



# **Federally Funded (and Other) Internetworking Testbeds**

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# Federal Networking and Information Technology Research and Development (NITRD) Program

- Coordinates and focuses interagency IT R&D:
  - Identify common research needs
  - Plan inter-agency research programs
  - Coordinate and collaborate on research announcements and funding
  - Review research results and adjust accordingly
- Evolved from the Federal High Performance Computing and Communications Initiative (HPCC), Computing Information and Communications Program (CIC), and Next Generation Internet Program (NGI)
- Includes 14 federal agencies, about \$2B budget
- [www.nitrd.gov](http://www.nitrd.gov)



# Participating Agencies and Departments

- Department of Defense
  - Defense Advanced Research Projects Agency (DARPA)
  - Defense Information Systems Agency (DISA)
  - National Security Agency (NSA)
  - Office of the Director of Defense Research and Engineering (ODDR&E)
- Department of Energy
  - Office of Science (DOE/SC)
  - National Nuclear Security Administration (DOE/NNSA)
- Department of Health and Human Services
  - National Institutes of Health (NIH)
  - Agency for Health Research and Quality (AHRQ)
- Department of Commerce
  - National Institute of Standards and Technology (NIST)
  - National Oceanic and Atmospheric Administration (NOAA)
- National Science Foundation (NSF)
- National Aeronautics and Space Administration (NASA)
- Environmental Protection Agency (EPA)
- Observer: Federal Aviation Administration (FAA)



## Several organizations have set up network research testbeds

- **NSF: Experimental Infrastructure Network (EIN)**
- **DOE/SC: Science UltraNet**
- **Internet2: Abilene upgrade**
- **National LambdaRail**
- **Corporation for Education Network Initiative in California (CENIC): CalREN-XD**
- **High Performance Wireless Research and Education Network (HPWREN)**
- **Others ...**



## **Major Focus of Network Testbeds is on High Bandwidth Performance**

- **Issues include**
  - Improving effective bandwidth
  - Improving reliability and predictability
  - Improving end-to-end performance
- **Researching new technologies, topologies, protocols**
- **Some research networks are intended to be “broken” by research activities**
- **Security issues are not major concerns of most testbeds**
- **Some testbeds could be used for research to improve security**

- **Access, analyze, respond to network traffic data**
  - Real data
  - Sanitized data
  - Synthetic data
- **Try new technologies in breakable environment**
- **Test interoperability of subsystems**
- **Provide nationwide infrastructure for organizations to work together on “dangerous” projects**
- **Allow tests of security features in broader network research context**
  - “Do things securely” rather than “Do security”



