OSCER: State of the Center

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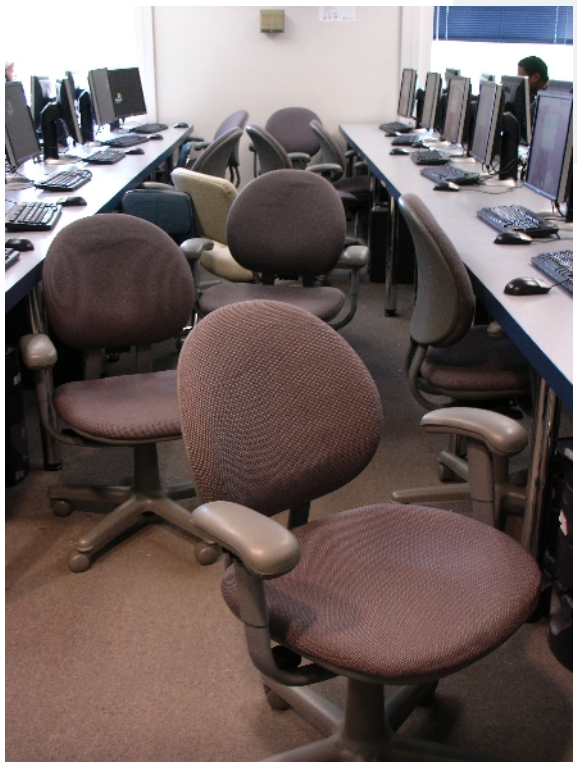
OU Supercomputing Center for Education & Research

Wednesday October 3 2007
University of Oklahoma

People


EXIT
Fall Semester 2003
Integration of HPC in
Nanotechnology
National Science Foundation

Things



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
- 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
- Radiological Sciences
- Surgery
- Zoology

More than 150 faculty & staff in **24 depts** in Colleges of Arts & Sciences, Atmospheric & Geographic Sciences, Business, Earth & Energy, Engineering, and Medicine – with **more to come**!

Who is OSCER? OU Centers

- Advanced Center for Genome Technology
- Center for Analysis & Prediction of Storms
- Center for Aircraft & Systems/Support Infrastructure
- Cooperative Institute for Mesoscale Meteorological Studies
- Center for Engineering Optimization
- Fears Structural Engineering Laboratory
- Human Technology Interaction Center
- Institute of Exploration & Development Geosciences
- Instructional Development Program
- Interaction, Discovery, Exploration, Adaptation Laboratory
- Microarray Core Facility
- National Severe Storms Laboratory
- NOAA Storm Prediction Center
- OU Information Technology
- OU Office of the VP for Research
- Oklahoma Center for High Energy Physics
- Oklahoma Climatological Survey
- Oklahoma Medical Research Foundation
- Oklahoma School of Science & Math
- Robotics, Evolution, Adaptation, and Learning Laboratory
- Sasaki Applied Meteorology Research Institute
- Symbiotic Computing Laboratory

Who? Off Campus Collaborators

1. California State Polytechnic University Pomona
2. Colorado State University
3. Contra Costa College (CA)
4. Delaware State University
5. East Central University (OK)
6. Emporia State University (KS)
7. Great Plains Network
8. Kansas State University
9. Langston University (OK)
10. Longwood University (VA)
11. Marshall University (WV)
12. Navajo Technical College (NM)
13. Oklahoma Baptist University
14. Oklahoma EPSCoR
15. Oklahoma School of Science & Mathematics
16. Riverside Community College (CA)
17. St. Cloud State University (MN)
18. St. Gregory's University (OK)
19. Southwestern Oklahoma State University
20. Texas A&M University-Corpus Christi
21. University of Arkansas
22. University of Arkansas Little Rock
23. University of Central Oklahoma
24. University of Nebraska-Lincoln
25. University of North Dakota
26. University of Northern Iowa

- **YOU COULD BE HERE!**

Who is OSCER? Personnel

- Director: Henry Neeman
- Associate Director for Remote & Heterogeneous Computing: Horst Severini
- Manager of Operations: Brandon George
- System Administrator: David Akin (hired Jan 2005)
- System Administrator: Brett Zimmerman (hired July 2006)
- Undergraduate Condor developer: Josh Alexander

Who is OSCER? Interns

OSCER has been attracting interns.

- **French Universities**
  - 2005: 2 from Limoges, 1 from Claremont-Ferrand
  - 2006: 3 from Limoges, 10 from Claremont-Ferrand
  - 2007: 3 from Limoges, 3 from Claremont-Ferrand
  - **2008: in discussion now**

Who Are the Users?

Over 380 users so far, including:

- Roughly equal split between students vs faculty/staff;
- many off campus users;
- … more being added every **week**.

