



National LambdaRail

JET Roadmap Workshop

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What is National LambdaRail (NLR)?

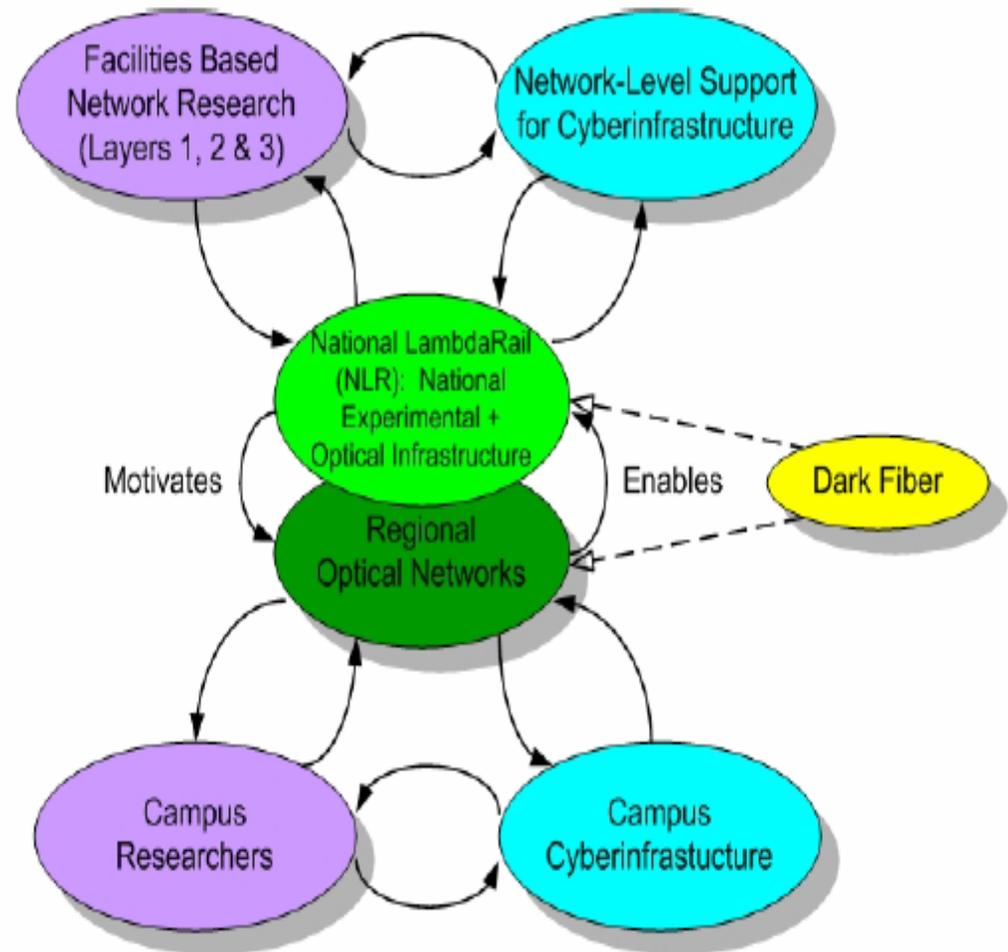


- **NLR is the largest member-owned/managed optical networking & research facility in the world**
 - Research community will have direct control of a nationwide optical fiber facility for both application level and networking level experiments
- **NLR is not a single network**
 - Set of facilities, capabilities and services that support multiple experimental and production networks for the U.S. research community
 - Networks will exist side-by-side on same fiber but will be physically and operational independent

NLR Based on the 'Virtuous Circles' Concept



- Participants commit to work toward improving end-to-end performance by providing dedicated optical capabilities from their campus research labs to the NLR network.
- NLR commits to work closely with regional optical networking initiatives to deliver NLR capabilities to the campuses.