## **Examples of Network Testbeds**

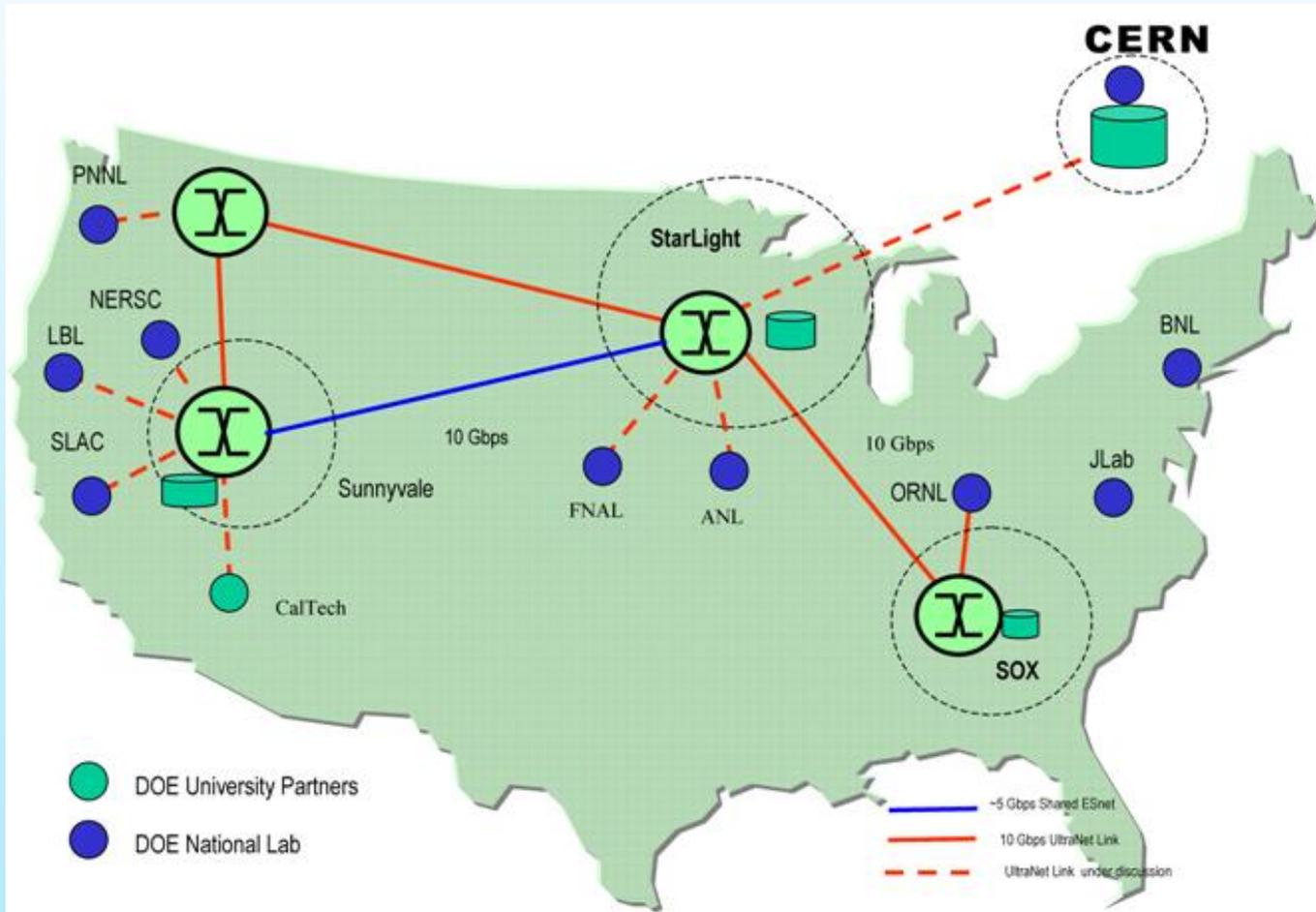
- **Most of the following material is quoted from testbed descriptions**