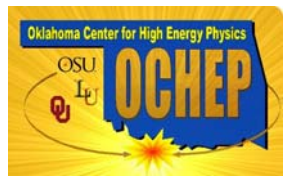
Comparison: National Center for Supercomputing Applications (NCSA), after **20 years of history** and **hundreds of millions in expenditures**, has about **2150 users;**[*] the TeraGrid is 4500 users.[†]

[*] Unique usernames on cu.ncsa.uiuc.edu and tungsten.ncsa.uiuc.edu
[†] Unique usernames on maverick.tacc.utexas.edu

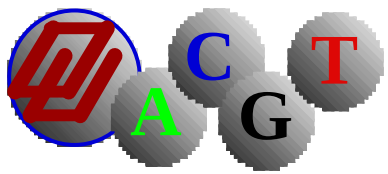
Biggest Consumers

- **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



- **Advanced Center for Genome Technology**: bioinformatics (e.g., Human Genome Project)



Where is OSCER?

OU is building a new research campus.

The first building to open (March 29 2004), the **Stephenson Research & Technology Center** (SRTC), now houses bioinformatics, bioengineering, robotics and **OSCER**.

The **reception/poster session** was there last night.

Where is OSCER?

- OSCER's big Linux cluster is housed at the Merrick Computing Center, on OU's North Base, a few miles north of campus.

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 it's seen as needing too much computing background, and needs 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?

What Does OSCER Do?

- Resources
- Teaching
- Research
- Dissemination

OSCER Resources

2005 OSCER Hardware

- **TOTAL:** 1477 GFLOPs*, 366 CPUs, 430 GB RAM
- Aspen Systems Pentium4 Xeon 32-bit Linux Cluster
  - 270 Pentium4 Xeon CPUs, 270 GB RAM, 1.08 TFLOPs
- Aspen Systems Itanium2 cluster
  - 64 Itanium2 CPUs, 128 GB RAM, 256 GFLOPs
- IBM Regatta p690 Symmetric Multiprocessor
  - 32 POWER4 CPUs, 32 GB RAM, 140.8 GFLOPs
- IBM FAStT500 FiberChannel-1 Disk Server
- Qualstar TLS-412300 Tape Library

* GFLOPs: billions of calculations per second

2007 OSCER Hardware

- **TOTAL:** 14,663 GFLOPs*, 2211 CPUs, 3931 GB RAM
- **Dell Pentium4 Xeon 64-bit Linux Cluster**
  - 1024 Pentium4 Xeon CPUs, 2176 GB RAM, 6553 GFLOPs
- Aspen Systems Itanium2 cluster
  - 64 Itanium2 CPUs, 128 GB RAM, 256 GFLOPs
- **Condor Pool:** 775 student lab PCs, 7853 GFLOPs
- **National Lambda Rail** (10 Gbps network)
- **NEW! Storage library**

* GFLOPs: billions of calculations per second

Intel Xeon Linux Cluster

- 1,024 Intel Xeon CPUs (3.2 GHz)
- 2,176 GB RAM
- 23,000 GB disk
- Cisco Systems Infiniband
- Force10 Networks Gigabit Ethernet
- Red Hat Enterprise Linux 4
- Peak speed: 6,553 GFLOPs*

*GFLOPs: billions of calculations per second

topdawg.oscer.ou.edu

Intel Xeon Linux Cluster

DEBUTED AT #54 WORLDWIDE, #9 AMONG US UNIVERSITIES, #4 EXCLUDING BIG 3 NSF CENTERS

CURRENTLY #88 WORLDWIDE, #17 AMONG US UNIVERSITIES, #10 EXCLUDING BIG 3 NSF CENTERS

topdawg.oscer.ou.edu

Itanium2 Cluster

- 64 Itanium2 1.0 GHz CPUs
- 128 GB RAM
- 5,774 GB disk
- SilverStorm Infiniband
- Gigabit Ethernet
- Red Hat Linux Enterprise 4
- Peak speed: 256 GFLOPs*
- *GFLOPs: billions of calculations per second
- Purchased with NSF Major Research Instrumentation grant

Aspen Systems Inc.

schooner.oscer.ou.edu

Condor Pool

Condor is a software package that allows number crunching jobs to run on idle desktop PCs.

OU IT is deploying a large Condor pool (775 desktop PCs) over the course of the 2007.

When fully deployed, it'll provide a huge amount of additional computing power – more than was available in all of OSCER in 2005.

And, the cost is very very low.

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

What is Condor?

Condor is **grid computing** technology:

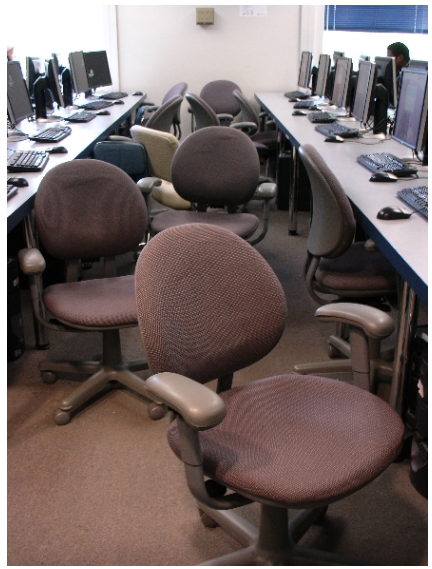
- it **steals compute cycles** from existing desktop PCs;
- it **runs in background** when no one is logged in.

