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## Internet 2: Cyber Infrastructure Seminar

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# Internet 2

Cyber Infrastructure Seminar

# Introduction

- Edward Aractingi
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- <http://twitter.com/earactingi>

# Cyberinfrastructure visualized



# What is Internet 2?

- Advanced networking consortium led by the **research and education** community since **1996**
- **361** Members, 130 Sponsored Participants
  - 211 Higher Education Members
  - 33 Research and Education Network Members
  - 58 Affiliate Members
  - 37 Industry Members

# Collaboration!!

By bringing **research** and **academia** together with technology leaders from **industry**, government and the international community, Internet2 **promotes collaboration** and **innovation** that has a fundamental impact on the **future** of the Internet

# Vision and Mission

- **Goal I** Design, operate, and continually advance a leading-edge research and education network as a national asset
- **Goal II** Provide researchers and scholars with the tools and support they need to envision and execute the next generation of collaborative discovery
- **Goal III** Maintain vigorous partnership, outreach, and advocacy programs to jointly develop, promote, and share the transformational power of *cyberinfrastructure* throughout the communities in which we work and live.
- **Goal IV** – Operate the *Internet2 organization* as an exemplary membership organization with empowered leadership, financial transparency and member engagement.

# About Internet 2

- A forum to which researchers, scholars and administrators naturally gravitate in order to learn about and engage in general cyberinfrastructure initiatives.
- Approach to collaboration, security, and privacy services which enable faculty, staff, and students at every member institution to use their institutional credentials to securely access local, national, and international academic resources.

