OSCER
State of the Center
Henry Neeman, Director
OU Supercomputing Center for Education & Research
A Division of OU Information Technology
hneeman@ou.edu

Wednesday September 23 2015
University of Oklahoma
Our ugly Symposium website

http://symposium2015.oscer.ou.edu/

has pretty complete agenda and speaker information, and is so ugly that it’s actually reasonably optimized for handhelds like phones and tablets.

We encourage you to use it!
Preregistration Profile 2015

- **Organizations**: 78 preregistered (or speaking)
  - **Academic**: preregistered 36 institutions in 12 states (AR, IN, KS, LA, MO, ND, NE, NJ, OK, SD, TN, TX)
    - Includes 28 institutions in 8 EPSCoR states (AR, KS, LA, MO, ND, NE, OK, SD)
  - **Industry**: preregistered 28 private companies
  - **Government**: preregistered 9 agencies (federal, state)
  - **Non-governmental**: preregistered 6 organizations

- **Demographics**: 319 preregistered (and/or speaking)
  - 28% OU, 72% non-OU (or unknown)
  - 68% Oklahoma, 32% non-Oklahoma (or unknown)
  - 83% from EPSCoR states, 17% non-EPSCoR (or unknown)
  - 64% academic, 36% non-academic (or unknown)
Attendee Profile 2002-2014

- Over 3300 attendees at the previous 13 Symposia
  - 69 in 2002, 225-325 per year thereafter, usually 275±25
- Organizations: 312 through 2014
  - **Academic**: from 112 institutions in 27 US states & territories
    - 70 institutions in 14 EPSCoR jurisdictions
    - 32 institutions in Oklahoma
      - PhD-granting, masters-granting, bachelors-granting, community colleges, career techs, high school
      - Historically Black University, Tribal College, 3 Native American Serving Non-tribal Institutions
    - public, private, for-profit
  - **Industry**: attendees from 143 firms
  - **Government**: attendees from 37 agencies (federal, state, municipal, foreign)
  - **Non-governmental/nonprofit**: attendees from 20 organizations
Symposium 2015 Sponsors: Thank You!

- Academic sponsor (1)
  - Great Plains Network
- Industry sponsors (17/18)
  - Platinum (1): Intel + HP
  - Gold (7): Arista Networks, Brocade/Lumenate, Dell, Mellanox Technologies, NVIDIA, Quantum, Qumulo
  - Silver (4): Cray, DataDirect Networks, SGI, Spectra Logic

Thank you all! Without you, the Symposium couldn’t happen. Over the past 14 Symposia, we’ve had a total of 84 companies as sponsors – and more than half have repeated (or were acquired by/merged with other sponsors).
Thanks!

- **OU IT**
  - OU CIO/VPIT Loretta Early
  - Symposium committee: Josh Alexander (OU), Dana Brunson (OSU), Debi Gentis (OU), George Louthan (OII), Franklin Fondjo Fotou (LU), Joel Snow (LU), Karl Frinkle (SE), Evan Lemley (UCO)
  - Symposium coordinator: Debi Gentis
  - Sponsorship coordinator: Chance Grubb
  - OSCER Operations Team: Dave Akin, Brett Zimmerman, Josh Alexander, Patrick Calhoun
  - All of the OU IT folks who helped put this together

- **CCE Forum**
  - Jake Maurer, Kristin Livingston
  - The whole Forum crew who helped put this together
Thanks: Plenary Speakers

- Jim Kurose, NSF Computer & Information Science & Engineering Directorate
- Carl Grant (OU), Adrian Alexander (TU), Jennifer Fitzgerald (Noble), Mark Laufersweiler (OU), Robin Leech (OSU), Habib Tabatabai (UCO)
- Monica Martinez-Canales, Intel & Stephen Wheat, HP (Platinum sponsors)
Thanks: Gold Sponsor Speakers

- Mickey Stewart, Arista Networks
- Dan DeBacker, Brocade Communications Systems Inc.
- DJ Spry, Dell
- Kashif Chauhan & D. Kent Snider, Mellanox Technologies
- Bob Crovella, NVIDIA
- Neal Wingenbach, Quantum
- Bob Collins, Qumulo
Thanks: Breakout Speakers

1. Kate Adams, GPN
2. Dan Andresen, KSU
3. Joseph Babb, Tinker AFB
4. Dana Brunson, OSU
5. Eduardo Colmenares, MWSU
6. Nick Davis, OU Tulsa
7. Kendra Dresback, OU
8. Jim Ferguson, NICS
9. John Hale, Peter Hawrylak, Andrew Kongs, TU
10. Utkarsh Kapoor, OSU
11. Scott Lathrop, XSEDE/Shodor
12. David Monismith
13. Mukundhan Selvam, WSU
14. Dan Stanzione, TACC
Thanks!

