



ESnet

ENERGY SCIENCES NETWORK

The Energy Sciences Network: Overview and Impact

NERSC Users Group 2016

Berkeley, CA

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Kate Petersen Mace

Energy Sciences Network (ESnet)

Science Engagement Engineer

Lawrence Berkeley National Laboratory

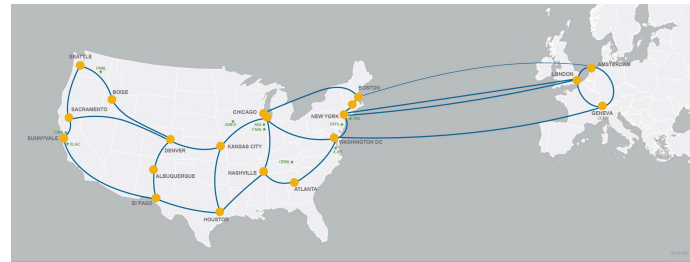


U.S. DEPARTMENT OF
ENERGY

Office of Science



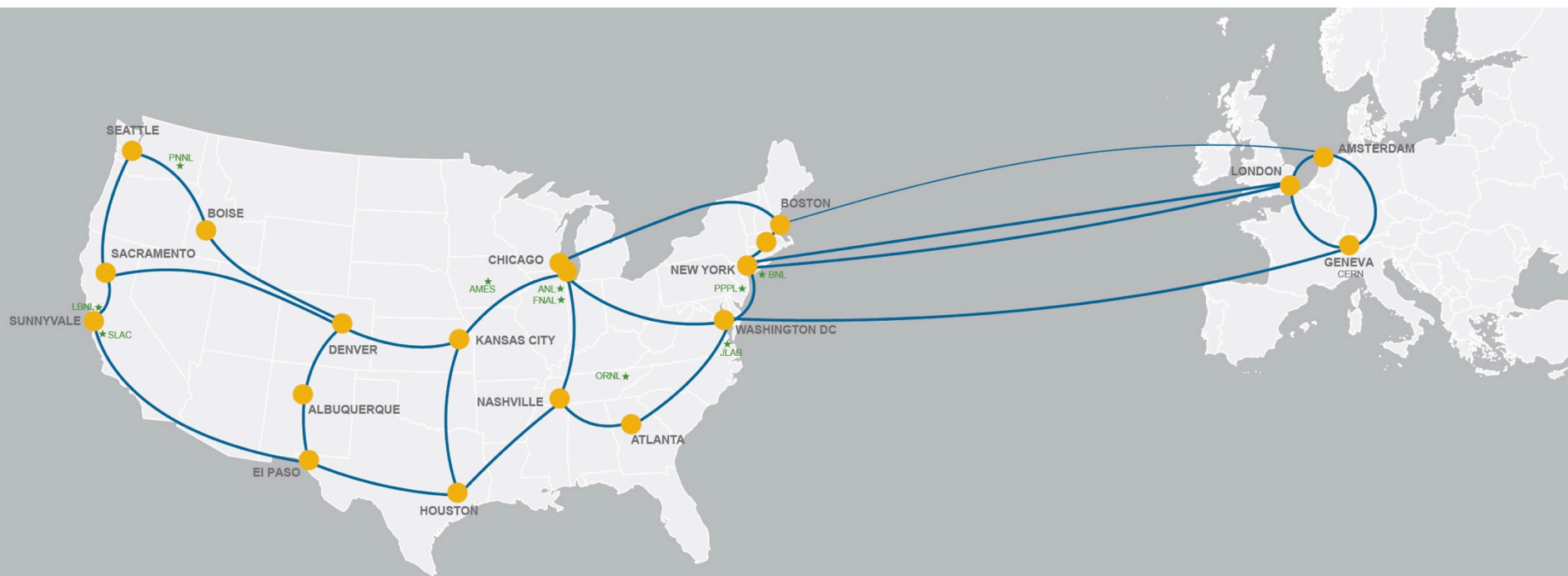
Overview



Impact



ESnet is a **dedicated mission network** engineered to accelerate a broad range of science outcomes.



We do this by offering unique capabilities, and optimizing the network for data acquisition, data placement, data sharing, data mobility.

