

Cyberinfrastructure as a strategic university asset

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For Hessian HPC Competence Center Leaders

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**RESEARCH
TECHNOLOGIES**

INDIANA UNIVERSITY
University Information Technology Services



**PERVASIVE TECHNOLOGY
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First a language issue

Cyberinfrastructure (primarily an US term): Cyberinfrastructure consists of computing systems, data storage systems, advanced instruments and data repositories, visualization environments, and people, all linked together by software and high performance networks to improve research productivity and enable breakthroughs not otherwise possible. (Stewart, 2007)

eScience (primarily an EU term): “In the future, e-Science will refer to the large scale science that will increasingly be carried out through distributed global collaborations enabled by the Internet. Typically, a feature of such collaborative scientific enterprises is that they will require access to very large data collections, very large scale computing resources and high performance visualization back to the individual user scientists.” (National e-Science Centre, 2010)

Probably cyberinfrastructure = eScience + support staff



- Background about myself and about IU
- User service and e-learning
- Software for business functions: Quali
- Networking
- Research
- Assessment and Governance
- Some lessons learned and thoughts about the future



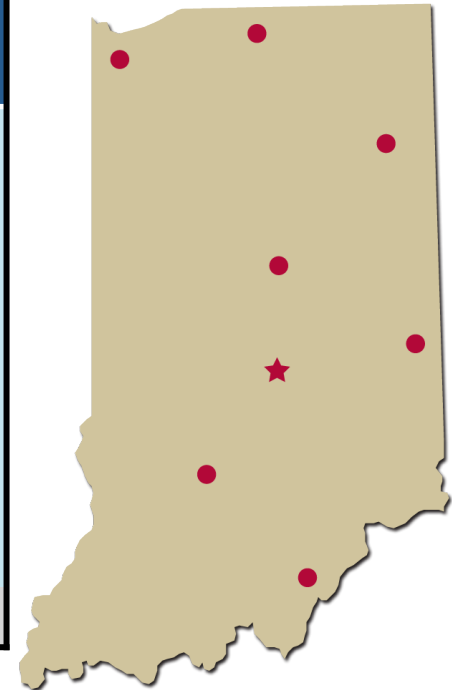
Key Events in my Professional History

1981	Graduated with BA in biology and mathematics from Wittenberg University (Springfield, OH). Started as graduate student at Indiana University in biology.
1982	Met Marion Krefeldt (in Bremen geboren)
1984	Switched from being teaching assistant in biology to assistant consultant with Bloomington Academic Computing Services, starting with Lotus 1-2-3 Key Disks.
1985	Full-time appointment at BACS Information Center (Service Desk).
1986	Manager, Business Computing Facilities (IU School of Business), finished Ph.D. in Biology
1991	Manager, Center for Statistical and Mathematical Computing (UCS).
1995	Manager, University Computing Services Support Center.
1996-7	Senior Manager, Assistant Director, Acting Director, Director research and academic computing
1997	Michael McRobbie arrived at IU from the supercomputing center at ANU to become IU's first full VP for IT and CIO and reorganized IT organization into University Information Technology Services.
1997	US Dept. of Commerce imposes a 4X tariff on purchase of Japanese supercomputers within the US
2005	April Fool's Day: Promoted to Associate Vice President for Research and Academic Computing and COO of Pervasive Technology Labs
2008	Associate Dean for Research Technologies, Executive Director of Pervasive Technology Institute.
	<i>Key point: I have been around a long time – from when IU was unimportant in IT to when IU was sued by Metallica to having the #23 system on the Top500 list. Long enough to see technological and cultural change happen at IU, lead some of it, and learn from all of it</i>



IU – Founded in 1820

Campus	Academic appointees	Nonacademic Staff	Undergrad Students	Grad. & Prof. Students
IUB	2,942	5,379	32,371	9,762
IUPUI	3,895	4,449	22,271	8,180
IU Northwest	425	243	5,636	548
IU South Bend	542	305	7,860	630
IU East	267	159	4,052	134
IP Fort Wayne	N/A	N/A	N/A	N/A
IU Kokomo	191	138	3,581	138
IU Southeast	498	243	6,203	701
Totals	8,760	10,916	81,974	20,093



1,200 degree programs

IU community: 121,743 people total

1.2 million credit hours per semester

Two core research/education campuses, six regional campuses

Tuition and mandatory fees per year: \$10,209 FY 13/14 for IUB Undergrads





IU Budget Category	2012/2013 Budget
Unrestricted	\$2,155,174,476
Restricted	\$640,532,854
Auxiliary	\$403,026,761
Total	\$3,198,734,091



Indiana University Health

IU Health Patient Metrics – 2012/2013	
Admissions	143,219
Outpatient visits	2,244,320
Staffed Beds	3,326

- No engineering
- No agricultural research
- No Veterinary school



IU Bloomington Annual Budget (~ 40,000 people)

OPERATING INCOME			EXPENSES		
	%	\$US		%	\$US
Tuition (35.5%)	36%	\$304,836,512	Compensation & benefits	65%	\$712,789,200
Grants and contracts	16%	\$136,532,410	Student financial Aid	6%	\$63,696,000
Other operating revenue	10%	\$82,434,662	Energy and utilities	3%	\$28,201,600
Auxiliary Enterprises	12%	\$103,043,328	Travel	2%	\$18,898,000
State Appropriations	17%	\$148,554,131	Supplies, general expense	19%	\$208,725,200
Investment Income	2%	\$13,739,110	Depreciation/amortization	5%	\$56,306,400
Gifts	3%	\$29,195,610	TOTAL		\$1,088,616,400
Other nonoperating	5%	\$40,358,637			
TOTAL		\$858,694,400			

FY 12-13 IU FOUNDATION

Contributions	\$50,783,283
Investment Income	\$63,964,288
IU FOUNDATION TOTAL	\$114,747,571

FY 12-13 FINANCING

Debt payments	\$387,693,200
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Office of the Vice President for Information Technology and Chief Information Officer

CIO for the entire university

“The Indiana University Office of the Vice President for Information Technology and Chief Information Officer provides leadership for the continued development of a modern information technology environment throughout the university. **The primary responsibility of this office is the development and use of information technology in support of the university's vision for excellence in research, teaching, outreach, and lifelong learning.** University Information Technology Services reports to the Office of the Vice President for Information Technology.”

