

*Supporting Advanced Scientific Computing
Research • Basic Energy Sciences • Biological
and Environmental Research • Fusion Energy
Sciences • High Energy Physics • Nuclear Physics*

Energy Sciences Network ESnet4 Update

July 22, 2009

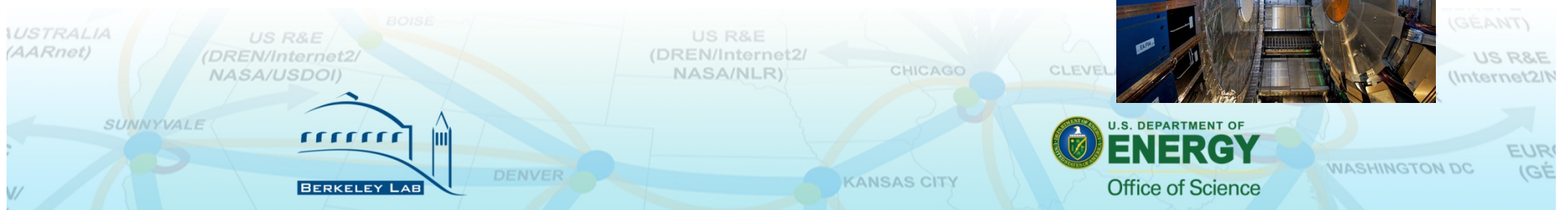
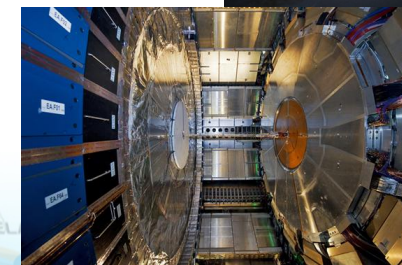
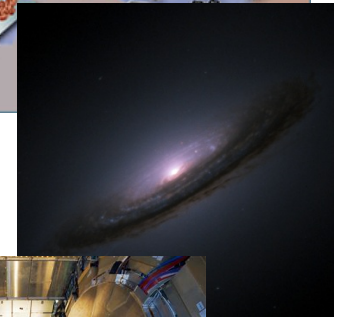
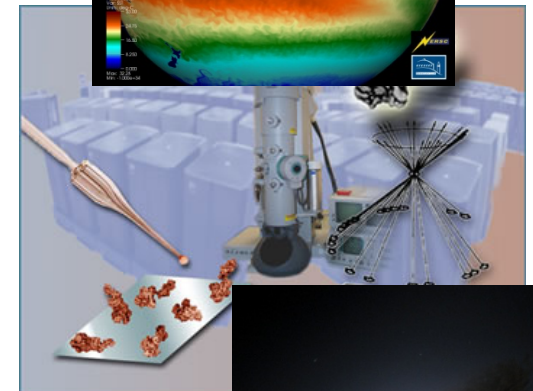
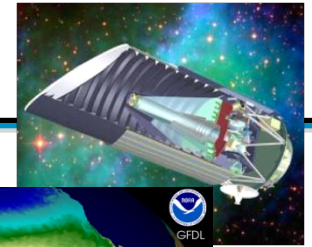
Steve Cotter steve@es.net
Dept. Head, Energy Sciences Network
Lawrence Berkeley National Lab

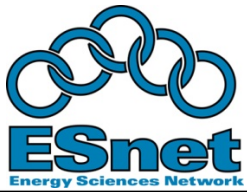









Agenda

- Network Update
 - Network builds
 - Circuit installs
- Services Update
- Futures





2009 Site Installs

Feb	Mar	Apr	May	June	July
					
Qwest AOA-HUB decommissioned	Qwest DC-HUB decommissioned				
FNAL MX40 & MX960 (replaced 6509)	NERSC MX480 (replaced 6509)				
JGI MX480 (replaced 6509)	BNL MX40 & MX960 (replaced 6509)	PAIX-PA M10i (replaced M10)	PAIX-PA M10i (replaced M10)	ANL MX960 (replaced 6509)	PAIX-PA M10i (replaced M10)
<p>1 10GE LIMAN#3 AofA-BNL IP up Feb 2nd</p> <p>1 10GE DF circuit between AofA-NEWY up on Feb 2nd</p> <p>1 1GE PPPL-HEP-PU Feb 4th</p> <p>1 10GE LIMAN#4 NEWY-BNL up on Feb 9th</p> <p>1 10GE STAR-HUB USLHCnet E300 Feb 10th</p>	<p>1 DS3 OSTI-WASH-HUB (backup) up on Mar 3rd</p> <p>1 10GE BOST-MIT IP peering enabled on Mar 19th</p>		<p>1 10GE peering BOST-HUB – NoX for BNL on May 27th</p>	<p>1 1GE SDN between PPPL (GFDL) – WASH on June 1st</p> <p>1 10GE SDN PNWG-HUB – PNNL on June 6th</p> <p>1 10GE NASH-ORNL-#2 SDN Wave on June 14th</p> <p>1 1GE Peering PNWG-HUB – CSTNET (China) on June 17th</p> <p>1 10M PNNL Sire office at OSTI June 19th</p> <p>1 10GE KANS-Great Plains Net (GPN) for the DUSAL & OneNet Peering June 27th</p>	<p>1 1GE Level3 private peering @ PAIX-PA up on July 2nd</p> <p>1 OC12 GA-LASV-HUB up on July 9th</p> <p>1 10GE SDN peering with ANL Site July 13th</p>



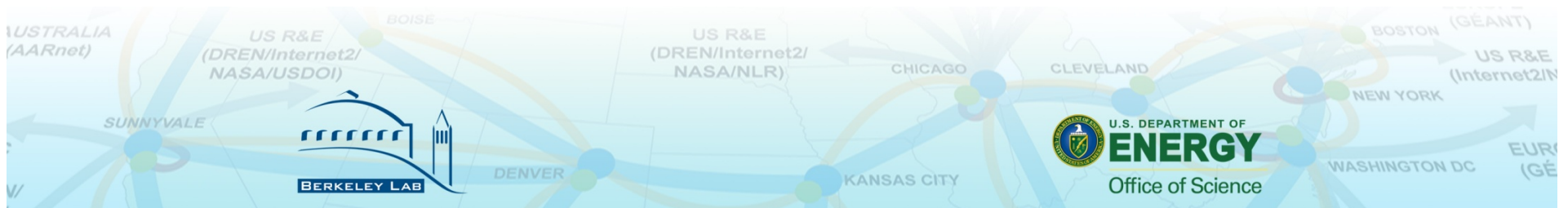
Backbone Hub & Wave Count

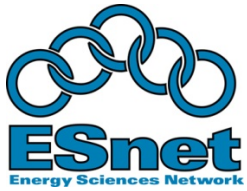
Current Hub Count: 21

- 32 AofA, NEWY, WASH, ATLA, NASH, CLEV, BOST, CHIC, STAR, KANS, HOUS, ELPA, DENV, ALBU, BOIS, PNWG, SUNN, SNV(Qwest), LOSA, SDSC, LASV (SwitchNap)

Current Backbone Wave Count:

- Internet2/Level3 10G waves:
 - IP: 17 new/split for a total of 25
 - SDN: 25 new/split for a total of 30
- NLR 10G waves:
 - 5 10G waves

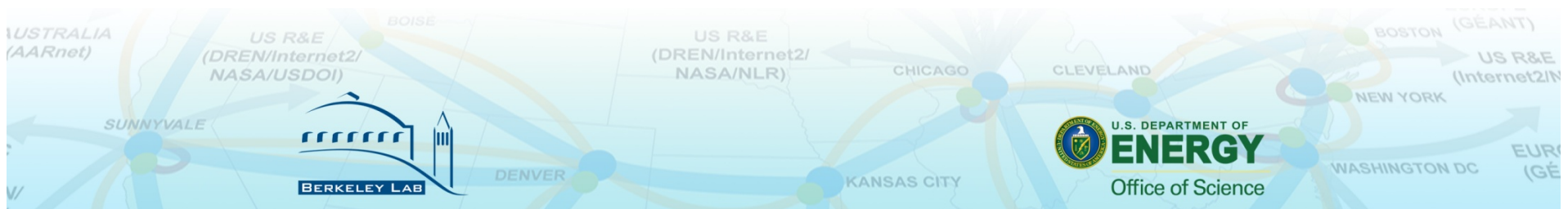


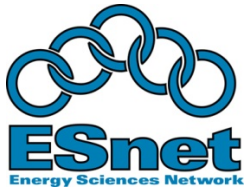


Circuit & Site Installs (cont.)

Circuit installs (cont.)

- 1 10GE in BOST to MIT enabled on Mar 19th
- 1 10GE peering BOST-HUB to NoX for BNL May 27th
- 1 1GE SDN between PPPL (GFDL) – WASH June 1st
- 1 10GE SDN PNWG-HUB – PNNL June 6th
- 1 10GE NASH-ORNL-#2 SDN Wave June 14th
- 1 1GE Peering PNWG-HUB – CSTnet (China) June 17th
- 1 10M PNNL Site Office @ OSTI June 19th
- 1 10GE KANS HUB-GPN for the 1GE DUSAL & 1GE OneNet Peering June 27th
- 1 1GE Level3 private peering @ PAIX-PA July 2nd
- 1 OC12 GA-LASV-HUB July 9th
- 1 10GE ANL SDN site peering July 13th

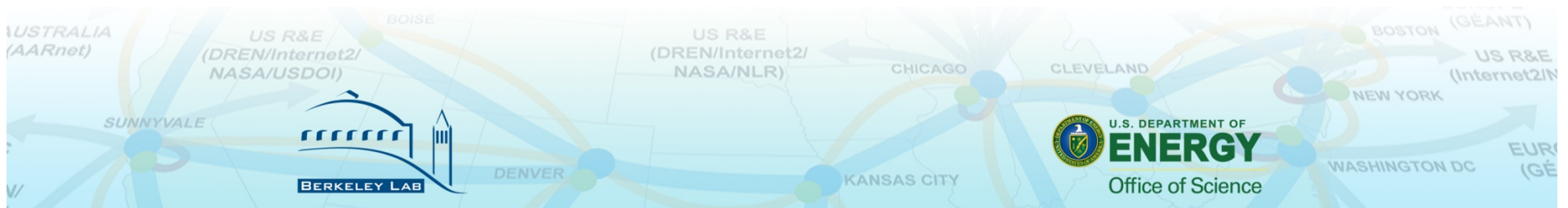




Future Circuit Installs

Future Circuit Installs:

