LOOKING TOWARD THE FUTURE OF RESEARCH AND EDUCATION NETWORKS

PREPARED FOR THE CERNET 20TH ANNIVERSARY CELEBRATION

H. DAVID LAMBERT
PRESIDENT & CEO INTERNET2

Innovation Powered by Community

Founded 1996

A Non Profit, 501c3 Organization Providing Advanced Technologies Infrastructure and Services to its R&E Members

Established, Operated, & Governed by the Nation's Leading Research Universities

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Internet2 Core Purposes

Realization of the power of collaborative effort across the higher education community to…

- Drive innovation and advance the global internet
- Extend the leading edge of scholarship by advancing core supporting infrastructure and technologies
- Use the power of collaborative scale to make possible capabilities no single institution could produce on its own
- Achieve a durable measure of control over key aspects of the community's operating environment to assure that those things will be there *when*, and *in the most useful manner*, they are needed

Community Engagement

Internet2 works because it is an expression of its higher education members themselves – it is the community

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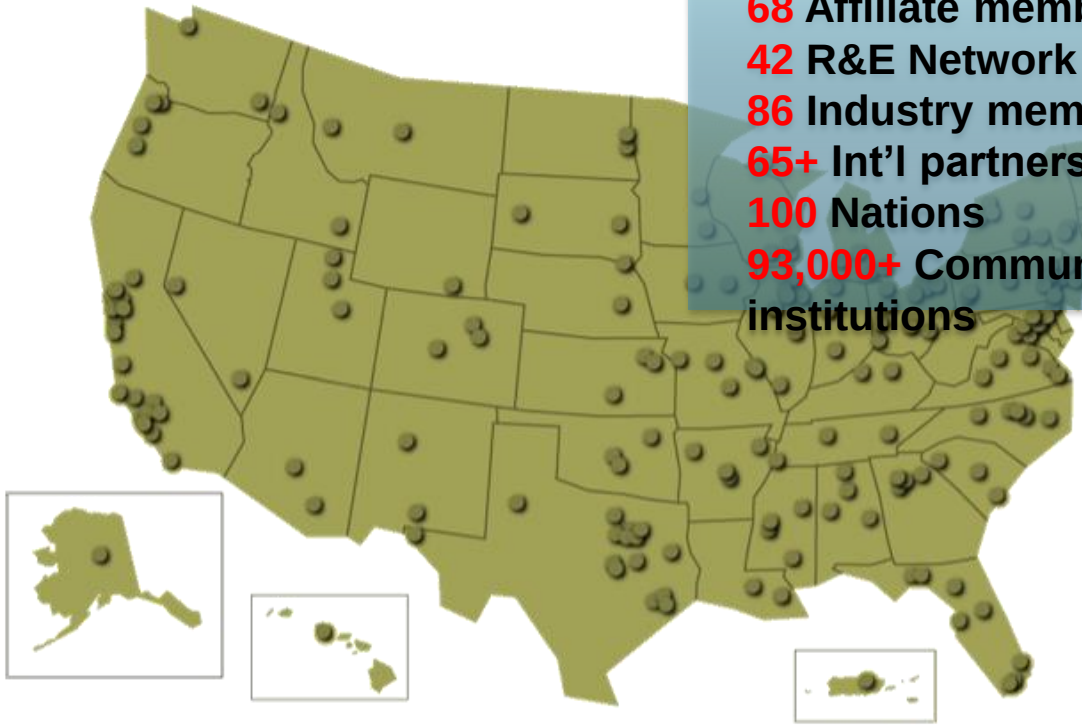
Internet2 Members and Partners

"The idea of being able to collaborate with anybody, anywhere, without constraint…"

—Jim Bottum, CIO, Clemson University



265 Higher Education members
68 Affiliate members
42 R&E Network members
86 Industry members
65+ Int'l partners reaching over 100 Nations
93,000+ Community anchor institutions

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100G Nationwide
SDN-Powered Innovation
Platform