NB: The text in bold is our strategy; everything else is tactic



Office of the VP for Information Technology

Staffing and Budget

Category	FTEs	Distinct Individuals
Academic	11	11
Student Academic	2	8
Appointed Professional Staff	967	977
Hourly Staff	126	505
Total	1,106	1,501

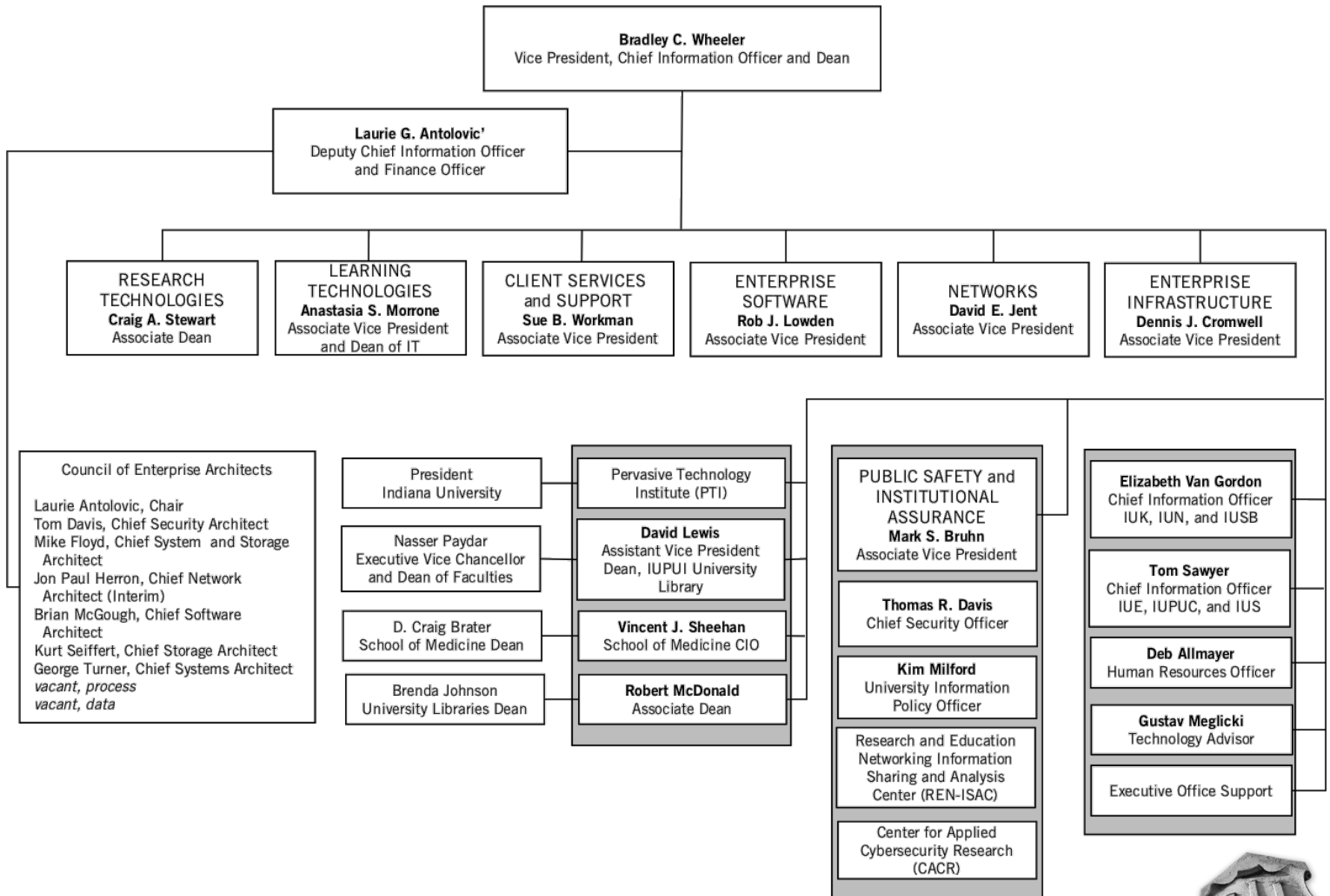
Budget

~\$120 M US / year

Of this, roughly \$13 M US / year is from grants and contracts, primarily federal research grants and contracts

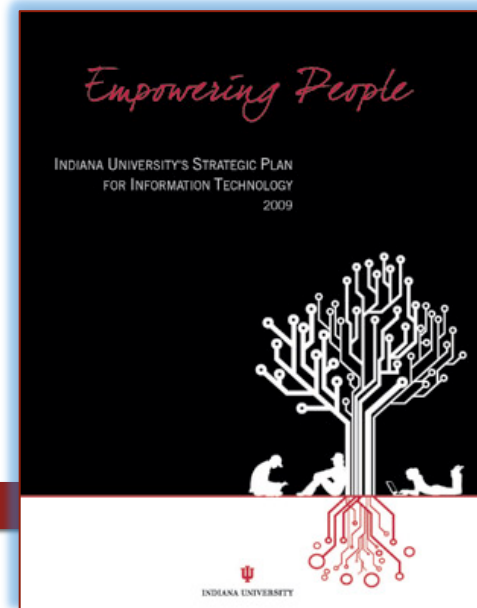


Office of the VP for Information Technology and CIO



IU goals

- To be a leader, “in absolute terms for uses and applications of IT” (Myles Brand, 16th President of IU, 1996)
 - In 1996 IT services at IU were so bad people laughed at this goal
 - Modems were always busy
 - Research computing was inadequate
 - Services were not well organized
- Two IU IT Strategic Plans
 - 1998 plan – get technology right
 - 2005 plan – serve needs of IU community specific to different roles
- To be one of the great public universities of the 21st Century (Michael A. McRobbie, 18th President of IU, 2005)



1998 – Indiana University Information Technology Strategic Plan: Architecture for the 21st Century

A University IT strategic plan – *not a strategic plan for the university IT organization*

10 Recommendations, 68 Actions

Theme: Get the technology stacks right (We did not have them right in 1997.)

Financing

Network access *“In the language of today's technology, “No busy signals!”*

Incentivize use of IT

Teaching and learning IT

Research

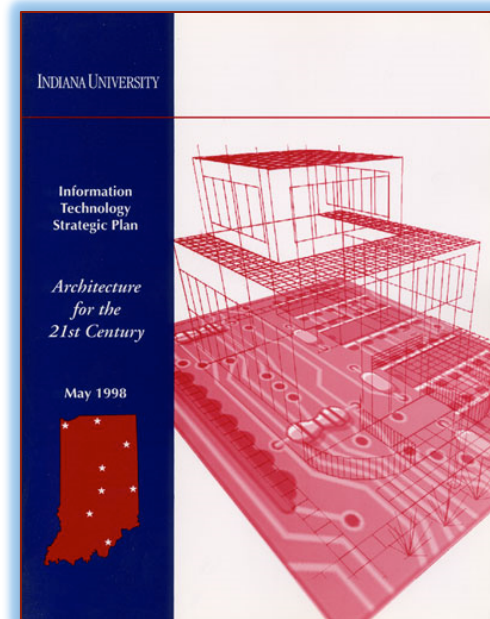
Student systems

Telecomm convergence

Learning IT

Digital libraries

Policies



2008- 2nd IU IT Strategic Plan, Empowering People

The hard part: role-centric view: 15 Recommendations, 72 Actions.