Condor is like SETI@home, but **better**:

- it's **general purpose** and can work for any **"loosely coupled"** application;
- it can do all of its **I/O over the network**, not using desktop PC's disk.

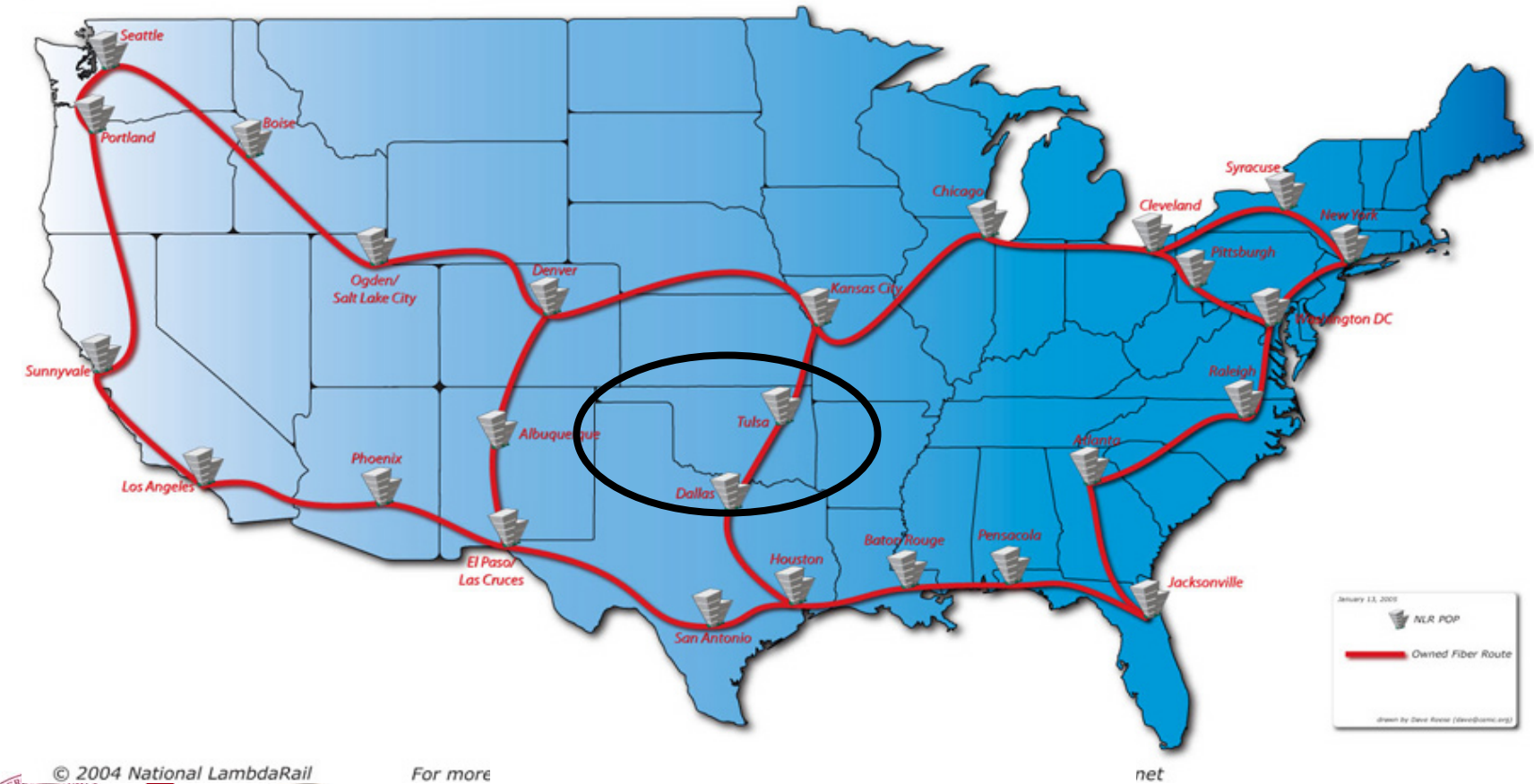
Current Status at OU

- Deployed to 775 machines in OU IT PC labs
- Submit/management from Neeman's desktop PC
- Fully utilized
- Some machines are burping, but will be fixed shortly
- **COMING:** 2 submit nodes, large RAID,
  2 management nodes



National Lambda Rail

The ***National Lambda Rail*** *(NLR)* is the next generation of high performance networking: 10 Gbps.



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).

