



Discovery, unconstrained by geography.



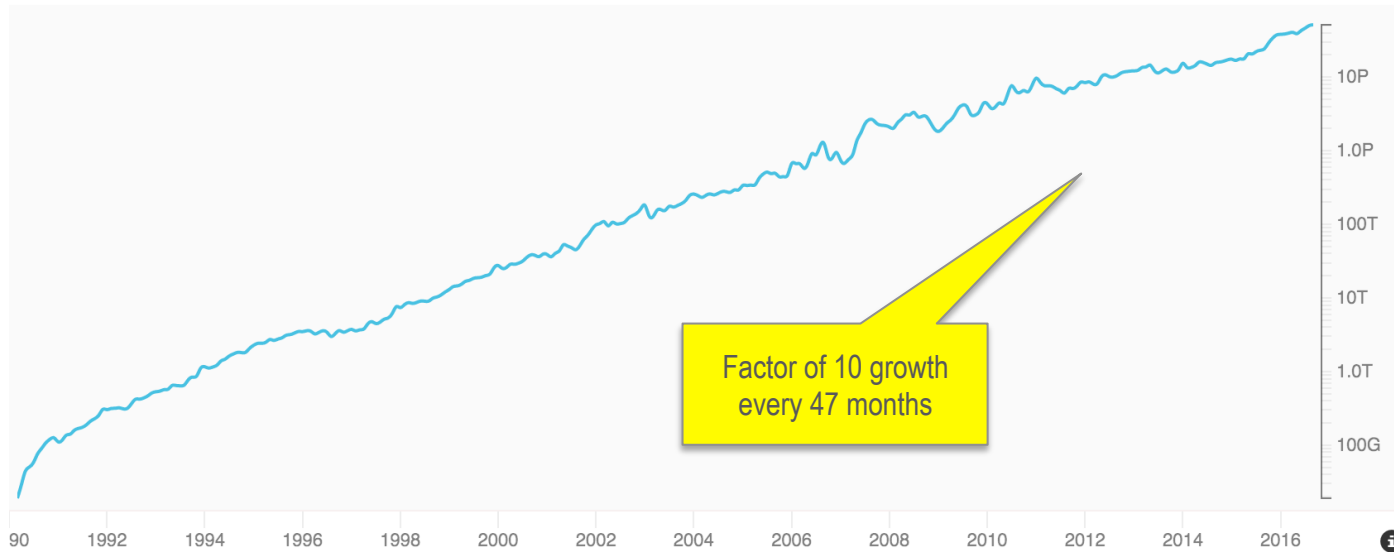
The Energy Sciences Network Update

Inder Monga, Brian Tierney
ESnet

GLIF Americas
September 28th, 2016



Science Data Transferred Monthly by ESnet

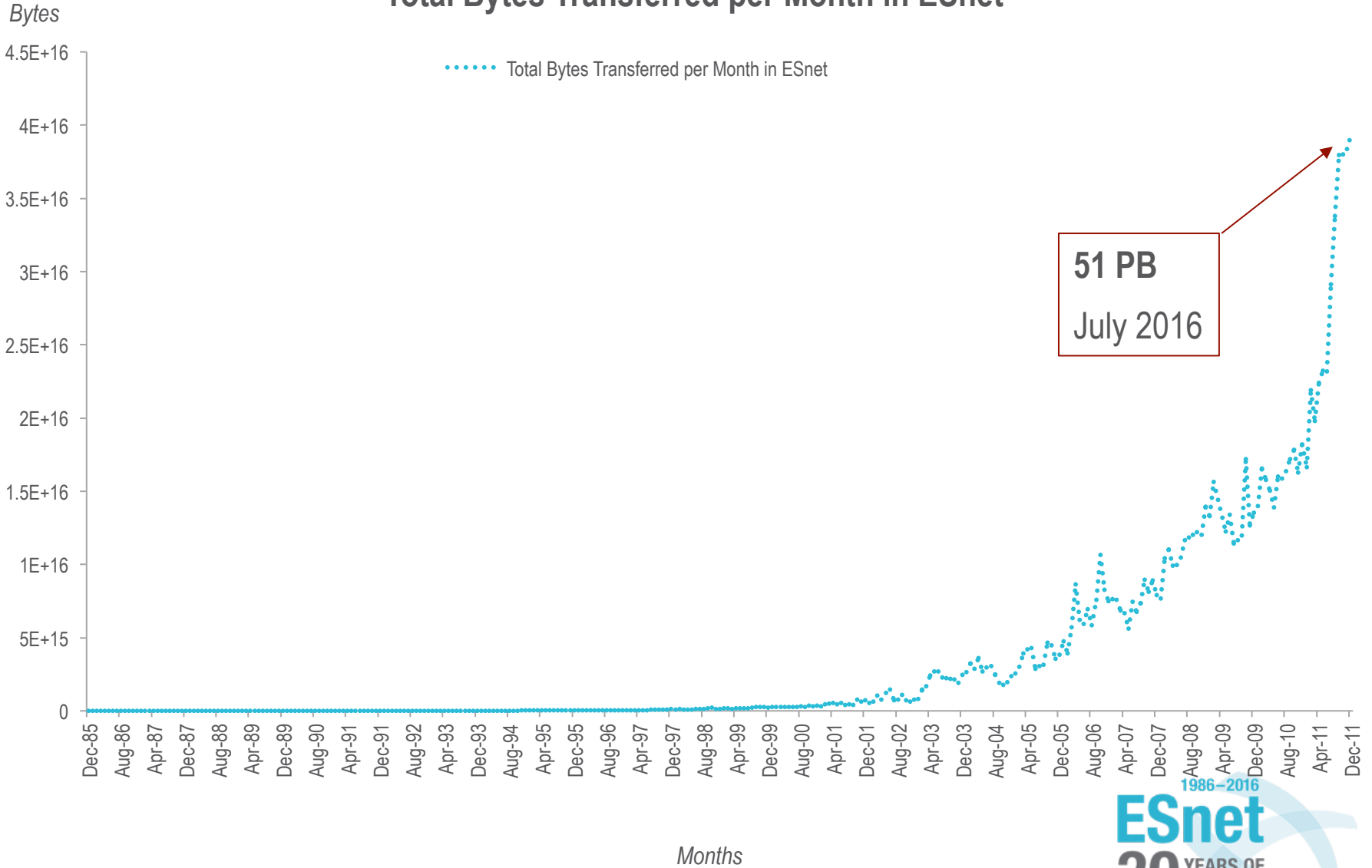


◀ July 2016 ▶

	Bytes	Percent of Total	One Month Change	One Year Change	