<http://ep.iu.edu>

IT Foundations

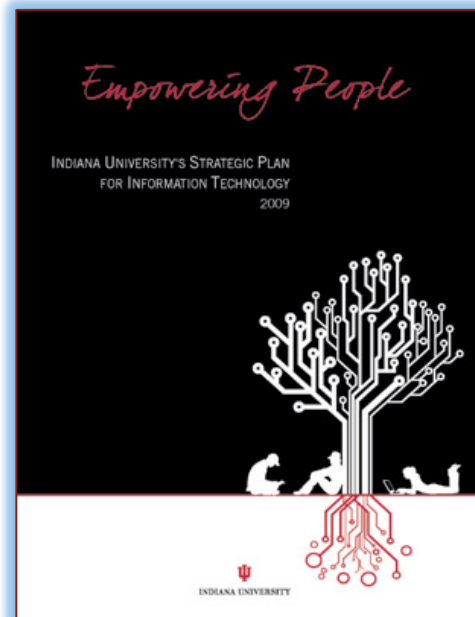
1. Infrastructure
2. Networks
3. Collaboration
4. Financials
5. Security
6. Environment
7. IT Staff

Human-centric IT

8. IT Development
9. Institutional Data
10. Student Success
11. Engagement Beyond

Grand Challenges

12. Scholarly Record
13. Health Care
14. Teaching & Learning
15. Research & Scholarship



A few non-research service examples



Starting in 1995, users were trained to consult the knowledge base first: “Do you have a web browser? Great. Go to <http://kb.iu.edu>. Got it? Great. Search on <whatever>. See the question Entitled <something>? Great. Read it, follow the directions, call us back if you have any more problems.

The screenshot shows the University of Indiana Knowledge Base website. At the top left is the IU logo and the text "INDIANA UNIVERSITY". Below this is the header "University Information Technology Services" and "KNOWLEDGE BASE". A search bar contains the text "eduroam" and has a "Search" button. To the right of the search bar are options for "Include archived documents" (unchecked) and "Search results per page" (set to 15). Below the search bar is a navigation menu with "Home", "Menus", "Glossary", and "Help". A "Login>>" link is also present. The main content area displays "Showing Documents 1 - 4 out of 4 for 'eduroam' ." followed by a list of four links: "About eduroam at Indiana University", "As an IU user, how can I connect to eduroam at another institution?", "IP addresses at IUB and IUPUI", and "About wireless connections to the Internet at IU". On the right side, there is a "Chat with a consultant" section featuring an "ITHelpLive" button (noted as "IU login required") and the text "Available 24 hours a day, 7 days a week". The footer contains the IU logo, "UITS Services and Support", "About the Knowledge Base", "KB Comments", "Copyright 2005-2013, The Trustees of Indiana University", and "Copyright Complaints".



UITs Support Center Contacts and Costs

Support Center Contacts – FY 2011/2012			
Type	# / year	\$ / contact*	\$ / year
<i>Human – to - Human</i>			
Email	37,035	\$13.90	\$514,892
Chat	33,667	\$10.44	\$361,562
Walk-in	28,378	\$16.87	\$444,892
Telephone	191,369	\$14.42	\$1,462,304
Total	200,449		
<i>Self-serve</i>			
KB	30,000,000	\$0.047	\$1,396,647

*These costs are draft as of giving of this talk. These represent fully-loaded activity based costs for these services, representing all of the services such as financial management, administration, network management, server management that contribute to the overall service.





PC

Mac

Linux

Featured Software

SOFTWARE

[Academic Resources](#)[Analysis & Modeling](#)[Databases](#)[Design & Production](#)[Development Tools](#)[Multimedia](#)[Network & Printing](#)[Office Tools](#)[Operating Systems](#)[Retired](#)[Security](#)[Utilities](#)[Web & Email](#)

Office 2013

Office Professional Plus 2013. Includes Access, Excel, OneNote, Outlook, PowerPoint, Publisher, and Word.



Windows 8

The latest version of Windows. Only \$20 from the IU bookstore.



Acrobat XI

Edit PDFs far more intuitively. Build forms from scratch in minutes. And more.



Creative Suite 6

Adobe Creative Suite 6 delivers a whole new experience for digital media creation, enabling you to work lightning fast and reach audiences wherever they may be.



IITS Network Repair Tool

Helps troubleshoot and resolve network issues when connecting to IU network.



IU Wireless Wizard

Configure your computer to use the IU secure wireless network.

TRAINING

[IITS IT Training](#)[Download Workshop Materials](#)[All Self-Study Options](#)

Most Popular Downloads

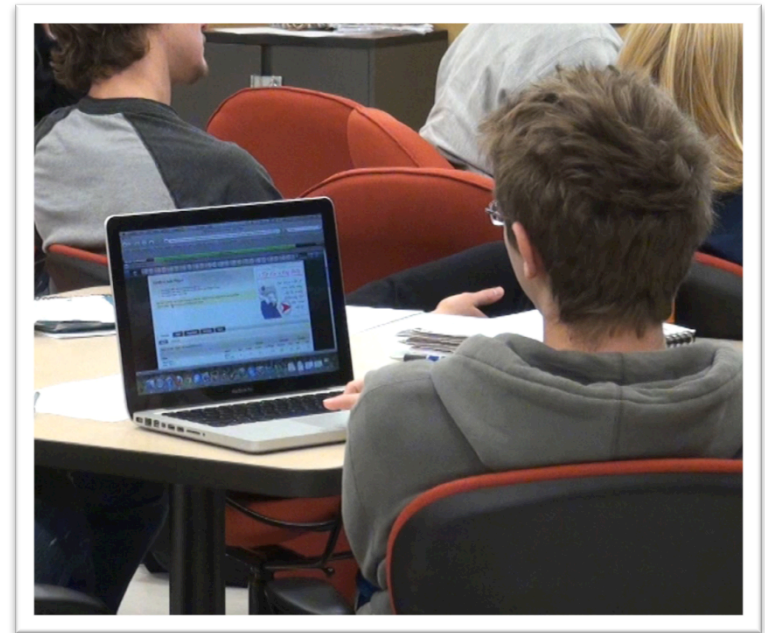
[Office 2013](#)[Creative Suite 6](#)[Symantec Endpoint Protection](#)

Latest Releases

[08/08/2013 - TurningPoint 5](#)[08/08/2013 - ArcPad 10.2](#)[08/08/2013 - ArcGIS Server 10.2](#)

A New Personal Computing Model: Common Good Services

- Microsoft SCCM for managing the machines
- IUanyWARE – Citrix for application and desktop virtualization
- Support for smart devices
- New model of licensing
- Efficiency and effectiveness
- A new model for student labs
- Public and private cloud storage
- Efficient file/print serving



This is how students use computers today (not big rooms of old computers paid for by the university)



Physical textbooks are part of an economic game in which students are generally the losers.

