NSF, INTERNET2 & UNIVERSITY OF DAYTON

About UD:

- Private, Catholic University – 11,000 Students
- $81 Million in Annual Research – 2012
  - Ranked #160 by NSF National Center for Science & Engineering Research
  - Engineering-intensive - Ranked #2 Nationally for Materials Research
- Won NSF CC-NIE Network Infrastructure Award in 2013
- Joined Internet2 in 2013 – Driven by NSF Grant.
  - Level 2 Member – “High Research Activity”

The Internet2 Journey:

- CIO since 2004 – Took Nine Years to Move to Full Internet2 Membership
  - “Sponsored Educational Group Participant” Membership Allowed us to Claim Internet2 membership “in name only.”
  - In reality, the SEGP limited bandwidth made the membership meaningless and hurt the value proposition for a full membership!
4634
TOTAL U.S. HIGHER EDUCATION INSTITUTIONS*

*Carnegie Classified Institutions
655
HIGHER EDUCATION INSTITUTIONS IN U.S. EXPENDING $150,000 OR MORE ON R&D IN 2012*

*NSF National Center for Science & Engineering Statistics, 2012 Survey
$65.8 BILLION
TOTAL R&D EXPENDITURES BY U.S. HIGHER EDUCATION IN 2012*

*NSF National Center for Science & Engineering Statistics, 2012 Survey
266
INTERNET2 HIGHER EDUCATION MEMBERS*

*As of January 8, 2015
$58.9 BILLION
TOTAL R&D EXPENDITURES BY INTERNET2 MEMBERS IN 2012

That’s 89.5% of the entire R&D pool!
Nearly 90% of all higher education R&D funds are expended by Internet2 members.
## Internet2 Members R&D Expenditure Profile

<table>
<thead>
<tr>
<th>Internet2 Higher Education Institutions: Classification</th>
<th>All Carnegie Institutions(^1)</th>
<th>All Internet2 Members(^2)</th>
<th>2012 R&amp;D Expenditures(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1: Very High Research Activity</td>
<td>108</td>
<td>108</td>
<td>$47.8 Billion</td>
</tr>
<tr>
<td>Level 2: High Research Activity</td>
<td>99</td>
<td>79</td>
<td>$6.0 Billion</td>
</tr>
<tr>
<td>Level 3: Doctoral, Large Masters, Medical</td>
<td>556</td>
<td>54</td>
<td>$4.2 Billion</td>
</tr>
<tr>
<td>Level 4: All Other Carnegie Classifications</td>
<td>3871</td>
<td>25</td>
<td>$0.9 Billion</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4634</strong></td>
<td><strong>266</strong></td>
<td><strong>$58.9 Billion</strong></td>
</tr>
</tbody>
</table>

\(^1\) [http://carnegieclassifications.iu.edu/resources/](http://carnegieclassifications.iu.edu/resources/)

\(^2\) [http://www.internet2.edu/communities-groups/members/higher-education/](http://www.internet2.edu/communities-groups/members/higher-education/) (as of January 8, 2015)


- It Could be Argued that this Elite Group of 266 Schools Drive the Research and Innovation Agendas for all of Higher Education.
WHERE TO NEXT?

- Given the dominance of Internet2 schools in R&D expenditures, why expand membership?
  - **Institutional Interest**: The Cost of Internet2 Is Increasing as the Network Expands. We Need to Spread Those Costs.
  - **National Interest**: Sustaining the Broad-Based Excellence of U.S. Higher Education Requires that Scholars and Researchers have Unconstrained Access to Data, Tools, and Applications.
  - **Global Interest**: World-class Researchers Operate in a Borderless Educational Environment.
Membership in Levels 1 & 2 are extremely robust.

Level 3 Membership Growth is Critical for the Future of Internet2 and Offers Opportunity
Value propositions for these institutions must extend beyond “Pure R&D Expenditures.”
Small and Mid-Sized Schools are questioning the investment:

- “I’m not hearing requests from enough faculty to justify the cost”
- “All I need is more bandwidth on my commodity connection”
- “Budgets are getting tighter, this investment won’t win out over other critical needs”
Internet2 Investments at Medium to Smaller Schools are Facing Challenges:

1. IT & Administrative Leadership Do Not See a Difference in Internet2 and Commodity Internet Services

2. The Perceived High Annual Cost of Internet2 Memberships Are Barriers for Some Institutions

3. Many smaller schools have difficulty articulating benefits beyond the “sponsored research” uses.
CREATING THE FUTURE...

“When we equip lots of really smart people with really great technology and no barriers, that’s when they start creating the future.”

David Lambert
President & CEO
Internet2

The higher education technical community has a critical role to play in not only deploying and sustaining high performance cyberinfrastructure - but also in telling the story as to why these technologies are so critically important to the future of higher education.
The original $250 Million investment in the development of the Internet has resulted in a global market that is now worth $1.4 trillion annually.

“The critical aspect of any educational institution now is recognizing that it doesn’t happen within their four walls – it’s a borderless world. Internet2 provides that borderless environment.”

Shelton Waggener, Senior VP | Internet2

www.internet2.edu/.../executive-insights/strategic-leadership/
CHANGING NATURE OF DISCOVERY & LEARNING

- From **Hypothesis** Driven to **Data** Driven
- NSF’s Farnam Jahanian contends that this is a paradigm shift that will place substantial demands on our high performance cyberinfrastructure.
- Smaller institutions may be undervaluing the need and importance of high performance computing.
  - All areas of educational endeavor – including the humanities and social sciences - will be embracing the new scholarly opportunities presented by big data.
  - “In a world awash with data from systems and sensors of all kinds, scientists and philosophers alike will be grappling with an array of academic questions that will demand unconstrained access to troves of big data.”
Is there an “Internet2 Advantage” for institutions that see their mission primarily as “educational?”