NLR Objectives



The objectives of NLR are:

- To bridge the gap between leading-edge optical network research and state-of-the-art applications research;
- To push beyond the technical and performance limitations of today's Internet backbones;
- To provide the growing set of major computationally intensive science projects, initiatives and experiments with the dedicated bandwidth, deterministic performance characteristics, and/or other advanced network capabilities they need; and
- To enable and to rekindle the possibilities for highly creative, out-of-the-box experimentation and innovation that characterized facilities-based network research during the early years of the Internet.

NLR's Distinguishing Features

- **First & foremost, it's an experimental platform for research**
 - Optical, switching and network layers
 - Research committee (2 Board seats), Chief Scientist
 - 50% of capacity reserved for research
 - Experimental Support Center
- **Use of high speed Ethernet for WAN transport**
 - First national scale network to deploy transcontinental 'circuits' based upon Ethernet technology end-to-end
- **Sparse backbone topology**
 - Members responsible for developing optical networking capabilities and performance in their region
- **NLR is open to all R&E organizations, government agencies and corporations who share NLR's research goals**
- **'Acceptable Use Policy' Free**

Planned NLR Capabilities and Services



- **Point-to-point waves**
 - 10GE LAN PHY, OC-192 using Cisco I5808 long haul and extended long haul and Cisco I5454 extended metro DWDM systems
- **Switched Ethernet network**
 - Using Cisco switches
- **Experimental routed IP network**
 - Using Cisco routers
- **Dark fiber for optical layer research**
- **Traditional NOC services and also “Experiments Support Center” services**
 - Instrumentation, measurement, config/re-config management, tool development

NLR Infrastructure



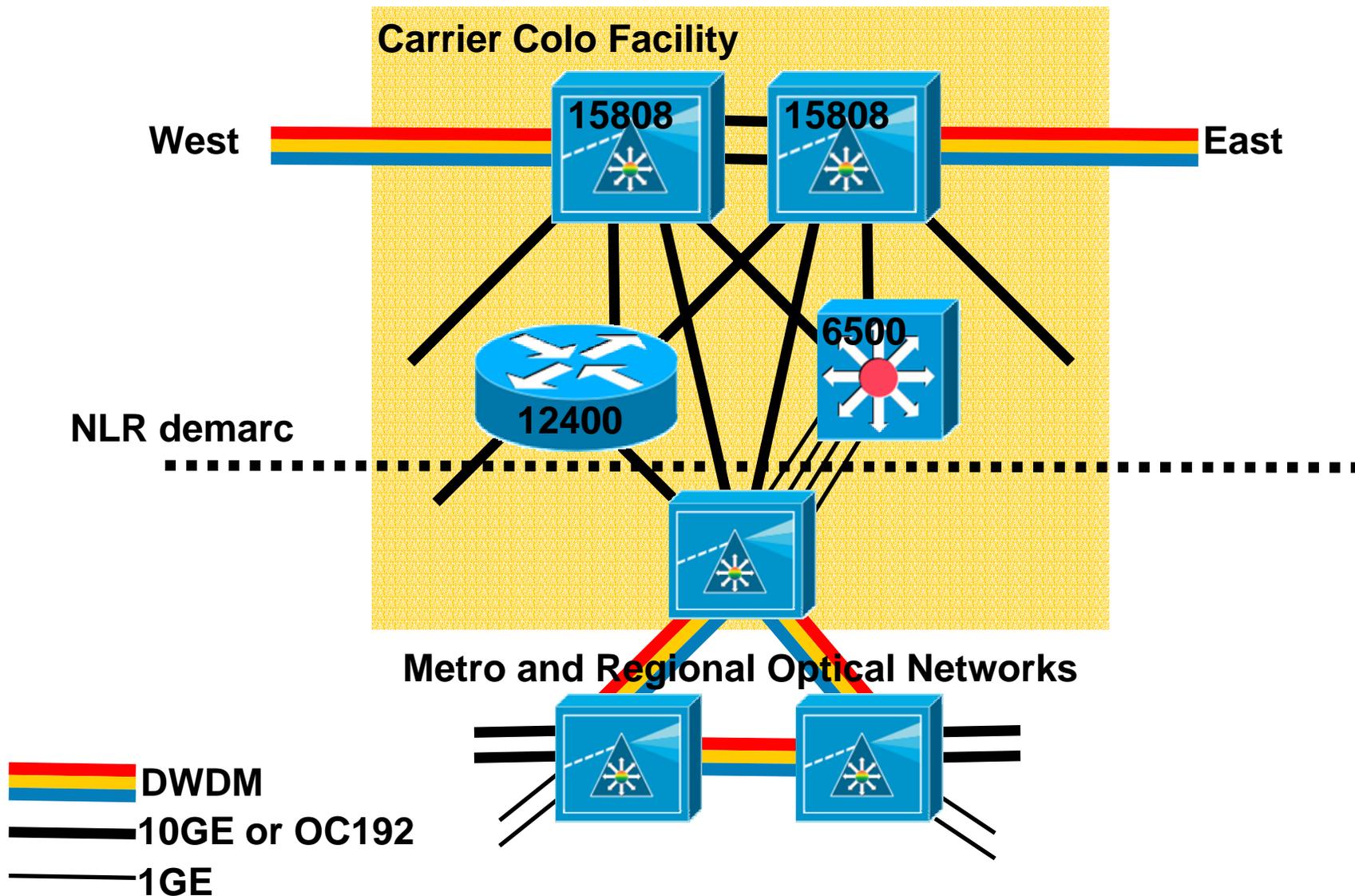
- **Dense Wave Division Multiplexing (DWDM)-based national optical footprint**
 - Capacity for 40 wavelengths (λ s) per fiber pair
 - Deployed on ~10,000 miles of dark fiber
- **Using DWDM technology allows:**
 - Multiple concurrent large-scale experiments to be conducted
 - Network researchers to develop and control their own dedicated testbeds with full visibility and access to underlying switching and transmission fabric.
- **Using standards-based Ethernet LAN PHY allows:**
 - NLR to achieve a significant decrease in the cost of ultra high-speed network services

