

ESnet Update

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ESCC

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DOE Network Requirements Workshops



Capacity

(Science Data > Planned ESnet capacity growth)

Multiple 100G links by 2015

Increased commodity Internet peering

Increased capacity for private peering

Services

Differentiated services on the IP routed network

Expanded capability set for virtual circuits (L2, L3, etc.)

Integrated Services Model

Operations

End-site education, best practices and consulting services

Performance management, personalized reporting

Network Knowledgebase like fasterdata

Additional Topics

Energy efficiency, reduced carbon footprint

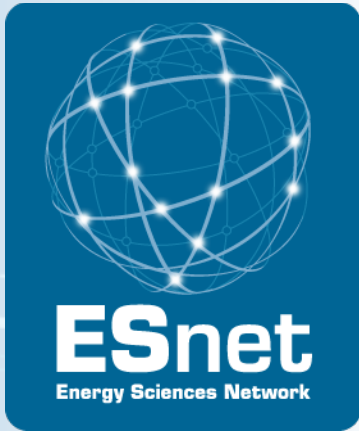
Security

Research and Testbeds



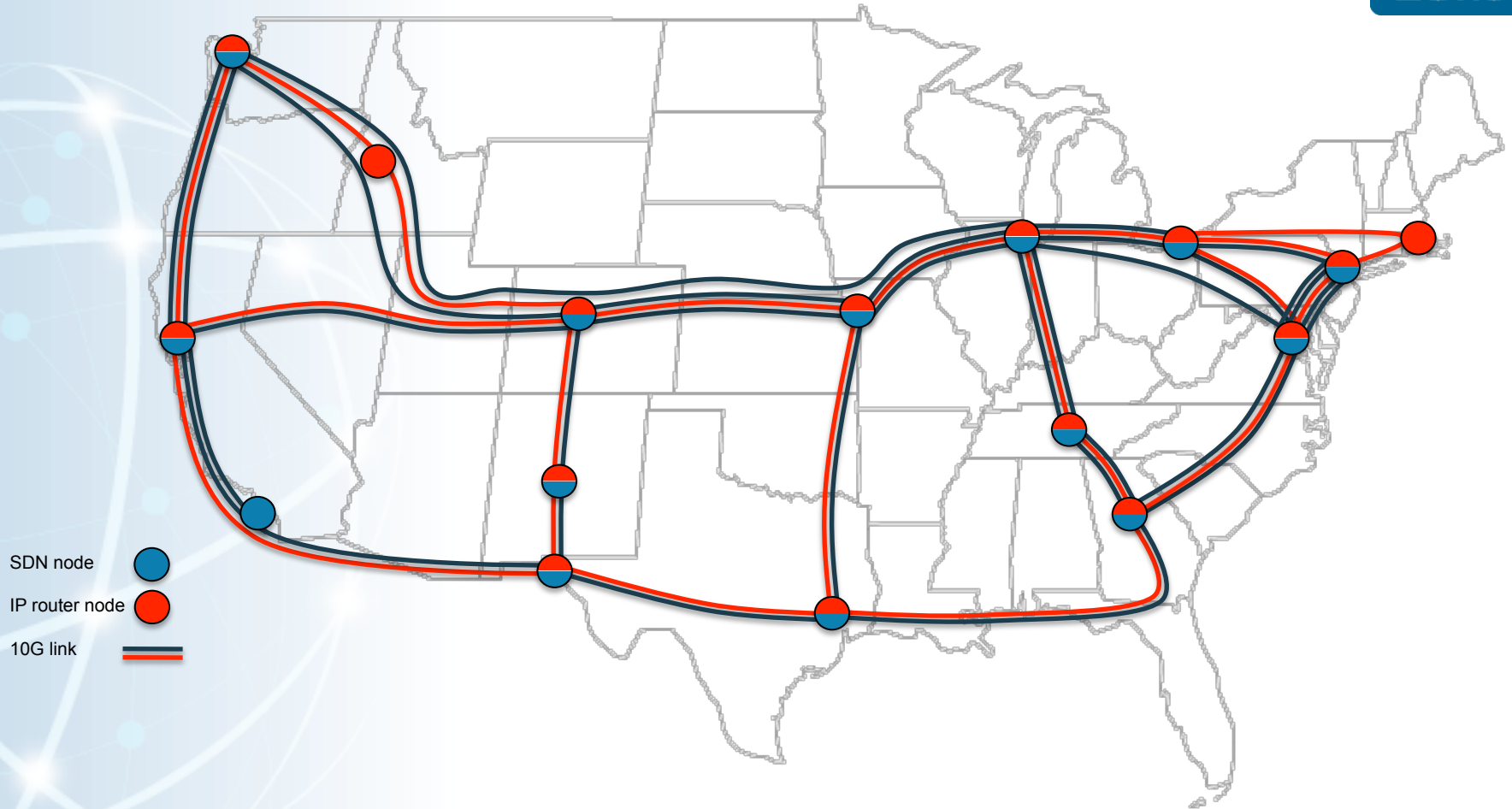
Strategic Imperatives for ESnet

- More bandwidth to DOE facilities and Labs at lower costs
- Richer network services in support of distributed science
 - Develop ‘network aware’ integrated services that deliver ‘end-to-end’ high-performance data transfer, HPC/cloud computing, and science collaborative services
- Carrier-class network operations providing high network availability to all DOE facilities
 - Seamless network interoperability across multiple network domains
- Develop and deploy energy-aware and efficient networking infrastructure
- Provide a networking research testbed for DOE community
 - Conduct/enable groundbreaking research in new protocols/storage/energy efficient networking