- Faculty and students engaging in research is the aspiration and mission of most every institution.

- The future of “impactful scholarship” will require “remote access” to data, research tools and collaborators.

- We need to demonstrate that Internet2 is the most compelling way to achieve those goals.
FROM 20,000 FEET: INTERNET2 “RELATIVE ADVANTAGES”

Faculty & Student Benefits:

- Remote Access to Tools, Applications & Data
- Assured Capacity, Speed & Low-Latency
- Unmatched Reliability, Accuracy and Security
- Engagement in a Community of Scholars and Collaborators

Institutional Benefits:

- Promise of Innovation
- Advancing Faculty Development
- Strengthening Institutional Competitiveness
- Elevating Academic Reputation
- Lowering or Avoiding Cost while Enhancing Student Learning Opportunities
WE NEED OPINION LEADERS TOUTING THE RELATIVE ADVANTAGES OF INTERNET2

- Attracting and retaining outstanding faculty by
  - supporting teaching and research through robust resources that connect scholars and mentors in a borderless environment
  - providing latency-free remote access to tools and technologies that were previously unavailable at smaller schools
  - enabling ultrafast and accurate downloading of datasets for research and teaching

- Engaging students beyond the confines of campus by
  - connecting students via high definition interactive systems with leading experts in their fields – and conducting on-line real-time lab experiments and demonstrations.
  - collaborating with Supercomputer Centers on a course that provides students with remote access to the world’s most powerful computational environments.
COMPATIBILITY, COMPLEXITY, TRIALABILITY & OBSERVABILITY

Inoculate Against the Counter Argument:

1. How do I justify the costs?
2. Where will you take me that I can’t already get to with my Commodity Pipe?
3. I don’t have enough depth in my technical staff to manage this complexity?
4. Can we try it for free and see if we like it?
5. What metrics do you have to prove the benefit?
6. What evidence can I provide to my non-technical community that demonstrates the value of this connection?
7. What exclusivity does Internet2 provide that my faculty will be most interested in seeing?
1. **Brand it**
   - Users need to know when they are “traveling on Internet2”

2. **Showcase the “Unique Value” of Internet2**
   - Demonstrate how Internet2 “amps up” the opportunities for teaching and research collaboration.
     - Do we need an Internet2 “App Store” for teachers?
     - Portal to “Borderless Resources” for Scholarship and Teaching
     - Should there be an Internet2 Scholarship & Teaching Portal?

3. **Demonstrate how Internet2 enables deeper engagement for active scholars and teachers**
   - Internet2 can do “big data” better than anyone – Access to data and tools is a core strength.
   - The new “data driven” science community will have greater and faster access to the tools and data sources that support the intellectual work of faculty and students at all sizes and shapes of academic institutions
Science DMZ Stories: Ensuring High-Quality HD Video & Multichannel Interactions

- Cross-institutional Nanotechnology STEM Education and Workforce Training

- **Goal:** Bring high-end laboratory environments to high school and college students via alternative delivery methods that provide interactive nanotechnology laboratory experiences.

Dr. Andrew Sarangan, Electro-Optics
Investigating patterns of precipitation change as a result of global climate change, and projecting future precipitation changes

Goal: rapidly and accurately move massive climate study data to the Ohio Supercomputer Center in Columbus Ohio from the University of Dayton Campus for remote processing and analysis.

Dr. Shuang-ye Wu, Geology
SCIENCE DMZ STORIES: OPERATE REMOTE INSTRUMENTATION WITH EXTREMELY LOW LATENCY

- Support world-class materials characterization research by enabling remote access and manipulation of instrumentation located at the Ohio State University Center for Electron Microscopy and Analysis (CEMAS)

- **Goal:** Efficiently and productively share highly scarce scientific instruments via an ultra high speed/low latency network connection between UDayton and OSU.

Dr. Charlie Browning, Materials Engineering
Collaborative Research on Human Centric Intelligence, Surveillance & Reconnaissance (ISR) Sensors between UDayton and Central State University

Goal: Develop signatures for human activity recognition and threat detection by analyzing data captured by multiple sensors that will distinguish normal and abnormal gait behaviors caused by additional weight placed on the body.
"While we must find new ways to manage the volume and velocity of data, transparency about the tools used to help produce data will both reassure and enable researchers to test and reproduce it more easily – and thereby help to speed discovery and innovation."

Shirley Ann Jackson
President - RPI

www.internet2.edu/.../video-kit/#innovators
TO THE POINT: “Unconstrained Collaboration, Unparalleled Community, Unprecedented Technologies.”

1. High Performance Cyberinfrastructure is Critical to the Success of All Higher Education Institutions.

2. The Internet2 Community is the Essential Enterprise for Advancing Cyberinfrastructure Innovation in Higher Education.

3. Growing the Internet2 Community Beyond its Core of Research-Focused Institutions is Key to Higher Education’s Transformation into a “Borderless Learning & Scholarship for the 21st Century”

4. The “Value Proposition” of Internet2 Must Address the Needs, Interests and Financial Capabilities of Medium to Small Universities and Colleges.

5. The Internet2 Technical Communities are Critical Partners in Implementing the Tools and Practices that will Help us Capture the Stunning Metrics, Compelling Examples and Observable Benefits needed to Grow Internet2 into a Resource for all Higher Education Members.