



Corporation for Education Network  
Initiatives in California

CalREN XD/HPR Workshop

Dave Reese, CTO

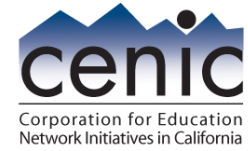
San Diego, September 15 2008

# CENIC Services Today

- Layer 1 (>2,700 route miles fiber)
  - Cisco 15454 & 15808 DWDM backbone
    - OC-48, OC-192, 10GE LANPHY
- Layer 2
  - Future services
- Layer 3
  - CalREN/DC: production/commodity services
    - 10GE LANPHY backbone
  - CalREN/HPR: research network
    - 10GE LANPHY backbone
  - CalREN/XD: custom services focused on research

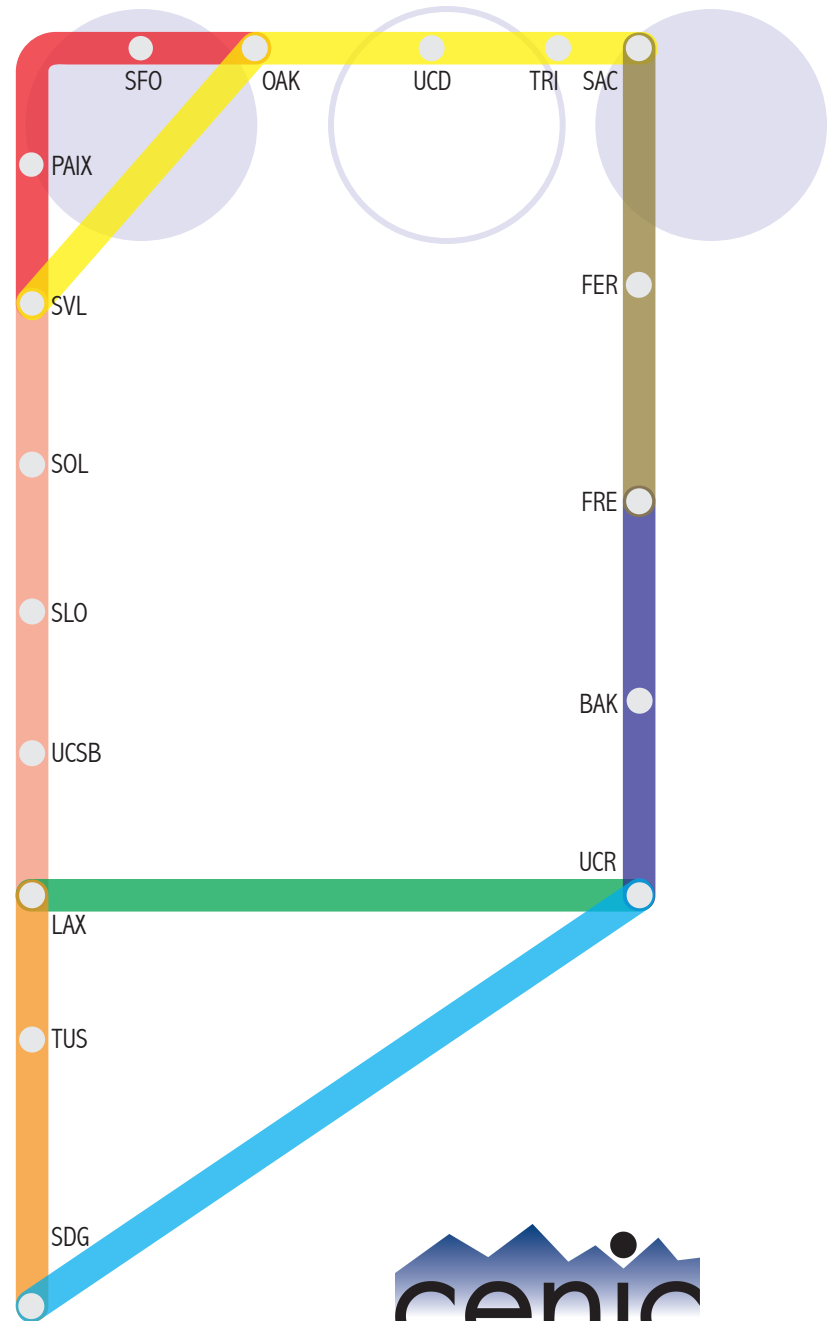


# CalREN Optical Backbone Serving California's Research and Education Community



# CENIC DWDM Subway Map

Each segment supports up  
to 32 10Gb channels



# CENIC DWDM Backbone

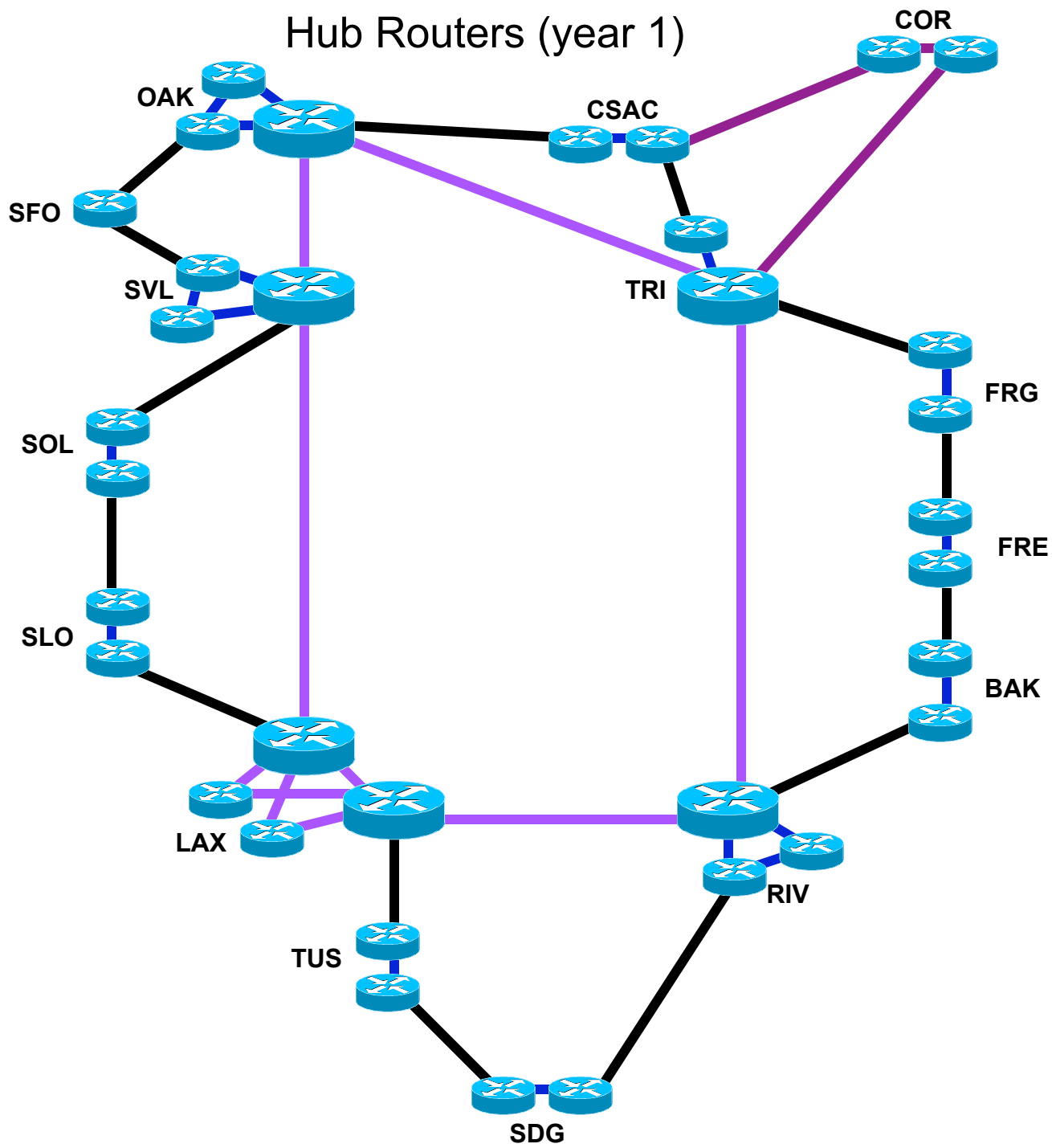
- Cisco 15454 & 15808 DWDM Optics
  - 15808 transponders are fixed encoding
    - OC-48, OC-192 or 10GE LANPHY
  - 15454 transponders are s/w configurable
    - Supports other bandwidths/formats
  - CENIC is replacing all 15808 systems with 15454
    - 2 segments completed