What Does OSCER Do? Rounds

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

OSCER's Education Strategy

- "Supercomputing in Plain English" workshops
- Supercomputing tours (like last night)
- Q&A
- Rounds

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: almost 200 from 2001 to 2004

Workshop Topics

- Overview
- The Storage Hierarchy
- Instruction Level Parallelism
- High Performance Compilers
- Shared Memory Parallelism
- Distributed Parallelism
- Grab Bag: Scientific Libraries, I/O libraries, Visualization

Teaching: Workshops

- Supercomputing in Plain English
  - 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
  - **NEW! Fall 2007: 41 @ OU, 80 at 28 other institutions**
- NCSI Parallel & Cluster Computing workshop (Aug 8-14 2004)
- Linux Clusters Institute workshop (June 2005)
- NCSI Parallel & Cluster Computing workshop (summer 2005)
- Taught at NCSI Parallel & Cluster Computing workshop (May 2006) at Houston Community College
- Linux Clusters Institute workshop (Feb 2007)
- **NEW! SC07 Education Committee Parallel & Cluster Computing workshop (yesterday)**

… and more to come.

OU is the only institution to host workshops sponsored by NCSI, LCI and SC.

Teaching: Academic Coursework

- 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)

Teaching: Presentations & Tours

- Courses at OU
  - Chem Engr: Industrial & Environmental Transport Processes (D. Papavassiliou)
  - Engineering Numerical Methods (U. Nollert)
  - Math: Advanced Numerical Methods (R. Landes)
  - Electrical Engr: Computational Bioengineering (T. Ibrahim)
- Research Experience for Undergraduates at OU
  - Ind Engr: Metrology REU (T. Reed Rhoads)
  - Ind Engr: Human Technology Interaction Center REU (R. Shehab)
  - Meteorology REU (D. Zaras)
- External
  - American Society of Mechanical Engineers, OKC Chapter
  - Oklahoma State Chamber of Commerce
  - National Educational Computing Conference 2006 (virtual tour via videoconference)

- Other Universities
  1. SUNY Binghamton (NY)
  2. Bradley University (IL)
  3. Cameron University (OK)
  4. El Bosque University (Colombia)
  5. Southwestern University (TX)
  6. Louisiana State University
  7. Midwestern State University (TX)
  8. Northwestern Oklahoma State University
  9. Oklahoma Baptist University
  10. Oklahoma City University
  11. Oklahoma State University – OKC
  12. **NEW! Oral Roberts University (OK)**
  13. St. Gregory's University (OK)
  14. Southeastern Oklahoma State University (TORUS)
  15. **NEW! Southwestern Oklahoma State University**
  16. **NEW! Texas A&M-Commerce**
  17. University of Arkansas at Little Rock
  18. University of Central Oklahoma
- High Schools and High School Programs
  - Oklahoma School of Science & Mathematics
  - Oklahoma Christian University's Opportunity Bytes Summer Academy
  - Dept of Energy National Scholarship Finalists
  - Ardmore High School (OK)

Teaching: Q & A

OSCER has added a new element to our education program:

When students take the Supercomputing in Plain English workshops, they then are required to ask 3 questions per person per video.

Dr. Neeman meets with them in groups to discuss these questions.

Result: A much better understanding of supercomputing.

What Does OSCER Do? Rounds

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

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.

Teaching: Rounds Ride-Alongs

Ride-alongs: students in CS 1313 (Programming for Non-majors) get extra credit for **taking the supercomputing tour** and **"riding along"** on a round: a **"living lab"** of scientists & engineers in their native habitat.

- Library & Information Studies: on-campus internships
- History of Science: like CS students

OSCER Research

OSCER Research

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

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 is **unique**: 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 2007

OSCER played a major role in the Spring Storm Experiment, which involved the Center for Analysis & Prediction of Storms, the NOAA Storm Prediction Center, the Pittsburgh Supercomputing Center, 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), as well as a provider for the Linked Environments for Atmospheric Discovery (LEAD) project, setting up the first dedicated 10 Gbps connection from OU (to PSC).

This project consumed about 1/3 of topdawg for 2 1/2 months.

External Research Grants

- K. Droegemeier et al., "Engineering Research Center for Collaborative Adaptive Sensing of the Atmosphere," NSF, $17M (total), $5.6M (OU)
- K. Droegemeier et al., "Linked Environments for Atmospheric Discovery (LEAD)," NSF, $11.25M (total), $2.5M (OU)
- M. Strauss, P. Skubic et al., "Oklahoma Center for High Energy Physics", DOE EPSCoR, $3.4M (total), $1.6M (OU)
- M. Richman, A. White, V. Lakshmanan, V. DeBrunner, P. Skubic, "Real Time Mining of Integrated Weather Data," NSF, $950K
- D. Weber, K. Droegemeier, H. Neeman, "Modeling Environment for Atmospheric Discovery," NCSA, $435K
- H. Neeman, K. Droegemeier, K. Mish, D. Papavassiliou, P. Skubic, "Acquisition of an Itanium Cluster for Grid Computing," NSF, $340K
- J. Levit, D. Ebert (Purdue), C. Hansen (U Utah), "Advanced Weather Data Visualization," NSF, $300K
- L. Lee, J. Mullen (Worcester Polytechnic), H. Neeman, G.K. Newman, "Integration of High Performance Computing in Nanotechnology," NSF, $400K
- R. Wheeler, "Principal mode analysis and its application to polypeptide vibrations," NSF, $385K
- R. Kolar, J. Antonio, S. Dhall, S. Lakshmivarahan, "A Parallel, Baroclinic 3D Shallow Water Model," DoD - DEPSCoR (via ONR), $312K
- D. Papavassiliou, "Turbulent Transport in Wall Turbulence," NSF, $165K
- D. Papavassiliou, M. Zaman, H. Neeman, "Integrated, Scalable MBS for Flow Through Porous Media," NSF, $150K
- Y. Wang, P. Mukherjee, "Wavelet based analysis of WMAP data," NASA, $150K