NLR Wavelengths

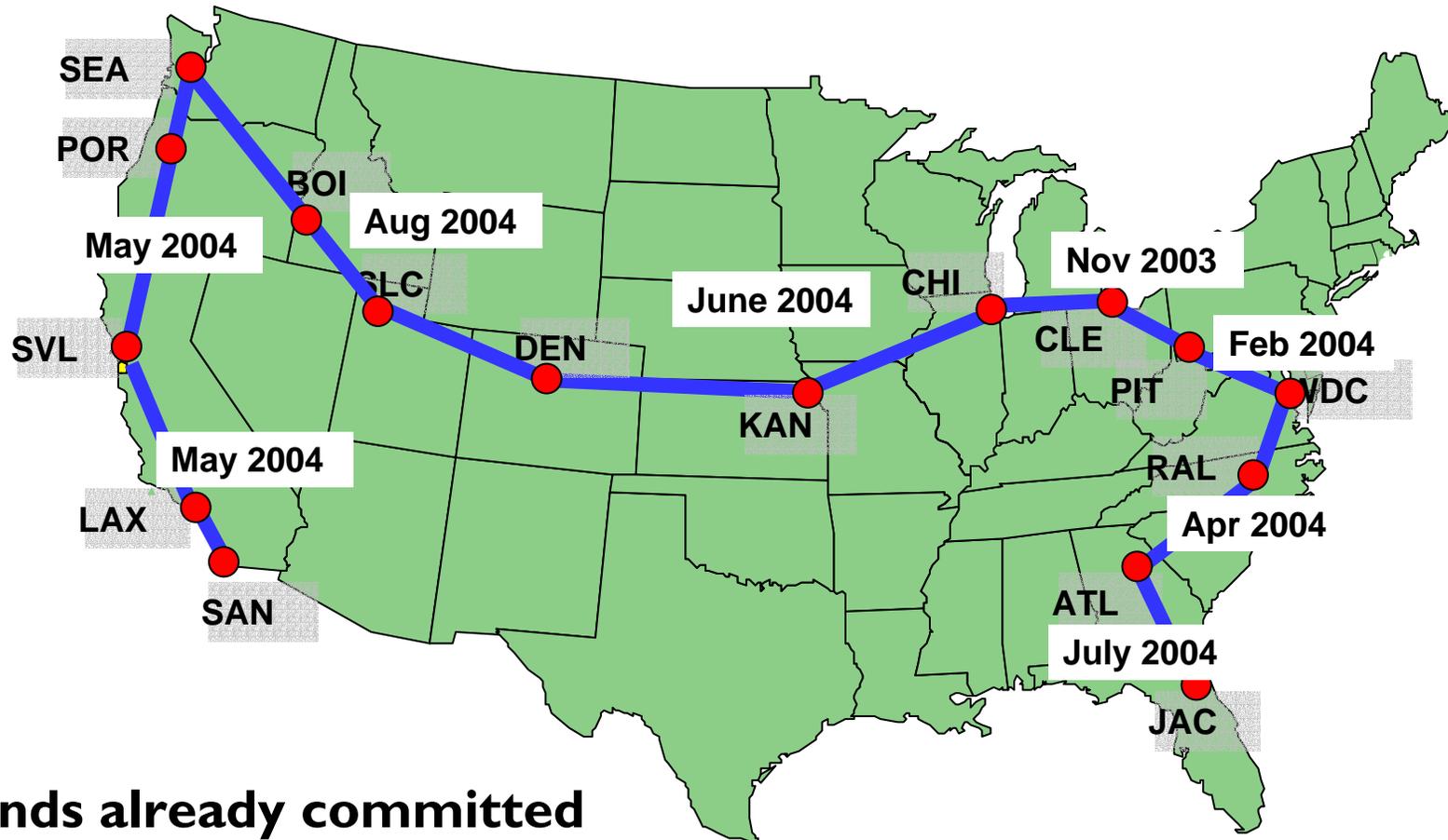


- **Initial complement of 4 λ s installed and available at outset**
 - One λ for national switched Ethernet experimental network
 - Another λ for national 10 Gbps IP network to support internetworking and end-to-end transport protocol experiments
 - Similar to Internet2's Abilene except routers will be available for measurement and experimentation
 - Third λ will serve as a quick start facility for new research projects
 - Fourth λ will be used by Internet2's HOPI testbed
- More λ s will be activated as needed to support the research and operational objectives of the community**