# CaIREN/DC

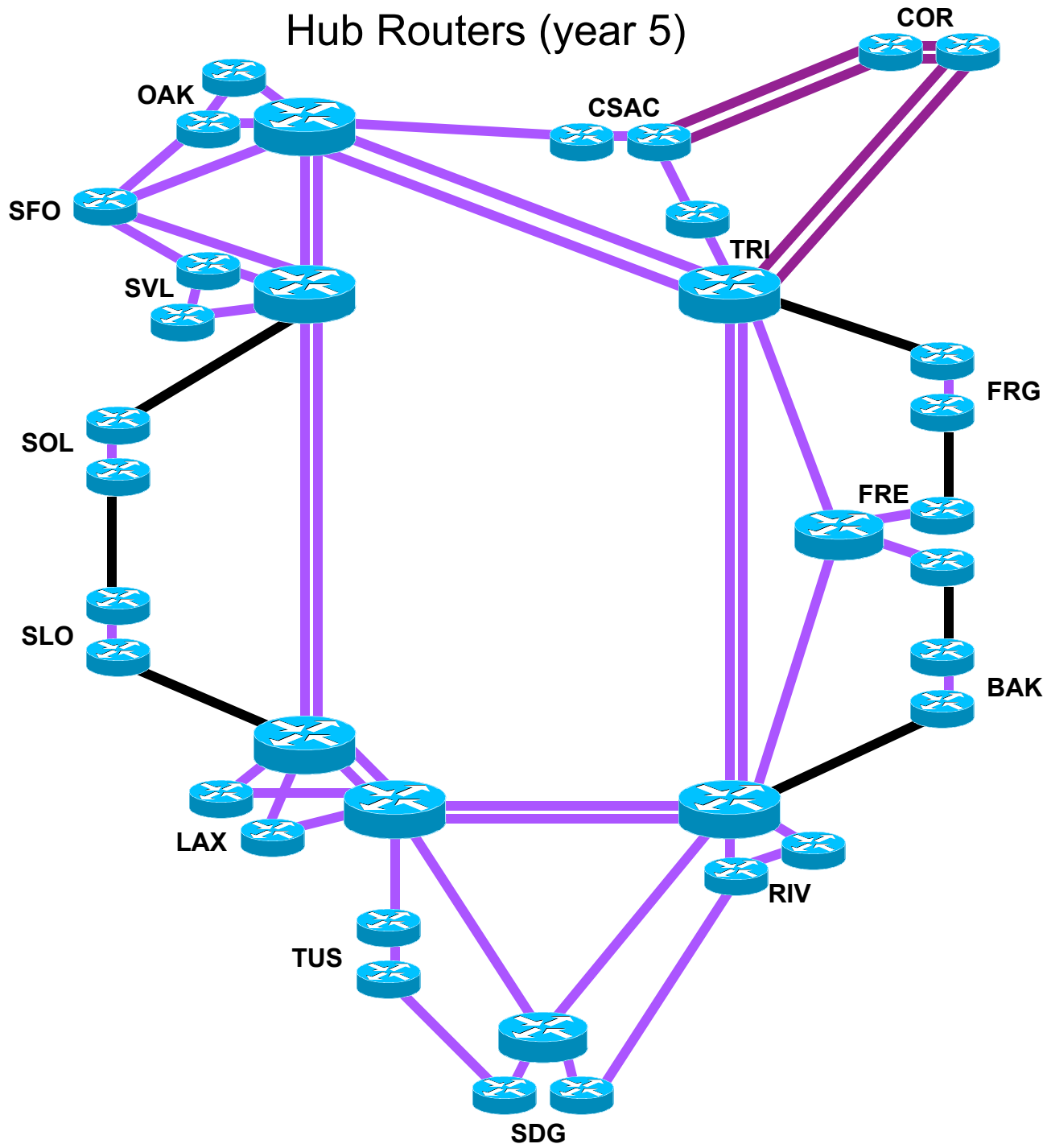
*Digital California*

- 10GE backbone
- Multi-year bandwidth upgrade plan
- IPV6, jumbo frame are required features
- Cisco CRS-1 and 124xx routers
  - Will use some DWDM optics for backbone links as cost and active component count reduction

# Hub Routers (year 1)



# Hub Routers (year 5)



# CaIREN/HPR

*High Performance Research*

- Backbone is 10GE LANPHY
- Some campuses connected at 10GE
- HPR Refresh/Upgrade Project underway
- Router RFP is in evaluation phase
- Other components TBD

# CaIREN/XD

*High Performance Research*

- Services beyond CaIREN/DC or HPR
- Users of CaIREN/XD Services:
  - CalIT2 – GE transport to UCI and LA
  - CalIT2 – 10GE transport to LA
  - UC Davis – 10GE to UC San Diego
  - Supports special events (CalIT2, Super Computer, etc.)

