

# Shaping Collaboration 2006

Geneva, Switzerland  
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# Introduction

- CERN has been an affiliate member of Internet2 since 1997
  - Only member outside the United States
  - Recognizes CERN's role as a pioneer in the use of and development of large scale information and communications technology

# Internet2 Mission and Goals

## *Internet2 Mission*

- Develop and deploy advanced network applications and technologies, accelerating the creation of tomorrow's Internet.

## *Internet2 Goals*

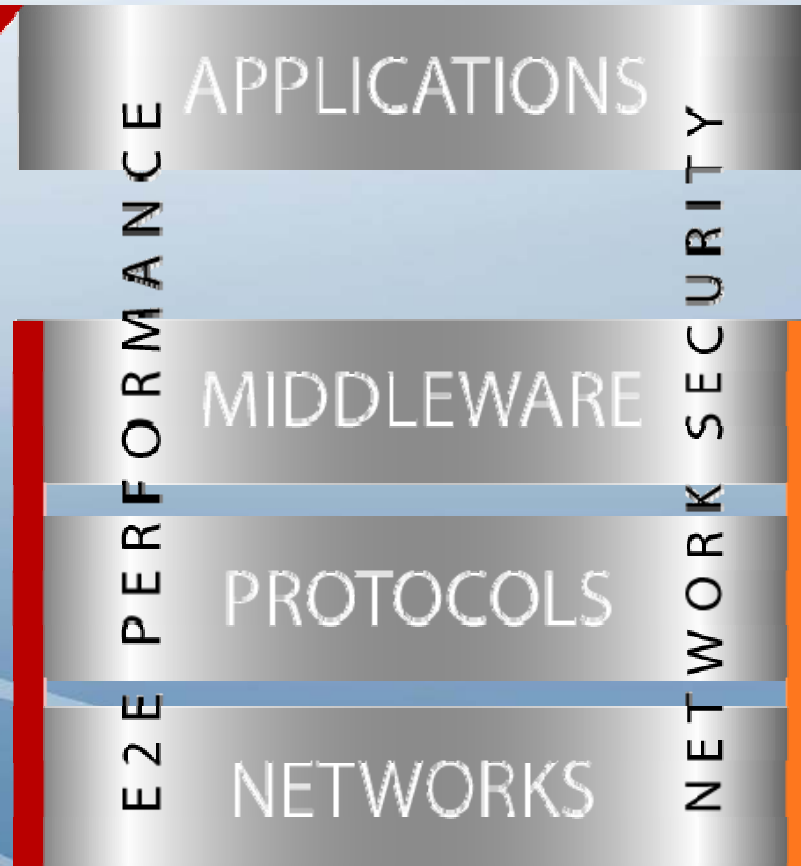
- Enable new generation of applications
- Re-create leading edge R&E network capability
- Transfer technology and experience to the global production Internet

## Internet2

- Not-for-profit membership organization
- 322 members
- 84 employees
  - 36 at member institutions
- Offices in Ann Arbor, Michigan & Washington, D. C.
- ~ \$30 M annual budget
  - 90% from member dues and fees
  - 8% US government

# Internet2 -- More than a network

**Motivate**



**Enable**

# Internet2 Partnerships

Internet2 fosters the partnerships and collaboration that spurred the development of the Internet.

