National LambdaRail

ONT3

Dave Reese

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Acknowledgements

- Tom West, NLR
- John Silvester, USC
- John Moore, MCNC

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National LambdaRail - Overview

- National LambdaRail is a non-profit corporation created by major regional US R&E networks in conjunction with Cisco Systems
- Owns (20yr IRU's) and operates a national optical fiber infrastructure
- Provides a range of services to its members over this infrastructure

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National LambdaRail Members and Associates

- CENIC
- Pacific Northwest Gigapop
- Pittsburgh Supercomputing Center/University of Pittsburgh
- Duke University, representing a coalition of NC universities
- Mid-Atlantic Terascale Partnership
- Cisco Systems
- Internet2
- Florida LambdaRail
- Georgia Institute of Technology
- Committee on Institutional Cooperation (CIC)
- Cornell University
- Louisiana Board of Regents
- Oklahoma State Board of Regents
- Lonestar Education and Research Network (LEARN)
- University of New Mexico (on behalf of the State of New Mexico)
- UCAR/FRGP
- SURA
- Oak Ridge National Lab (ORNL)
- Case Western Reserve University

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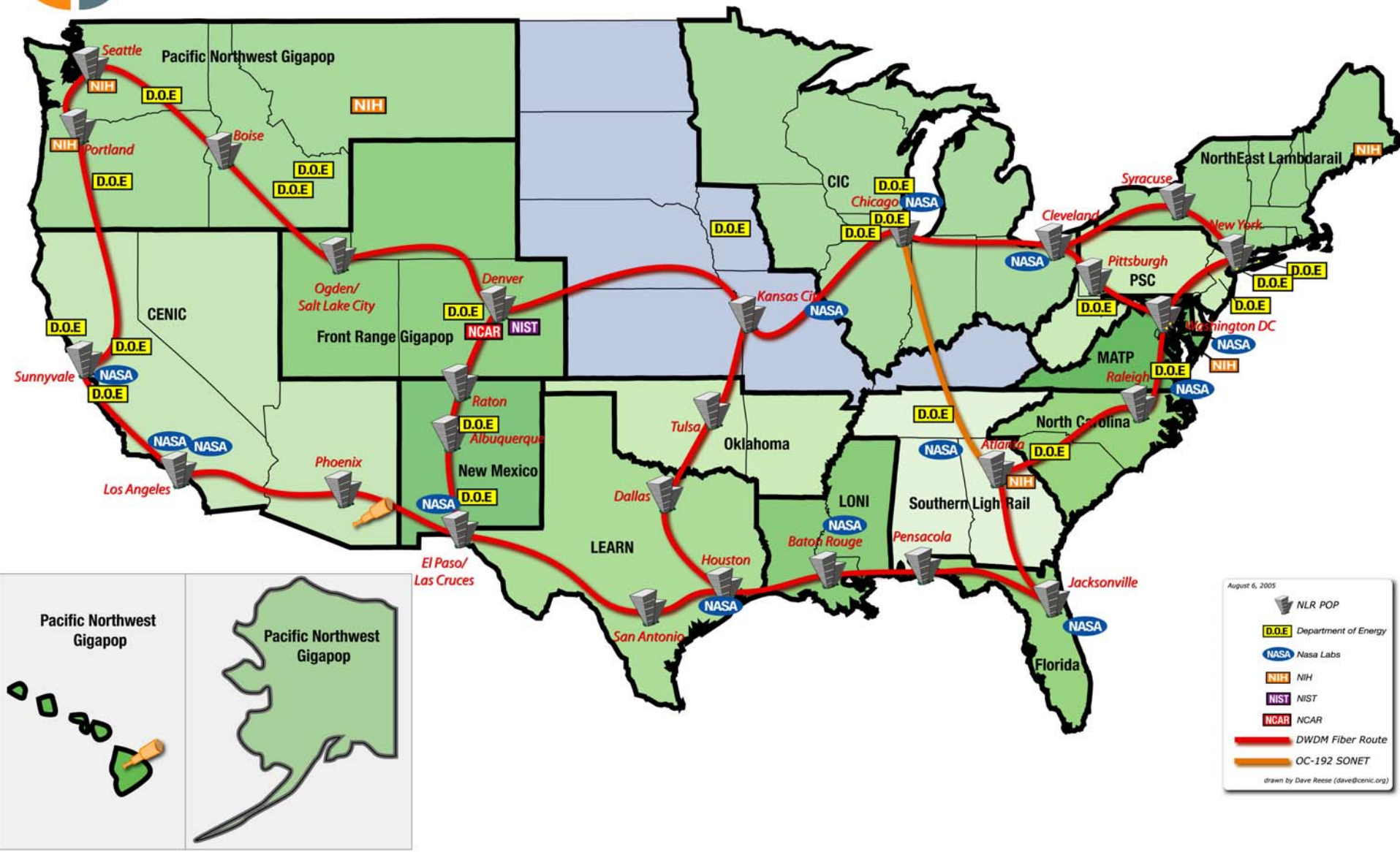
National LambdaRail Architecture