# CENIC/CalREN Advisory Structure

- DC-TAC (Technical Advisory Council)
  - Chaired by campus representative
  - Advises CENIC on technical and operational issues regarding CalREN/DC, peering and commodity services
- HPR-TAC (Technical Advisory Council)
  - Chaired by campus representative
  - Advises CENIC on issues regarding CalREN /HPR network and national research networks



**CalREN Infrastructure:  
the next-generation CalREN-HPR  
network**

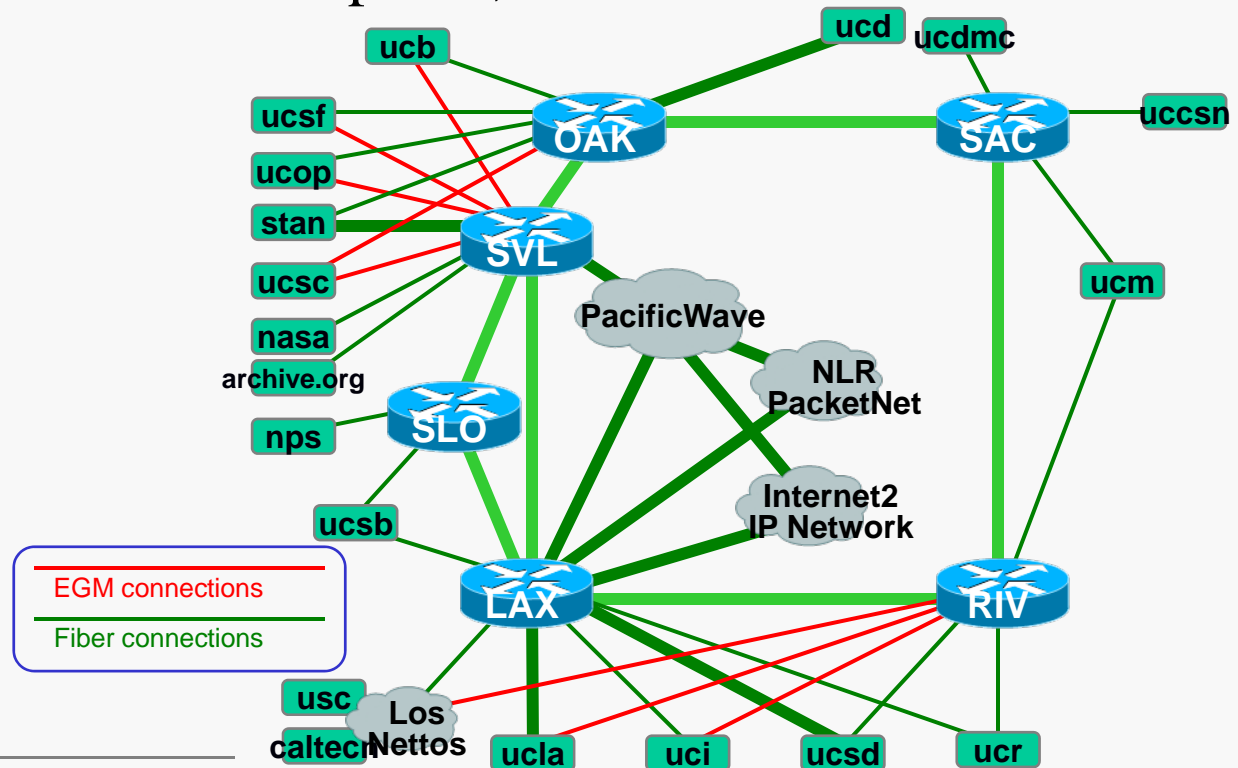
ken lindahl

Chair, CalREN-HPR Technical Advisory Council

[lindahl@berkeley.edu](mailto:lindahl@berkeley.edu)

# CalREN-HPR today

- a high performance, routed IP network
  - 10GE backbone links.
  - 10 GE links to peer networks: Internet2 IP Network, NLR PacketNet, PacificWave, ESnet.
  - mostly GE links to campuses, with a few 10GE links.