To all of you for participating, and to those many of you who’ve shown us so much loyalty over the past 13 years.
Outline

- OU
  - Resources
  - Accomplishments
- OCII/OneOCII
Resources
874 Intel Xeon CPU chips/6992 cores
412 dual socket/oct core Sandy Bridge 2.0 GHz, 32 GB
23 dual socket/oct core Sandy Bridge 2.0 GHz, 64 GB
1 quad socket/oct core Westmere, 2.13 GHz, 1 TB

15,680 GB RAM
~360 TB global disk
QLogic Infiniband
(16.67 Gbps, ~1 microsec latency)
Dell Force10 Gigabit/10G Ethernet
Red Hat Enterprise Linux 6
Peak speed: 110.6 TFLOPs*
*TFLOPs: trillion calculations per second

Just over 3x (300%) as fast as our 2008-12 supercomputer.
Just over 100x (10,000%) as fast as our first cluster supercomputer in 2002.
874 Intel Xeon CPU chips/6992 cores
412 dual socket/oct core Sandy Bridge 2.0 GHz, 32 GB
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*TFLOPs: trillion calculations per second

19% of the nodes are
“condominium” (owned by individual research teams): ~4x as many as all OSCER’s previous clusters combined.
Schooner: non-condominium nodes

- Compute nodes, non-condominium
  - 268 x R430, dual E5-2650v3 10-core 2.3 GHz, 32 GB RAM
  - 46 x R430, dual E5-2670v3 12-core 2.3 GHz, 64 GB RAM

- Accelerator-capable nodes, non-condominium
  - 28 x R730, dual E5-2650v3 10-core 2.3 GHz, 32 GB RAM
  - 8 x R730, dual E5-2670v3 12-core 2.3 GHz, 64 GB RAM

- Large RAM node, non-condominium
  - 1 x R930, quad E7-4809v3 8-core 2.0 GHz, 1024 GB RAM

- Accelerators, non-condominium
  - 6 x NVIDIA K20M
  - 24 x Intel Xeon Phi 31S1P

- Subtotal peak CPU speed, non-condominium: 266.57 TFLOPs
Schooner: non-condominium other

- Interconnects
  - Infiniband: Mellanox FDR10 3:1 oversubscribed
  - Ethernet: GigE downlinks to nodes, 10GE uplinks to core
- Storage (user-accessible)
  - DataDirect Networks SFA7700X w/70 x 6 TB = ~300 TB useable
  - 6 x home/scratch 12 x 6 TB = ~291 TB useable
Schooner: Old Condominium

As an experiment, we’re transferring condominium nodes from Boomer over to Schooner.

- Compute nodes, condominium, old
  - 73 x R620, dual E5-2650 (Sandy Bridge), oct core, 2.0 GHz
- Accelerator-capable nodes, condominium, old
  - 6 x R720, dual E5-2650, oct core, 2.0 GHz
- Accelerators, condominium, old
  - 12 x NVIDIA M2075
  - 6 x NVIDIA K20M
- Storage, diskfull nodes, condominium, old
  - 4 x R720xd, 12 x 3 TB = ~19 TB useable each
- Subtotal peak CPU speed, old condominium: 20.22 TFLOPs
Schooner: New Condominium

- Compute nodes, condominium, new
  - 6 x R430, dual E5-2650Lv3 12-core 1.8 GHz, 64 GB RAM
  - 39 x R430, dual E5-2670v3 12-core 2.3 GHz, 64 GB RAM
- Accelerator-capable nodes, condominium, new
  - 1 x R730, dual E5-2650v3 10-core 2.3 GHz, 32 GB RAM
  - 3 x R730, dual E5-2670v3 12-core 2.3 GHz, 64 GB RAM
- Accelerators
  - 8 x NVIDIA K20M
- Storage nodes, condominium, new
  - 1 x T630, 16 x 6 TB, 128 GB RAM, ~N TB useable each
  - 1 x T630, 16 x 8 TB, 128 GB RAM, ~N TB useable each
- Subtotal peak CPU speed, new condominium: 41.98 TFLOPs
Schooner: Peak Speed

- Subtotal peak CPU speed, non-condominium: 266.57 TFLOPs
- Subtotal peak CPU speed, old condominium: 20.22 TFLOPs
- Subtotal peak CPU speed, new condominium: 41.98 TFLOPs
- Total peak CPU speed, public + old condominium + new condominium: 328.78 TFLOPs
- Schooner will be ~3 times as fast as Boomer.
- As on Boomer, roughly 19% of Schooner’s peak speed will be condominium.
**OU Research Cloud**
(virtualized server pool)
Draft 4/23/2013

Per compute node, the User Data Network can fit:
* at 4 x GigE, 4 x MD3200i;
* at 5 x GigE, 2 x MD3200i;
* at 6 x GigE, 0 x MD3200i.
Capacity can be increased by stacking another PCT5548.

