



The Corporation for Education
Network Initiatives in California

CENIC 101: The Story Behind California's High- Performance Networking

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CENIC

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Presentation Outline

The Who and Why of CENIC

The CA Research & Education Network
(CalREN)

CalREN-DC

CalREN-HPR

CalREN-XD

Technical Advisory Councils

Network-Related CENIC Services

Connectivity Beyond California

Ongoing CENIC Initiatives

The 2009 CENIC Annual Conference



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The Who and Why of CENIC

Nonprofit, formed in 1997 by CA R&E community to exploit economies of scale in networking

Originally 9 UC campuses, 3 CSU campuses, Caltech, Stanford, and USC

Now, all of CA K-20 public educational institutions, 3 original privates, Naval Postgraduate, USD, USF, NASA Ames, Pepperdine, Wharton West etc.

Governed by & answerable to K-20 segments



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The CA Research & Education Network (CaREN)



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The CA Research & Education Network

CalREN

consists of:

- 2700 route miles of fiber
- 70+ routers
- 80+ switches
- 50+ optical components
- 300 high-speed circuits from telcos



Sites in all 58 counties connect via leased lines or fiber



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The CA Research & Education Network

Connectivity to Internet2,
National LambdaRail, on to
Europe

Connectivity to CUDI,
CA*net4

Connectivity to Pacific
Rim and beyond

24/7 NOC services

High-quality
videoconferencing



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The CA Research & Education Network

California K-12 system (8,000+ schools and COEs)

California's Community Colleges (110 campuses + SO)

CSU (23 campuses + CO)

UC (10 campuses + UCOP)

Caltech, USC, Stanford, MBARI

Naval Postgrad, USD, USF

Pepperdine, Wharton West



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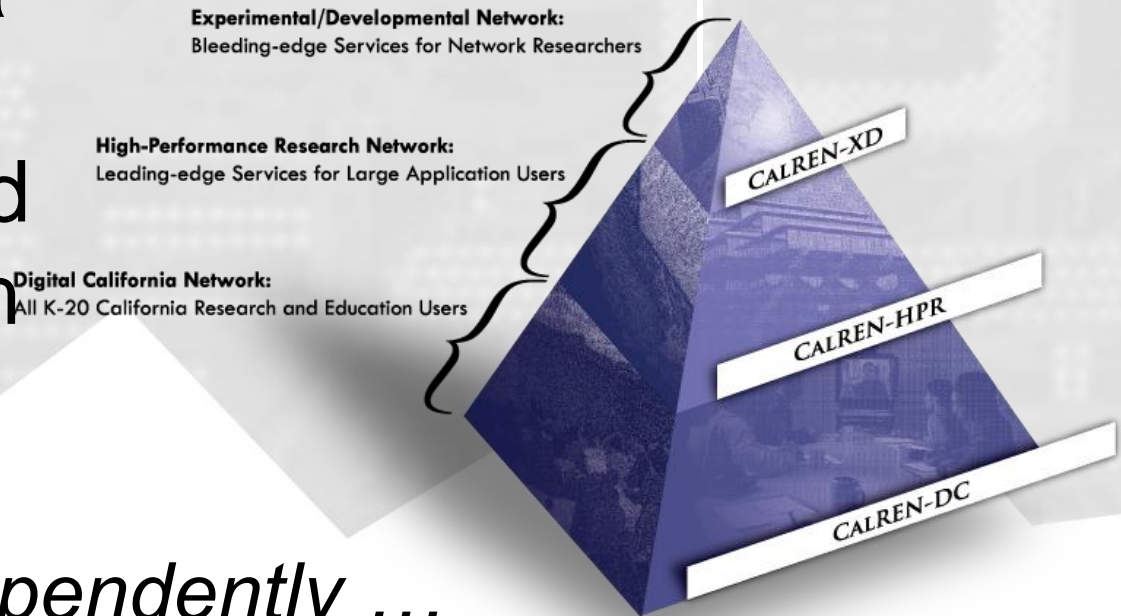
CaIREN: A 3-Tiered Network

CaIREN-DC: production/commodity services

CaIREN-HPR: high-performance research

CaIREN-XD: a collection of resources used to build custom research networks

All operate independently ...



