OSCER: State of the Center

Henry Neeman, OSCER Director

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OU Supercomputing Center for Education & Research

A Division of OU Information Technology

Wednesday October 12 2011

University of Oklahoma

Preregistration Profile 2011

- Organizations: 86
  - **Academic**: preregistered 41 institutions in 13 states & territories (AR,CA,FL,GA,IA,ID,IN,KS,MO,ND,OK,TX;PR)
    - Includes 31 institutions in 7 EPSCoR states (AR,IA,ID,KS,ND,OK,PR)
  - **Industry**: preregistered 29 firms
  - **Government**: preregistered 11 agencies (federal, state)
  - **Non-governmental**: preregistered 5 organizations
- Demographics (290 preregistered)
  - 37% OU, 63% non-OU
  - 76% Oklahoma, 24% non-Oklahoma
  - 84% from EPSCoR states, 16% non-EPSCoR
  - 78% academic, 22% non-academic

Attendee Profile 2002-2011

- Over 2000 attendees at 10 Symposia
  - 69 in 2002, 225-325 per year thereafter
- Organizations: 244
  - **Academic**: attendees from 96 institutions in 27 states & territories
    - 60 institutions in 14 EPSCoR jurisdictions
    - 28 institutions in Oklahoma
      - PhD-granting, masters-granting, bachelors-granting, community college, career tech, high school
      - Historically Black University, Tribal College
      - public, private, for-profit
  - **Industry**: attendees from 102 firms
  - **Government**: attendees from 32 agencies (federal, state, local, foreign)
  - **Non-governmental**: attendees from 14 organizations

Symposium 2011 Sponsors

- Academic sponsors
  - Oklahoma EPSCoR
  - Great Plains Network
- Industry sponsors
  - Platinum: Intel
  - Gold: Dell, Hewlett Packard, IBM, Isilon, Mellanox, Qlogic
  - Silver: Fujitsu
  - Bronze: Advanced Clustering Technologies, Cisco Systems, ScaleMp, Tripp Lite

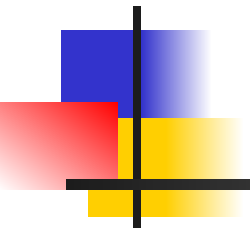
Some Accomplishments

- NSF EPSCoR C2, MRI grant progress
- Over 6 million batch jobs run already on Sooner, the cluster that we deployed a year ago – almost 5 times all of the jobs on the previous cluster, Topdawg, over its entire lifetime!
- In Oklahoma, we've now given the "Supercomputing in Plain English" overview talk to 11 of 13 public universities, 7 private universities, 1 tribal college and 1 high school, and to 12 universities outside Oklahoma.
- "A Day in the Life of an IT Professional" talks: so far 21 talks to over 400 students, faculty, staff and guests at 16 institutions.
- WebMO web front end to chemistry codes crashed last week – too popular! (Fixed shortly after.)

Outline

- Who, What, Where, When, Why, How
- What Does OSCER Do?
  - Resources
  - Education
  - Research
  - Dissemination
- OSCER's Future

OSCER:
Who, What, Where, When, Why, How



What is OSCER?

- Multidisciplinary center
- Division of OU Information Technology
- Provides:
  - Supercomputing **education**
  - Supercomputing **expertise**
  - Supercomputing **resources**: hardware, storage, software
- For:
  - Undergrad students
  - Grad students
  - Staff
  - Faculty
  - Their collaborators (including **off campus**)

Who is OSCER? Academic Depts

- Aerospace & Mechanical Engr
- Anthropology
- Biochemistry & Molecular Biology
- Biological Survey
- Botany & Microbiology
- Chemical, Biological & Materials Engr
- Chemistry & Biochemistry
- Civil Engr & Environmental Science
- Computer Science
- Economics
- Electrical & Computer Engr
- Finance
- Health & Sport Sciences
- History of Science
- Industrial Engr
- Geography
- Geology & Geophysics
- Library & Information Studies
- Mathematics
- Meteorology
- Petroleum & Geological Engr
- Physics & Astronomy
- Psychology
- Radiological Sciences
- Surgery
- Zoology

More than 150 faculty & staff in **26 depts** in Colleges of Arts & Sciences, Atmospheric & Geographic Sciences, Business, Earth & Energy, Engineering, and Medicine – with **more to come**!

Who is OSCER? OU Groups

1. Advanced Center for Genome Technology
2. Center for Analysis & Prediction of Storms
3. Center for Aircraft & Systems/Support Infrastructure
4. Cooperative Institute for Mesoscale Meteorological Studies
5. Center for Engineering Optimization
6. Fears Structural Engineering Laboratory
7. Human Technology Interaction Center
8. Institute of Exploration & Development Geosciences
9. Instructional Development Program
10. Interaction, Discovery, Exploration, Adaptation Laboratory
11. Microarray Core Facility
12. OU Information Technology
13. OU Office of the VP for Research
14. Oklahoma Center for High Energy Physics
15. Robotics, Evolution, Adaptation, and Learning Laboratory
16. Sasaki Applied Meteorology Research Institute
17. Symbiotic Computing Laboratory

Oklahoma Collaborators

1. Cameron U (**masters)**
2. East Central U (**masters**)
3. Langston U (**minority-serving**, **masters**)
4. NOAA National Severe Storms Laboratory
5. NOAA Storm Prediction Center
6. Northeastern State U (**masters)**
7. Oklahoma Baptist U (**bachelors**)
8. Oklahoma City U (**masters**)
9. Oklahoma Climatological Survey
10. Oklahoma Medical Research Foundation
11. Oklahoma Panhandle State U
12. Oklahoma School of Science & Mathematics (**high school**)
13. Oklahoma State U (Stillwater)
14. Rogers State U (**masters**)
15. St. Gregory's U (**bachelors**)
16. Samuel Roberts Noble Foundation
17. Southeastern Oklahoma State U (**masters**)
18. Southern Nazarene U (**masters**)
19. Southwestern Oklahoma State U (**masters**)
20. U Central Oklahoma (**masters**)
21. U Tulsa

- **YOU COULD BE HERE!**

National Collaborators (22 states)

1. California State Polytechnic U Pomona (**minority-serving**, **masters**)
2. Colorado State U
3. Contra Costa College (CA, **minority-serving**, **2-year**)
4. Delaware State U (**EPSCoR**, **masters**)
5. Earlham College (IN, **bachelors**)
6. Emporia State U (KS, **EPSCoR**, **masters**)
7. Florida State U
8. Georgia Institute of Technology
9. Great Plains Network
10. Harvard U (MA)
11. Indiana U
12. Kansas State U (**EPSCoR**)
13. Kean U (NJ)
14. Longwood U (VA, **masters**)
15. Marshall U (WV, **EPSCoR**, **masters**)
16. Navajo Technical College (NM, **tribal**, **EPSCoR**, **2-year**)
17. Purdue U (IN)
18. Riverside Community College (CA, **2-year**)
19. St. Cloud State U (MN, **masters**)
20. Syracuse U (NY)
21. Texas A&M U
22. Texas A&M U-Corpus Christi (**masters**)
23. U Arkansas (**EPSCoR**)
24. U Arkansas Little Rock (**EPSCoR**)
25. U California Santa Barbara
26. U Illinois at Urbana-Champaign
27. U Kansas (**EPSCoR**)
28. U Nebraska-Lincoln (**EPSCoR**)
29. U North Dakota (**EPSCoR**)
30. U Northern Iowa (**masters**)
31. U Utah (**EPSCoR**)
32. Widener U (**masters**)
33. Worcester Polytechnic Institute (MA)

- **YOU COULD BE HERE!**

Who Are the Users?

Over 900 users so far, including:

- Roughly equal split between students vs faculty/staff (students are the bulk of the active users);
- many off campus users (roughly 20%);
- … more being added **every month**.
- Our user headcount doubles roughly every two years.

Biggest Consumers

- **Center for Analysis & Prediction of Storms**: daily real time weather forecasting
- **Oklahoma Center for High Energy Physics**: simulation and data analysis of banging tiny particles together at unbelievably high speeds
- **Chemical Engineering**: lots and lots of molecular dynamics

Who? OSCER Personnel

- Director: Henry Neeman
- Associate Director for Remote & Heterogeneous Computing: Horst Severini
- Manager of Operations: Brandon George
- System Administrator: David Akin
- System Administrator: Brett Zimmerman
- HPC Application Software Specialist: Josh Alexander
- **NEW! Petascale Storage Administrator: Patrick Calhoun**

Why OSCER?

- Computational Science & Engineering has become **sophisticated enough** to take its place alongside experimentation and theory.
- **Most students** – and most faculty and staff – **don't learn much CSE**, because CSE is seen as needing too much computing background, and as needing HPC, which is seen as very hard to learn.
- **HPC can be hard to learn**: few materials for novices; most documents written for experts as reference guides.
- **We need a new approach**: HPC and CSE for computing novices – **OSCER's mandate!**

Why Bother Teaching Novices?

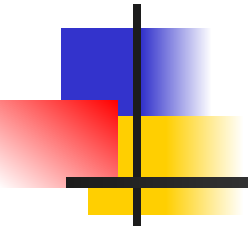
- Application scientists & engineers typically know their applications very well, much better than a collaborating computer scientist ever would.
- Commercial software lags far behind the research community.
- Many potential CSE users don't need full time CSE and HPC staff, just some help.
- One HPC expert can help dozens of research groups.
- Today's novices are tomorrow's top researchers, especially because today's top researchers will eventually retire.

What Does OSCER Do? Teaching

Science and engineering faculty from all over America learn supercomputing at OU by playing with a jigsaw puzzle (NCSI @ OU 2004).

What Does OSCER Do? Rounds

OU undergrads, grad students, staff and faculty learn how to use supercomputing in their specific research.



