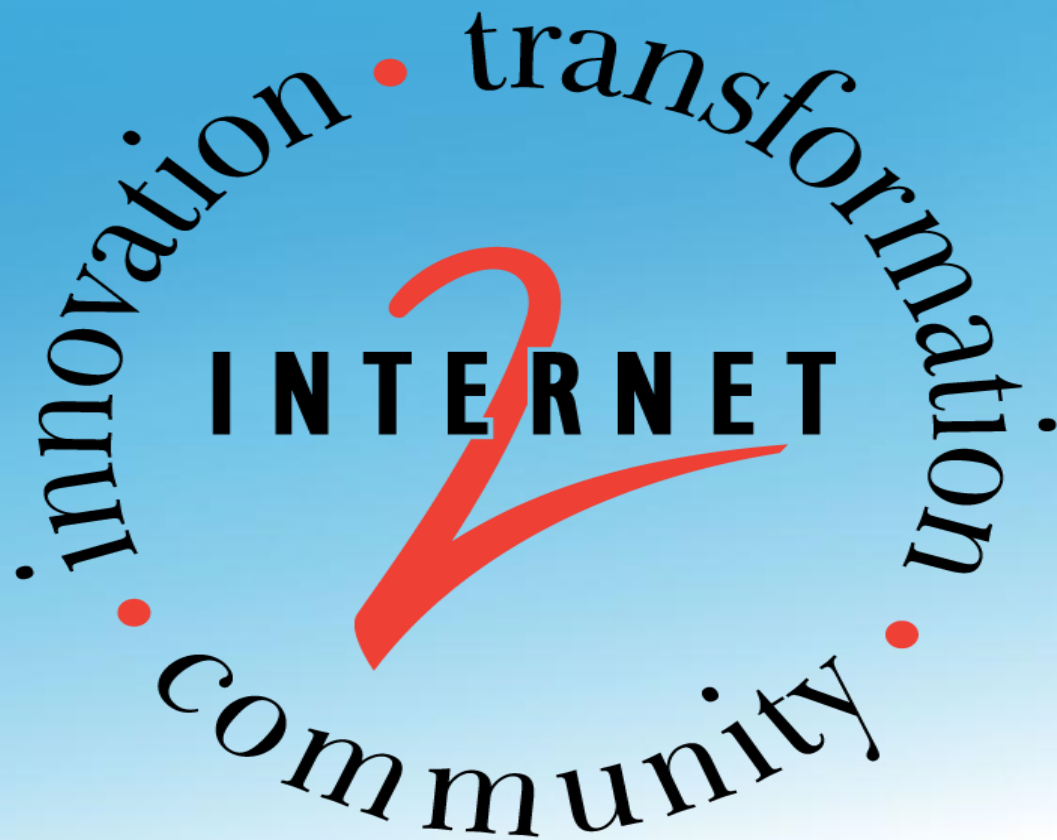




# Internet2 Update

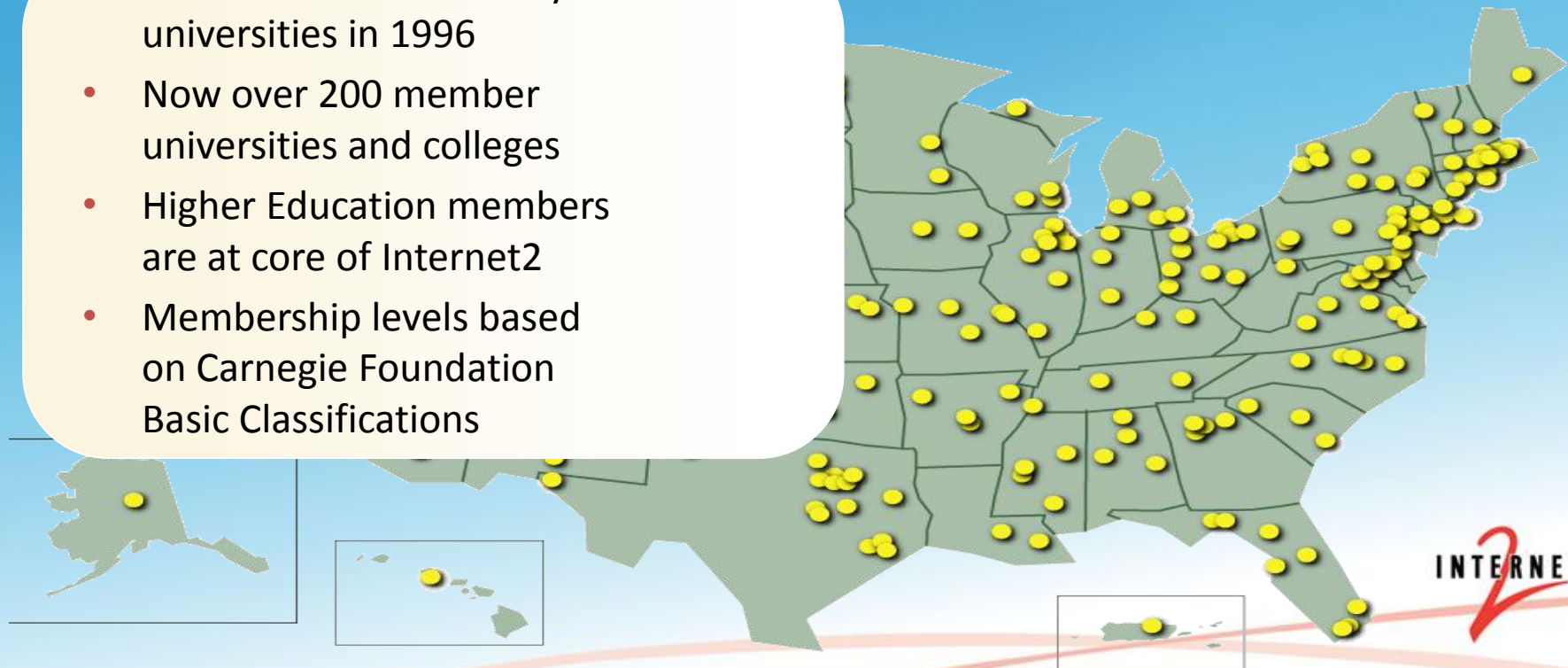
Edward Moynihan  
Program Manager, Global Programs

October 30, 2012



# 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



# The New Internet2 Network

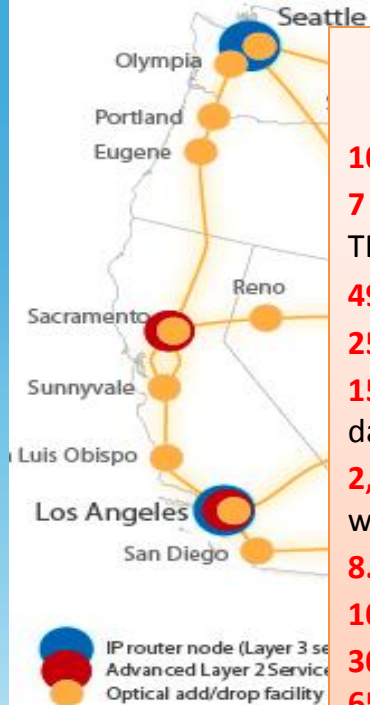
## Internet2 Network *by the numbers*

- 10** Juniper T1600 routers
- 7** Juniper MX960 nodes for TR-CPS
- 49** custom colocation facilities
- 250+** amplification racks
- 15,500** miles of newly acquired dark fiber
- 2,400** miles of partnered capacity with NTNC
- 8.8** Tbps of optical capacity
- 100** Gbps of IP capacity
- 300+** Ciena ActiveFlex
- 6500** network elements

