

An ESnet Project Overview

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ESnet: In Support of DOE Science



- Mission:
 - Provide, interoperable, highly capable and reliable communications infrastructure and leading-edge network services that support DOE's missions
- Vision:
 - Provide seamless and ubiquitous access, via shared collaborative information and computational environments, to the facilities, data, and colleagues needed to accomplish their goals.
- Role:
 - A component of the Office of Science infrastructure critical to the success of its research programs.

ESnet: What Is It?



- A nation-wide high-performance “agency mission” network
 - chartered to provide advanced network services to support scientific research in DOE
- Centrally funded by DOE/Office of Science
 - operated and managed by project staff at LBNL
- An immense (and very successful) cooperative effort
- Was rated both “outstanding” and “extremely cost effective” at the last formal Program Review
- Has an extensive structure of domestic (commercial and R&E) and international interconnects
- Has a growing Advanced Technology and Research program

ESnet: What Is The User Base?



- 10,000-100,000 researchers in U.S. use ESnet (guestimate)
- Mostly Office of Science programs: HEP, NP, FES, BES, BER, MICS
- Traffic also carried for DP and others
- Involves essentially all U.S. national labs
- Hundreds of universities
- Hundreds of foreign institutions
- Large and small collaborations (from a few to almost 2000 members)

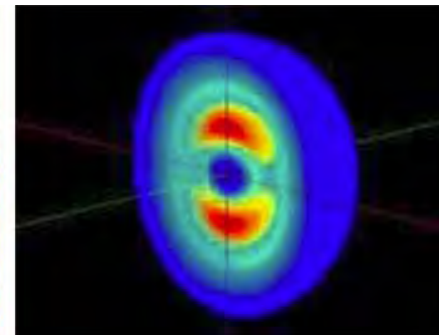
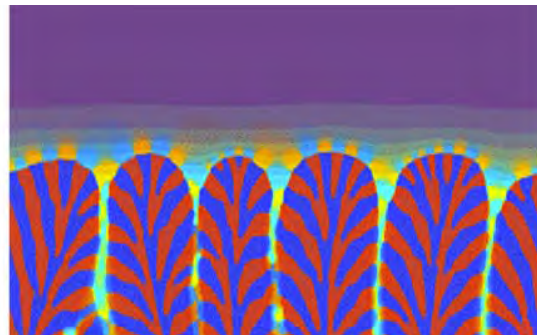
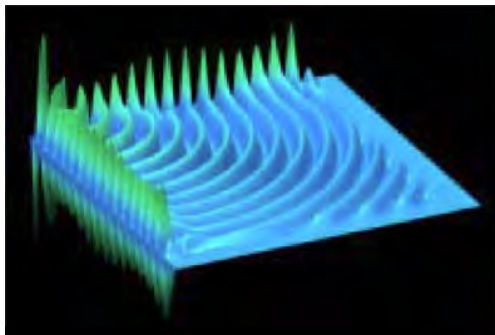
CHARACTERISTICS OF USER BASE

- Many (unaware) casual users
- Variety and breadth in science
- Size and geographic distribution of research community
- Many data intensive and computationally intensive tasks supported

ESnet: An Enabler for DOE Science



- We've seen a dramatic change in the way science is done
- Increase in scientific productivity - much shorter turn around time for disseminating, assimilating and testing new ideas
- Innumerable meetings via remote conference technologies
- This DOE community has been a leader in use of the network for science
- Network planning and deployment based on program requirements and technological opportunities - **push/ pull**



ESnet:Network Usage



- Basic services - email, file transfer, remote login, distributed file systems
- Teleconferencing - integral part of work flow, planning, coordination
- Remote access to unique facilities
 - experiments
 - supercomputers
 - databases
 - installed codes
- Collaboratories
 - Traditional approach - visit and/or relocate
 - New approach - virtual laboratories, remote participation
- Distributed computing - Grid Computing



ESnet: Research Life Cycle Support



- Planning and coordination
- Design of experiments by distributed teams
- Engineering/analysis
- Online documentation
- Remote Participation
- Distributed code development
- Distributed data analysis and visualization