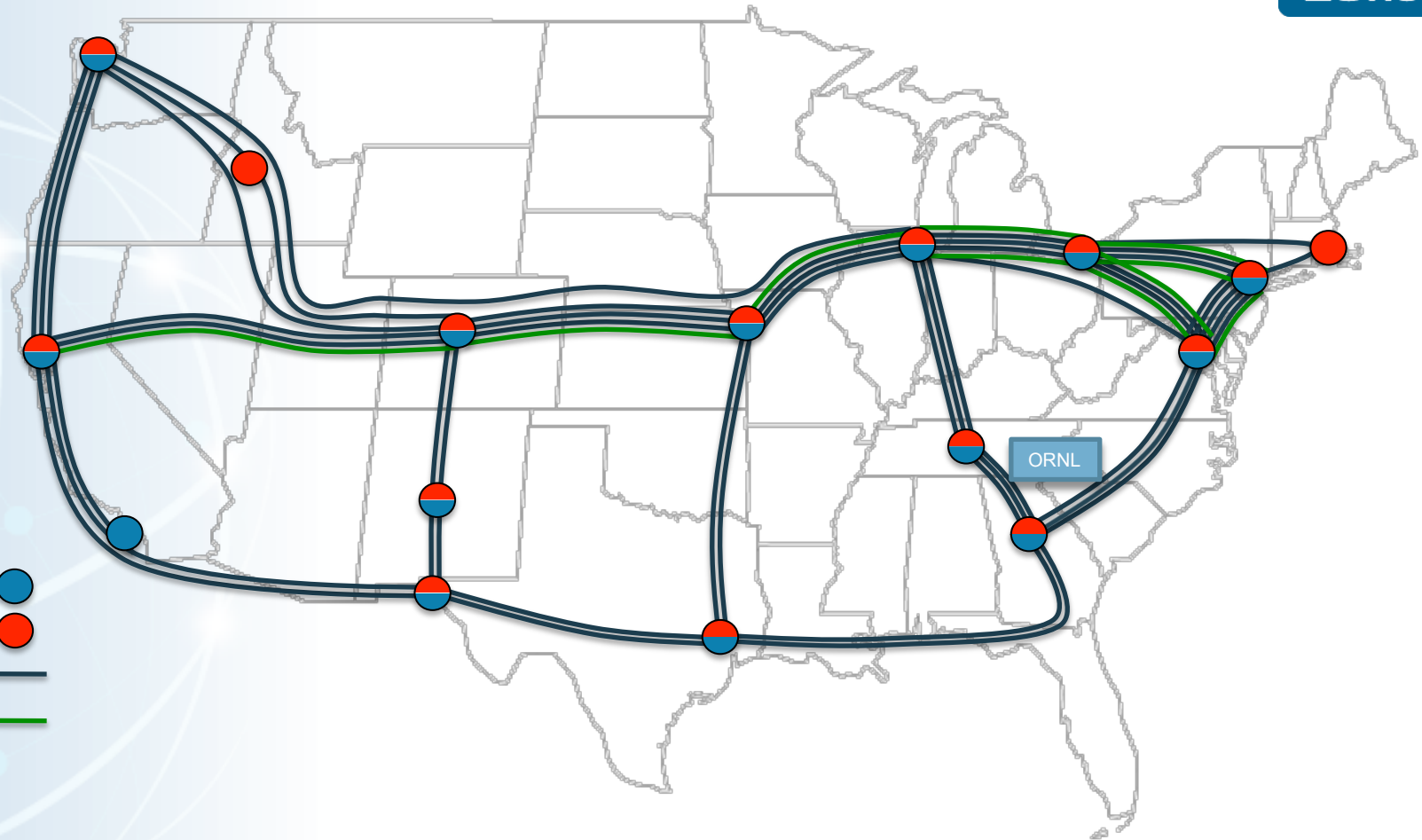






ESnet4 IP & SDN Networks

Current ESnet4 Topology



ESnet4 Topology End-2011



- SDN node 
- IP router node 
- 10G link 
- New 10G link 



ESnet4 Network

Peaked at 10.6 PB in Nov

>1PB of genomics traffic between JGI – NERSC that month alone

More than 50% continue to go over OSCARS circuits

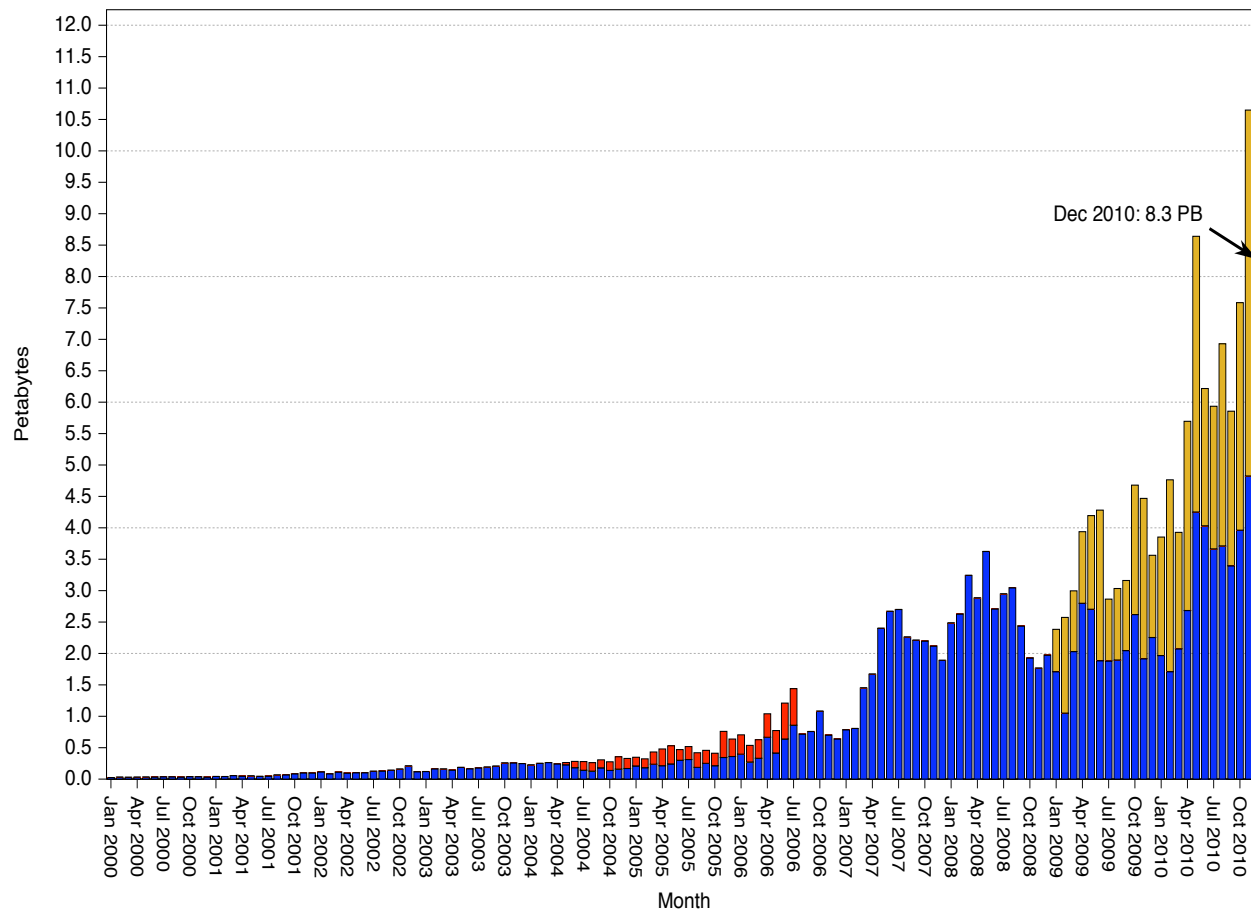
Instrumenting with perfSONAR all connections 1G and up

99.9983% network availability to Office of Science labs

ESnet Accepted Traffic: Jan 2000 - Dec 2010

Petabytes/Month, Maximum Volume: 10.6 PB

- Traffic Accepted
- OSCARS Accepted
- Top 1000 Host-Host Accepted



Site Upgrades



- AOFA-HUB 1 Infinera DTC chassis installed (Dec 2010)
- NEWY-HUB 3 Infinera DTC Chassis installed (Dec 2010)
 - Testbed servers at LBL to be installed (Mar/Apr 2011)
- BNL 4 Infinera DTC chassis installed (Dec 2010)
 - Testbed servers at LBL to be installed (Mar/Apr 2011)
- Adding perfSONAR servers to ESnet small sites
 - Completed PPPL, PANTEX, PAIX-PA, OSTI, ORAU, FORR, INL, GA,
 - Future installs: AMESLAB, DOE-GTN, EQX-CHI, EQX-SJ, LASV, LVK, NREL, NSO, SNLA, SRS
- PPPL M120: to be replaced with MX480 TBD

Site Disconnects



- YMP 1GE XC via LASV disconnected (Sept 2010)
- NOAA T1 via ORAU disconnected (Oct 2010)
- NSTec-Liv-OPS disconnected DS3 and removed router (Dec 2010)

Circuit Installs & Upgrades



- 1GE private peering at EQX-ASH with Level3 (July 2010)
- 10GE Level3 circuit replaced the 1GE circuit between Equinix SJ (SV1) (July 2010)
- 10GE MAXGigapop circuit replaced the Qwest 1GE link between Equinix Ashburn (DC2) (July 2010)
- 10GE peering with CICnet at CHIC (Aug 2010)
- 1GE peering with FNAL DOE-FSO (Aug 2010)
- 2 10GE Cross-connect for future peering with NOAA at DENV-HUB and CHIC-HUB (Aug 2010)
- 10GE private peering with MERIT at Starlight (Aug 2010)
- 10GE MERIT wave added to the existing 1GE MERIT link between Equinix Chicago (CH2) (Aug 2010)
- 3 1GE private peering with TATA Communications at all Equinix (EQX-ASH, EQX-SJ and EQX-CHI) (Sept/Oct 2010)



Circuit Installs & Upgrades

- 1GE private peering with SAVVIS at EQX-ASH (Nov 2010)
- 4 10GE SC2010 waves (2 from ATLA, 1 from HOUS, 1 from STAR) (Nov 2010)
- 1GE site ordered from KCP to KANS-HUB (replaced OC3 to ALBU) (Dec 2010)
- 10GE peering with LLNL LVOC (Jan 2011)
- 20G (2x10GE aggraded) connection to FNAL (Jan 2011)
- OC3c to LANL-SW peering in DENV-HUB (Jan 2011 Pending XC)
- NEWY to AOFA Metro OCG darkfiber installed and under test (Jan 2011)
- 100M → 1GE upgrade to Teliasonera peering at EQX-SJ (Jan 2011)
- OC3 to 1GE upgrade on the AOL peering at EQX-ASH (Oct 2010)
- 10M to 100M upgrades for the Sprint peering at EQX-ASH & EQX-SJ (Oct 2010)

In Progress



- 1GE backup PPPL-AofA MAGPI wave, waiting on hardware (Date TBD)
- 10GE SDN / ION peerings in CHIC and SUNN / SEAT (via PacificWave fabric) (date TBD)
- PNNL-OSTI 10M → 100M upgrade pending contract mod.
- SRS-EM 10M → 100M upgrade pending contract mod.
- Future 1GE for NNSA peering at FORR (date TBD)
- Future 1GE for OSTI-Y12 disaster recovery (TBD)
- 1GE wave in BOIS to INL via IRON (TBD)

Long Island MAN

Argh! No more snow! It's impossible to find manholes under 15' snow

Light between 111 8th & 32 AofA waiting for portions of the ring to be constructed

Southern: (was) early Feb

Northern: Mid-March

Will handle testbed & production traffic (eventually) using Layer 1 VPN capability

Dramatically reduces our costs to reach BNL

Learned some lessons that will be helpful when ANI gets going



OSCARS Development Status



PCE SDK (v01.11.11) is done

- SDK for development of PCEs for use in OSCASR (v0.6)
- ESnet has used the PCE SDK to develop bandwidth and VLAN selection PCEs
- Several DOE funded projects have identified interest in using the SDK
- PCE SDK is available for downloads to beta-user (contact chin@es.net)

OSCARS (v0.6 native) is close to code complete

- ~120,000 lines of code now (~130K when complete)
- Undergoing testing right now
- OSCARS v0.6 native (i.e. communicates with other OSCARS v0.6 servers) should be in beta in February
- Backward compatibility with v0.5.x is on target to be completed by April

OSCARS Deployment Status



OSCARS is now one of the core applications deployed by SCinet to support dynamic circuits

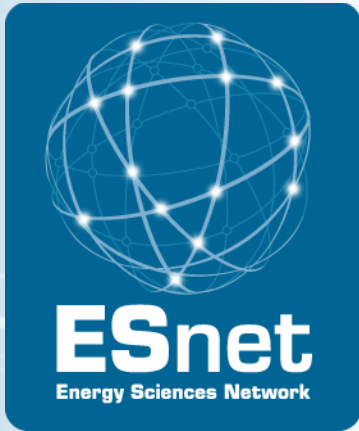
- First deployed in SCinet in SC09
- For SC10 over 150 dynamic circuits were configured in support of roughly 15 demonstrations

First deployments of OSCARS (v0.6) will be in 2Q2011

- Green field installations as part of I2's DYNES project

Proven use cases

- Extending site LAN over the WAN (Genomics: JGI/NERSC)
- Traffic engineering to avoid congestion points (Cloud testing: LBNL/Google)
- Guaranteeing network resources (LHC T0-T1, T1-T2)
- Deadline scheduling (Fusion DIII-D: GA/NERSC)



Fermi Challenge: Between 10G and 100G

Architectural Issues



The current ESnet backbone architecture has 3 types of links:

- IP links for carrying normally routed traffic
- SDN links for carrying traffic in engineered circuits (OSCARS)
- DMZ's for connections to sites & peers

The general philosophy has been:

- Move large and predictable flows to circuits over SDN
- 'Everything else' should fit in the 10G IP backbone

FERMI Challenge



They moved the bulk of their traffic to more than 15 OSCARS circuits distributed across multiple 10GE interfaces.

The remaining traffic was still approaching 10G from time to time.

They could not move it to Layer 2 OSCARS circuits because that requires a willing and able partner at the far end of the circuit!

