SC26 Network Research Exhibition: Demonstration Publishable Abstract

Disk-to-Disk Packet Marking and Global Production Workflow Visibility

Tristan Sullivan, University of Victoria, tssulliv@uvic.ca

Abstract

Managing large-scale scientific workflows over international WANs will become increasingly complex as multiple science projects share underlying resources while governed by divergent variables, constraints, and technologies. This NRE demonstration will showcase scientific network tags (Scitags), an open-source initiative promoting high-fidelity visibility into how individual science domains utilize end-to-end network resources. Building upon previous international demonstrations, this SC26 NRE will expand the scope to showcase two distinct areas: advanced 1.6 Tbps networking capabilities and active production workflow monitoring.

The high-rate portion of the NRE will consist of multiple sites sending marked transfers to the Starlight booth at the exhibition floor. The participating sites are the University of Victoria (UVic), CERN, and Fermilab (FNAL), which will be connected at 1.6 Tbps, 1.2 Tbps, and 400 Gbps, respectively. All connectivity will come to SCinet via Starlight. The path from UVic is partly provisioned as two 800 Gbps links using coherent optics; the path from CERN to UVic consists of multiple 300 Gbps paths, provisioned across multiple 400G transatlantic circuits using SENSE.

Each sending site is equipped with multiple 400 Gbps Data Transfer Nodes (DTNs). Transfers will be done with iperf3 to assess the maximum achievable bandwidth, and also with xRootd and dCache to demonstrate the viability of packet marking in disk-to-disk transfers and assess the bandwidth achievable in that case.

We will also conduct a live production demonstration of the flow labelling ("fireflies"), in collaboration with US/ATLAS and US/CMS sites, including Brookhaven National Laboratory (BNL) and Fermi National Accelerator Laboratory (FNAL). The sites will actively participate by exchanging data over production networks. We will produce monitoring dashboards showing the flows sorted by applied scientific activities and will report the live results directly at the StarLight booth on the SC26 show floor. This will demonstrate how any intermediate network or end-site can easily identify both the owner and the purpose of the traffic, providing standardized and detailed visibility into the nature of HEP traffic running to and from their sites.

Goals

1. Demonstrate international WAN services for data intensive sciences, including at 1.6 Tbps E2E from Uvic to the StarLight booth at the SC26venue and 1.2 Tbps from CERN to the SC6 venue using several 300 Gbps links provisioned across multiple domains and paths
2. Utilize all available bandwidth to the exhibition floor with memory-to-memory transfers from multiple 400 Gbps DTNs at UVic, CERN, and FNAL
3. Demonstrate international 2x800 Gbps WAN paths, in part using coherent optical channels
4. Evaluate achievable bandwidth in disk-to-disk transfers using the same WAN services and infrastructure
5. Produce a monitoring dashboard showing the flows sorted by label applied
6. Showcase the usage of Scitags in production by displaying firefly statistics on the exhibition floor
7. Demonstrate the utility of SENSE as a provisioning method

Impacts

The main initial goal of the Scitags project is to enhance visibility into R&E network flows. Using Scitags, not only the owner of the traffic but also the purpose can be identified. With the flow labeling approach, many other network statistics can also be exposed. By showing the current status of production usage, we can demonstrate how experiments can use the information provided to gain a deeper understanding of their network usage.

Previous NREs have mainly focused on the bandwidth achievable by memory-to-memory transfers with packet marking enabled. For SC26, we will also test the impact of packet marking on disk-to-disk transfers from multiple sites. This is a more direct measurement of the impact that would be expected by enabling packet marking on production storage. This is an important measurement ahead of the WLCG Data Challenge to be held in early 2027, for which a significant fraction of storage elements are expected to enable packet marking.

Resources

This NRE demonstration will be conducted using resources of the collaborating domains, including global high-bandwidth paths among DTNs at or connected to international Open

Exchange Points and the SC26 venue, especially the paths developed for that venue by the SCinet WAN group. These include a 1.6 Tbps paths provided by CANARIE, StarLight, NA-REX, the Meteropolitan Research and Education Network (MREN), PacWave, and the SCinet WAN, a 1.2 Tbps path from CERN provided by ESNet, and a 400G path from FNAL provided by ESNet. Participating Open Exchange Points include CERNLight, the StarLight International/National Communications Exchange Facility, and the Pacific Northwest GigaPoP. At the venue, 1.6 Tbps network and server resources in the StarLight booth will be used.

Involved Parties

The Scitags initiative is an open international collaboration that originated as a WLCG Networking Technical Working group developing practical networking capabilities for HEP research using National Research and Education Networks (NRENs), including the LHCOPN and LHCONE.

- Tristan Sullivan, UVic, tssulliv@uvic.ca
- Marian Babik, CERN, Marian.Babik@cern.ch
- Shawn McKee, U Michigan, smckee@umich.edu
- Edoardo Martelli, CERN, edoardo.martelli@cern.ch
- Maria Del Carmen Misa Moreira, CERN, carmen.misa.moreira@cern.ch
- Joe Mambretti, StarLight/MREN/iCAIR Northwestern Univ, j-mambretti@northwestern.edu
- Jim Chen, StarLight/iCAIR Northwestern Univ, jim-chen@northwestern.edu
- Tom Lehman, ESnet, tlehman@es.net
- Phil DeMar, FNAL, demar@fnal.gov
- Syed Asif Shah, FNAL, sshah@fnal.gov
- Diego Davila, UCSD, didavila@ucsd.edu
- Arno Bakker, SURF <arno.bakker@surf.nl>
- Motohashi Kodai, SINET, ko-motohashi@ote.kddi.com
- Osamu Akashi, SINET, akashi@nii.ac.jp
- Hirotaka Sato, SINET, ir-satou@ote.kddi.com
- Xi Yang, ESnet, xiyang@es.net
- John Graham, UCSD, jjgraham@ucsd.edu
- Richard Klinger, CANARIE, richard.klinger@canarie.net
- Fei Yeh, StarLight/MREN/iCAIR Northwestern Univ, <fyeh@northwestern.edu>
- Scott Kohlert, Ciena, skohlert@ciena.com