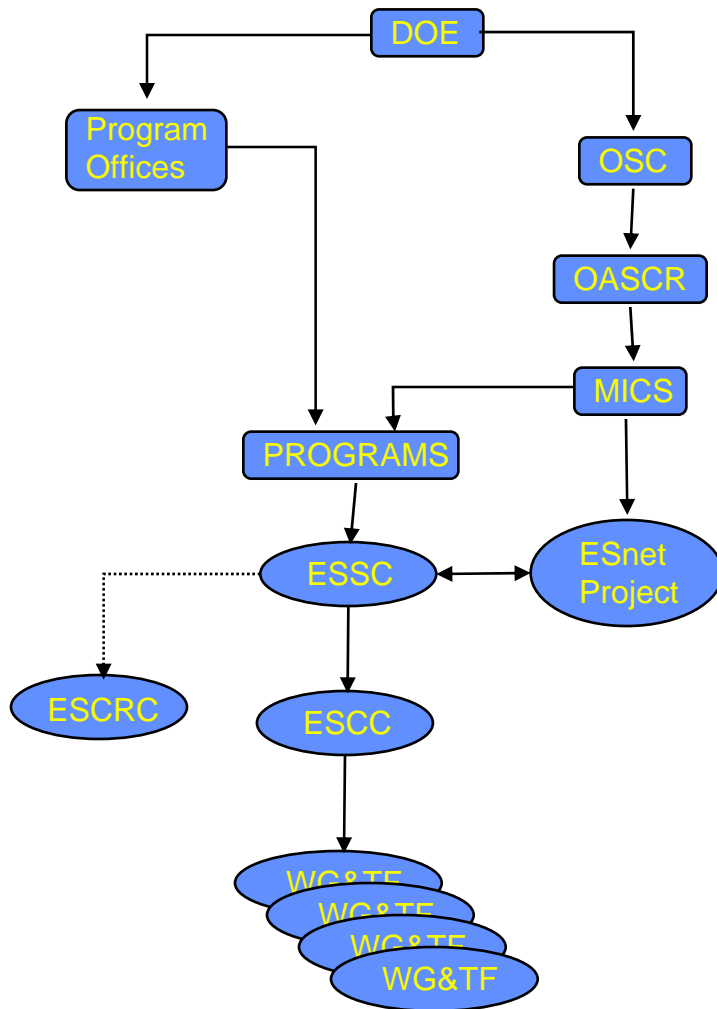


ESnet: A Very Brief History



- One line of ancestry can be traced back to '74 dial-up access to CTRCC
- MFEnet, HEPnet (I.e. DECnet) & ARPAnet development continued over '75-'85 timeframe
- Memo signed in Oct, 1986 to create multi-program "ESnet"
- 1987-1990: The "sociology of DOE-wide networking" barrier broken
- Dec '89: ESnet DECnet turned on
- Feb '90: Log shows security problem with hacker
- Mar '90: All T1 trunks and routers for "ESnet (1)" on-line
- Feb '92: ESnet (2) RFP released
 - Jun '94: 3 T3s turned on (LLNL-LANL, LANL-FNAL, FNAL-PPPL)
 - Aug '94: Sprint master contract signed for fast-packet service
- 1995-1998: T3, OC3, and OC12 ATM connections brought on-line
- Nov '95: Decision to move ESnet and NERSC to LBNL announced
- Jun '99: ESnet (3) RFP released
 - Dec '99 Contract with Qwest signed
 - And a major transition is underway

ESnet: It's the Sociology that's Hard



- The ESnet project enjoys an excellent working relationship with both its technical and program “user” communities
 - The ESnet Steering Committee (ESSC) deals with requirements and priorities as established by DOE representative Program Principal Investigators.
 - The ESnet Coordinating Committee (ESCC) deals with associated site and technical issues.

ESnet: The FY01 Budget



- The ESnet project is centrally funded by the MICS office in DOE/SC

\$6.42M	Base budget
6.92	Communications
1.19	International
.35	DCS
1.00	Testbed&Research
.89	Equipment