OSCARS	12.32 PB	24.0%	-12.1%	+104%	Point-to-point circuits
LHCONE	18.41 PB	35.9%	+4.75%	+277%	LHCONE (T1-T1/2) traffic
Normal traffic	20.56 PB	40.1%	+7.08%	+68.1%	
Total	51.29 PB		+0.973%	+121%	

Available at <https://my.es.net/network/traffic-volume>

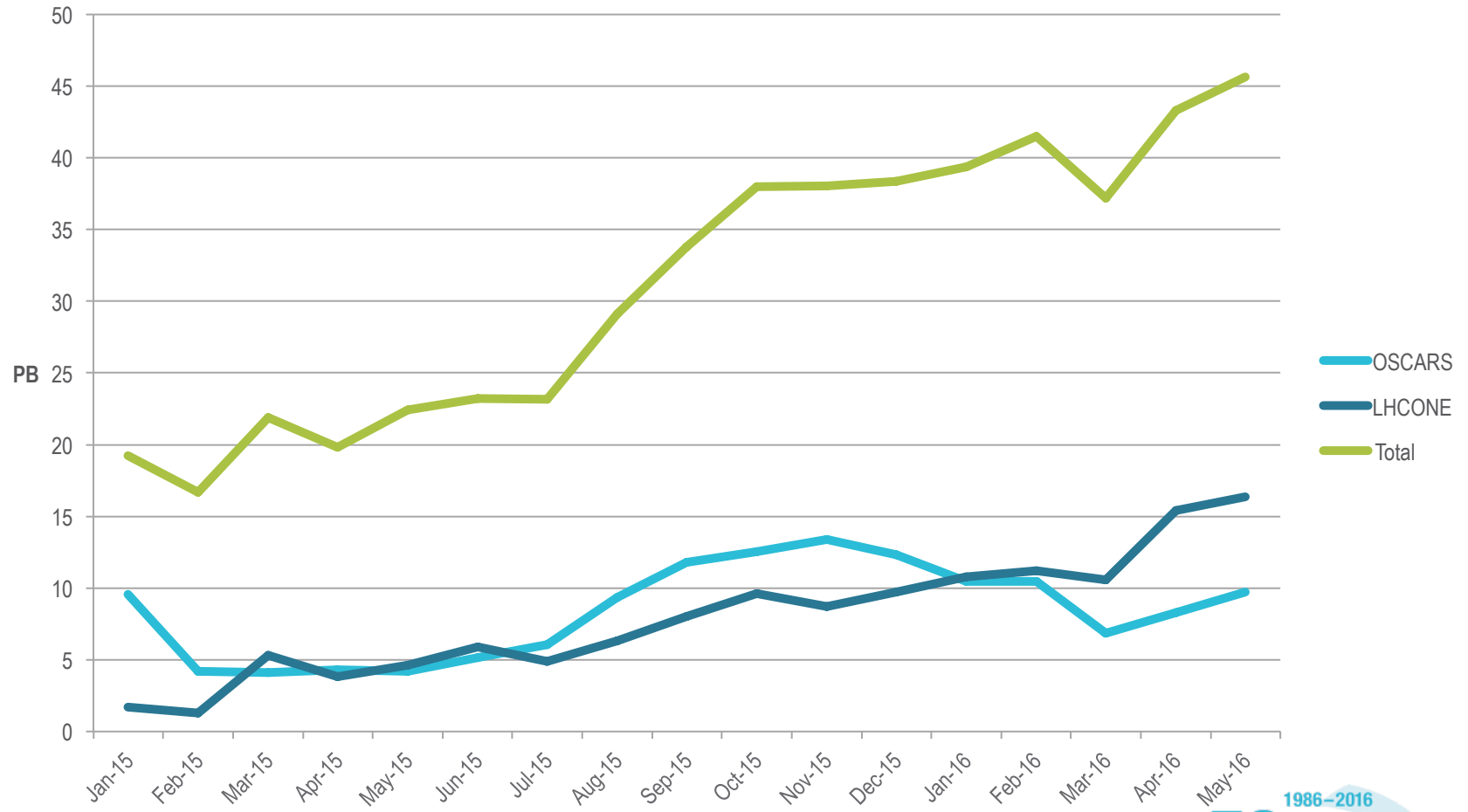
Total Bytes Transferred per Month in ESnet