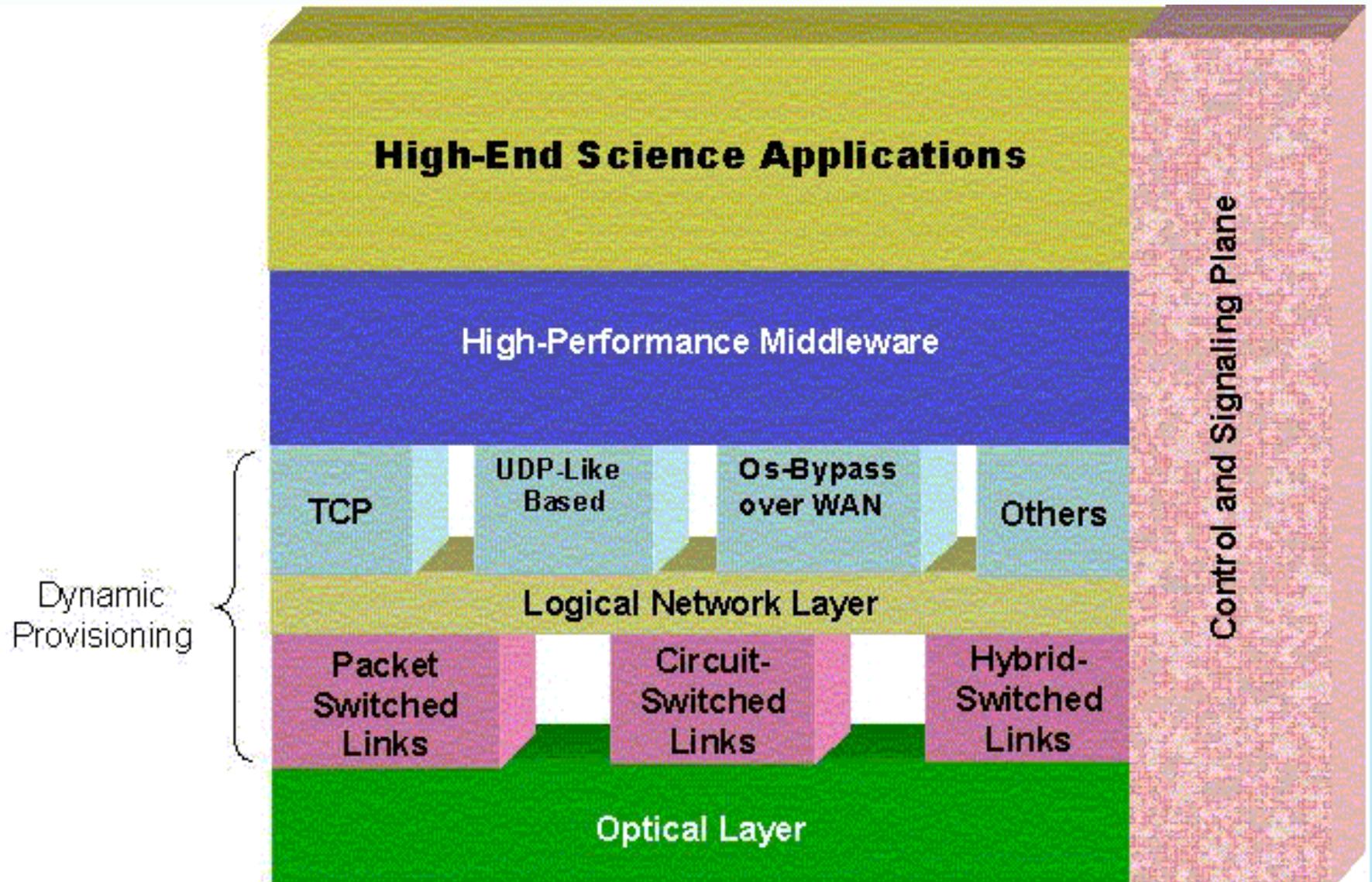


# **NSF: Experimental Infrastructure Network (EIN) Awards**

- **End to End Provisioned Optical Network Testbed for Large –Scale eScience Applications**
  - (ORNL, NCSU, UVa, CUNY plus others)
- **Dynamic Resource Allocation via GMPLS (Generalized MultiProtocol Label Switching) Optical Networks (DRAGON)**
  - (GMU, UMd, USC)

- Currently taking proposals
- Major focus on research for reliable, high-bandwidth networks





