INTERNET2 OVERVIEW:
ENGAGEMENT, NETWORK & SERVICES
UNPARALLELED HUMAN NETWORK

Internet2’s unparalleled human network includes

• Over 330 member institutions
• Over 65,000 community institutions connected
• Initiatives, working groups and special interest groups
• International partners
• Core staff
Higher Education members

- Internet2 was formed by 34 universities in 1996
- Now over 200 member universities and colleges
- Higher Education members are at core of Internet2
- Membership levels based on Carnegie Foundation Basic Classifications
Industry members

- Over 45 members from industry
- Committed to development and deployment of advanced networking applications and services in partnership with R & E community
- Membership levels based on annual revenues
- Work toward transferring technology developed within community to broader public
Affiliate members

- Over 50 Affiliate members: non-profit, research- or education-oriented organizations
- Membership levels based on annual operating budgets
- Many government organizations with important roles in creating and executing national policy

US Dept of State
Howard Hughes Medical Institute
Library of Congress

National Geographic
National Institutes of Health (NIH)
Nat’l Oceanic & Atmospheric Admin (NOAA)
National Science Foundation (NSF)
The World Bank

United Nations System of Organizations (UN)
US Antarctic Program (USAP)
US Dept of Energy ESnet
ESnet Laboratories
Federal Highway Admin, Turner-Fairbank Center
Jet Propulsion Lab
Los Amos National Lab
NASA Goddard Space Flight Center
Nat’l Institute of Standards & Technology (NIST)
The Children’s Hospital of Philadelphia
US Department of Commerce, Boulder Labs
Coalition For Networked Information (CNI)
Desert Research Institute
Educause
Healthcare Info & Mgmt Sys Society (HIMSS)
Indiana Higher Education Telecom System
Internet Educational Equal Access Foundation
Laboratory for Telecom Sciences (LTS)
National Archives & Records Administration
New World Symphony
Online Computer Library Center (OCLC)
Open Student Television Network (OSTN)
Philadelphia Orchestra Association
Ruth Lilly Health Education Center
Southeastern Universities Research Association
US Holocaust Memorial Museum
Univ Corp for Atmospheric Rsrch (UCAR/NCAR)
Non-profit sub-state, state or multi-state network organizations provide infrastructure and services.

Provide critical link to Internet2 Network.

Are important partners in creating the advanced R & E network infrastructure of the future.
# Internet2 member communities

<table>
<thead>
<tr>
<th>Oct 2007</th>
<th>Member community</th>
<th>Sep 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>209</td>
<td>Higher Education Members</td>
<td>212</td>
</tr>
<tr>
<td>11</td>
<td>Industry Partners</td>
<td>11</td>
</tr>
<tr>
<td>9</td>
<td>Industry Sponsors</td>
<td>4</td>
</tr>
<tr>
<td>35</td>
<td>Industry Members</td>
<td>24</td>
</tr>
<tr>
<td>46</td>
<td>Affiliate Members</td>
<td>58</td>
</tr>
<tr>
<td>30</td>
<td>Regional Network Members</td>
<td>33</td>
</tr>
<tr>
<td>56</td>
<td>International MoU Partners (reaching 100+ networks)</td>
<td>56</td>
</tr>
</tbody>
</table>
International partners

- Agreements between Internet2 and international networking partners offer interoperability and access
- Enable collaboration between U.S. researchers and overseas counterparts
- Create bridges for virtual collaboration between R & E communities and over 100 international R & E networks
Government Relations Program

- Represents members on major federal policy issues
- Encourages an open and active dialogue between policymakers and the Internet2 community
- Extends ongoing support to members on major research funding efforts
Broader Internet2 community

- 39 education networks across U.S. connect to the Internet2 Network through member sponsors
- Over 65,000 community anchor institutions connect to advanced network capabilities
- Includes primary and secondary schools, community and vocational colleges, public libraries, healthcare institutions, museums, zoos and aquariums
Initiatives and special communities

- Bring together thought leaders from member organizations and broader research and education community
- Work together to advance frontiers of network-enabled applications in various communities of interest
- Arts and Humanities, Health Sciences, Health Network, Science and Engineering, K20, Network Research
Working, special interest, advisory groups