OSCER Resources
(and a little history)

2002 OSCER Hardware

- **TOTAL: 1220.8 GFLOPs*, 302 CPU cores, 302 GB RAM**
- Aspen Systems Pentium4 Xeon 32-bit Linux Cluster (Boomer)
  - 270 Pentium4 Xeon CPUs, 270 GB RAM, 1080 GFLOPs
- IBM Regatta p690 Symmetric Multiprocessor (Sooner)
  - 32 POWER4 CPUs, 32 GB RAM, 140.8 GFLOPs
- IBM FAStT500 FiberChannel-1 Disk Server
- Qualstar TLS-412300 Tape Library
- Internet2

* GFLOPs: billions of calculations per second

2005 OSCER Hardware

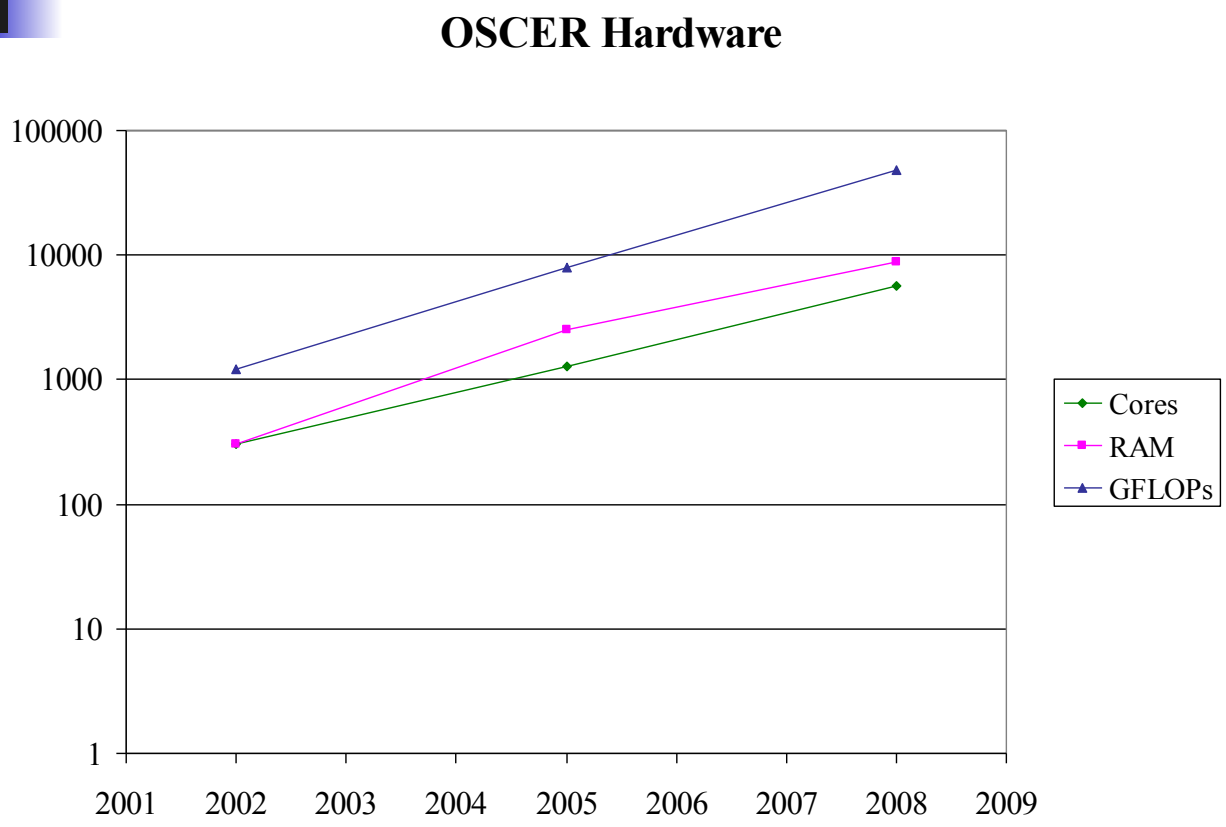
- **TOTAL: 8009 GFLOPs*, 1288 CPU cores, 2504 GB RAM**
- Dell Pentium4 Xeon 64-bit Linux Cluster (Topdawg)
  - 1024 Pentium4 Xeon CPUs, 2176 GB RAM, 6553.6 GFLOPs
- Aspen Systems Itanium2 cluster (Schooner)
  - 64 Itanium2 CPUs, 128 GB RAM, 256 GFLOPs
- Condor Pool: 200 student lab PCs, 1200 GFLOPs
- National Lambda Rail (10 Gbps network), Internet2
- Storage library: Qualstar (10 TB, AIT-3)

* GFLOPs: billions of calculations per second

Current OSCER Hardware

- **TOTAL: 54,626.88 GFLOPs; 6304 cores; 12,390 GB RAM**
- Dell Xeon Quad Core Linux Cluster (Sooner)
  - 531 Xeon 2.0 GHz Harpertown dual socket quad core, 16 GB RAM
  - 3 Xeon 2.33 GHz Clovertown dual socket quad core, 16 GB RAM
  - 2 Xeon 2.4 GHz quad socket quad core nodes, 128 GB RAM each
  - 34,514.88 GFLOPs
  - 24 NVIDIA Tesla C1060 cards (933/78 GFLOPs each)
- Condor Pool: 795 lab PCs, 20,112 GFLOPs, 3590 GB RAM
  - 205 x Intel Core i7 quad 2.4 GHz with 6 GB RAM each
  - 400 x Intel Core2 Duo 2.4 GHz with 4 GB RAM each
  - 190 x Intel Core2 Duo 3.0 GHz with 4 GB RAM each
- National Lambda Rail, Internet2 (10 Gbps networks)

Improvement in OSCER Hardware



GFLOPs:
2008 = 39 x 2002

RAM:
2008 = 29 x 2002

CPU cores:
2008 = 19 x 2002

Moore's Law:
2008 = 16 x 2002

OK Cyberinfrastructure Initiative

- Triggered by Oklahoma's current NSF EPSCoR Track-1 grant.
- Memorandum of Understanding between OU and OSU.
- All academic institutions in Oklahoma are eligible to sign up for free use of OU's and OSU's centrally-owned CI resources.
- Other kinds of institutions (government, NGO, commercial) are eligible to use, though not necessarily for free.
- Everyone can participate in our CI education initiative.
- The Oklahoma Supercomputing Symposium, our annual conference, continues to be offered to all.

Dell Intel Xeon Linux Cluster

1,076 Intel Xeon CPU chips/4288 cores

- 528 dual socket/quad core Harpertown 2.0 GHz, 16 GB each
- 3 dual socket/quad core Harpertown 2.66 GHz, 16 GB each
- 3 dual socket/quad core Clovertown 2.33 GHz, 16 GB each
- 2 x quad socket/quad core Tigerton, 2.4 GHz, 128 GB each

8,800 GB RAM

~130 TB globally accessible disk

QLogic Infiniband

Force10 Networks Gigabit Ethernet

Red Hat Enterprise Linux 5

Peak speed: 34.5 TFLOPs*

*TFLOPs: trillion calculations per second

sooner.oscer.ou.edu

Dell Intel Xeon Linux Cluster

DEBUTED NOVEMBER 2008 AT:

- **#90 worldwide**
- **#47 in the US**
- **#14 among US academic**
- **#10 among US academic excluding TeraGrid**
- **#2 in the Big 12**
- **#1 in the Big 12 excluding TeraGrid**

sooner.oscer.ou.edu

Dell Intel Xeon Linux Cluster

Purchased mid-July 2008

First friendly user Aug 15 2008

Full production Oct 3 2008

Christmas Day 2008: >~75% of nodes and ~66% of cores were in use.

sooner.oscer.ou.edu

Condor Pool

Condor is a software technology that allows idle desktop PCs to be used for number crunching.

OU IT has deployed a large Condor pool (795 desktop PCs in IT student labs all over campus).

It provides a huge amount of additional computing power – more than was available in all of OSCER in 2005.

20+ TFLOPs peak compute speed.