\$16.77M	FY01 MICS Funding

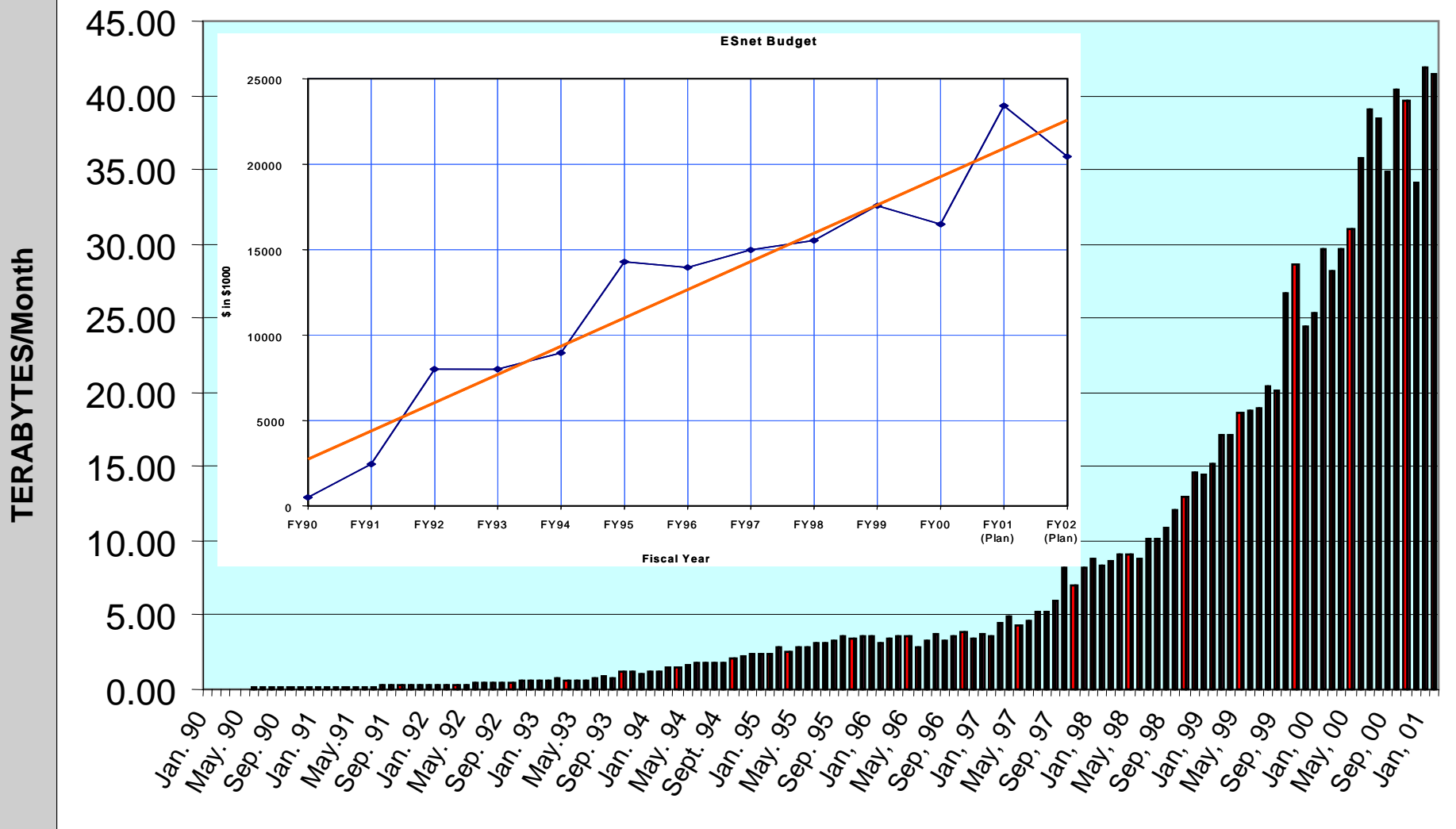
Additional funds are collected for special project/program support (mostly pass-through) now at roughly \$2.5M/yr

ESnet: Staffing



	Career Contract	
Engineering Services Group:	6.0	
Information & Services Group:	4.0	
Technical Services Group:	10.0	1.0
Operations :	2.0	
Admin Support:	1.0	
Management :	2.0	
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	23.0	3.0

ESnet Monthly Traffic Compared to Budget



ESnet: Qwest Contract Overview



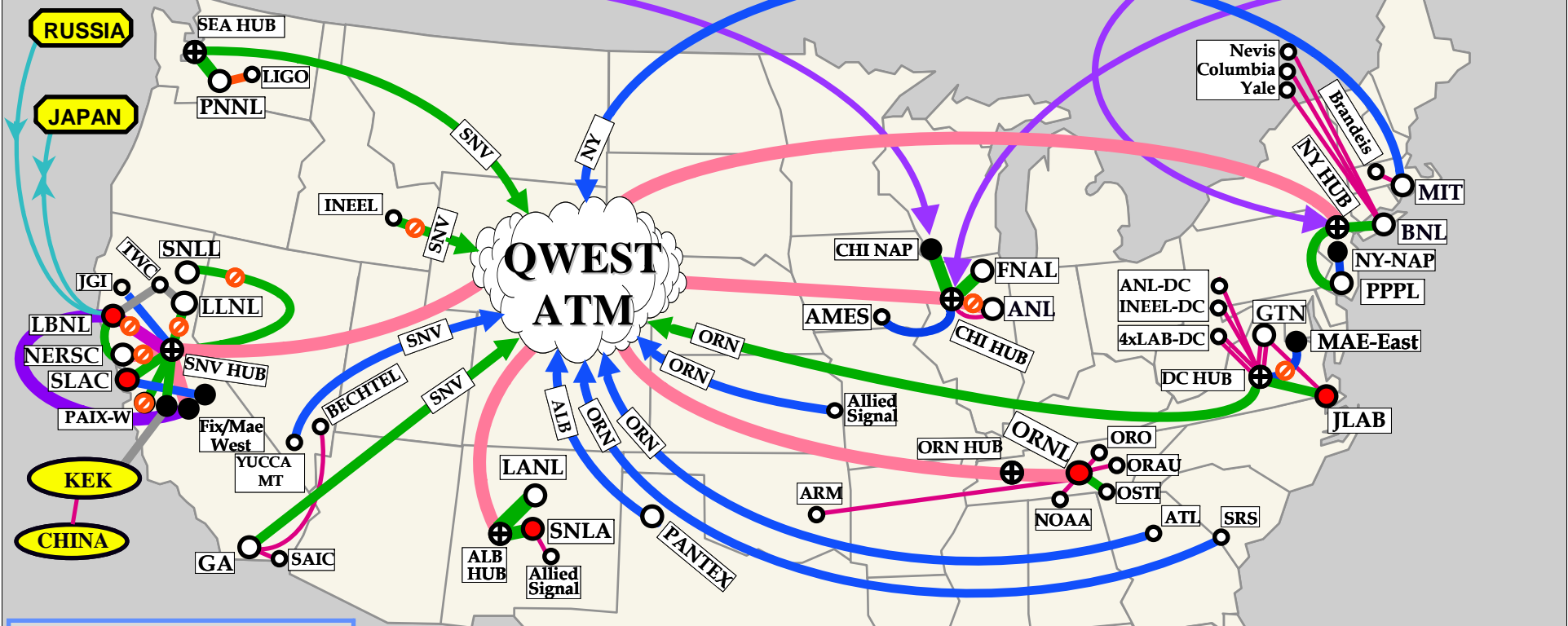
- Procurement for “Umbrella Services Contract”
 - Includes three major components
 - advanced services and technology for production network
 - high-performance test-bed
 - research collaboration
 - Multi-year contract (3+2+2 years), \$50M+
 - Will overlap with existing Sprint contract
 - nearly 2 year overlap possible, but not expected
 - includes very competitive ATM pricing
 - Contract signature Dec ‘99
 - Transition planning & implementation underway
 - First sites went on-line in August, 2000
 - Approximately 90% done with initial transition