## Internet2 Network *platform architecture*

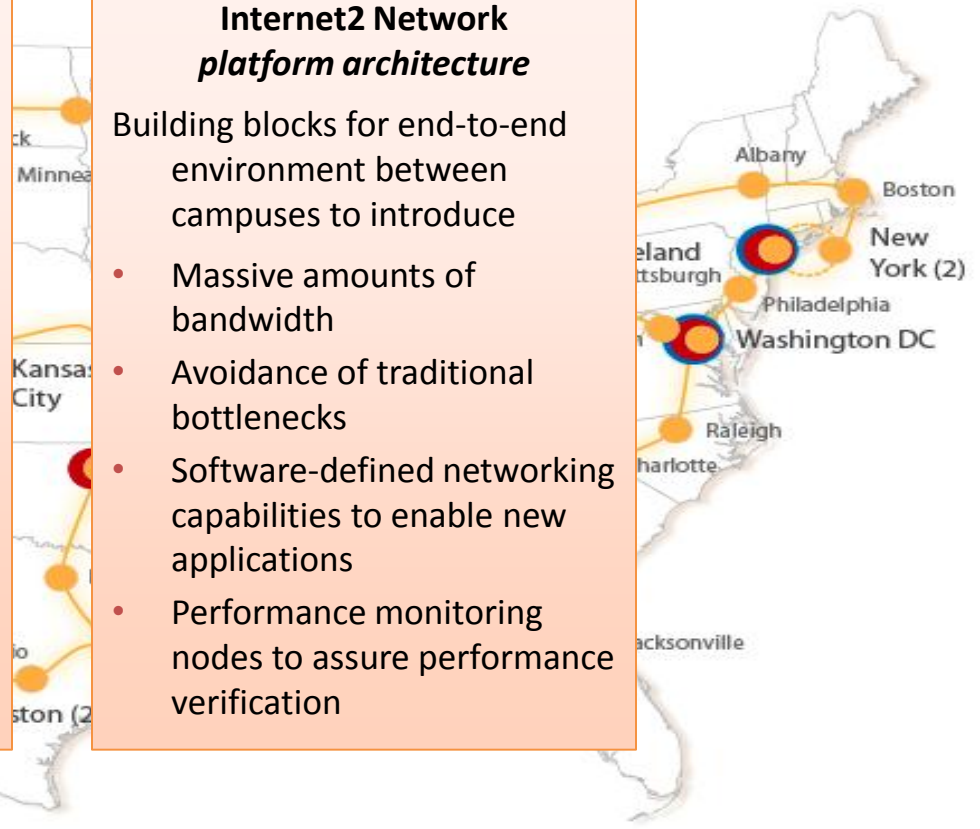
Building blocks for end-to-end environment between campuses to introduce

- Massive amounts of bandwidth
- Avoidance of traditional bottlenecks
- Software-defined networking capabilities to enable new applications
- Performance monitoring nodes to assure performance verification



### Internet2 Network by

10 Juniper T1600 routers  
7 Juniper MX960 nodes for TR-  
49 custom colocation facilities  
250+ amplification racks  
15,500 miles of newly acquired dark fiber  
2,400 miles of partnered capacity with NTNC  
8.8 Tbps of optical capacity  
100 Gbps of IP capacity



# Domestic and International connectivity

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



# Fall 2012 Updates

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- Committed to a growing partnership between UCAID and CUDI
- Creation of new VLANs:
  - 1) to Internet2 traffic (ID 3065)
  - 2) to Starlight and CERN in Chicago (ID 3067)
  - 3) to U of Maryland (ID 3066).
- Potential for future move to Brocade switch in El Paso; discussions already underway
- Pursuing joint support for increased connectivity to Latin America







**National  
Research &  
Education  
Networks:**

*Not just  
networks  
anymore*

# What an NREN is not—*what it must become*

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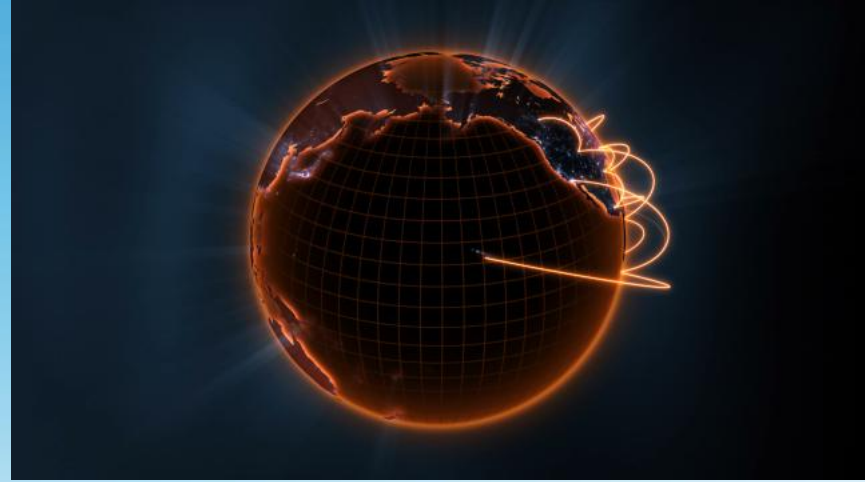
specialized regional ISP— *essential global platform*  
afraid to take risks and experiment— *innovation incubator*  
supply-side market player— *demand-side market maker*  
contract broker— *market aggregator*  
knowledge carrier— *knowledge multiplier*  
provider of shrink-wrapped solutions— *economic development engine*  
business-as-usual partner— *transformation vehicle*  
neutral collaboration connection— *collaboration enabler*  
disinterested community service— *community developer*  
political tool— *political stabilizer*