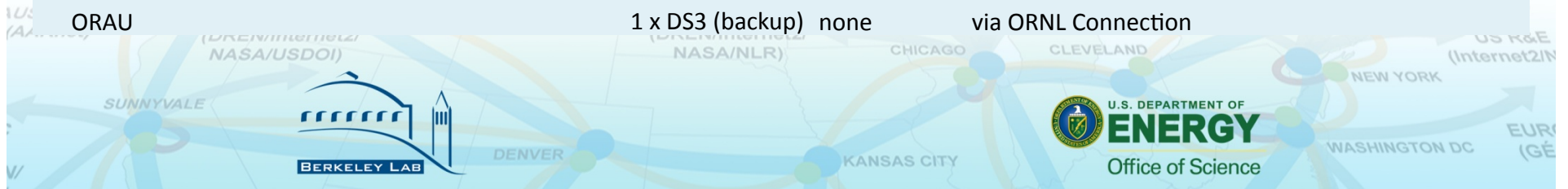
- OC12 between DENV-HUB and Pantex (TBD)
- 1GE wave in BOIS to INL via IRON (TBD)
- 1GE links in D.C. Area for Germantown, IN to WASH-HUB (TBD)
- OC3 for NSTech-NV to LASV-HUB (on order)
- 10G peering at PNWG-HUB with Korea (KSTAR & KISTI) (TBD)





ESnet Connections

Sites	IP Access	SDN Access	Notes
Office of Science Laboratories			
Ames Laboratory	2 x 1G	none	
Argonne National Laboratory	2 x 10G	1 x 10G	CHIMAN
Brookhaven National Laboratory	2 x 10G	2 x 10G	LIMAN
Fermi National Accelerator Laboratory	2 x 10G	4 x 10G	CHIMAN
Thomas Jefferson National Accelerator Facility	1 x 10G	none	Via MATP & ELITE
Lawrence Berkeley National Laboratory	2x10G	2 x 10G	SF BA MAN
Oak Ridge National Laboratory	1 x 10G + OC48	1 x 10G	ORNL extended demark to NASH-HUB (capacity 2x10G IP & 4x10G SDN) Qwest OC48 to ATLA
Pacific Northwest National Laboratory	1 x 10G	1 x 10G	PNNL entended demark to PNWG-HUB (capacity 2x10G IP & 4x10G SDN) Future 10G to BOIS-HUB
Princeton Plasma Physics Laboratory	1 x 10G	none	
SLAC National Accelerator Laboratory	2 x 10G	2 x 10G	SF BA MAN
Multi-Purpose Laboratories			
Lawrence Livermore National Laboratory	2 x 10G	2 x 10G	SF BA MAN
Los Alamos National Laboratory	1 x 10G	none	LANL extended demark to ALBU hub (capacity 2x10G IP & 2x10G SDN)
Sandia National Laboratory - California (SNL-CA)	2 x 10G	2 x 10G	SF BA MAN
Office of Science Facilities			
NERSC	2 x 10G	2 x 10G	SF BA MAN
OSTI	1 x 1G + T1	none	via ORNL Connection
Office of Science Collaborative Facilities			
JGI	2 x 10G	2 x 10G	SF BA MAN
ORAU	1 x 1G + 1 x DS3 (backup)	none	via ORNL Connection

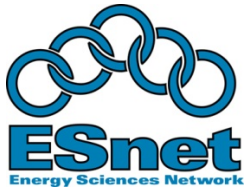




ESnet Connections

Sites	IP Access	SDN Access	Notes
Bechtel Jacobs Company (BJC)	44 Mb/s	none	via ORNL connection
DOE NNSA Headquarters - Germantown (DOE-NNSA-GTN)	155 Mb/s	none	Future: DC MAN participant
DOE NNSA Service Center - Albuquerque (DOE-NNSA-SC)	52 Mb/s	none	via SNL-NM connection
NNSA Information Assurance Response Center (IARC)	45 Mb/s	none	at LASV-Hub
Idaho National Laboratory (INL)	155 Mb/s	none	Future: 1G to BOIS-Hub
Kansas City Plant (KCP)	155 Mb/s	none	
KCP Kirtland AFB Site Office (KCP-KIRTLAND)	52 Mb/s	none	via SNL-NM connection
LANL DC Office (LANL-DC)	22 Mb/s	none	shared DS3 with LLNL-DC Office
LLNL DC Office (LLNL-DC)	22 Mb/s	none	shared DS3 with LANL-DC Office
Mathematical Sciences Research Institute (MSRI)	44 Mb/s	none	via LBNL SF BA MAN connection
National Geospatial-Intelligence Agency - Forrestal Bldg	20 Mb/s	none	Future: DC MAN participant
National Geospatial-Intelligence Agency - LLNL	20 Mb/s	none	via LLNL SF BA MAN connection
National Geospatial-Intelligence Agency - NVIC	20 Mb/s	none	via NSTec NTS connection
National Geospatial-Intelligence Agency - SNL-NM	80 Mb/s	none	via SNL-NM connection
National Geospatial-Intelligence Agency - SRS	20 Mb/s	none	via SRS connection
National Renewable Energy Laboratory (NREL)	1 G	none	site owned circuit to DENV-Hub
NSTec Livermore Operatios (NSTec-LivOps)	45 Mb/s	none	at LASV-Hub
NSTec Nevada Test Site Office (NSTec-NTS)	45 Mb/s	none	Future: DS-3 to be upgraded to rate-limited OC3
PANTEX	155 Mb/s	none	Future: OC3 to be upgraded to OC12
Sandia National Laboratory - New Mexico (SNL-NM)	2 x 1G	none	1 SNL and 1 NGA
Savannah River Site (SRS)	155 Mb/s	none	Future: additional OC3 for backup
Y-12 National Security Complex (Y-12)	45 Mb/s	none	portion of OR OC48
Yucca Mountain Project (YUCCA)	45 Mb/s	none	at LASV-Hub





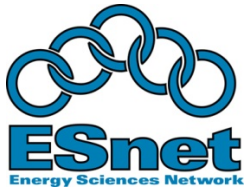
ESnet Connections

Interchange Points	IP Access	SDN Access	Notes
CENIC (Sunnyvale, CA)	1 x 10G	none	
CENIC (Seattle, WA)	1 x 10G	none	
Equinix Ashburn	1 x 1G	none	Future: upgrade to 10G peering
Equinix Chicago	1 x 1G	none	Future: upgrade to 10G peering
Equinix San Jose	1 x 1G	none	Future: upgrade to 10G peering
MANLAN (New York, NY)	2 x 10G	none	
MAX Gigapop	1 x 10G	none	
MREN at STARLIGHT (Chicago, IL)	1 x 10G	none	
PAIX (Palo Alto, CA)	1 x 1G	none	
STARLIGHT (Chicago, IL)	1 x 10G	none	

US R&E Peerings: 3ROX, ABQ Gigapop, CICNET, DREN, DUSEL, FRGP, GFDL, Indiana Gigapop, Internet2, LOSNETTOS, NASA, NLR, NOX, NYSERNET, NWU, OMNIPOP, ONENET, OSOGRANDE, PSC, PU-HEP, SDSC, SOX, TECHNET, UCHICAGO, UI-ICCN, ULTRALIGHT, USDOJ, UWMadison, and WISCNET

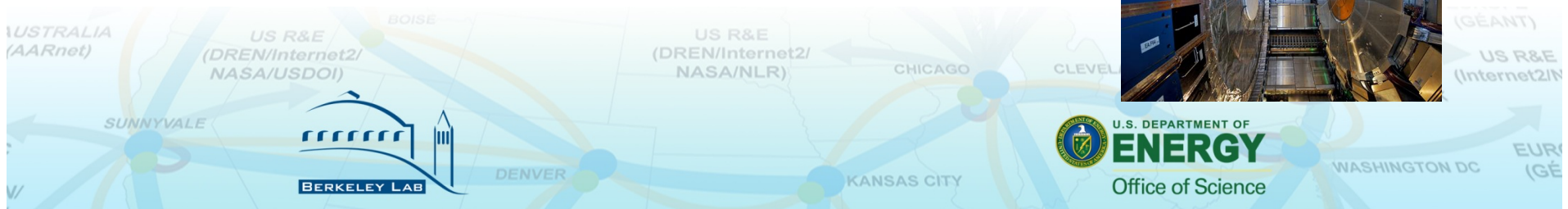
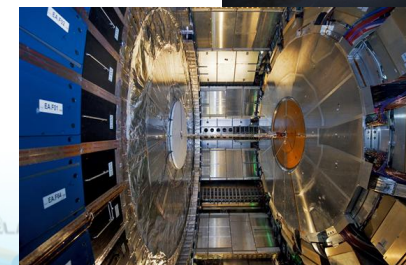
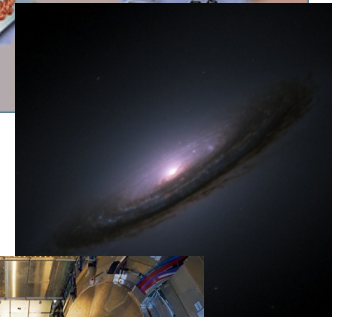
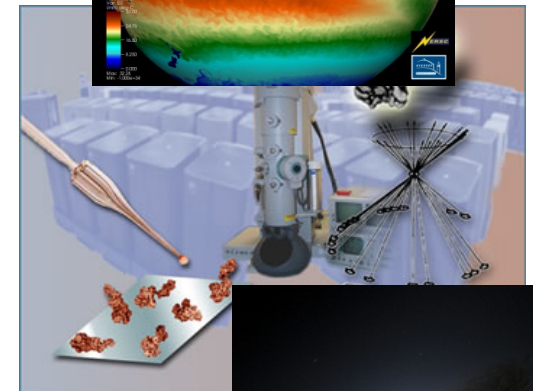
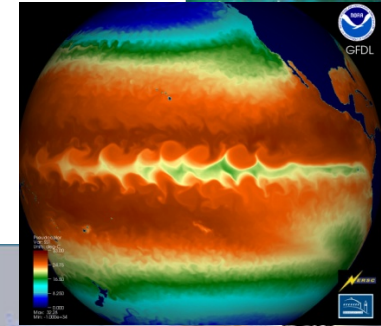
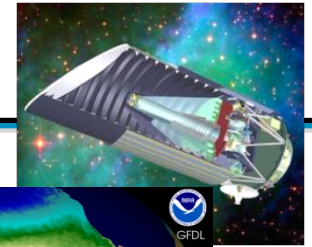
International Peerings: AARnet (Australia), AMPATH (South America), ASGC (Asia-Pacific), BINP (Asia-Pacific), CANARIE (Canada), CLARA (South America), CUDI (Latin America), GEANT (Europe), GLORIAD (China and Russia), HEPNET (Asia-Pacific), KAREN (Asia-Pacific), KREONET2 (Asia-Pacific), NUS-GP (Asia-Pacific), ODN (Asia-Pacific), OPEN TRANSIT (France), REANNZ (Asia-Pacific), SINET (Asia-Pacific), TANET2 (Asia-Pacific), TRANPAC2 (Asia-Pacific), and USLHCNet (CERN)