OSCER-RELATED FUNDING TO DATE:
$59.2M total, $33.5M to OU

External Research Grants (cont'd)

- E. Mansell, C. L. Ziegler, J. M. Straka, D. R. MacGorman, "Numerical modeling studies of storm electrification and lightning," $605K
- 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
- R. Wheeler, T. Click, "National Institutes of Health/Predoctoral Fellowships for Students with Disabilties," NIH/NIGMS, $80K
- K. Pathasarathy, D. Papavassiliou, L. Lee, G. Newman, "Drag reduction using surface-attached polymer chains and nanotubes," ONR, $730K
- D. Papavassiliou, "Turbulent transport in non-homogeneous turbulence, " NSF, $320K
- C. Doswell, D. Weber, H. Neeman, "A Study of Moist Deep Convection: Generation of Multiple Updrafts in Association with Mesoscale Forcing," NSF, $430K
- D. Papavassiliou, "Melt-Blowing: Advance modeling and experimental verification," NSF, $321K
- R. Kol,ar et al., "A Coupled Hydrodynamic/Hydrologic Model with Adaptive Gridding," ONR, $595K
- 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.
- J. Gao, K. Droegemeier, M. Xue, "On the Optimal Use of WSR-88D Doppler Radar Data for Variational Storm-Scale Data Assimilation," NSF, $600K.
- K. Mish, K. Muraleetharan, "Computational Modeling of Blast Loading on Bridges," OTC, $125K
- V. DeBrunner, L. DeBrunner, D. Baldwin, K. Mish, "Intelligent Bridge System," FHWA, $3M
- D. Papavassiliou, "Scalar Transport in Porous Media," ACS-PRF, $80K
- Y. Wang, P. Mukherjee, "Wavelet based analysis of WMAP data," NASA, $150K
- R. Wheeler et al., "Testing new methods for structure prediction and free energy calculations (Predoctoral Fellowship for Students with Disabilities)," NIH/NIGMS, $24K
- L. White et al., "Modeling Studies in the Duke Forest Free-Air CO2 Enrichment (FACE) Program," DOE, $730K

External Research Grants (cont'd)

- Neeman, Severini, "Cyberinfrastructure for Distributed Rapid Response to National Emergencies", NSF, $132K
- Neeman, Roe, Severini, Wu et al., "Cyberinfrastructure Education for Bioinformatics and Beyond," NSF, $250K
- K. Milton, C. Kao, "Non-perturbative Quantum Field Theory and Particle Theory Beyond the Standard Model," DOE, $150K
- J. Snow, "Oklahoma Center for High Energy Physics", DOE EPSCoR, $3.4M (total), $169K (LU)
- J. Snow, "Langston University High Energy Physics," $155K (LU)
- M. Xue, F. Kong, "OSSE Experiments for airborne weather sensors," Boeing, $90K
- M. Xue, K. Brewster, J. Gao, A. Shapiro, "Storm-Scale Quantitative Precipitation Forecasting Using Advanced Data Assimilation Techniques: Methods, Impacts and Sensitivities," NSF, $835K
- Y. Kogan, D. Mechem, "Improvement in the cloud physics formulation in the U.S. Navy Coupled Ocean-Atmosphere Mesoscale Prediction System," ONR, $889K
- 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
- 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
- B. Wanner, T. Conway, et al., "Development of the www.EcoliCommunity.org Information Resource," NIH, $1.5M (total), $150K (OU)
- 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
- T. Ibrahim et al., "Micro-Neural Interface," OCAST, $135K

External Research Grants (cont'd)

- L.M. Leslie, M.B. Richman, C. Doswell, "Detecting Synoptic-Scale Precursors Tornado Outbreaks," NSF, $548K
- L.M. Leslie, M.B. Richman, "Use of Kernel Methods in Data Selection and Thinning for Satellite Data Assimilation in NWP Models," NOAA, $342K
- P. Skubic, M. Strauss, et al., "Experimental Physics Investigations Using Colliding Beam Detectors at Fermilab and the LHC," DOE, $503K
- E. Chesnokov, "Fracture Prediction Methodology Based On Surface Seismic Data," Devon Energy, $1M
- E. Chesnokov, "Scenario of Fracture Event Development in the Barnett Shale (Laboratory Measurements and Theoretical Investigation)," Devon Energy, $1.3M
- A. Fagg, "Development of a Bidirectional CNS Interface or Robotic Control," NIH, $600K
- A. Striolo, "Heat Transfer in Graphene-Oil Nanocomposites: A Molecular Understanding to Overcome Practical Barriers." ACS Petroleum Research Fund, $40K
- D.V. Papavassiliou, "Turbulent Transport in Anisotropic Velocity Fields," NSF, $292.5K
- V. Sikavistsas and D.V. Papavassiliou , "Flow Effects on Porous Scaffolds for Tissue Regeneration," NSF, $400K
- D. Oliver, software license grant, $1.5M
- R. Broughton et al, "Assembling the Eutelost Tree of Life – Addressing the Major Unresolved Problem in Vertebrate Phylogeny," NSF, $3M ($654K to OU)

