsa@umass.edu
- Jessa Westclark, UMASS, jessicaw@umass.edu
- Fei Yeh, Northwestern University, fyeh@northwestern.edu
- Jim Hao Chen, Northwestern University, jim-chen@northwestern.edu
- Joe Mambretti, Northwestern University, j-mambretti@northwestern.edu

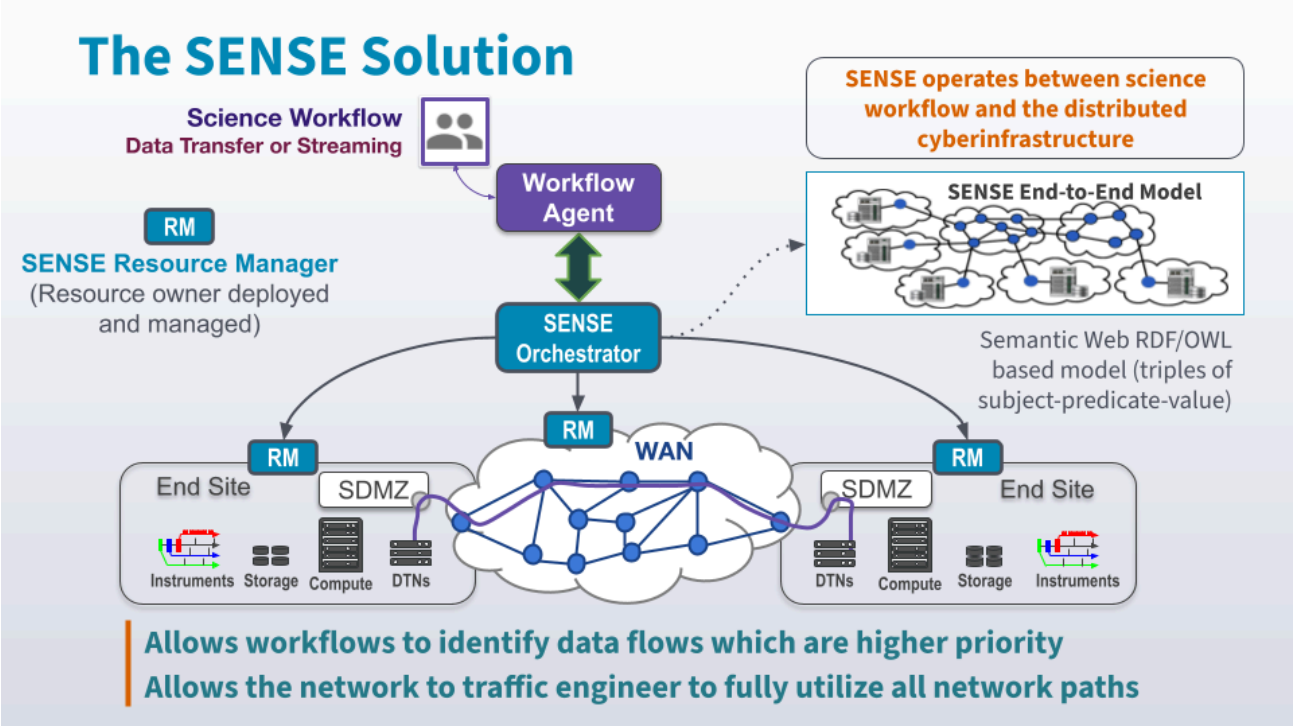


Figure 1 SENSE operation within a science domain workflow ecosystem

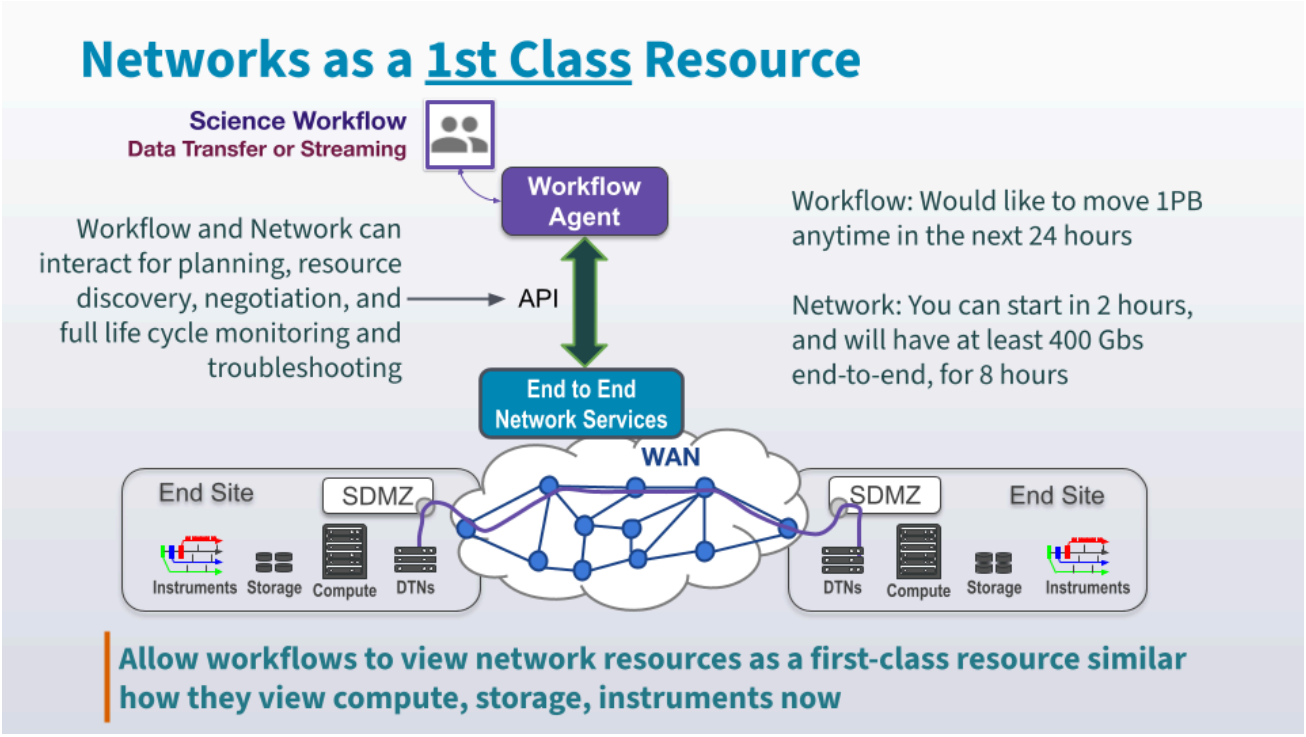


Figure 2 Network Resources available for science workflow planning and scheduling