Agenda

- Network Update
- Services Update
 - Network
 - OSCARS
- ARRA
- Misc

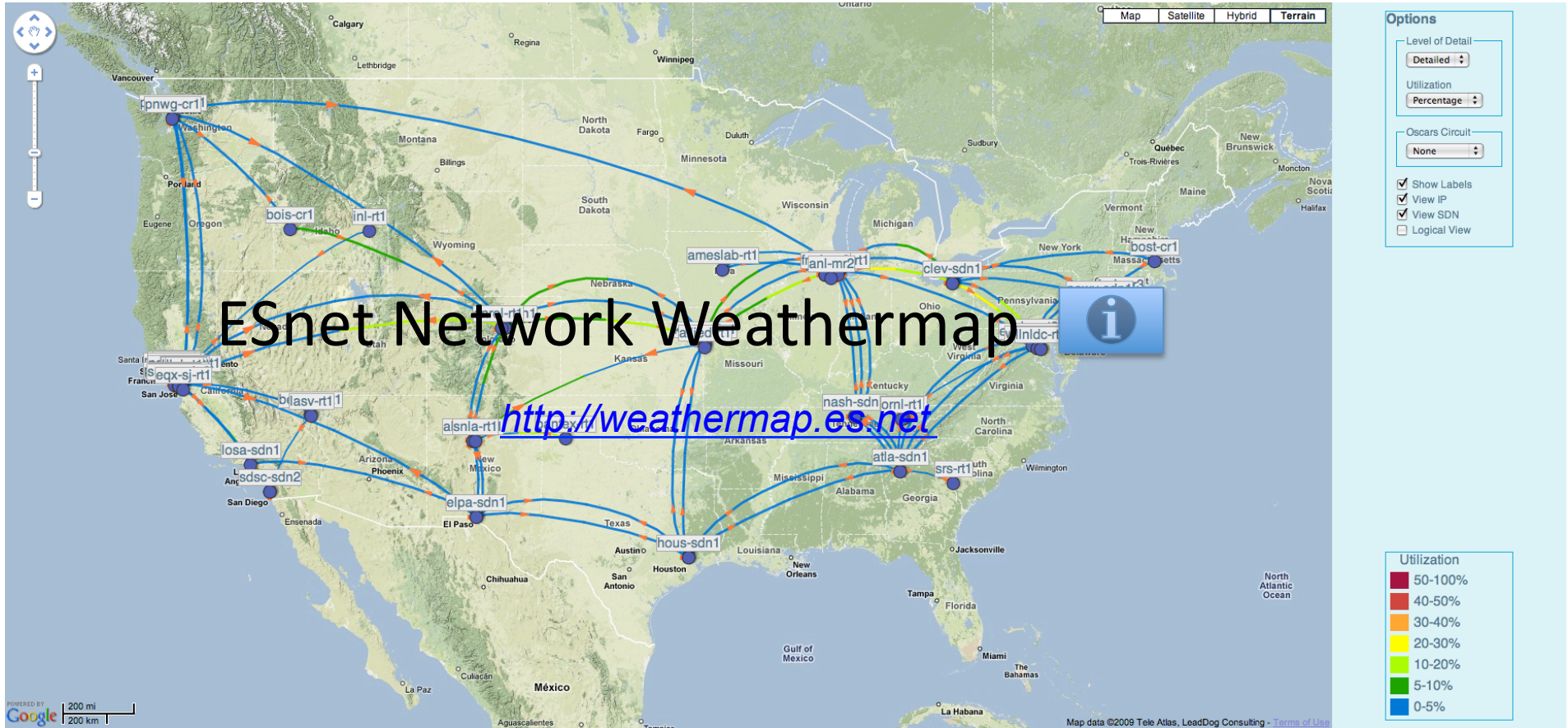




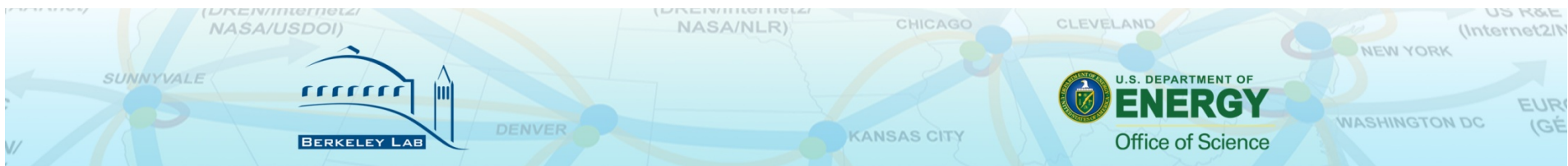
ESnet4 – July 09



Network Weather Map



POWERED BY Google
 Welcome to the alpha version of the ESnet weathermap.

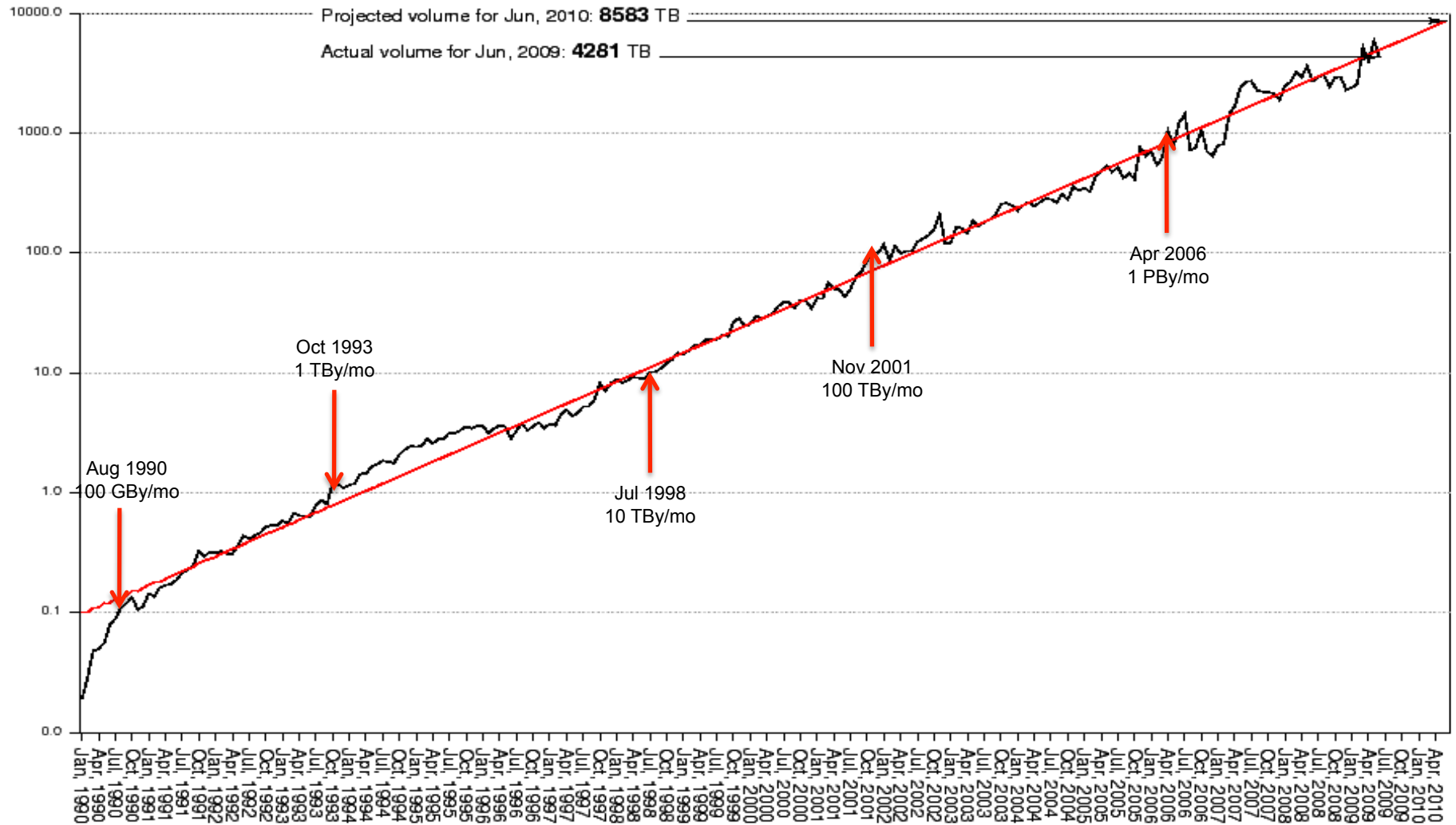




ESnet Traffic Growth

ESnet Accepted Traffic (TB/mo) - Log Scale

—Actual
—Exponential regression extended 12 months beyond actual



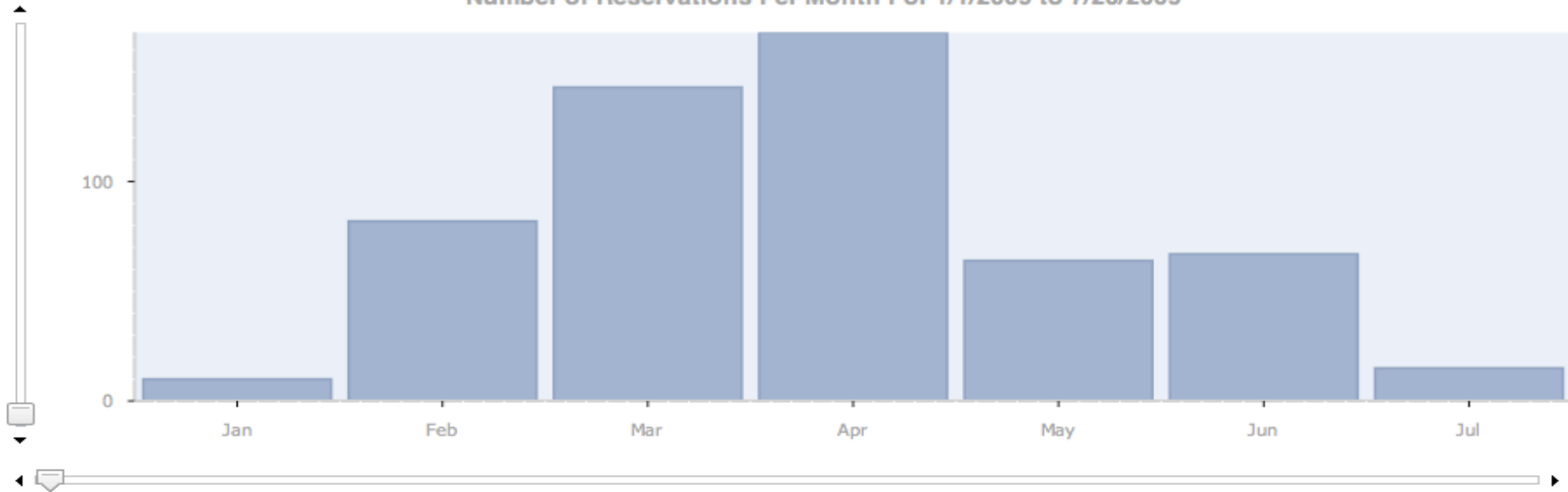


SDN Statistics

<https://oscars.es.net/stats/>

Settings

Number of Reservations Per Month For 1/1/2009 to 7/20/2009



BW=Bandwidth (Mbps), Dur=Duration (Minutes)