- Integral part of Internet2
- Currently 30 WGs, 20 SIGs, 12 advisory groups
- Develop common tools, encourage common approaches and standards
- Support discipline-specific development efforts and address their network needs
- Provide strategic framework and guide efforts
- Communicate through Web sites and e-mail lists and sponsor special events
Open governance process and structure

• Board of Trustees is member-focused, elected by member representatives, provides strategic direction, leadership and oversight
• Four Advisory Councils offer strategic guidance and set priorities, nominations open to Internet2 Level 1–3 members
• Open election and strategic planning process
• Governance structure agile enough to be responsive, strong enough to guarantee accountability
Core staff

• Support efforts and projects of Internet2 members, initiatives and special communities
• Dedicated staff support advanced network applications, services development and deployment and develop open source software
• Member engagement team for productive 1-on-1 consultation and involvement
• Administer benefits, coordinate community communications and activities—host or organize 50 events per year
“Cyberinfrastructure integrates hardware for computing, data and networks, digitally-enabled sensors, observatories and experimental facilities, and an interoperable suite of software and middleware services and tools.” —NSF

Cyberinfrastructure: What and why?

- Cyberinfrastructure defined and visualized
- Internet2 takes systems-based approach
- Internet2 is involved in Network Performance, Security and Middleware Initiatives
Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking

Cyber-infrastructure visualized

Advanced Networking
Services platform – Systems approach

- Internet2 takes systems-based approach to advanced networking
- Provides wide range of services and tools
- Motivated by member application goals
- Emphasizes how all the elements work together to help members get the most from their network investments
Campus Cyberinfrastructure (CI) Days

- Brings together players from campus, region and nation to share information and plan how to provide CI to meet campus requirements.
- Better positions participants to help direct the evolution of CI services to meet these needs.
- Sponsored by a partnership between Internet2, EDUCAUSE, TeraGrid, Open Science Grid, SURAgrid, NLR and the IRNC.
NETWORK SERVICES

Rob Vietzke
Executive Director,
Network Services
rvietzke@internet2.edu
ADVANCED HIGH-PERFORMANCE IP AND OPTICAL NETWORK

Internet2 Network: dynamic, innovative, cost-effective

- Provides both IP (packet) and optical networks and services
- Offers scalable, next-generation production services
- Offers advanced research and development platform
- Controlled by Internet2 community
Group A vision: “Our evolving global research and education network environment should constitute a general purpose, flexible, interoperable, cohesive, and secure communications platform that accommodates current, anticipated, and unforeseen requirements gracefully, reliably, and cost-effectively in ways which maximize options and accommodate change.”
Internet2 Network capacities

• Initial capacity 10 times previous network
  – 10 wavelengths at 10 Gbps each; some segments now at 200 Gbps (20 waves)

• 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 affiliations

• **Connector** – Maintains direct connection to Internet2 Network; provides connections and network services to Internet2 members
• **Participant** – Internet2 member that has entered into Internet2 Network Participation Agreement
• **Sponsored Participant** – Non-member educational institution sponsored by Higher Education members
• **Sponsored Education Group Participant (SEGP)** – Aggregate of one or more networks serving educational and education-related organizations and state/local government institutions within the same state
### Internet2 network communities

<table>
<thead>
<tr>
<th>Oct 2007</th>
<th>Network community</th>
<th>Sep 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>Regional Network Members</td>
<td>33</td>
</tr>
<tr>
<td>22</td>
<td>Connectors</td>
<td>23</td>
</tr>
<tr>
<td>245</td>
<td>Participants</td>
<td>249</td>
</tr>
<tr>
<td>155</td>
<td>Sponsored Participants</td>
<td>148</td>
</tr>
<tr>
<td>38</td>
<td>Sponsored Education Group Participants (SEGPs)</td>
<td>39</td>
</tr>
</tbody>
</table>

Internet2 network communities

Oct 2007

- 30 Regional Network Members
- 22 Connectors
- 245 Participants
- 155 Sponsored Participants
- 38 Sponsored Education Group Participants (SEGPs)

Sep 2009

- 33 Regional Network Members
- 23 Connectors
- 249 Participants
- 148 Sponsored Participants
- 39 Sponsored Education Group Participants (SEGPs)
Coordinating across geographic scales
SEGPs and the K20 Initiative