- Academia
- Industry
- Government
- International

# Internet2 Universities

208 University Members December 2006



# Internet2 Affiliate Members

- Altarum
- American Distance Education Consortium
- Association of Universities for Research in Astronomy (AURA)
- CERN
- Charles R. Drew University
- Children's Hospital of Philadelphia
- Cleveland Institute of Music
- Cleveland Museum of Art
- CENIC
- Desert Research Institute
- EDUCAUSE
- ESnet
- Healthcare Information and Management Systems Society (HIMSS)
- Howard Hughes Medical Institute
- Indiana Higher Education Telecommunications System (IHETS)
- Inter-American Development Bank
- Internet Educational Equal Access Foundation
- Jet Propulsion Laboratory
- LEARN
- The Library of Congress
- Los Alamos National Laboratory
- Manhattan School of Music
- MCNC
- Merit Network, Inc.
- MOREnet
- NASA Goddard Space Flight Center
- NASA Marshall Space Flight Center
- National Archives and Records Administration
- National Institutes of Health
- NOAA – Washington, D.C.
- National Science Foundation
- New World Symphony
- NJEDge.Net
- NYSERNet, Inc.
- Oak Ridge National Laboratory
- OARnet
- OneNet
- Pacific Northwest National Laboratory
- PeachNet
- Ruth Lily Health Education Center
- SURA
- Southwest Research Institute
- TOPIX
- U.S. Census Bureau
- United Nations System of Organizations
- United States Antarctic Program
- United States Dept. of Commerce Boulder Labs
- United States Holocaust Memorial Museum
- University Corporation for Atmospheric Research
- University of North Carolina General Administration
- The World Bank



# Advanced Networking Organizations around the World



# Internet2 International Partners

## Europe-Middle East

ARNES (Slovenia)  
BELNET (Belgium)  
CARNET (Croatia)  
CESnet (Czech Republic)  
DANTE (Europe)  
DFN-Verein (Germany)  
FCCN (Portugal)  
GARR (Italy)  
GIP-RENATER (France)  
GRNET (Greece)  
HEAnet (Ireland)  
HUNGARNET (Hungary)  
Israel-IUCC (Israel)  
NORDUnet (Nordic Countries)  
POL-34 (Poland)  
Qatar Foundation (Qatar)  
RedIRIS (Spain)  
RESTENA (Luxemburg)  
RIPN (Russia)  
SANET (Slovakia)  
Stichting SURF (Netherlands)  
SWITCH (Switzerland)  
JISC, UKERNA (United Kingdom)

## Asia-Pacific

AAIREP (Australia)  
APAN (Asia-Pacific)  
ANF (Korea)  
CERNET, CSTNET, NSFCNET  
(China)  
ERNET, C-DAC (India)  
JAIRC (Japan)  
JUCC (Hong Kong)  
SingAREN (Singapore)  
MYREN/MDeC (Malaysia)  
NECTEC / UNINET(Thailand)  
TANet2 (Taiwan)  
NGI-NZ (New Zealand)  
TERENA (Europe)

## Africa

MCIT [EUN/ENSTINET] (Egypt)  
TENET (South Africa)

## Americas

CANARIE (Canada)  
CLARA (Latin America &  
Caribbean)  
CEDIA (Ecuador)  
CNTI (Venezuela)  
CR2Net (Costa Rica)  
CUDI (Mexico)  
REUNA (Chile)  
RETINA (Argentina)  
RNP [FAPESP] (Brazil)  
SENACYT (Panama)

# Internet2 Corporate Partners

**Microsoft**<sup>®</sup>

**ciena.**

**IBM**

  
**CISCO**

**Qwest.**   
*Spirit of Service*<sup>®</sup>

 **Juniper**<sup>™</sup>  
NETWORKS

 **infinera**

**FORCE10**<sup>™</sup>

**Level (3)**<sup>®</sup>  
COMMUNICATIONS

**NORTEL**

**merit**   
NETWORKS

 **Sun**<sup>®</sup>  
microsystems

**INTERNET**<sup>®</sup>  


## Internet2 Corporate Sponsors

- Arbor Networks
- Campus Televideo
- Codian, Inc.
- Ford Motor Company
- Foundry Networks
- Glimmerglass
- HP
- inSORS Integrated Communications
- Polycom Worldwide
- RADVISION
- Raptor Networks Technology, Inc
- TANDBERG
- VBrick Systems

# Internet2 Corporate Members

- ADVA Optical Networking
- Apparent Networks
- C-SPAN
- Caterpillar, Inc.
- Comcast Cable
- CommuniGate Systems
- EBSCO Information Services
- Education Networks of America, Inc.
- Eli Lilly and Company
- Fujitsu Laboratories of America
- GigaBeam Corporation
- Google
- HaiVision Systems, Inc.
- Hong Kong Cyberport Management Co. Ltd
- KDDI Corporation
- LifeSize Communications
- Lucent Technologies
- Marratech AB
- Motion Picture Association of America
- Napster, LLC
- Nippon Telephone and Telegraph (NTT)
- Northrop Grumman Information Technology
- OCLC Online Computer Library Center
- PAETEC Communications, Inc.
- Prous Science, S.A.
- RIAA
- Red Hat, Inc.
- Ruckus Network, Inc.
- Schlumberger
- Star Valley Solutions, Inc.
- Steelcase, Inc.
- The Thomson Corporation
- V3 Enterprises, Inc.
- VoEx, Inc
- VSNL International.
- Warner Bros.