5 x GigE + 1 x iDRAC per compute node would fill the pair of world-facing PCT5548 switches.

The world-facing switches will be the Science DMZ S4810s.
OURcloud
Oklahoma PetaStore

A mix of disk and tape, available to researchers at OU (and statewide), with a unique business model that makes long term archival storage affordable.
OSCER Personnel

- Director: Henry Neeman
- Associate Director for Remote & Heterogeneous Computing: Horst Severini
- Manager of Operations: Brett Zimmerman
- Senior System Administrator: David Akin
- HPC Application Software Specialist: Josh Alexander
- Research IT Coordinator: Debi Gentis
- Petascale Storage Administrator: Patrick Calhoun
- Student Tech: Katy Franks
- Informatics: Mark Stacy
Accomplishments
# External Research Grants

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<th>Research Description</th>
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<td>4.</td>
<td>J. Straka, “Challenges in understanding tornadogenesis and associated phenomena (supplement),”</td>
<td>NSF, $29K</td>
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## OSCER-FACILITATED FUNDING TO DATE: $291M total, $174M to OU

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**OneGrid/OneOCII**
External Research Grants (cont’d)

22. A. Striolo, “Hydrates Inhibitor Research,” Halliburton, £69K
23. A. Striolo, “Fraccing Fundamentals,” Marie Curie Career Integration Grant, €100K
24. J. Li, “Targeting Mosquito FREP1 Protein for Malaria Control,” NIH, $424K
25. J. Li, “CAREER: Genetic and Molecular Mechanisms of Parasite Infection in Insects,” NSF, $783K
27. J. Li, “Genomics analysis of Anopheles gambiae mosquitoes to Plasmodium falciparum parasite Infection,” OCAST, $135K
30. B. Capogrosso-Sansone, “Multi-Worm Algorithm for Path Integral Quantum Monte Carlo in Ultracold Dipolar Gases, NSF, $293K
32. U. Hansmann, “Modeling the molecular mechanism of amyloid oligomer and fibril self assembly,” OCAST, $90K

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34. M. Engle et al, “Resilience and vulnerability of beef cattle production in the Southern Great Plains under changing climate, land use and markets,” $9.5M (total), $1.9M (OU)


39. D. LaDue, K. Kloesel, “REU Site: Research Experiences for Undergraduates at the National Weather Center,” NSF, $822K


41. L. Krumholz, J. Zhou, M. McInerney, J. Wall, “Characteristics of H2 Producing Biological Systems Operating at 1 nM H2 Concentration,” DOE, $819K (total), $693K (OU)


43. M. Xue, K. Brewster, F. Kong, “Establishment of Precision Weather Analysis and Forecasting Systems (PWAIFS) for the Jiangsu Province Meteorological Bureau (JSMB),” NRIET, $505K


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## External Research Grants (cont’d)

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<tr>
<th>No.</th>
<th>Principal Investigator</th>
<th>Project Title</th>
<th>Funding Agency</th>
<th>Amount</th>
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<td>47</td>
<td>R. Kolar</td>
<td>“Dynamic Integration of Natural, Human, and Instructure Systems for Hurricane Evacuation and Sheltering,”</td>
<td>NSF</td>
<td>$456K</td>
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<tr>
<td>48</td>
<td>L. Ding</td>
<td>“Neuroimaging Study of Mental Fatigue,”</td>
<td>FAA</td>
<td>$430K</td>
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<td>50</td>
<td>L. Ding</td>
<td>“Large-Scale Computational Neuroimaging of Brain Electrical Activity,”</td>
<td>NSF CAREER</td>
<td>$400K</td>
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<td>51</td>
<td>P. Attar</td>
<td>“Optimal Spatiotemporal Reduced Order Modeling for Nonlinear Structural Dynamics,”</td>
<td>NSF</td>
<td>$360K</td>
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<tr>
<td>53</td>
<td>P. Vedula, P. J. Attar</td>
<td>“Fast simulations of turbulent flows based on spatiotemporal statistical information,”</td>
<td>NSF</td>
<td>$330K</td>
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<tr>
<td>54</td>
<td>M. Xue, K. Brewster, F. Kong</td>
<td>“Development of a Short-Range Realtime Analysis and Forecasting System based on the ARPS for Taiwan Region Year 3 (IA#24) and Year 4 (IA #25),”</td>
<td>NOAA</td>
<td>$310K</td>
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<td>55</td>
<td>E. Bridge, J. Kelly, X. Xiao</td>
<td>“Enhancing and disseminating miniaturized tracking technology for widespread use on small migratory songbirds,”</td>
<td>NSF</td>
<td>$302K</td>
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<td>56</td>
<td>J. Kelly, L. Gruenwald, P. Chilson, V. Lakshmanan, E. Bridge</td>
<td>“Advancing Biological Interpretations of Radar Data,”</td>
<td>NSF EAGER</td>
<td>$299K</td>
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<td>57</td>
<td>L. Ding</td>
<td>“High-Resolution Noninvasive Computational Neuroimaging,”</td>
<td>OCAST</td>
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<td>58</td>
<td>F. Kong</td>
<td>“Further Development to the Storm-Scale Numerical Weather Prediction Capability for Shenzhen Meteorological Bureau,”</td>
<td>SIATCAS</td>
<td>$251K</td>
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<td>59</td>
<td>R. Slatt, Consortium from 14 oil and gas company</td>
<td>$245K</td>
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<td>60</td>
<td>J. Brotzge, F. Carr</td>
<td>“Prootyping and Evaluating Key Network-of-Networks Technologies: Project Extension,”</td>
<td>NOAA</td>
<td>$210K</td>
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<td>62</td>
<td>J. Ruyle</td>
<td>“BRIGE: Investigation of Slot Antenna Reconfiguration Mechanisms,”</td>
<td>NSF</td>
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<td>63</td>
<td>J. Brotzge, F. Carr</td>
<td>“CASA Warning System Innovation Institute,”</td>
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External Research Grants (cont’d)