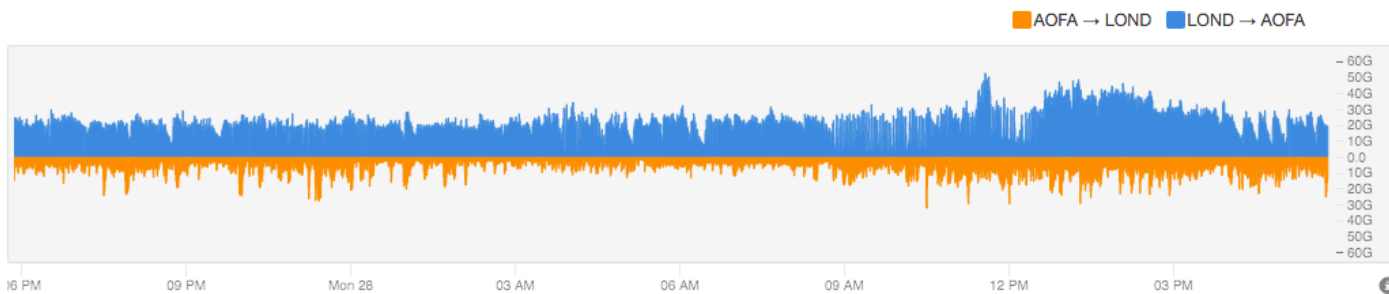
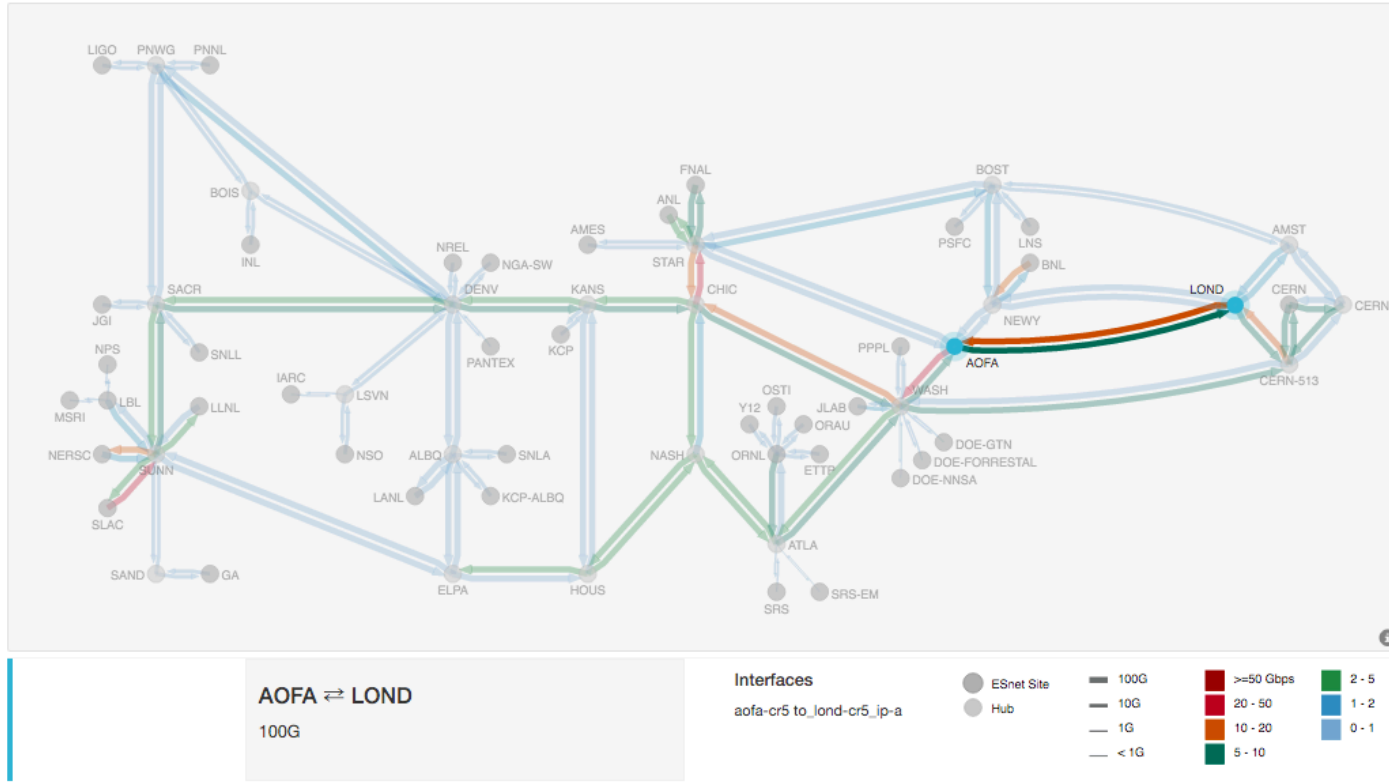
51 PB
July 2016