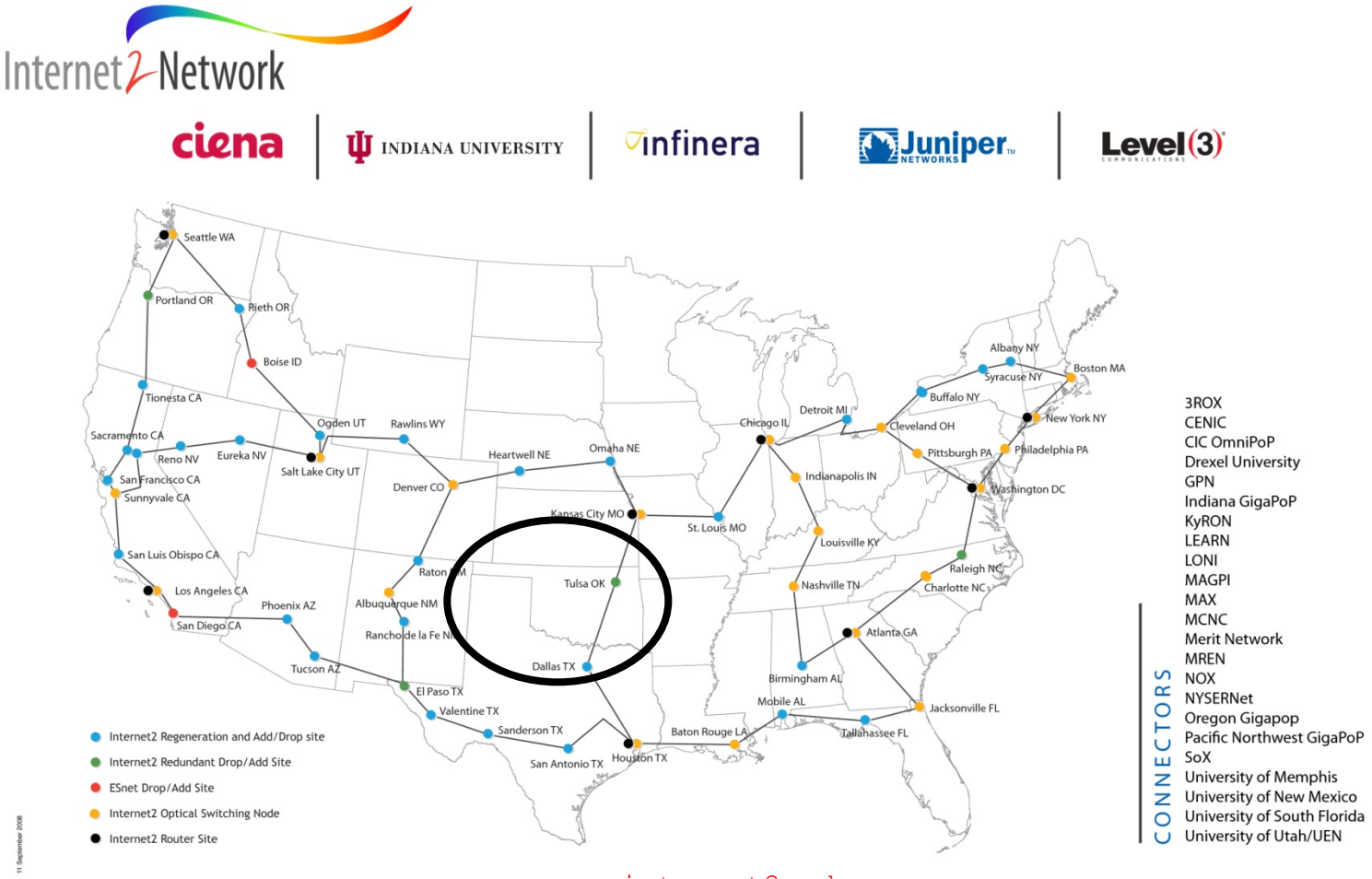
And, the cost is very very low – almost literally free.

Also, we've been seeing empirically that Condor gets about 80% of each PC's time.

Condor Pool

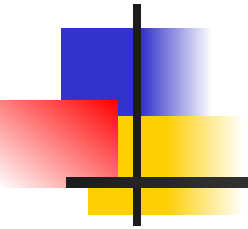
National Lambda Rail

Internet2



www.internet2.edu

What Does OSCER Do?



What Does OSCER Do?

- Resources
- Teaching
- Research
- Dissemination
- Oklahoma Cyberinfrastructure Initiative

OSCER Teaching

What Does OSCER Do? Teaching

Science and engineering faculty from all over America learn supercomputing at OU by playing with a jigsaw puzzle (NCSI @ OU 2004).

Supercomputing in Plain English

Supercomputing in Plain English workshops target not only people who are sophisticated about computing, but especially students and researchers with strong science or engineering backgrounds but modest computing experience.

Prerequisite: 1 semester of Fortran, C, C++ or Java

Taught by analogy, storytelling and play, with minimal use of jargon, and assuming very little computing background.

Streaming video: http://www.oscer.ou.edu/education.php

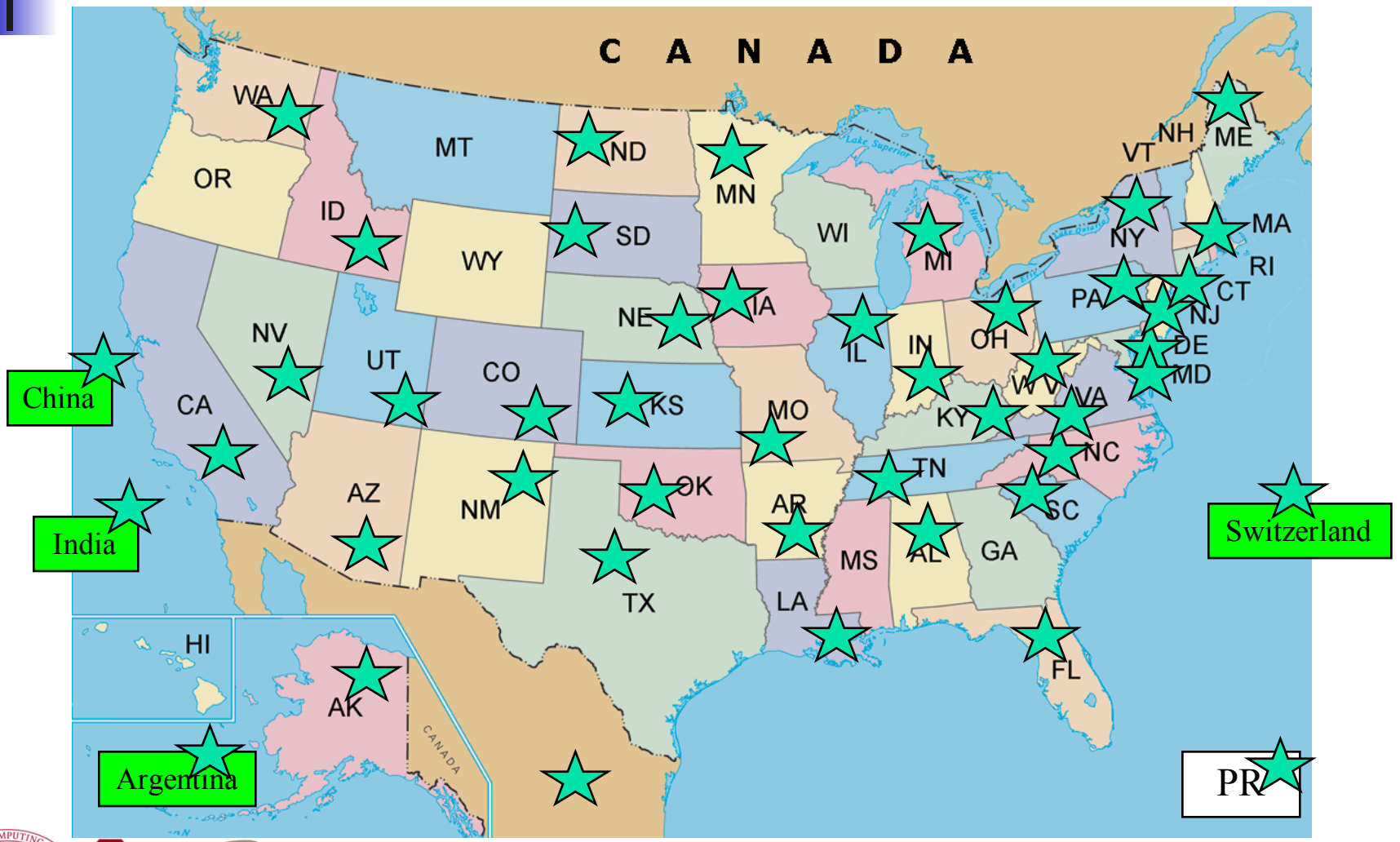
Registrations: over 1000 from 2001 to 2011

Workshop Topics

- Overview
- The Storage Hierarchy
- Instruction Level Parallelism
- High Performance Compilers
- Shared Memory Parallelism
- Distributed Parallelism
- Applications & Types of Parallelism
- Multicore
- High Throughput Computing
- GPGPU: Number Crunching in Your Graphics Card
- Grab Bag: Scientific Libraries, I/O libraries, Visualization

Includes temporary accounts on OSCER resources for exercises.

SiPE Workshop Participants 2001-11



Teaching: Workshops

- Supercomputing in Plain English: 746 so far!
  - Fall 2001: 87 registered, 40 – 60 attended each time
  - Fall 2002: 66 registered, c. 30 – 60 attended each time
  - Fall 2004: 47 registered, c. 30-40 attend each time
  - Fall 2007: 41 @ OU, 80 at 28 other institutions
  - Spring 2009: 65 @ OU, 360 at over 70 other institutions
- NCSI Parallel & Cluster Computing workshop (summer 2004, summer 2005)
- Linux Clusters Institute workshop (June 2005, Feb 2007)
- Co-taught at NCSI Parallel & Cluster Computing workshop at Houston Community College (May 2006)
- SC08-09 Education Program: Parallel Programming & Cluster Computing workshop Aug 2008, Aug 2009
- SC08 Education Program Parallel Programming & Cluster Computing daylong workshop at OK Supercomputing Symposium 2007, 2008, 2009
- NCSI Intermediate Parallel Programming & Cluster Computing workshop (summer 2010, summer 2011)
- **NEW! LittleFe baby supercomputer buildout (summer 2011 – first ever anywhere!)**

… and more to come.

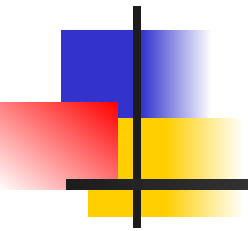
OU is the only institution in the world to host and co-instruct multiple workshops sponsored by each of NCSI, LCI and the SC education program.