CalREN Services: CalREN-DC Network

Backbone bandwidth: 10 GE; Recent router refresh increased this from 2.5 Gb/s

Supports: Day-to-day research and education applications, high-quality videoconferencing

Connects to: Commercial Internet

Projects: Router refresh complete



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CalREN Services: CalREN-HPR Network

Backbone bandwidth: 10 GE; Refresh is underway to allow increase to as much as 40 GE

Supports: Bandwidth-intensive research applications

Connects to: Internet2, NLR PacketNet, Pacific Wave via 10 GE links

Projects: Router and Switch refresh in various stages



CalREN Services: CalREN-XD Network

Backbone bandwidth: unlimited

Supports: Custom services for bleeding-edge research

special connectivity between campuses: ex. UCLA and UCD, UCI and UCSD

special events: ex. SC07, iGrid 05, CalREN-XD Workshop

Connects to: NLR WaveNet and FrameNet



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CaREN Advisory Councils (TACs)

CaREN-DC Technical Advisory Council:

Advises CENIC on technical and operational issues regarding the DC tier, peering and commodity services

CaREN-HPR Technical Advisory

Council: Advises CENIC on technical and operational issues regarding the HPR tier and national RENs

Both chaired by member campus representatives



Network-Related CENIC Services

24/7/365 Network Operations Center:

96% -- NOC response times exceeded or met their expectations

98% -- received communications providing status of their problem in a timely manner

96% -- time to resolution exceeded or met their expectations

96% -- satisfied with service (83% reporting "very satisfied")

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Network-Related CENIC Services

CaREN Video Services (CVS):

High-quality videoconferencing to 150+ K-20 sites

Multiple MCUs, gatekeepers, online scheduler, 24/7 support via NOC

27,200 hours of videoconferencing in 2007-08 FY

Strong growth of intersegmental use

Development of software/equipment refresh, streaming, archiving, and HD for the future

cvs.cenic.org



CalREN: Connectivity Beyond California

CalREN connects Californians with each other, and with the US and the Western Hemisphere.

CENIC also empowers RENs to connect with others nation- and worldwide through peering.