ESnet (Qwest) BACKBONE Apr 2001

- SINGAPORE
- RUSSIA
- ISRAEL
- NL
- TAIWAN
- CANADA
- NORDUNET
- FRANCE

- GERMANY
- DANTE
- ITALY
- UK

CERN



NTON OC12	
OC48 ATM	
OC12 ATM	
OC3 ATM	
T3 ATM	
T1-T3 ATM	
T3	
T1-T3	
T1	
<T1	
Sprint Connected	

ESnet Direct IP Neighbors EARLY 2001

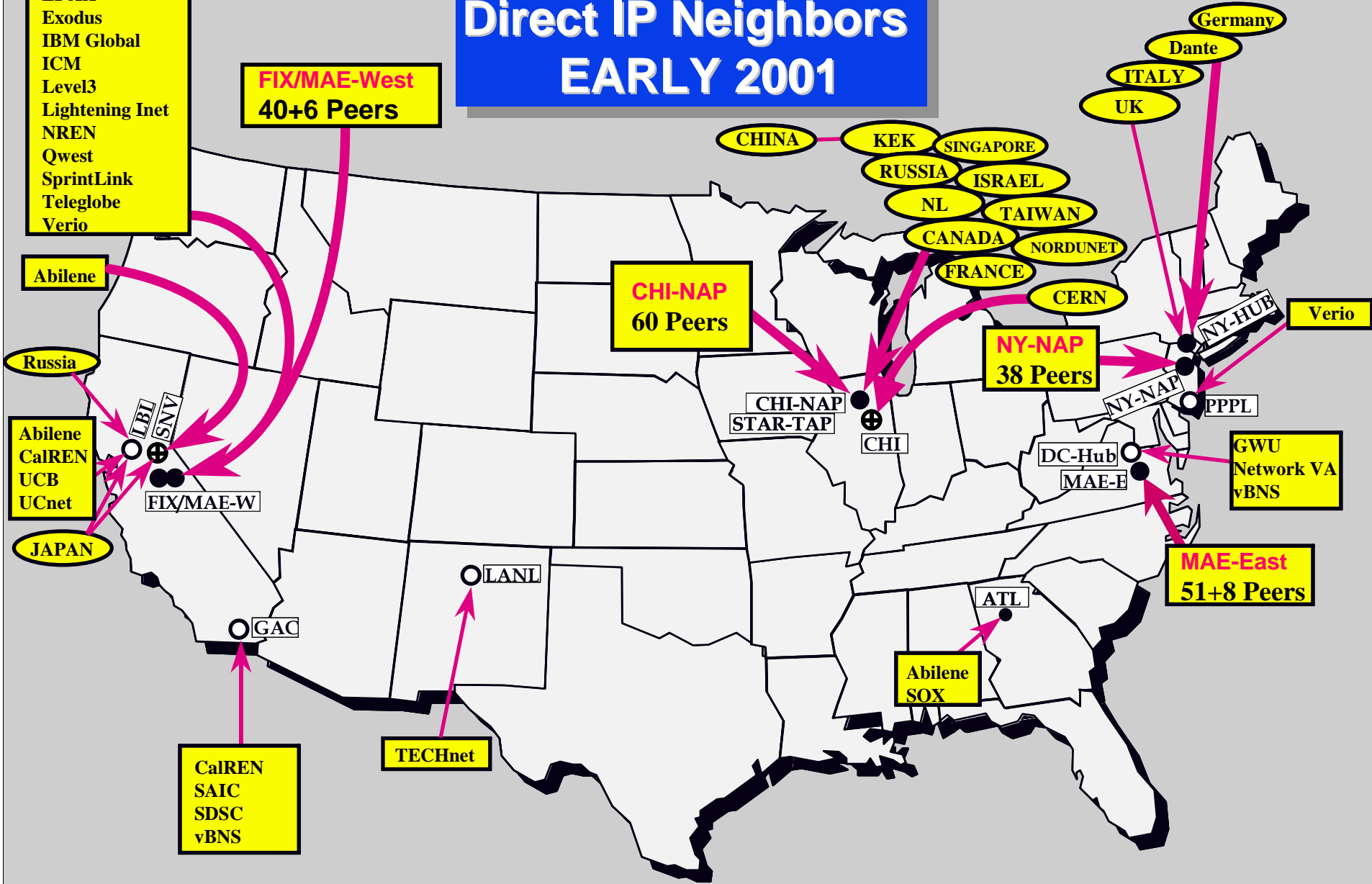
- MIX-West**
- Abilene
 - DREN
 - EI-AX
 - Exodus
 - IBM Global
 - ICM
 - Level3
 - Lightening Inet
 - NREN
 - Qwest
 - SprintLink
 - Teleglobe
 - Verio