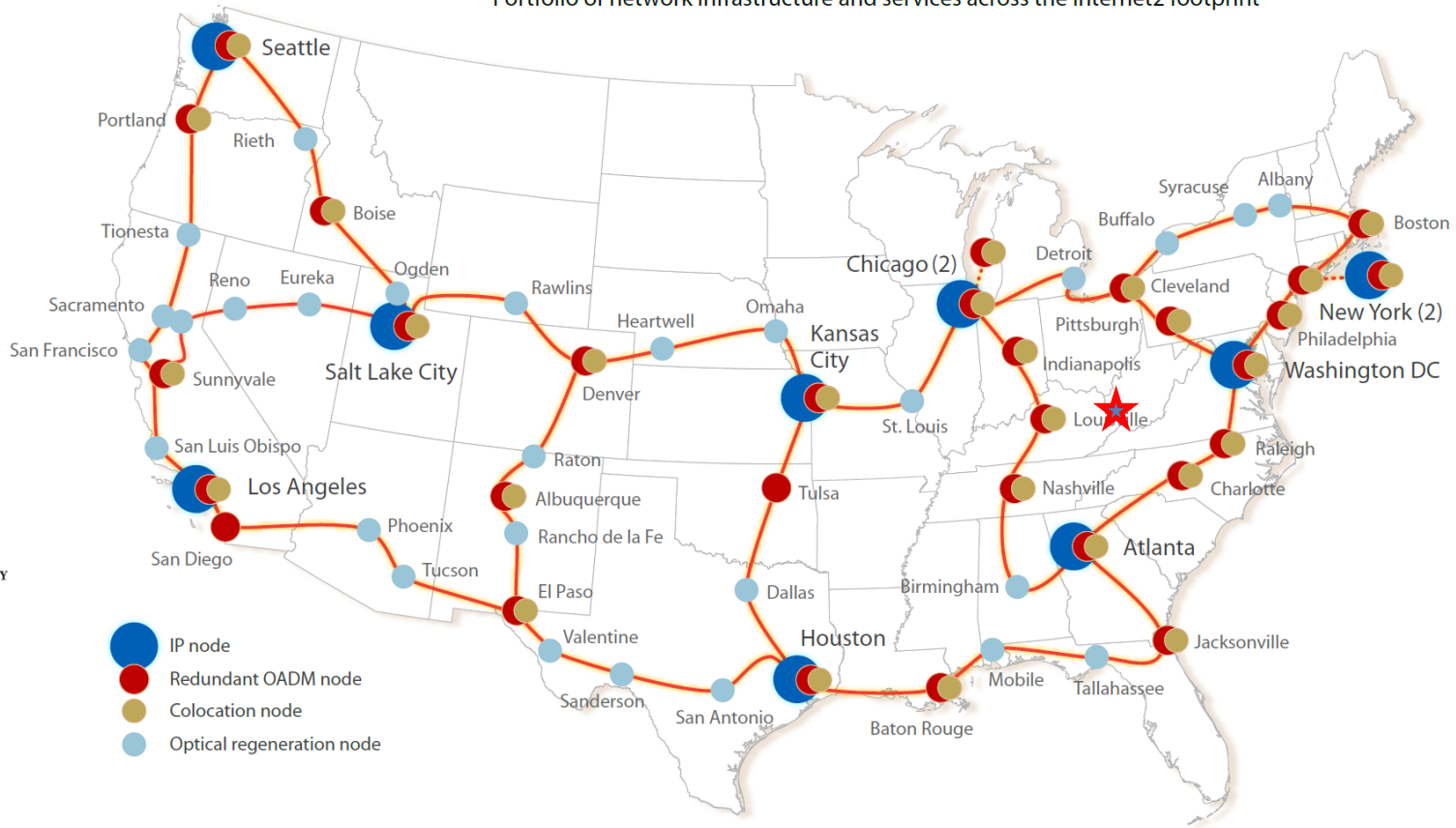


# Infrastructure Topology Map



## Internet2 Combined Infrastructure Topology

Portfolio of network infrastructure and services across the Internet2 footprint



NETWORK PARTNERS

ciena

INDIANA UNIVERSITY

infinera

Juniper NETWORKS

Level 3

- IP node
- Redundant OADM node
- Colocation node
- Optical regeneration node

- CONNECTORS**
- 3ROX
  - CENIC
  - CIC OmniPoP
  - Drexel University
  - GPN
  - Indiana GigaPoP
  - KyRON
  - LEARN
  - LONI
  - MAGPI
  - MAX
  - MCNC
  - Merit Network
  - MREN
  - NOX
  - NYSERNet
  - Oregon Gigapop
  - Pacific Northwest GigaPoP
  - SoX
  - University of Memphis
  - USF/FLR
  - University of Utah/UEN

# Working & special interest groups

- IPv6 WG
- Information Services, Discovery, & Topology (ISDT) WG
- MACE-paccman (Privilege and Access Management) WG
- Performance WG
- Salsa-Computer Security Incidents - Internet2 (Salsa-CSI2) WG
- DNSSEC SIG & Network Storage SIG

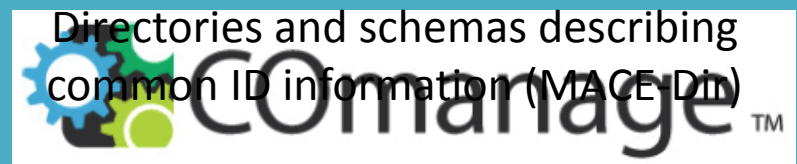
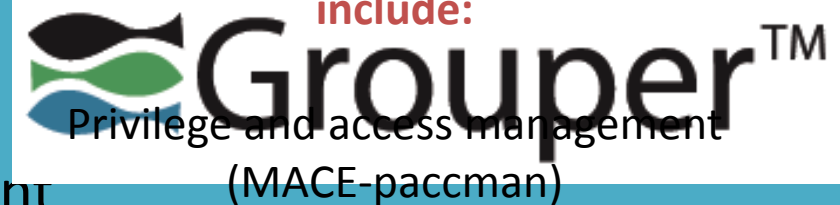
# Middleware Initiatives

- 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



Working Groups

include:

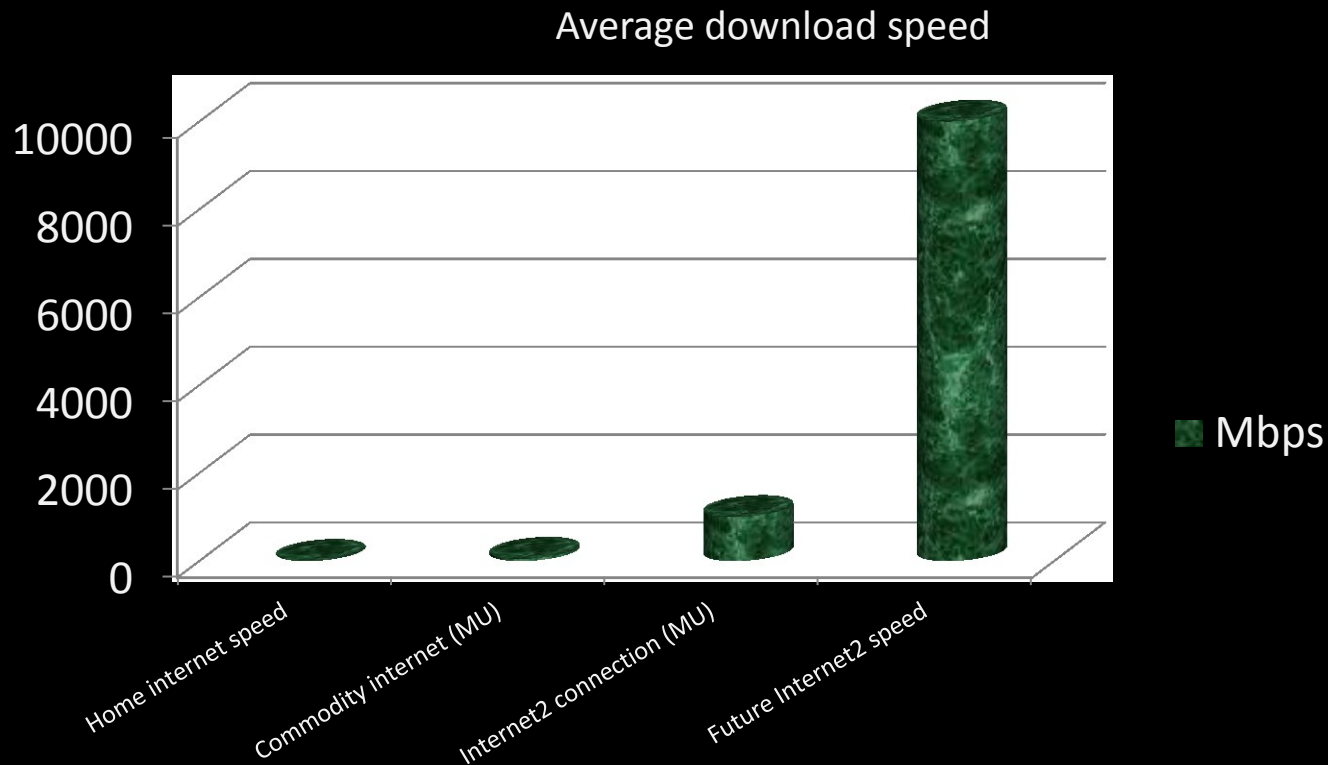


Public Key Infrastructure for Higher Education (MACE-PKI)

Inter-Institutional Resource Sharing (MACE-Shibboleth)

# Internet2 Speed

- Announced Nov 11<sup>th</sup> the world's first 100 GigE nationwide research network



[I2-NEWS] Internet2 to Deploy First 100 Gigabit Ethernet Research Network, Lauren Rotman, 11/11/2010

# Future of Internet2

- The Path Forward, Envisioning Opportunities
- Globalization of Higher Education
- Services Above the Network
  - Cloud Services
- Distributed Science
- Research Partnership