# Essential *global platform* for R&E institutions

- Essential global representation and leadership
- Innovation platform encourages the development of new technologies
- Transparent operations mean easier solutions, avoidance of problems
  - Supporting 'end-to-end' domain science and education
- Collaborative environment for solving common challenges, developing common solutions



# Innovation incubator

- Facilitates development of advanced applications supporting global R&E
  - Distributed lab environments
  - Remote access to rare scientific instruments
  - Large-scale computation and data access
  - Medical and biological research
  - Teaching and learning
- Delivers abundant bandwidth, setting stage for next generation of innovation
- Provides testing “playground” for new technologies that hold enormous value for current (and future) constituents



# Market maker



- Many companies have been created or re-invented through R&E community innovations
- Students capitalize on network-rich platform to create new technologies
- In the U.S., this has created fast-growing economic impact
- Now contributes over \$8 trillion dollars annually to the global economy



# Market aggregator

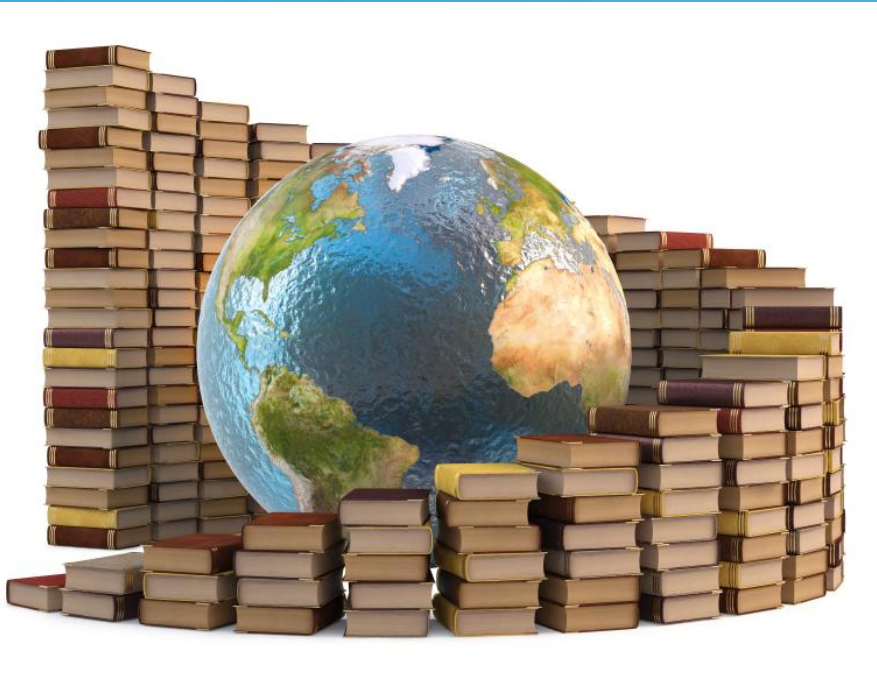


- Research and Education is a large market but not large enough to gain leverage over suppliers.
- R&E network aggregation enabled access to advanced services for lower cost, enabling R&E to benefit from the most advanced capabilities.
- Efforts are now being launched to apply network aggregation success to services above the network.
  - Internet2 'Net+'
  - Surfnets 'SurfConnects'
  - JANET 'Brokerage'