X	# of Resv	BW Sum	BW Avg.	BW Max	BW Min	BW Std Dev	Dur. Sum	Dur. Avg.	Dur. Max	Dur. Min	Dur. Std Dev	Avg Hops	Max Hops	Min Hops	Hop Std Dev
Jan	10	10600	1060	5000	100	1575.56	2880029	288002.9	2619364	4	780993.92	4.8	9	2	2.48
Feb	82	137850	1681.1	10000	50	2272.97	142018292.1	1731930.39	5258884	3	2471154.49	3.62	8	2	1.8
Mar	143	193400	1352.45	7000	50	1337.74	9462905.87	66174.17	1051204	3.6	255280.85	3.64	7	2	1.23
Apr	168	160050	952.68	5000	100	763.18	31475933.75	187356.75	3146404	4	724499.84	5.29	9	2	1.43
May	64	64050	1000.78	5000	50	932.59	29107163.33	454799.43	3182404	3.6	1077214.03	5.27	9	2	1.42
Jun	67	53250	794.78	9000	50	1467.28	6333843.75	94534.98	3166564	4	538869.54	4.93	6	2	0.94
Jul	15	14864	990.93	3000	1	1128.22	1058494	70566.27	525604	4	178481.67	4.53	9	2	1.78

*Developed by Andy Lake (Internet2)

SUNNYVALE



DENVER

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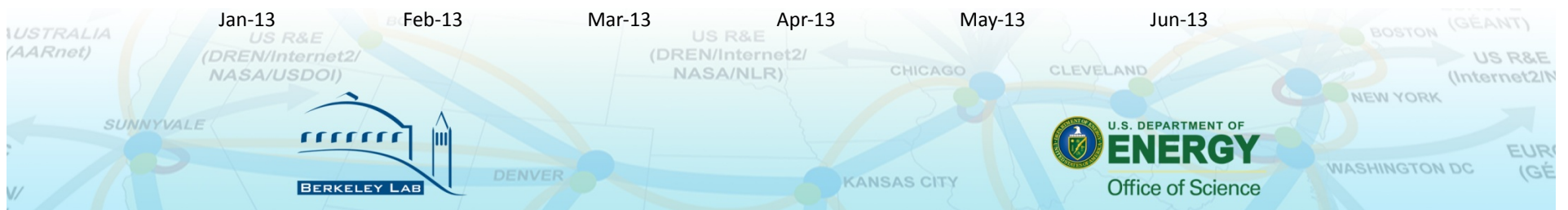
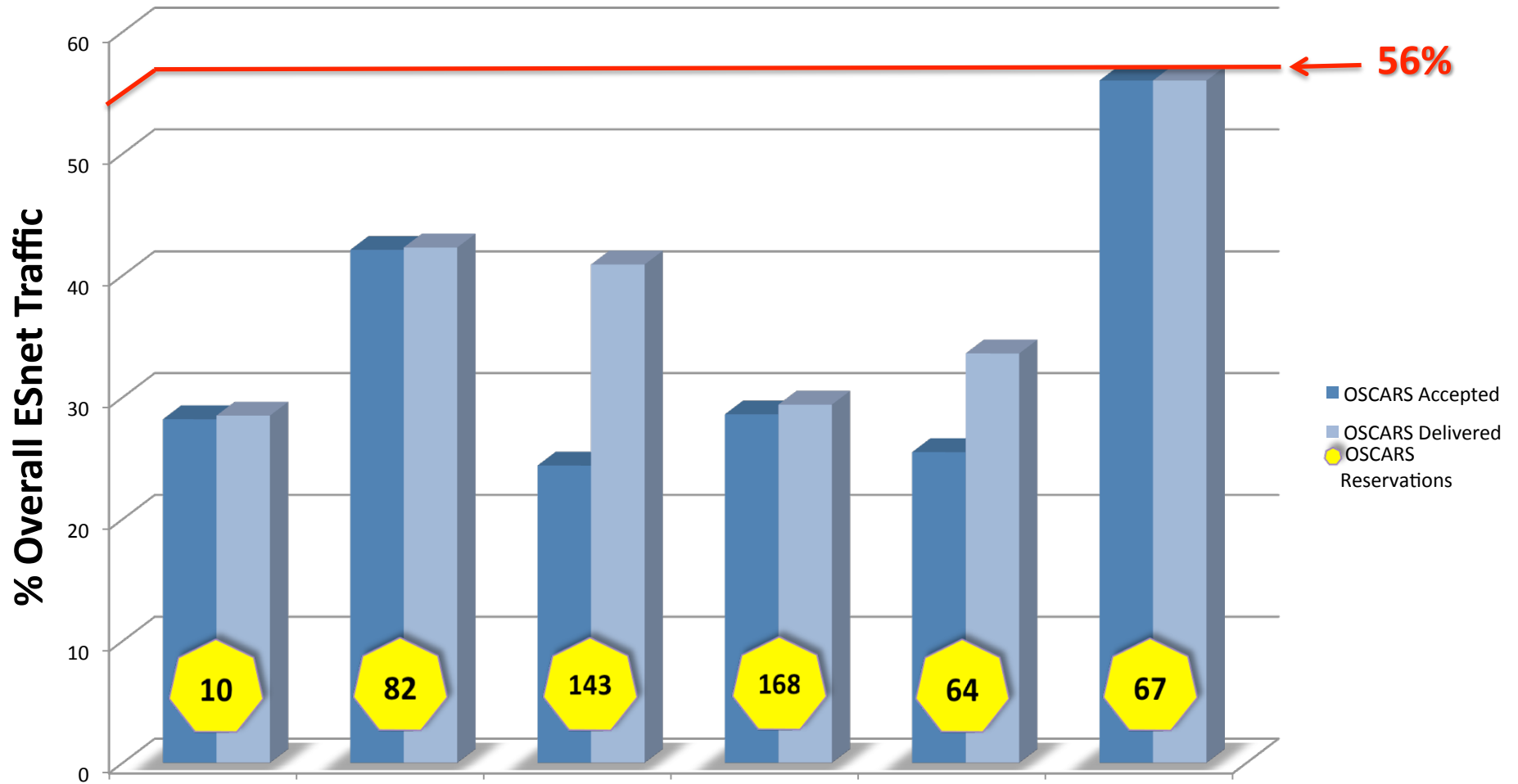
NEW YORK

WASHINGTON DC

EUR (GÉ)