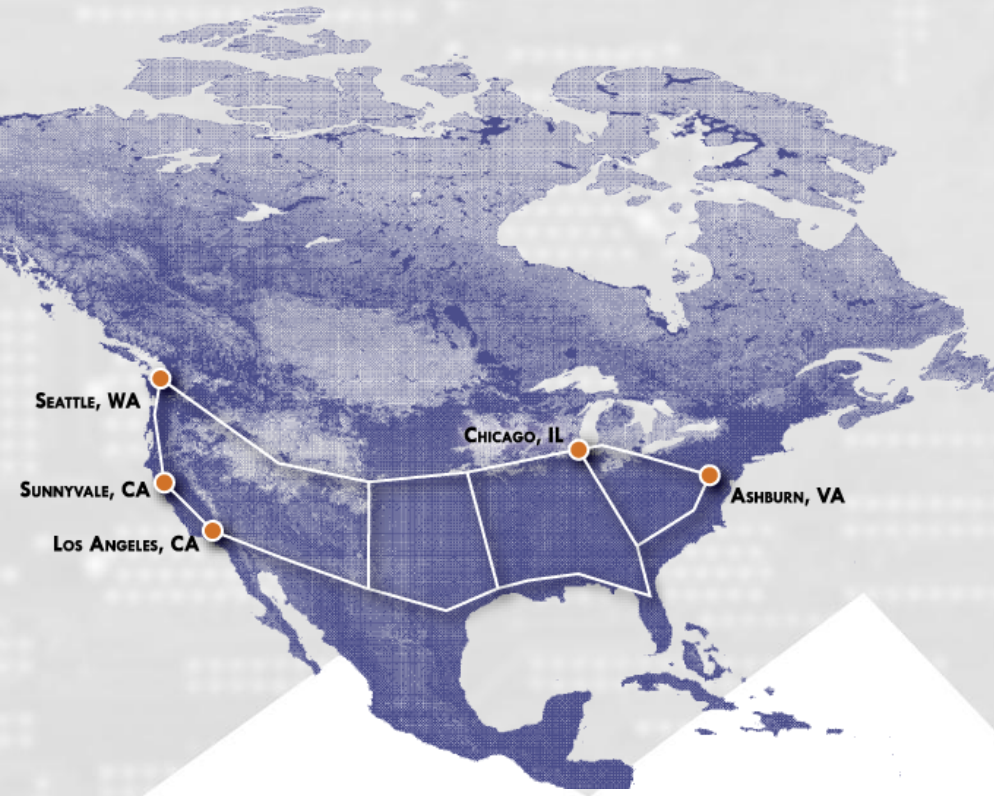


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CENIC & Nat'l Network Peering



TransitRail: distributed national peering facility for US RENs and other institutions

Joint project between CENIC and Pacific NW Gigapop
Five peering facilities (LA and Palo Alto, Seattle, Chicago, Ashburn, VA)

Thirteen participants nationwide (universities, state RENs, research institutions)

<http://www.transitrail.net/>



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CENIC & Int'l Network Peering

Pacific Wave: distributed *international* peering facility for US/Pacific Rim R&E networks (RENs)

Joint project between CENIC and Pacific NW Gigapop w/ support from USC and U Wash.

Four PW peering facilities (Sunnyvale, Palo Alto, LA, Seattle)

12 countries – in and beyond Pacific Rim

<http://www.pacificwave.net/>



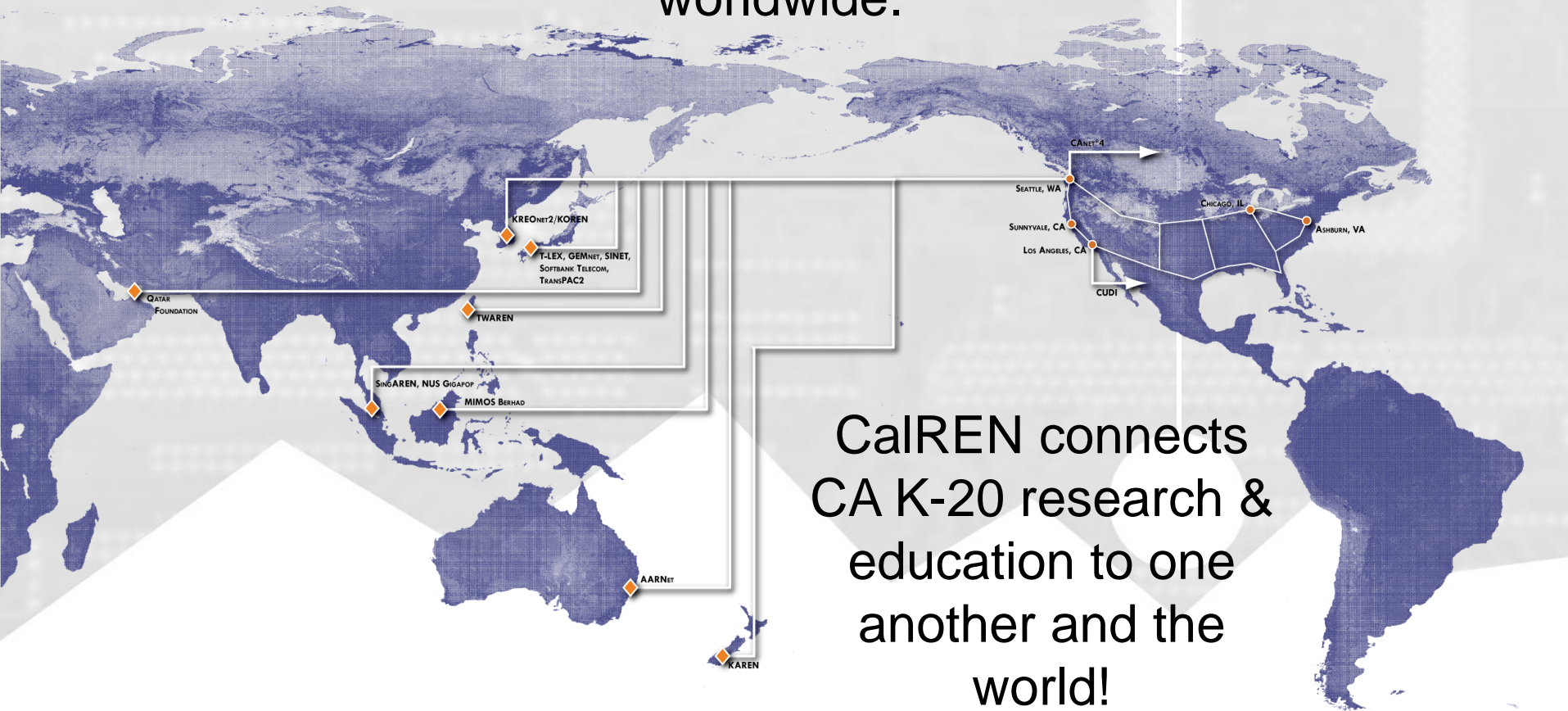
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CalREN Connects CA to the World!

