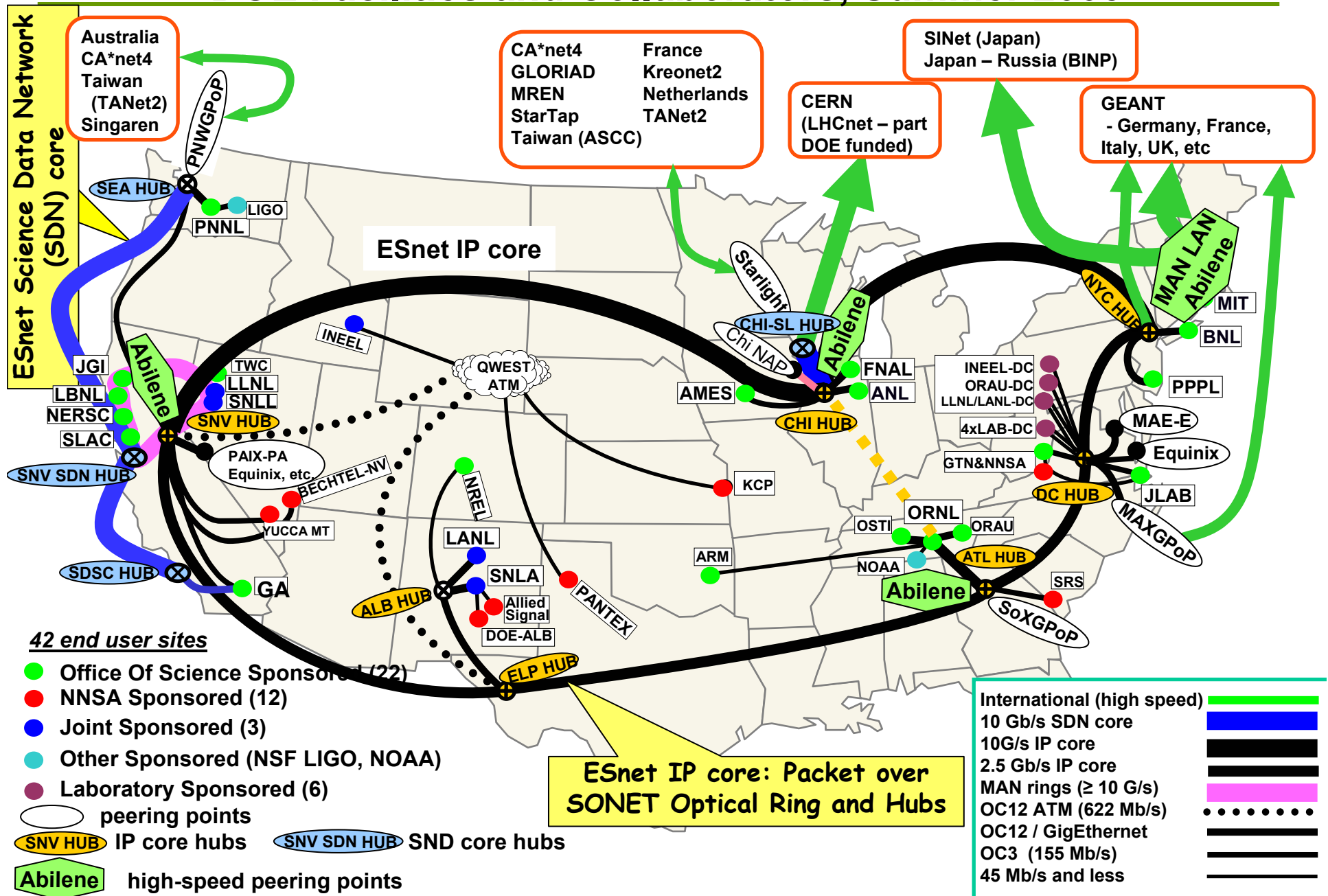# ESnet Planning for the LHC T0-T1 Networking