- 39 state and regional networks connected as of October, 2009
- Expanding access to the educational mainstream
- More innovators = Accelerated cycle of innovation
## K20 status and growth

<table>
<thead>
<tr>
<th>Organization Type</th>
<th>Sep 2002</th>
<th>Oct 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>K12 Schools/Orgs</td>
<td>7,173</td>
<td>59,714</td>
</tr>
<tr>
<td>Community Colleges</td>
<td>551</td>
<td>674</td>
</tr>
<tr>
<td>Four Year Colleges and Universities</td>
<td>526</td>
<td>695</td>
</tr>
<tr>
<td>Public Libraries</td>
<td>1,482</td>
<td>4,270</td>
</tr>
<tr>
<td>Museums, Zoos, Aquariums and Science Centers</td>
<td>102</td>
<td>167</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td>9,834</td>
<td>65,520</td>
</tr>
</tbody>
</table>
Production network services

• Advanced, highly reliable, carrier-class network
• 100+ Gbps scalable bandwidth
• Supports both traditional and experimental protocols
• Integrates IPv6 and multicast with commercial providers
• Enables active headroom management for big data flows
• New Internet2 ION service provides circuits on demand
• Provides connections to over 100 national and international R & E networks
### Internet2 ION – Optical circuits on demand

- Built on technology developed in collaboration with ESnet, GÉANT and others
- Realizes community vision of hybrid networking
- Provides on-demand, dedicated optical circuits between endpoints
- Allows network researchers and engineers to reserve circuits in 50Mbps increments via easy-to-use Web interface
- Application programming interface allows automated circuit provisioning via applications
Commercial Peering Service

- Leverages existing Internet2 Network investments to serve commercial Internet needs
- Saves costs by enabling members to offload commercial traffic onto their Internet2 connection
- Enhances network performance for all applications
- Enables more rapid technology transfer of services like multicasting and IPv6 to the commercial Internet
WaveCo static circuit services

• Static circuits are circuits that have two fixed endpoints across the Internet2 circuit infrastructure
• Currently set up manually by the Internet2 NOC
• Can have any bandwidth from 50Mbps to a full 10Gbps wave or multiple 10G waves
• Can be provisioned directly over the Infineras (waves) or through the Cienas (sub-rate circuits)
• Circuits can be offered with and without dedicated protection; if dedicated, may be subject to additional fees
• Can be ordered for periods of weeks to years: 30-day billing minimum; can be reserved up to one year in advance
• Have a fee for service based on distance, bandwidth, duration and protection scheme
Network research services

- Extends a robust research and development platform
- Supports large-scale projects like GENI, 100x100, others
- Delivers colocation, waves, circuits and management network capabilities
- Provides usable network measurement data
- Offers staff support to facilitate large-scale research project deployments
Domestic and international connectivity

- Peer networks extend domestic and international reach
- U.S.-based exchange points provide key facilities and capabilities
- Peering agreements extend Internet2 members’ reach to more than 100 research and education networks around the world
MAN LAN

- Manhattan Landing in New York City
  - Partnership with NYSERNet, Indiana University, Internet2 and the IEEAF
  - High performance exchange facility for R&E networks
  - Located at 32 AoA in NYC - easy interconnection to many national and international carriers and other R&E networks
  - Offers connectors ability to peer with other R&E networks via the distributed Atlantic Wave peering fabric

- Peering model is open and bilateral
- Cost recovery model – Minimal connection charges
# International partners

## EUROPE
- 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)
- JISC, JANET (United Kingdom)
- NORDUnet (Nordic Countries)
- PSNC, PIONIER (Poland)
- RedIRIS (Spain)
- RESTENA (Luxemburg)
- RIPN (Russia)
- SANET (Slovakia)
- SURF (Netherlands)
- SWITCH (Switzerland)
- TERENA (Europe)

## MIDDLE EAST
- Khalifa University of Science and Technology (UAE)
- Israel-IUCC (Israel)
- MCIT [EUN, ENSTINET] (Egypt)
- Qatar Foundation (Qatar)