Agreements so far: Cengage Learning, Elsevier Science & Technology Books, Flat World Knowledge, Harvard Business School Publishing, IU Press, MacMillan, McGraw Hill, Pearson, SAGE, Wiley, and W.W. Norton.

Students “lease” access and the cost is included as a course fee, Students gain in ease of access, cost, ability to use the text integrated with eLearning system.

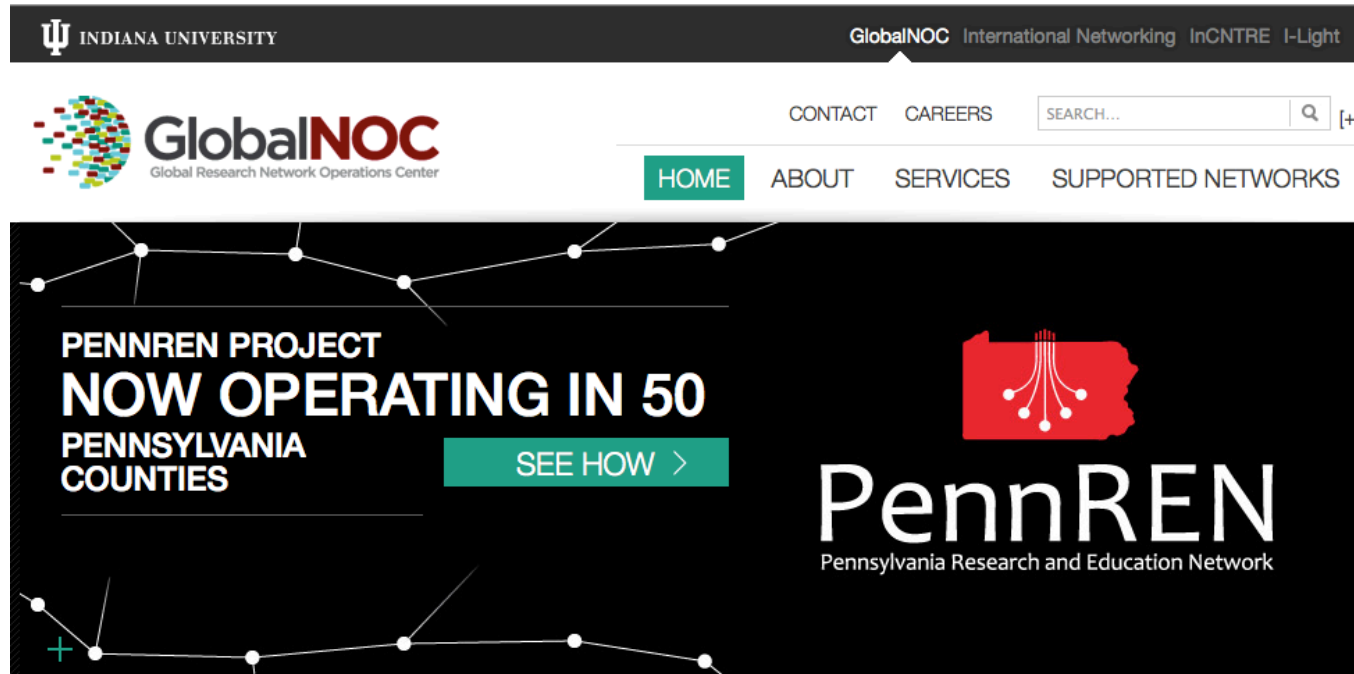
Publishers gain since it puts an end to students using the text without paying.

Faculty have more e-publishing options.

Opt in – Students gain in ease of access, cost, ability to use the text integrated with the eLearning system – ~10,000 students in 250 classes, spring 2013.

Analytics capability added through third-party software.





The screenshot shows the GlobalNOC website homepage. At the top left is the Indiana University logo (Ψ) and the text "INDIANA UNIVERSITY". To the right are navigation links: "GlobalNOC", "International Networking", "InCNTRE", and "I-Light". Below the logo is the "GlobalNOC" logo with the tagline "Global Research Network Operations Center". To the right of the logo is a search bar with "SEARCH..." and a magnifying glass icon, followed by a "[+]" button. Below the search bar are navigation links: "HOME" (highlighted in a teal box), "ABOUT", "SERVICES", and "SUPPORTED NETWORKS". The main content area features a dark background with a network diagram. On the left, it says "PENNREN PROJECT NOW OPERATING IN 50 PENNSYLVANIA COUNTIES" with a teal button that says "SEE HOW >". On the right, there is a red map of Pennsylvania with a network diagram overlay, and the text "PennREN" in large white letters, with "Pennsylvania Research and Education Network" below it.

- **Started as statewide networking organization in Indiana**
- Supports 22 networks or landing points
- National networks (e.g., Internet2)
- International connections (TransPAC, new 100 Gbps link between the US and the EU)



Internet2 and InCommon

Internet2

- started as network organization
- Serves hundreds of universities in the US
- First production 100 Gbps network backbone in US
- Someday there will be no reason to have Internet2 run networks

InCommon

- Meets two needs:
 - Identity management
 - Creates reason for Internet2 to continue existing
- Based on legal certification of quality of local identity management
- Uses XSAML certificates and authentication management
- Supports collaboration
- E.g. Box



Box

Powered by: 

[login](#)

[Terms of Use](#)


[Help](#)

Box is designed as a flexible storage service and collaboration tool, but is not acceptable for any institutional data classified as "limited access/restricted" or "critical".

Please review the [Enterprise Box acceptable use responsibilities](#) for more information.


Tweets



 **Box @ IU** 27 Jun
@BoxAtIU

@BoxHQ never sleeps. New changes coming to the Box interface. See [support.box.com/hc/en-us/artic...](#) for details.

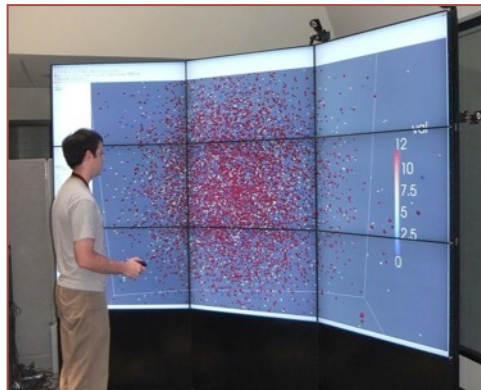
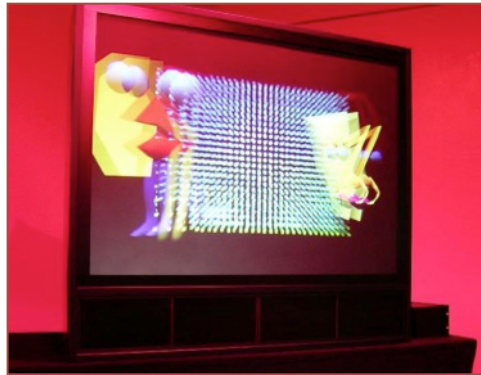
Expand