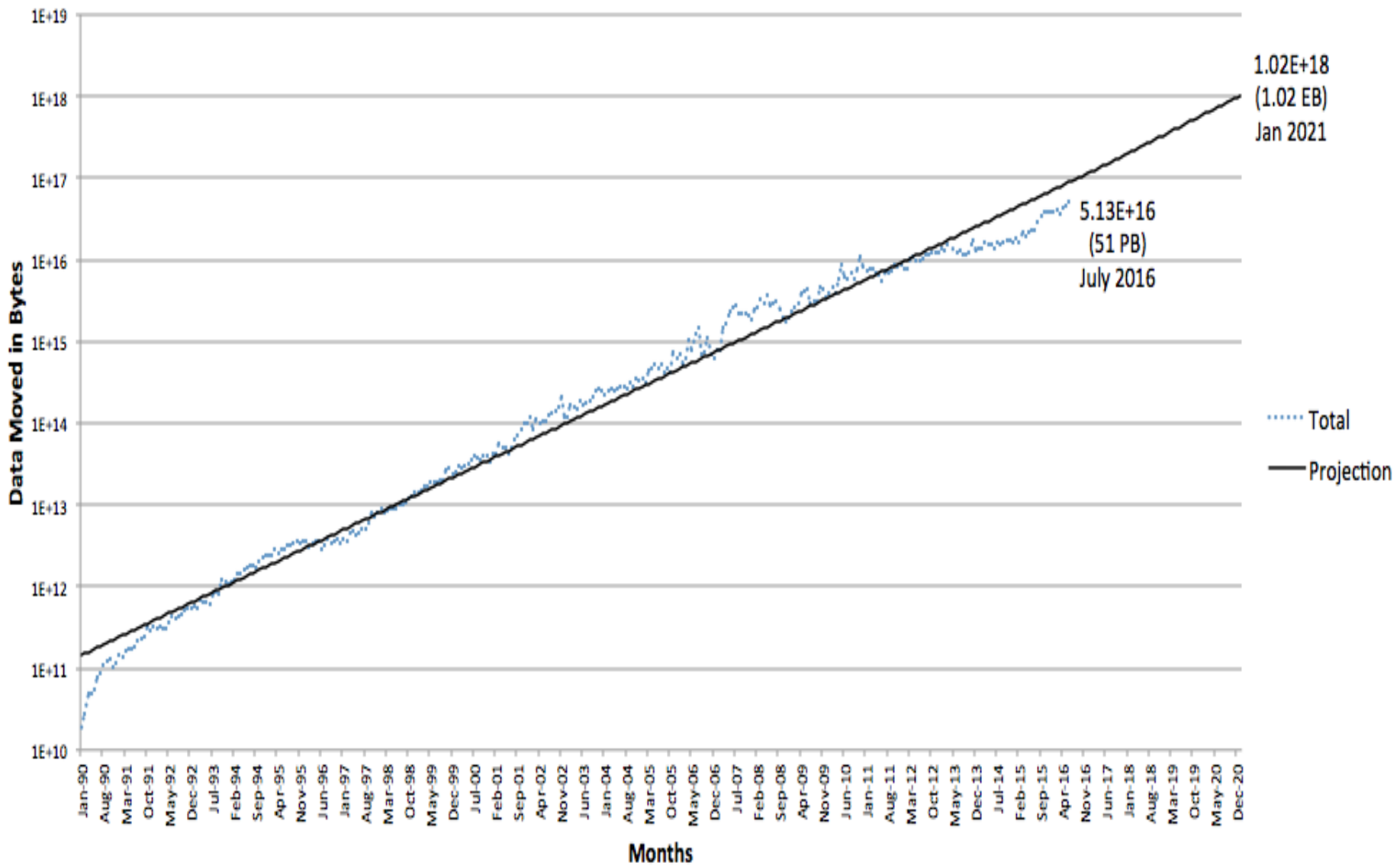
Overall Traffic doubled, LHCONE up 1500+% in Run 2 [January 2015 – May 2016]