Teaching: Academic Coursework

- CS: Empirical Methods (A. Fagg)
- CS: Scientific Computing (S. Lakshmivarahan)
- CS: Computer Networks & Distributed Processing (S. Lakshmivarahan)
- Meteorology: Computational Fluid Dynamics (M. Xue)
- Chemistry: Molecular Modeling (R. Wheeler)
- Electrical Engr: Computational Bioengineering (T. Ibrahim)
- Chem Engr: Nanotechnology & HPC (L. Lee, G. Newman, H. Neeman)
- Parallel Computing course at Cameron U (OK)
- Software Engineering course at Oklahoma City U
- Bioinformatics course at U Tulsa (OK)
- Parallel Computing course at East Central U (OK)
- Chemistry course at Northeastern State U (OK), Fall 2011
- PLANNED: Chemistry courses at OU, Spring 2012
- PLANNED: Chemistry course at Rogers State U (OK), Spring 2012

Teaching: Presentations & Tours

- Courses at OU
  1. Chem Engr: Industrial & Environmental Transport Processes (D. Papavassiliou)
  2. Engineering Numerical Methods (U. Nollert)
  3. Math: Advanced Numerical Methods (R. Landes)
  4. Electrical Engr: Computational Bioengineering (T. Ibrahim)
- Research Experience for Undergraduates at OU
  1. Ind Engr: Metrology REU (T. Reed Rhoads)
  2. Ind Engr: Human Technology Interaction Center REU (R. Shehab)
  3. Meteorology REU (D. Zaras)
- External
  1. American Society of Mechanical Engineers, OKC Chapter
  2. Association for Computing Machinery (ACM) Special Interest Group on Computer Science Education (SIGCSE) 2010
  3. Oklahoma State Chamber of Commerce
  4. National Educational Computing Conference 2006 (virtual tour via videoconference)
  5. Norman (OK) Lions Club
  6. Society for Information Technology & Teacher Education conference 2008, 2009, 2010
  7. Acxiom Conference on Applied Research in Information Technology 2008
  8. Shawnee (OK) Lions Club
  9. Oklahoma Louis Stokes Alliance for Minority Participation (@ OSU) 2010 **(Keynote)**
  10. **NEW! Norman (OK) Science Café**
  11. **NEW! Tech Forum Texas 2010**
  12. **NEW! Texas Computer Education Association 2011**
  13. **NEW! Consortium for School Networking 2011**
  14. **NEW! Consortium for Computing Sciences in Colleges 2011 (Keynote)**
- Other Universities
  1. SUNY Binghamton (NY)
  2. Bradley University (IL)
  3. Cameron University (OK)
  4. The Citadel (SC)
  5. College of the Muscogee Nation (OK)
  6. DeVry University (OK)
  7. East Central University (OK)
  8. El Bosque University (Bogota Colombia)
  9. Southwestern University (TX)
  10. Langston University (OK)
  11. Louisiana State University
  12. Midwestern State University (TX)
  13. Northeastern Oklahoma State University
  14. Northwestern Oklahoma State University
  15. Oklahoma Baptist University
  16. Oklahoma City University
  17. Oklahoma State University x 2
  18. Oklahoma State University – OKC
  19. Oral Roberts University (OK) x 2
  20. **NEW! Philander Smith College (AR)**
  21. St. Gregory's University (OK) x 2
  22. Southeastern Oklahoma State University x 2
  23. Southern Nazarene University (OK)
  24. Southwestern Oklahoma State University x 2
  25. Texas A&M-Commerce
  26. University of Arkansas Fayetteville
  27. University of Arkansas at Little Rock
  28. **NEW! University of Arkansas at Pine Bluff**
  29. University of Central Oklahoma
  30. **NEW! University of Oklahoma-Tulsa**
  31. University of Tulsa (OK)
- High Schools and High School Programs
  1. Oklahoma School of Science & Mathematics x 2
  2. Oklahoma Christian University's Opportunity Bytes Summer Academy
  3. Dept of Energy National Scholarship Finalists
  4. Ardmore High School (OK)



OSCER Research

OSCER Research

- OSCER's Approach
- Rounds
- Grants
- Upcoming Initiatives

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What Does OSCER Do? Rounds

OU undergrads, grad students, staff and faculty learn how to use supercomputing in their specific research.

Research: OSCER's Approach

- **Typically**, supercomputing centers provide resources and have in-house application groups, but **most users are more or less on their own**.
- OSCER's approach: we **partner directly** with research teams, providing supercomputing expertise to help their research move forward faster (**rounds**).
- This way, OSCER has a stake in each team's success, and each team has a stake in OSCER's success.

Research & Teaching: Rounds

Rounds: interacting regularly with several research groups

- **Brainstorm** ideas for applying supercomputing to the group's research
- **Code**: design, develop, debug, test, benchmark
- **Learn** new computing environments
- **Write** papers and posters

Has now evolved into **supercomputing help sessions**, where many different groups work at the same time.

Research: Grant Proposals

- OSCER provides text not only about resources but especially about education and research efforts (workshops, rounds, etc).
- Faculty write in small amount of money for:
  - funding of small pieces of OSCER personnel;
  - storage (disk, tape);
  - special purpose software.
- In many cases, OSCER works with faculty on developing and preparing proposals.
- OSCER has a **line item** in the OU proposal web form that all new proposals have to fill out.

Spring Storm Experiment 2011

As usual, OSCER played a major role in the Spring Storm Experiment, which involved the Center for Analysis & Prediction of Storms, the NOAA Storm Prediction Center, Oak Ridge National Laboratory, and others.

We were the primary HPC provider for the part of the project run by the Center for Collaborative Adaptive Sensing of the Atmosphere (CASA).

This project consumed 20-60% of Sooner every day for 3 months.

We're also now supporting an annual hurricane forecasting experiment.

High Energy Physics

- Dzero project: #1 most productive US academic site, 2008-11
- ATLAS project: #5-7 most productive US academic site, 2008-11

External Research Grants

1. B. Moore III et al, "Department of the Interior South-Central Regional Climate Science Center," US Dept of the Interior, $4M (total), $2M (OU)
2. A. Striolo, D. Resasco et al, "Center for Application of Single-Walled Carbon Nanotubes," DOE, $1M
3. J. K. Shen, "CAREER: Electrostatic Mechanisms in Protein Stability and Folding, NSF, $773K
4. Y. Kogan, "Parameterization of cumulus convective cloud systems in mesoscale forecast models," ONR, $594K
5. X. Wang, M. Xue, F. Kong, "Optimal Design of Multi-scale Ensemble Systems for Convective-Scale Probabilistic Forecasting," NSF, $395K
6. R. D. Palmer, T.-Y. Yu, "NMQ and WDSS-II for the KMA radar network: Real-time, effective, and integrated weather products," Space Environment Laboratory, Inc., $361K
7. B. Grady, A. Striolo, "Novel Supramolecular Structures of Laterally Confined Amphiphilic Molecules," NSF, $335K
8. D. Resasco, D. Papavassiliou et al, "Interfacially active SWNT/silica nanohybrids," Advanced Energy Consortium, $331K
9. C. Y. Tang , R. Ramakumar, N. Jiang , "Control and Operation of Large-Scale Wind Farms in the Power System", NSF, $231K
10. J. Shen, "Electrostatic Modulation of Protein Stability and Folding," NIH, $282K
11. Y. Wang, "Theoretical Tools for Measuring Dark Energy from Galaxy Clustering," DOE, $230K
12. F. Kong, M. Xue, "Further Enhancement to the Hourly Assimilation and Prediction System (HAPS) for Shenzhen Meteorological Bureau." Shenzhen Institute of Advanced Technology, Chinese Academy of Science, $228K
13. P. Attar, P. Vedula, "Multi-fidelity Modeling and Simulation (M&S) Tool for Nonlinear Aeroelasticity," Advanced Dynamics, $160K
14. B. Eskridge, "CDI-TYPE I: RUI: Emergent Hierarchies of Leaders in Multi-Robot Systems," NSF, $159K
15. A. Striolo, "Mixed-Volatile Fluids Relevant to Subsurface Energy Systems," DOE, $120K
16. P. Skubic, M. Strauss, "OU Contribution to the ATLAS Southwest Tier 2 Computing Center (Supplement)," NSF, $110K
17. P. Attar, "High-Fidelity Computational Aeroelastic Solver Research," Ohio Aerospace Institute, $53K
18. P. Skubic, M. Strauss, "OU Contribution to the ATLAS Southwest Tier 2 Computing Center (Supplement)," NSF, $50K

OSCER-RELATED FUNDING TO DATE:
$195M total, $106M to OU

External Research Grants (cont'd)

19. P. Skubic, M. Strauss, "University of Oklahoma Contribution to OSG Software Development," Brookhaven National Laboratory, $50K.
20. P. Attar, "Computational Model Development and Experimental Validation Measurements for Membrane-Batten Wing," Ohio Aerospace Institute, $43K
21. A. Striolo, "Reduced Carbon in Earth's Crust and Mantle I," Alfred P. Sloan Foundation, $39K.
22. J. Gao, "Advancing Research on Realtime Weather-Adaptive 3DVAR Analyses with Automatic Storm Positioning and On-demand Capability," NOAA, $36K
23. M. Xue, "Probabilistic Forecasting for Aviation Decision Aid Applications," Impact Technologies,$20K
24. P. Attar, P. Vedula, "Towards Better Modeling and Simulation of Nonlinear Aeroelasticity On and Beyond Transonic Regimes," Advanced Dynamics, $20K
25. P. Attar, P. Vedula, "High-Fidelity Computational Aeroelastic Models in Support of Certification Airworthiness of Control Surfaces with Freeplay and Other Nonlinear Features," Advanced Dynamics, $9K

OSCER-RELATED FUNDING TO DATE:
$195M total, $106M to OU

External Research Grants (cont'd)