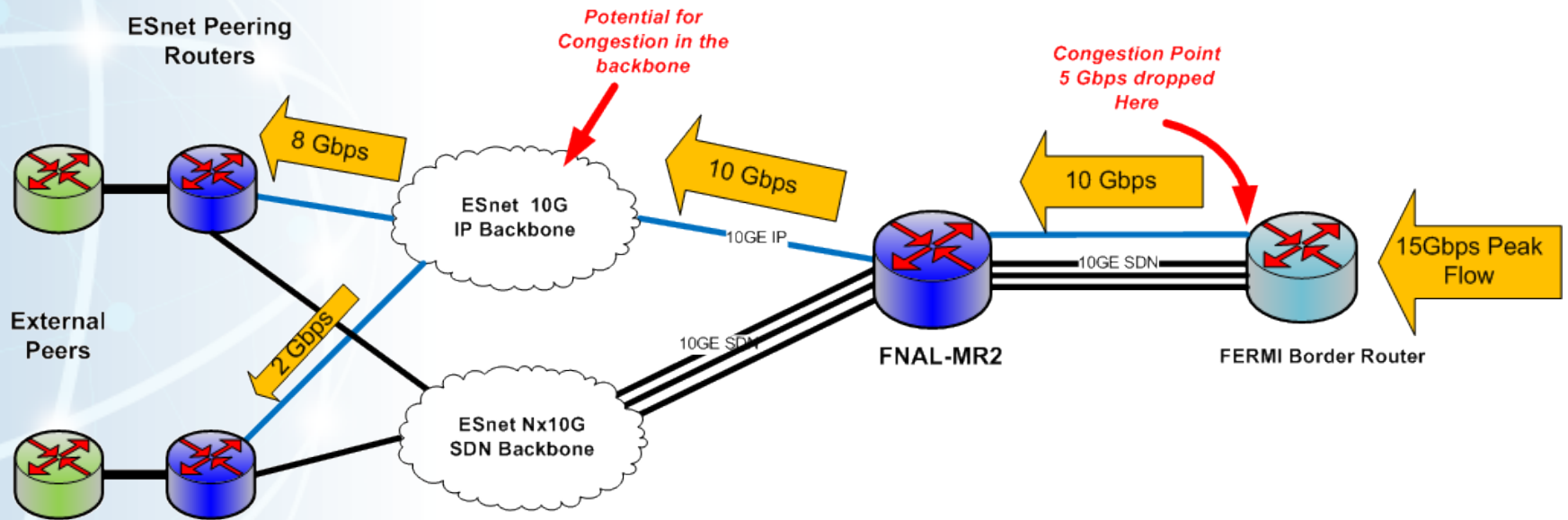
They could not move it to Layer 3 OSCARS circuits because OSCARS Layer 3 circuits start and terminate on ESnet routers, and the bottleneck was on the 10GE link to ESnet on the FERMI egress router

Plan

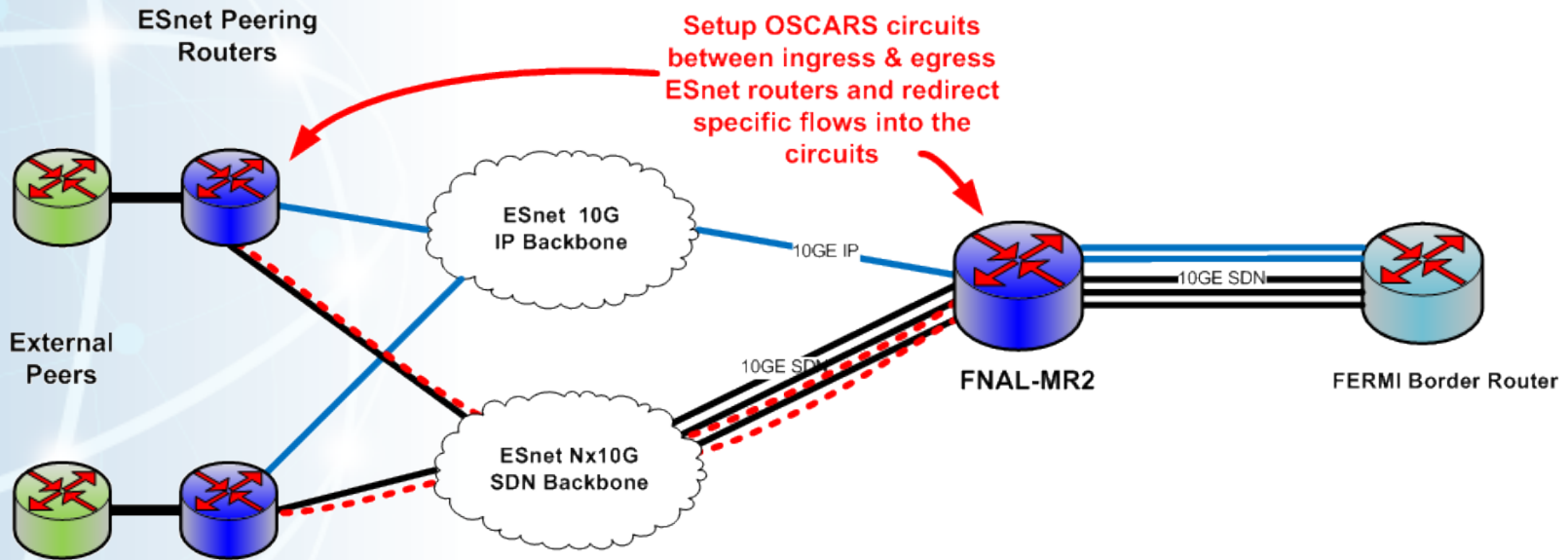


1. Moved FERMI 'IP' DMZ to a 2x10GE aggregated connection
2. Deploy a minor enhancement to OSCARS
 - Allow Layer 3 circuits to dump packets into the standard forwarding table if the MPLS LSP supporting the circuit fails.
3. Re-route several large FERMI 'IP' flows onto SDN across the backbone
 - Note that re-routing a flow into a circuit is hit less!
4. Automate portions of the process of identify candidate large flows and re-routing them over OSCARS Layer3 circuits
5. Develop circuit life-cycle management processes
 - Documented processes for deciding when to turn up, change bandwidth, or turn down circuits

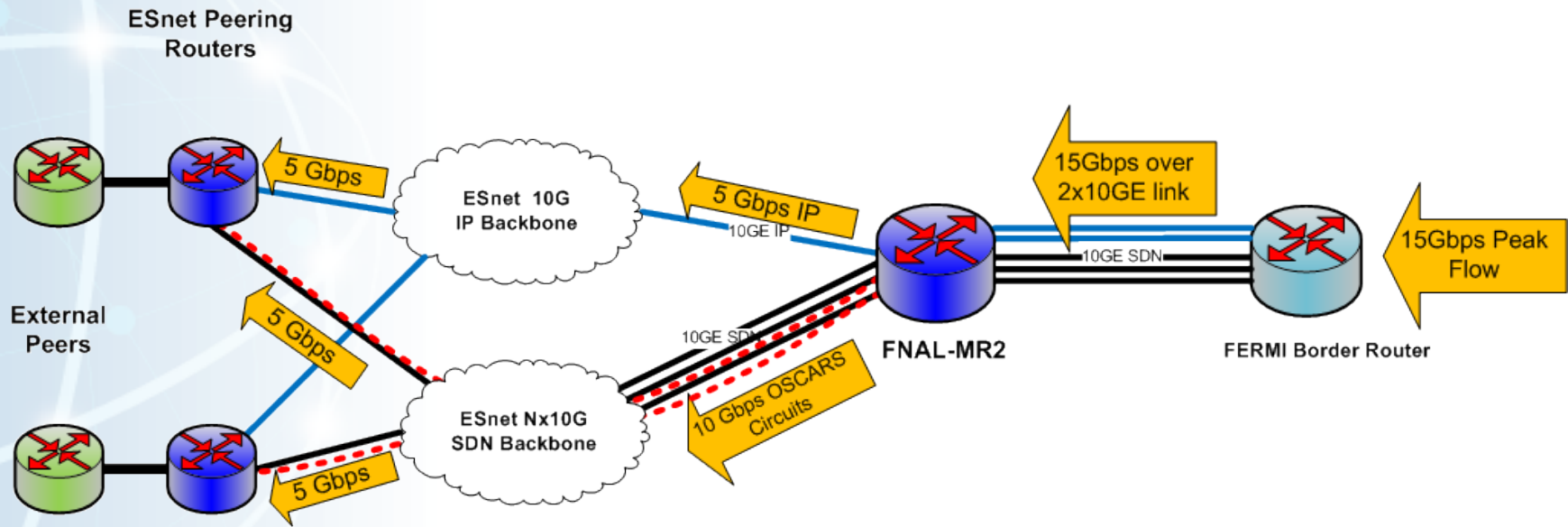
Before



Transition



Future



Open Questions



The tools to re-route IP flows over SDN are available to OSCARS users including:

- ESnet Engineers
- Site Technical Contacts
- Others

Currently, ESnet is taking the lead creating the OSCARS circuits. Do others want to be involved?

What level of coordination should we have between ESnet engineers and site technical contacts when we re-route flows?



ANI & Testbeds

Advanced Networking Initiative



\$62M ARRA funded 100G prototype network and testbed

- Leveraging this infusion of funds to lower long-term networking costs
 - Dark fiber in metro areas
 - Scalable, cost-effective 100G network
 - National dark fiber testbed
- Testbed already in use
 - Table-top being used by first round of research projects
 - Disassembled and shipped to Long Island as LI MAN fiber build completes
 - Second round of research projects selected by Advisory Committee comprising of R&E, lab, and commercial members

Minimizing the Impact of ANI



On staff:

- Hing Chow, PMP certified project manager
- Chris Tracy, Network Engineer
 - Optical experience

New hires:

- Michael Sinatra, Network Engineer (UC Berkeley) starts Feb 8th
 - DNSSec and IPv6 experience
- Patrick Dorn, Network Engineer (NCSA) starts Feb 22nd
 - Active w/Supercomputing
- Gopal Vaswani, Web Apps Dev (start-up) starts Feb 22nd
 - Web portal, working w/Dugan on network tool development

Open positions:

- Group Lead, Infrastructure Team
- Strategic Partnerships & Site Outreach Coordinator
- Software Developer

Upgrading infrastructure with an eye toward:

- Scalability
- Automation
- Reduced support requirements

Don't hesitate to bring it to our attention if you see issues!