64. J. Kelly, “Developing Innovative Tools to Use Weather Radar Data to Assess and Monitor Impacts of Existing and Future Energy Facilities on Aerial Faunas in California,” CIEE, $150K (total), $49K (OU)
65. J. Brotzge, F. Carr, “Prototyping and Evaluating Key Network-of-Networks Technologies,” NOAA, $145K
68. L. Ding, “Neurophysiological Assessment of Mental Fatigue and Cognitive Performance,” FAA, $115K
69. K. Dresback, R. Kolar, "Next Generation ADCIRC Tidal Database: Phase 2 - West Coast," DOD, $75K
70. K. Dresback, R. Kolar, "Next Generation ADCIRC Tidal Database,” NOAA, $75K
71. P. Risser, J. Duckles, J. Bratton, NSF I-Corps, $50K
73. M. Yeary, M. Xue, “GRDS: Request to support a Native American Indian graduate student beginning his PhD within the CASA Engineering Research Center,” NSF, $32K

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External Research Grants (cont’d)


75. J. P. Shaffer, T. Pfau, “A Rydberg Atom Electric Field Sensor,” DARPA-ARO, $1.18M (total), $1.06M (OU)

76. Y. Luo, “Data Synthesis and Data Assimilation at Global Change Experiments and Fluxnet toward Improving Land Process Models,” DOE, $1.05M


80. J. P. Shaffer, “Rydberg Atom Interactions and Collective Behavior,” NSF, $436K

81. J. P. Shaffer, “Interactions in Cold Rydberg Gases,” NSF, $422K


83. M. Yuan, “Supplement to Developing and Evaluating the Effectiveness of the Location-based Offender Monitoring System for Offender Supervision,” National Institute of Justice, $396K


89. M. Xue, R. McPherson, J. Brotzge, B. Moore, “Very High-Resolution Dynamic Downscaling of Regional Climate and Hydrology,” USG, $24K


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External Research Grants (cont’d)


95. M. Xue, K. Brewster, F. Kong, “Ensemble Simulation of GOES-R Proxy Radiance Data from CONUS Storm-Scale Ensemble Forecasts, Product Demonstration and Assessment at the Hazardous Weather Testbed GOES-R Proving Ground,” NOAA, $126K

96. M. Xue, K. Brewster, F. Kong, “Ensemble Simulation of GOES-R Proxy Radiance Data from CONUS Storm-Scale Ensemble Forecasts, Product Demonstration and Assessment at the Hazardous Weather Testbed GOES-R Proving Ground,” NOAA, $94K


98. F. Kong, “CAPS support to the WRF Lightning Forecast Algorithm for the NOAA R3 effort,” NOAA GOES-R/Universities Space Research Assn, $48K