William E. Johnston
ESnet Manager and Senior Scientist

Lawrence Berkeley National Laboratory
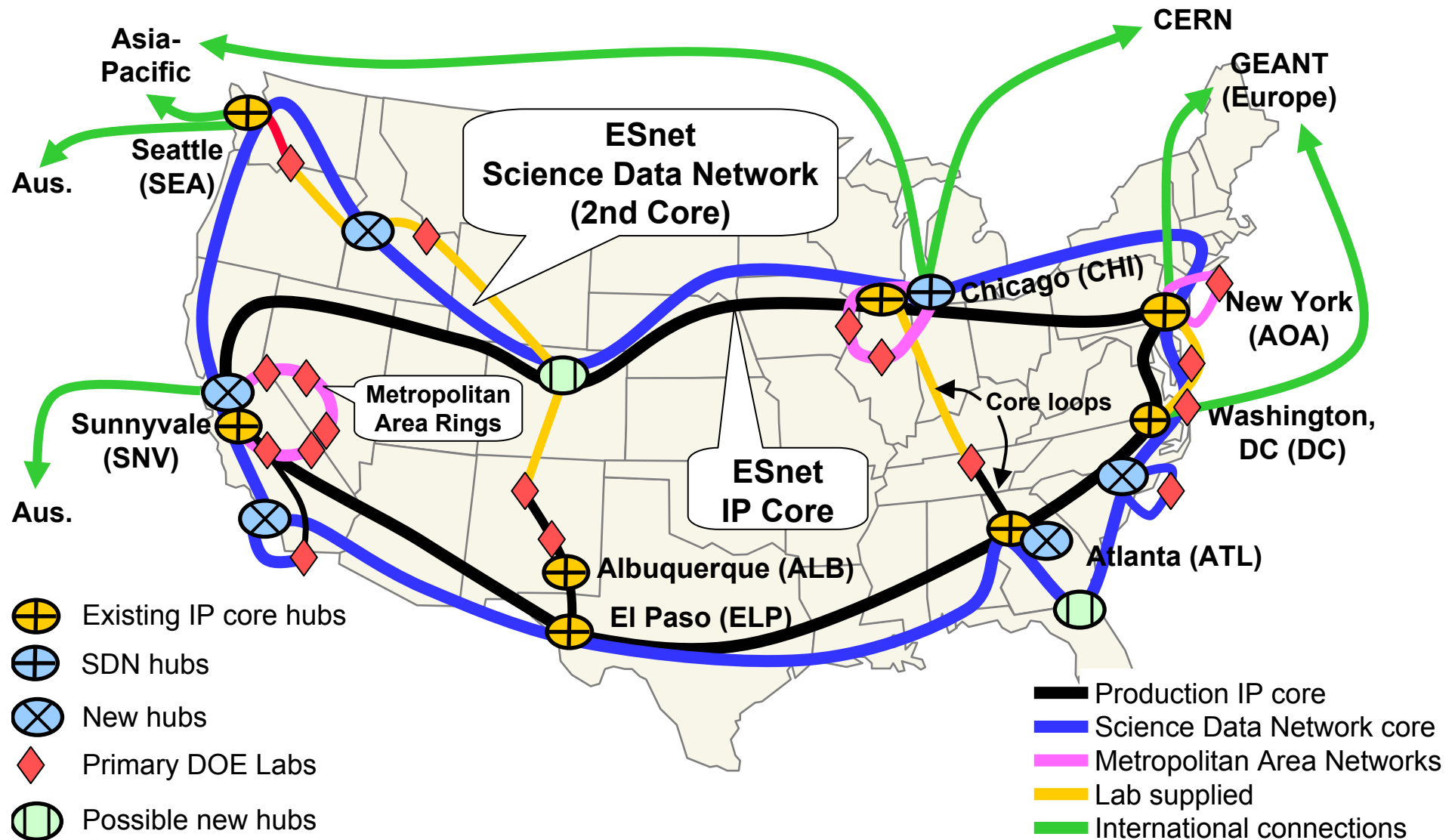