Through Pacific Wave and TransitRail, CalREN provides a high-performance path for users to interact with colleagues worldwide.



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Ongoing CENIC Initiatives

Last-Mile:

Identifying, analyzing, and overcoming the challenges to providing diverse, reliable connectivity to every CENIC member site in CA

Commodity Peering:

Focus on ways to expand and leverage peering (much more cost-effective and has significantly lowered the cost of access to the commodity Internet for CENIC member institutions)

Green IT:

Making CENIC more climate-aware, testing "cloud computing" access and investigation of the trade-offs between more power-efficiency versus more capabilities, climate-sensitive storage

Disaster Recovery:

Disaster recovery plan for CENIC NOC, also studying the ways in which CENIC members depend on CalREN for their own disaster recovery



The 2009 CENIC Annual Conference: RIDING THE WAVES OF INNOVATION

Date: March 9-11, 2009

Place: Hilton Hotel, Long Beach, CA

Theme: Riding the Waves of Innovation

On-line hotel reservations at:

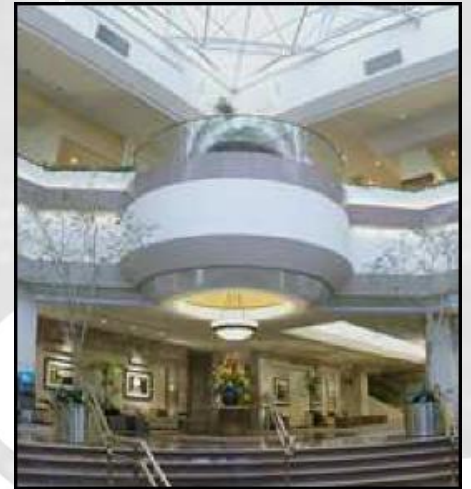
<http://cenic09.cenic.org/hotel>

On-line conference registration at:

<http://cenic09.cenic.org/registration>

Currently accepting nominations for
Innovations in Networking Awards for 2009 at:

<http://cenic09.cenic.org/cfa.html>



cenic09.cenic.org



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RIDING THE WAVES OF INNOVATION: Previous Award Winners

Pac-10 Internet Video Exchange: Pac-10 sports scouting videos exchanged online (using tuned FTP developed for HEP)

CineGrid @ Holland Festival: 75 minute live performance streamed from Amsterdam to Calit2