100. P. Attar, “Numerical Simulation of a Membrane Micro Air Vehicle in a Gust Field, Ohio Aerospace Institute, $35K


103. L. Sells, J. Goulden, H. Aboudja, “LittleFe grant,” LittleFe project, $2.5K

104. L. Sells, J. Goulden, “Early Adopter Grant,” NSF/TCPP, $2.5K

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<table>
<thead>
<tr>
<th>No.</th>
<th>Researcher(s)</th>
<th>Project Description</th>
<th>Funding Agency</th>
<th>Total</th>
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<td>105</td>
<td>B. Moore III et al</td>
<td>“Department of the Interior South-Central Regional Climate Science Center,”</td>
<td>US Dept of the Interior</td>
<td>$3.5M</td>
<td>$1.4M</td>
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<td>106</td>
<td>A. Striolo, D. Resasco et al</td>
<td>“Center for Application of Single-Walled Carbon Nanotubes,”</td>
<td>DOE</td>
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<td>108</td>
<td>Y. Kogan</td>
<td>“Parameterization of cumulus convective cloud systems in mesoscale forecast models,”</td>
<td>ONR</td>
<td>$594K</td>
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<td>110</td>
<td>R. D. Palmer, T.-Y. Yu</td>
<td>“NMQ and WDSS-II for the KMA radar network: Real-time, effective, and integrated weather products,”</td>
<td>Space Environment Laboratory, Inc.</td>
<td>$361K</td>
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<td>111</td>
<td>B. Grady, A. Striolo</td>
<td>“Novel Supramolecular Structures of Laterally Confined Amphiphilic Molecules,”</td>
<td>NSF</td>
<td>$335K</td>
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<td>112</td>
<td>D. Resasco, D. Papavassiliou et al</td>
<td>“Interfacially active SWNT/silica nanohybrids,”</td>
<td>Advanced Energy Consortium</td>
<td>$331K</td>
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<td>114</td>
<td>J. Shen</td>
<td>“Electrostatic Modulation of Protein Stability and Folding,”</td>
<td>NIH</td>
<td>$1.4M</td>
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<td>116</td>
<td>F. Kong, M. Xue</td>
<td>“Further Enhancement to the Hourly Assimilation and Prediction System (HAPS) for Shenzhen Meteorological Bureau,”</td>
<td>Shenzhen Institute of Advanced Technology, Chinese Academy of Science</td>
<td>$228K</td>
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<td>117</td>
<td>P. Attar, P. Vedula</td>
<td>“Multi-fidelity Modeling and Simulation (M&amp;S) Tool for Nonlinear Aeroelasticity,”</td>
<td>Advanced Dynamics</td>
<td>$160K</td>
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<td>118</td>
<td>B. Eskridge</td>
<td>“CDI-TYPE I: RUI: Emergent Hierarchies of Leaders in Multi-Robot Systems,”</td>
<td>NSF</td>
<td>$159K</td>
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<td>119</td>
<td>A. Striolo</td>
<td>“Mixed-Volatile Fluids Relevant to Subsurface Energy Systems,”</td>
<td>DOE</td>
<td>$120K</td>
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<td>120</td>
<td>P. Skubic, M. Strauss</td>
<td>“OU Contribution to the ATLAS Southwest Tier 2 Computing Center (Supplement),”</td>
<td>NSF</td>
<td>$110K</td>
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<td>121</td>
<td>P. Attar</td>
<td>“High-Fidelity Computational Aeroelastic Solver Research,”</td>
<td>Ohio Aerospace Institute</td>
<td>$53K</td>
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<td>122</td>
<td>P. Skubic, M. Strauss</td>
<td>“OU Contribution to the ATLAS Southwest Tier 2 Computing Center (Supplement),”</td>
<td>NSF</td>
<td>$50K</td>
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**OSCER-FACILITATED FUNDING TO DATE:**

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External Research Grants (cont’d)


124. P. Attar, “Computational Model Development and Experimental Validation Measurements for Membrane-Batten Wing,” Ohio Aerospace Institute, $43K.

125. A. Striolo, “Reduced Carbon in Earth’s Crust and Mantle I,” Alfred P. Sloan Foundation, $39K.


129. 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.

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External Research Grants (cont’d)

130. 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


132. D. Resasco, J. Harwell, F. Jentoft, K. Gasem, S. Wang, “Center for Interfacial Reaction Engineering (CIRE),” DOE EPSCoR, $2.4M ($1.97M OU)


136. D. Cole, Alberto Striolo, “Structure and Dynamics of Earth Materials, Interfaces and Reactions,” DOE, $1.5M ($90K OU)

137. 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


143. J. Straka, K. Kanak, “Challenges in tornadogenesis and associated phenomena,” NSF, $584K

OSCER-FACILITATED FUNDING TO DATE:
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OSCER State of the Center Address
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External Research Grants (cont’d)

144. M. Xue, F. Kong, “Advanced Multi-Moment Microphysics for Precipitation and Tropical Cyclone Forecast Improvement with COAMPS,” ONR, $592K


149. X. Wang, “Improving satellite radiance data assimilation using a hybrid ensemble-Gridpoint Statistical Interpolation (GSI) method for global numerical weather prediction,” NASA, $276K