# Knowledge multiplier



- NRENs don't just enable access to knowledge, their services increase the pace of knowledge development.
- Knowledge enables economic, social and cultural development.
- Technology, networks and the explosion of knowledge spur development.
  - The Roman Road System.
  - 18<sup>th</sup> – 20<sup>th</sup> Centuries
    - Canals, railroads, telephone & telegraph
  - 20<sup>th</sup> & 21<sup>st</sup> centuries
    - The Internet



# Economic development engine

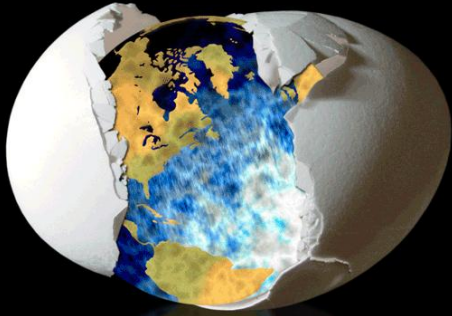


- **Buying power:** NREN uniquely positioned to bring advanced ICT service
- **Innovation engine:** Does not take shrink-wrapped solutions for granted
- **New market creator:** Creates new markets
- **Market pull creator:** Students exposed to high-end ICT demand the same afterward
- **Trusted party:** As member of the family, can act in joint buying role





# Transformational vehicle



- Enables big changes across the spectrum
- Empowers R&E responses to challenges in funding, pedagogy and online resources, technology, “consumerization”
- Refactors fundamental business operations and productivity across entire supply chain
- Equips constituents to accomplish their missions to serve and transform global communities



# Collaboration enabler



LOLA demo, Oct 2011  
Photo courtesy  
Matthew Libera

- Provides key enabling technologies, like global video services
- Provides broad range of participatory opportunities, including training
- Provides expertise to help solve technology challenges
- Provides transparent, favorable environment for cooperation
  - Identity Federations like Common

In-  
INTERNET<sup>2</sup>

# Community developer

- Provide connectivity to satisfy growing needs
- Change the way content, applications, and services are delivered
- Foster regional and international anchor collaboration
- Ultimately, transform communities



INTERNET<sup>2</sup>

# Political stabilizer

- NRENs create collaborative relationships in the international R&E communities that transcend cultures and outlast political regimes
- Open, reliable avenues of communication foster a safe haven for political dialogue and intellectual freedom





Internet *2* NET+

INTERNET *2*

## Education Market Historically Underserved by Commercial IT Providers

- Research Institutions demanded unique implementations of hardware and software solutions
- State schools, small liberal arts and community colleges, IT spending dominated by administration
- K-12 technology investment a very small percentage of their total spend during two decades of reductions
- For all three groups, very long procurement cycles, low margins, low turnover (repeat business)
- Too much of the resource went to sales and marketing and not enough to the classrooms and labs



# Internet2 NET+ Cloud Services

## Higher Education Opportunity

- Major investments (venture capital \$\$) flowing into cloud services for commercial offerings that can be adapted to higher education use.
- Customization of commercial services can happen once, adoption many times. Better R&D leverage.
- Top 200 Research institutions (I2 Members) >\$10b in IT spending. Leverage that leading investment.
- Reduce costs of staff and pensions which are increasing faster than technology costs.
- Facilitate cross institutional engagement combining Network and Services.



# Internet2 NET+ objective & approach

## ***Objective***

Create technical and business models for provisioning above-the-network services that

- Leverage the Internet2 Network, middleware and federated authentication
- Encourage an interoperable services marketplace where individual institutions may procure services from a wide range of providers

## ***Approach***

- Coordinate existing above-the-network initiatives under single services organization
- Establish vendor partnerships
- *Explore alternative specifications, interoperability requirements, user and program interfaces, service-level definitions, business services and pricing models*



# Internet2 NET+ Service Provider Ecosystem

Infrastructure-as-a-Service

Software-as-a-Service

Communications-as-a-Service

Other Services



CenturyLink<sup>TM</sup>  
Business

Microsoft<sup>®</sup>



DURASPACE<sup>TM</sup>



Level(3)<sup>®</sup>



# Internet2 NET+ Portfolio Growth

One year ago, Internet2 NET+ was announced with  
**2** services and **13** participating campuses

Six months ago, there were  
**20** services and **23** participating campuses

Today, there are **29** services and  
**87** participating campuses...