 **Box @ IU** 24 Jun
@BoxAtIU

Have you upgraded to Firefox 30? If so, you must go in and activate plugins like Box Edit. See [iu.box.com/BoxEditFirefox...](#)

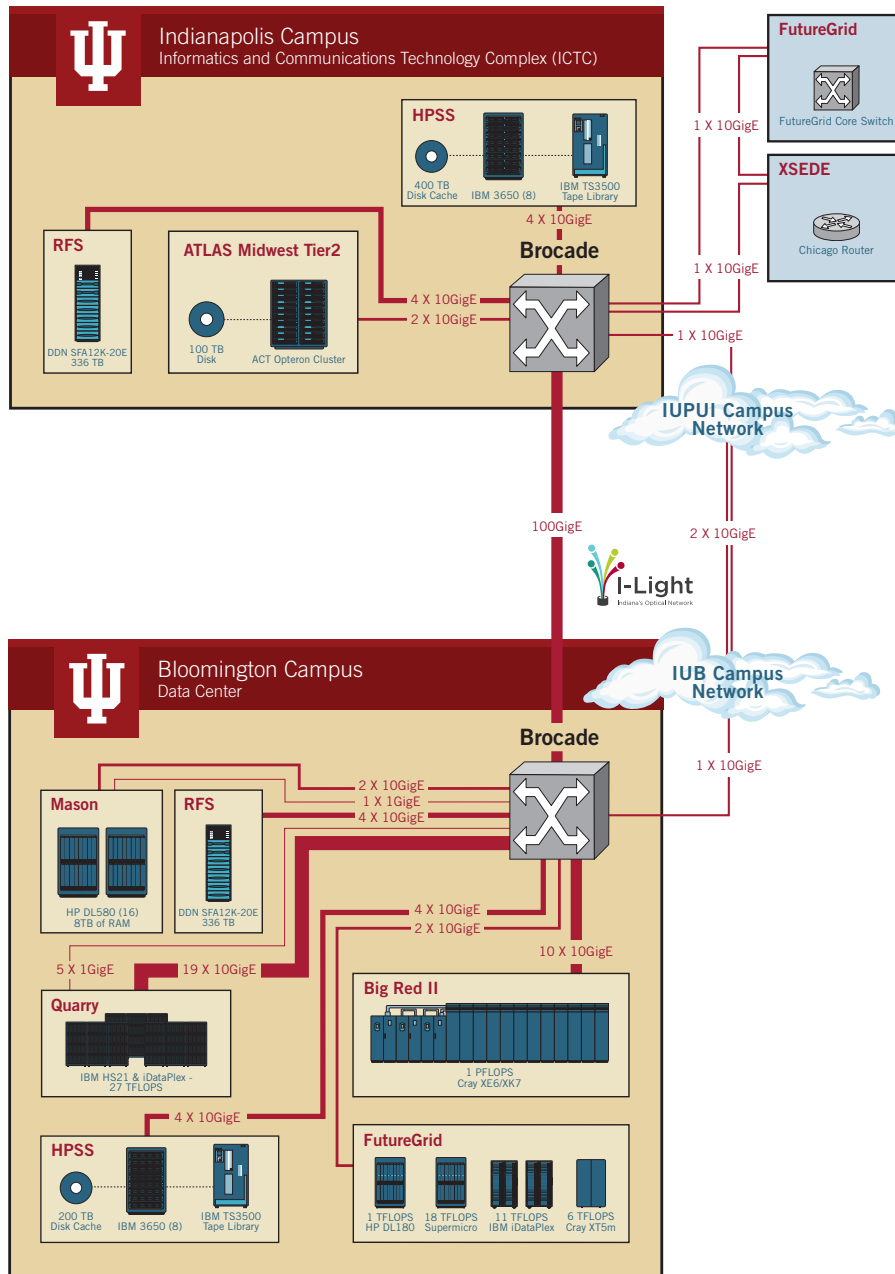
Expand

Tweet to @BoxAtIU



The key issue here: perceived value, perceived ease of use

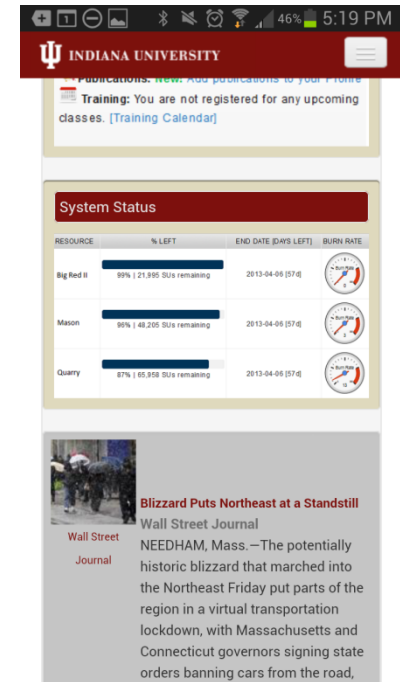






Changing the Way We Interact with Cyberinfrastructure – IU CI Gateway

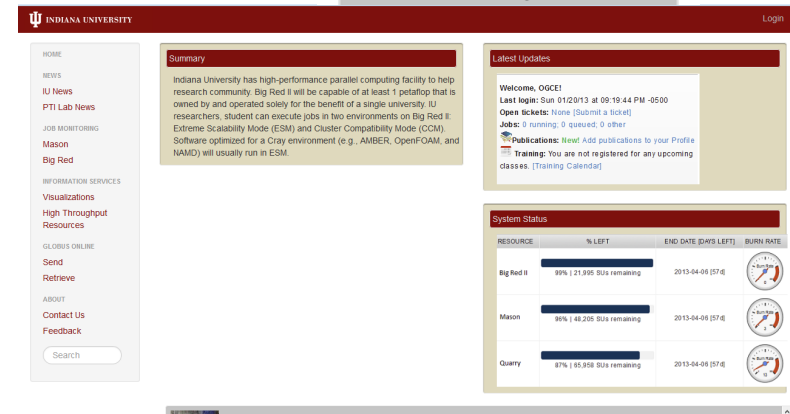
- *Born-mobile Web interface will allow users to access IU cyberinfrastructure from anywhere.*
- Access to IU's Big Red II, Quarry, and Mason computing queues
- File transfers from desktop to IU to national systems
- Information on resource availability, usage
- Accounts secured with CAS and InCommon authentication



Mobile view of the IU CI Gateway interface. The header shows the IU logo and navigation menu. A notification banner reads: "Training: You are not registered for any upcoming classes. [Training Calendar]". Below is a "System Status" section with a table:

RESOURCE	% LEFT	END DATE (DAYS LEFT)	BURN RATE
Big Red II	99% 21.995 SUs remaining	2013-04-06 (57d)	
Mason	96% 48.205 SUs remaining	2013-04-06 (57d)	
Quarry	87% 85.958 SUs remaining	2013-04-06 (57d)	

Below the table is a news article titled "Blizzard Puts Northeast at a Standstill" from the Wall Street Journal, with a small image of a snowy street.