Our vision:

Scientific progress will be **completely unconstrained** by the physical location of instruments, people, computational resources, or data.

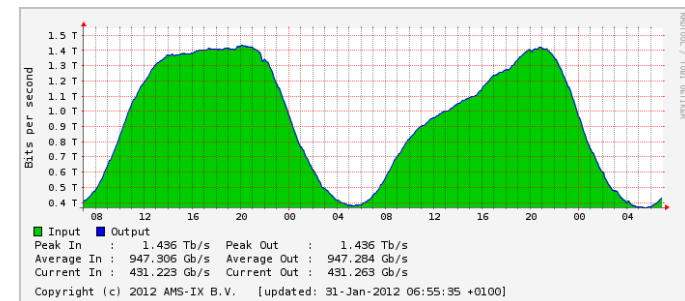
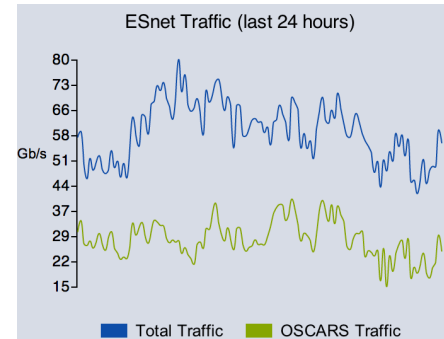
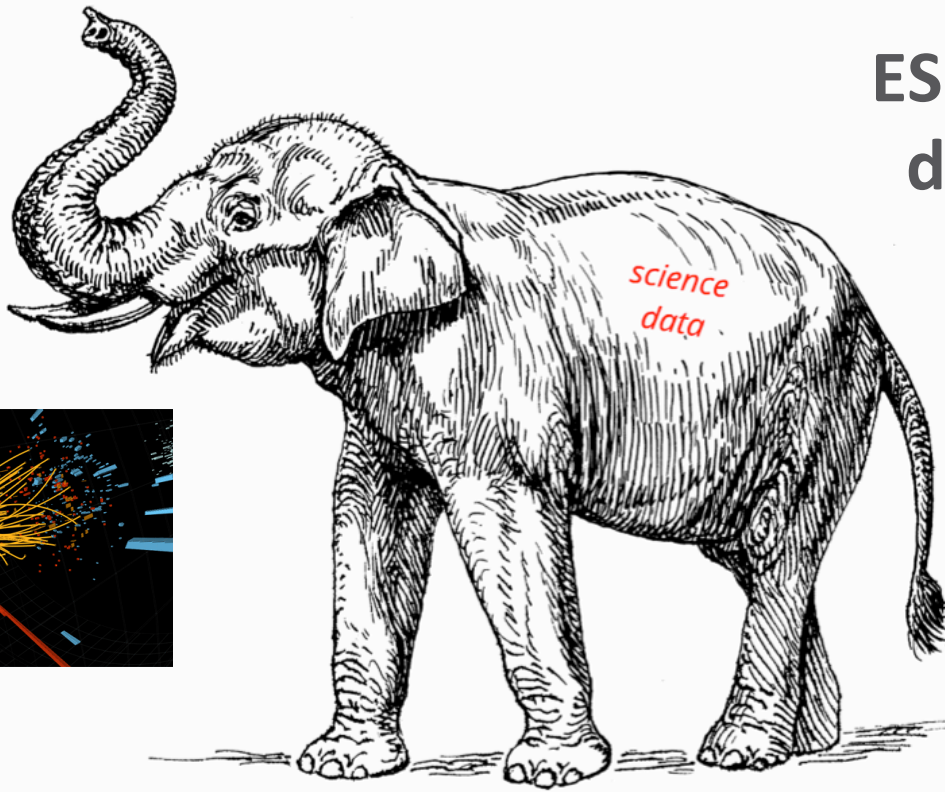
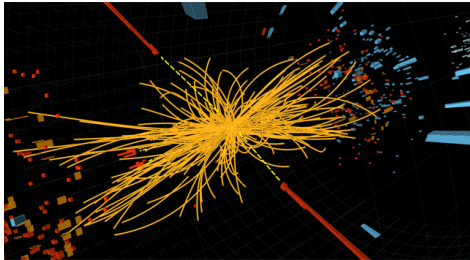
The basic facts (new or notable):