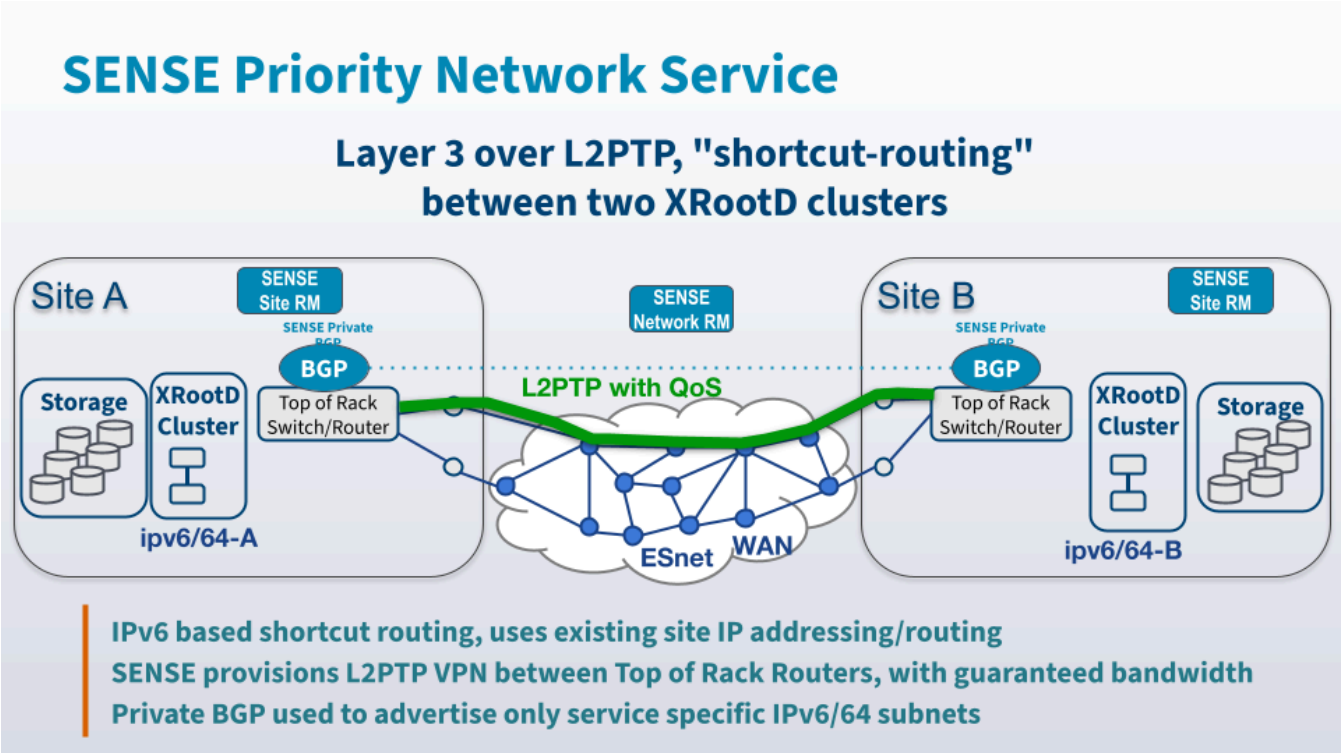


Figure 3 SENSE Priority Network Service

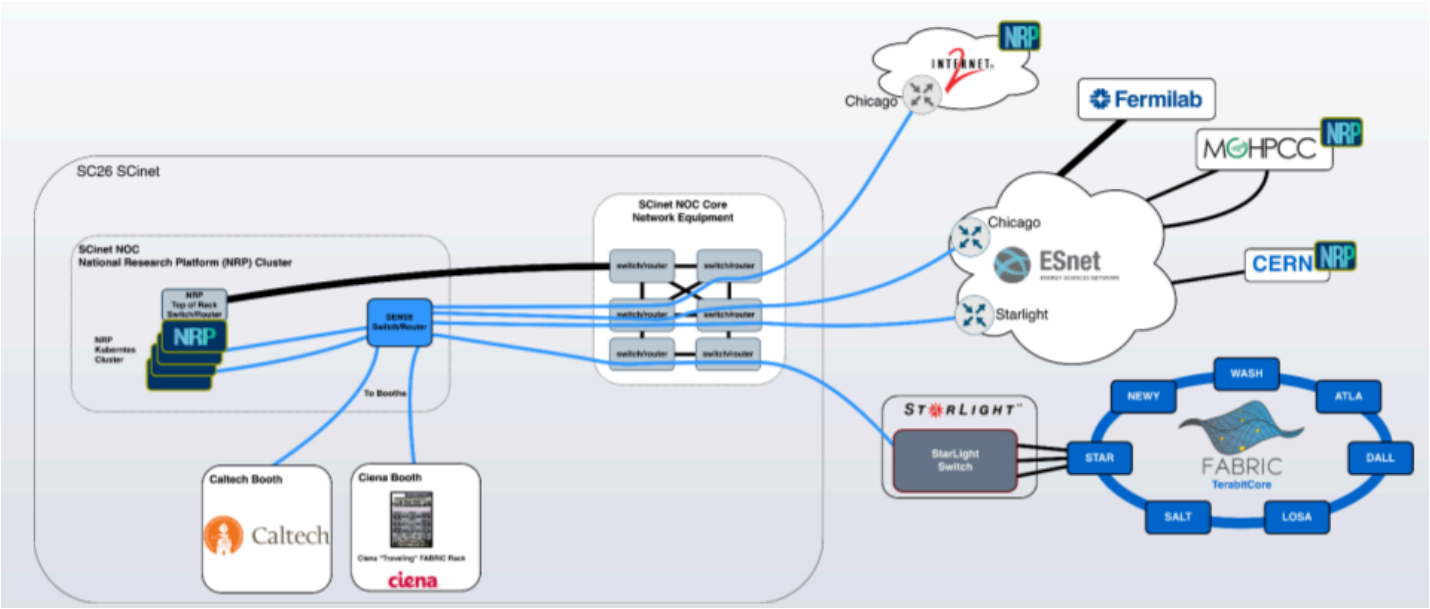


Figure 4 SENSE SC26 NRE Demonstration Topology