# The Digital Technology Base

- Computing
  - Cost/effective, ubiquitous, distributed
- Networks
  - Cost/effective, pervasive, reliable
- Information
  - Born digital and converted from analog
- Human/computer interfaces
  - Multi-mode, immersive, portable
- Sensor technology
  - Autonomous, distributed, adaptive

# The Collaboration Imperative

- Today's information and computing technology base has the capability to enhance collaborative science
- Instruments increasingly expensive and/or distributed
- Multi-disciplinary, multi-capability teams
- Faculty geographically distributed for instructional mission
- Enhanced performance

**Requirements**

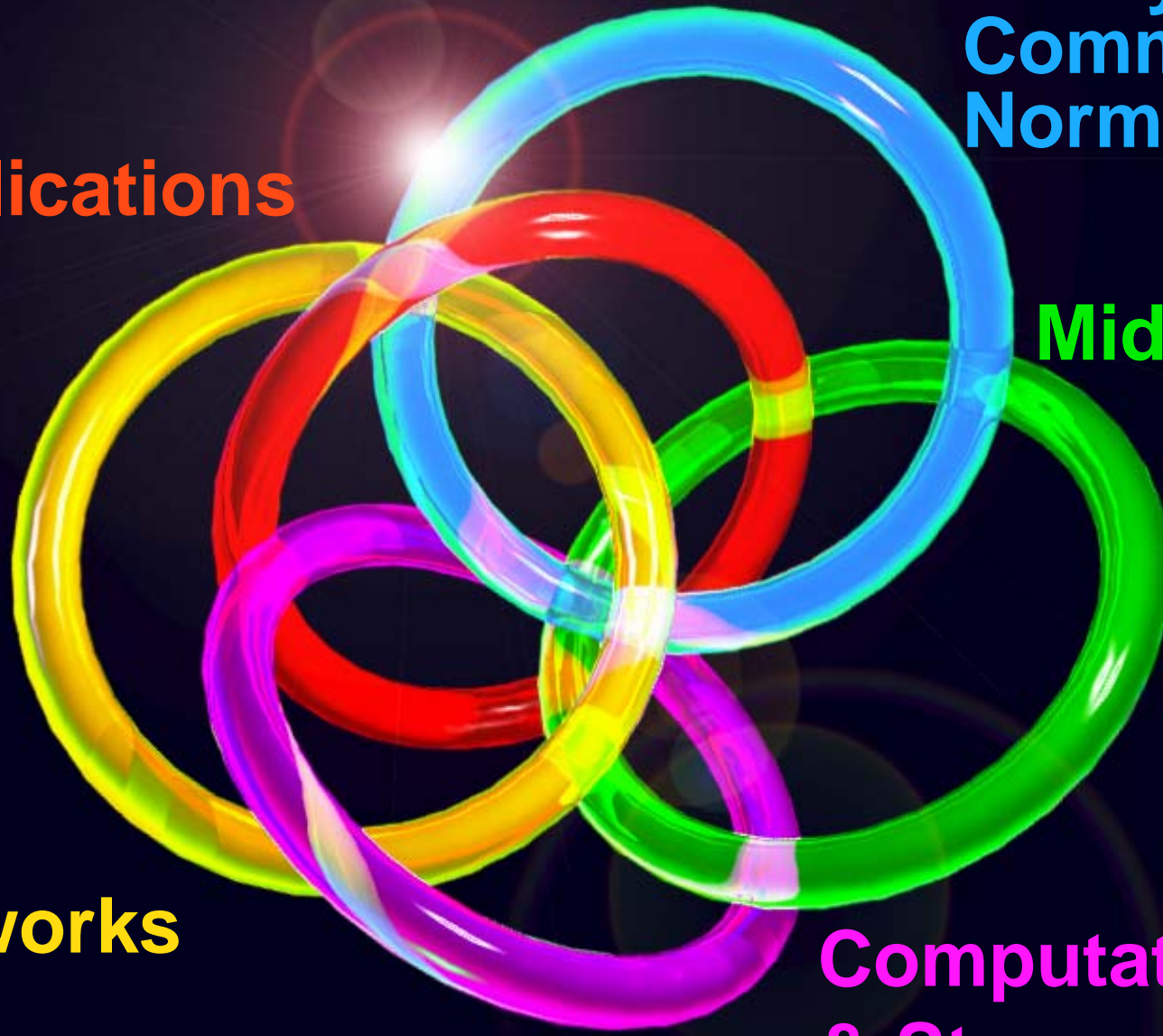
**Institutional  
Policy &  
Community  
Norms**