High-speed **international** networking facility, optimized for DOE science missions:

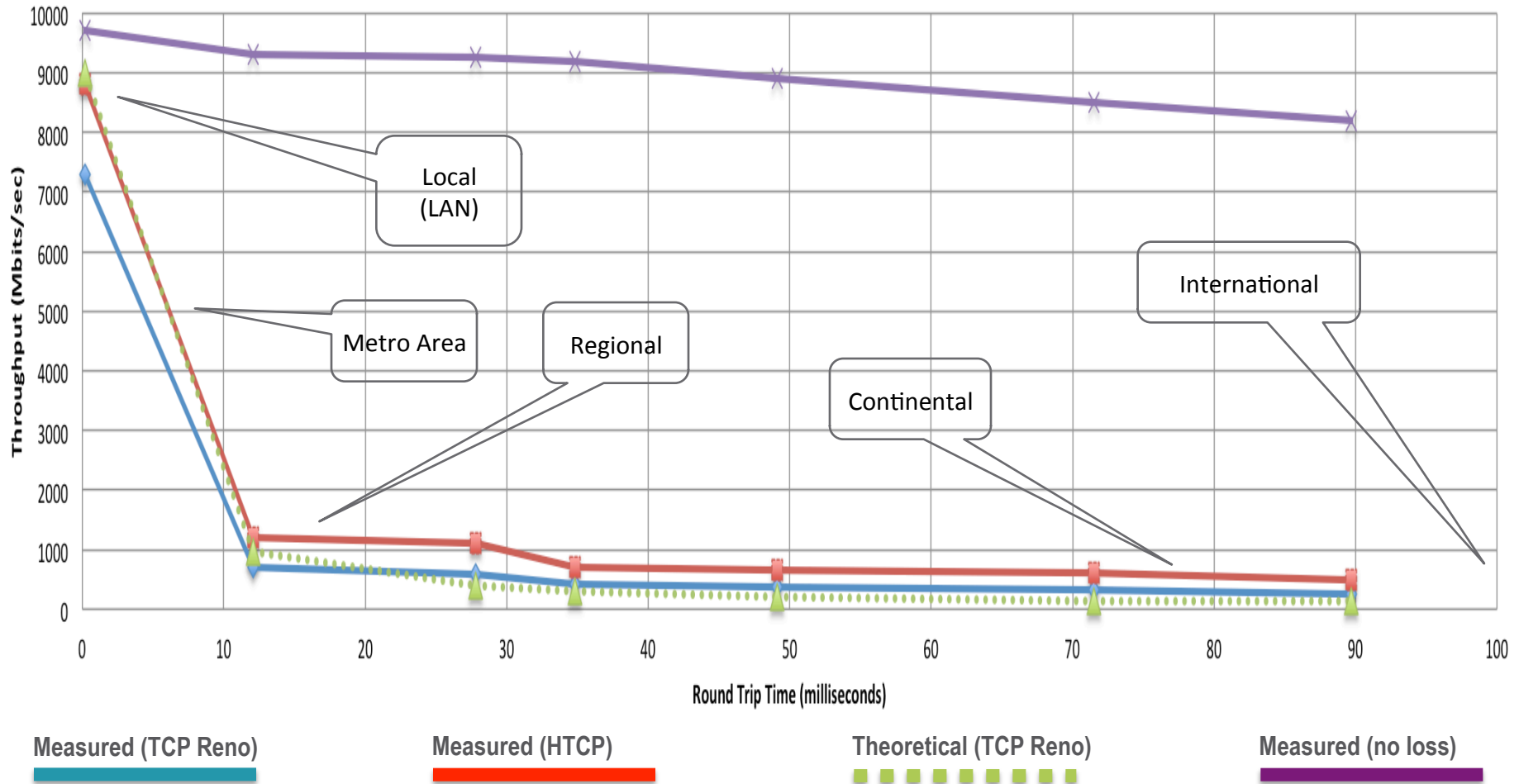
- connecting 50 labs, plants and facilities with >150 networks, universities, research partners globally
- **340Gbps transatlantic capacity**
- university connections to better serve LHC science
- \$35M in FY15, 42FTE
- older than commercial Internet, growing ~twice as fast
- the DOE user facility that serves all others

ESnet is designed for different goals than general Internet.