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Internet2 Network Infrastructure Topology

April 2014

15,717 miles of newly acquired dark fiber

8.8 Tbps of optical capacity

2,400 miles partnered capacity with Zayo Communications in support of the Northern Tier region

100 Gbps of hybrid Layer 2 and Layer 3 capacity

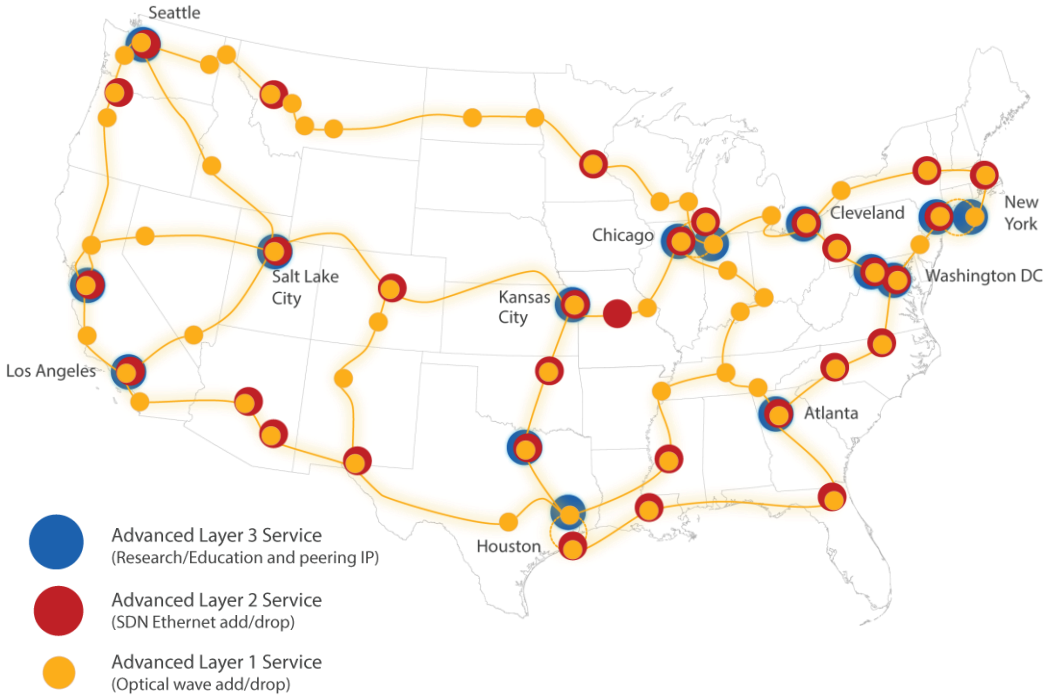
17 Juniper MX960 routers supporting Layer 3 service