FIX/MAE-West
40+6 Peers

CHI-NAP
60 Peers

NY-NAP
38 Peers

MAE-East
51+8 Peers



ESnet: Collaboration Services



- Began in '90-91 with HEP use of “excess” bandwidth on T1 trunks
- Now grown to the point that a “typical” month includes over 1200 conferences at ~2 Hours average, supporting roughly 100 conference-days of collaboration per month!

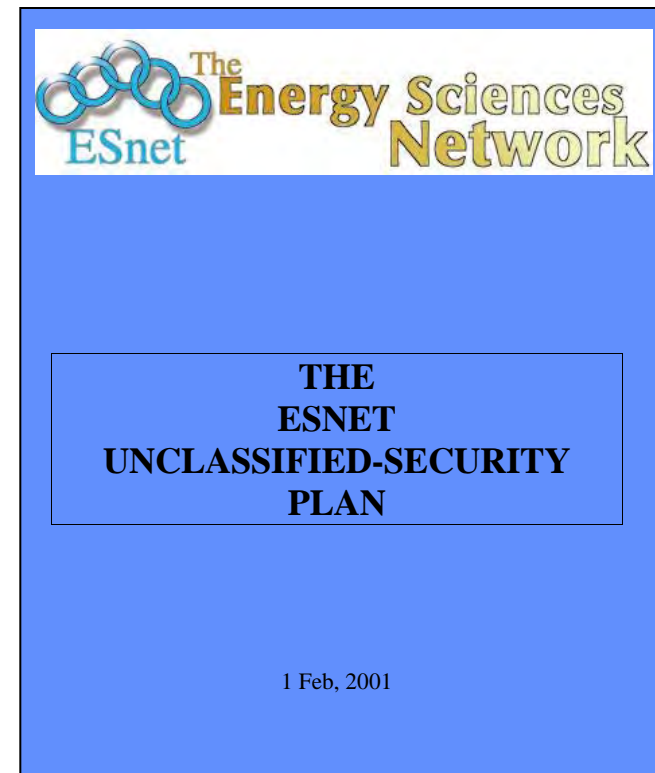
All Conferences - March, 2001	
Number of Conferences	1279
Conference Hours	2440
Audio Bridge Port Hrs	5137
MCU Port Hours	4155
Room Hours	5529

- DCS Resources now include:
 - Accord ISDN MCU (48 ports)
 - Latitude Audio Bridge (76 ports)
 - A web based reservation system (DCS)
- A commercial replacement for the DCS scheduler is being evaluated
- H323 (IP Video) support and interoperation with H320 (ISDN Video) now being researched and tested for system integration

ESnet: Security Considerations



- ESnet supports unclassified activity only
- ESnet security responsibility falls under the auspices of the LBNL CPPM
- ESnet has it's own Project Security Officer
 - point-of-contact for ESnet Project to LBNL CPPM
- ESnet has a defined AUP
- ESnet's security responsibilities:
 - cover ESnet resources
 - end at the site demarc!
- ESnet's security requirements cover:
 - network utilization
 - component access
 - user services
 - office environment



ESnet: Research & Adv. Technology



- Multiprotocol Routers
 - IPv4, DECnet, OSI, X.25 at one point
- ATM
 - Industry catalyst for carrier deployment
 - First production nation-wide WAN deployment
- Advanced Protocols-one of earliest adopters of:
 - CIDR
 - BGP-4
 - MBGP
 - IPv6:
- QoS
 - Queue management research
 - Policing (CAR)
 - VoIP (application)
- Testbed (planned)
- PKI/Directory (proposed)