Elephant flows require almost *lossless* networks.

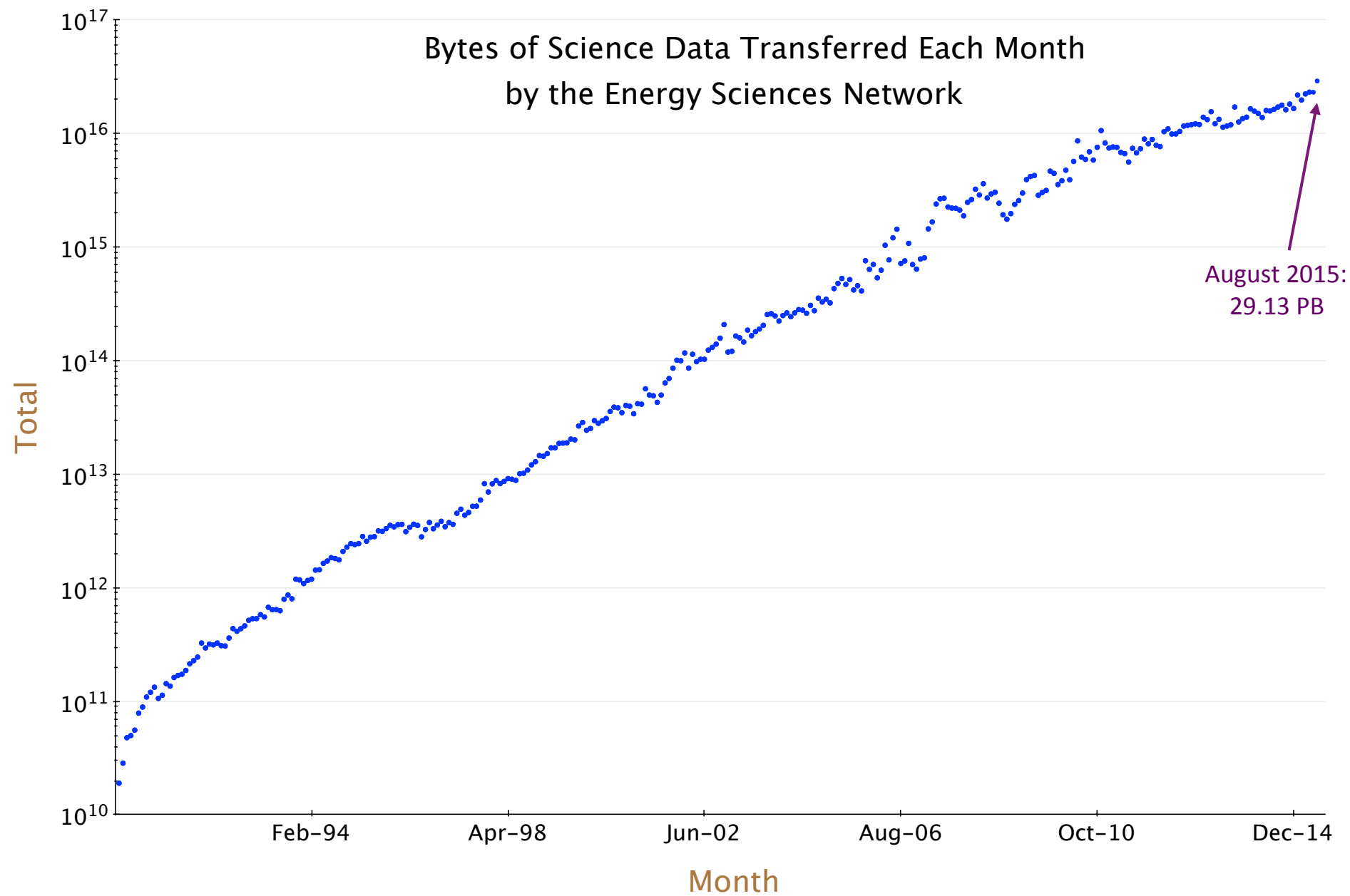
Throughput vs. Increasing Latency with .0046% Packet Loss