**Applications**

**Middleware**

**Networks**

**Computation  
& Storage**





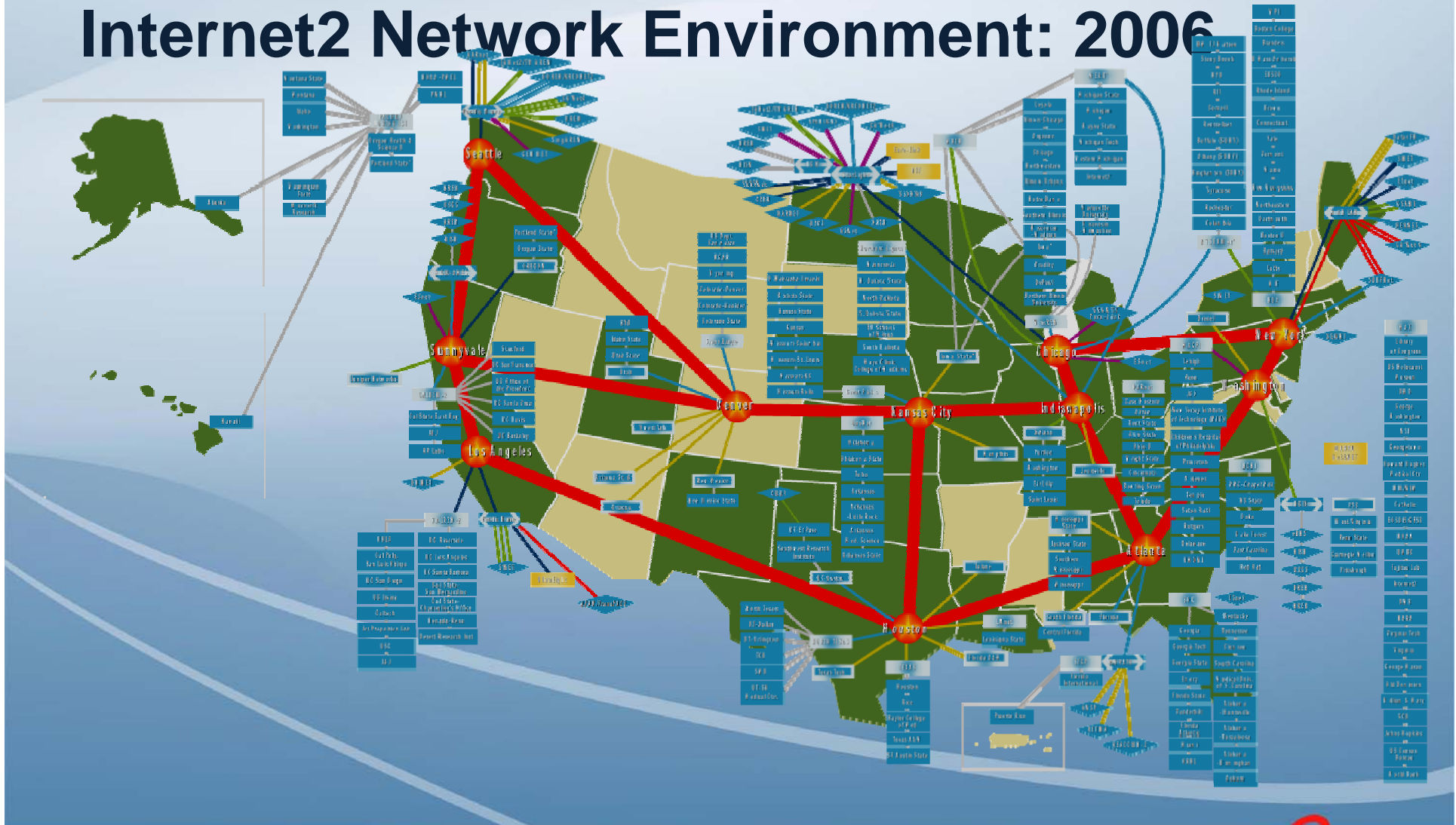
# The View from Internet2

- Computation and Storage
- Network
- Middleware
- Applications
- Institutional Policy and Community Norms

# Computation & Storage

- Collaborating with Open Science Grid and Teragrid
  - Teragrid file system access
- Support for Tier 2 and Tier 3 LHC data distribution
- Distributed Storage Infrastructure