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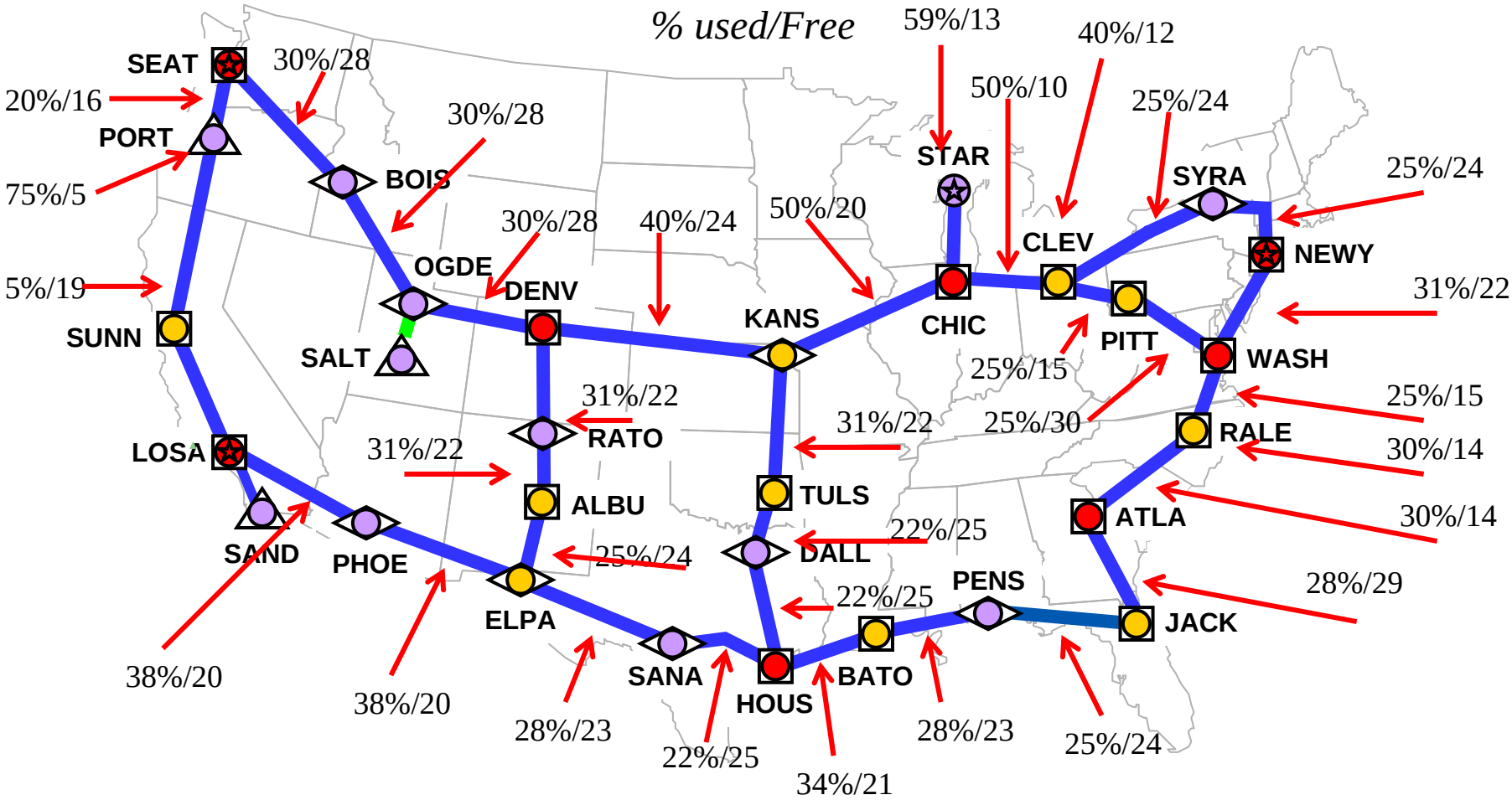
For more information regarding NLR see http://www.nlr.net or contact info@nlr.net