26. H. Neeman, D. Brunson (OSU), J. Deaton (OneNet), J. He (Noble Foundation), D. Schoenefeld (TU), J. Snow (Langston U), M. Strauss (OU), X. Xiao (OU), M. Xue (OU), "Oklahoma Optical Initiative," NSF, $1.17M
27. H. Neeman, M. Jensen, M. Strauss, X. Xiao, M. Xue, E. Baron, K. Dresback, R. Kolar, A. McGovern, R. Palmer, D. Papavassiliou, H. Severini, P. Skubic, T. Trafalis, M. Wenger, R. Wheeler (Duquesne U), "MRI: Acquisition of Extensible Petascale Storage for Data Intensive Research," NSF, $793K
28. D. Resasco, J. Harwell, F. Jentoft, K. Gasem, S. Wang, "Center for Interfacial Reaction Engineering (CIRE)," DOE EPSCoR, $3M ($2M OU)
29. P. Skubic, M. Strauss, B. Abbott, P. Gutierrez, "Experimental Physics Investigations Using Colliding Beam Detectors at Fermilab and the Large Hadron Collider (LHC) (TASK A) 2010-2013 Renewal," DOE, $2.8M
30. R. Palmer, Y. Zhang, G. Zhang, T. Yu, M. Yeary, Y. Hong, J. Crain, P. Chilson, "Next Generation Phased Array," NSSL, $2M
31. P. Skubic, M. Strauss, B. Abbott, P. Gutierrez, "Experimental Physics Investigations Using Colliding Beam Detectors at Fermilab and the Large Hadron Collider (LHC) (TASK A) 2010-2013 Renewal-Revision," DOE, $1.52M
32. D. Cole, Alberto Striolo, "Structure and Dynamics of Earth Materials, Interfaces and Reactions," DOE, $1.5M ($90K OU)
33. R. Sigal, F. Civan, D. Devegowda, "Simulation of Shale Gas Reservoirs Incorporating the Correct Physics of Capillarity and Fluid Transport," Research Partnership to Secure Energy for America (RPSEA), $1.05M
34. M. Biggerstaff, J. Straka, L. Wicker, Zrnic, Zahari, "MRI Development of C-Band Mobile Polarimetric Weather Radars," NSF, $989K ($439K OU)
35. D. Resasco, D. Papavassiliou et al, "Carbon Nanotube Technology Center," DOE, $925K
36. M. Saha, D. Papavassiliou, A. Striolo, K. Mullen, B. Grady, C. Altan, D. Resasco, "Experimental and theoretical studies of carbon nanotube hierarchical structures in multifunctional polymer composites," DoD-EPSCoR, $897K
37. E. Mansell, J. Straka, C. Ziegler, D. MacGorman, "Numerical modeling studies of storm electrification and lightning," NSF, $817K
38. E. Rasmussen, J. Straka, K. Kanak, "Collaborative Research: Challenges in understanding tornadogenesis and associated phenomena, $755K ($489K OU)
39. J. Straka, K. Kanak, "Challenges in tornadogenesis and associated phenomena," NSF, $584K

OSCER-RELATED FUNDING TO DATE:
$195M total, $106M to OU

External Research Grants (cont'd)

40. M. Xue, F. Kong, "Advanced Multi-Moment Microphysics for Precipitation and Tropical Cyclone Forecast Improvement with COAMPS," ONR, $592K
41. J. Straka, K. Kanak, "Collaborative Research: Challenges in Understanding Tornadogenesis and Associated Phenomena," NSF, $515K
42. D. MacGorman, E. Mansell, C. Ziegler, A. Fierro, M. Xue, "Techniques for Assimilating Geostationary Lightening Mapper Data and Assessment of the Resulting Impact on Forecasts," NOAA, $415K
43. M. Xue, F. Kong, K. Brewster, X. Wang, "A Partnership to Develop, Conduct, and Evaluate Realtime High-Resolution Ensemble and Deterministic Forecasts for Convective-scale Hazardous Weather: Moving to the Next Level," NOAA CSTAR, $375K
44. M. Xue, K. Brewster, J. Gao, X. Wang, "Advanced Data Assimilation and Prediction Research for Convective-Scale 'Warn-on-Forecast,'" $375K, NOAA
45. X. Wang, "Improving satellite radiance data assimilation using a hybrid ensemble-Gridpoint Statistical Interpolation (GSI) method for global numerical weather prediction," NASA, $334K
46. X. Wang, M. Xue, "Improving NOAA operational global numerical weather prediction using a hybrid-ensemble Kalman filter data assimilation and ensemble forecast system," NOAA, $322K
47. D. Resasco, D. Papavassiliou et al, "Interfacially active SWNT/silica nanohybrids," Advanced Energy Consortium (AEC), $333K
48. D. Oliver, "Data analysis and inversion for mobile nanosensors," AEC, $320K
49. R. Palmer, T. Yu, G. Zhang, M. Yeary, P. Chilson, Y. Zhang, J. Crain, "Advancements in Phased Array Weather Radar Research at OU," NOAA National Severe Storms Laboratory (NSSL), $270K
50. A. Striolo, "The Emergent Behavior of Solid Nanoparticles at Oil-Water Interfaces: A Multi-Scale Thermodynamic Approach to Enable Bio-Oil Upgrade," NSF, $238K
51. M. Xue, K. Brewster, F. Kong, "Development of a Short-Range Realtime Analysis and Forecasting System based on the ARPS for Taiwan Region," NOAA, $200K
52. J. Straka, K. Kanak, "Formative dynamics of the mammatus clouds in thunderstorm cirrus," NSF, $318K
53. M. Yeary, C. Tang, "Computationally Efficient Linear Transforms for Remote Sensing Systems," NSF, $299K
54. A. Striolo, "Probing regular solution theory for mixed amphoteric/ionic surfactant systems by molecular dynamics simulations," ACS, $100K

OSCER-RELATED FUNDING TO DATE:
$195M total, $106M to OU

External Research Grants (cont'd)

55. K. Brewster, M. Xue, F. Kong, meteorology project, $211K
56. M. Xue, meteorology project, $120K
57. A. McGovern, "Learning to guide search in large state spaces," IBM DARPA, $95K
58. J. Straka, K. Kanak, "Supplement: Challenges in tornadogenesis and associated phenomena (VORTEX2)," NSF, $87K
59. F. Kong, M. Xue, "Establishment of an Experimental Real-Time Short-Term Storm Prediction System for Shenzhen Meteorological Bureau," $58K
60. J. Straka, "Improved Understanding/Prediction of Severe Convective Storms and Attendant Phenomena through Advanced Numerical Simulation," NSF, $58K
61. M. Xue, "Assimilation of NEXRAD Radial Winds in a Regional Mesoscale Model," Miss State U, $79K
62. J. Cruz, R. Todd, "Medium-Density Parity-Check Codes for Tape Systems," INSIC, $36K
63. M. Xue, D. Stensrud, J. Gao, "Advancing Warn on Forecast – Storm-scale Analysis of Vortex 2 Thunderstorms," NSSL, $70K
64. P. Attar, "High-Fidelity Computational Aeroelastic Solver Research," Ohio Aerospace Institute, $60K
65. J. Straka, K. Kanak, "Development of Unmanned Aircraft System for Research in a Severe Storm Environment and Deployment within the VORTEX 2," NSF, $44K
66. J. Cruz, "Equalization, Detection, and Coding Algorithms for Bit Patterned Media Recording Channels," International Storage Industry Consortium (INSIC), $35K
67. J. Cruz, R. Todd, "Signal Processing for Magnetic Recording Channels," private company, $30K
68. P. Attar, P. Vedula, "Deterministic and Statistical Characterization of the Impact of Control Surface Freeplay on Flutter and Limit-Cycle Oscillation (LCO) using Efficient Computational Modeling," Advanced Dynamics, $30K
69. P. Attar, P. Vedula, "Novel Reduced Order in time Models for Problems in Nonlinear Aeroelasticity," Advanced Dynamics, $29K
70. F. Carr, J. Straka, "Severe storm research," Jonathon Merage Foundation, $21K
71. F. Carr, J. Straka, "Severe storm research," Jonathon Merage Foundation, $20K

OSCER-RELATED FUNDING TO DATE: $195M total, $106M to OU

External Research Grants (cont'd)

72. A. Striolo, "Electrolytes at Solid-Water Interfaces: Theoretical Studies for Practical Applications," DOE EPSCoR, $450K
73. A. Striolo, Saha, "Experimental and Theoretical Studies of Carbon Nanotube Hierarchical Structures in Multifunctional Polymer Composites," DOD EPSCoR, $450K
74. D. Cole (ORNL), A. Striolo, "Structure and Dynamics of Earth Materials, Interfaces and Reactions," DOE, $1.5M ($75K OU)
75. D. Papavassiliou, A. Striolo, "Effects of Hydrophobicity-Induced Wall Slip on Turbulence Drag and Turbulence Structure," NSF, $230K
76. A. Striolo, D. Resasco, U. Nollert, "Understanding the Interactions between Carbon Nanotubes and Cellular Membranes," NSF, $380K
77. M. Xue, Y. Hong, X. Hu (GSU), "Integrated Weather and Wildfire Simulation and Optimization for Wildfire Management," NSF, $997K ($483K OU)
78. Y. Hong, "Next Generation QPE: Toward a Multi-Sensor Approach for Integration of Radar, Satellite, and Surface Observations to Produce Very High-resolution Precipitation Data," NOAA/OAR/NSSL via CIMMS, $83K
79. R. Palmer, Y. Hong, "Phased Array Technology for Weather Radar Applications," NOAA/OAR/NSSL via CIMMS, $426K
80. Y. Hong, Baski (OSU), "Proactive approach to transportation resource allocation under severe winter weather emergencies," OK-DOT/OTC, $261K ($101K OU)
81. R. Palmer, Y. Hong, "Atmospheric Observations using Phased Array Technology," $340K
82. Y. Hong, "Toward Improved Flood Prediction and Risk Mitigation: Capacity Building for Africa," NASA, $87K
83. Y. Hong, "Improving NASA Global Hazard System and Implementing SERVIR-Africa," NASA, $272K
84. Y. Hong, "Link SERVIR-Africa Work to NASA Land Information System: Workshop Training and Data Assimilation of GRACE to NASA-OU Hydrologic Model," NASA, $10K
85. R. Adler (NASA), Y. Hong, "Global Hazard (Flood-Landslide) Decision-Support System," NASA, $900K
86. S. Schroeder, "CAREER: Advancing Viral RNA Structure Prediction," NSF, $750K