## ASIA and PACIFIC RIM
- AARNet (Australia)
- ANF (Korea)
- APAN (Asia - Pacific)
- CDAC, ERNET (India)
- CERNET, CSTNET, NSFCNET (China)
- JAIRC (Japan)
- JUCC (HongKong)
- MYREN, MDeC (Malaysia)
- NECTEC, UniNet (Thailand)
- NREN (Nepal)
- PERN (Pakistan)
- REANNZ (New Zealand)
- SingAREN (Singapore)
- TWAREN (Taiwan)
- VinaREN (Vietnam)

## SUBSAHARAN AFRICA
- TENET (South Africa)

## AMERICAS
- CANARIE (Canada)
- CEDIA (Ecuador)
- CKLN (Caribbean)
- CLARA (Latin America and Caribbean)
- CNTI (Venezuela)
- CR2Net (Costa Rica)
- CUDI (Mexico)
- INNOVA|RED (Argentina)
- REUNA (Chile)
- RNP [FAPESP] (Brazil)
- SENACYT (Panama)
- University of the West Indies (Caribbean)
Federal peering

PacWave: DREN, NREN, ESnet

NGIX-Ames: NREN, DREN, NISN, USGS

StarLight: TeraGrid, NREN, DREN, NISN, USGS, ESNet

New York: ESnet

DC: DRAGON

NGIX-East: DREN, NISN, NREN, USGS, ESNet
Performance Initiative

- Helps members leverage their investment by getting the most out of their existing network
- Explores end-to-end network performance problems
- Creates “routinely successful experiences” for Internet2 Network users
- Focuses on improving problem detection and resolution
- Leader in development and deployment of perfSONAR
- Holds workshops, involved in monitoring, measurement and performance enhancement projects
MIDDLEWARE AND SECURITY INITIATIVES

Renée Woodten Frost
Director, Technology Transfer and Outreach
rwfrost@internet2.edu
Middleware Initiative

- Simplifies secure access to online resources
- Projects include:
  - Shibboleth® Federated Single Sign-On software
  - Grouper™ Groups Management Toolkit
- COmanage collaborative organization management platform
- MACE advisory group forms working groups
• Focus
  – Inter-institutional collaboration
  – Scalable authenticated/authorized access to remote resources

• Internet2 role
  – Defining/creating architecture: Shibboleth
  – Tools to implement: Shibboleth, Grouper, COmanage
  – Infrastructure/Services to scale: InCommon, USHER

http://www.internet2.edu/middleware
National Science Foundation
Middleware Initiative (NMI)

- Program – Support, deploy middleware for R & E
- Two types of awards
  - System Integrators – Tools and services
  - Other – Academic pure research components
- Periodic NMI releases of software, services, architectures, object classes and best practices
Major work

- Consensus standards
- Best practices and deployment strategies
- Tools
- Software systems
- Outreach
- Services

Consensus standards:
- eduPerson
- eduOrg
- eduMember
- eduCourse

Best practices and deployment strategies:
- LDAP Recipe
- Group Management
- Metadirectories
- Authentication
- Roadmaps
- Extending the Reach program
- Case Studies

Tools:
- KX.509
- LDAP Analyzer
- LOOK

Software systems:
- OpenSAML
- Shibboleth
- Grouper
- COmanage

Outreach:
- CAMP workshops
- Presentations
- Web/wikis
- Publications, articles, case studies
Grouper

- Group management tool – v1.4.2
- Lead institution – Univ of Chicago; other key contributors include Duke, Brown, Georgia Tech, Univ of Penn, Univ of Memphis, Univ of Newcastle
- Adoption accelerating as versions add capabilities, GUI is refined, performance improves
Privilege and access management

- MACE – Paccman Working Group
- Chair – Tom Dopirak, Carnegie Mellon
- Privilege Management Survey
  - To gauge readiness
  - To validate understanding of technical and functional requirements
- Glossary
Shibboleth

- March 2008 – Version 2 released
- Lead universities – Brown, Ohio State, Univ of Washington, Duke, USC, Georgetown
- Adoption – More than 10,000 deployed sites; nat’l federating software for more than 20 countries
- Commercial adoption – Microsoft, Google, Elsevier, OCLC...
- Current uses – Content acquisition, collaboration tools, access to federal gov’t applications, access to domain applications
Federated identity model/federations