Desktop view of the IU CI Gateway interface. The header shows the IU logo and a "Login" link. A navigation menu on the left includes: HOME, NEWS (IU News, PTI Lab News), JOB MONITORING (Mason, Big Red), INFORMATION SERVICES (Visualizations, High Throughput Resources), GLOBALS ONLINE (Send, Retrieve), ABOUT (Contact Us, Feedback), and a Search box.

The main content area has a "Summary" section: "Indiana University has high-performance parallel computing facility to help research community. Big Red II will be capable of at least 1 petaflop that is owned by and operated solely for the benefit of a single university. IU researchers, student can execute jobs in two environments on Big Red II: Extreme Scalability Mode (ESM) and Cluster Compatibility Mode (CCM). Software optimized for a Cray environment (e.g., AMBER, OpenFOAM, and NAVIO) will usually run in ESM."

Below the summary is a "Latest Updates" section with a welcome message: "Welcome, DGC! Last login: Sun 01/02/13 at 09:10:44 PM -0500. Open tickets: None [Submit a ticket]. Jobs: 0 running, 0 queued, 0 other. Publications: New! Add publications to your Profile. Training: You are not registered for any upcoming classes. [Training Calendar]".

At the bottom right is a "System Status" section with a table identical to the one in the mobile view.



We've supported some REALLY interesting and important research and creative activity along the way.

Higgs boson

One-Degree Imager

Operation Ice Bridge

Daphnia genome

Fetal alcohol spectrum disorder

Indiana CTSI

Cell-surface function

History of philosophy and science

Variations

Ethnography

Music composition

Fine arts

Performing arts



M51 - WHIRLPOOL GALAXY

K. RHODE, M. YOUNG, INDIANA UNIVERSITY/WIYN/NOAO/NSF



Trinity

RNA-Seq De novo Assembly Using Trinity

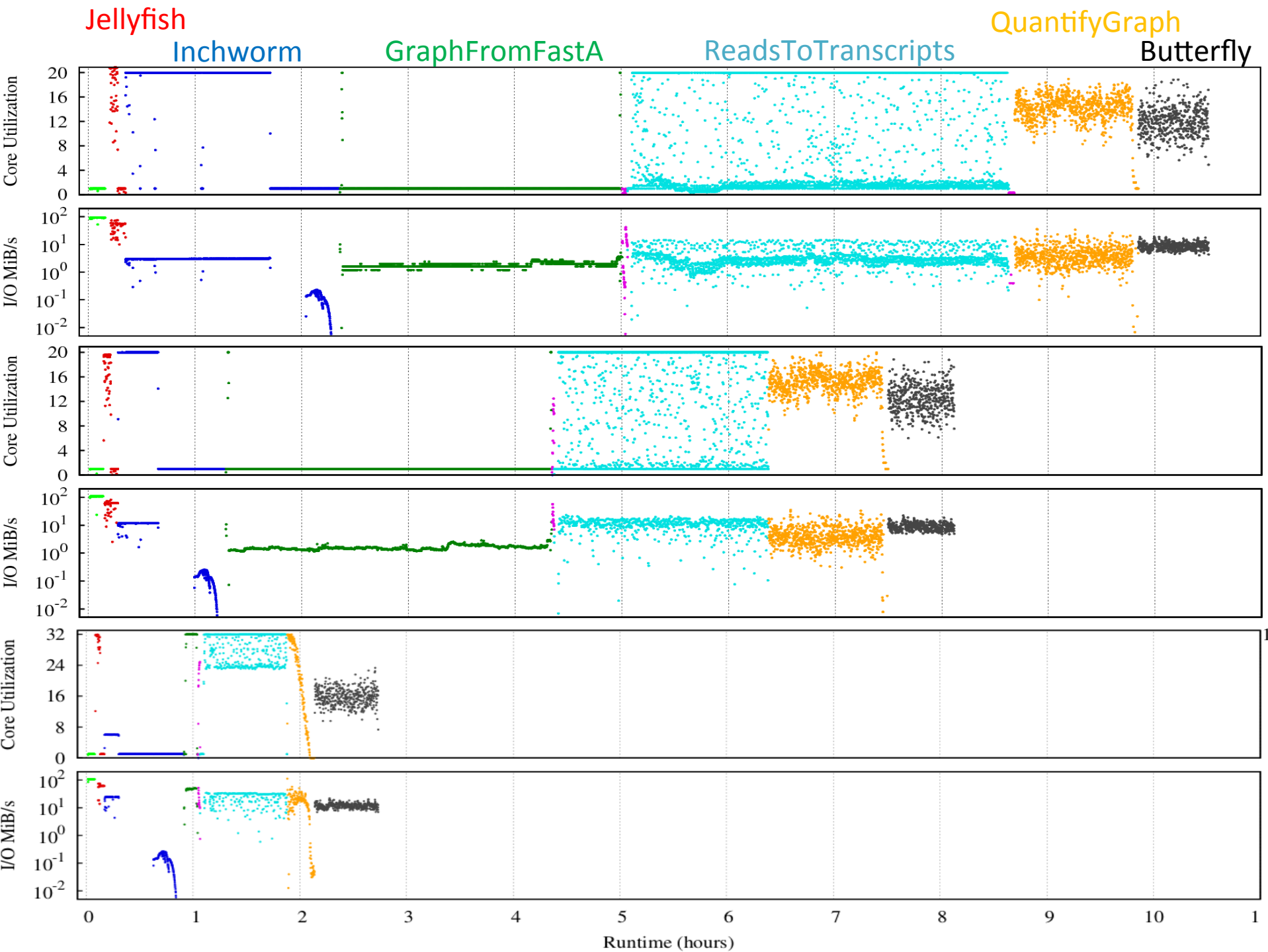


Trinity, developed at the [Broad Institute](#) and the [Hebrew University of Jerusalem](#), represents a novel method for the efficient and robust de novo reconstruction of transcriptomes from RNA-seq data. Trinity combines three independent software modules: Inchworm, Chrysalis, and Butterfly, applied sequentially to process large volumes of RNA-seq reads. Trinity partitions the sequence data into many individual de Bruijn graphs, each representing the transcriptional complexity at a given gene or locus, and then processes each graph independently to extract full-length splicing isoforms and to tease apart transcripts derived from paralogous genes. Briefly, the process works like so:

- **Inchworm** assembles the RNA-seq data into the unique sequences of transcripts, often generating full-length transcripts for a dominant isoform, but then reports just the unique portions of alternatively spliced transcripts.
- **Chrysalis** clusters the Inchworm contigs into clusters and constructs complete de Bruijn graphs for each cluster. Each cluster represents the full transcriptional complexity for a given gene (or sets of genes that share sequences in common). Chrysalis then partitions the full read set among these disjoint graphs.
- **Butterfly** then processes the individual graphs in parallel, tracing the paths that reads and pairs of reads take within the graph, ultimately reporting full-length transcripts for alternatively spliced isoforms, and teasing apart transcripts that corresponds to paralogous genes.