ESnet High-Speed Physical Connectivity to DOE Facilities and Collaborators, Summer 2005
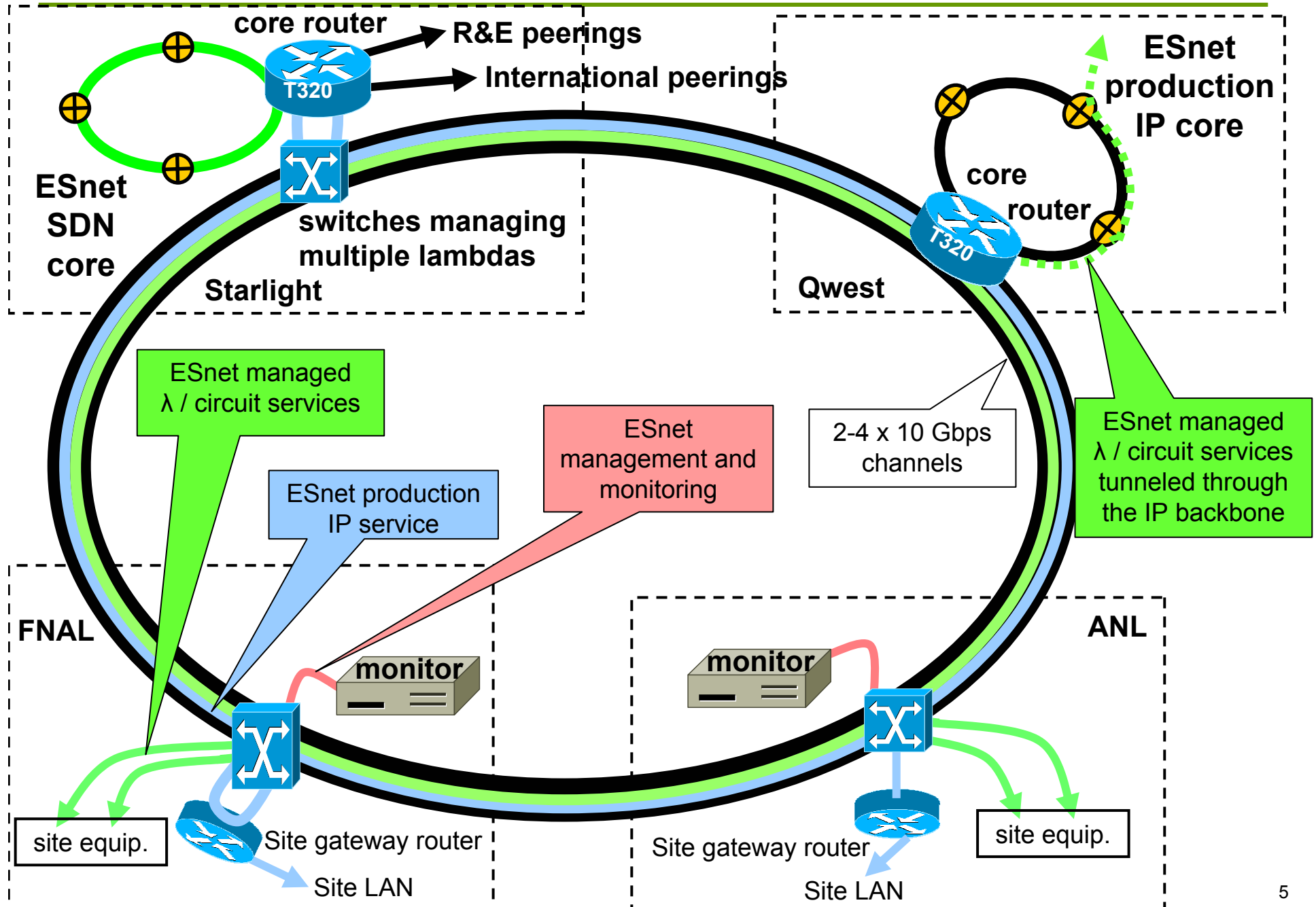
ESnet