New Ticketing System



- Moving to Service-Now.com SaaS (Software-as-a-Service) solution for ticketing
- Same vendor as UC Berkeley, NERSC, LBNL IT Division
- Benefits: easier to open, query, update tickets, track issues
- On our roadmap: integration with new website
 - ticketing portal + knowledge base for the entire community
- We're interested in your experience: have you adopted a new ticketing system recently?
 - please share your experience with greg@es.net



OpenDevNet



Platform for testing software/systems prior to deployment

Virtualization

- 40 cores, 128 GB RAM, 6TB storage

Performance hosts

- 2 Data Transfer hosts (10G disk to disk, RDMA capable)

Networking

- 1 OpenFlow switch

OpenDevNet

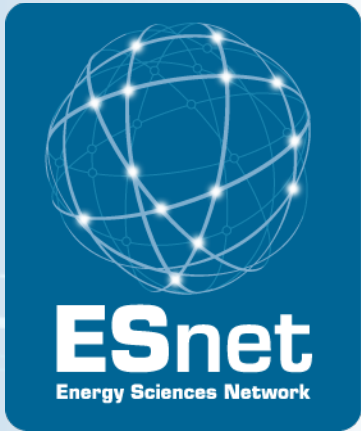


Users

- 13 users (9 ESnet, 4 external collaborators)
- 30 virtual machines

Projects

- OSCARS 0.5 testing
- OSCARS 0.6 development and testing
- perfSONAR development and testing
- ANI testbed control framework development and testing
- Iperf testing
- OpenFlow testing
- GENI/ORCA testing
- RDMA testing with WAN simulation



New ESnet Website



Our Vision and Goals

More relevant, engaging, up-to-date content

World-class tools for DOE networking community and beyond

- 'My ESnet portal' to offer custom view of information you care about: interface / circuit utilization, maintenance calendar, tickets, knowledge base...
- Talented tools developer (Gopal Vaswani) starting Feb 22

Easier to update, maintain, extend

- CMS (content management system) technology



No New Passwords

To customize your 'My ESnet' portal, a login is required

- But we won't force you to get a new password...
- instead we'll leverage federated identity, using InCommon or OpenID accounts

It's likely you have one of these already

- Existing accounts with Google, Yahoo, AOL (and many other organizations) will work

We've been promoting federated identity throughout the DOE community

- Science Identity Federation

Status



Currently finalizing content and site architecture

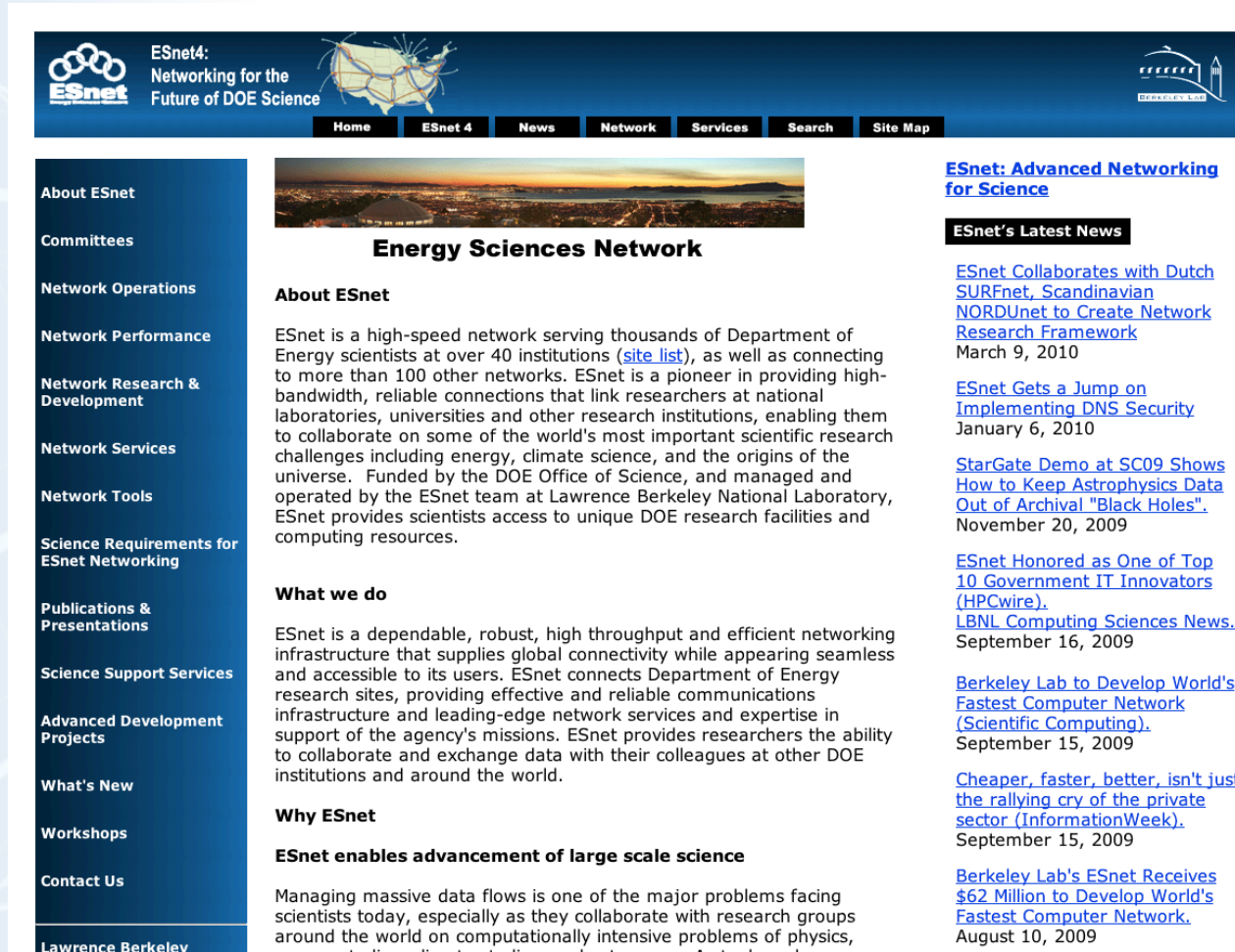
Our web contractor is finishing styling, integrations

Hope to 'go live' in early March

We'll be eager to get feedback on the new site

- CMS makes it very easy to update, refine, optimize

ESnet Website: now



The screenshot shows the ESnet website homepage. At the top, there is a navigation bar with the ESnet logo and the tagline "ESnet4: Networking for the Future of DOE Science". Below the navigation bar is a main content area with a large image of a city at sunset. The main heading is "Energy Sciences Network". To the left is a vertical sidebar with various menu items. To the right is a section titled "ESnet's Latest News" with several news items.

ESnet4: Networking for the Future of DOE Science

Home | ESnet 4 | News | Network | Services | Search | Site Map

Energy Sciences Network

About ESnet

ESnet is a high-speed network serving thousands of Department of Energy scientists at over 40 institutions ([site list](#)), as well as connecting to more than 100 other networks. ESnet is a pioneer in providing high-bandwidth, reliable connections that link researchers at national laboratories, universities and other research institutions, enabling them to collaborate on some of the world's most important scientific research challenges including energy, climate science, and the origins of the universe. Funded by the DOE Office of Science, and managed and operated by the ESnet team at Lawrence Berkeley National Laboratory, ESnet provides scientists access to unique DOE research facilities and computing resources.

What we do

ESnet is a dependable, robust, high throughput and efficient networking infrastructure that supplies global connectivity while appearing seamless and accessible to its users. ESnet connects Department of Energy research sites, providing effective and reliable communications infrastructure and leading-edge network services and expertise in support of the agency's missions. ESnet provides researchers the ability to collaborate and exchange data with their colleagues at other DOE institutions and around the world.

Why ESnet

ESnet enables advancement of large scale science

Managing massive data flows is one of the major problems facing scientists today, especially as they collaborate with research groups around the world on computationally intensive problems of physics,

ESnet: Advanced Networking for Science

ESnet's Latest News

- [ESnet Collaborates with Dutch SURFnet, Scandinavian NORDUnet to Create Network Research Framework](#)
March 9, 2010
- [ESnet Gets a Jump on Implementing DNS Security](#)
January 6, 2010
- [StarGate Demo at SC09 Shows How to Keep Astrophysics Data Out of Archival "Black Holes"](#)
November 20, 2009
- [ESnet Honored as One of Top 10 Government IT Innovators \(HPCwire\). LBNL Computing Sciences News.](#)
September 16, 2009
- [Berkeley Lab to Develop World's Fastest Computer Network \(Scientific Computing\).](#)
September 15, 2009
- [Cheaper, faster, better, isn't just the rallying cry of the private sector \(InformationWeek\).](#)
September 15, 2009
- [Berkeley Lab's ESnet Receives \\$62 Million to Develop World's Fastest Computer Network.](#)
August 10, 2009

ESnet Website: soon



The screenshot shows the ESnet website header with the logo and navigation menu. The main content area features a large image of a particle accelerator tunnel. To the right of the image is a 'Quick Links' section with three categories: Network Performance, ESnet Sites, and ESnet User Services. Below the image is a news snippet titled 'ESnet: Particle physics research' with a 'READ MORE' link.

ESnet Energy Sciences Network

My ESnet | Share

search... >>

Home Network Services R&D Publications Events About ESnet Contact Us

Quick Links

Network Performance

- » Fasterdata Knowledge Base
- » perfSONAR Network Monitoring
- » Network & Utilization
- » ESnet Weathermap

ESnet Sites

- » ESnet FAQ
- » My ESnet
- » ANI Testbed

ESnet User Services

- » ECS Audio/Video Conferencing
- » OSCARS Virtual Circuits

ESnet: Particle physics research

ESnet carries data from the Large Hadron Collider to Tier 1 and Tier 2 sites around the U.S. > [READ MORE](#)

The Energy Sciences Network connects Department of Energy scientists at more than 40 institutions, as well as with over 100 other research and education networks around the world.

The footer section contains four columns of news items. The first column is 'DOE Science Community News', the second is 'See Our Network', the third is 'ESnet Blog: Network Matters', and the fourth is 'What's New at ESnet?'. Each column lists recent news items with dates and times.

DOE Science Community News

- Scientist Finds Nature and Geometry Dancing to the Same Tune
24 NOVEMBER 2010, 12:00 AM
- Energy from the Center of the Milky Way May Be the Remnant of Dark Matter
17 NOVEMBER 2010, 12:00 AM

See Our Network

ESnet Blog: Network Matters

- Engineering mixed traffic on ANI testbed
21 JANUARY 2011, 4:55 PM
- ESnet publishes design guide for high-performance data movers
3 JANUARY 2011, 10:16 AM
- ESnet 2010 Round-up: Part 2
22 DECEMBER 2010, 7:32 PM

What's New at ESnet?

- Sowmya Balasubramanian joins ESnet
MAY 28, 2010
- NERSC, ESnet and JGI Explore Hardware as a Service
APRIL 30, 2010

ESnet Website: Soon



ESnet

Energy Sciences Network

My ESnet | Share

search... >>

Home Network Services R&D News & Publications Events About ESnet Contact Us

Home » My ESnet

My ESnet

Edit Preferences

In the "My ESnet" portal, you can add add the content you choose, including a calendar of upcoming ESnet events, selected overviews of ESnet traffic, link to the ESnet blog and Twitterfeed, and network tools according to your individual needs.