From: <http://trinityrnaseq.sourceforge.net> - no copyright terms stated







- Working with Cummins exploring combustion of new biofuels
- How are soot particles created during and after combustion
- Collaborating with Convergent Sciences, maker of the popular Converge CFD application, and Lawrence Livermore National Lab



Collaboration and self promotion can be very useful, especially starting off



What is RT's mission?

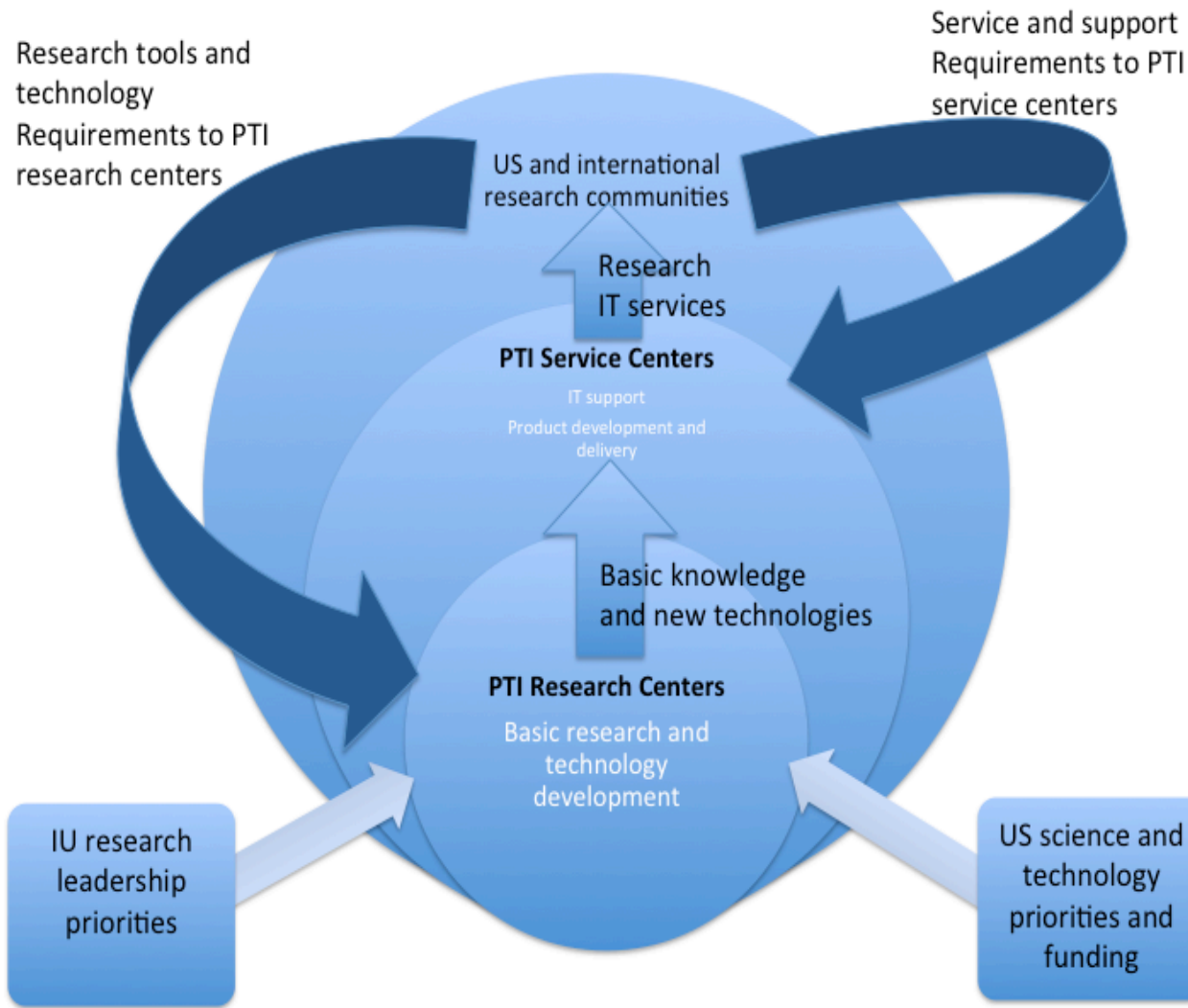
The mission of the Research Technologies division of UITS is to develop, deliver and support advanced technology solutions that improve the productivity of and enable new possibilities in research, scholarly endeavors, and creative activity at Indiana University and beyond; and to complement this with education and technology translation activities to improve the quality of life of people in Indiana, the nation, and the world.

We are a mission- and value-driven organization. We are not a technology-driven organization.