150. X. Wang, M. Xue, “Improving NOAA operational global numerical weather prediction using a hybrid-ensemble Kalman filter data assimilation and ensemble forecast system,” NOAA, $207K


152. D. Oliver, “Data analysis and inversion for mobile nanosensors,” AEC, $320K


156. J. Straka, K. Kanak, “Formative dynamics of the mammatus clouds in thunderstorm cirrus,” NSF, $318K


158. A. Striolo, “Probing regular solution theory for mixed amphoteric/ionic surfactant systems by molecular dynamics simulations,” ACS, $100K

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159. K. Brewster, M. Xue, F. Kong, meteorology project, $211K
160. M. Xue, meteorology project, $120K
164. J. Straka, “Improved Understanding/Prediction of Severe Convective Storms and Attendant Phenomena through Advanced Numerical Simulation,” NSF, $58K
166. J. Cruz, R. Todd, “Medium-Density Parity-Check Codes for Tape Systems,” INSIC, $36K
168. P. Attar, “High-Fidelity Computational Aeroelastic Solver Research,” Ohio Aerospace Institute, $60K
175. F. Carr, J. Straka, “Severe storm research,” Jonathon Merage Foundation, $20K
External Research Grants (cont’d)

178. D. Cole (ORNL), A. Striolo, “Structure and Dynamics of Earth Materials, Interfaces and Reactions,” DOE, $1.5M ($75K OU)
182. 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
184. Y. Hong, Baski (OSU), “Proactive approach to transportation resource allocation under severe winter weather emergencies,” OK-DOT/OTC, $261K ($101K OU)
186. Y. Hong, “Toward Improved Flood Prediction and Risk Mitigation: Capacity Building for Africa,” NASA, $87K

OSCER-FACILITATED FUNDING TO DATE: $291M total, $174M to OU
191. P. Attar, “High Fidelity Computational Aeroelastic Analysis of a Flexible Membrane Airfoil Undergoing Dynamic Motion,” Ohio Aerospace Institute, $35K

192. P. Attar, “Computational Model Development and Experimental Validation Measurements for Membrane-Batten Wing” Flexible Membrane Airfoil Undergoing Dynamic Motion,” Ohio Aerospace Institute, $43K


196. Y. Luo, S. Lakshimiravan, “Development of a Data Assimilation Capability towards Ecological Forecasting in a Data-Rich Era,” NSF, $1.08M


199. P. Risser et al, “A cyberCommons for Ecological Forecasting,” NSF, $6M ($2.78M OU)


OSCER-FACILITATED FUNDING TO DATE: $291M total, $174M to OU
External Research Grants (cont’d)


204. D.S. Oliver, software, $16.7M


206. K. Droegemeier, F. Kong, “Multisensor Studies of Precipitation for Model Verification and Data Assimilation,” U Minn, ($7K OU)


208. M. Nollert, Scholarship, FD-OMRF, $12K

209. R. Sigal, R. Philp, C. Rai, S. Shah, R. Slatt, C. Sondergeld, D. Zhang, energy company, $1.9M

210. B. Grady, D. Schmidtke, A. Striolo, A. Cheville, D. Teeters, “Polymer Nanostructures on Solid Surfaces,”$208K ($125K OU)

211. T. Conway, “E. coli Model Organism Resource,” UN-Purdue, ($685K OU)


213. D. Cole (ORNL), A. Striolo, “Rates and Mechanisms of Mineral-Fluid Interactions at the Nanoscale,” DOE, $1.65M (total), ($55K OU)


216. M. Xue, “Contribution to WRF Model Development by the Center for Analysis and Prediction of Storms,” DOC-NOAA, $821K


OSCER-FACILITATED FUNDING TO DATE:
$291M total, $174M to OU
External Research Grants (cont’d)

220. 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

221. M. Xue, “Contribution to Model Development and Enhancement Research Team by the Center for Analysis and Prediction of Storms,” DOC-NOAA, $620K

222. M. Xue, K. Brewster, “Ensemble-based Data Assimilation for Convective Storms and Hurricanes,” DOC-NOAA, $100,000


224. S. Schroeder, "Computational Advances Toward Predicting Encapsidated Viral RNA Structure;“, Pharmaceutical Research and Manufacturer's Association of America, $60K

225. R. Kolar, "Outer Boundary Forcing for Texas Coastal Models,“ Texas Water Development Board, $20K


227. A. McGovern, "Developing Spatiotemporal Relational Models to Anticipate Tornado Formation;“, NSF, $500K

228. Y. Kogan, "Midlatitude Aerosol-Cloud-Radiation Feedbacks in Marine Boundary Layer Clouds", ONR, $638K


230. Y. Hong, "Improvement of the NASA Global Hazard System and Implement Server-Africa;“, NASA, $272K

231. 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

232. A. Striolo, "Electrolytes at Solid-Water Interfaces: Theoretical Studies for Practical Applications;“, OSRHE Nanotechnology, $15K