# CalREN-HPR “tomorrow” †

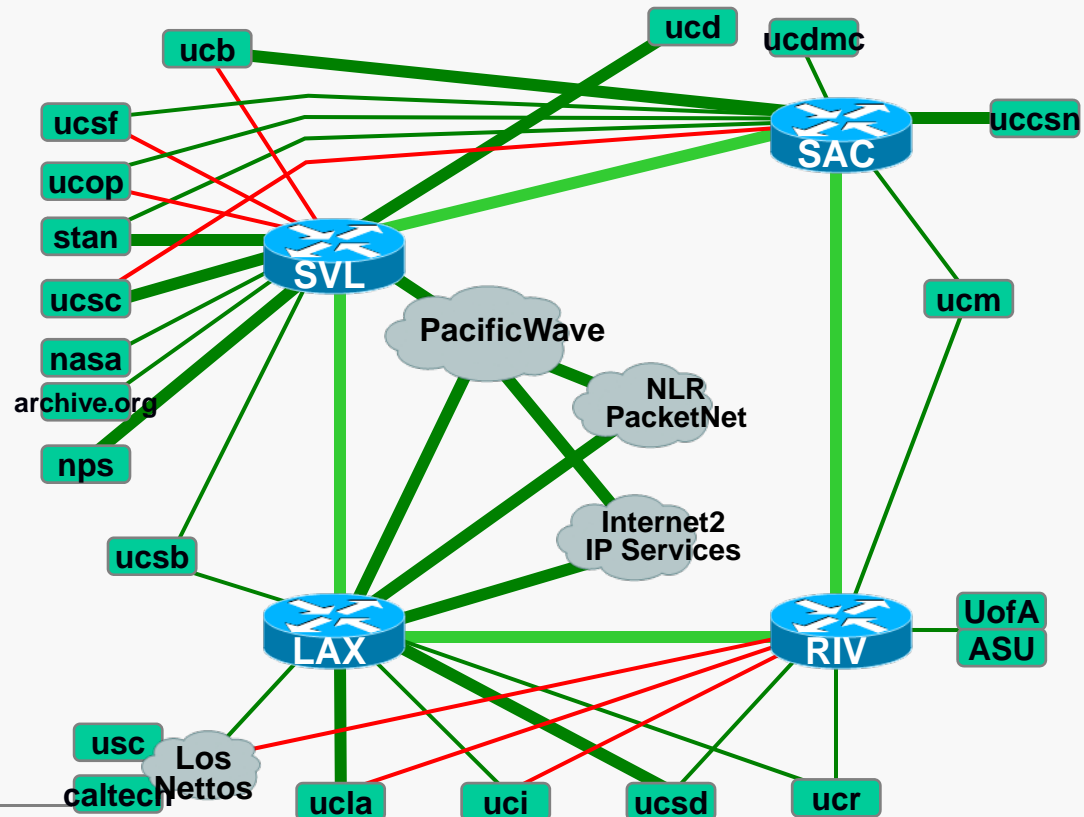
- a *hybrid* network, incorporating traditional routed IP service and frame and optical *circuit services*:
  - a higher performance, routed IP network
  - a GE/10GE switched Ethernet network
  - an  $n \times 10$ Gbps optically switched network