31 Brocade and Juniper switches supporting Layer 2 service

49 custom colocation facilities

250+ amplification racks

300+ Ciena ActiveFlex 6500 network elements



IN SUPPORT OF U.S.UCAN

NETWORK PARTNERS

ciena

cisco

INDIANA UNIVERSITY

infinera

JUNIPER NETWORKS

Northern Tier

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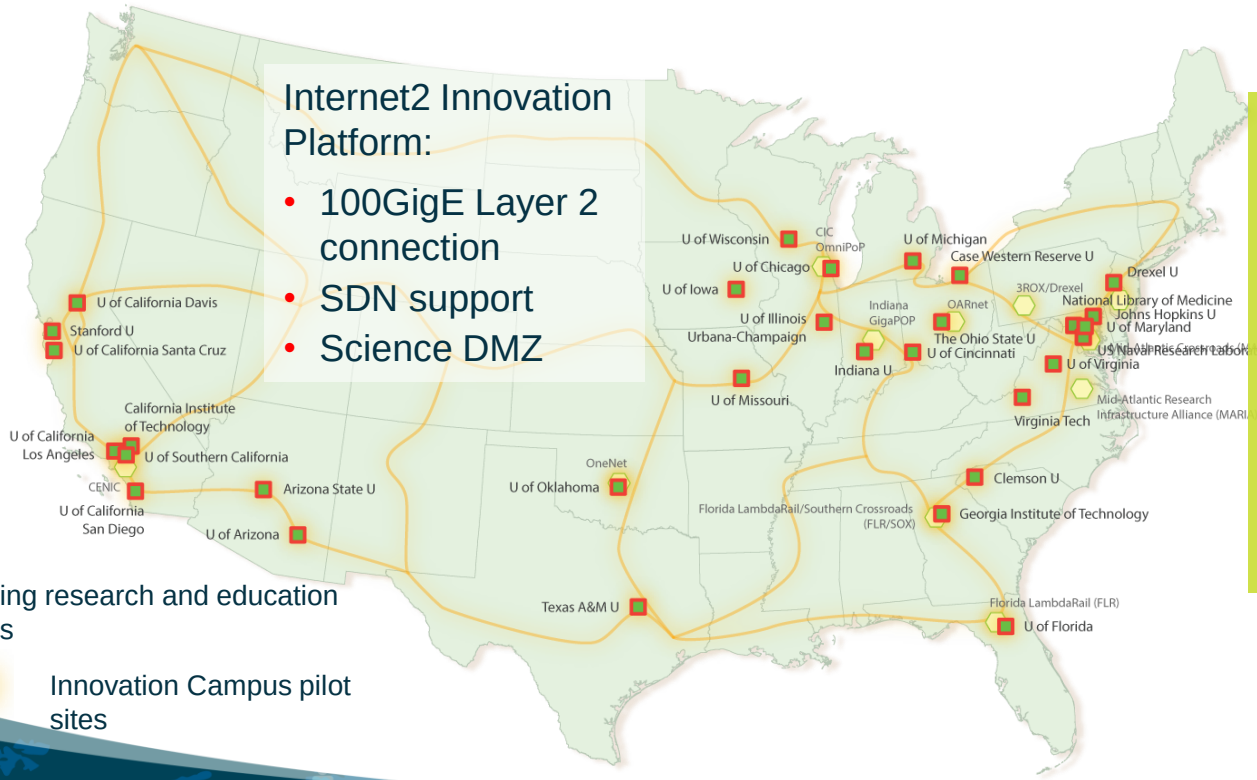
Innovation Platform Collaborators



Internet2 Innovation Platform:

- 100GigE Layer 2 connection
- SDN support
- Science DMZ

"To be in a time where we can merge the research data with the theory is very exciting."

—Michael Lynch Biology Professor, IU

Supporting research and education networks

Innovation Campus pilot sites

Putting Research on the Internet2 Fast Track

Internet2's mission is to ensure that researchers have access to the advanced networks, tools and support required for the next generation of collaborative discovery and innovation.