## Abilene Upgrade – Current



# Abilene Focus Areas: 2003-2004

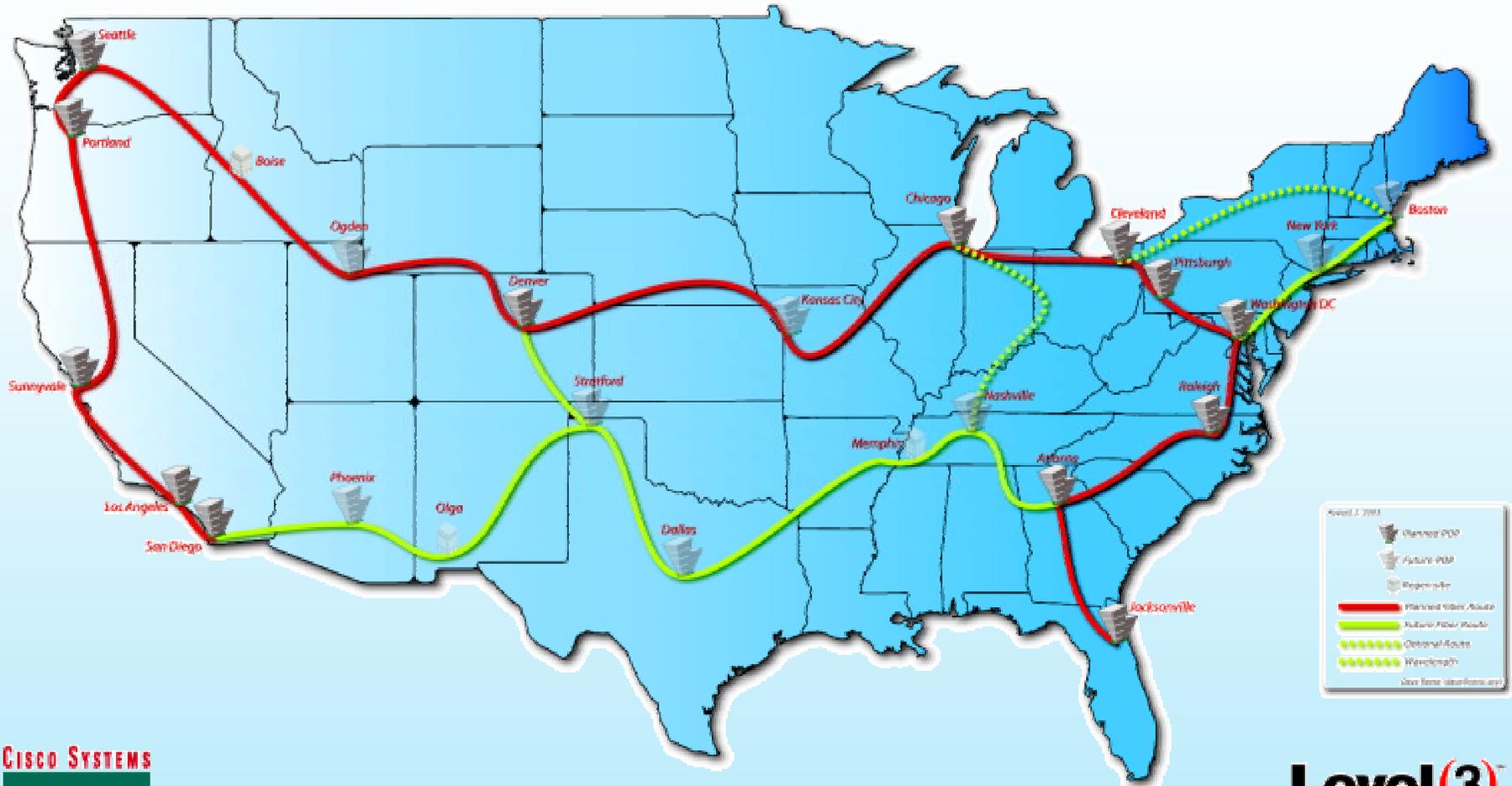
- High performance, native advanced services
  - Multicast
  - IPv6
  - Large Flows End-to-End
- Abilene Observatory
  - Supporting Network Research Community
  - Open Measurement & Experimentation Platform
- Dedicated Capability Experimentation
  - QoS-Enabled MPLS tunnels, for example
- Network Security
  - Role of the REN-ISAC
- Advanced Restoration Techniques