Transatlantic traffic is healthy



ESnet: An exascale facility in 2021



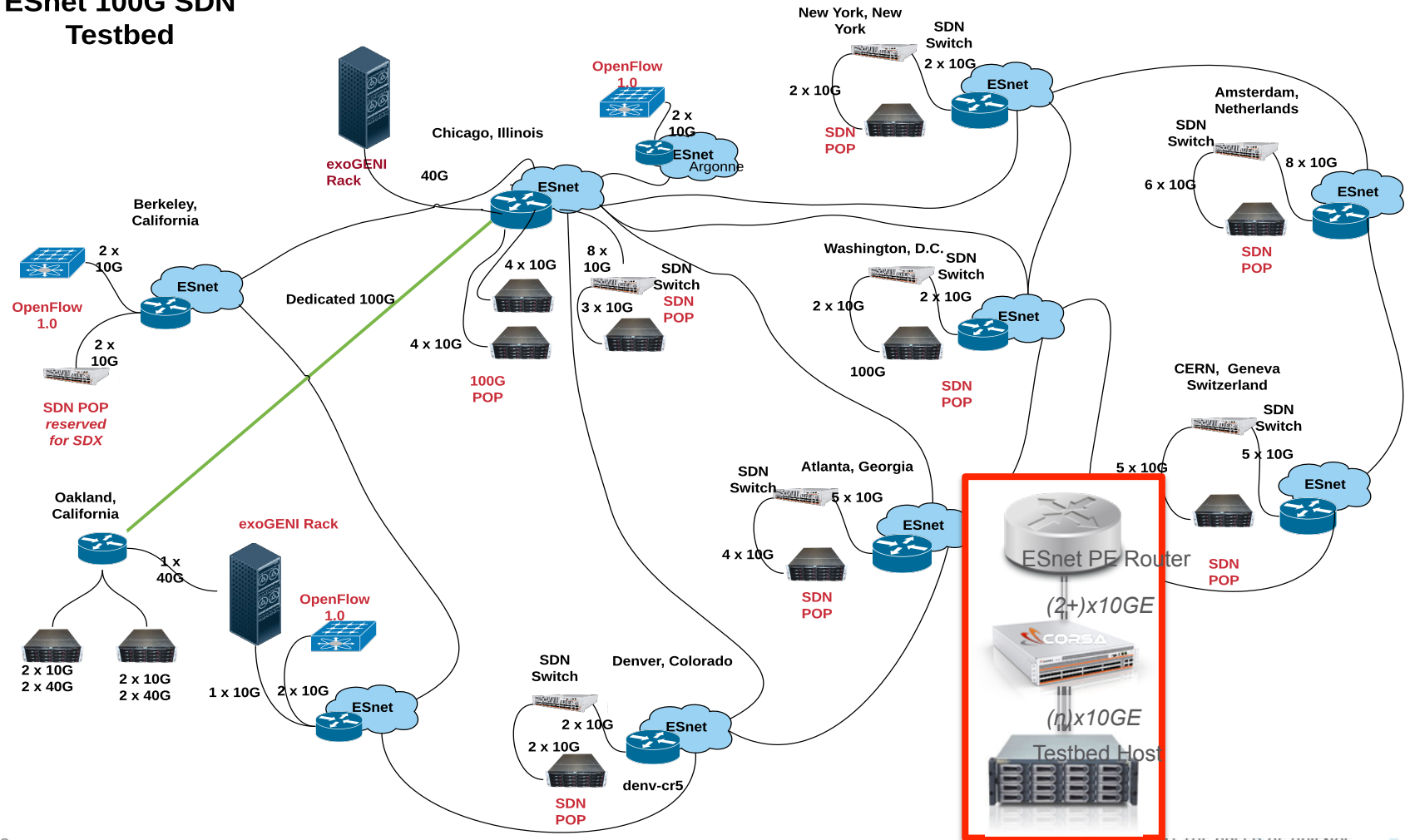
ESnet6

- Next-generation of ESnet needs to address the next ten years of science requirements
- Three key design goals
 - Capacity
 - Handle exponential traffic growth
 - Ex. 1 Tbps from SLAC - NERSC
 - Reliability and Resiliency
 - Distributed science facilities, computing, data – scientists depend on the network for their science research to work
 - Cyber-resiliency – protection against increasing level of cyber-security attacks
 - Cost
 - Exponential data growth with near flat budgets
- Current Status
 - Deep within R&D cycle to explore all technology alternatives, build prototypes and engage scientists for future requirements

ESnet's 100G SDN Testbed – significant footprint growth and dedicated bandwidth.