NSF CI-TEAM Grant

"Cyberinfrastructure Education for Bioinformatics and Beyond" ($250,000, 12/01/2006 – 11/30/2008)

OSCER received a grant from the National Science Foundation's Cyberinfrastructure Training, Education, Advancement, and Mentoring for Our 21st Century Workforce (CI-TEAM) program.

NSF CI-TEAM Grant

"Cyberinfrastructure Education for Bioinformatics and Beyond" ($250,000)

Objectives:

- Provide Condor resources to the national community
- Teach users to use Condor
- Teach sysadmins to deploy and administer Condor
- Teach bioinformatics students to use BLAST on Condor

NSF CI-TEAM Grant

Participants at OU (29 faculty/staff in 16 depts)

- Information Technology
  - OSCER: Neeman (PI)
- College of Arts & Sciences
  - Botany & Microbiology: Conway, Wren
  - Chemistry & Biochemistry: Roe (Co-PI), Wheeler
  - Mathematics: White
  - Physics & Astronomy: Kao, Severini (Co-PI), Skubic, Strauss
  - Zoology: Ray
- College of Earth & Energy
  - Sarkeys Energy Center: Chesnokov
- College of Engineering
  - Aerospace & Mechanical Engr: Striz
  - Chemical, Biological & Materials Engr: Papavassiliou
  - Civil Engr & Environmental Science: Vieux
  - Computer Science: Dhall, Fagg, Hougen, Lakshmivarahan, McGovern, Radhakrishnan
  - Electrical & Computer Engr: Cruz, Todd, Yeary, Yu
  - Industrial Engr: Trafalis
- Health Sciences Center
  - Biochemistry & Molecular Biology: Zlotnick
  - Radiological Sciences: Wu (Co-PI)
  - Surgery: Gusev

Participants at other institutions (26 institutions in 15 states)

1. California State U Pomona (masters-granting, minority serving): Lee
2. Colorado State University: Kalkhan
3. Contra Costa College (2-year, minority serving): Murphy
4. Delaware State University
5. Earlham College (4-year): Peck
6. East Central U (masters-granting): Ferdinand, Myers
7. Emporia State U (masters-granting): Pheatt, Ballester
8. Kansas State U: Andresen, Monaco
9. Langston U (masters-granting, minority serving): Snow
10. Longwood U
11. Marshall University : Richards
12. Navajo Technical College: Ribble
13. Oklahoma Baptist U (4-year): Chen, Jett, Jordan
14. Oklahoma School of Science & Mathematics (high school): Samadzadeh
15. Riverside Community College
16. St. Cloud State U: Herath
17. St. Gregory's U (4-year): Meyer
18. Southwestern Oklahoma State U: Linder, Moseley
19. Texas A&M University-Corpus Christi
20. U Arkansas: Apon
21. University of Arkansas Little Rock
22. U Central Oklahoma (masters-granting): Lemley, Wilson
23. U Kansas: Bishop
24. U Nebraska-Lincoln: Swanson
25. University of North Dakota
26. U Northern Iowa (masters-granting): Gray

NSF CI-TEAM Grant

"Cyberinfrastructure Education for Bioinformatics and Beyond" ($250,000)

OSCER is providing "Supercomputing in Plain English" workshops via videoconferencing starting in Fall 2007.

INTERESTED? Contact Henry (hneeman@ou.edu)

140 people at 29 institutions nationwide, via:

- Access Grid
- VRVS
- iLinc
- QuickTime
- Phone bridge (land line)

NSF CI-TEAM Grant

"Cyberinfrastructure Education for Bioinformatics and Beyond" ($250,000)

OSCER will be providing supercomputing rounds via videoconferencing starting in Spring 2008.

INTERESTED? Contact Henry (hneeman@ou.edu)

NSF CI-TEAM Grant

"Cyberinfrastructure Education for Bioinformatics and Beyond" ($250,000)

OSCER is producing software for installing Linux-enabled Condor inside a Windows PC.

INTERESTED? Contact Henry (hneeman@ou.edu)

NSF CI-TEAM Grant

"Cyberinfrastructure Education for Bioinformatics and Beyond" ($250,000)

OSCER is providing help on installing Linux as the native host OS, VMware, Windows as the desktop OS, and Condor running inside Linux.