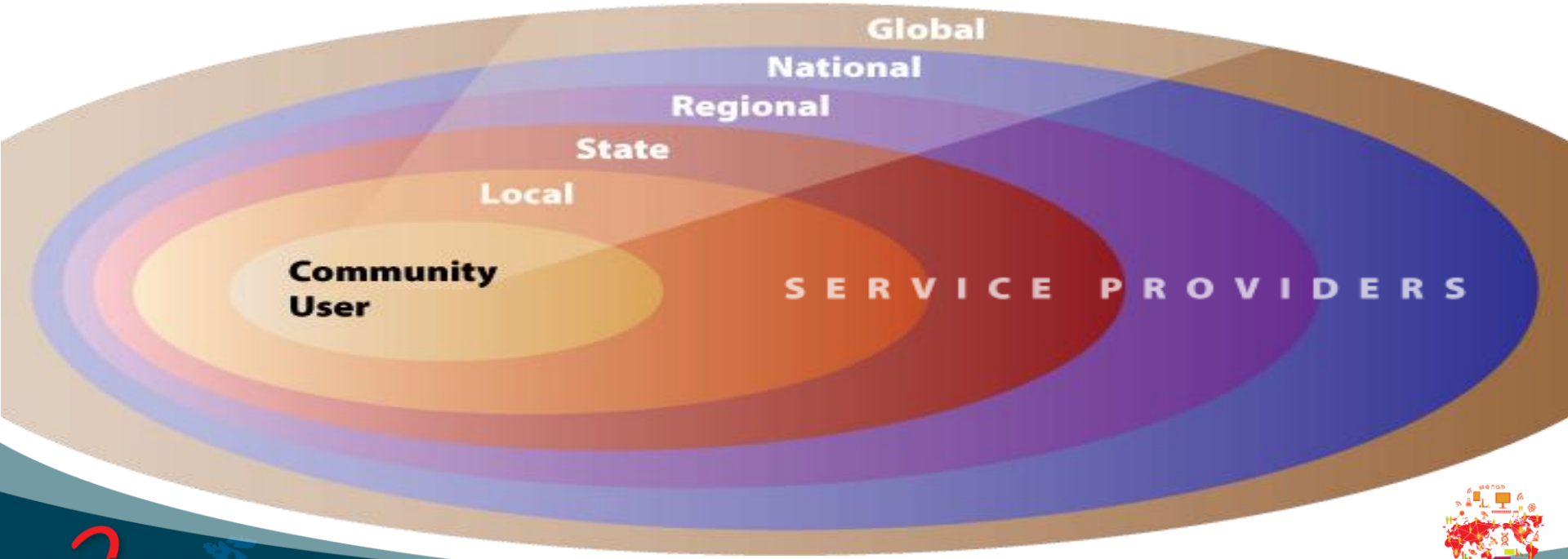
Advanced Layer 3 Services
Specialized, dependable IP solutions, engineered specifically for research and education

Advanced Layer 2 Services
Global collaboration support for data-intensive science—via existing connection or dedicated port

Advanced Layer 1 Services
Research Wave program, optical channels between nodes on the entire Internet2 footprint

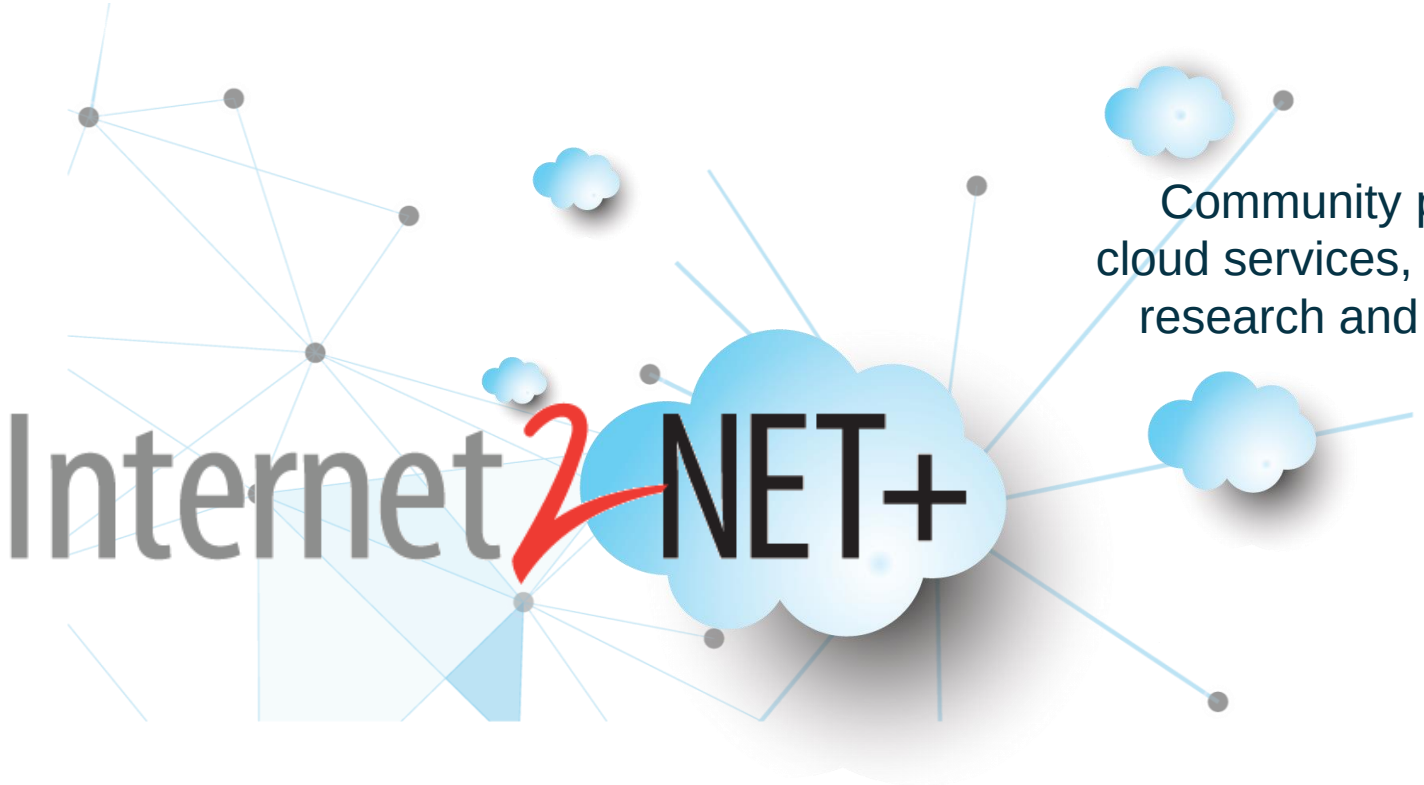
Advanced collaboration tools
Internet2 Global Video Services in cooperation with leading national R&E networks