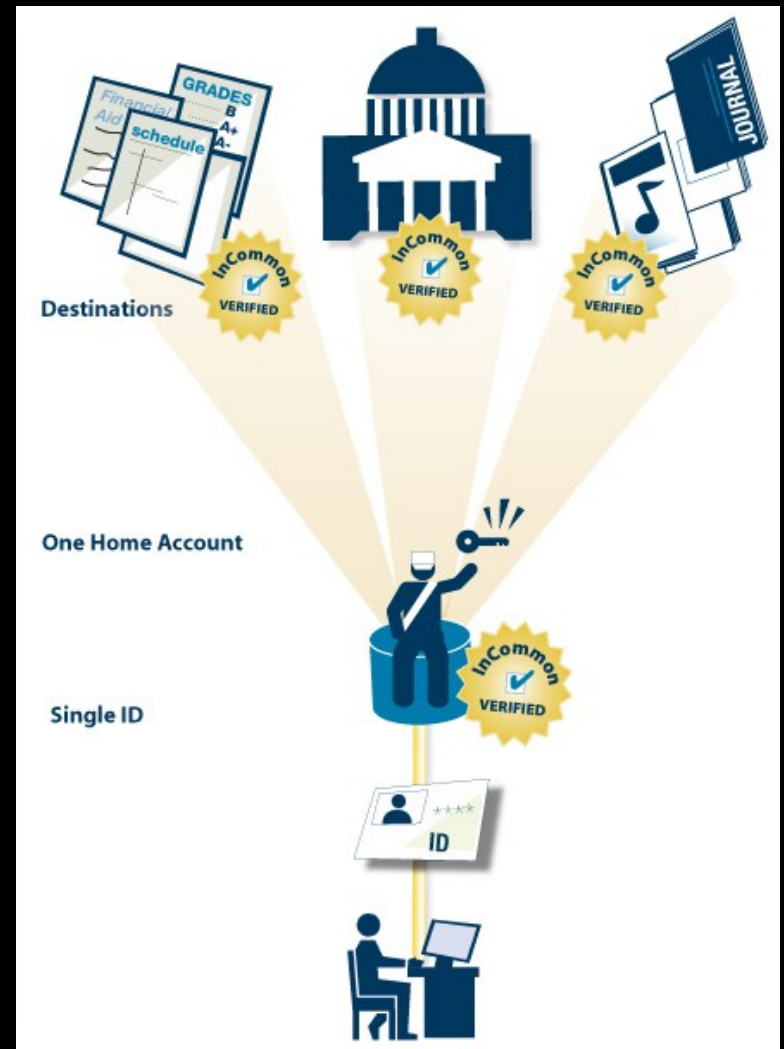
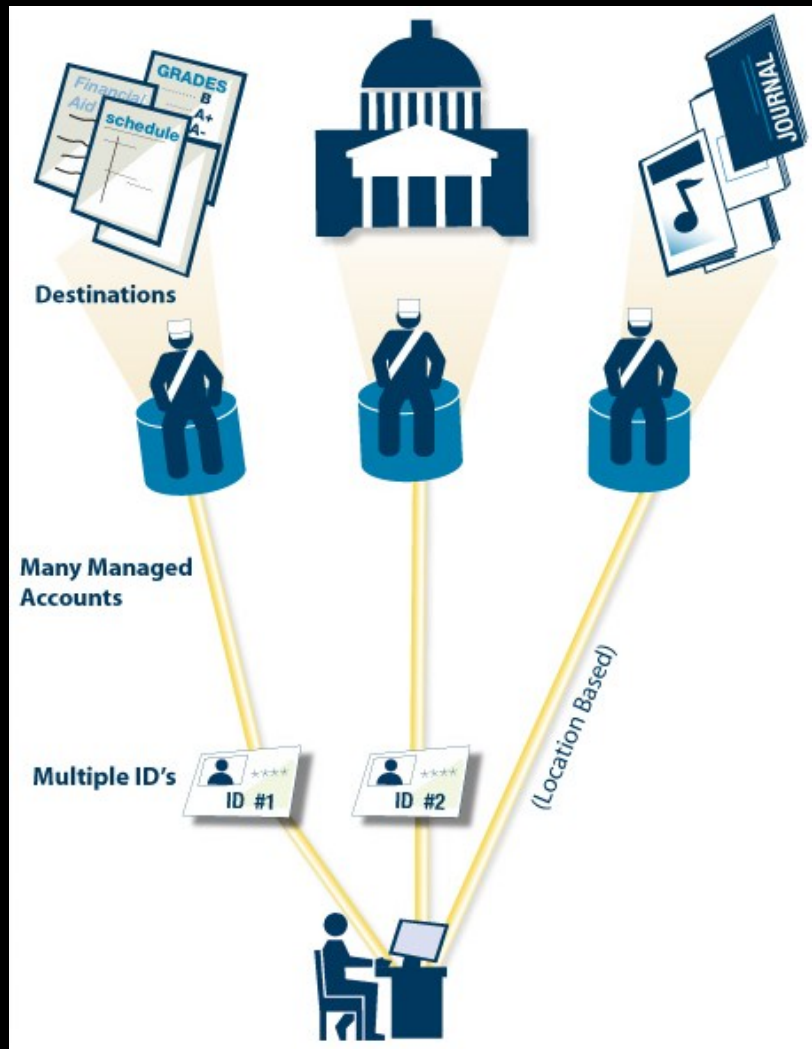
# InCommon

- U.S. access and identity management federation
- Manages a shared trust environment
- Technology based on globally adopted standards
- Members include:
  - Higher education
  - Federal research labs
  - Government agencies
  - Online service providers





# InCommon Model, before & After



# The InCommon Cert Service

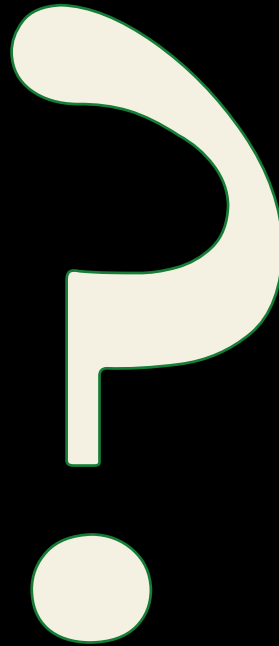
- Created by and for the higher education community
- Provides unlimited SSL certs for one fixed annual fee.
- Servers and plans to soon add EV and personal signing certificates
- All domains owned by the university are included (such as a professional society or athletic department)



# Sponsored Educational Group Participants (SEGP)

- In 40 States
- Provide advance networking services to schools, libraries & museums
- Marshall is a SEGP provider for state of WV