OSCER-RELATED FUNDING TO DATE: $195M total, $106M to OU

External Research Grants (cont'd)

87. P. Attar, "High Fidelity Computational Aeroelastic Analysis of a Flexible Membrane Airfoil Undergoing Dynamic Motion," Ohio Aerospace Institute, $35K
88. P. Attar, "Computational Model Development and Experimental Validation Measurements for Membrane-Batten Wing" Flexible Membrane Airfoil Undergoing Dynamic Motion," Ohio Aerospace Institute, $43K
89. K. Droegemeier, F. Kong, P. Attar, "A Partnership to Develop, Conduct, and Evaluate Realtime High-Resolution Ensemble and Deterministic Forecasts for Convective-scale Hazardous Weather," NOAA, $375K
90. M. Xue, G. Zhang, K. Brewster, F. Kong, "Prediction and Predictability of Tropical Cyclones over Oceanic and Coastal Regions and Advanced Assimilation of Radar and Satellite Data for the Navy Coupled Ocean-Atmosphere Mesoscale Prediction System," ONR/DOD EPSCoR, $454K; OK Board of Regents $100K
91. S. Ahalt, A. Apon, D. Lifka, H. Neeman, "NSF Workshop High Performance Computing Center Sustainability," NSF, $49K ($0 OU)
92. Y. Luo, S. Lakshmivarahan, "Development of a Data Assimilation Capability towards Ecological Forecasting in a Data-Rich Era," NSF, $1.08M
93. Y. Luo, D. Schimmel (NEON), J. Clark (Duke U.), Kiona Ogle (U. Wyoming), S. LaDeau (Cary Institute of Ecosystem Study), "RCN: Forecasts Of Resource and Environmental Changes: Data Assimilation Science and Technology (FORECAST)," NSF, $500K
94. J. Straka, K. Kanak, Davies-Jones, H. Neeman, "Challenges in understanding tornadogenesis and associated phenomena," NSF, $854K
95. P. Risser et al, "A cyberCommons for Ecological Forecasting," NSF, $6M ($2.78M OU)
96. M. Xue, X. Wang, X. Li (OSU), R. Barnes, S. Sanielevici (PSC), H. Neeman, "Enabling Petascale Ensemble-Based Data Assimilation for the Numerical Analysis and Prediction of High-Impact Weather," NSF, $1.2M ($902K OU)
97. P. Skubic, B. Abbott, P. Gutierrez, M. Strauss, "ATLAS Southwest Tier 2 Computing Center," NSF, $600K/year ($60K/year OU)
98. Y. Hong, "Evaluation of NASA Global Hazard System," NASA, $45K

OSCER-RELATED FUNDING TO DATE: $195M total, $106M to OU

External Research Grants (cont'd)

99. J Wicksted, F. Waxman et al, "Building Oklahoma's Leadership Role in Cellulosic Bioenergy," NSF EPSCoR, $15M ($5.7M OU)
100. D.S. Oliver, software, $16.7M
101. K.K. Muraleetharan, G. Miller, and A. Cerato, "Understanding and Improving the Seismic Behavior of Pile Foundations in Soft Clays," NSF, $1.15M ($500K OU)
102. K. Droegemeier, F. Kong, "Multisensor Studies of Precipitation for Model Verification and Data Assimilation," U Minn, ($7K OU)
103. K. Droegemeier, M. Xue, F. Kong, "Observing System Simulation Experiments for Airborne Weather Sensors," HRL, ($33K OU)
104. M. Nollert, Scholarship, FD-OMRF, $12K
105. R. Sigal, R. Philp, C. Rai,, S. Shah, R. Slatt, C. Sondergeld, D. Zhang, energy company, $1.9M
106. B. Grady, D. Schmidtke, A. Striolo, A. Cheville, D. Teeters, "Polymer Nanostructures on Solid Surfaces,"$208K ($125K OU)
107. T. Conway, "E. coli Model Organism Resource," UN-Purdue, ($685K OU)
108. R. Kolar, "Storm Surge Modeling in SE Liousiana - 2006," ARCADIS, ($37K OU)
109. D. Cole (ORNL), A. Striolo, "Rates and Mechanisms of Mineral-Fluid Interactions at the Nanoscale," DOE, $1.65M (total), ($55K OU)
110. R. Kolar, "A Prototype Operational Modeling System for Waves, Coastal Currents, Inundation and Hydrologic Flooding for Eastern North Carolina," UN-UNC-CH, ($209K OU)
111. R. Kolar, "A Coupled Regional-Coastal Ocean Model: HYCOM/CG-ADCIRC," DOD-NRL, ($333K OU)
112. M. Xue, "Contribution to WRF Model Development by the Center for Analysis and Prediction of Storms," DOC-NOAA, $821K
113. K. Marfurt, "Improving Geologic and Engineering Models of Midcontinent Fracture and Karst Modified Reservoirs Using 3-D Seismic Attributes," UKCRINC, ($61K OU)
114. P. Attar, P. Vedula, "Novel, Optimal, Physics-based Reduced Order Models for Nonlinear Aeroelasticity," Advanced Dynamics, $49K
115. S. Dhall, "Autonomous Data Partitioning using Data Mining for High Performance Computing," NSF, ($125K OU)

OSCER-RELATED FUNDING TO DATE: $195M total, $106M to OU

External Research Grants (cont'd)

116. M. Xue, K. Brewster, J. Gao, "Ensemble-based Data Assimilation for Tropical Storms, and Realtime 3DVAR Analysis for Initial Proof of 'Warn-on-Forecast' Concept: Collaborative Research between CAPS and NSSL," DOC-NOAA, $100,000
117. M. Xue, "Contribution to Model Development and Enhancement Research Team by the Center for Analysis and Prediction of Storms," DOC-NOAA, $180,000
118. M. Xue, K. Brewster, "Ensemble-based Data Assimilation for Convective Storms and Hurricanes," DOC-NOAA, $100,000
119. S. Schroeder, "Discovering Satellite Tobacco Mosaic Virus Structure," OCAST, $85K
120. S. Schroeder, "Computational Advacnes Toward Predicting Encapsidated Viral RNA Structure," Pharmaceutical Research and Manufactuerer's Association of America, $60K
121. R. Kolar, "Outer Boundary Forcing for Texas Coastal Models," Texas Water Development Board, $20K
122. K. Milton, "Collaborative Research: Quantum Vacuum Energy", NSF, $250K
123. A. McGovern, "Developing Spatiotemporal Relational Models to Anticipate Tornado Formation," NSF, $500K
124. Y. Kogan, "Midlatitude Aerosol-Cloud-Radiation Feedbacks in Marine Boundary Layer Clouds", ONR, $638K
125. J. Straka, K. Kanak, Davies-Jones, "Challenges in understanding tornadogenesis and associated phenomena," NSF, $854K (total), $584K (OU)
126. Y. Hong, "Improvement of the NASA Global Hazard System and Implement Server-Africa," NASA, $272K
127. J. Antonio, S. Lakshmivarahan, H. Neeman, "Predictions of Atmospheric Dispersion of Chemical and Biological Contaminants in the Urban Canopy." Subcontract No. 1334/0974-01, Prime Agency DOD-ARO, Subcontract through Texas Tech University, Lubbock, TX, Sep. 29, 2000 to Nov. 3, 2001, $75K
128. A. Striolo, "Electrolytes at Solid-Water Interfaces: Theoretical Studies for Practical Applications," OSRHE Nanotechnology, $15K
129. D. Papavassiliou, "Turbulent transport in non-homogeneous turbulence," NSF, $320K

OSCER-RELATED FUNDING TO DATE: $195M total, $106M to OU

External Research Grants (cont'd)

130. K. Droegemeier et al., "Engineering Research Center for Collaborative Adaptive Sensing of the Atmosphere," NSF, $17M (total), $5.6M (OU)
131. K. Droegemeier et al., "Linked Environments for Atmospheric Discovery (LEAD)," NSF, $11.25M (total), $2.5M (OU)
132. M. Strauss, P. Skubic et al., "Oklahoma Center for High Energy Physics", DOE EPSCoR, $3.4M (total), $1.6M (OU)
133. M. Richman, A. White, V. Lakshmanan, V. DeBrunner, P. Skubic, "Real Time Mining of Integrated Weather Data," NSF, $950K
134. D. Weber, K. Droegemeier, H. Neeman, "Modeling Environment for Atmospheric Discovery," NCSA, $435K
135. H. Neeman, K. Droegemeier, K. Mish, D. Papavassiliou, P. Skubic, "Acquisition of an Itanium Cluster for Grid Computing," NSF, $340K
136. J. Levit, D. Ebert (Purdue), C. Hansen (U Utah), "Advanced Weather Data Visualization," NSF, $300K
137. D. Papavassiliou, "Turbulent Transport in Wall Turbulence," NSF, $165K
138. L. Lee, J. Mullen (Worcester Polytechnic), H. Neeman, G.K. Newman, "Integration of High Performance Computing in Nanotechnology," NSF, $400K
139. R. Wheeler, "Principal mode analysis and its application to polypeptide vibrations," NSF, $385K
140. R. Kolar, J. Antonio, S. Dhall, S. Lakshmivarahan, "A Parallel, Baroclinic 3D Shallow Water Model," DoD - DEPSCoR (via ONR), $312K
141. R. Luettich (UNC), R. Kolar, B. Vieux, J. Gourley, "The Center for Natural Disasters, Coastal Infrastructure, and Emergency Management," DHS, $699K
142. D. Papavassiliou, M. Zaman, H. Neeman, "Integrated, Scalable MBS for Flow Through Porous Media," NSF, $150K
143. Y. Wang, P. Mukherjee, "Wavelet based analysis of WMAP data," NASA, $150K
144. E. Mansell, C. L. Ziegler, J. M. Straka, D. R. MacGorman, "Numerical modeling studies of storm electrification and lightning," $605K