- The IP core is primarily a layer 3 infrastructure

  o However, supports layer 2 via MPLS

  o Directly connects sites

  o Provides global peering for sites

- The SDN core is primarily a layer 2 infrastructure

  o Targeted at providing virtual circuit services

ESnet Target Architecture:
IP Core + Science Data Network + MANs

Asia-Pacific

CERN

GEANT (Europe)

Aus.

Seattle (SEA)

ESnet Science Data Network (2nd Core)

Chicago (CHI)

New York (AOA)

Metropolitan Area Rings

Core loops

Sunnyvale (SNV)

Washington, DC (DC)

ESnet IP Core

Aus.

Albuquerque (ALB)

Atlanta (ATL)

El Paso (ELP)

Existing IP core hubs

SDN hubs

New hubs

Primary DOE Labs

Possible new hubs

Production IP core

Science Data Network core

Metropolitan Area Networks

Lab supplied

International connections

ESnet MAN Architecture (e.g. Chicago)

core router

R&E peerings

International peerings

T320

ESnet SDN core

switches managing multiple lambdas

Starlight

ESnet production IP core

core router

T320

Qwest

ESnet managed λ / circuit services

ESnet production IP service

ESnet management and monitoring

2-4 x 10 Gbps channels

ESnet managed λ / circuit services tunneled through the IP backbone

FNAL

ANL

monitor

monitor

site equip.

Site gateway router

Site LAN

Site gateway router

site equip.