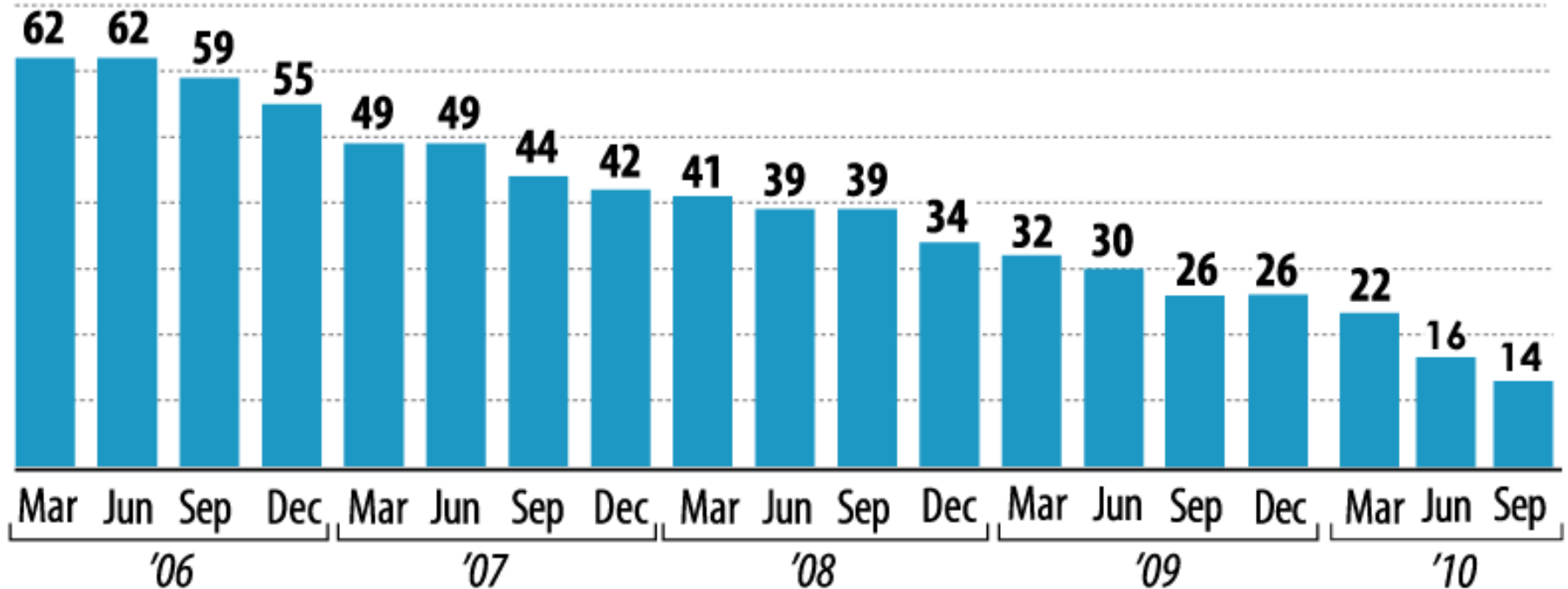
# Questions???





IPv6

# Available IPv4 Space in /8s



In 2010, RIRs have been allocated fifteen /8 blocks as of 11 November, leaving eleven /8s unallocated (11/256 - 4.3%).