Graphite Portal

Here is an interface to graphite, a real time view of all the maps available of network traffic. You can pick your own. [Choose Images](#)

ani-mr2/interface/x-e-7_0_0/in ani-mr2/interface/x-e-7_0_0/out

Upcoming ESnet & Community Events

With this calendar you can track upcoming ESnet talks, presentations, and meetings as well as events of interest to the greater DOE scientific and technical community.

ESnet Events

Today January 26, 2011

Print Week Month Agenda

Sun	Mon	Tue	Wed	Thu	Fri	Sat
26	27	28	29	30	31	Jan 1

Blogging ESnet "Network Matters"

Get a quick update on latest ESnet developments, technology trends, job postings, and the DOE science that ESnet supports by subscribing to our blog "Network Matters"

[On our way to Joint Techs 2011, in Clemson S.C.](#)
26 JANUARY 2011, 3:06 PM

[Engineering mixed traffic on ANI testbed](#)
21 JANUARY 2011, 4:55 PM

[ESnet publishes design guide for high-performance data movers](#)
3 JANUARY 2011, 10:16 AM

[ESnet 2010 Round-up: Part 2](#)
22 DECEMBER 2010, 7:32 PM

[ESnet 2010 Round-up: Part 1](#)
21 DECEMBER 2010, 5:11 PM

ESnet Tweets

ESnet@ESnetUpdates Berkeley, CA
The high-speed Energy Sciences Network serves the needs of the Office of Science by linking Department of Energy Labs
<http://www.es.net>

[ESnetUpdates: RT @PNNLNews: CyberCARD 2011 kicks off today addressing the challenges of building a strong framework for](#)



Web Content

Are existing sites like blog or fasterdata.es.net useful to you?

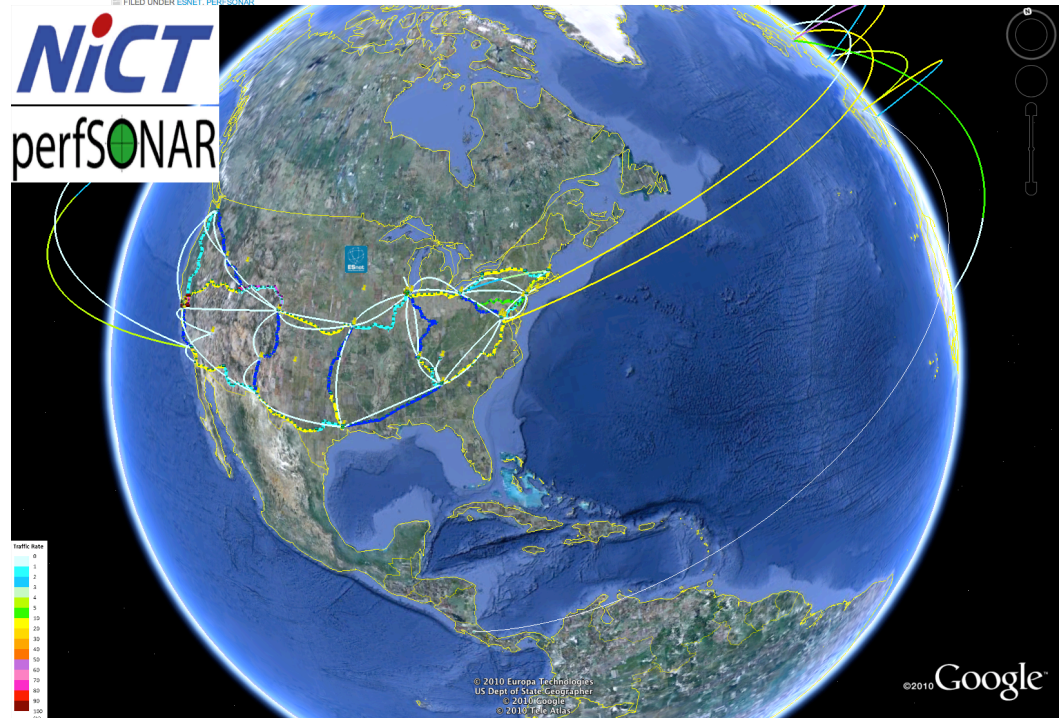
What sort of portal content, tools or visualizations would you like to see?

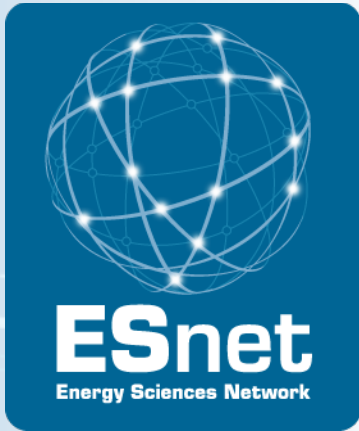
Real-time, global perfSONAR app on Google Earth?

OSCARS circuit visualizations?

Network performance data/interface utilization stats?

Is there interest in social networking applications to share project specific information, publications, slides, maybe instruments etc.?





Authentication & Trust Fabrics Update

DOEGrids CA



DOEGrids v4 nears completion

- Distributed key management devices (netHSM) are online
 - Sunnyvale
 - Chicago
- Distributed key management in place
 - California: OSF (ESnet operations)
 - New York: ESnet remote engineer
- CA Cloning tested – current efforts
 - Smooth transition between old and new CA operation
 - Uniform certificate revocation management
 - Uniform agent and user interfaces



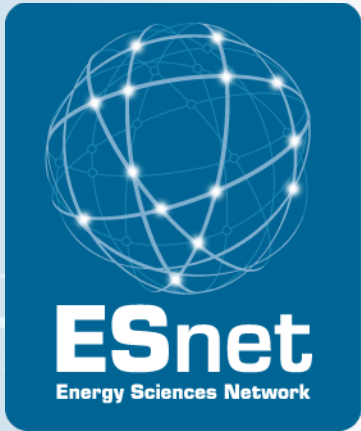
Science Identity Federation (SIF)

Focus: Get labs into InCommon

- Blanket agreement in place
 - 3 year memberships in InCommon for DOE labs, sites, user facilities
 - Primary: SC sites - but there should be sufficient funding for some non-SC
- Sites sign a participation agreement with InCommon
- Berkeley Lab will manage the procurement (billing)
- Agreement web sites will be available soon (maybe this week)

Future focus: applications; interoperability with DOE – ICAM

(Contact Mike Helm helm@fionn.es.net for more information)



Network Analytics

Network Traffic and Routing Analysis



Key Benefits

- Provides a data-driven understanding of the conduct of science as seen by the network
- Observation of network traffic flow characteristics over time allows us to understand how the conduct of science is changing from the perspective of the network
 - Examples include:
 - Dramatic rise in the mid-2000s of the parallel data movers
 - Growing dominance of science traffic as the primary customer of ESnet
- Enables ESnet staff to trace large flows and understand where they are coming from and going to
- Improves productivity of staff, reduces network instability/anomalies

Network Traffic and Routing Analysis



Legacy NetFlow and BGP analysis system (2004-present)

- ESnet staff has developed and maintained an in-house, custom analysis system
 - Based on open-source tools
 - Limited number of reporting options
 - Significant overhead involved in maintenance, debugging and development of new features

Motivation for switching to a commercial system

- Provides more sophisticated reporting options, “what-if” analysis
- Minimize overhead in maintenance and development of legacy system (will be kept for purpose of raw data archiving)
- Commercial support, increased robustness

Network Traffic and Routing Analysis



Deployment of Commercial Appliances

- Arbor Networks: Peakflow SP
 - Models traffic across the entire network by monitoring NetFlow statistics and BGP attributes at the peering edge
 - Chosen for their extensive BGP analytics and automatic tracking mechanisms which provide many different ways of examining network traffic
 - Provides ESnet staff with the necessary data to make informed decisions about routing, transit, partners, customers and quality of service
 - Includes alerting capability to notify operations of significant changes to the network (DDoS attack, link saturation, etc.)
 - Includes support for a customer-facing web-based portal

Network Traffic and Routing Analysis

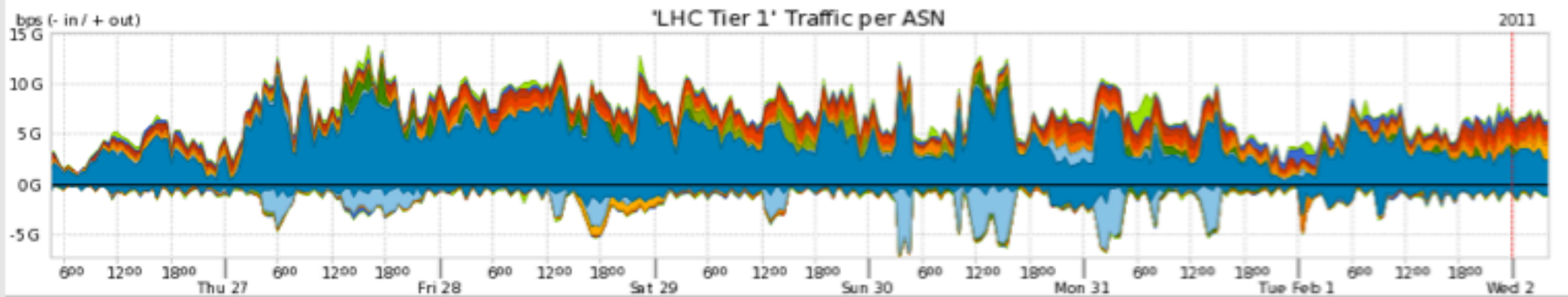
Arbor Networks: Peakflow SP



Profile 'LHC Tier 1' ASNs (Peer)

DETAILS | Period: This Week | Units: bps | Graph Type: Stacked | Update

Profile: LHC Tier 1 | Select Profile: +



Clear All | Update | Showing > Average | Max | PCT95

AS Name	ASN	In	Out	Total (In + Out)
<input checked="" type="checkbox"/> GEANT	20965	1.79 Gbps	8.04 Gbps	9.83 Gbps
<input checked="" type="checkbox"/> BNL	43	3.72 Gbps	530.00 Mbps	4.25 Gbps
<input checked="" type="checkbox"/> SINET	2907	227.01 Mbps	1.12 Gbps	1.35 Gbps
<input checked="" type="checkbox"/> SLAC	3671	104.10 Mbps	1.06 Gbps	1.17 Gbps
<input checked="" type="checkbox"/> GLORIAD	20388	680.06 Mbps	455.00 Mbps	1.14 Gbps
<input checked="" type="checkbox"/> NLR	19401	194.00 Mbps	853.00 Mbps	1.05 Gbps