An Ecosystem Built on Partnerships



EDUCAUSE Top 10 IT Issues -- 2014

- 1. Improving student outcomes through technology
- 2. Partnership between IT and institutional leadership
- 3. Instructional integration of information technology
- 4. IT staffing
- 5. Using analytics to help drive critical institutional outcomes
- 6. IT funding
- 7. The wireless and device explosion
- 8. Sourcing cloud services
- 9. Technology strategy for online learning.
- 10 Risk management and information security
- 10. Enterprise architecture



Community portfolio of cloud services, by and for research and education

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NET+ Program Charter 2012

Internet2 NET+

"Dedicated to the widespread adoption of federated cloud services that benefit the research and education community. In partnership with those we serve, the NET+ program provides simple, consistent and streamlined access to highest value cloud services, community and commercial, offered at the best possible terms and conditions, to all participating institutions."

Internet2 NET+

Launched by Research Universities

2010 – 13 member campuses had a vision

2011 – Designed NET+ to leverage InCommon

2012 – Internet2 NET+ launched with 2 services

2013 – 86 campuses involved in Service Validation

Cornell University University of Michigan University of Washington University of Maryland Baltimore County University of Utah Tulane University University Indiana University University of Arizona University Yale University University of Alaska Clemson University George Mason University Ohio State University Pennsylvania State University University of Colorado University Wayne State University Auburn University Colorado State University Columbia University Florida State University Georgetown National Lab Michigan State University University Princeton University Rochester University Temple Tufts University University of Akron University of California Davis University of Chicago University of Iowa University of Miami Minnesota University University of Southern Florida University of Texas San Antonio University of Texas-Dallas University of Texas-System University of Tulsa

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Internet2 NET+

2014 – Over 350 campuses have participated and subscribed over 650 times to an Internet2 NET+ Service

collectively receiving
$250M+ benefit

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Blackboard

E-Content

DURACLOUD

SAVVIS
A CenturyLink Company

labarchives
Chance Favors the Organized Lab

SIP Services
powered by
AASTRA
Level (3)