Focused on ESnet6 testing for FY17

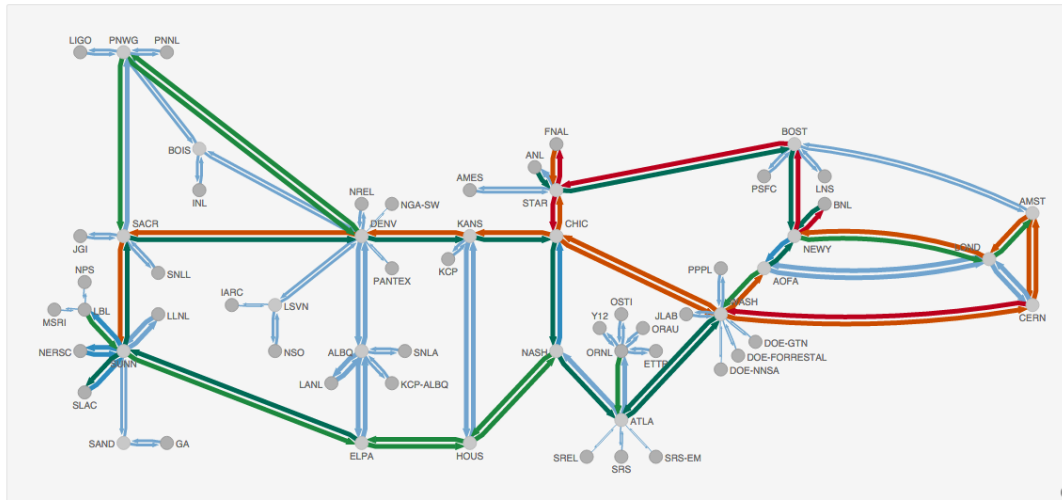
ESnet 100G SDN Testbed



ESnet continues to build a strong software development team

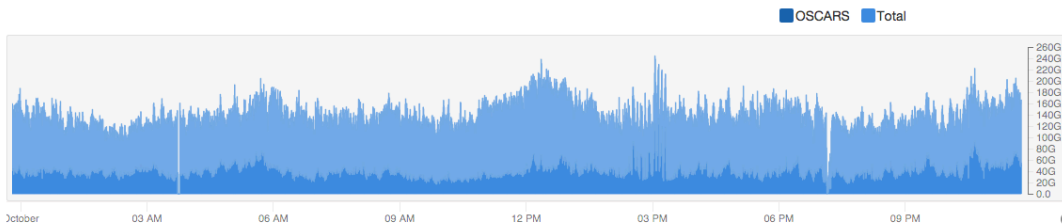
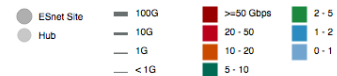
MyESnet Portal

A data-driven website for displaying information and visualizations about ESnet, its sites and community.



Network Wide Total Traffic

This map highlights the sites ESnet serves, the structure of the network and the current traffic load. Clicking on a node or edge will show details. Please note that this map does make some simplifications, click ⓘ on the map or chart for more details. The map of the transatlantic extension is a work in progress, more details are available in the info box.



<https://my.es.net/>



Open Source

Good news everyone, it's all open source!