# IPV6

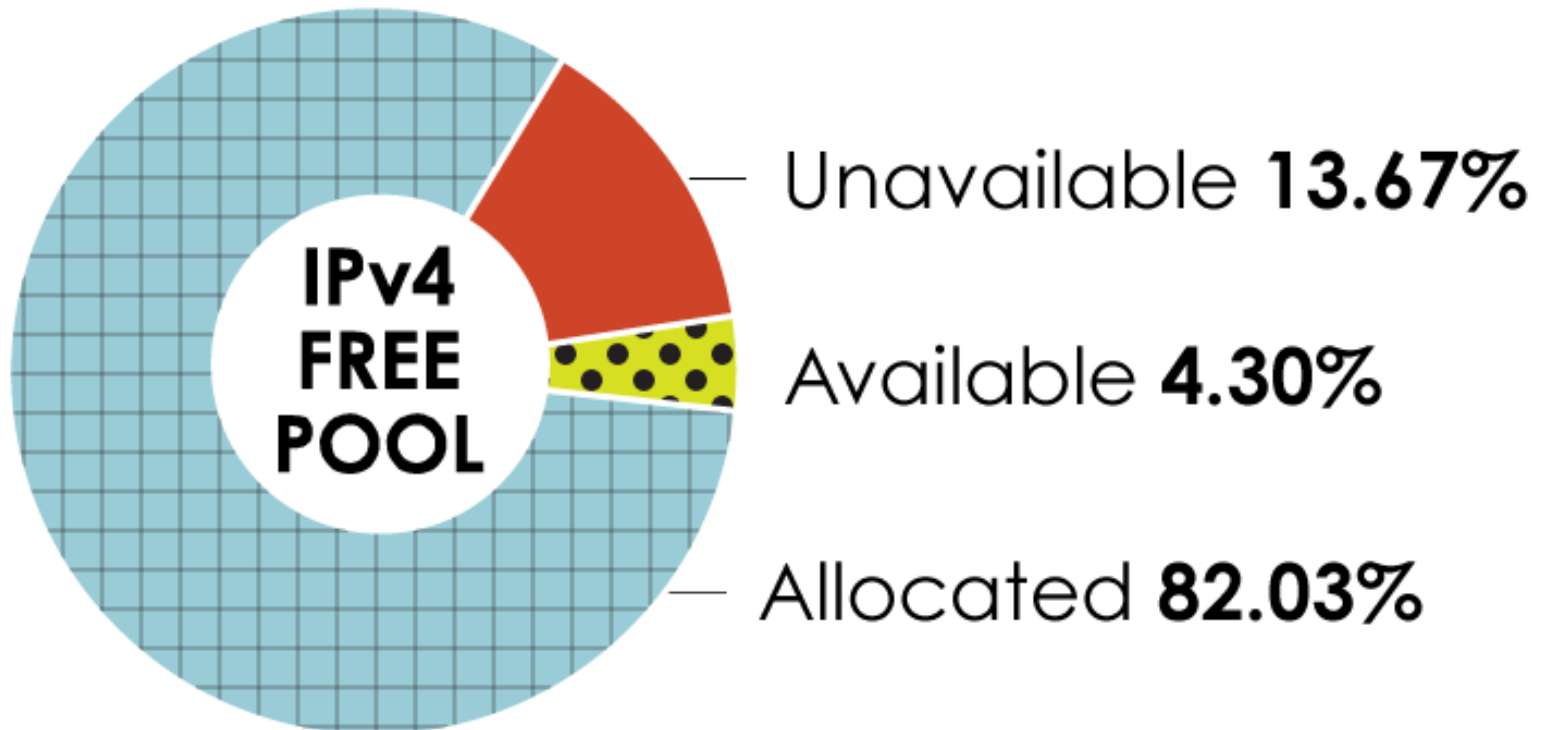
- Design started in 1993 when IETF forecasts showed IPv4 depletion between 2010 and 2017
- Completed, tested, and available for production since 1999
- Total of 340,282,366,920,938,463,463,374,607,431,768,211,456 IP addresses available
- Used and managed similar to IPv4

# IPv4 vs IPv6

IP version	IPv4	IPv6
Deployed	1981	1999
Address Size	32-bit number	128-bit number
Address Format	Dotted Decimal Notation: 192.0.2.76	Hexadecimal Notation: 2001:0DB8:0234:AB00: 0123:4567:8901:ABCD
Number of Addresses	$2^{32} = 4,294,967,296$	$2^{128} = 340,282,366,920,938,463,463,374,607,431,768,211,456$
Examples of Prefix Notation	192.0.2.0/24 10/8 (a "/8" block = $1/256^{\text{th}}$ of total IPv4 address space = $2^4 = 16,777,216$ addresses)	2001:0DB8:0234::/48 2600:0000::/12

Source: Arin 2011

# IPv4 Address Space Utilization



\*as of 11 November 2010

# Why IPv6?

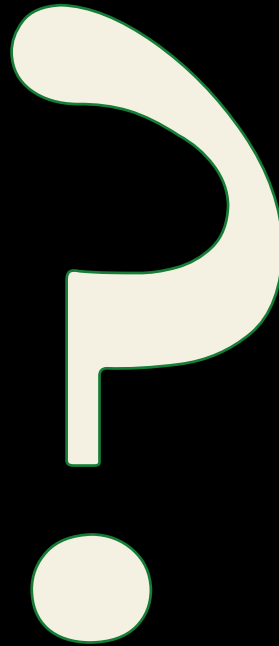
- You want access to the **entire** Internet, and this means IPv4 and IPv6 websites
- Content must be reachable to **all** users.
- New users and organizations will have IPV6 only
- New resources will have IPV6 only



# Where is Marshall at?

- IT representative on Internet2 IPV6 working group
- 1.208 octillion IPv6 addresses
- 1,208,907,372,870,555,465,154,560 IPv6
- Planned deployment: **Spring 2011**