NLR Allocated Waves - planned



- NLR owned fiber*
- NLR WaveNet, FrameNet & PacketNet PoP
- NLR WaveNet & FrameNet PoP
- NLR WaveNet PoP

* Fiber on the SAND-LOSA-SUNN path belongs to CENIC

- PoP for primary connection point by a member ("MetaPoP")
- PoP needed because of signal regeneration requirements but can also be used for secondary connection by a member
- PoP established by NLR for members regional needs
- PoP established at exchange points

NLR Infrastructure

- Over 11,000 route miles of fiber
- Owned Fiber: 20-yr IRUs [Level(3), AT&T]
- Layer 1 DWDM: Cisco 15808s and 15454s supporting up to 40 10 Gbps lambdas LANPHY, WANPHY or OC-192
- Layer 2: Cisco 6509 switches
- Layer 3: Cisco CRS-1 routers
- Wavelengths available for experimental or production networks

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NLR Services

- Main Services
  - WaveNet – point-to-point “lambdas” consisting of concatenated (OEO) dedicated segments
  - FrameNet – Dedicated and shared Ethernet services
  - PacketNet – IP based network
- Other Services
  - Co-location
  - Remote Hands
  - Fiber IRUs

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Projects using NLR WaveNet

TeraGrid	NSF, U. of Chicago
TeraGrid	NSF, PSC
TeraGrid	NSF, TACC
OptiPuter	NSF, UCSD/UIC
UltraScience	DOE, ORNL
ESNet	DOE, LBNL
Ames/Goddard	NASA
Pacific Wave	CENIC/PNWGP
Cheetah	NSF Project (U of VA)
FLR Backhaul	FLR
LEARN Backhaul	LEARN
Cornell Backhaul	Cornell

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Cisco Research Wave Projects

- EnLightened
  - PI Gigi Karmous-Edwards, MCNC
  - Developing a dynamic, adaptive, coordinated and optimized use of networks connecting geographically distributed high-end computing resources and scientific instrumentation.
  - Infrastructure - WaveNet circuits

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Cisco Research Wave Projects

- CHEETAH
  - PI - Malathi Veeraraghavan, Uva
  - A high-performance, experimental, optical network infrastructure capable of: (a) on-demand provisioning of end-to-end high-speed circuits, (b) stable transport to sustain control and streaming operations, and (c) middleware and application software to support data transfers, visualization, steering and control
  - Infrastructure - WaveNet circuit
- Translight Interconnect
  - Pis - John Silvester, USC; Tom DeFanti, UIC
  - Interconnect PacificWave and Starlight to expand distributed exchange facility to allow interconnection of international research and education networks in the US and participation in GLIF
  - Infrastructure - WaveNet circuit

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FrameNet Overview

- **National Exchange Fabric Birthright Service**
  - *Service Description* - The NEF is a single VLAN and broadcast domain that extends to every member who elects to participate in the service. It allows members to arrange bi-lateral peerings with any of the other participants in this birthright service.
  - *Physical Connectivity* - Every member gets a single 1GigE interface on their local NLR FrameNet node for use of the NEF service.
- **Point-to-point, Dedicated Bandwidth Service**
  - *Service Description* - Members may order private VLANs to connect 2 different locations together, with dedicated bandwidth, for a circuit-like service.
  - *Bandwidth Minimums/Maximums* - There is a 100Mbps minimum bandwidth requirement for the Point-to-pointed dedicated layer2 service. The maximum bandwidth for this service is 10Gbps.
- **Point-to-multipoint, Best Effort Service**
  - *Service Description* - Members may order private VLANs to more than 2 different locations together, for a circuit-like service.
  - *Bandwidth* -Traffic on these VLANs will be carried through the network on a best effort basis.