- <http://software.es.net/pond/>
- <http://software.es.net/react-timeseries-charts/>
- <http://software.es.net/react-network-diagrams/>

Motivation

- Develop a common toolkit for visualizing networks
- Lower barrier to entry
- Allow people to use what we've built so they don't have to build their own
- Encourage others to share their visualizations
- Give back to the community



Strong research collaborations helps explore future network architectures with an eye towards end-to-end

SENSE: SDN for End-to-end Networked Science

Inder Monga [Lead-PI] (ESnet), Phil Demar (FNA)
Linda Winkler (ANL), Tom Lehman (UMD/MA)
Mar 2016 – Feb 2017

Goal

- Leverage the emerging Software Defined Network (SDN) capabilities to create a next-generation, science networking architecture friendly to data-intensive applications

Impacts

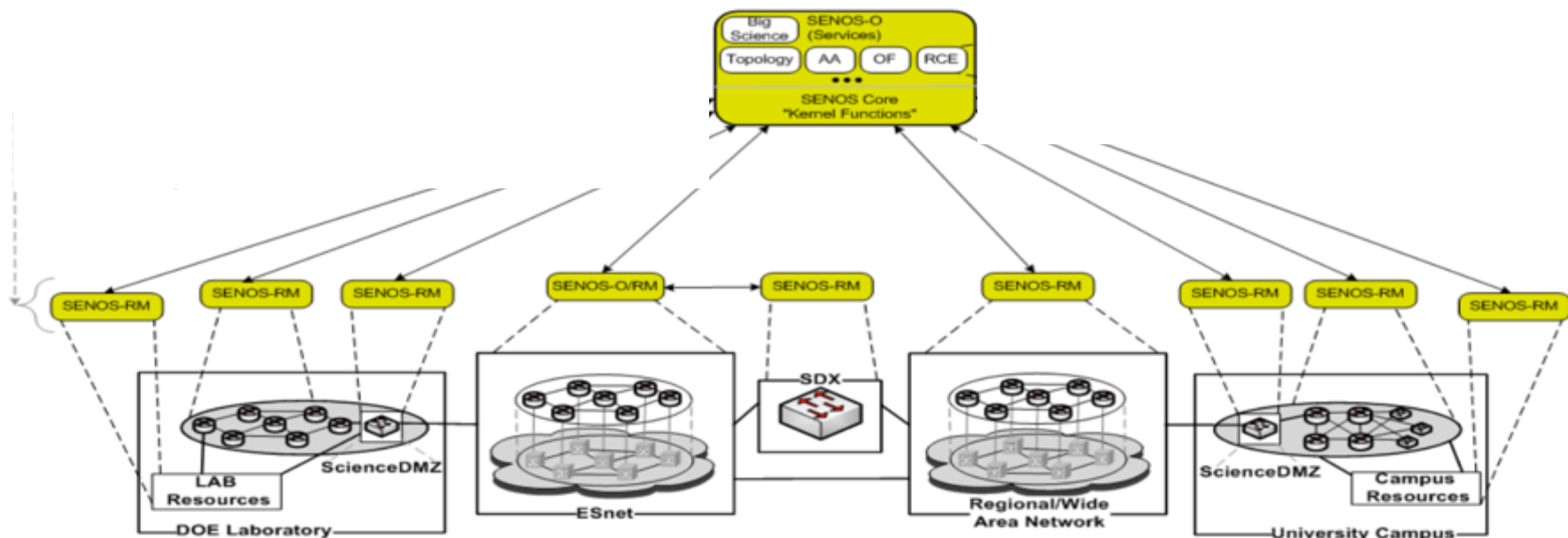
- Present geographically distributed resources (datacenters, instruments, etc.) as components of a local facility
- Simplifies complex massive datasets distribution with coordinated, multi-domain, smart and secure services
- Enable seamless application-network interaction for new near real-time distributed computing and data analytics

- **Collaborators:** FERMI, ANL, Caltech, UMD/Max, NERSC, ESnet

- **Vision:** Enable National Labs and Universities to request and provision end-to-end intelligent network services for their application workflows