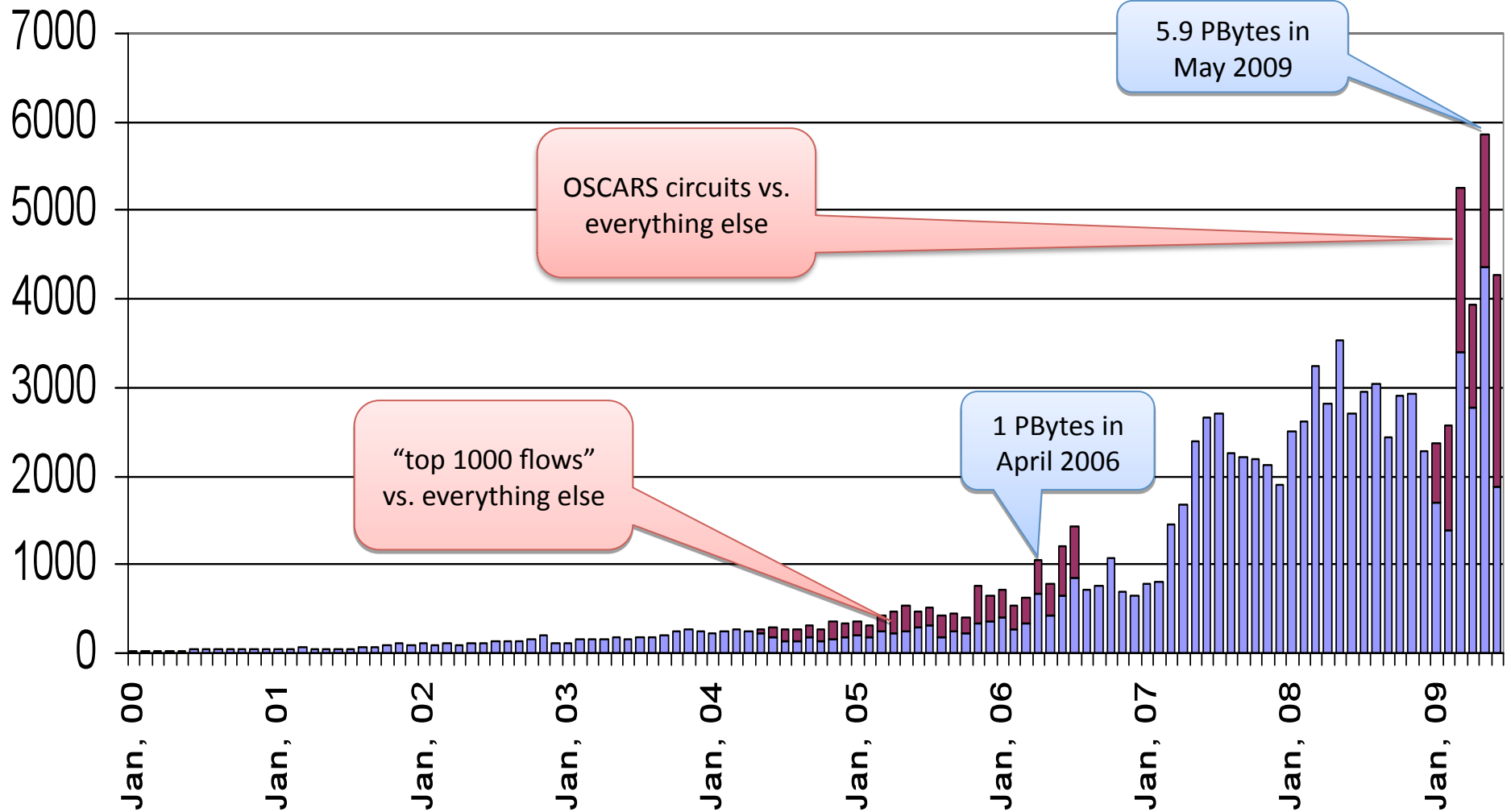


SDN - IP Traffic Breakdown





ESnet Total Accepted Traffic, TBy/mo

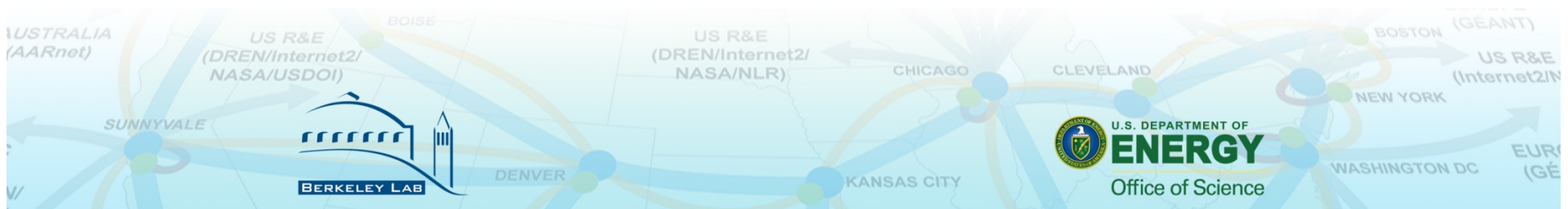




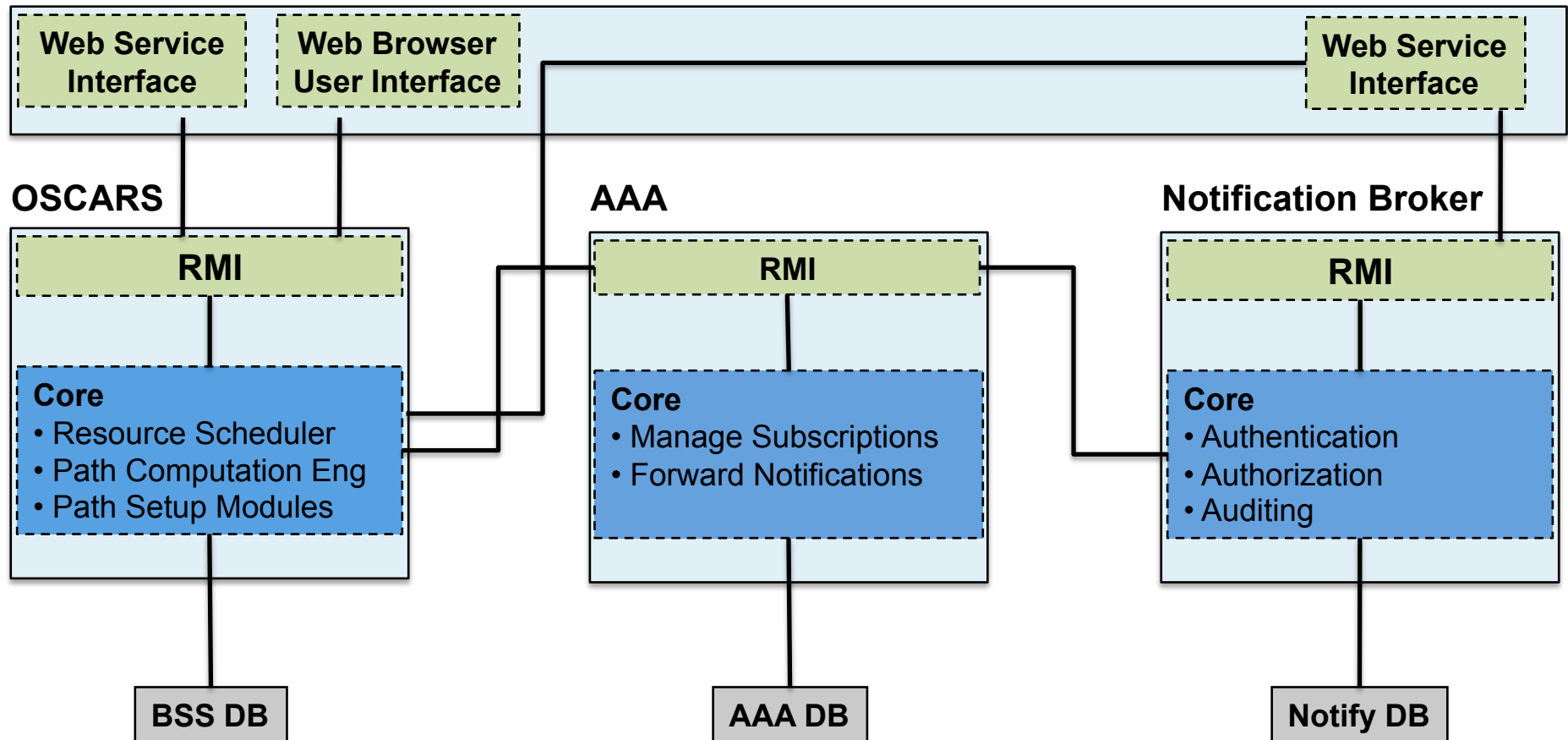
OSCARS: Multi-Domain VC Service

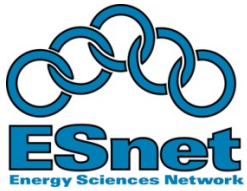
OSCARS Services

- Guaranteed bandwidth with resiliency: User specified bandwidth for primary and backup paths - requested and managed in a Web Services framework
- Traffic isolation: Allows for high-performance, non-standard transport mechanisms that cannot co-exist with commodity TCP-based transport
- Traffic engineering (for ESnet operations): Enables the engineering of explicit paths to meet specific requirements
 - e.g. bypass congested links; using higher bandwidth, lower latency paths; etc.
- Secure connections: Circuits are “secure” to the edges of the network (the site boundary) because they are managed by the control plane of the network which is highly secure and isolated from general traffic
- End-to-end, cross-domain connections between Labs and collaborating institutions



OSCARS 0.5 Architecture (1Q09)





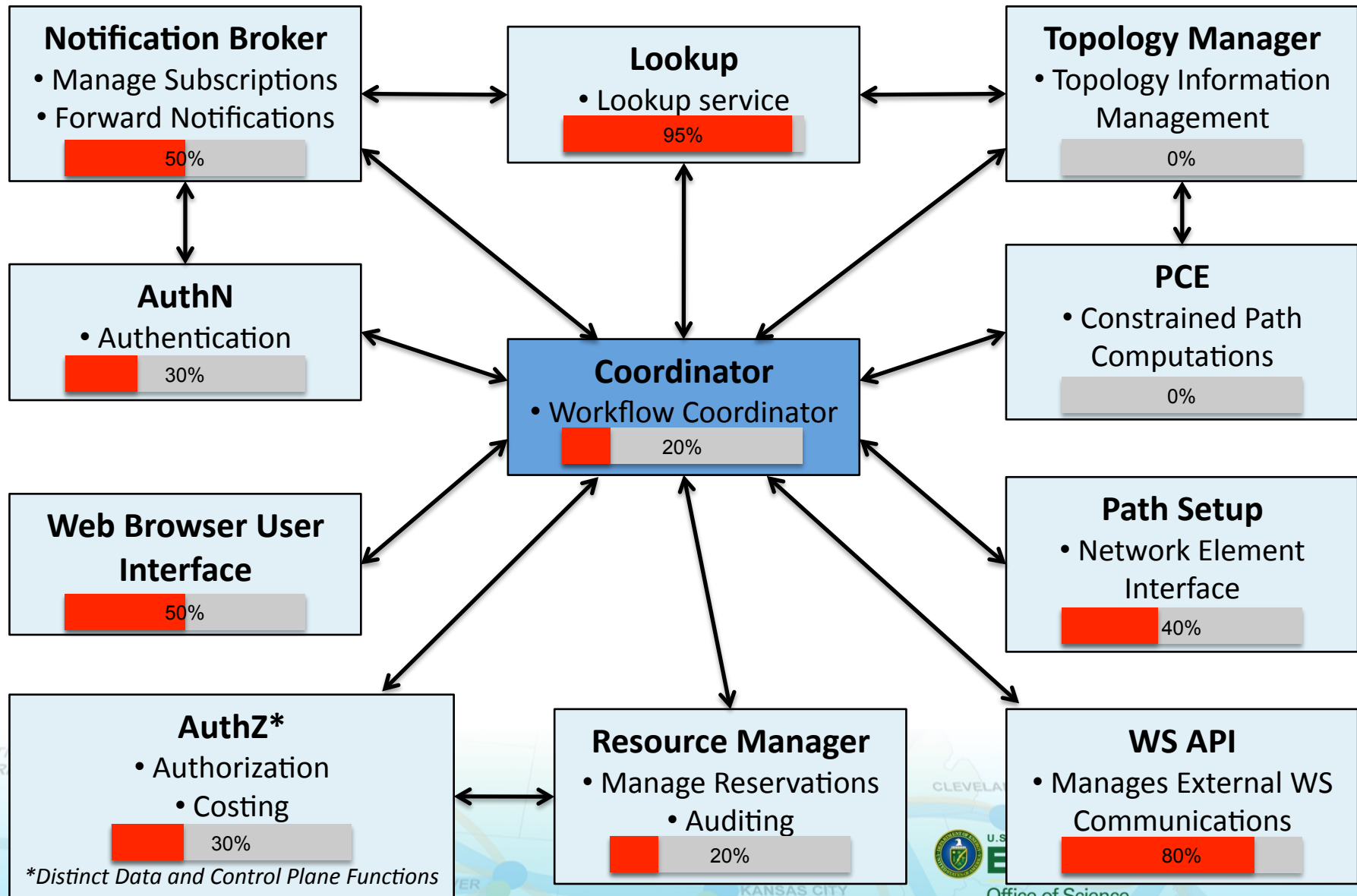
OSCARS 0.6 Design / Implementation Goals

- Support production deployment of service and facilitate research collaborations
 - Distinct functions in stand-alone modules
 - Supports distributed model
 - Facilitates module redundancy
 - Formalize (internal) interface between modules
 - Facilitates module plug-ins from collaborative work (e.g. PCE)
 - Customization of modules based on deployment needs (e.g. AuthN, AuthZ, PSS)
 - Standardize external API messages and control access
 - Facilitates inter-operability with other dynamic VC services (e.g. Nortel DRAC, GÉANT AuthBAHN)
 - Supports backward compatibility of IDC protocol





OSCARS 0.6 Architecture (Target 12/09)



CLEVELAND



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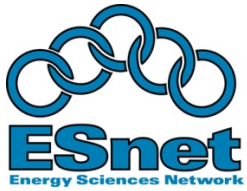