ESnet: Future Initiatives as Drivers



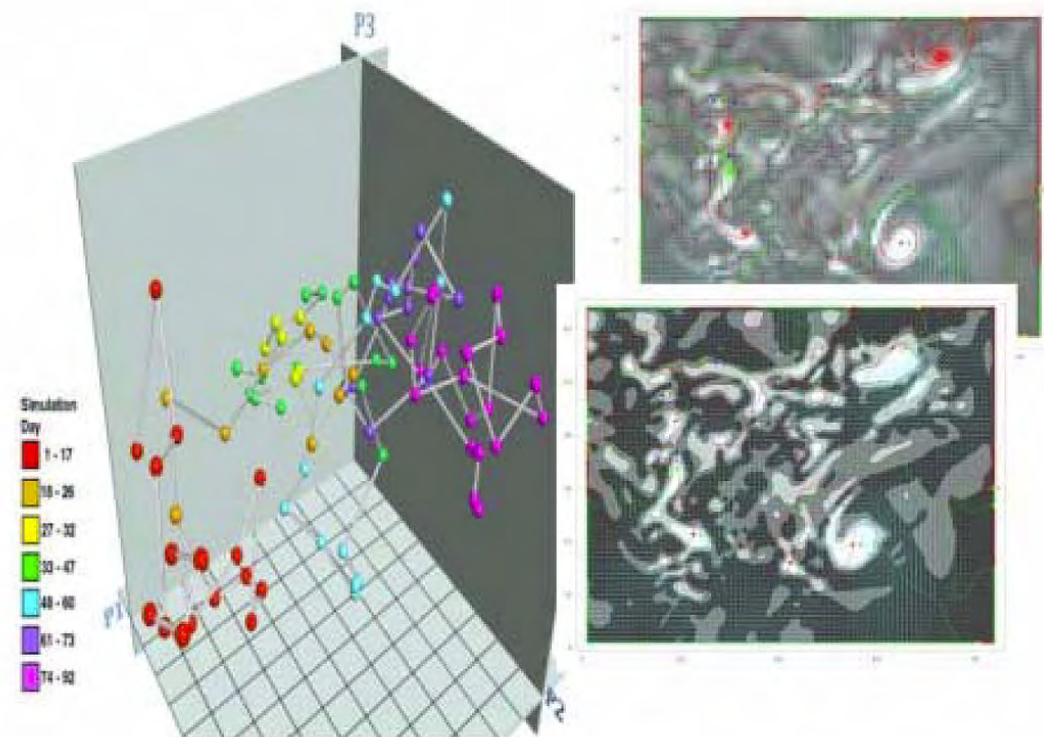
- Nano-technology
- Computational materials science network
- LHC
- RHIC detectors come fully on line
- Burning plasma experiment
- SciDAC
- SNS
- Post-genome
- Network research initiatives



ESnet: Critical Issues for the Future



- Keep ahead of the curve on domestic connectivity
- Closely monitor quality of connections to universities
- Continue to improve International links
- Deployment and support of advanced services



Summary



- The ESnet project thrives in an environment that
 - is experiencing phenomenal growth in usage
 - has an extremely rapid pace and broad spectrum of technology
 - Has simultaneous user demand for performance & reliability
 - is extraordinarily dependent upon wide-scale collaboration and interaction with “peers”
- The program is highly service oriented and enjoys the trust, confidence, and support of both its technical and end user community
- ESnet is a highly successful, effective, and cooperative effort in meeting the networking and data communications requirements of the agency science research community.

The ESnet Project



THE

Thank You
For
Listening

END

The “Transition”