Network Traffic and Routing Analysis

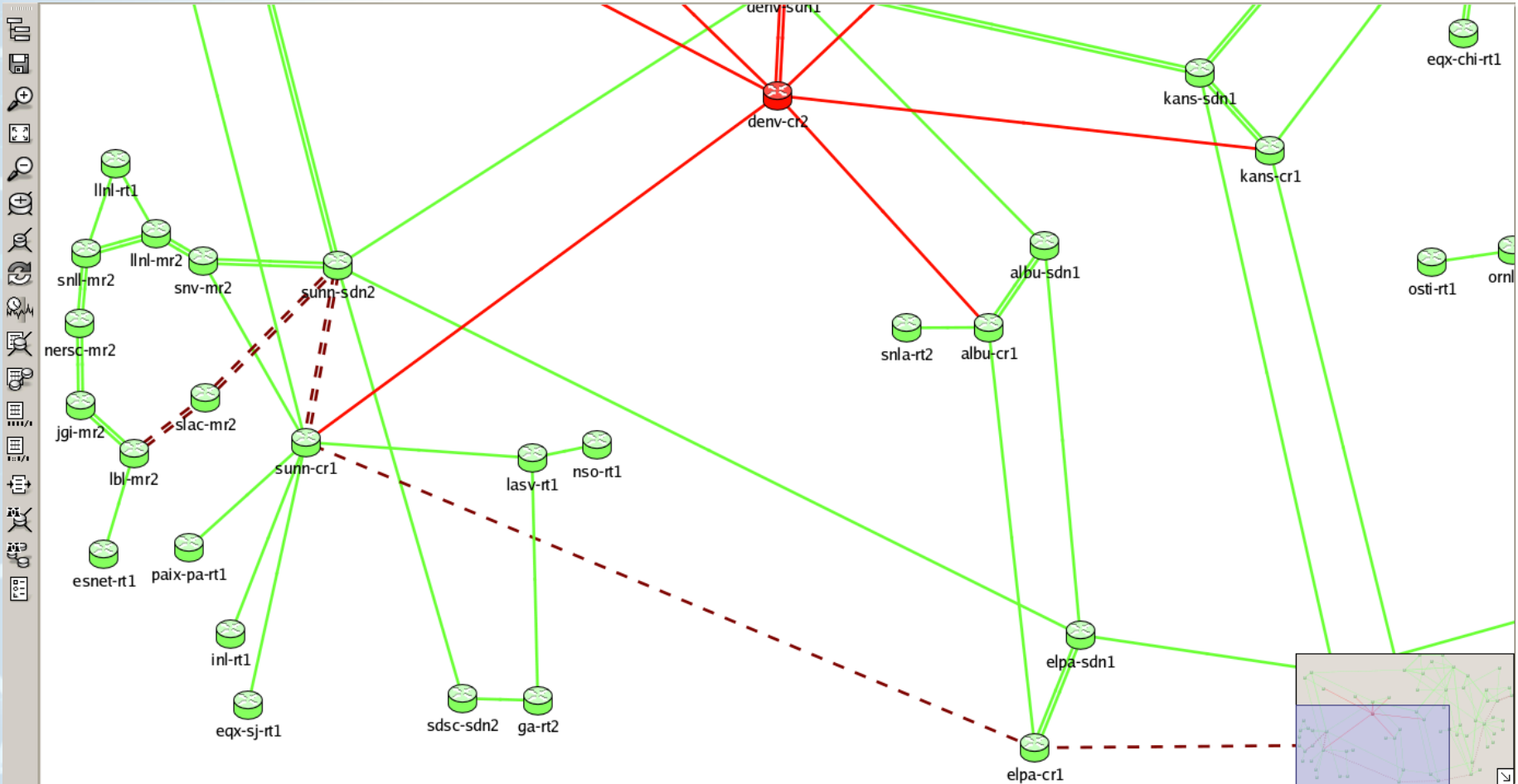


Deployment of Commercial Appliances

- Packet Design: Traffic Explorer & Route Explorer
 - Provides integrated, real-time view of network-wide routing and traffic behavior by monitoring NetFlow data and routing protocols
 - Chosen for their planning mode features and routing analytics
 - Enables ESnet staff to rapidly prototype network optimization schemes and perform “what-if” analyses with historical data
 - e.g., report on impact of link/node failures, understand impact of expected traffic growth for one particular science community
 - Traffic grouping features allow flows belonging to a particular customer or science community to be reported on separately
 - Improves productivity of network engineering staff by automating the analysis of complex problems previously done manually

Network Traffic and Routing Analysis

Packet Design: Traffic Explorer & Route Explorer



Network Traffic and Routing Analysis



Current Status of Deployment

- Both Arbor and Packet Design provided loaner systems which were evaluated by ESnet staff during a 60-day trial period
 - Evaluation period has given ESnet staff the opportunity to become familiar with how to deploy and manage each system
 - Insight provided by these systems during our evaluation helped to identify problems which had gone unnoticed
 - Asymmetric IP routing
 - Duplicate flow sampling
- Orders placed for Arbor and Packet Design appliances in Aug 2010
 - Deployed at LBNL in early Nov 2010
 - Now used by ESnet staff for traffic, routing and peering analysis

Arbor Managed Objects

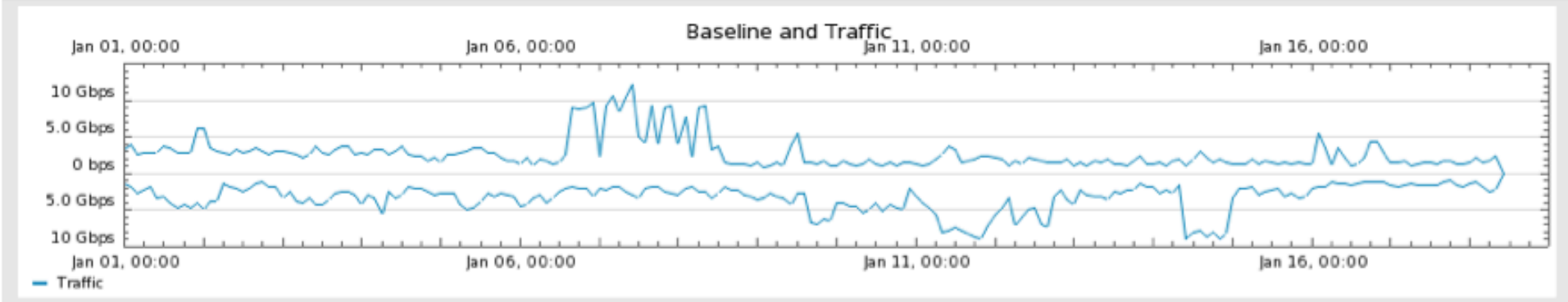
Baseline traffic to/from GEANT (as20965)



Summary

DETAILS Period: Start: End: Units:

Peer:



Showing > [Average](#) | [Max](#) | [PCT95](#)

Name	In	Out	Total (In + Out)
Traffic	7.86 Gbps	8.95 Gbps	16.81 Gbps

Showing 1 items

Arbor Managed Objects

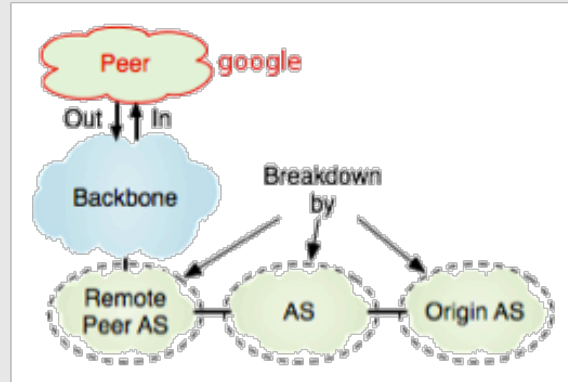
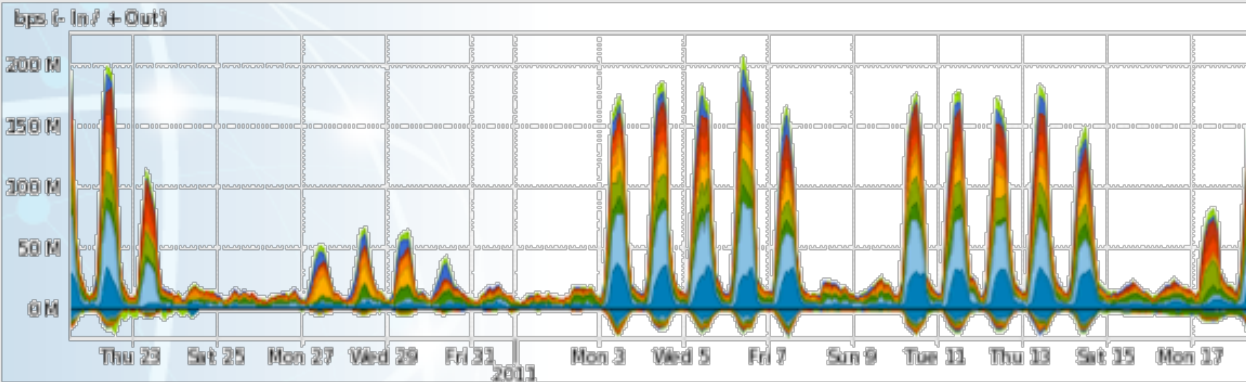
Traffic to/from Google broken down by ESnet customers (DOE sites)



Peer 'google' x Remote AS

DETAILS Period: This Month Units: bps Update

Peer: google Select Peer:



Clear All Update

Showing > Average | Max | PCT95

AS Name	ASN	Into Peer	Out of Peer	Total (In + Out)	% Total
<input checked="" type="checkbox"/> LBL	16	1.92 Mbps	6.90 Mbps	8.81 Mbps	14.01%
<input checked="" type="checkbox"/> LANL-INET	68	527.20 Kbps	8.21 Mbps	8.74 Mbps	13.89%
<input checked="" type="checkbox"/> BNL	43	672.56 Kbps	4.30 Mbps	4.97 Mbps	7.90%
<input checked="" type="checkbox"/> SNLA-NET	377	419.94 Kbps	4.50 Mbps	4.92 Mbps	7.82%
<input checked="" type="checkbox"/> LLL-TIS	45	300.92 Kbps	4.08 Mbps	4.38 Mbps	6.96%
<input checked="" type="checkbox"/> FNAL	3152	452.89 Kbps	3.63 Mbps	4.08 Mbps	6.49%
<input checked="" type="checkbox"/> INL	10702	306.80 Kbps	3.55 Mbps	3.86 Mbps	6.13%
<input checked="" type="checkbox"/> ARGONNE	683	651.00 bps	3.39 Mbps	3.39 Mbps	5.39%
<input checked="" type="checkbox"/> ORNL-MSRNET	50	310.47 Kbps	2.88 Mbps	3.19 Mbps	5.07%
<input checked="" type="checkbox"/> ESNET-WEST	292	581.02 Kbps	2.26 Mbps	2.84 Mbps	4.51%

01/11/11

Arbor Managed Objects

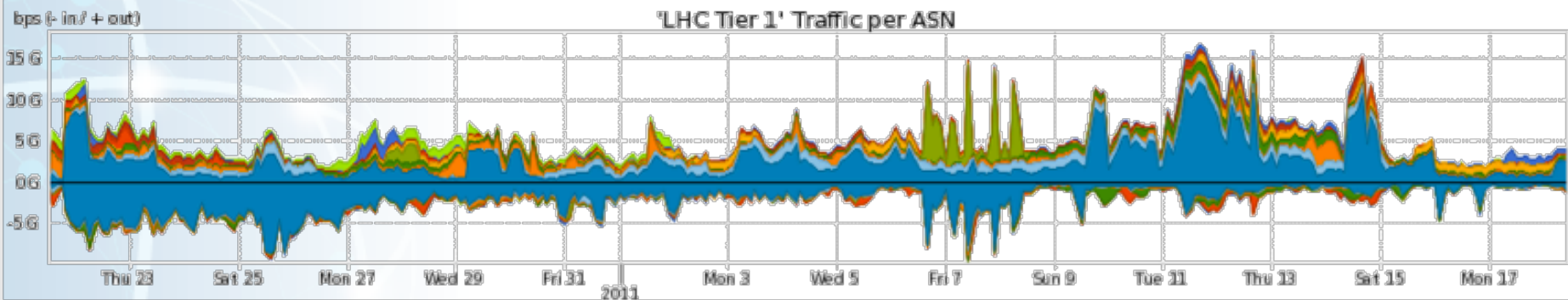
Traffic to/from LHC Tier 1 sites broken down by ESnet peers



Profile 'LHC Tier 1' ASNs (Peer) ?

DETAILS Period: ▼ This Month Units: ▼ bps Graph Type: ▼ Stacked Update

Profile: LHC Tier 1 Select Profile: +



Clear All Update Showing > Average | Max | PCT95

AS Name	ASN	In	Out	Total (In + Out) ▼
<input checked="" type="checkbox"/> GEANT	20965	2.11 Gbps	2.44 Gbps	4.55 Gbps
<input checked="" type="checkbox"/> NLR	19401	91.16 Mbps	609.48 Mbps	700.65 Mbps
<input checked="" type="checkbox"/> GIGAPOP-NE	10578	112.78 Mbps	423.51 Mbps	536.29 Mbps
<input checked="" type="checkbox"/> ABILENE	11537	144.35 Mbps	389.03 Mbps	533.38 Mbps
<input checked="" type="checkbox"/> FNAL	3152	68.47 Mbps	321.25 Mbps	389.72 Mbps
<input checked="" type="checkbox"/> CSUNET-NE	2153	3.15 Mbps	323.77 Mbps	326.92 Mbps
<input checked="" type="checkbox"/> BNL	43	135.64 Mbps	146.99 Mbps	282.63 Mbps
<input checked="" type="checkbox"/> CERN	513	17.52 Mbps	256.38 Mbps	273.90 Mbps
<input checked="" type="checkbox"/> GLORIAD	20388	43.72 Mbps	213.91 Mbps	257.63 Mbps
<input checked="" type="checkbox"/> AS14041	14041	5.52 Mbps	244.07 Mbps	249.58 Mbps

01/11/11

Arbor Peering Analytics

Verizon Business Peering in SJ is Warm - Who's using it most?



Peering Source, Destination Analysis

DOWNLOAD EMAIL PRINT

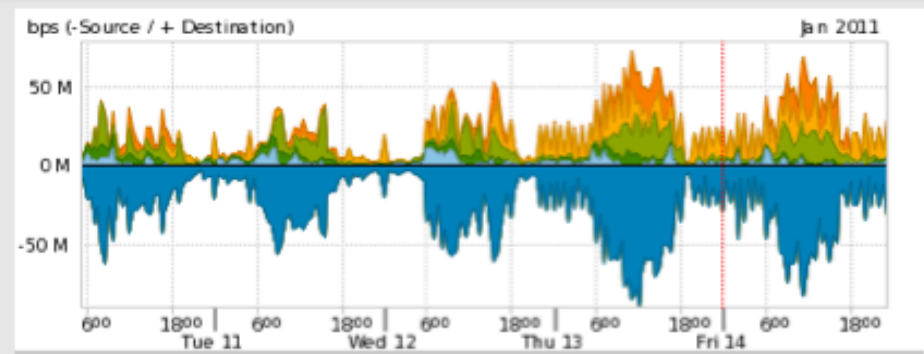
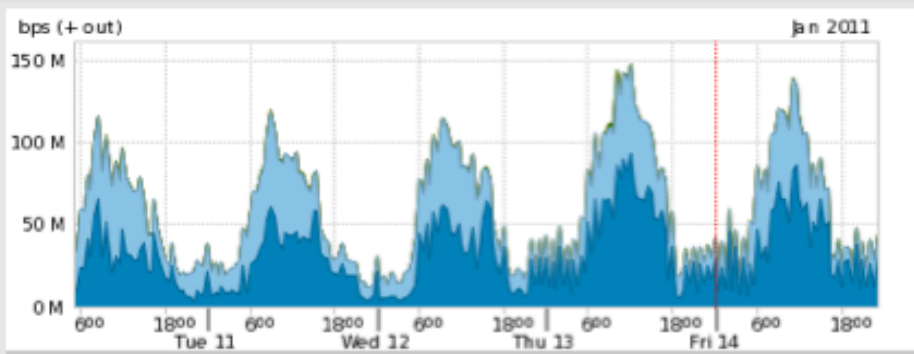
DETAILS Period: Start: End: Between ASes: and Units:

Update

Peer:

Peering Source, Destination Analysis for verizonbusiness

Traffic for interface ge-0/0/4.0



Showing > Average | Max | PCT95

Showing > Average | Max | PCT95

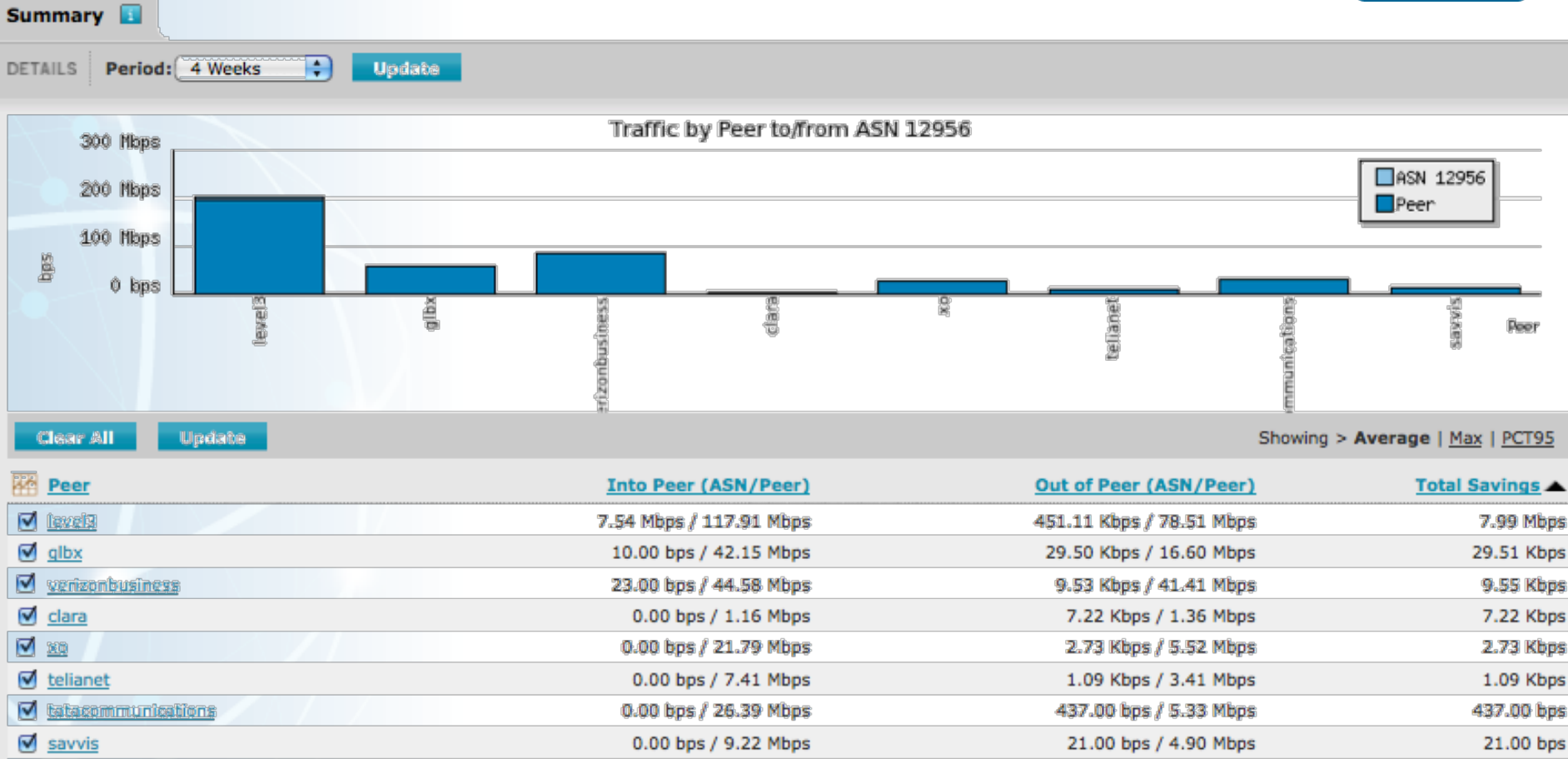
Interface	Capacity	Out of Peer	% of Peer
<input checked="" type="checkbox"/> eqx-sj-rt1.es.net ge-0/0/4.0 eqx-sj-rt1->verizonbusiness(as701):fe:eqx(sj):hide:com-intercloud	100 Mbps	31.99 Mbps	53.9%
<input checked="" type="checkbox"/> eqx-ash-rt1.es.net ge-0/0/4.0 eqx-ash-rt1->verizonbusiness(as701):fe:eqx(ash):hide:com-intercloud	100 Mbps	27.02 Mbps	45.1%