# Internet2 Network Environment: 2006



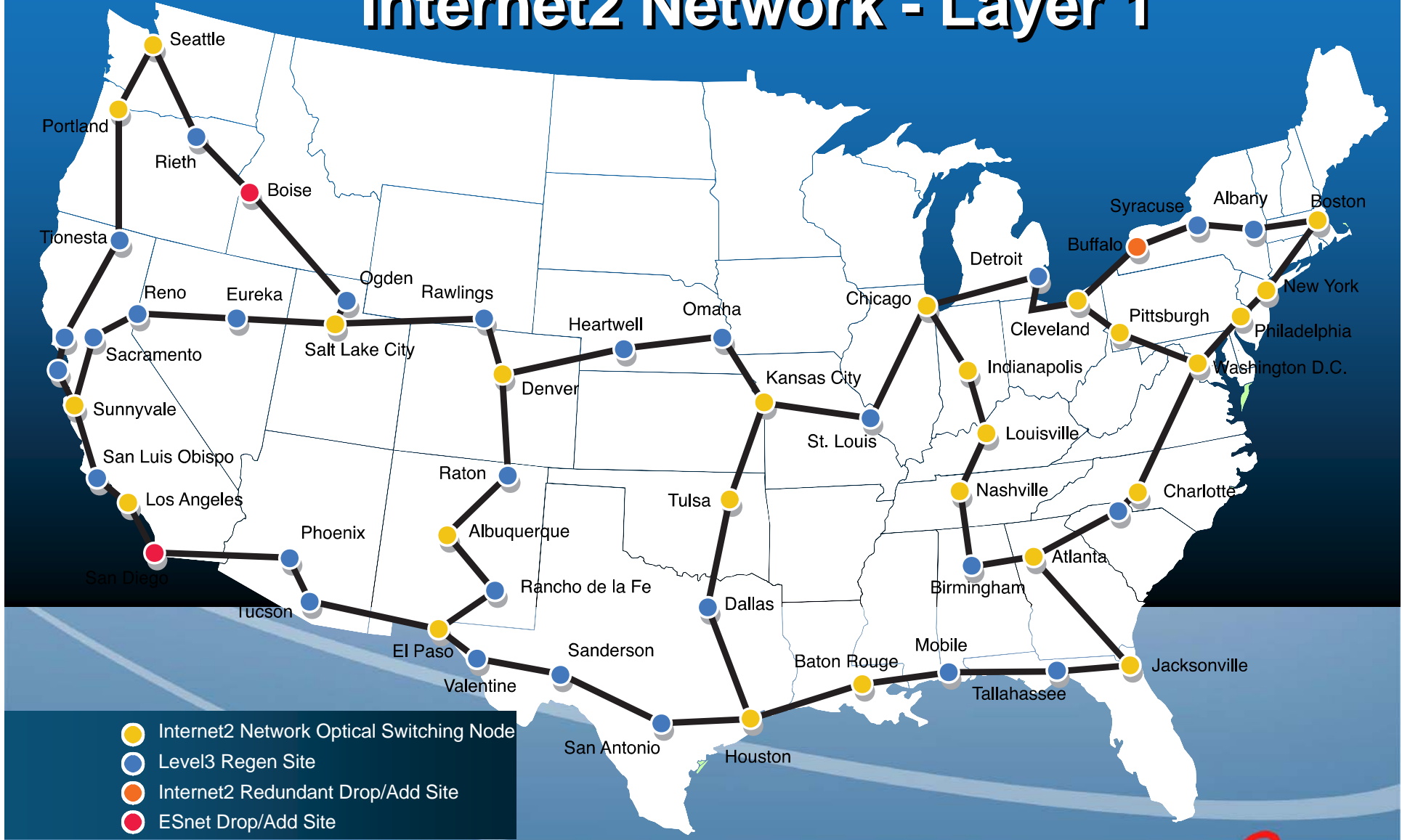
# New Internet2 Network Characteristics

- Hybrid networking capabilities
- Dedicated equipment and fiber
- Carrier-provided maintenance
- Simultaneous support of diverse requirements
  - experimental projects
  - production services
- Integrated with international networks

## New Internet2 Network Capacities

- Initial capacity 10x today's network
  - 10 wavelengths at 10 Gbps
- Future capacity nearly unlimited
  - 40 Gbps and 100 Gbps wavelength capabilities
  - Unlimited additional wavelengths available
- Rapid provisioning of dedicated circuits
- Flexibly-sized circuit capacity