 *circuit services*

† “tomorrow” != Tuesday, September 16, 2008

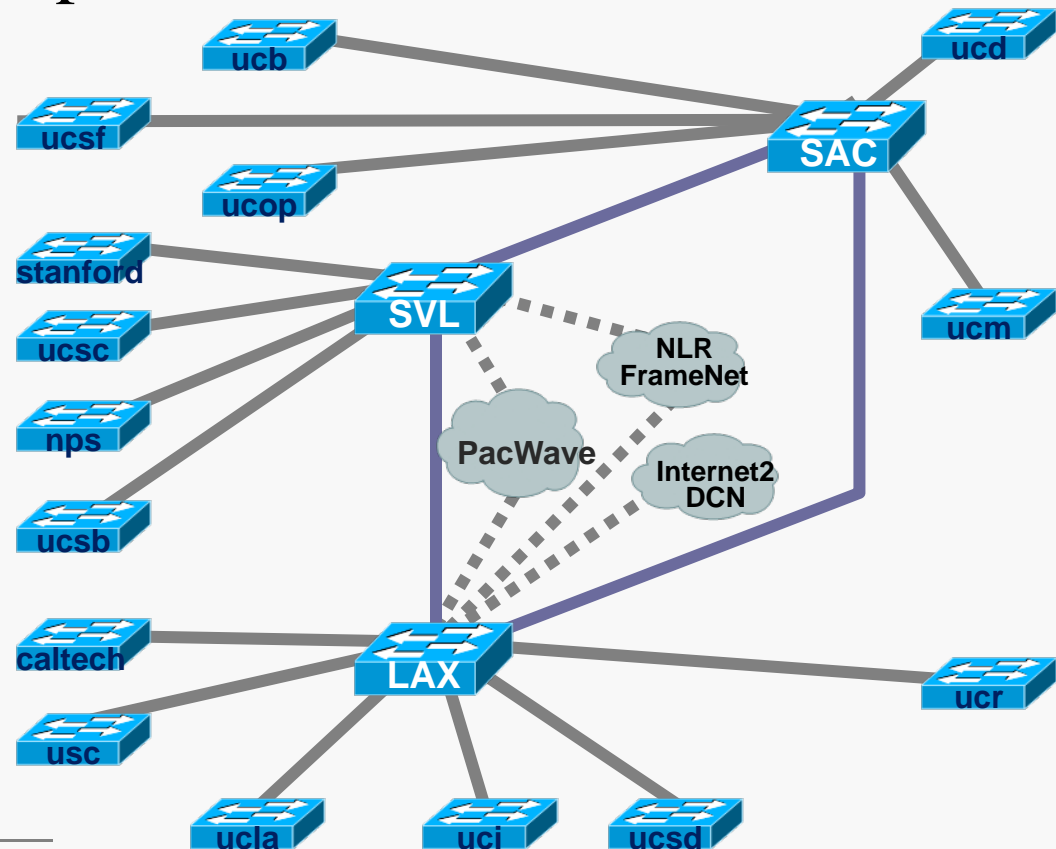
# HPRng routed IP network

- higher performance:
  - backbone links, can scale to 40Gbps (4 x 10GE), and to 100Gbps in the future.
  - every campus can have 1 or 2 10GE links.