- Leverages enterprise identity for inter-realm purposes
  - Uses local authentication
  - Allows variety of authentication options
- Passes agreed upon authentication and attributes (identifiers, affiliations, memberships, entitlements)
- Based on privacy, security, and trust
- More scalable
- Federations widespread internationally now

International federations:
- UK
- Spain
- France
- Sweden
- Finland
- Switzerland
- Netherlands
- Germany
- Denmark
- Norway
- Australia
- Brazil
- Japan
- Canada
  and more...
InCommon Federation

- U.S. identity and access management federation for higher education and its partners
- Addresses legal, Level of Assurance, shared attributes, business proposition
- Participants are universities, service/resource providers, government agencies, labs
- Collaboration groups
- Uses range from popular & academic content access to administrative services to wiki & list control to accessing NIH applications to...

InCommon

www.incommon.org
InCommon Federation as Trust Fabric

- Participants agree to be Governed for mutual benefit: Steering, Legal Agreement
- Agreed upon Trust System – IdM, SAML, EduPerson, Shib
- Standards for Trusting Attributes, for protecting Attributes: POP – Declare What You Do
- Identity Proofing of Organizations: Registration Authority
- Central Repository for Registered Orgs: Metadata
Users have one sign-on point for different resources. Fewer user accounts for application owners to manage access based on attributes, not identity or location (IP address). Fine-grained control over user identity info and approved access. Standards-based and open source.

New resource providers and users integrated quickly.
“...we conservatively estimate that we save $85K per federated application (does not include power and cooling savings). With 10 federated applications, that's $850K annually. These are just the central IT cost savings and do not include what we know to be reduced support costs, which are impossible to capture. In our first production app, an 80% reduction in help desk calls was measured between semesters due to password resets.”

—Research university CIO, September 2009
Recent history for the “future”

- **Jan** 2009 – InCommon Future Group formed
- **March** 2009 – Future Group meets in Oakland
- **April** 2009 – Draft Report for public comment
- **May** 2009 – Three Town Hall forums for comment
- **September** 2009 – Financial plan for Board discussion
- **December** 2009 – Final business plan due for approval

**Adoption history:**
- 2004: **10** (pilot)
- 2005: **12**
- 2006: **41**
- 2007: **72**
- 2008: **124**
- 2009: **165** (September)

**InCommon classes:**
- **HE:** 117
  (3.6 million end users)
- **Partners:** 48
  (NIH, NSF Labs, TeraGrid, K12 School Pilot, Marketplace of applications)
InCommon

Three *proposed* divisions of the identity middleware ecosystem:

1. Leadership, Advocacy, Outreach
2. Foundation: Development and Research
   - Shib, Grouper, COmanage, Paccman, ISOC (DKIM)…
3. Trust Services
   - InCommon Federation (basic)
   - Bronze, Silver Profiles for Levels of Assurance of Identity
   - Certificate Services for U.S. Higher Education
   - Shib and IdM Training and Consulting
   - Outsourced Federation Services
USHER — U.S. Higher Ed Root Certificate Authority

• A public key infrastructure (PKI) supported by higher ed community for emerging deployments in research, education, and transactions that require PKI – relatively high level of assurance
• Operated by the USHER Policy Authority and Internet2
• Issuing campus authority certs since 2007

www.usherca.org
Collaboration tools/platform

- Collaboration management platform – Externalizes identity management from collaboration applications
- Supported in part by a NSF OCI grant, being developed by the Internet2 community, with Stanford as a lead institution
- Open source, open protocol
- Works with Shibboleth, Grouper, Confluence
- Parallels activities in the UK and Australia
Work with open source community

- Advanced CAMP: Identity Services Summit for Higher Ed
  Open/Community Source Projects
    - June 18-19, 2009, in Philadelphia, PA
- Follow on Collaboration Groups
Security Initiative

- Security challenges compounded by demands of advanced applications
- Part of EDUCAUSE/Internet2 Higher Education Information Security Council, affiliated with Salsa
- Assures high performance
- Sponsors working groups
- Close relationship with Middleware Initiative

Working Groups include:

Disaster Planning and Recovery (Salsa-DR)