# Questions about IPv6???





**HUBzero™**

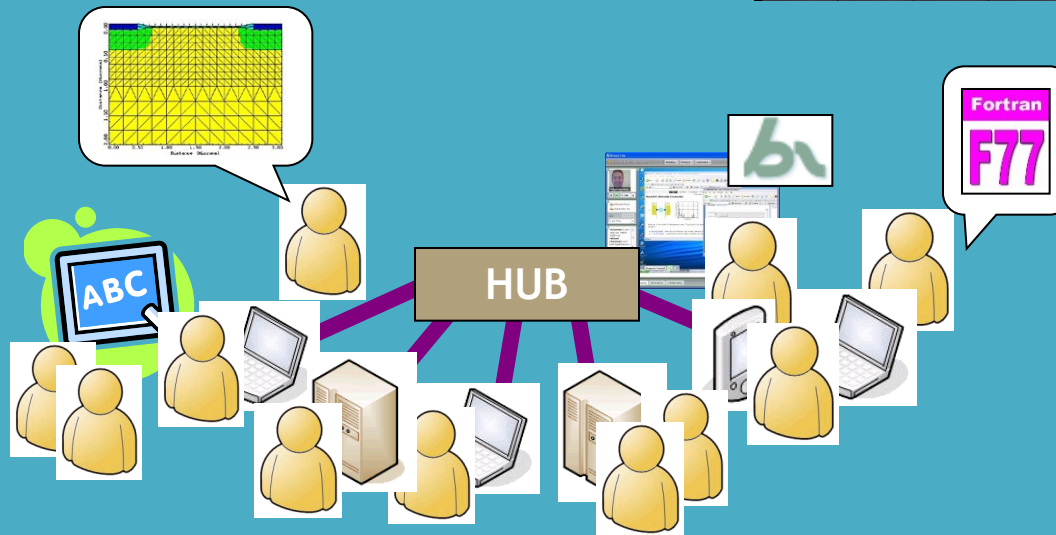
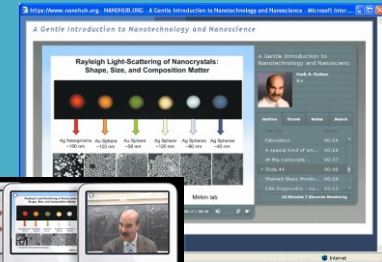
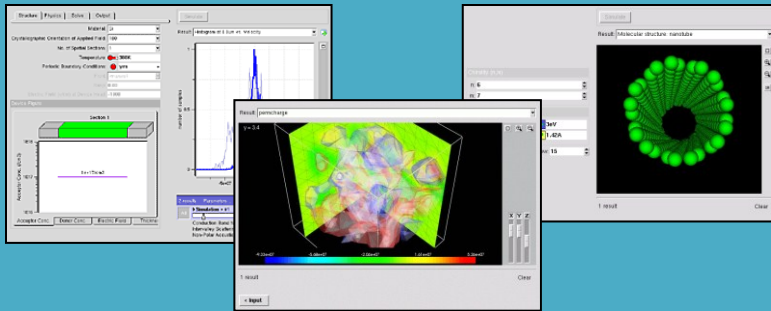
Scientific research & education  
collaboration platform

- A platform used to create dynamic web sites for scientific research and educational activities
- Allow users to easily publish research software and related educational materials on the web
- Infrastructure to create an environment in which researchers, educators, and students can access tools and share information

# Cyberinfrastructure = HUB

*Online simulation...*

*...and more!*



# HUBzero Features

- Interactive Simulation Tools
- Online Presentations
- Mechanism for Uploading New Resources
- Tool Development Area
- Ratings and Citations
- Content Tagging
- Wikis and Blogs
- User Groups for Private Collaboration
- Usage Metrics
- News and Events
- Feedback mechanisms

# Example: nanoHUB.org

nanoHUB.org - Simulation, Education, and Community for Nanotechnology - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://nanohub.org/

Search

Login Register

Home My HUB Resources Members Explore About Support Help!

ONLINE SIMULATION AND MORE

## Do you Teach

Teaching introductory quantum mechanical principles in an electrical engineering or physics curriculum

AQME Quantum Mechanics for Engineers

Usage for prior 12 months

Users	90275
Resources	1543
Tools	137
Simulations	394918

Who's online? More >

### SIMULATE

### RESEARCH

### TEACH & LEARN

### CONTRIBUTE

### NANO NETWORKS

- National Nanotechnology Infrastructure Network
- National Center for Learning and Teaching in Nanoscale Science and Engineering
- International Institute for Nanotechnology

### FEATURED TOOL

**Crystal Viewer Tool:** Visualize different lattices and planes

### FEATURED ONLINE PRESENTATION

**Ionic Selectivity in Channels:** complex biology created by the balance of simple physics: An important class of biological molecules—proteins called ionic channels—conduct ions (like  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Ca}^{2+}$ , and  $\text{Cl}^-$ ) through a narrow ...

### FEATURED PROFILE

**Eric Jakobsson:** Eric Jakobsson, Ph.D., is a faculty member in the department of Molecular and Integrative Physiology at the University of Illinois at ...