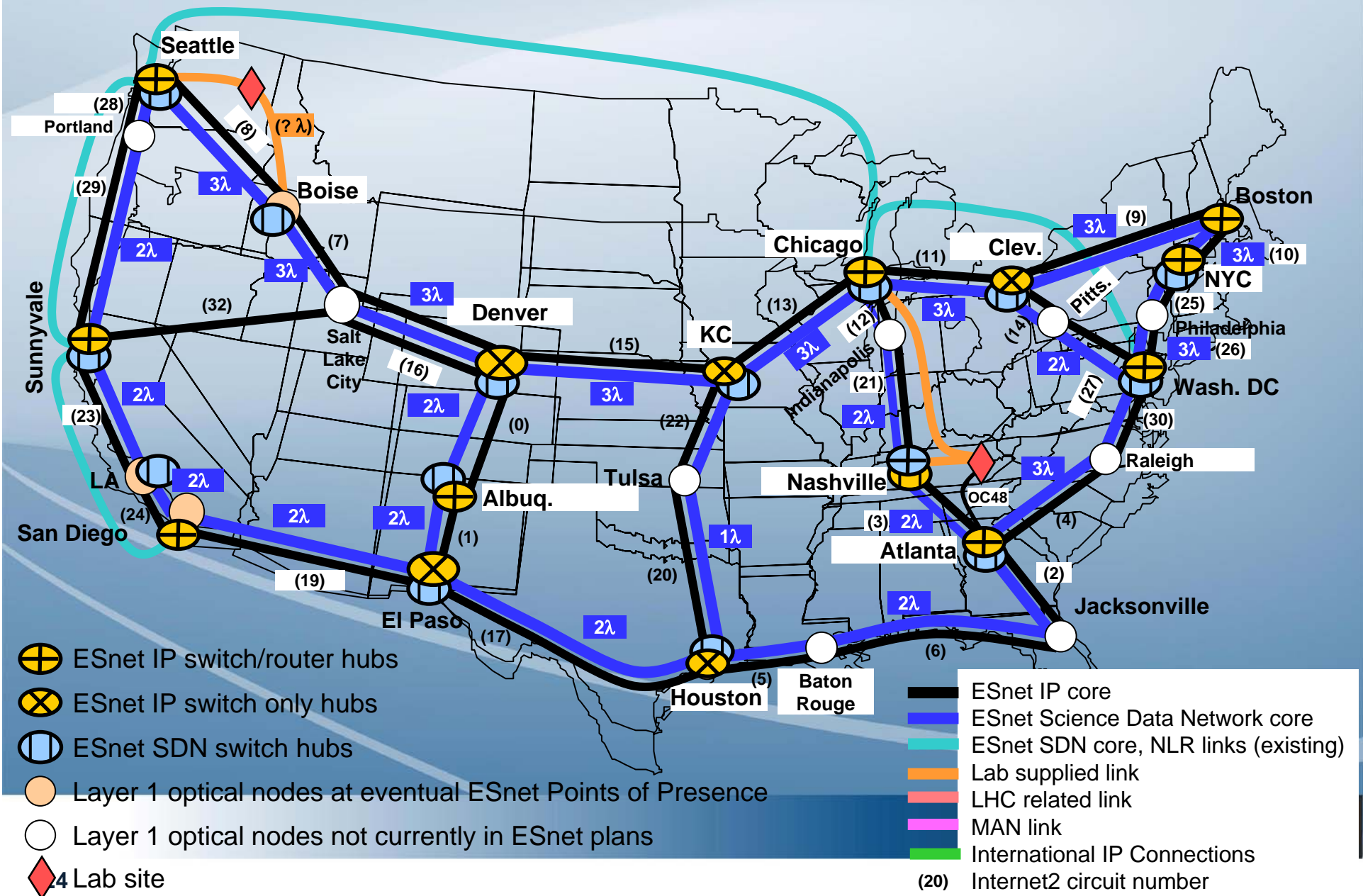
# Internet2 Network - Layer 1



# ESnet4

- ESnet has partnered with Internet2 to:
  - Share the optical infrastructure
  - Develop new circuit-oriented network services
  - Explore mechanisms that could be used for the ESnet Network Operations Center (NOC) and the Internet2/Indiana University NOC to back each other up for disaster recovery purposes

# ESnet4 2009 Configuration





# Middleware

- The Vision - a systems approach to scientific collaboration.
  - A consistent management experience across a rich variety of scientific and collaborative activities
- Building an infrastructure linked to that vision
  - National and international networking capabilities
  - Sustainable campus infrastructure that
    - Increases effectiveness in collaboration
    - Integrates science and education
- Linking applications to the infrastructure

# Why middleware?

- Ease of use
  - Common tools used in a consistent fashion
  - Allow students to access research capabilities in instructional environments
- Better security
  - Integrate with local security
  - Facilitate flexible options for effective use
  - Preserve privacy but maintain accountability
- Facilitate advanced networking and science
  - Trust-mediated transparency
  - Transparent-to-use tools for collaboration
  - Better diagnostics
- Realizes efficiencies, economic and strategic, that serves both the institution and its individuals

# Middleware Integration

- The standard suite...
  - List serve, protected wiki, IM buddy list, collaboration and learning environments (Sakai), audio & videoconferencing, access-controlled web site, shared calendaring, etc...