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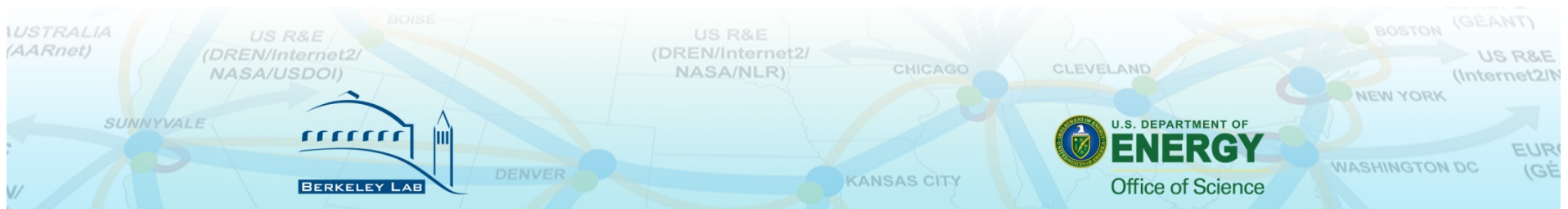
Office of Science





OSCARS Support for SC09

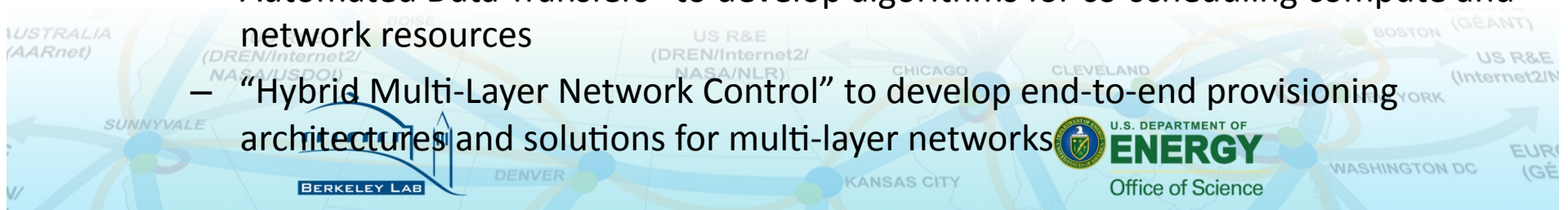
- SCinet will deploy an IDC to manage VC bandwidth allocations for demos and Bandwidth Challenge
- Committed participants running an IDC include
 - ESnet (SDN)
 - Internet2 (DCN)
 - University of Amsterdam (Netherlight)
- Potential collaborating participants include
 - GÉANT
 - AIST, Japan
 - KREONet2 (KISTI), Korea





OSCARS Collaborative Research Efforts

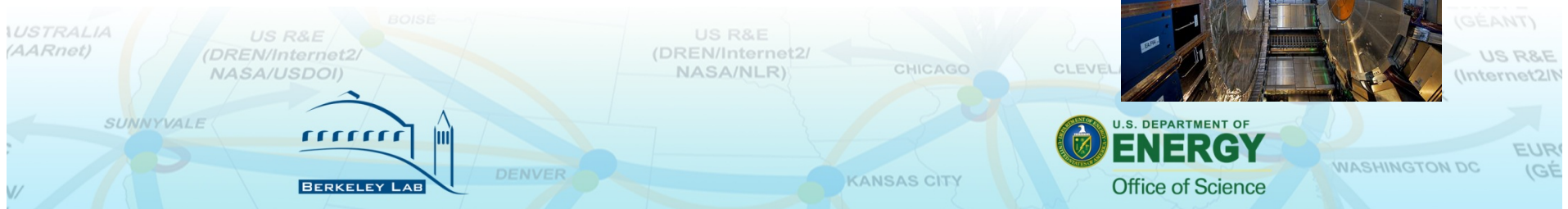
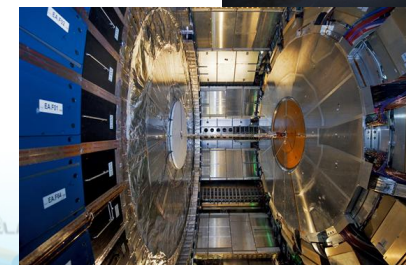
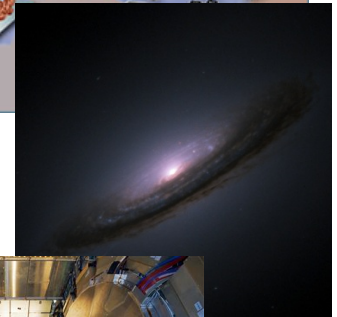
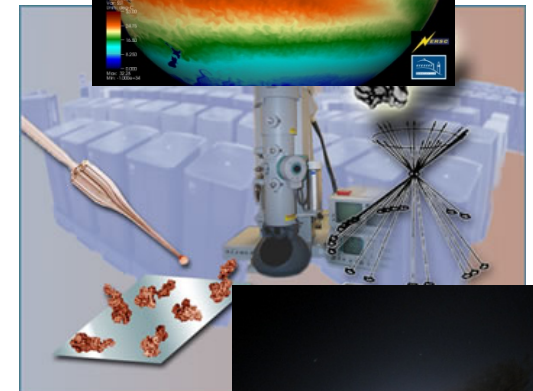
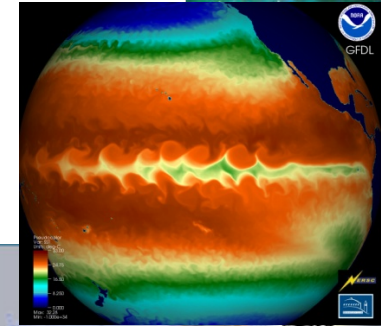
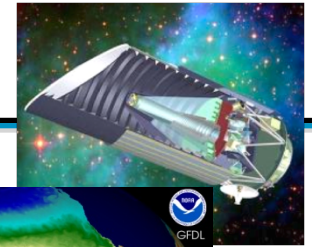
- LBNL LDRD “On-demand overlays for scientific applications”
 - To create proof-of-concept on-demand overlays for scientific applications that make efficient and effective use of the available network resources
- GLIF GNI-API “Fenius” to translate between the GLIF common API to:
 - DICE IDCP: OSCARS IDC (ESnet, I2) ✓
 - GNS-WSI3: G-lambda (KDDI, AIST, NICT, NTT) ✓
 - Phosphorus: Harmony (PSNC, ADVA, CESNET, NXW, FHG, I2CAT, FZJ, HEL IBBT, CTI, AIT, SARA, SURFnet, UNIBONN, UVA, UESSEX, ULEEDS, Nortel, MCNC, CRC)
- DOE Projects:
 - “Virtualized Network Control” to develop multi-dimensional PCE (multi-layer, multi-level, multi-technology, multi-layer, multi-domain, multi-provider, multi-vendor, multi-policy)
 - “Integrating Storage Management with Dynamic Network Provisioning for Automated Data Transfers” to develop algorithms for co-scheduling compute and network resources
 - “Hybrid Multi-Layer Network Control” to develop end-to-end provisioning architectures and solutions for multi-layer networks

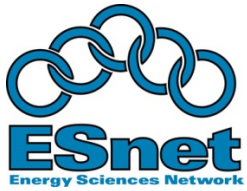




Agenda

- Network Update
- Services Update
- ARRA
- Misc

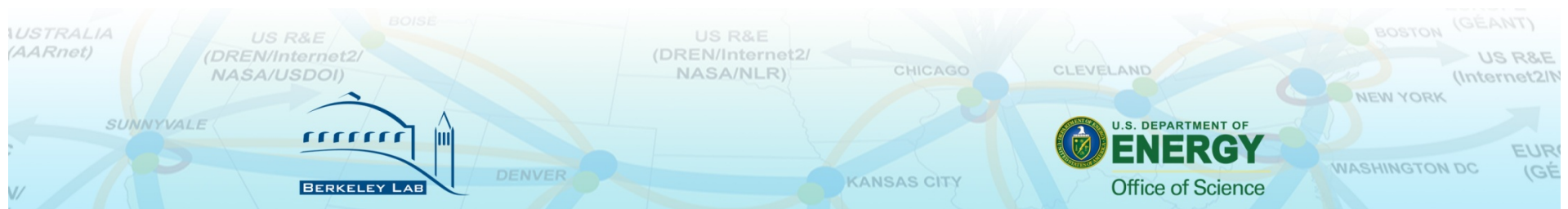




ARRA Plans

ESnet designated to received ~\$67M in ARRA funds for an Advanced Networking Initiative

- Build a prototype wide area network to address our growing data needs while accelerating the development of 100 Gbps networking technologies
- Build a network testbed facility for researchers and industry
- Fund \$5M in network research with the goal of near term technology transfer to the production network





Advanced Networking Initiative



POWERED BY Google 200 mi 200 km



SUNNYVALE DENVER KANSAS CITY WASHINGTON DC



Experimental Optical Testbed

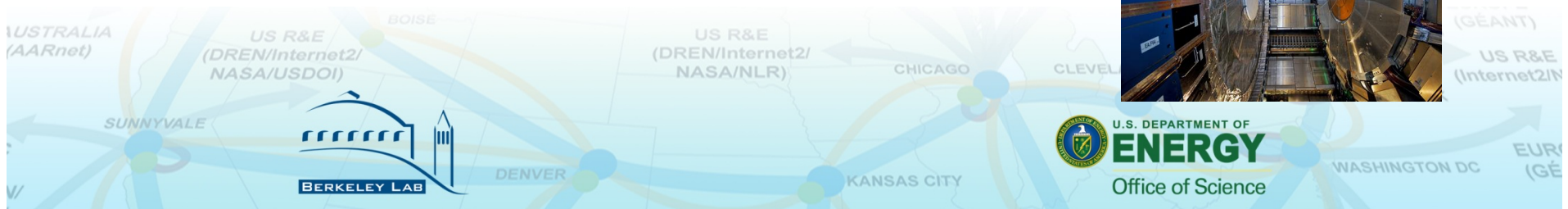
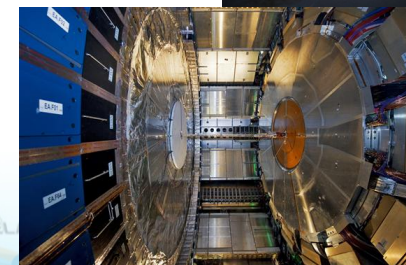
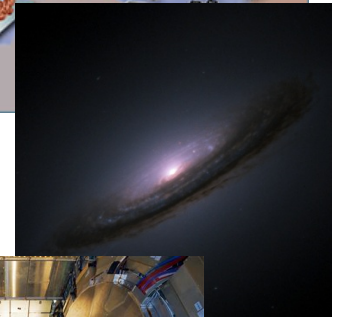
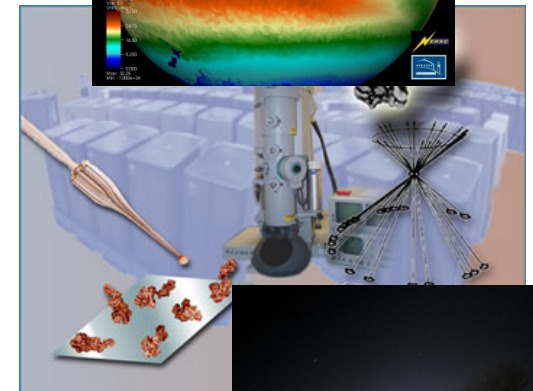
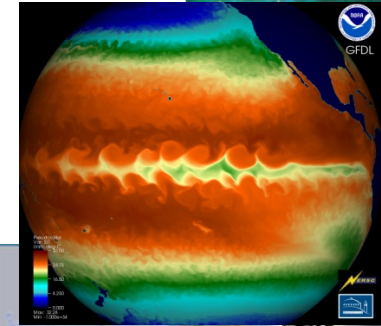
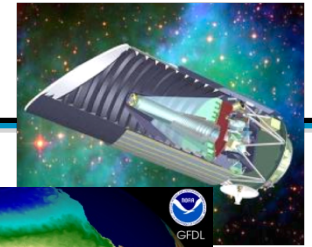
- Will consist of advanced network devices and components assembled to give network and middleware researchers the capabilities to prototype ESnet capabilities anticipated in the next decade.
- A community network R&D resource – the experimental facility will be open to researchers and industry to conduct research activities
- Multi-layer dynamic network technologies - that can support advanced services such as secure end-to-end on-demand bandwidth and circuits over Ethernet, SONET, and optical transport network technologies
- Ability to test the automatic classification of large bulk data flows and move them to a dedicated virtual circuit
- Network-aware application testing – provide opportunities for network researchers and application developers such as Grid-based middleware, cyber security services, and so on, to exploit advanced network capabilities in order to enhance end-to-end performance and security
- Technology transfer to production networks – ESnet, as host of the facility, will develop strategies to move mature technologies from testing mode to production service