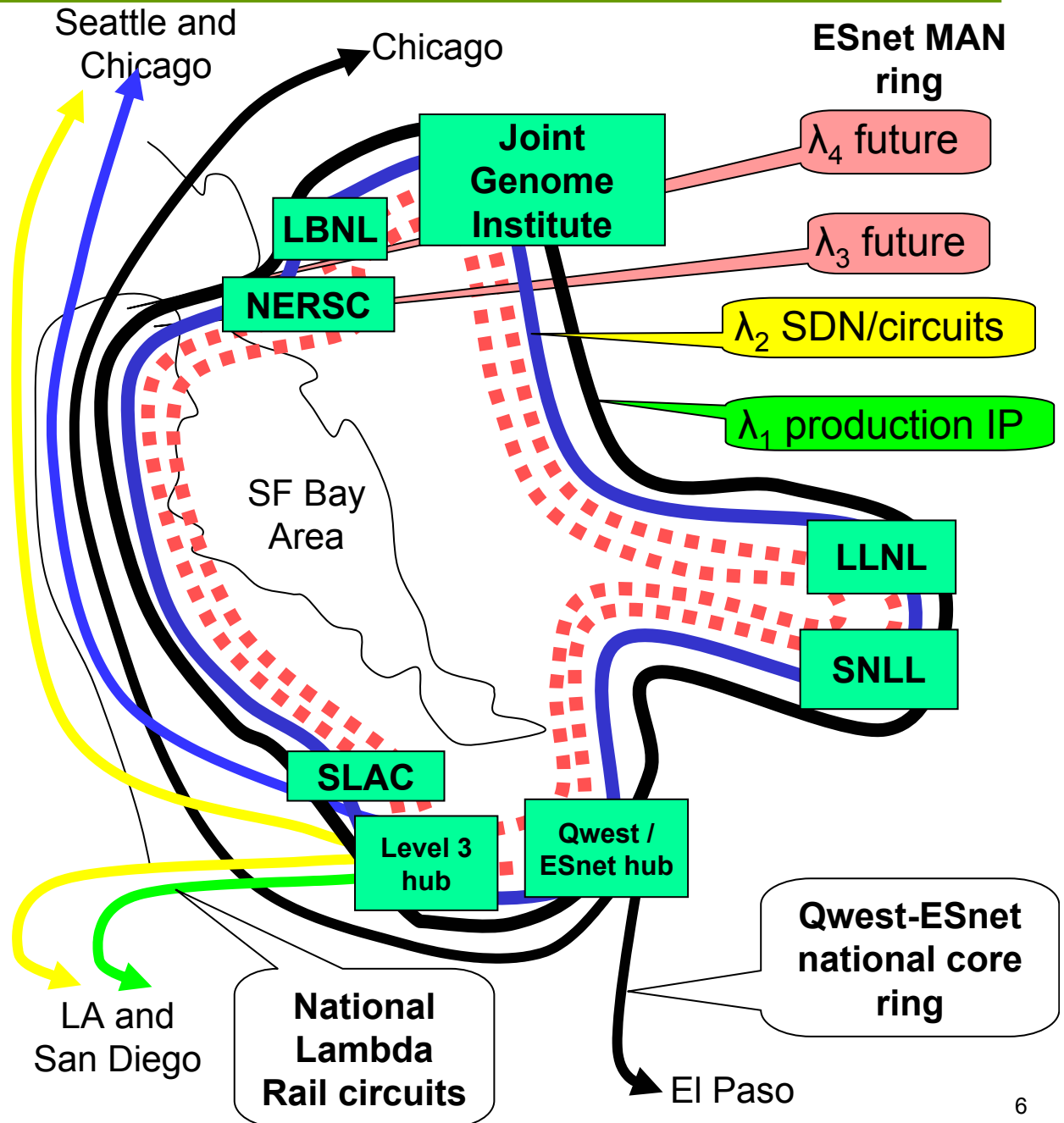