OSCER-FACILITATED FUNDING TO DATE:
$291M total, $174M to OU

OSCER State of the Center Address
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External Research Grants (cont’d)


235. K. Droegemeier et al., “Linked Environments for Atmospheric Discovery (LEAD),” NSF, $11.25M (total), $2.5M (OU)

236. M. Strauss, P. Skubic et al., “Oklahoma Center for High Energy Physics”, DOE EPSCoR, $3.4M (total), $1.6M (OU)


240. J. Levit, D. Ebert (Purdue), C. Hansen (U Utah), “Advanced Weather Data Visualization,” NSF, $300K


243. R. Wheeler, “Principal mode analysis and its application to polypeptide vibrations,” NSF, $385K


OSCER-FACILITATED FUNDING TO DATE:
$291M total, $174M to OU
External Research Grants (cont’d)


250. R. Wheeler, T. Click, “National Institutes of Health/Predoctoral Fellowships for Students with Disabilities,” NIH/NIGMS, $80K


257. 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


259. K. Mish, K. Muraleetharan, “Computational Modeling of Blast Loading on Bridges,” OTC, $125K


263. R. Wheeler et al., “Testing new methods for structure prediction and free energy calculations (Predoctoral Fellowship for Students with Disabilities),” NIH/NIGMS, $24K


OSCER-FACILITATED FUNDING TO DATE: $291M total, $174M to OU

OSCER State of the Center Address
Wed Sep 23 2015
266. Neeman, Roe, Severini, Wu et al., “Cyberinfrastructure Education for Bioinformatics and Beyond,” NSF, $250K
268. J. Snow, "Oklahoma Center for High Energy Physics", DOE EPSCoR, $3.4M (total), $169K (LU)
269. M. Xue, F. Kong, “OSSE Experiments for airborne weather sensors,” Boeing, $90K
270. M. Xue, K. Brewster, J. Gao, A. Shapiro, “Storm-Scale Quantitative Precipitation Forecasting Using Advanced Data Assimilation Techniques: Methods, Impacts and Sensitivities,” NSF, $835K
<table>
<thead>
<tr>
<th>Grant No.</th>
<th>Principal Investigators</th>
<th>Project Title</th>
<th>Funding Agency</th>
<th>Amount</th>
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<tr>
<td>278.</td>
<td>L.M. Leslie, M.B. Richman, C. Doswell</td>
<td>Detecting Synoptic-Scale Precursors Tornado Outbreaks</td>
<td>NSF</td>
<td>$548K</td>
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<td>281.</td>
<td>E. Chesnokov</td>
<td>Fracture Prediction Methodology Based On Surface Seismic Data</td>
<td>Devon Energy</td>
<td>$1M</td>
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<td>282.</td>
<td>E. Chesnokov</td>
<td>Scenario of Fracture Event Development in the Barnett Shale (Laboratory Measurements and Theoretical Investigation)</td>
<td>Devon Energy</td>
<td>$1.3M</td>
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<td>283.</td>
<td>M. Xue, K. Brewster, J. Gao</td>
<td>Study of Tornado and Tornadic Thunderstorm Dynamics and Predictability through High-Resolution Simulation, Prediction and Advanced Data Assimilation</td>
<td>NSF</td>
<td>$780K</td>
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<td>284.</td>
<td>A. Striolo</td>
<td>Heat Transfer in Graphene-Oil Nanocomposites: A Molecular Understanding to Overcome Practical Barriers</td>
<td>ACS Petroleum Research Fund</td>
<td>$40K</td>
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<td>285.</td>
<td>D.V. Papavassiliou</td>
<td>Turbulent Transport in Anisotropic Velocity Fields</td>
<td>NSF</td>
<td>$292.5K</td>
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<td>286.</td>
<td>D. Oliver</td>
<td>software license grant</td>
<td>$1.5M</td>
<td></td>
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<td>287.</td>
<td>R. Broughton et al</td>
<td>Assembling the Eutelost Tree of Life – Addressing the Major Unresolved Problem in Vertebrate Phylogeny</td>
<td>NSF</td>
<td>$3M ($654K to OU)</td>
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<td>288.</td>
<td>A. Fagg</td>
<td>Development of a Bidirectional CNS Interface or Robotic Control</td>
<td>NIH</td>
<td>$600K</td>
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<tr>
<td>289.</td>
<td>M. Xue, J. Gao</td>
<td>An Investigation on the Importance of Environmental Variability to Storm-scale Radar Data Assimilation</td>
<td>NSSL</td>
<td>$72K</td>
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<tr>
<td>290.</td>
<td>J.V. Sikavistsas and D.V. Papavassiliou</td>
<td>Flow Effects on Porous Scaffolds for Tissue Regeneration</td>
<td>NSF</td>
<td>$400K</td>
</tr>
</tbody>
</table>