- Integrated with enterprise-based systems
  - No separate calendars to maintain
  - Consistent user interface in managing local and virtual lives

# Middleware Tools

- Security Assertion Markup Language (SAML)
  - Shibboleth – federating software
  - Signet – privilege management
  - Grouper – group management
- GridShib
  - Federated identity in service of the grid
- Federations
  - Federations have been formed in a large number of countries (SWITCH-AAI, Surfnet, InCommon, DK-AAI, FRA-AAI, etc.)
  - For instance, Internet2 member meeting demo of campus credentials for FastLane

# Applications

- Large scale file transfer
- Video conferencing and telepresence
  - Internet2 commons
    - Support for H.323, VRVS/EVO, Access Grid
    - Site coordinator training, MCU access
  - Digital Video Transport System (DVTS)
  - Research Channel iHDTV
- Remote instrument control
- Visualization

# Institutional Policy & Community Norms

- Campus cyberinfrastructure days
  - With Open Science Grid and Teragrid
  - Work with:
    - Researchers
    - CIOs
    - Administration
    - Regional network providers
  - Providers/supporters of critical applications

## In conclusion:

- Internet2 is focused on working with others to build a comprehensive collaboration environment
- LHC is the largest, most demanding collaboration in the world
- Internet2 looks forward to supporting the LHC collaborators
- While the LHC collaborations are required for science, they could once again lead the world to a new paradigm