### TOP TAGS

- algorithms
- carbon nanotubes
- course lecture
- devices
- education/outreach
- material science
- molecular electronics
- nano/bio
- nanobio applications
- nano electro-mechanical systems
- nanoelectronics
- nanomedicine
- nanophotonics
- nano-transistors
- NEGF
- quantum transport
- research seminar
- transistors
- tutorial
- uiuc

### RESOURCES



# nanoHUB Usage Statistics

*90,000 users worldwide*

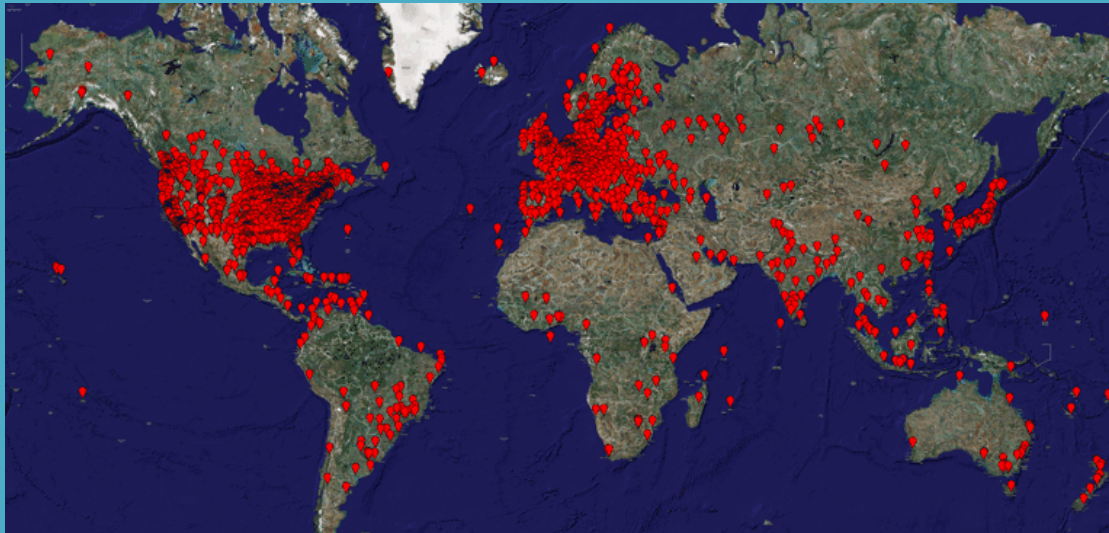
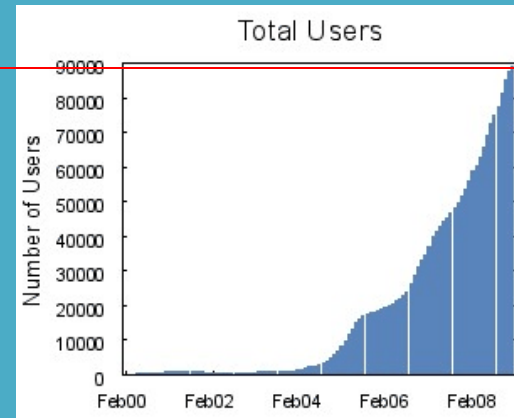
>5,000,000 hits/month

All Top 50 US Engr Schools

14% of all .edu domains

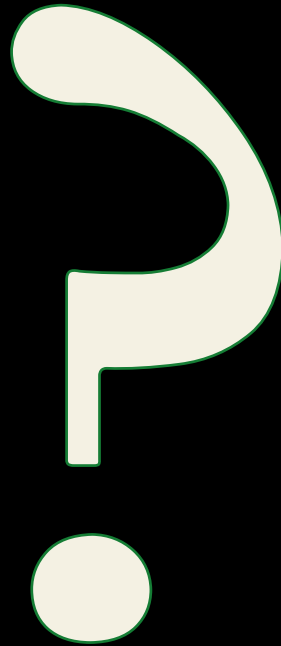
333 International Ed Institutions


233 US K-12 schools





# Questions about HUBZero???





# Cyberinfrastructure Day

Marshall University | April 7, 2011

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## FREE Conference

- ◆ Learn about the power of technology and supercomputing to enhance research, teaching and external funding!
- ◆ See how others are using CI at Marshall and around the state and region!
- ◆ Find out what national resources are available and how to access them!
- ◆ Present your research at a poster session!
- ◆ Network with colleagues!

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## Who Should Attend?

Faculty, Staff and Students from Any Field and All Institutions  
Researchers  
High-Tech Business Community  
Technology Providers  
Government Agencies  
Anyone interested in CI!

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Register today!

[www.marshall.edu/ciday](http://www.marshall.edu/ciday)



Made possible through a grant from the National Science Foundation.