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FrameNet Research Projects

- VINI
  - PI Larry Petersen/Jennifer Rexford
  - Virtual network infrastructure that allows network researchers to evaluate their protocols and services in a realistic environment that provides a high degree of control over network conditions.
  - Infrastructure - an overlay testbed using NLR co-location, FrameNet and PacketNet services

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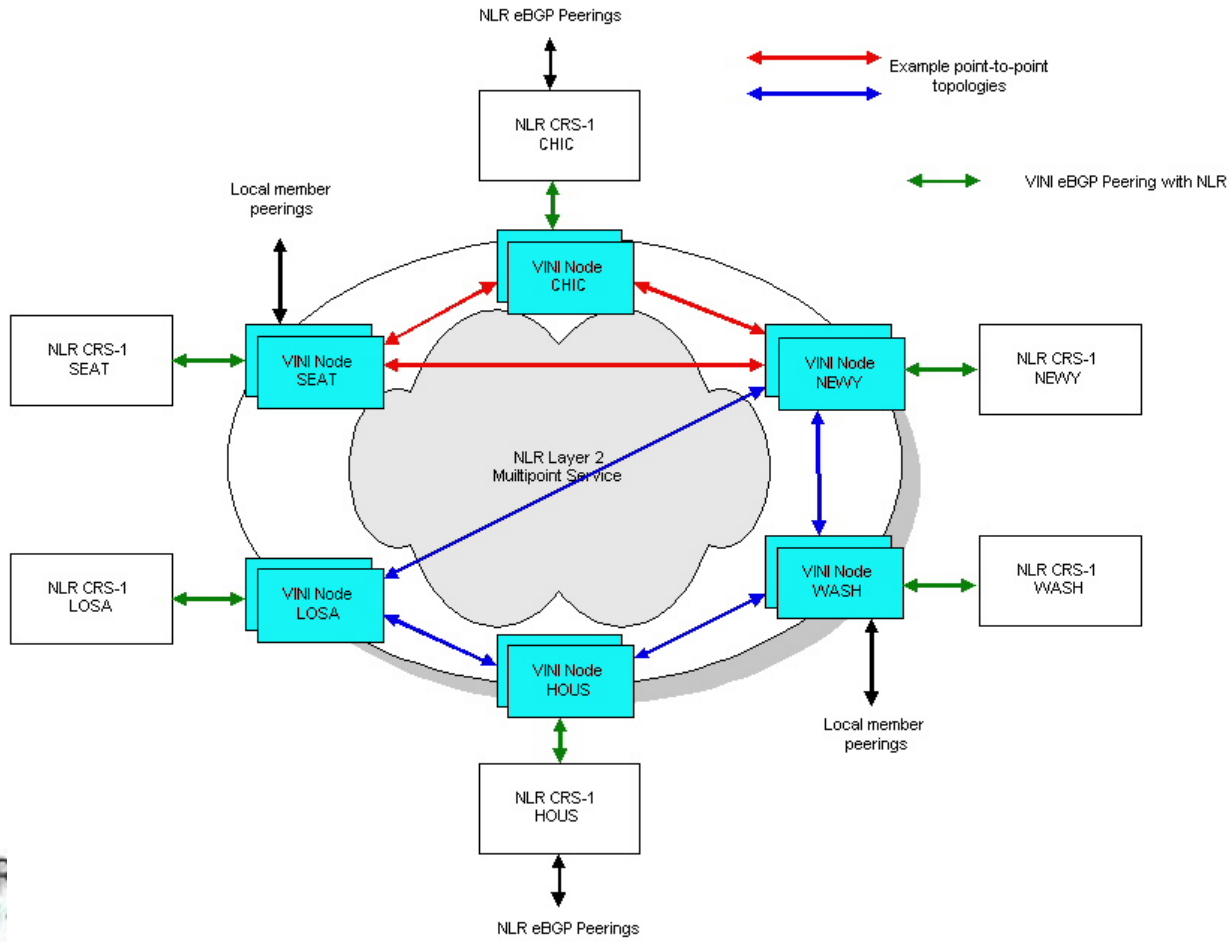
VINI Overview



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PacketNet Status

- Connection status
  - 13 out of 15 Members are connected
  - 10 of the 13 have 10 GE connections
  - 6 also have 1 GE secondary connections
  - 3 with GE or multiple GE
- Presence at PacificWave, Starlight & MANLAN
- Domestic Peering
  - DREN, ESNet, USGS
- International Peering
  - TransPac2, CA*Net4, UltraLight/LHCnet,TWAREN