# Internet2 NET+ Portfolio Growth

...plus service trials  
already underway  
means over

**150** campuses now involved  
in Internet2 NET+!



# Internet2 NET+ Portfolio Growth

## **Regional Partners Program**

extends the benefits of  
Internet2 NET+ services  
to more communities

A new **Global Partners Program**  
in development!





# Internet2 NET+ Global Partner Program

- Support International NREN's Adoption of NET+ Services – beyond Internet2 members
- International NRENs become distributor of NET+ services to their constituencies
- Service costs are offered to NET+ Global Partner Program participants at wholesale NET+ member pricing
- As volumes increase across all subscribers, prices drop. Members will always receive better pricing than standard educational discount
- Services from one NET+ Global Partner to others supported through model



# About InCommon

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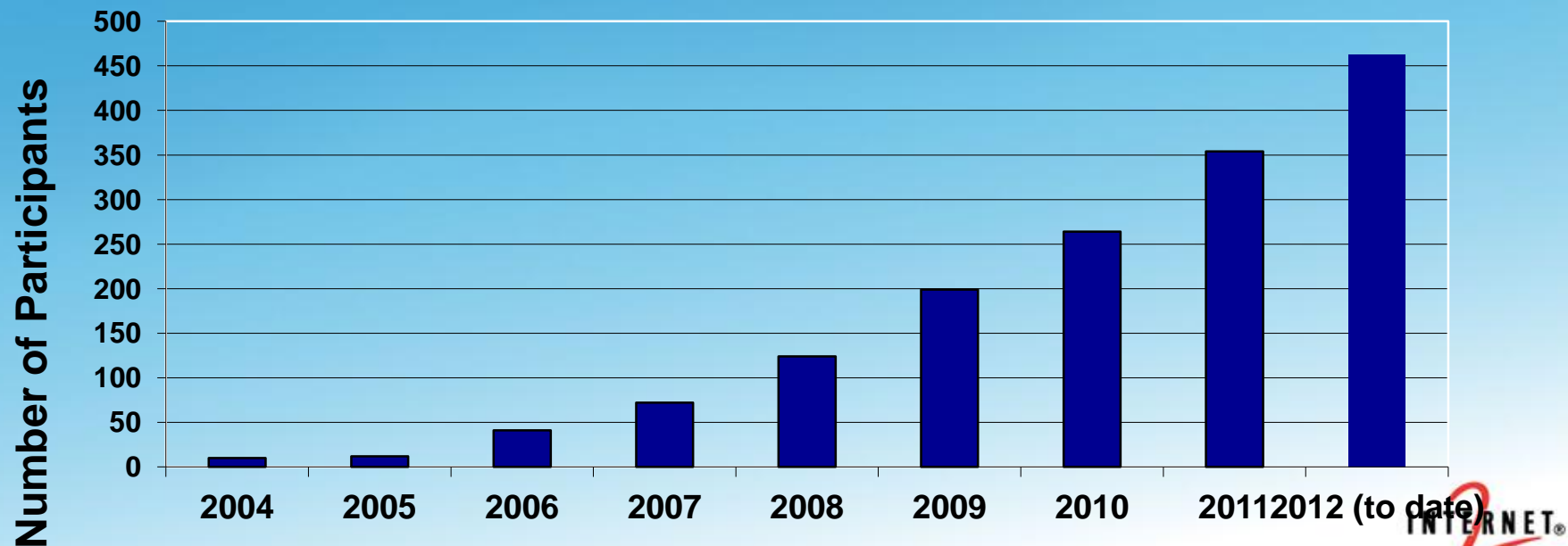


- Providing a framework of trust for safe sharing of online resources
- Four services within the InCommon trust framework
  - InCommon Federation
  - InCommon Certificate Service
  - InCommon Assurance Program
  - InCommon Multifactor Authentication Program