OSCER-RELATED FUNDING TO DATE:
$195M total, $106M to OU

External Research Grants (cont'd)

145. K. Brewster, J. Gao, F. Carr, W. Lapenta, G. Jedlovec, "Impact of the Assimilation of AIRS Soundings and AMSR-E Rainfall on Short Term Forecasts of Mesoscale Weather," NASA, $458K
146. R. Wheeler, T. Click, "National Institutes of Health/Predoctoral Fellowships for Students with Disabilties," NIH/NIGMS, $80K
147. K. Pathasarathy, D. Papavassiliou, L. Lee, G. Newman, "Drag reduction using surface-attached polymer chains and nanotubes," ONR, $730K
148. D. Papavassiliou, "Turbulent transport in non-homogeneous turbulence," NSF, $320K
149. C. Doswell, D. Weber, H. Neeman, "A Study of Moist Deep Convection: Generation of Multiple Updrafts in Association with Mesoscale Forcing," NSF, $430K
150. D. Papavassiliou, "Melt-Blowing: Advance modeling and experimental verification," NSF, $321K
151. R. Kol,ar et al., "A Coupled Hydrodynamic/Hydrologic Model with Adaptive Gridding," ONR, $595K
152. D. Papavassiliou, "Scalar Transport in Porous Media," ACS-PRF, $80K
153. M. Xue, F. Carr, A. Shapiro, K. Brewster, J. Gao, "Research on Optimal Utilization and Impact of Water Vapor and Other High Resolution Observations in Storm-Scale QPF," NSF, $880K.
154. J. Gao, K. Droegemeier, M. Xue, "On the Optimal Use of WSR-88D Doppler Radar Data for Variational Storm-Scale Data Assimilation," NSF, $600K.
155. K. Mish, K. Muraleetharan, "Computational Modeling of Blast Loading on Bridges," OTC, $125K
156. V. DeBrunner, L. DeBrunner, D. Baldwin, K. Mish, "Intelligent Bridge System," FHWA, $3M
157. D. Papavassiliou, "Scalar Transport in Porous Media," ACS-PRF, $80K
158. Y. Wang, P. Mukherjee, "Wavelet based analysis of WMAP data," NASA, $150K
159. R. Wheeler et al., "Testing new methods for structure prediction and free energy calculations (Predoctoral Fellowship for Students with Disabilities)," NIH/NIGMS, $24K
160. L. White et al., "Modeling Studies in the Duke Forest Free-Air CO2 Enrichment (FACE) Program," DOE, $730K

OSCER-RELATED FUNDING TO DATE: $195M total, $106M to OU

External Research Grants (cont'd)

161. Neeman, Severini, "Cyberinfrastructure for Distributed Rapid Response to National Emergencies", NSF, $132K
162. Neeman, Roe, Severini, Wu et al., "Cyberinfrastructure Education for Bioinformatics and Beyond," NSF, $250K
163. K. Milton, C. Kao, "Non-perturbative Quantum Field Theory and Particle Theory Beyond the Standard Model," DOE, $150K
164. J. Snow, "Oklahoma Center for High Energy Physics", DOE EPSCoR, $3.4M (total), $169K (LU)
165. M. Xue, F. Kong, "OSSE Experiments for airborne weather sensors," Boeing, $90K
166. M. Xue, K. Brewster, J. Gao, A. Shapiro, "Storm-Scale Quantitative Precipitation Forecasting Using Advanced Data Assimilation Techniques: Methods, Impacts and Sensitivities," NSF, $835K
167. Y. Kogan, D. Mechem, "Improvement in the cloud physics formulation in the U.S. Navy Coupled Ocean-Atmosphere Mesoscale Prediction System," ONR, $889K
168. G. Zhang, M. Xue, P. Chilson, T. Schuur, "Improving Microphysics Parameterizations and Quantitative Precipitation Forecast through Optimal Use of Video Disdrometer, Profiler and Polarimetric Radar Observations," NSF, $464K
169. T. Yu, M. Xue, M. Yeay, R. Palmer, S. Torres, M. Biggerstaff, "Meteorological Studies with the Phased Array Weather Radar and Data Assimilation using the Ensemble Kalman Filter," ONR/Defense EPSCOR/OK State Regents, $560K
170. B. Wanner, T. Conway, et al., "Development of the www.EcoliCommunity.org Information Resource," NIH, $1.5M (total), $150K (OU)
171. T. Ibrahim et al., "A Demonstration of Low-Cost Reliable Wireless Sensor for Health Monitoring of a Precast Prestressed Concrete Bridge Girder," OK Transportation Center, $80K
172. T. Ibrahim et al., "Micro-Neural Interface," OCAST, $135K
173. J. Snow, "Langston University High Energy Physics," $155K (LU)

OSCER-RELATED FUNDING TO DATE: $195M total, $106M to OU

External Research Grants (cont'd)

174. L.M. Leslie, M.B. Richman, C. Doswell, "Detecting Synoptic-Scale Precursors Tornado Outbreaks," NSF, $548K
175. L.M. Leslie, M.B. Richman, "Use of Kernel Methods in Data Selection and Thinning for Satellite Data Assimilation in NWP Models," NOAA, $342K
176. J. Gao, K. Brewster, M. Xue, K. Droegemeier, "Assimilating Doppler Radar Data for Storm-Scale Numerical Prediction Using an Ensemble-based Variational Method," NSF, $200K
177. E. Chesnokov, "Fracture Prediction Methodology Based On Surface Seismic Data," Devon Energy, $1M
178. E. Chesnokov, "Scenario of Fracture Event Development in the Barnett Shale (Laboratory Measurements and Theoretical Investigation)," Devon Energy, $1.3M
179. M. Xue, K. Brewster, J. Gao, "Study of Tornado and Tornadic Thunderstorm Dynamics and Predictability through High-Resolution Simulation, Prediction and Advanced Data Assimilation," NSF, $780K
180. A. Striolo, "Heat Transfer in Graphene-Oil Nanocomposites: A Molecular Understanding to Overcome Practical Barriers." ACS Petroleum Research Fund, $40K
181. D.V. Papavassiliou, "Turbulent Transport in Anisotropic Velocity Fields," NSF, $292.5K
182. D. Oliver, software license grant, $1.5M
183. R. Broughton et al, "Assembling the Eutelost Tree of Life – Addressing the Major Unresolved Problem in Vertebrate Phylogeny," NSF, $3M ($654K to OU)
184. A. Fagg, "Development of a Bidirectional CNS Interface or Robotic Control," NIH, $600K
185. M. Xue, J. Gao, "An Investigation on the Importance of Environmental Variability to Storm-scale Radar Data Assimilation," NSSL, $72K
186. JV. Sikavistsas and D.V. Papavassiliou, "Flow Effects on Porous Scaffolds for Tissue Regeneration," NSF, $400K
187. P. Skubic, M. Strauss, et al., "Experimental Physics Investigations Using Colliding Beam Detectors at Fermilab and the LHC," DOE, $503K

OSCER-RELATED FUNDING TO DATE: $195M total, $106M to OU

External Funding Summary

- External research funding facilitated by OSCER (Fall 2001- Fall 2009): **$195M total, $106M to OU**
- Funded projects: **187**
- **105** OU faculty and staff in **19** academic departments and 2 other campus organizations (research centers etc)
- Comparison: Fiscal Year 2002-11 (July 2001 – June 2011): OU Norman externally funded research expenditure: $701M

Since being founded in fall of 2001, OSCER has enabled research projects comprising more than **1 / 7 of OU Norman's total externally funded research expenditure**, with a **7-to-1 return on investment**.

Publications Facilitated by OSCER

- **124** publications facilitated by OSCER rounds/help sessions
  - 2010: 9 publications
  - 2009: 9
  - 2008: 19
  - 2007: 12
  - 2006: 29
  - 2005: 18
  - 2004: 12
  - 2003: 5
  - 2002: 8
  - 2001: 3

These publications would have been impossible, or much more difficult, or would have taken much longer, without OSCER's direct, hands-on help.

- **563** publications facilitated by OSCER resources only
  - **2011: 90** (so far)
  - 2010: 113
  - 2009: 95
  - 2008: 84
  - 2007: 61
  - 2006: 56
  - 2005: 45
  - 2004: 15
  - 2003: 4

Includes: 22 MS theses, 22 PhD dissertations

TOTAL SO FAR: 687 publications

http://www.oscer.ou.edu/papers_from_rounds.php

OK Cyberinfrastructure Initiative

- Oklahoma submitted an NSF EPSCoR Research Infrastructure Proposal in Jan 2008 ($15M).
- Starting that year, all NSF EPSCoR RII "Track 1" proposals HAD TO include a statewide Cyberinfrastructure plan.
- Oklahoma's plan – the Oklahoma Cyberinfrastructure Initiative (OCII) – involves:
  - all academic institutions in the state are eligible to sign up for free use of OU's and OSU's centrally-owned CI resources;
  - other kinds of institutions (government, NGO, commercial) are eligible to use, though not necessarily for free.
- To join: See Henry after this talk.