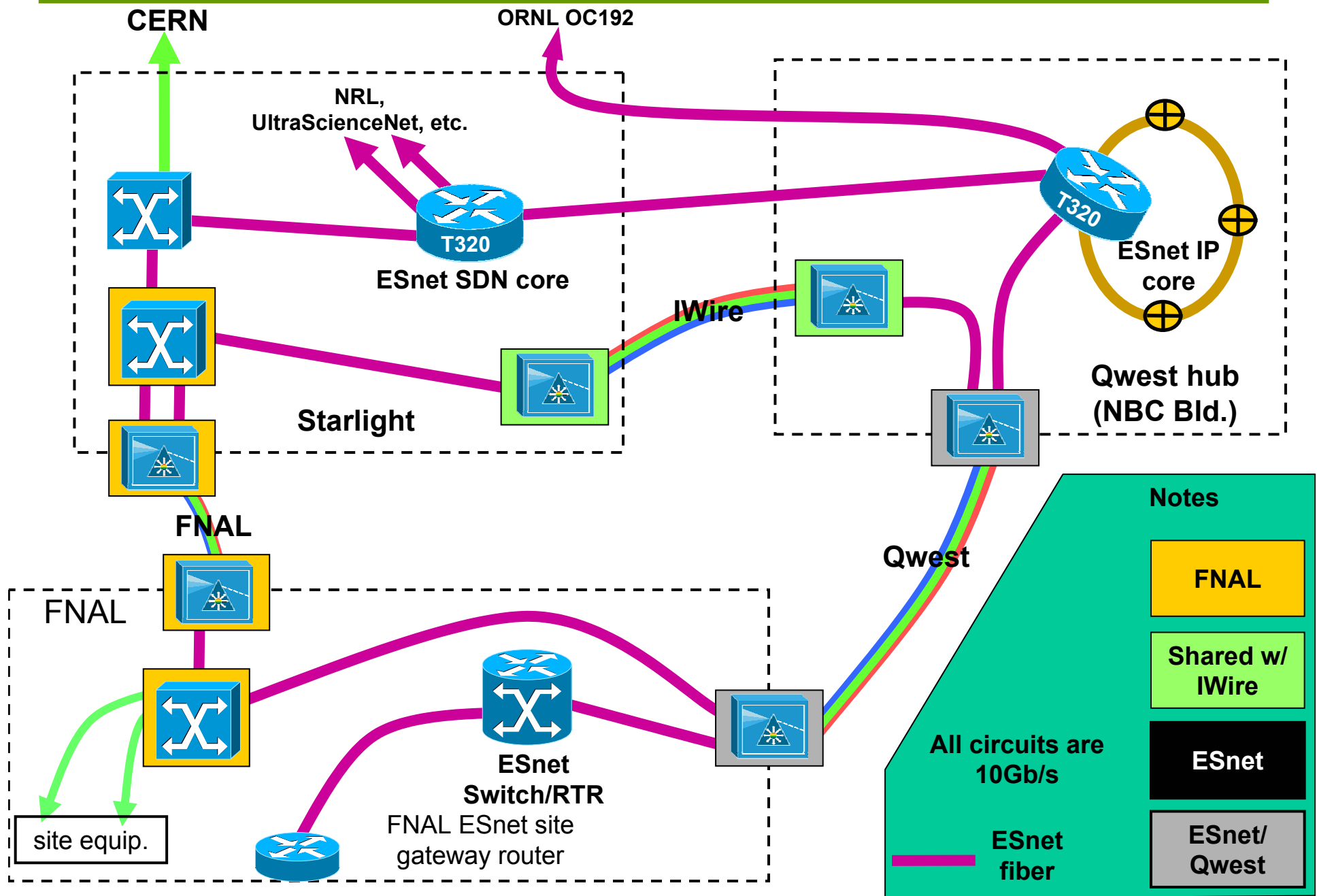