Name	ASN	Traffic as Source	Traffic as Destination
<input checked="" type="checkbox"/> UUNET	701	61.95 Mbps	0.00 bps
<input checked="" type="checkbox"/> LANL-INET	68	0.00 bps	8.33 Mbps
<input checked="" type="checkbox"/> DOE-NTS	11678	0.00 bps	7.17 Mbps
<input checked="" type="checkbox"/> LBL	16	0.00 bps	21.00 Mbps
<input checked="" type="checkbox"/> SLAC	3671	0.00 bps	22.00 Mbps
<input checked="" type="checkbox"/> LLL-TIS	45	0.00 bps	17.00 Mbps

Showing 6 items

Arbor Peering Analytics

Is it worth it to peer directly with Telefonica (as12956) ?



Arbor DDoS Alert

To single IP address at SLAC - really an attack, or slashdot effect?



System Alerts Explore Reports Mitigation Administration MY ACCOUNT HELP LOGOUT

DoS Alert 1088 MITIGATE DOWNLOAD EMAIL PRINT

Alert Summary

DoS Alert 1088 Classification: Possible Attack Dec 22 10:38 - Ongoing (3:46)

Importance	Impact	Type	Affected	Direction	Mitigations
High	5.2 Mbps 12.8 Kpps	TCP SYN Misuse	slac	Incoming	None

Alert Characterization

Sources	Source Ports	Destinations	Destination Ports	Protocols	TCP Flags
0.0.0.0/0 178.0.0.0/8	49152 - 65535 49152 - 57343	ppa-herbst.slac.stanford.edu (134.79.229.87/32)	443 (https) 80 (www-http)	tcp (6)	SEW (0xC2)

[Generate Raw Flows Report](#) [View Raw Flows Report](#)



Experimental Capacity Planning Tool

Experimental Capacity Planning Tool



ESnet has grown to beyond the point where it is no longer feasible to use manual processes to determine when a circuit needs to be upgraded.

What kinds of traffic patterns can we detect that might give us an idea when a link is becoming saturated?

But what does saturated mean?

- There is no widely held idea of what percentage of utilization indicates that a circuit is becoming saturated. A thread on NANOG has ranges from 40% to 95%
<http://nanog.markmail.org/thread/vmkjrldzvsrbz3en>
- The traffic profile of the network will effect this threshold. R&E networks are significantly different than the commercial Internet.



Approach

Taking some of the ‘art’ out of deciding when to add capacity

Process:

- Define metrics that can describe utilization patterns that may indicate circuits are busy
- Analyze all circuits each day and assign a score for each metric
- Initially the thresholds for the metrics and for which values of each metric indicate an “interesting” circuit will require human supervision
- Over time note which circuits are upgraded
- Use the decisions from step 4 along with the historical scores for each metric as an input for logistic regression

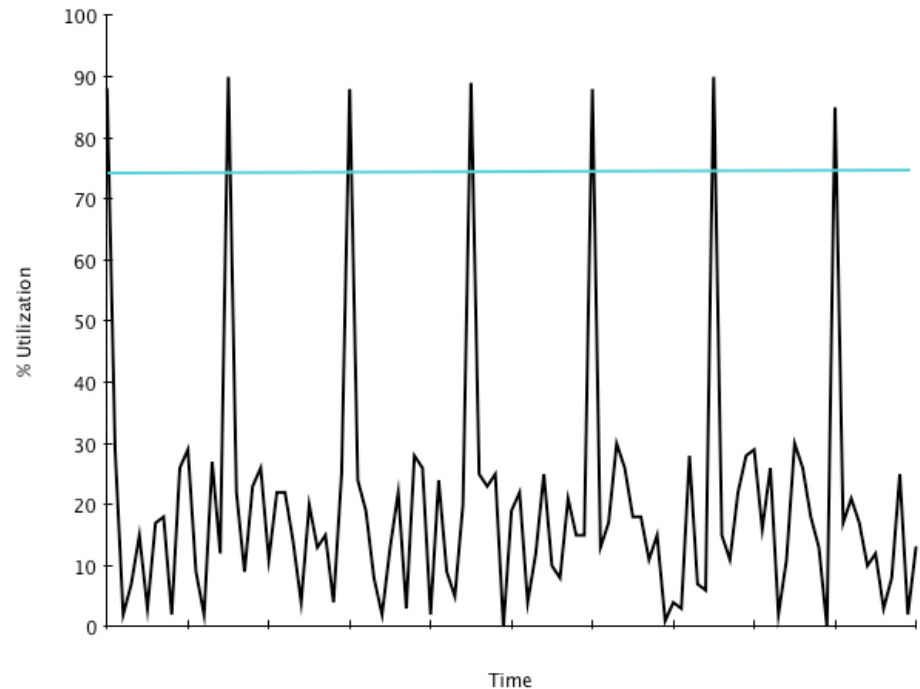
Peaks Metric



The number of sampling intervals where the utilization is over some threshold T .

In this example:

- $T = 75\%$
- The value of the metric is 7 (there is a peak at time 0)



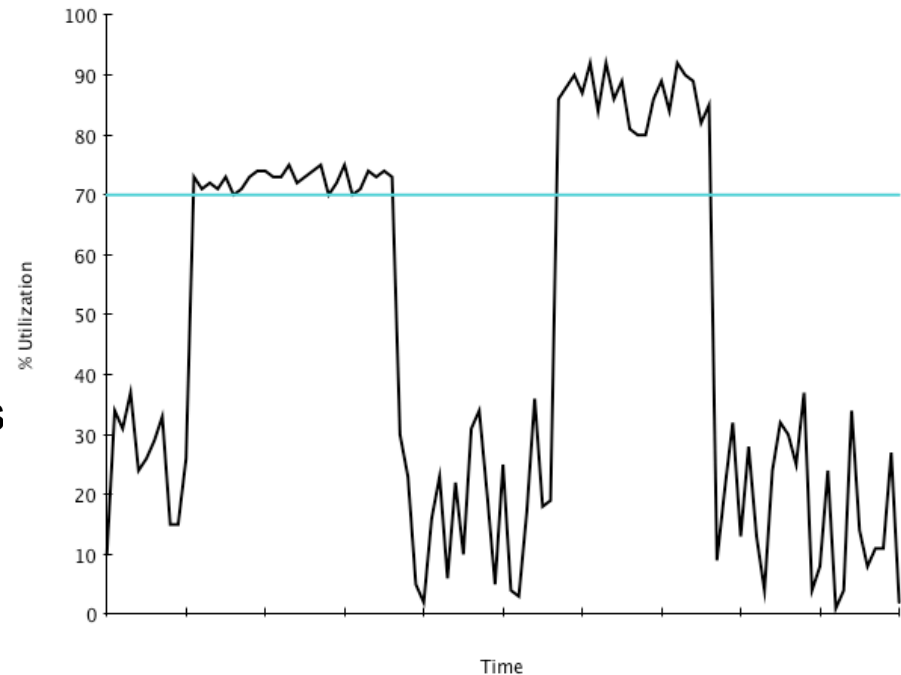
Plateaus Metric



The number of sampling intervals where the utilization is over some threshold T for at least t intervals.

In this example:

- T is 70%
- t is 20
- Metric value is 48 (left plateau is 27 time intervals wide, the right is 21 time intervals wide)
- Peaks which persist for less than t intervals are NOT counted



Current Status And Limitations



Status

Peaks and Plateaus metrics are both implemented

In the process of finding appropriate thresholds for each metric

Need more data regarding past upgrades to feed the logistic regression

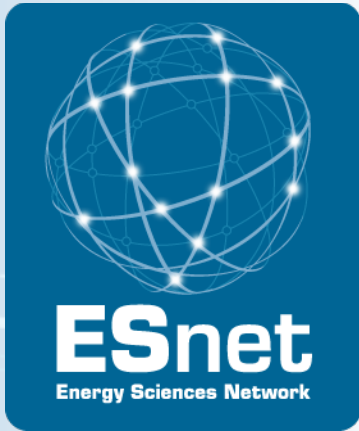
The peaks and plateaus metrics when properly tuned may provide enough filtering to allow a human to evaluate the remaining circuits

Limitations of the regression

- Topology (both physical and routing) changes can complicate things
- The past may or may not be a good predictor of the future
- Additional metrics would be helpful

Contact Jon Dugan

(jdugan@es.net) with questions, comments or suggestions!



Focus Areas for the Next 12 Months

Finding Ways to Make the Network More Useful



If your scientists aren't effectively using the network, it's unlikely you are going to invest in the network because there are other areas with a better return on investment

- Science productivity and collaboration suffer

How do we get there?

- WAN: Improved efficiency (OSCARS), perfSONAR, security, etc.
- LAN: Science DMZs, perfSONAR, Openflow, data transfer nodes, security, etc.
- New tools for LANs that improve WAN effectiveness, visualization
- What else?

How do we become the Dept of (Less) Energy?



Ideas we're contemplating:

- Begin to understand how to measure the energy cost of moving data using existing infrastructure
 - Extend to 100G network
- Expand <http://weathermap.es.net/> to include energy costs
- Test movement of VMs in terms of energy costs
- What is more energy efficient – computing in the cloud or locally? How can this decision be made?
- Use path computation engine SDK to create virtual networks on demand that satisfy not just BW allocation costs but also min energy cost, or max green energy costs
- Analyze the idleness of the paths – is there a chance for power management there? Does it make sense to purposefully create idle paths at a slight performance cost?
- Switch to move flows dynamically to create idleness along a path



Twitter: ESnetUpdates

Blog: <http://esnetupdates.wordpress.com/>

Thank you