ESnet: Internal Measurements



We maintain an extensive set of performance and traffic measurements

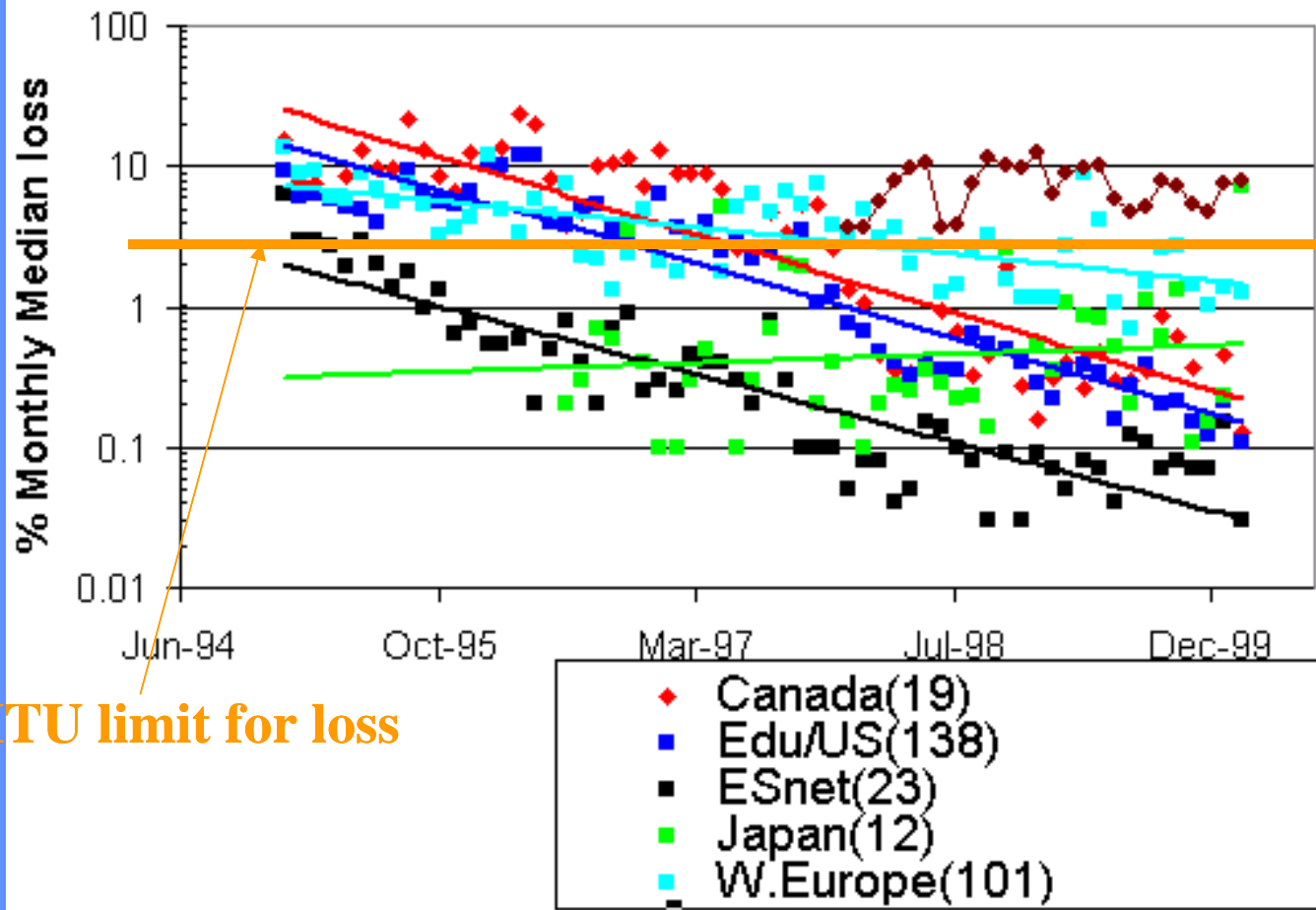
Include monthly, by site, mrtg

ESnet: Outside Measurements



Loss seen from Esnet to groups of Sites

Packet Loss Seen from ESnet



ITU limit for loss

ESnet: Other Services



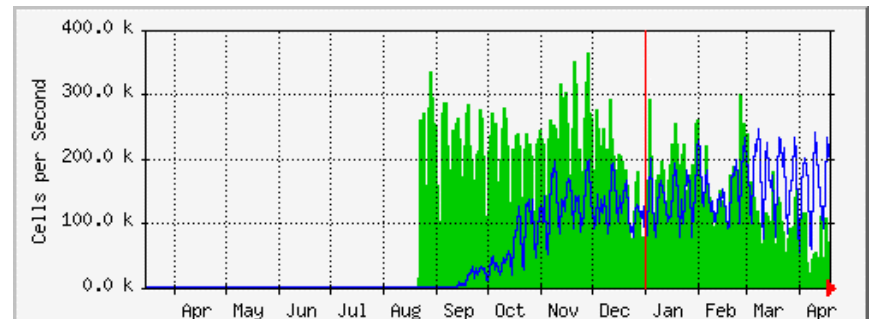
- NTP
- PGP Key Server
 - over 1 million keys now
 - roughly 10K updates/day
- Multi-cast Backbone – now native mode on backbone
- Secondary DNS
- Certificate Authority, Certificate Server
- Directory Services
- Meeting and conference networking support

What Makes It “Fun”? (1/2)

- Moving 35+ sites without a break in service
- Economics
 - 1) Service overlap, e.g. overlap between hubs
 - 2) Termination charges
 - 3) Bridging between vendors
- Trying to forecast install dates for planning
- Every site seems to have its unique set of issues
 - LBL – city of Berkeley wants a franchise
 - ANL – required an environmental impact study
 - NY – power shortage in collocation bldg
 - NERSC – new site, operational date before circuit can be installed