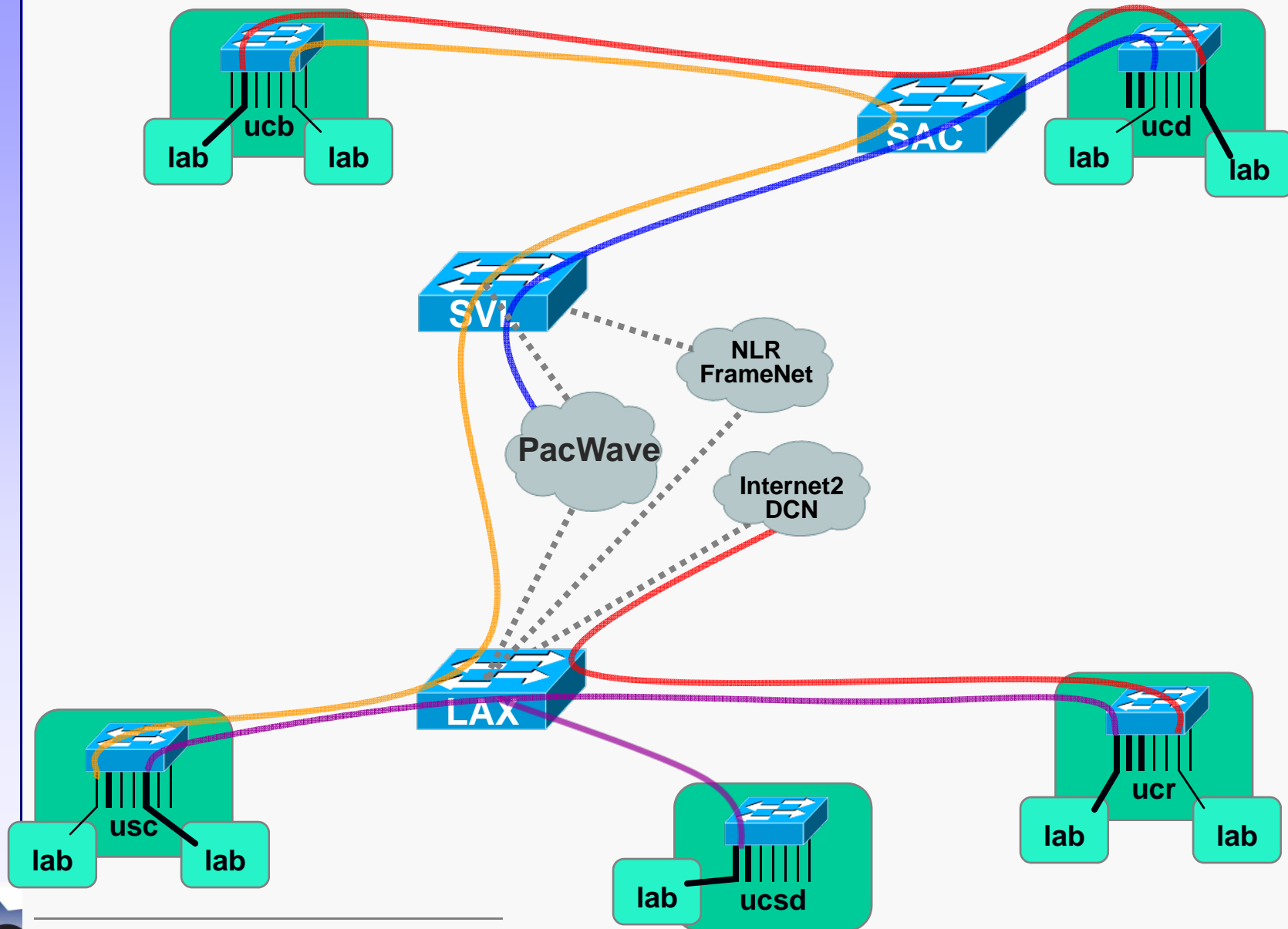


# HPRng switched Ethernet network

- 10GE links between switches in the backbone (SAC, SVL, LAX), and 10GE to switches on campuses.
- Campus switches present GE and 10GE ports for connection to equipment in research labs.
- 10GE links to PacificWave, Inetrnet2 DCN, NLR PacketNet.