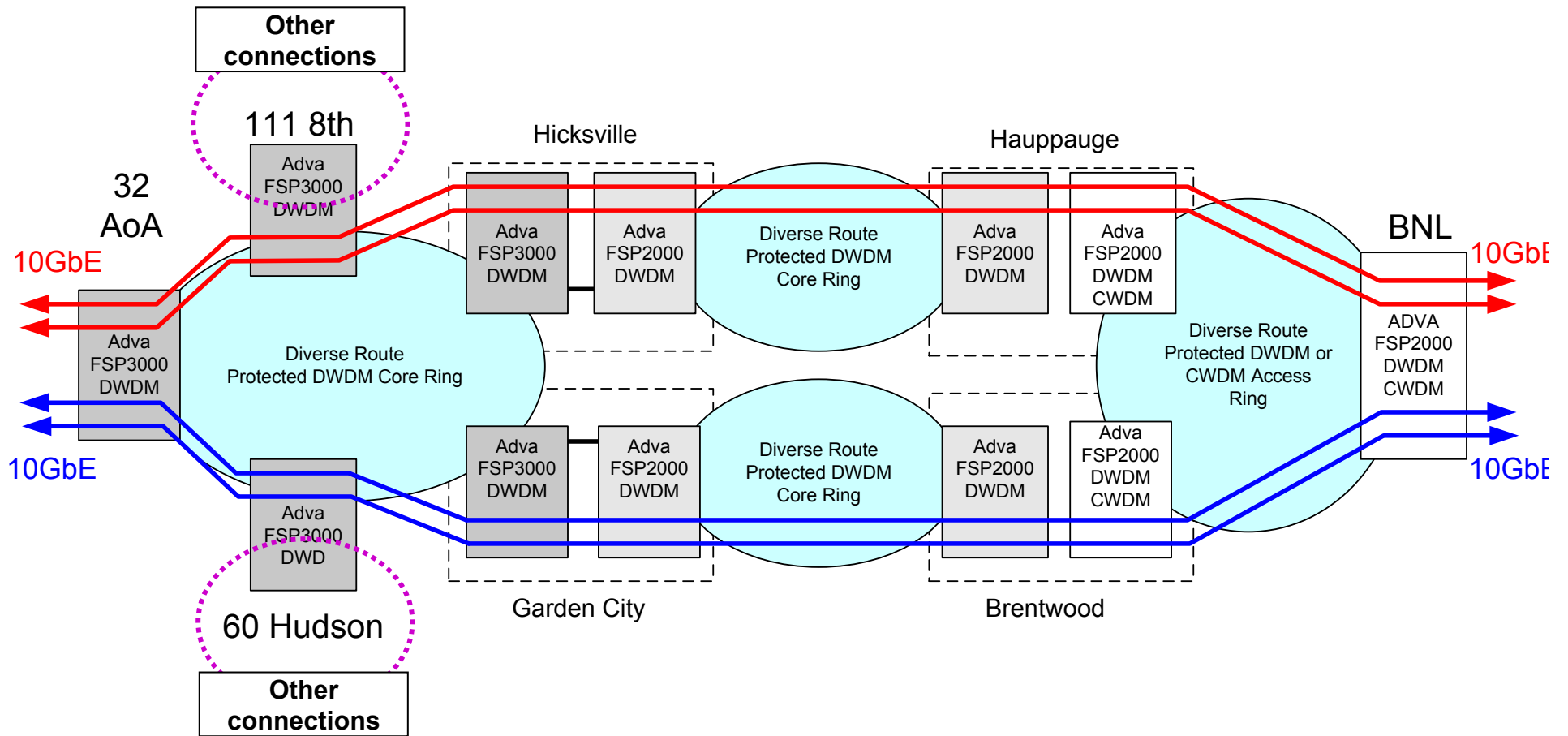Site LAN