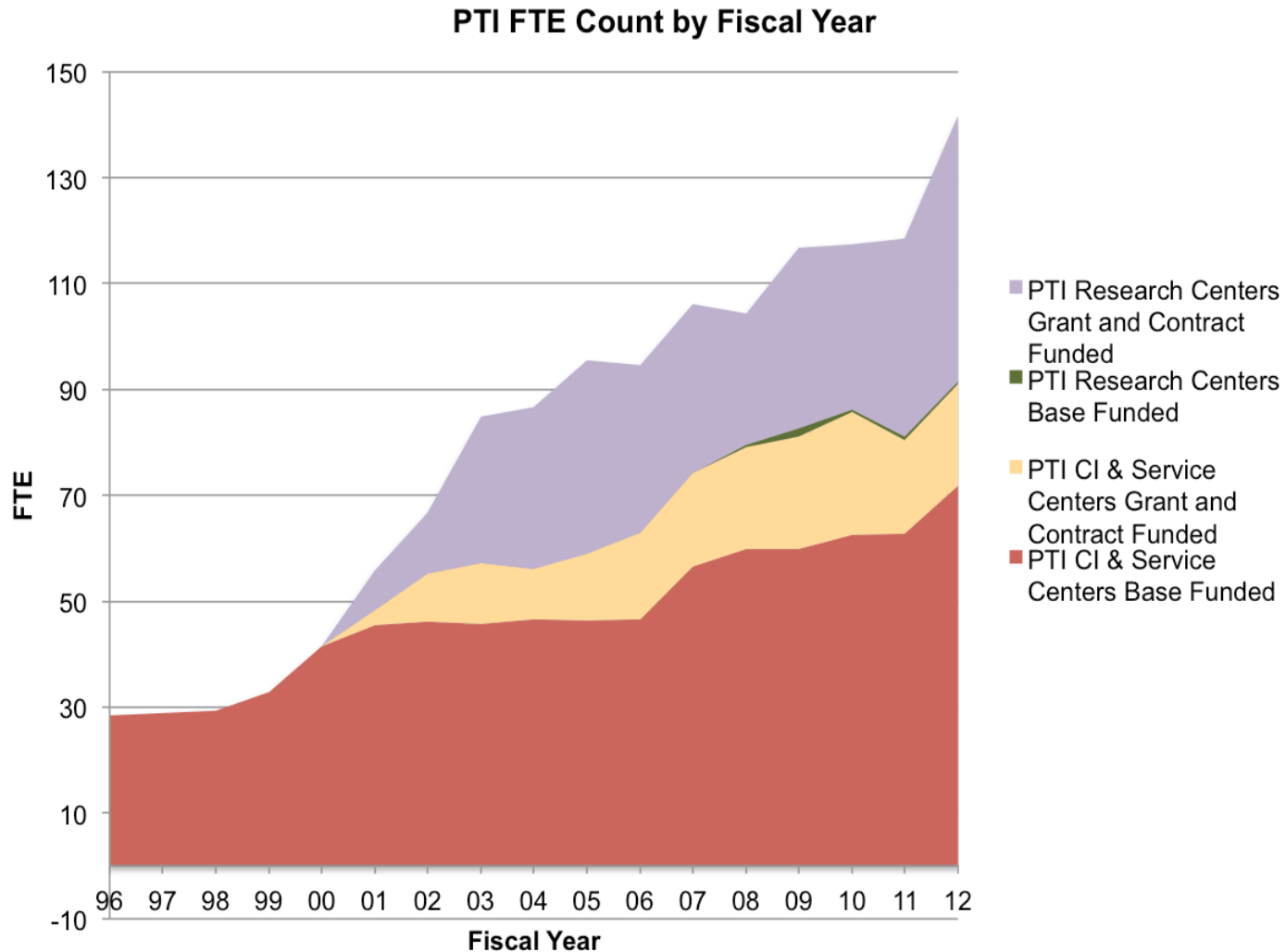
We identify needs, identify possibilities, and discover new ways to meet those needs, realize those possibilities, and create new ones. In so doing, we create, deploy, and support technology. **We are a technology-driving organization.**

Roughly 40% of personnel are funded by external agencies





Growth of CI support and research staff over time In PTI



How the University Sees IT at IU

Formal survey, done with human-subjects approval, executed by independent office

All results since 1991, and every comment since 1992 (except obscenities and names) are available on the Web (<http://www.indiana.edu/~uitssur/>)

Leads to fact-based discussions

- “I think this service is terrible” And survey agrees => service change
- “I think this service is terrible” And survey results are different => why?

Current overall satisfaction with IT organization services (2013 Survey)

Area	Ave Score (Likert)	% Satisfaction (≥ 3)
Teaching (faculty)	4.03	93.2
Research (faculty, staff, grad)	4.06	96.0
Learning (students)	4.15	97.4
Overall	4.11	97.1



Governance & Organization

Good operational principles

- Make decisions at lowest level of hierarchy possible
- Depend upon organizational structure for execution
- Do NOT depend upon organizational structure for information, discussion, flow of ideas

Formal Governance Model

- Weill & Ross - IT Governance: How Top Performers Manage IT Decision Rights for Superior Results
- Decision rights, input rights, and right to execute

OVPIT/UITs is one organization across the whole university

- All “IT Organization” staff on all campuses now report to CIO and are on University Account financial chart
- @iu.edu email addresses

Contentions:

- Work flows to demonstrated competence
- Over a long time, you can make significant changes in organizational roles, accomplishments, national standing, and the world’s collective body of scholarly and artistic works
- Having ‘the basics’ right is essential to having good community support for research HPC



Value creation & destruction, guiding structures

What we experience in our private lives is the result of an ongoing process of value creation, stock speculation, and value destruction

- Once important, now quaint: MySpace, Lycos, Alta Vista, Reinhard Mey
- Currently hot, soon to be quaint: FaceBook, Twitter, ColdPlay

How do you manage mission and service orientation in an organization?

- We for many years focused on:
 - User Satisfaction
 - Activity Based Costing
 - Leadership training (via one approach)
- We are now adding focus on
 - Architecture-based methods
 - ITIL

How do we manage service destruction and creation?

- Budget reductions – 5% per year (most years) cut from each budget
- Formal proposal process for creating new services from \$ pool



Mistakes we made, things we learned (1)

Mistakes we should try not to repeat

- Some times: too much tactic, not enough strategy (especially at times we were ahead of our faculty)
- Not saying goodbye quickly enough to staff who did not adhere to our goals & principles (*NB: US employment laws are different than German laws*)
- Sometimes promising too much first, figuring out how to deliver later (=> too much stress). You have to promise somewhat more than you know how to deliver or you simply won't be at the front edge of technology. The key is 'how much depends upon miracles'?

Things that went wrong that we will repeat as necessary

- Pursuing a strategy and having that strategy collapse for external reasons
- But we try to get good data from the industry and community to improve our guesses



Things the literature tells us

- Technology adoption choices are based on perceived value and perceived ease of use

Things we learned

- ***First and second derivatives matter much more than current location***
- ***Collaborations are important especially early on***
- Support and promote the staff who support the mission strongly
- Embrace (the good part of) your history, believe in and build organizational capacity.
- Build on your unique capabilities to differentiate your organization
- Your opportunity to distinguish your organization depends upon supporting current & future distinguished researchers Work and responsibility flow to demonstrated competence
- Cloud computing is just a technology trend, and all we need to do is figure out how to deliver and support cloud services effectively



What technologies are strategic for the future?

Is email in general a commodity or a differentiator? Probably commodity

Is it hard to sell part but not all of your soul to Microsoft? Hard but possible

Is file storage strategic? Sometimes, not always

eLearning and business systems? Definitely, at least for now

Cloud computing? Sometimes

High-performance computing? If you can manage to be different

Curation and archiving of artistic, scholarly, and research output (including source data): Definitely

Big data – hype or important? Currently mostly hype, but it will be important



Contentions

- In the coming several years, universities are likely to sort themselves into categories of those that treat IT as a commodity and those that treat IT as a strategic asset.
- There are critical areas of research and development that require advanced IT, eScience, or cyberinfrastructure, and universities that wish to lead in these areas must invest in IT as a strategic asset.
- Leading in research IT is possible only if everything else is also working well

My conclusions:

- **IU's IT organization has shown that it can deliver a wide variety of excellent services, and in the process change science, scholarship in the humanities, artistic expression, and at least affect the world a little bit.**
- **Collaboration is important to success – and can make up for a lot of money**
- **If we can do it, so can you**



We Live the Myth of Sisyphus



Examples of rolling rocks up hills:

- Physics
- Global climate change

Sisyphus (1548-1549) by Titian, Prado Museum, Madrid, Spain
http://en.wikipedia.org/wiki/File:Punishment_sisyph.jpg
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Thanks!

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I never mistake the leader for the team



Questions and discussion?