# Participation Year-to-Year

464 InCommon Participants (as of Oct. 24, 2012)



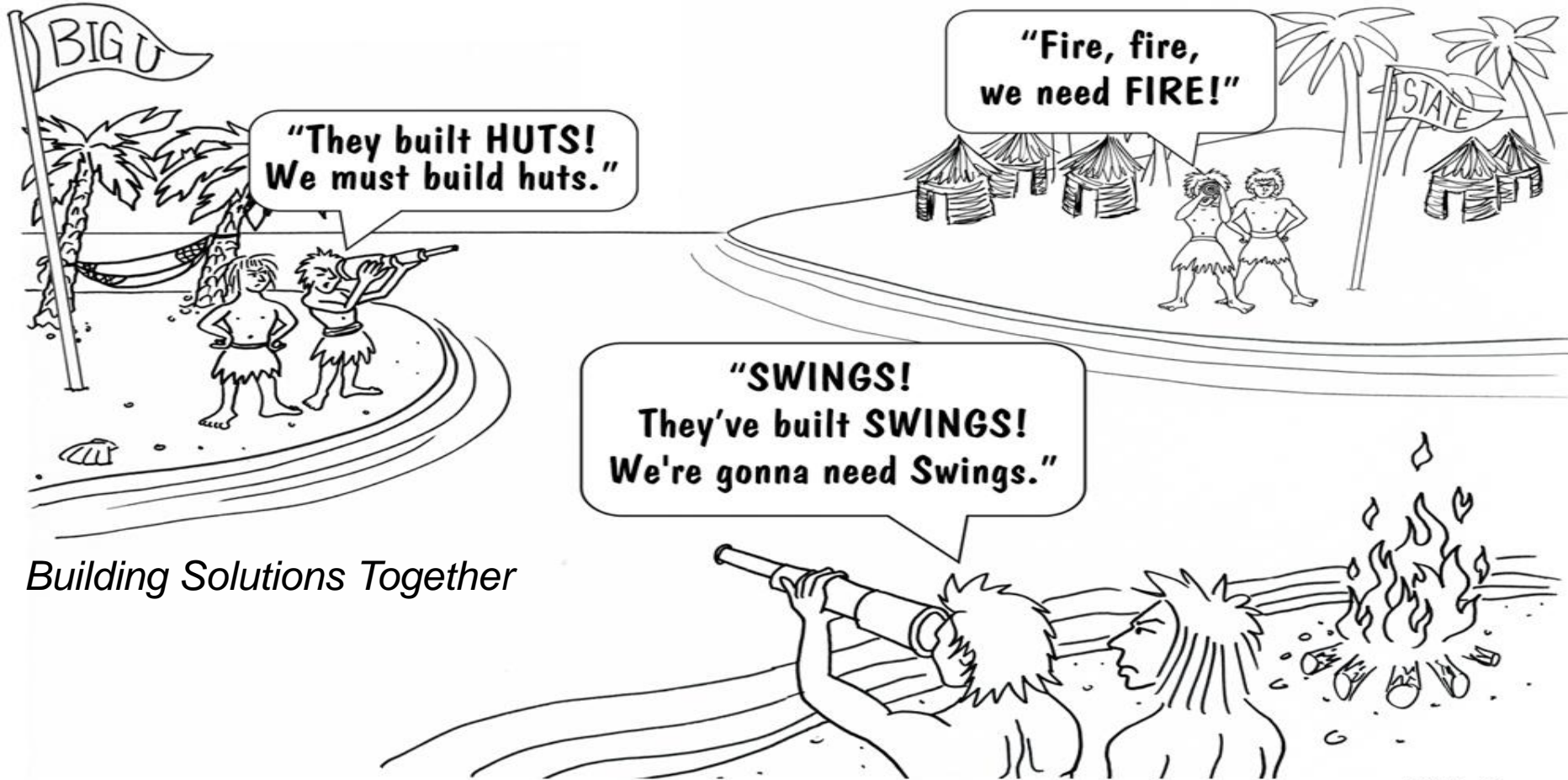
# InCommon Federation



- Campuses leverage their identity databases to allow for the use of one set of credentials to access multiple resources.
- Online service providers no longer need to maintain user accounts.
- Identity providers manage the levels of their users' privacy and information exchange.
- InCommon uses SAML-based authentication and authorization systems (such as Shibboleth®) to enable scalable, trusted collaborations among its community of participants.
- Increasing opportunity for international expansion



# Higher Education Islands





<http://www.internet2.edu/international/index.cfm>

<http://www.internet2.edu/netplus/>

<http://www.incommon.org/>

Thank you!

Questions?

email: [emoynihan@internet2.edu](mailto:emoynihan@internet2.edu)