SC18 Network Research Exhibition

SENSE: SDN for End-to-end Networked Science at the Exascale

Submitted by the SENSE Team

Abstract

The Software-defined network for End-to-end Networked Science at Exascale (SENSE) research project is building smart network services to accelerate scientific discovery in the era of 'big data' driven by Exascale, cloud computing, machine learning and AI. The project's architecture, models, and demonstrated prototype define the mechanisms needed to dynamically build end-to-end virtual guaranteed networks across administrative domains, with no manual intervention. In addition, a highly intuitive 'intent' based interface, as defined by the project, allows applications to express their high-level service requirements, and an intelligent, scalable model-based software orchestrator converts that intent into appropriate network services, configured across multiple types of devices. The significance of these capabilities is the ability for science applications to manage the network as a first-class schedulable resource akin to instruments, compute, and storage, to enable well defined and highly tuned complex workflows that require close coupling of resources spread across a vast geographic footprint such as those used in science domains like high-energy physics and basic energy sciences.

Demonstration Activities

The SENSE SC18 demonstration showcases a comprehensive approach to request and provision end-to-end network services across domains that combines deployment of infrastructure across multiple labs/campuses, SC booths and WAN with a focus on usability, performance and resilience through:

- Intent-based, interactive, real time application interfaces providing intuitive access to intelligent SDN services for Virtual Organization (VO) services and managers;
- Policy-guided end-to-end orchestration of network resources, coordinated with the science programs' systems, to enable real time orchestration of computing and storage resources.
- Auto-provisioning of network devices and Data Transfer Nodes (DTNs);
- Real time network measurement, analytics and feedback to provide the foundation for resilience and coordination between the SENSE intelligent network services, and the science programs' system services.
- Priority QoS for SENSE enabled flows
- Multi-point and point-to-point services

Demonstration Topology

A SENSE testbed consisting of network and end-system resources has been deployed across DOE Laboratories, Universities facilities, and ESnet. To control network resources, the SENSE system interacts with production provisioning system of Energy Sciences Network (ESnet) and other regional and site networks. To control end-systems, SENSE software is deployed at the end-sites. For production DTNs, limited access is provided by tailoring the set of SENSE based dynamic configurations to match local site polices. This approach to use a mix of production and research

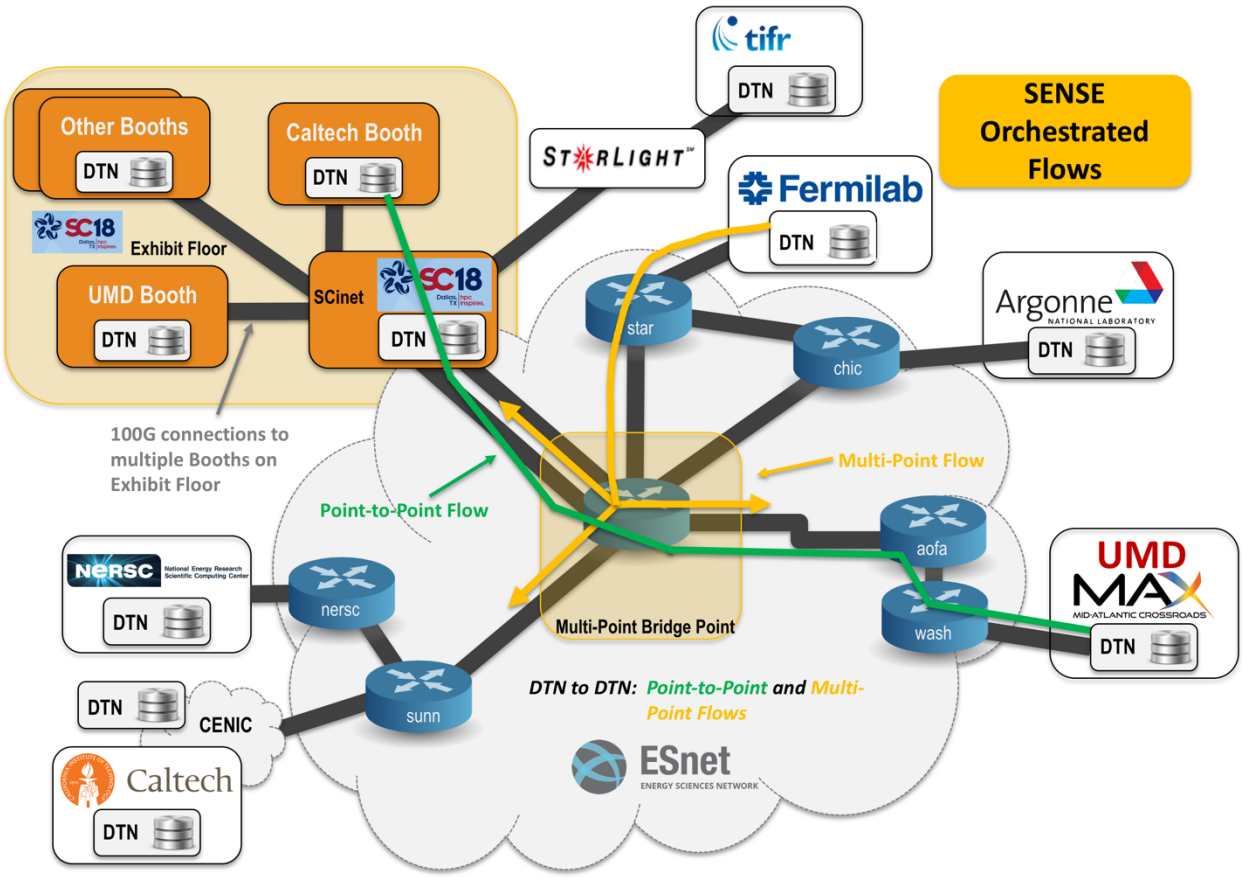

Figure 1 SENSE SC18 Demonstration Topology

resources enables experience with various real-world site deployments and considerations. This testbed is utilized to develop and test the SENSE software, as well as test with domain science use cases.

The SENSE demonstration at SC18 utilizes this persistent testbed and adds resources on the exhibit showroom floor at SC18. As shown in Figure 1, the SC18 resources include DTNs resources deployed in the Caltech and University of Maryland booths. Connections to the SC18 SCinet infrastructure provides multiple 100 Gbps connections back to the SENSE testbed. This infrastructure will be utilized to demonstrate the end-to-end SENSE services and includes high speed data transfers and provisioning services. The service provisioning demonstration illustrates the interaction between Application Workflow Agents and the SENSE system through an Intent based request API supporting interactive negotiations.

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