Computer Security Incident (Salsa-CSI2)

Federated Wireless Network Authorization (Salsa-FWNA)
Middleware and Security in integrated systems approach

- **Middleware** = Well-defined infrastructure layer
- **Security** = Not crisply defined, spans all layers
Computer Security Incidents (CSI2)

• Working group closely aligned with REN-ISAC at Indiana U
• Chaired by Chris Misra, UMass
• Facilitating secure exchange of real-time security information; for incident handlers
• Adding statistical analyses to signature analyses
• Funded in part by Dept of Justice grants in 2006 and 2008

Projects:

RENOIR
System for sharing incident information within trust community

Shared Darknets
Wide aperture analyses

APHIDS
Non-traditional intrusion detection system (IDS) monitors results returned by search engines; easy, automated method to find problematic content on web sites
DoJ Award, Fall 2008

Contributors: Univ of Mass., Indiana Univ, Carnegie Mellon, Univ of Buffalo, Univ of Oregon

CSI2 Projects:
• REN-ISAC Incident Information Sharing System
• DNS Service Telemetry
• SES: Security Events System
• Workshop and Outreach Activities
  – Collaborative Data-Driven Security for High Performance Networks – May 2009 at UMBC
  – Participants from higher education, government, private sector/commercial security firms
Other security initiatives

- **DNSSEC** – Advisory group on adopting DNSSEC; has begun a cross-signing project to sign at least one of their zones and exchange trust anchors to mutually validate their DNS records
- **Two-port Internet** – White paper on Causes and Cures
- **NetGuru** – Periodic meeting of senior network and security engineers; a forum to engage in discussion of timely topics.
Possible future themes

- **Cyberinfrastructure**
  - Supporting campus research needs with security
  - Firewalls versus Campus researchers
- **Collaborative security**
  - Data driven collaborative security workshop (Spring 09)
  - SES: Federated security events system
- **Security and identity management**
  - What is the role of the ISO in identity management
  - Role-based security, ISO27k standards,
- **Themes that are not so common (yet...)**
  - The security of the DNS, DNSsec
  - Information Security Architectures
  - Shifting landscape
COMMUNITIES

Ann Doyle
Sr. Program Manager, Arts & Humanities
adoyle@internet2.edu
ENABLING TOMORROW’S DISCOVERIES

EDUCATION APPLICATIONS ECONOMY QUALITY OF LIFE POSSIBILITIES ACHIEVEMENTS PROGRESS KNOWLEDGE

Network technology advancement is the means, not the end

- Internet2 thought leaders hail from wide range of disciplines
- Next-generation cyberinfrastructure impacts the lives of people today—wherever they are, whatever their interests
Science & Engineering Initiative

- Lone researcher is obsolete
- Today researchers collaborate in global labs
- Internet2 Science Outreach Group is playing new collaboration catalyst role
- Outreach partnerships:
  - Large Hadron Collider (LHC)
  - Electronic Very Long Baseline Interferometry (eVLBI)
  - Laser Interferometer Gravitational-Wave Observatory (LIGO)
  - Open Science Grid (OSG)
Facilitates creation and enhancement of advanced health applications, identifies guidelines and solutions

Extends connectivity to new and underserved areas

Extends clinical practice: “wounded warrior” diagnosis session

Extends education and training: live surgery events

Extends research: provides access to large datasets
Opens a new, global stage to a new, worldwide audience via high-definition broadcasts

Opens master classes and auditions to remote musicians

Enables live multi-site performances

Unlocks important content collections to worldwide audiences

Holds performance production workshops
K20 Initiative

- Connects over 65,000 community anchor institutions
- CAHSEE: Stepping Into Your Future
- Riverbluff: Broadcasts from an Ice Age cave
- NASA scientists take educators on “earth missions”
- Muse site connects K20 members and enthusiasts
Discover your future

- Internet2 community – Building an invaluable national asset
- Leadership and coordination will make sure the transformational power reaches everyone
- What role could you and your organization play in realizing America’s full potential?
INTERNET2 OVERVIEW:
ENGAGEMENT, NETWORK & SERVICES

October 2009

For more information, please visit us at
www.internet2.edu

For membership information, visit
www.internet2.edu/membership