- **Lead PI:** Inder Monga

SENSE SDN Control Plane Architecture for End-to-End Orchestration



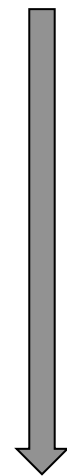
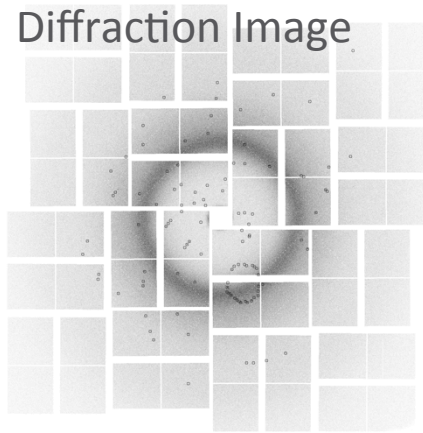
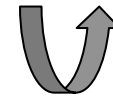
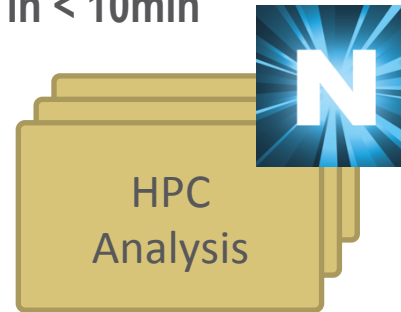
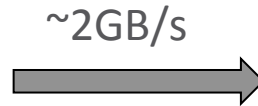
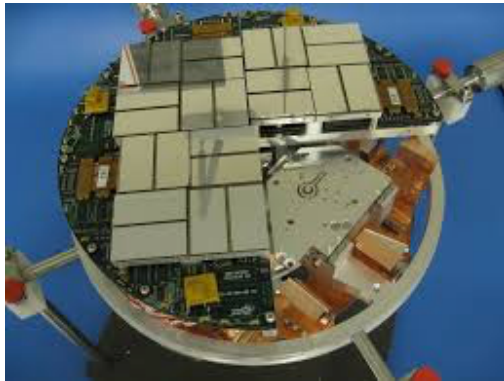
SENOS: SDN Operating System
SENOS-O: SDN Operating System - Orchestrator
SENOS-RM: SDN Operating System - Resource Manager

Figure 1. SENOS End-to-End Orchestration

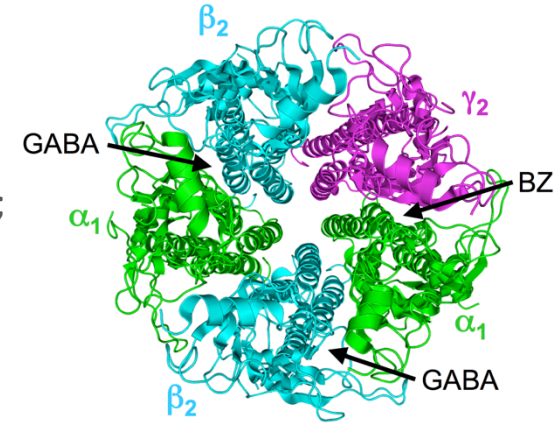
XFEL Computing Use Case:

Providing atomic scale vision to researchers at beamline in < 10min

LCLS



Reconstructed Structure



Streaming data from detector to HPC systems

- Provides quasi real-time (<10 min) computing
- Currently LCLS-I requires ~50 TFLOPS of computing
- Cori Supercomputer: > 30 PFLOPS

Pipeline critical for studying atomic scale structural dynamics and fluctuations in matter:

- Complex materials, nano-particle dynamics
- Catalysis: Chemical, structural, and electronic changes; Nano-particles; Interfacial chemistry
- Biological function: Protein crystallography: Macro-molecules

Networking Update: FY16

Project Updates

Major Projects Update....

- Networking team executing on average of 60+ active projects at any given time
- Completed Amazon Web Services (AWS) Direct Connect pilot
- Completed 400G study, validating next-gen ROADM technology, flexible (gridless), colorless mux/demux
- Capacity Planning process maturing-driving backbone upgrade priorities
- Migrating Equinix peering from 10G to 100G
- Thirteen university CMS or ATLAS connections completed

Organization Update....

- Networking reorganization in March 2016, integrated into one organization with distinct focus on planning, engineering and operational enhancements
- Patrick Dorn as acting Group Lead for Network engineering
- New hires: Paul Wefel, Dale Carder, Jackson Gor, Indira Kassymkhanova

On the Horizon....

- Long Island MAN resilient fiber connection
- Process enhancements and operational efficiency for Network Operations center
- ESnet6-technology investigation, research and pilots
- Change Management

Recent Press Release

- Berkeley Lab Collaboration Enhances Optical Chip Design Process
 - <http://www.es.net/news-and-publications/esnet-news/>
- “Computer scientists and mathematicians from the LBL Computing Sciences organization worked with engineers at Ciena, a leading networking company, to speed up the process by which Ciena validates the design of its ASIC chips. The collaboration grew out of the existing relationship between Ciena, a pioneer in high-bandwidth optical transport technology, and the DOE’s Energy Sciences Network (ESnet), which uses Ciena products to support its high-speed network.”