UltraLight: Using advanced networks to move vast amounts of data (SC07) in preparation for the LHC

iAnatomy: Stanford library of high-res medical images shared live in Ontario, Canada



Pac-10 Internet Video Exchange

College teams exchange videos of games

- Analyze opponents' prior games

- NCAA disallows in-person scouting

Physical media exchange
expensive, inconvenient

2005 season, UCLA begins pilot program

- UCLA, USC, Stanford, U Wash., Notre Dame

- Exchanging video via broadband

- Fast, reliable transfer using specially tuned FTP, broadband

2006 season, Pac-10 full electronic exchange



CineGrid @ Holland Festival 2007

From Amsterdam to San Diego

4k video, 5.1 surround sound

75 minutes of flawless live streaming

Unsurpassed sense
of live presence

Data archived at
CineGrid Exchange



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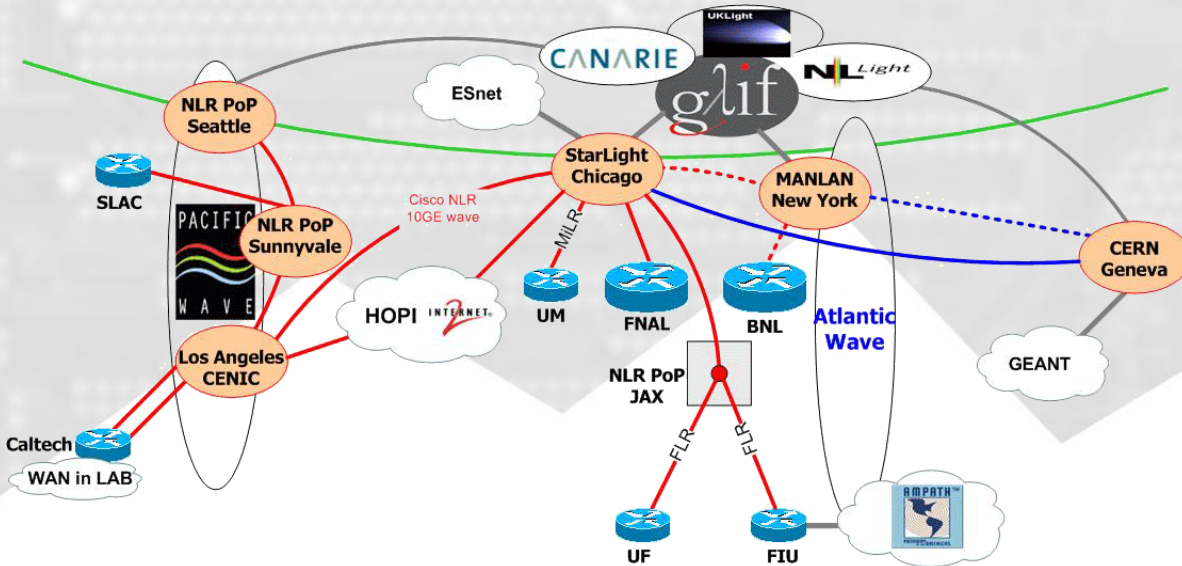
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UltraLight Project

Seeks to create the advances necessary to enable petabyte-scale analysis of distributed data sets (HEP-driven thanks to LHC)

Builds on MonALISA (2006 award winner!)



SC07 Bandwidth Challenge: multiple 10GE fiber paths enabled 80 Gb/s of bidirectional transfer



iAnatomy: Stanford and Canada

Bassett Collection of high-quality medical images at Stanford

Useful for other institutions, requires extremely high-performance networking

Live image interaction and instructional use at NOSM (Northern Ontario School of Medicine)

Connect through CalREN to Pacific Wave/Seattle, through CANARIE to ORION

Requires extremely large bandwidth and international fiber network connectivity



CENIC provides...

Basic commodity and R&E connectivity

Video conferencing services

Fiber design/procurement/consulting

Advanced/high-speed network services

Ad-hoc networking

??? (What do **you** need?)



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Thank you for listening!

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