INTERESTED? Contact Henry (hneeman@ou.edu)

NSF CI-TEAM Proposal

- Follow-on to existing CI-TEAM grant
- Implementation proposal: ~$1M
- Teach PhD students to be Henry, but remotely via videoconferencing

Papers from OSCER

- 85 papers enabled by OSCER rounds/help sessions
  - 2007: 11 papers
  - 2006: 30
  - 2005: 16
  - 2004: 12
  - 2003: 5
  - 2002: 8
  - 2001: 3

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

- 160 papers enabled by OSCER but not by rounds/help sessions
  - 2007: 110 papers
  - 2006: 26
  - 2005: 12
  - 2004: 9
  - 2003: 3

TOTAL: 245 papers, 121 in 2006

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

OSCER Resources

2005 OSCER Hardware

- **TOTAL:** 1477 GFLOPs*, 366 CPUs, 430 GB RAM
- Aspen Systems Pentium4 Xeon 32-bit Linux Cluster
  - 270 Pentium4 Xeon CPUs, 270 GB RAM, 1.08 TFLOPs
- Aspen Systems Itanium2 cluster
  - 64 Itanium2 CPUs, 128 GB RAM, 256 GFLOPs
- IBM Regatta p690 Symmetric Multiprocessor
  - 32 POWER4 CPUs, 32 GB RAM, 140.8 GFLOPs
- IBM FAStT500 FiberChannel-1 Disk Server
- Qualstar TLS-412300 Tape Library

* GFLOPs: billions of calculations per second

2007 OSCER Hardware

- **TOTAL:** 14,663 GFLOPs*, 2211 CPUs, 3931 GB RAM
- **Dell Pentium4 Xeon 64-bit Linux Cluster**
  - 1024 Pentium4 Xeon CPUs, 2176 GB RAM, 6553 GFLOPs
- Aspen Systems Itanium2 cluster
  - 64 Itanium2 CPUs, 128 GB RAM, 256 GFLOPs
- **NEW! Condor Pool:** 775 student lab PCs, 7853 GFLOPs
- **NEW! National Lambda Rail** (10 Gbps network)
- **NEW! Storage library**

* GFLOPs: billions of calculations per second

Intel Xeon Linux Cluster

1,024 Intel Xeon CPUs (3.2 GHz)
2,176 GB RAM
23,000 GB disk
Cisco Systems Infiniband
Force10 Networks Gigabit Ethernet
Red Hat Enterprise Linux 4
Peak speed: 6,553 GFLOPs*
*GFLOPs: billions of calculations per second

topdawg.oscer.ou.edu

Intel Xeon Linux Cluster

DEBUTED AT #54 WORLDWIDE, #9 AMONG US UNIVERSITIES, #4 EXCLUDING BIG 3 NSF CENTERS

CURRENTLY #88 WORLDWIDE, #17 AMONG US UNIVERSITIES, #10 EXCLUDING BIG 3 NSF CENTERS

topdawg.oscer.ou.edu

Itanium2 Cluster

- 64 Itanium2 1.0 GHz CPUs
- 128 GB RAM
- 5,774 GB disk
- SilverStorm Infiniband
- Gigabit Ethernet
- Red Hat Linux Enterprise 4
- Peak speed: 256 GFLOPs*
- *GFLOPs: billions of calculations per second
- Purchased with NSF Major Research Instrumentation grant

Aspen Systems Inc.

schooner.oscer.ou.edu

Condor Pool

Condor is a software package that allows number crunching jobs to run on idle desktop PCs.

OU IT is deploying a large Condor pool (775 desktop PCs) over the course of the 2007.

When fully deployed, it'll provide a huge amount of additional computing power – more than was available in all of OSCER in 2005.

And, the cost is very very low.

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

What is Condor?

Condor is **grid computing** technology:

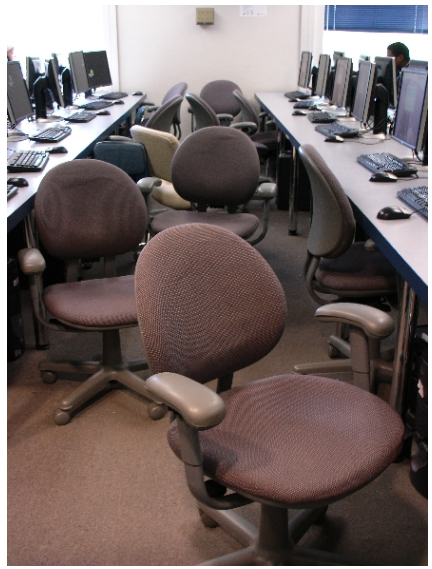
- it **steals compute cycles** from existing desktop PCs;
- it **runs in background** when no one is logged in.

Condor is like SETI@home, but **better**:

- it's **general purpose** and can work for any **"loosely coupled"** application;
- it can do all of its **I/O over the network**, not using desktop PC's disk.