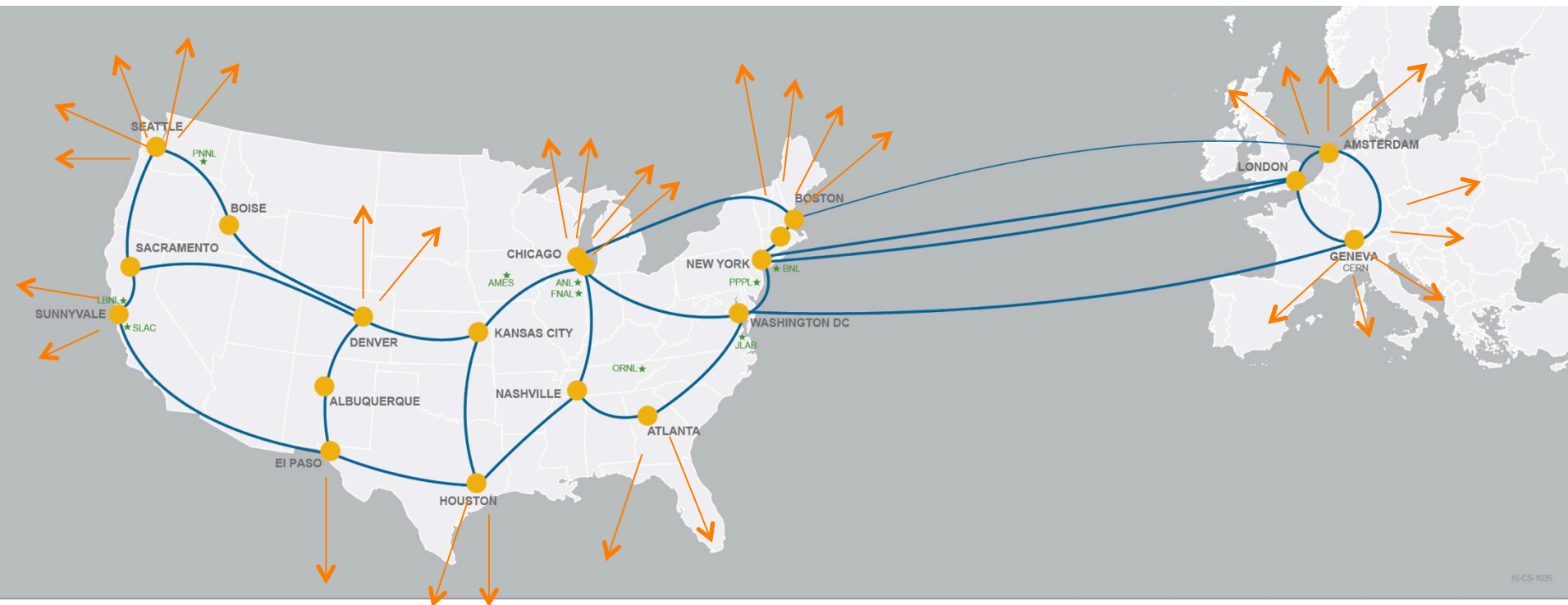
See Eli Dart, Lauren Rotman, Brian Tierney, Mary Hester, and Jason Zurawski. The Science DMZ: A Network Design Pattern for Data-Intensive Science. In *Proceedings of the IEEE/ACM Annual SuperComputing Conference (SC13)*, Denver CO, 2013.



Bytes of Science Data Transferred Each Month by the Energy Sciences Network



80% of ESnet traffic originates or terminates outside the DOE complex.



ESnet
ENERGY SCIENCES NETWORK

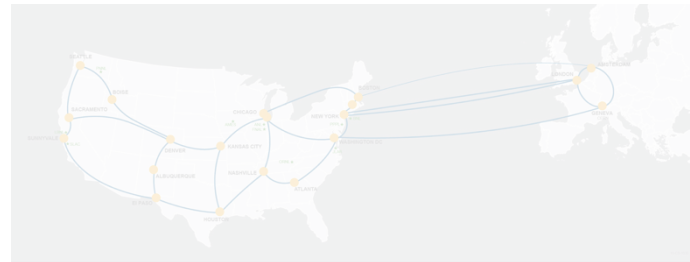
★ Department of Energy Office of Science National Labs
AMES Ames Laboratory (Ames, IA)
ANL Argonne National Laboratory (Argonne, IL)
BNL Brookhaven National Laboratory (Upton, NY)
FNAL Fermi National Accelerator Laboratory (Batavia, IL)
JLAB Thomas Jefferson National Accelerator Facility (Newport News, VA)