NSF EPSCoR C2 Networking

Oklahoma has been awarded an NSF EPSCoR RII Intra-campus and Inter-campus Cyber Connectivity (C2) grant (PI Neeman), a collaboration among OU, OneNet and several other academic and nonprofit institutions, which will:

- upgrade the statewide ring from routed components to optical components, making it straightforward and affordable to provision dedicated "lambda" circuits within the state;
- upgrade several institutions' connections;
- provide telepresence capability to institutions statewide;
- provide networking professionals to speak to data networks courses about what it's like to do networking for a living.

Oklahoma Optical Initiative

- Statewide ring goes from 3 sites (OU Norman as a sidebar) to 5 sites (OU Norman as co-equal) – **hardware delivered**
- Replace routed mux/demuxes with Reconfigurable Optical Add Drop Modules, add 10 Gbps line cards, crossponders.

"OOI will transform Oklahoma's existing research ring from a routed network to an optical network, leveraging existing infrastructure – chasses and fibers – while advancing optical switching components to a new level of technology, facilitating substantial improvement in reliability, robustness, availability and potentially bandwidth, as well as enabling the ability to provision dedicated lambdas straightforwardly and affordably."

Institutional Upgrades

- OU: Upgrade Sooner's connection to 10 Gbps (10X increase) – **DONE**
- OSU: Upgrade Pistol Pete's connection to 10 Gbps (10X) – **hardware delivered**
- U Tulsa: Upgrade research networking to 1 Gbps (5X) – **DONE**
- Langston U: Upgrade High Energy Physics cluster to 10 Gbps (100X) – quotes to be finalized
- Samuel Roberts Noble Foundation: upgrade research networking to 1 Gbps (22X), commodity Internet to 100 Mbps (2X) – paperwork being finalized
- College of the Muscogee Nation: networking equipment for new residence hall – **DONE**

Tribal Colleges

- We're working with Tribal Colleges and Tribal-serving institutions that have very low connectivity, to help improve their capabilities.
- College of the Muscogee is **DONE**.
- We're working with Pawnee Nation College on scheduling a visit.
- We have plans to finalize a date with Comanche Nation College soon.

OK IT Mentorship Program

The Oklahoma Information Technology Mentorship Program is sending networking professionals to universities, colleges, career techs and even a high school statewide.

These professionals will give talks on the practicalities of being a networking professional – what that career choice means day by day.

We also provide both live and virtual job shadowing opportunities – students can follow networking professionals around to see what their work looks like, either in person or via Twitter and Facebook.

OK IT Mentorship Program

Completed (21 talks to 400+ recipients at 16 institutions):

1. Cameron U (spring 2011, fall 2011)
2. East Central U (fall 2011)
3. Eastern Oklahoma County Technology Center (fall 2011)
4. Gordon Cooper Technology Center (fall 2010)
5. Langston U (fall 2010, fall 2011)
6. Oklahoma Christian U (fall 2010)
7. Oklahoma City U (fall 2011)
8. Oklahoma Panhandle State U (fall 2010, spring 2011)
9. Oklahoma School of Science & Mathematics (fall 2010)
10. Oklahoma State U (fall 2011)
11. Oklahoma State U-Oklahoma City (fall 2010, spring 2011)
12. Pontotoc Technology Center (fall 2011)
13. Rose State College (fall 2011)
14. U Central Oklahoma (spring 2011)
15. OU Norman (fall 2010)
16. OU Tulsa (fall 2010, fall 2011)

NSF MRI Petascale Storage Grant

OU has been awarded an NSF Major Research Instrumentation (MRI) grant (PI Neeman).

We've purchase and deployed a combined disk/tape bulk storage archive from IBM:

- the NSF budget paid for most of the hardware and software, plus warranties/maintenance for 3 years;
- OU cost share and institutional commitment pay for space, power, cooling and labor, as well as maintenance after the 3 year project period;
- individual users (e.g., faculty across Oklahoma) pay for the media (disk drives and tape cartridges).

OK PetaStore Strategy

- Many media slots, few media.
- Most of the media that the grant has purchased have been allocated to the research projects in the proposal.
- Slots are available on a first come first serve basis.
- Under the Oklahoma Cyberinfrastructure Initiative, this is also true for academic institutions statewide (and also many non-academic institutions).

MRI Research Projects

- **Numerical Prediction and Data Assimilation for Convection Storms, Tornadoes and Hurricanes**: Xue, Meteorology and Center for Analysis & Prediction of Storms (CAPS)
- **ATLAS Tier 2 High Energy Physics**: Strauss, Skubic, Severini, Physics & Astronomy, Oklahoma Center for High Energy Physics
- **Earth Observations for Biogeochemistry, Climate and Global Health**: Xiao, Botany & Microbiology, Center for Spatial Analysis
- **Adaption of Robust Kernel Methods to Geosciences**: Trafalis, Industrial Engr; Richman, Leslie, Meteorology
- **3D Synthetic Spectroscopy of Astrophysical Objects**: Baron, Physics & Astronomy
- **Credibility Assessment Research Initiative**: Jensen, Management Information Systems, Center for Applied Social Research

MRI Research Projects (cont'd)

- **Developing Spatiotemporal Relational Models to Anticipate Tornado Formation**: McGovern, Computer Science (CS), Interaction, Discovery, Exploration, Adaptation (IDEA) Lab
- **Coastal Hazards Modeling**: Kolar, Dresback, Civil Engineering & Environmental Science (CEES), Natural Hazards Center
- **High Resolution Polarimetric Radar Studies Using OU-PRIME Radar**: Palmer, Meteorology & Atmospheric Radar Research Center
- **Perceptual and cognitive capacity: Modeling Behavior and Neurophysiology**: Wenger, Psychology
- **Multiscale Transport in Micro- and Nano-structures**: Papavassiliou, Chemical, Biological & Materials Engr
- **Electron Transfer Cofactors and Charge Transport**: Wheeler, Chemistry & Biochemistry

NSF Data Management Plans

- Beginning mid-January 2011, **ALL** proposals to the NSF **MUST** have 2-page data management plans. (The plan could be an argument that no data management plan is needed).
- OSCER has worked with the Assoc VP for Research Alicia Knoedler on both boilerplate text describing the Oklahoma PetaStore, as well as strategizing how to assist researchers in constructing plans for metadata, provenance, etc.

OSCER Impact Footprint in OK

Components

- "Supercomputing in Plain English"
- "Supercomputing in Plain English" overview talk
- Oklahoma Supercomputing Symposia
- Oklahoma IT Mentorship Program
- Research support

Institutions

- 11 of 13 public universities, X private universities, 3 for-profit universities, 3 community colleges, 7 career techs, 1 high school, 2 public school systems – includes 2 tribal colleges, 1 historically black university
- dozens of private companies
- 25 government agencies (federal, state, municipal)
- 6 nonprofits

What a Bargain!

When you hand in a completed **EVALUATION FORM**, you'll get the following amazing swag:

- **A lovely t-shirt!**
- **A capacious coffee mug!**
- **A tiny post-it pad!**
- **A pen that's also a laser pointer!**
- **A plastic bag!**

What a bargain!

Thanks!

- Academic sponsors
  - Oklahoma EPSCoR
  - Great Plains Network
- Industry sponsors
  - Platinum: Intel
  - Gold: Dell, Hewlett Packard, IBM, Isilon, Mellanox, Qlogic
  - Silver: Fujitsu
  - Bronze: Advanced Clustering Technologies, Cisco Systems, ScaleMp, Tripp Lite

Thanks!

- OU IT
  - OU CIO/VPIT Loretta Early
  - Symposium coordinator Debi Gentis
  - Sponsorship coordinator Chance Grubb
  - OSCER Operations Team: Brandon George, Dave Akin, Brett Zimmerman, Josh Alexander, Patrick Calhoun
  - Videographer Kevin Blake
  - All of the OU IT folks who helped put this together
- CCE Forum
  - Joey Rodriguez
  - The whole Forum crew who helped put this together
- Tutorial co-instructor: Charlie Peck

Thanks!

- Keynote Speaker
  1. Barry I. Schneider, NSF
- Plenary Speakers
  2. Leesa Brieger, RENCI/UNC
  3. Douglas Cline, Lockheed Martin
  4. Stephen Wheat, Intel
- Panelists
  5. Dan Andresen, Kansas State U
  6. Dimitrios Papavassiliou, OU
  7. Dan Weber, Tinker Air Force Base
  8. Jim Wicksted, Oklahoma EPSCoR/OSU
- Breakout speakers
  9. Alex Barclay, Tulsa Community Supercomputing Center
  10. David Bigham, Isilon Systems
  11. Keith Brewster, OU
  12. Dana Brunson, OSU
  13. Brian Cremeans, OU
  14. Larry Fisher, Creative Consultants
- Breakout speakers (continued)
  15. Brian Forbes, Mellanox Technologies
  16. Jim Glover, OSU-OKC
  17. Jim Gutowski, Dell
  18. S. Kay Hunt, Purdue U
  19. Kirk Jordan, IBM
  20. Nick Materer, OSU
  21. Rick McMullen, U Kansas
  22. Charlie Peck, Earlham College
  23. Jeff Pummill, U Arkansas
  24. Lina Sawalha, OU
  25. James Stine, OSU
  26. Luis Vicente, Polytechnic U of PR
  27. Justin Wozniak, Argonne National Lab
  28. Tom Zahniser, QLogic Corp

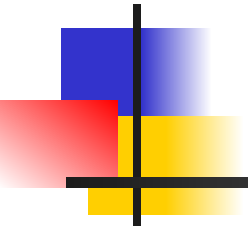
Thanks!

To all of your for participating, and to those many of you who've shown us so much loyalty over the past ten years.

Don't miss our next ten years!

To Learn More About OSCER

http://www.oscer.ou.edu/



Thanks for your attention!

Questions?