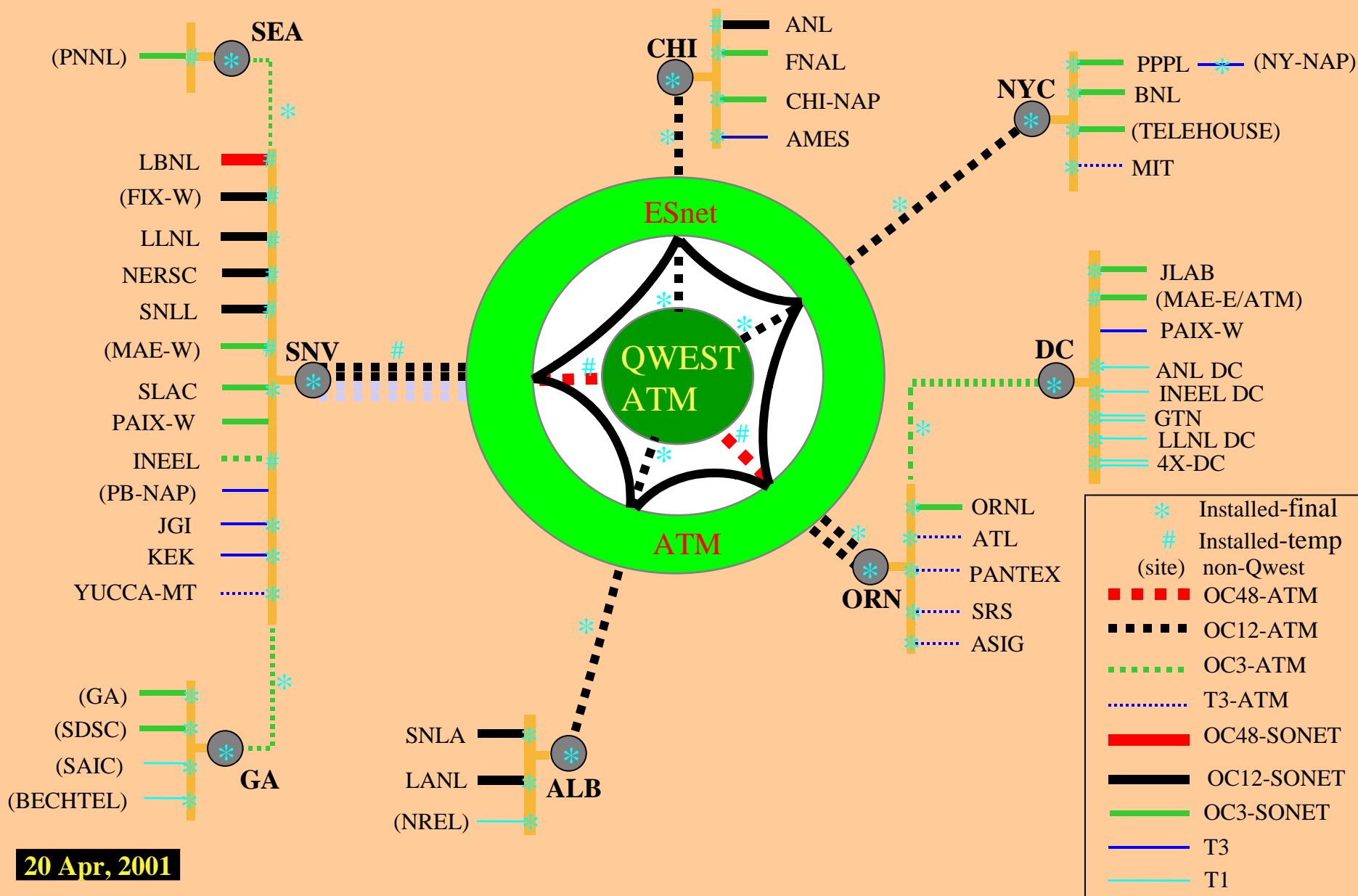
What Makes It “Fun”? (2/2)

- Hardware differences
 - Juniper vrs Cisco routers
 - Cisco vrs FORE ATM switches
- Topology differences
 - Hub routers vrs full BGP mesh
- Interoperability (ESnet <> ESnet3)
 - Tested CLIP, OSPF, BGP, MBGP, MSDP, PIM-SM
- Non-persistent bridge sites
 - Sites bridging between ESnet and ESnet3 will change during the transition
- **But – we’re nearly there!**



ESNET3 INITIAL CONFIGURATION

Top Level View – Qwest Access



20 Apr, 2001

ESnet: Staffing Analysis



Career Contract

Engineering Services Group:

6.0

Network engineering, 3rd level problem resolution (24x7), measurements & analysis, new protocols & technology system integration, documentation

Information & Services Group:

4.0

Security, DCS development, testing, operation (8x5), grid services

Technical Services Group:

10.0 1.0

2nd line problem resolution, installation coordination, security, desktop & server operation & system administration,

Operations:

2.0

Monitoring & 1st line problem resolution (24x7)

Admin Support:

1.0

Management:

2.0

23.0

3.0