LBNL Lawrence Berkeley National Laboratory (Berkeley, CA)
ORNL Oak Ridge National Laboratory (Oak Ridge, TN)
PNNL Pacific Northwest National Laboratory (Richland, WA)
PPPL Princeton Plasma Physics Laboratory (Princeton, NJ)
SLAC SLAC National Accelerator Laboratory (Menlo Park, CA)

In a nutshell:

- Data intensity drives network intensity.
- DOE traffic grows exponentially.
- Data 'point sources' are more numerous, less expensive.
- DOE data flows typically include universities, other collaborators.
 - only 20% of ESnet data flows are DOE $\leftrightarrow$ DOE

Overview



Impact



Our vision and strategic goals guide impacts.

vision:

Discovery is
unconstrained by
geography.

strategic
goals:

1. Improve
networking
practices globally.

2. Provide
information and
tools for optimal
network use.

3. Pioneer
architectures,
protocols,
applications.

Back to impacts: 'fasterdata' knowledgebase

vision:

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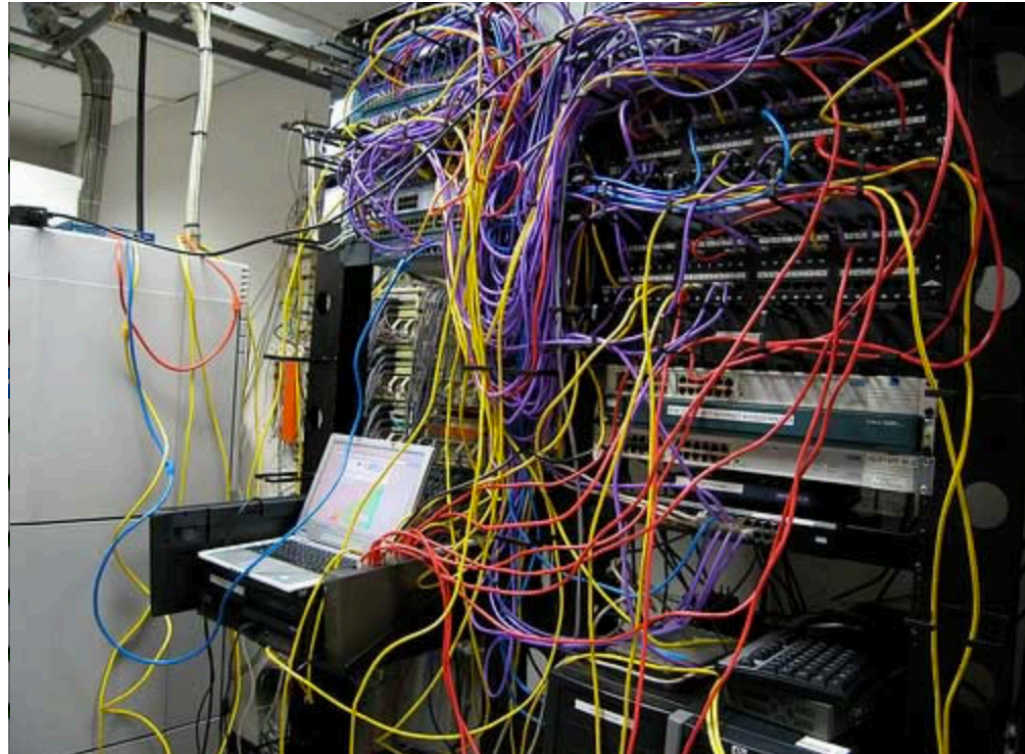
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Observed Challenges to Network Adoption

- Scientists want to do science not IT
- Causes of performance issues are complicated.
- Lack of collaboration between the CIO's office and researchers on campus.
- User's performance expectations are low ("The network is too slow", "I tried it and it didn't work").
- Cultural change is hard ("we've always shipped disks!").