## Available fiber topology



## NLR National Fiber Network



*Initial Coordinating Participants*

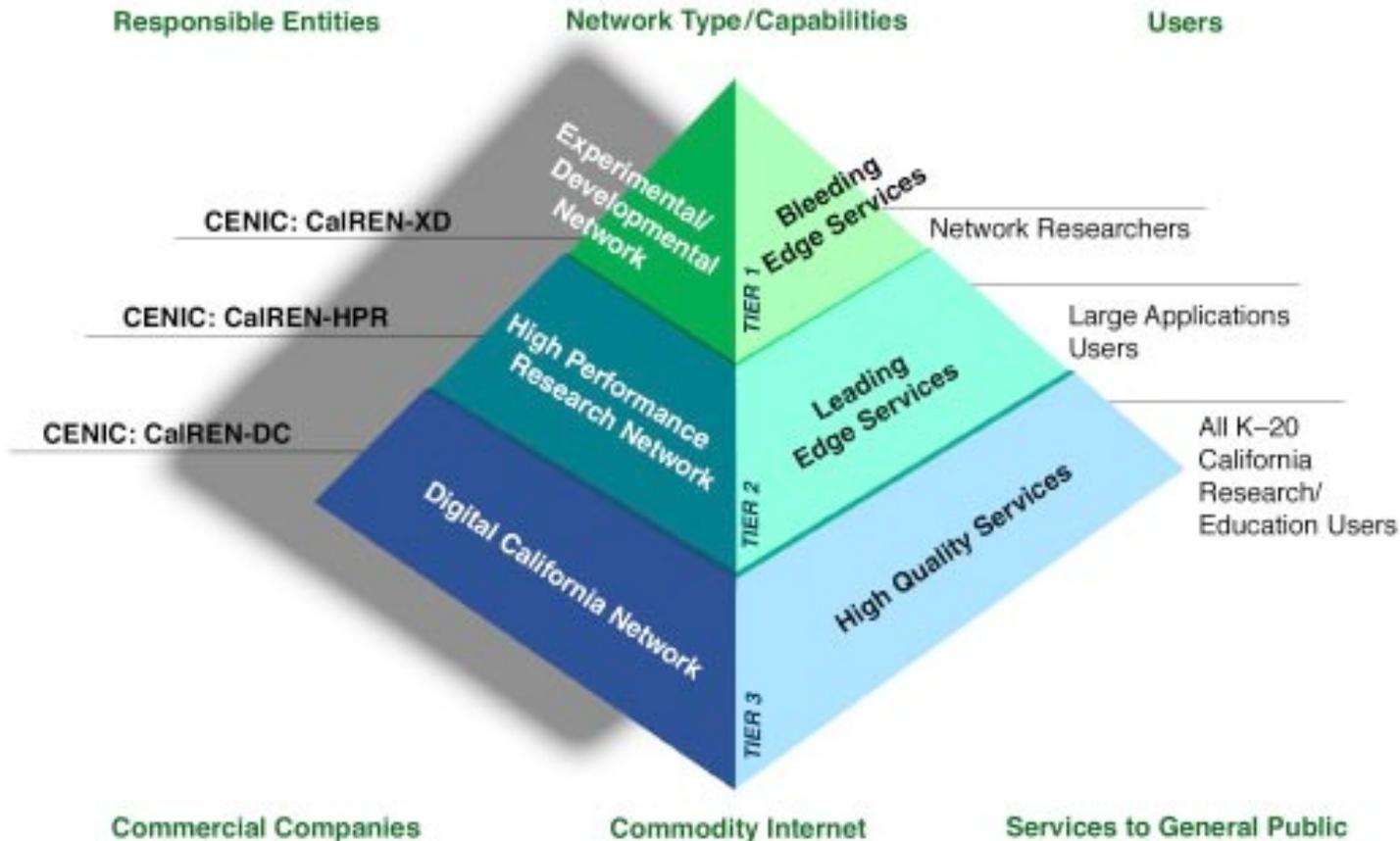


## **NLR Distinguishing Features**

- **Largest higher-ed owned/managed optical networking & research facility in the world**
  - ~10,000 route-miles of dark fiber
  - Four 10-Gbps  $\lambda$ 's provisioned at outset
- **First & foremost, an experimental platform for research**
  - Optical, switching & network layers
  - Research committee (with 2 board seats)
  - Advance reservation of  $\lambda$  capacity for research
  - Experimental support center