NLR PoP Architecture



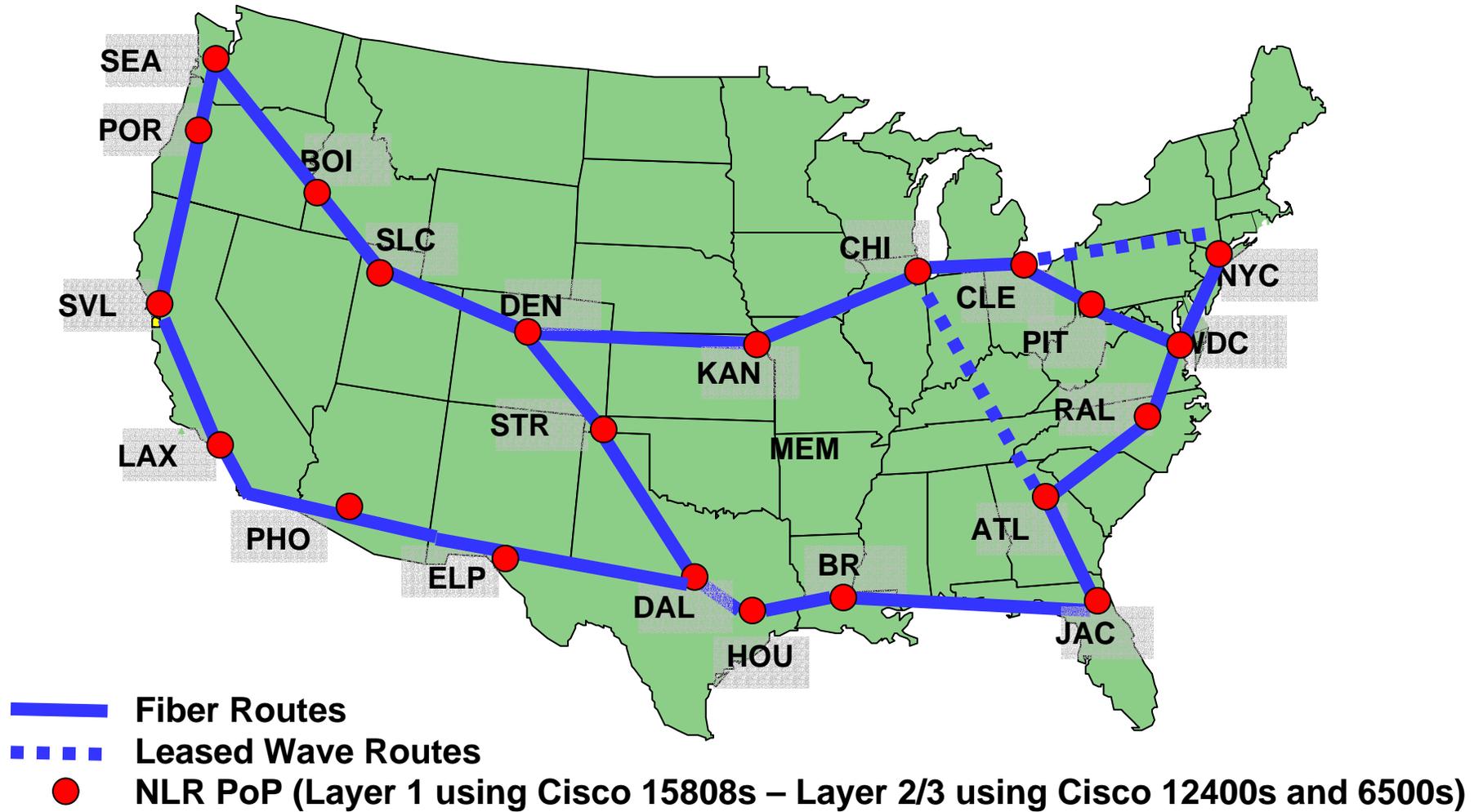
NLR Deployment Phase 1



Funds already committed

Installation: October 2003 through August 2004

NLR Planned Footprint



NLR Membership



Members who have committed:

- **Cisco Systems**
- **Corporation for Education Networking Initiatives in California (CENIC) representing CA research institutions**
- **Pacific Northwest Gigapop (PNWG)**
- **Pittsburgh Supercomputing Center (PSC) representing Pittsburgh Gigapop**
- **Internet2**
- **Virginia Tech representing Mid-Atlantic Terascale Partnership (MATP)**
- **Duke University representing a coalition of North Carolina Universities**
- **Georgia Tech representing Southern LambdaRail (SLR)**
- **Florida LambdaRail (FLR)**
- **Committee on Institutional Cooperation (Big 10 + Univ of Chicago)**
- **Oak Ridge National Laboratory (DOE's UltraScience Net project)**
- **Louisiana Board of Regents on behalf of Louisiana Optical Network Initiative**

NLR Membership – Cont'd



Ongoing discussions / in progress:

- **LoneStar Education and Research Network (LEARN)**
- **Cornell University**
- **Southeast University Research Association (SURA)**
- **University of New Mexico / New Mexico State**
- **Arizona institutions (UofAz, ASU, Northern Az)**

Summary



- **NLR is the first ever national scale ‘dual mission’ experimental and production infrastructure.**
- **NLR is a platform for new methods of research in science, engineering, health care, and education as well as for research and development of new Internet technologies, protocols, applications and services.**
- **NLR strives to connect a new generation of regional optical networks and drive regional R & E fiber projects.**
- **NLR intends to enable technology transfer into commercial development and the creation of new markets, and therefore stimulate economic development and contribute to U.S. national competitiveness.**

For more information...



For more info, see

<http://www.nationallambdaRail.org>

Or contact us at

info@nationallambdaRail.org

NLR puts the control, the power and the promise of experimental network infrastructure in the hands of our nation's scientists and researchers.