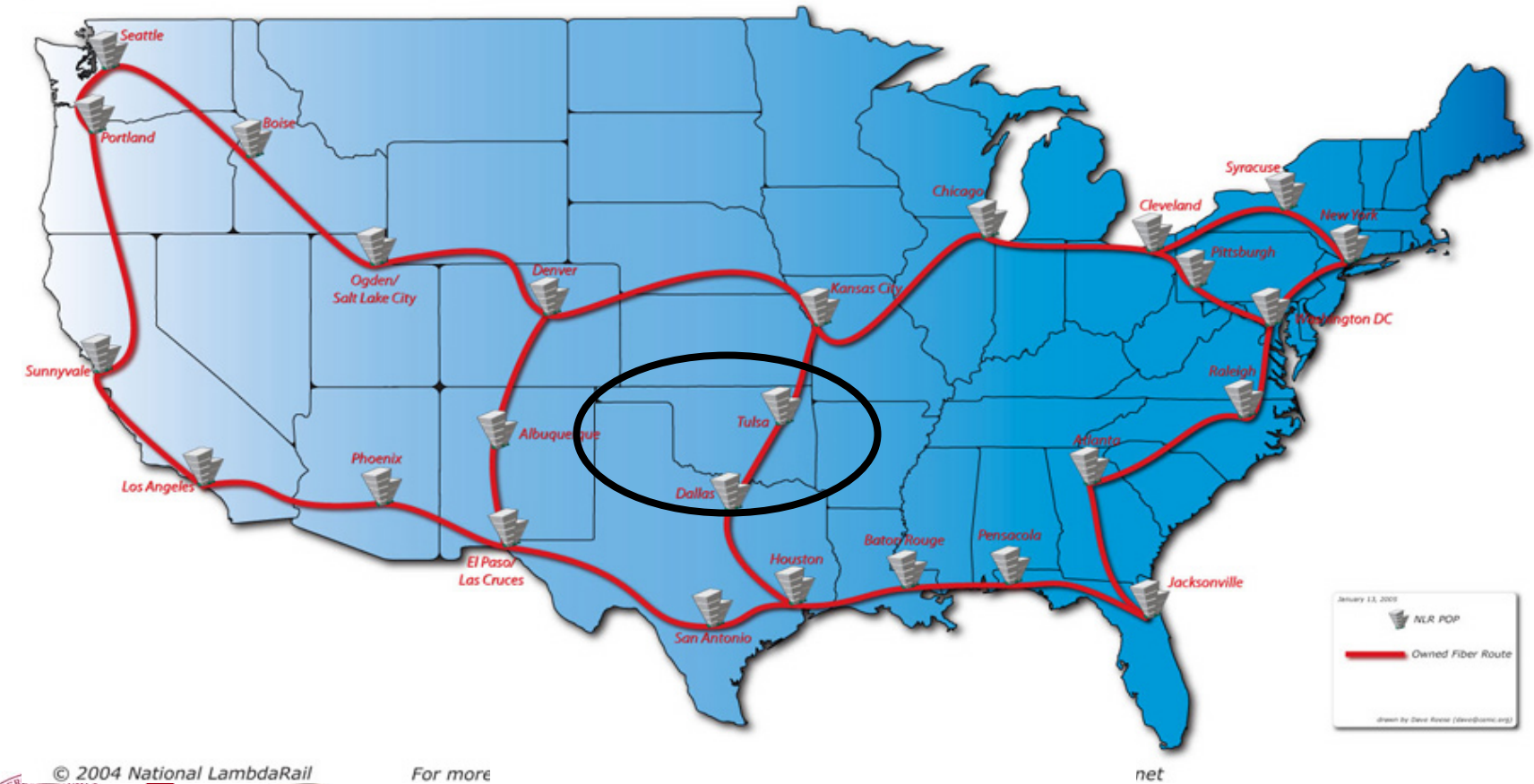
Current Status at OU

- Deployed to 775 machines in OU IT PC labs
- Submit/management from Neeman's desktop PC
- Fully utilized
- Some machines are burping, but will be fixed shortly
- **COMING:** 2 submit nodes, large RAID, 2 management nodes



National Lambda Rail

The ***National Lambda Rail*** *(NLR)* is the next generation of high performance networking: 10 Gbps.



What Next?

More, MORE, **MORE!**

- More users
- More rounds
- More workshops
- More collaborations (intra- and inter-university; high school; commercial; government; **INTERNATIONAL**)
- **MORE PROPOSALS!**

How Can You Get Involved?

To get involved with OSCER:

- Send e-mail to **hneeman@ou.edu**.
- By OSCER Board policy, to be eligible to use OSCER resources, you must be either:
  - an OU faculty or staff member, or
  - a student working on a research or education project directed/co-directed by an OU faculty or staff member, or
  - a non-OU researcher working on a project that has, as one of its PI/Co-PIs, an OU faculty or staff member.

So talk to us about starting a **collaboration**!

A Bright Future

- OSCER's approach is unique, but it's the right way to go.
- People are taking notice nationally – e.g., you!
- We'd like there to be more and more OSCERs around the country:
  - local centers can react quickly to local needs;
  - inexperienced users need one-on-one interaction to learn how to use supercomputing in their research.

Such a Bargain!

When you hand in a completed EVALUATION FORM, you'll get a beautiful new Oklahoma Supercomputing Symposium 2007 T-SHIRT, **FREE!**

And don't forget your FREE mug and FREE pen!

To Learn More About OSCER

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

Thanks for your attention!

Questions?