# Corporation for Education Network Initiative in California (CENIC)

## NETWORK DEVELOPMENT AND EVOLUTION FOR CALIFORNIA RESEARCH AND EDUCATION COMMUNITY

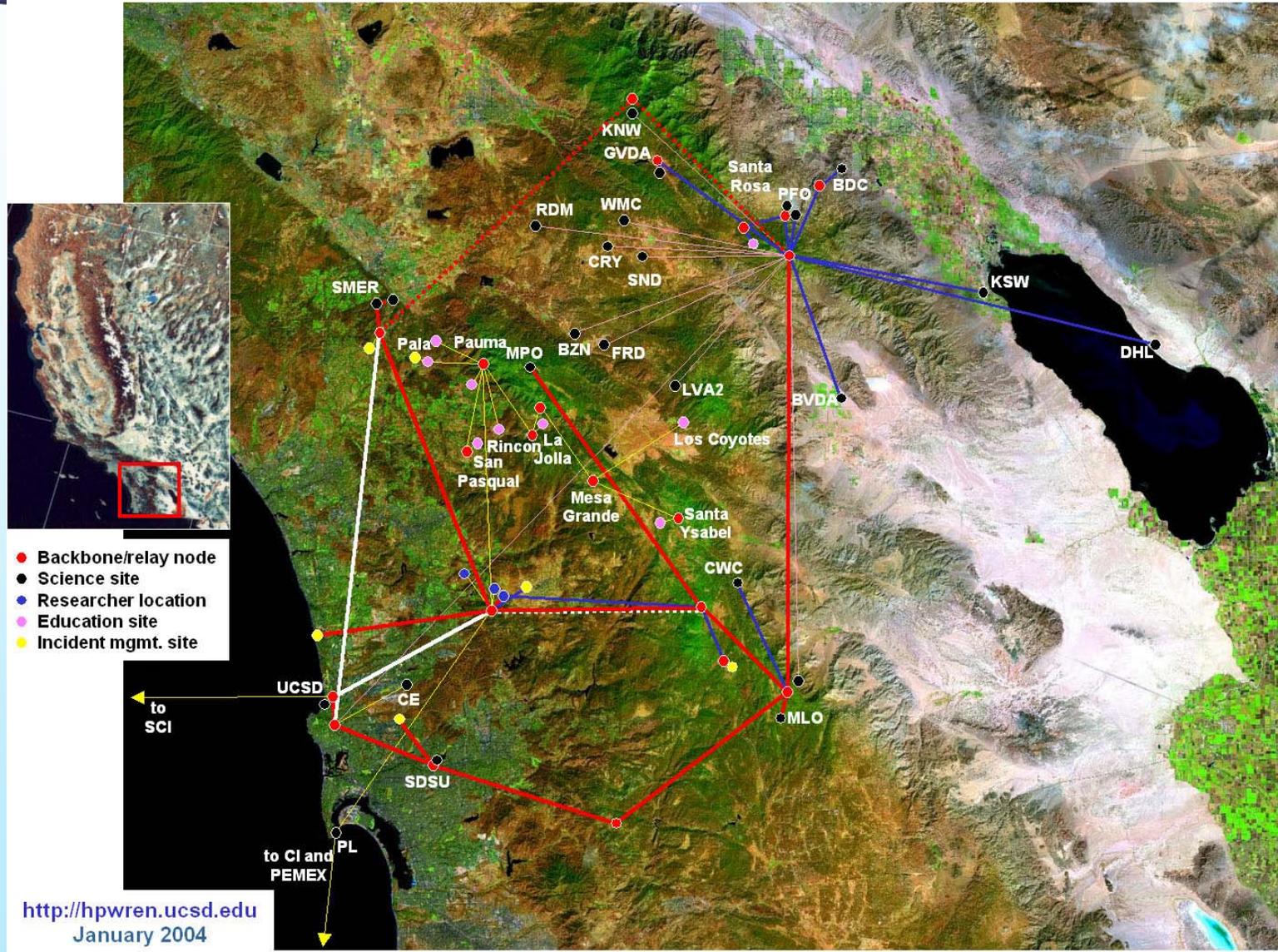




## **Corporation for Education Network Initiative in California (CENIC)**

- **“One Gigabit or Bust” Initiative to deliver one Gb broadband to all Californians by 2010**

# High Performance Wireless Research and Education Network (HPWREN)





## Summary

- **Several network research testbeds are appearing**
- **Research agendas not fully determined**
- **Opportunities to use some of these for security research**
- **Bring money**



## **For Further Information**

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**Or visit us on the Web:**

[www.itrd.gov](http://www.itrd.gov)