Agenda

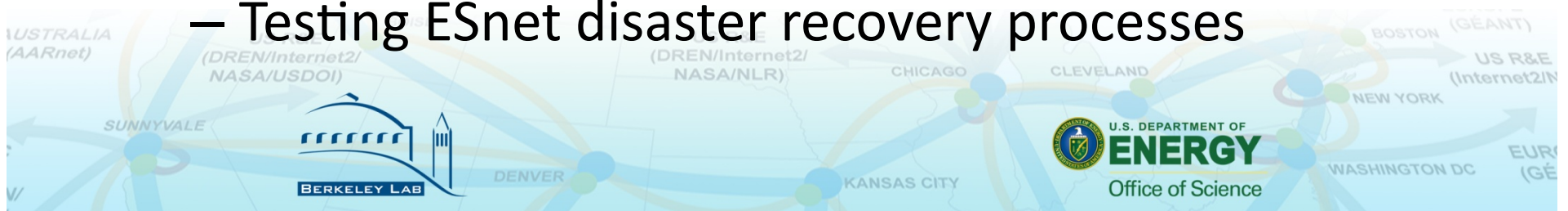
- Network Update
- Services Update
- ARRA
- Misc





Other Activities

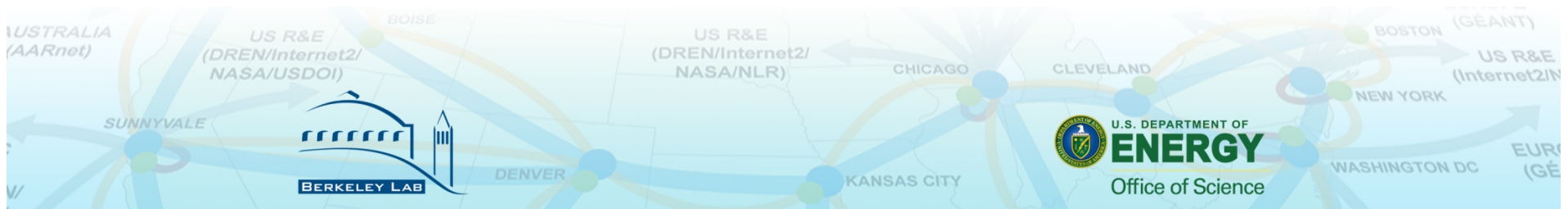
- Web site overhaul
 - Hardware and content management system upgrade
 - Requirements documented
 - RFP going out end of this month
- Infrastructure upgrades
 - Improve scalability of internal systems
- Table-top exercise simulating pandemic
 - Testing ESnet disaster recovery processes





Continuity / CA Cloning Project Update

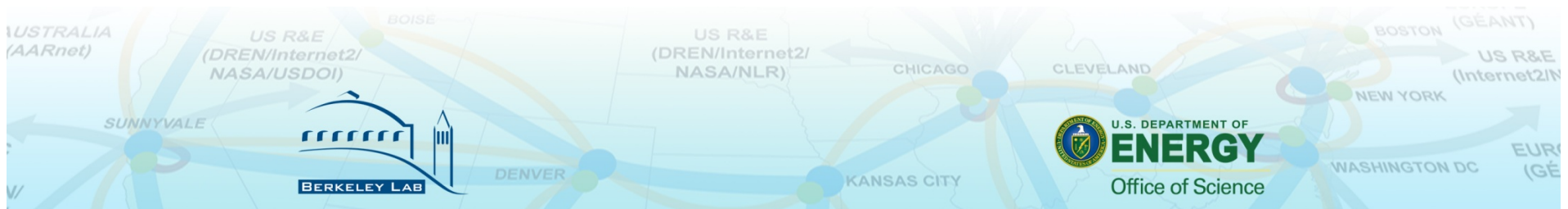
- Short summary:
 - Move to network based hardware security modules for key management
 - Clone the CA hosts and instances (UI + databases)
 - Distribute around the country at various ESnet coloc points
- See this slide deck for a more complete story / plan
 - <http://doegrids.posterous.com/esnet-ca-cloning-project>
- Current Progress
 - netHSM test host up and running
 - One Internal CA moving to netHSM very soon
 - Upgrading CAs to RedHat CS 7.3 – required version upgrade for cloning support

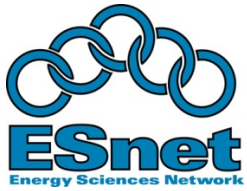




Federation Efforts

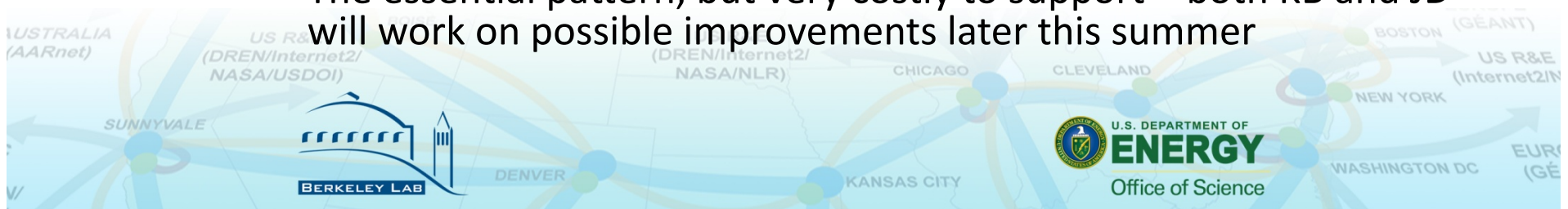
- Shibboleth Federation for DOE labs/sites?
 - Some Lab CIOs asked for a strategic discussion paper, to be taken up at next meeting
 - Proposed: Model after University of California and University of Texas local federations
 - Proposed: Join InCommon (US Shibboleth federation)
 - Interested parties please get in touch with Mike Helm helm@fionn.es.net





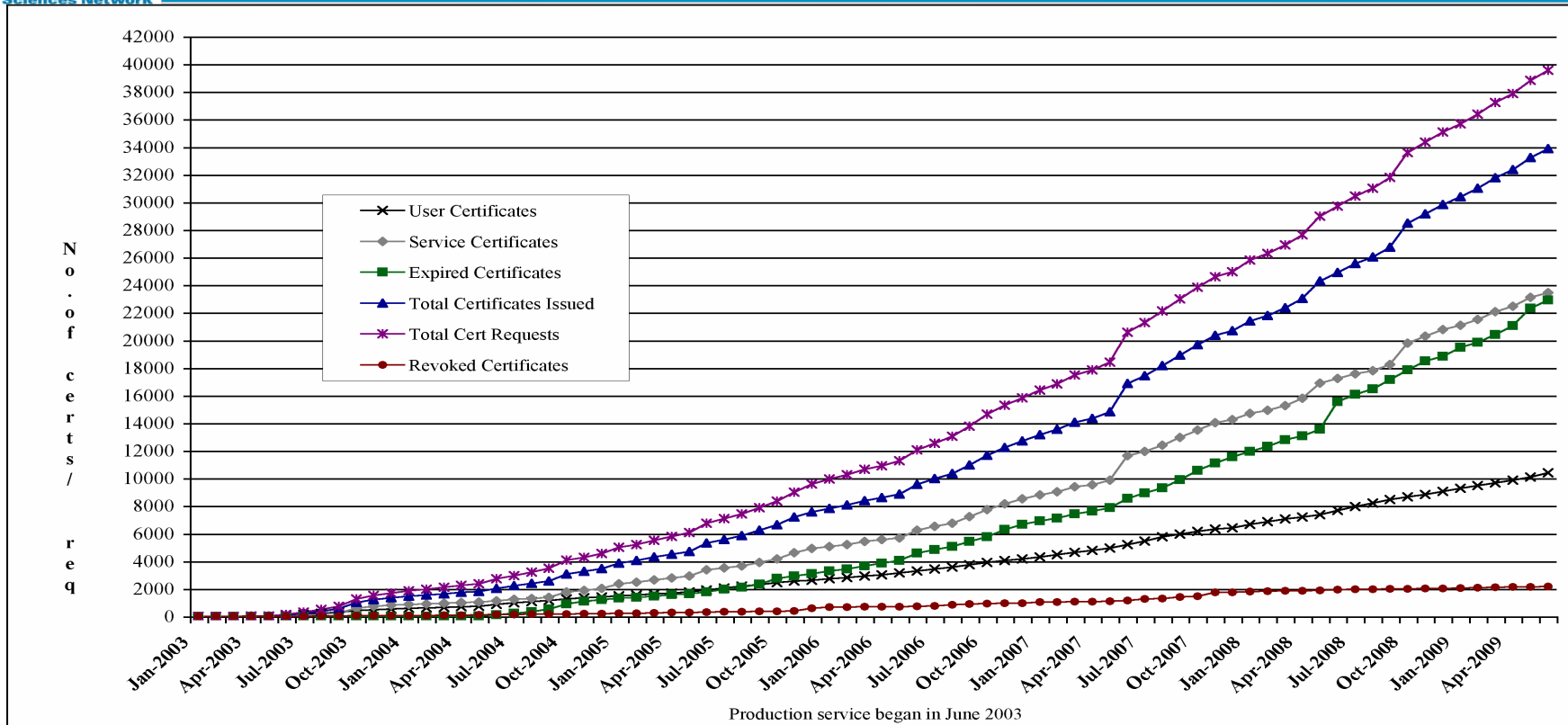
Federation Efforts

- Summer projects (student-powered)
 - OpenID – Kevin Bauer U Colorado
 - An OpenID consuming CA (OpenID->X.509 cert)
 - Additional work on OpenID consumers (relying party)
 - Attribute and information exchange
 - Security
 - UI – discovery – other topics
 - Shibboleth – Jan Durand, Grambling State
 - Shibboleth consuming CA (Shibboleth/SAML -> X.509 cert)
 - Additional work on Shibboleth/SAML relying parties
 - Interoperability with LBNL and other Shibboleth providers
 - Registration
 - How do I get myself registered in a service?
 - The essential pattern, but very costly to support – both KB and JD will work on possible improvements later this summer