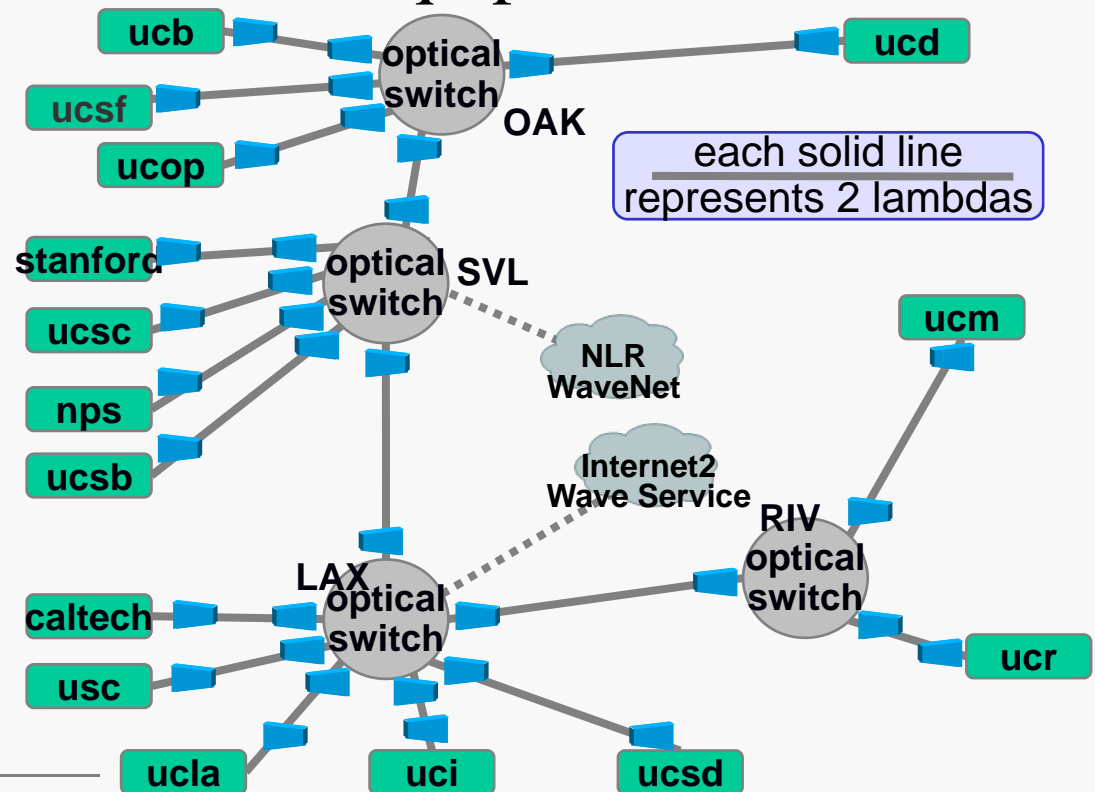


# VLANs on HPRng Ethernet

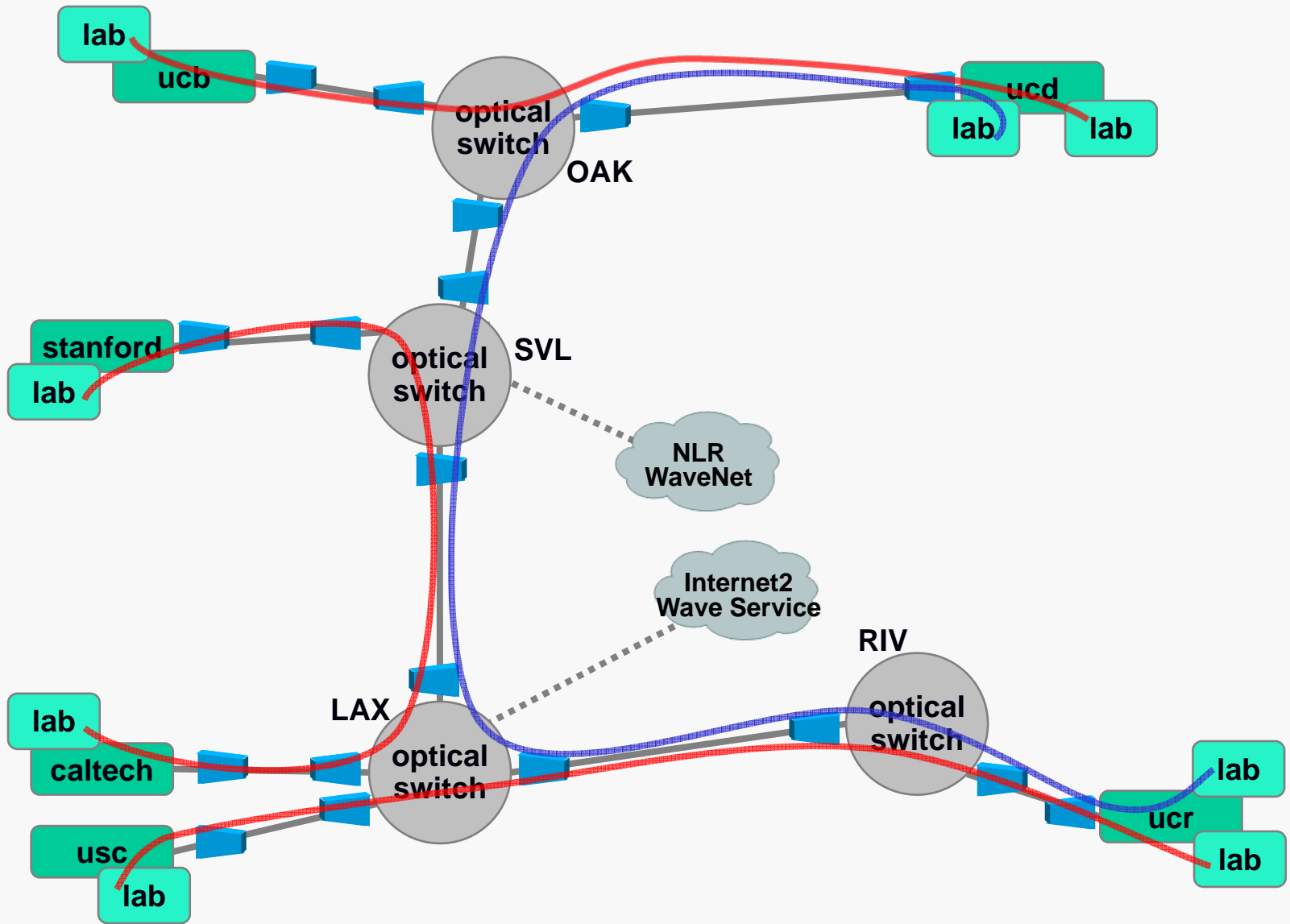


# HPRng optically switched network

- Two 10Gbps waves between optical switches in backbone (OAK, SVL, LAX, RIV), and to each campus.
- Campus DWDM gear presents two ports (10GE or OC-192) for connection to equipment in research labs.



# 10 Gbps circuits on HPRng



# How does this differ from XD?

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- XD is not really a network, but rather a collection of resources on the CalREN Optical Network, which can be used to build research networks.
  - HPRng will consist of already-built networks that can be quickly configured to meet research needs.
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- XD resources are devoted to specific research networks, for relatively long periods of time.
  - HPRng networks will be shared by researchers at all campuses; resources will be devoted for relatively short periods of time. This should lower the cost barrier.
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- CalREN-XD will continue to be a collection of resources available to researchers whose needs are not met by HPRng.

# If not tomorrow, then when?

- HPR TAC has just finished evaluating responses to the router RFP, we still need to run the Ethernet switch and optical switch RFPs.
- Schedule:
  - Routers will be installed by 2Q2009;
  - Ethernet switches by 3Q2009;
  - Optical switches by 4Q2009-1Q2010.
- However, this schedule does not include the new connections to campuses: each campus must purchase new equipment, and each campus is on its own schedule for that.

**Questions?**