Ignite IT™
to Drive Higher
Education

Alfresco

toopher

ICE

philo

One

eduroam

cloudbearing
Solutions for the Modern Workforce™

Kaltura
open source video

Growing Ecosystem of Cloud Services & Providers

lunk

CRASHPLANPRO

box

amazon
web services

Vidyo

merit
Cloud Storage

Docu
The Global Stand

globus

netskope

vmware

VCL

fuze

Office 365

BlueJeans

verizon
terremark

Windows Azure

rackspace
the open cloud company

LastPass ****

GreenButton™

Desire2Learn

KeyNe

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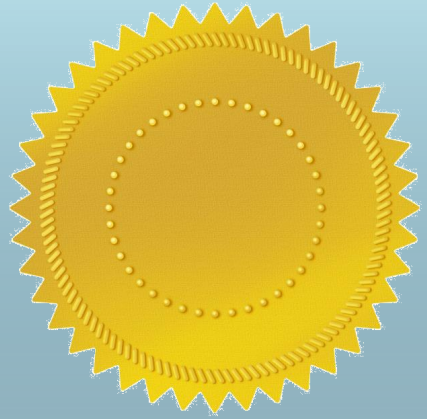
Trust and Identity in Education & Research

Community-developed framework of trust enables:

- Secure, streamlined sharing of protected resources
- Consolidated management of user identities and access
- Delivery of an integrated portfolio of community-developed solutions



The standard for over 700 higher education institutions—*and counting!*

InCommon®

Shibboleth®

COmanage™

Grouper™

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Global Services in Support of Research

"All research is now international."

—Michael McRobbie, President, Indiana University

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The Changing Environment in Research and Education

- Educational and Institutional Transformation
- Globalization of Research and Education
- The Emergence of the Age of Content
- Big Data and the Fourth Paradigm of Science
- The Virtualization of Technology Infrastructure
- Individual Empowerment is the New Expectation
- Mobility: Any Service, Any Time, Any Place
- Translational Relevance
- Trust Fabric, Identity and Security
- The Confounding Role of Acceleration

What an NREN (v2) is not—*what it HAS become*

specialized regional ISP—	*essential enabling platform*
afraid to take risks and experiment—	*innovation incubator*
supply-side market player—	*demand-side market maker*
contract broker—	*market aggregator*
carrier of knowledge—	*knowledge multiplier*
sinks of public and institutional investment—	*economic development engine*
operating company—	*transformation vehicle*
neutral connection service—	*collaboration enabler*
community effort—	*community developer*

Global Coherence through Collaboration

- The Global NREN CEO Forum
  - The Forum is a trust-based community of professional practice for the leaders of the world's major R&E networks. They jointly investigate and select topics where value can be generated on a global scale, and sponsor and resource either initial development or scale up existing regional solutions.

- The Forum is committed to:
  - consult and collaborate with the global R&E network community, working groups and users;
  - accelerate the implementation and adoption of solutions using clear articulation of the issues/solutions and its collaborative influence;
  - transfer its results – if needed – to the appropriate organizations and working groups in the global R&E network community in order that they can operationally take the solution forward for the good of all.

Forum Activity

- Working Groups
  - Next-generation Global Network Architecture (GNA)
  - Global Identity and Inter-Federation
  - Global Service Delivery
  - Global Collaboration
- Study Groups
  - Security and Privacy in the R&E World
  - Engaging Global Science
  - Knowledge Sharing Across the Global Community
  - Mobility

CERNET and Internet2: Committed Collaborators

- Assuring Leading Edge Network Connectivity
- Advancing Networking Technologies
- Supporting Research Collaborations
- Enabling Educational Partnerships
- Advancing the Vision for Global Infrastructure
- The China-America Network Symposium
  - 15 years and counting…..
- Building and sustaining friendships that change the world!

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中国教育和科研计算机网
China Education and Research Network

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BOUNDLESS COLLABORATION.

CONNECTED RESEARCH.

ACCELERATED DISCOVERY.

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