ESnet Science Engagement Approach



Partnerships

CrossConnects
WORKSHOP SERIES

Where Science
& Technology Meet



GOALS:

- To initiate an active dialogue between the R&E engineering and domain science communities with the goal of setting longer-term relationship building in motion.
- To give domain researchers or those supporting them on campuses with broad concrete, technical, immediately useful tools and resources for improved data transport and network performance.
- Successful workshops focused on Life Sciences, Climate, Cosmology, and Bioinformatics (coming up in April 2016)

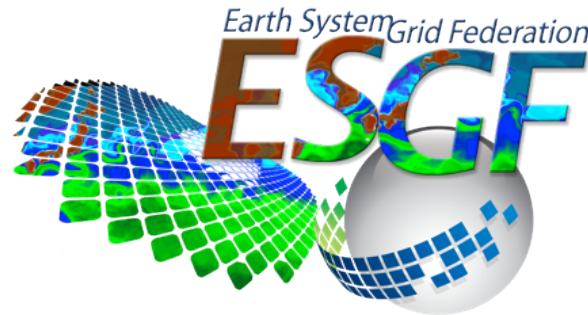


Partnerships: EYR - Global



- The program supports research collaborations with leading-edge network resources and consulting services to accelerate their science.
- Program committee solicits proposals from across the global community for technical and policy evaluations.
- ESnet “sponsored” one of the climate science proposals for the Earth System Grid Federation
- information about the program can be found at: <https://www.enlightenyourresearch.net>

Science Partnerships: EYR- Global



- **International Climate Network Working Group created in 2014**
- **Purpose: improve data transfer performance between climate data facilities**
 - Current tools won't scale to CMIP6-predicted data volumes
- **Near-term goals:**
 - Participating pilot sites have deployed perfSONAR to baseline performance
 - USA, Netherlands, Germany, Australia and others
 - All sites are working on deploying gridFTP-enabled data transfer nodes (DTNs).
 - Plan to sustain 500MB/sec (4Gbps) disk to disk transfer this year

Training: OIN

OIN Operating Innovative Networks



- Designed to equip university & lab network engineers with training needed to build next-gen campus networks that are optimized for data-intensive science.
- Focuses on Science DMZ network architectures, perfSONAR, Data Transfer Nodes, and emerging Software Defined Networking techniques
- Consists of 2 days of presentations and hands-on exercises
- By the end of the event, attendees have a better understanding of science requirements and tools/strategies that can be used to mitigate problems users may encounter.



“On-boarding”



- ESnet collaborates with Globus to jointly engage with research collaborations of mutual interest.
- Globus is essentially the scientists' gateway or “on ramp” to ESnet and the R&E network community

Community Resources: Fasterdata Knowledgebase



ESnet

FASTERDATA KNOWLEDGEBASE

Fasterdata

myESnet

ESnet

SEARCH...



SHARE



FASTERDATA HOME

SCIENCE DMZ

HOST TUNING

NETWORK TUNING

DATA TRANSFER TOOLS

PERFORMANCE TESTING

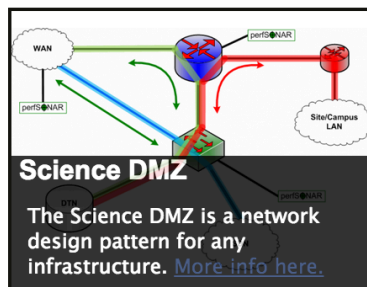
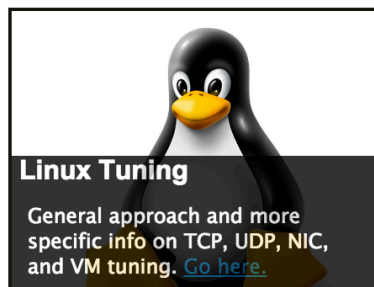
NSF DOCS

ESNET HOME

Home » Fasterdata Home

ESnet Fasterdata Knowledge Base

An Expert Guide for End-to-End Performance Tuning, Tools and Techniques



Quick Links

Video: The Bro IDS in Science DMZ Environments

NEW! A Brief Introduction to the Science DMZ - Webinar

Linux TCP Tuning

Cisco 6509 Tuning

Globus Overview

NEW! CC*IIE Sample CI Plans

NEW! NSF IREN Networking Doc



Thank you.

kate@es.net

engage@es.net