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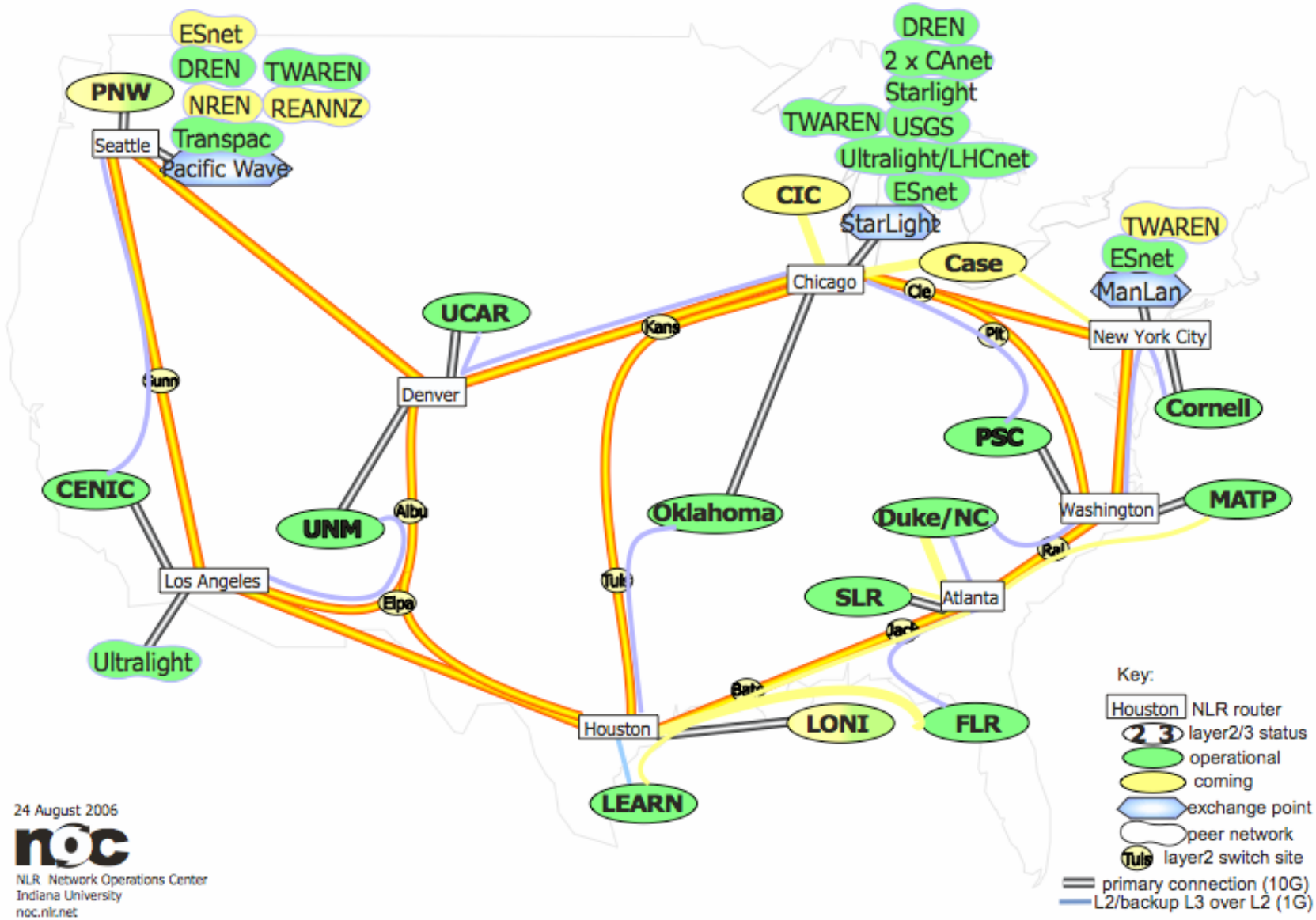
NLR Members' Layer3 "PacketNet" Connection Status



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NLR Optical Switching Project

- Using Calient switches
- Possible projects
  - Fault Tolerance?
  - GMPLS experimentation?
  - Experiment with shared control between backbone and RON?
- Specific plans and location are under review by Engineering committee

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Thank you

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