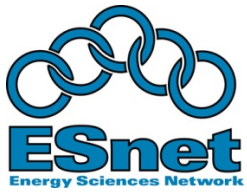




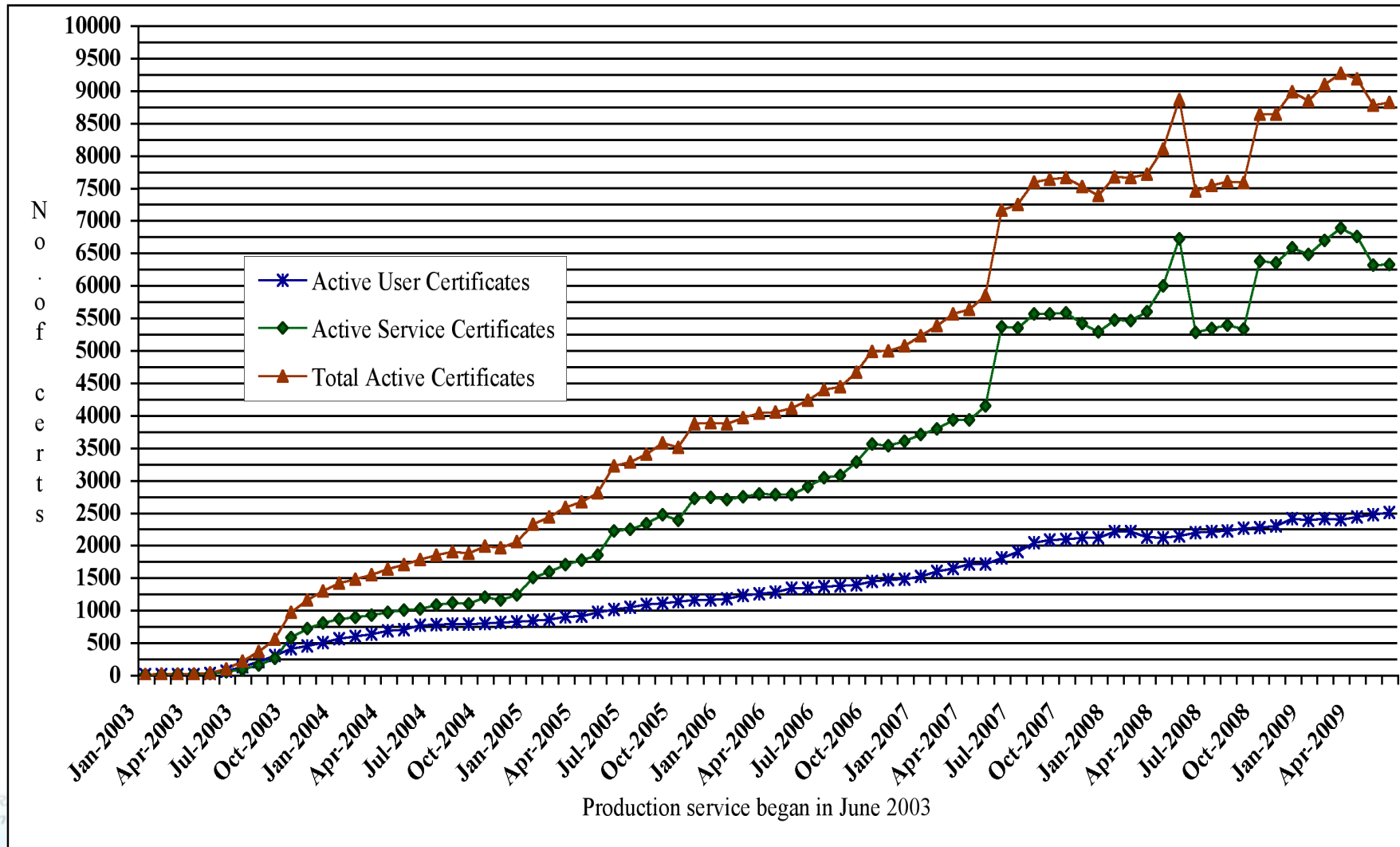
DOEGrids CA Usage Statistics



User Certificates	10398	Total No. of Revoked Certificates	2157
Host & Service Certificates	23459	Total No. of Expired Certificates	22923
Total No. of Requests	39549	Total No. of Certificates Issued	33886
		Total No. of Active Certificates	8806
ESnet SSL Server CA Certificates			52
FusionGRID CA certificates		* Report as of Jun 30, 2009	127



DOEGrids CA (Active Certs) Usage Statistics



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* Report as of June 30, 2009

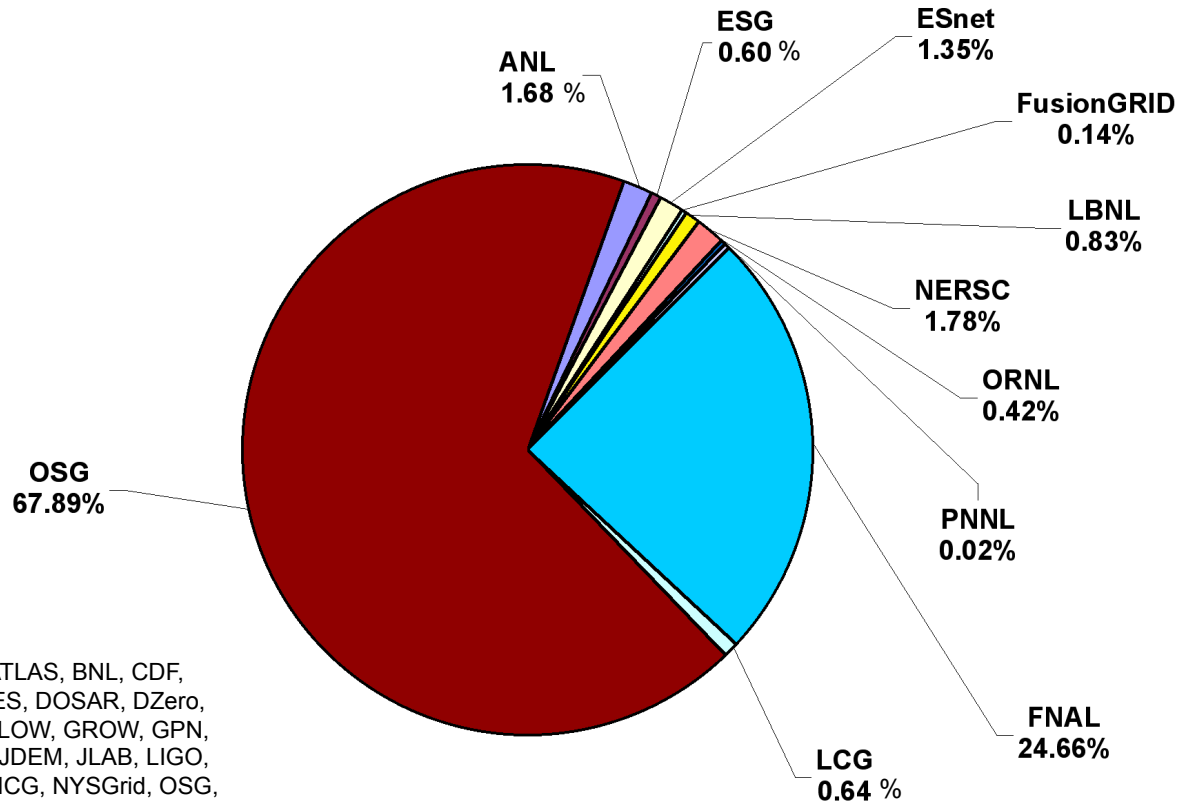
NEW YORK

WASHINGTON DC

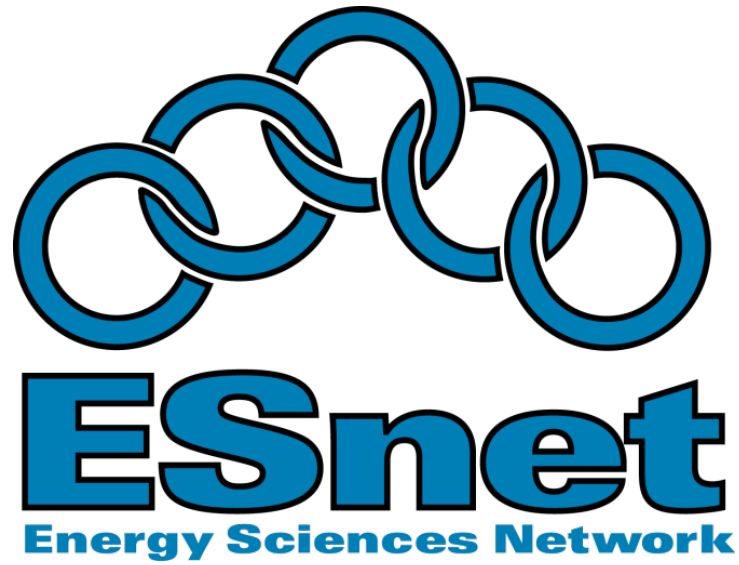
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Active DOEGrids CA Breakdown

DOEGrids CA Statistics(8806)



** OSG Includes (ALICE, ATLAS, BNL, CDF, CIGI, CMS, CompBioGrid, DES, DOSAR, DZero, Engage, Fermilab, geant4, GLOW, GROW, GPN, GRASE, i2u2, IceCube, ILC, JDEM, JLAB, LIGO, mariachi, MIS, nanoHUB, NWICG, NYSGrid, OSG, OSGEDU, SBGrid, SDSS, SLAC & STAR)

A large, stylized blue chain of four interlocking links is positioned above the text "ESnet" in a very large, bold, blue, sans-serif font. Below "ESnet" is the text "Energy Sciences Network" in a smaller, bold, blue, sans-serif font.

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