The First ESnet MAN: SF Bay Area

- 2 λs (2 X 10 Gb/s channels) in a ring configuration, and delivered as 10 GigEther circuits

- Dual site connection (independent "east" and "west" connections) to each site

- Will be used as a 10 Gb/s production IP ring and 2 X 10 Gb/s paths (for circuit services) to each site

- Qwest contract signed for two lambdas 2/2005 with options on two more

- Project completion date is

Seattle and Chicago

Chicago

ESnet MAN ring

Joint Genome Institute

LBNL

NERSC

λ_4 future

λ_3 future

λ_2 SDN/circuits

λ_1 production IP

SF Bay Area

LLNL

SNLL

SLAC

Level 3 hub

Qwest / ESnet hub

Qwest-ESnet national core ring

LA and San Diego

National Lambda Rail circuits

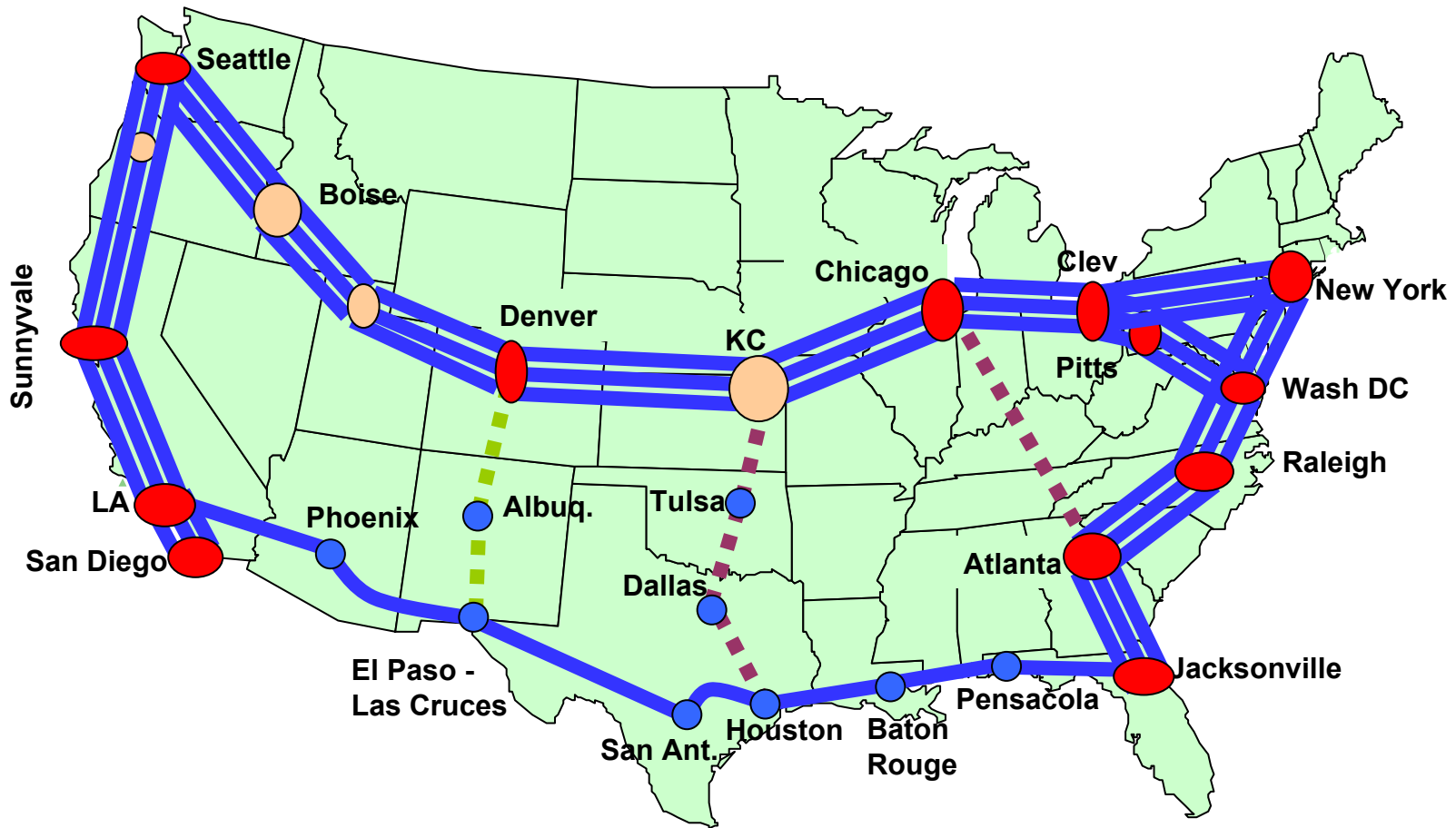El Paso

6

ESnet Near-Term Planning for FNAL

ESnet Planning for BNL (Long Island MAN Ring)

Engineering Study for LI MAN

Proposed ESnet Lambda Infrastructure
Based on National Lambda Rail – FY08

Seattle
Boise
Sunnyvale
Denver
KC
Chicago
Clev
New York
Pitts
Wash DC
Raleigh
LA
Phoenix
Albuq.
Tulsa
Atlanta
San Diego
Dallas
Jacksonville
El Paso - Las Cruces
San Ant.
Houston
Baton Rouge
Pensacola

⬤ NLR regeneration / OADM sites

🔴 NLR wavegear sites

ESnet Goal – 2007/2008

- 10 Gbps enterprise IP traffic
- 40-60 Gbps circuit based transport

ESnet Science Data Network (2nd Core – 30-50 Gbps, National Lambda Rail)

ESnet IP Core (≥10 Gbps)

Metropolitan Area Rings

Legend:

- ▲ ESnet hubs
- ▲ New ESnet hubs
- ● **Metropolitan Area Rings**
- ◆ **Major DOE Office of Science Sites**
- ✚ **High-speed cross connects with Internet2/Abilene**

- ▬▬ Production IP ESnet core
- ▬▬ Science Data Network core
- ▬▬ Lab supplied
- ▬▬ Major international

- ▬▬ 10Gb/s
- ▬▬ 10Gb/s
- ▬▬ 30Gb/s
- ▬▬ 40Gb/s

Labels on map: AsiaPac, SEA, Aus., SNV, Aus., SDG, DEN, ALB, ELP, ATL, CHI, Japan, CERN, Europe, Japan, Europe, NYC, DC

OSCARS: Guaranteed Bandwidth Service

- A high-priority R&D topic in "DOE Science Networking Challenge: Roadmap to 2008"

- The MICS funded OSCARS project is implementing dynamically provisioned circuit switching in ESnet
  - On-demand Secure Circuits and Advance Reservation System (OSCARS)
  - End-to-end provisioning will be initially provided by a combination of Ethernet switch management of λ paths in the MAN and Ethernet VLANs and/or MPLS paths in the ESnet core
  - Provisioning will initially be provided by manual circuit configuration, on-demand in the future
  - A technology collaboration with Internet2/Abilene

OSCARS: Guaranteed Bandwidth Service

- Progress
  - o Testing OSCARS Label Switched Paths (MPLS based virtual circuits)
    - A static LSP between BNL and FNAL has been configured for the sites to test their infrastructure
    - Multiple static LSPs have been configured between GA and NERSC to test local and wide-area QoS
  - o Collaboration – code is being jointly developed with Internet2's Bandwidth Reservation for User Work (BRUW) project

OSCARS: Guaranteed Bandwidth Service