**OSCER-FACILITATED FUNDING TO DATE:**

$291M total, $174M to OU
293. D. LaDue, K. Kloesel, “EPSCoR Funded Participant in the National Weather Center Research Experiences for Undergraduates Program,” Oklahoma EPSCoR, $9K
301. R. McPherson, E. White, M. Shafer, D. Rosendahl, M. Richman, "Trends in cold temperature extremes and winter weather for the SPTC region,” USDOT, $132K
303. M. J. McInerney, L. Krumholz, Bioremediation of Chromium and Arsenic from Industrial Wastewater,” Nat’l Academies of Science, $162K
304. M. Coniglio (PI), C. Doswell III, R. J. Trapp
305. "Improved understanding of convective-storm predictability and environment feedbacks from observations during the Mesoscale Predictability Experiment (MPEX)," NSF, $272K
307. S. Schroeder, "Predicting Viral RNA Structures, Function, and Drug Targets from Sequence,” OCAST, $145K

OSCER-FACILITATED FUNDING TO DATE: $291M total, $174M to OU

OSCER State of the Center Address
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External Research Grants (cont’d)

308. L. Ding, "NRI-Small: Robot Assistants for Promoting Crawling and Walking in Children at Risk of Cerebral Palsy," NSF, $1.135M
310. E. Baron, "Collaborative Research: Three-Dimensional Simulations of Type Ia Supernovae Constraining Models with Observations," NSF, $26K
313. R. Floyd, J. Pei, "Understanding the Behavior of Prestressed Concrete Girders after Years of Service," OK DOT, $327K
316. U. Hansmann, "Folding, Mis-folding and Aggregation of Proteins," NIH, $887K
319. M. Soe (RSU), "Unitary Qubit Lattice Algorithms for Quantum Turbulence with Non-Abeliam Vortices," NSF, $75K,

OSCER-FACILITATED FUNDING TO DATE:
$291M total, $174M to OU

OSCER State of the Center Address
Wed Sep 23 2015
External Research Grants (cont’d)

320. J. Cruz, "Two-Dimensional Channel Modeling, Detection and Coding for Shingled Magnetic Recording," NSF, $419K,


OSCER-FACILITATED FUNDING TO DATE:
$291M total, $174M to OU
External Funding Summary

- External research funding facilitated by OSCER (Fall 2001- Fall 2015): $291M total, $174M to OU (60%)
- Funded projects: OVER 300
- 134 OU faculty and staff in 21 academic departments and 6 non-academic units

Since being founded in fall of 2001, OSCER has enabled research projects comprising almost 1 / 6 of OU Norman's total externally funded research expenditure, with an 8-to-1 return on investment.
Publications Facilitated by Research IT

- Publications facilitated by Research IT resources
  - **2015:** 155 (so far)
  - 2014: 188
  - 2013: 215
  - 2012: 284
  - 2011: 206
  - 2010: 142
  - 2009: 107
  - 2008: 109
  - 2007: 77
  - 2006: 88
  - 2005: 64
  - 2004: 28
  - 2003: 9
  - 2002: 8
  - 2001: 3

**TOTAL SO FAR:** 1683 publications

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

Includes 34 MS theses, 37 PhD dissertations.
OU Supercomputing Club & Team

- In the past couple of years, OSCER operations team member Josh Alexander decided he wanted OU students to compete in the SC supercomputing conference’s Student Cluster Challenge.
- So, with the help of people in CS and ECE, he founded a team, they submitted a proposal to SC14 -- and got in!
- Founding the team led to founding the Sooner Supercomputing Club last year.
- This is the only effective way we’ve seen at OU to get students motivated to learn HPC.
Oklahoma Cyberinfrastructure Initiative 2008-13
OK Cyberinfrastructure Initiative

- 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, non-governmental) 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.
- Triggered by OK’s NSF EPSCoR RII Track-1 2008-13.
OCII Goals

- **Reach** institutions outside the mainstream of advanced computing.
- **Serve** every higher education institution in Oklahoma that has relevant curricula.
- **Educate** Oklahomans about advanced computing.
- **Attract** underrepresented populations and institution types into advanced computing.
OneOCII Strategy

- OneOCII doesn’t exactly have a strategy; it’d be more accurate to say we have an approach:
  - Every CI project in the state is part of the larger whole.
  - Each new project advances a subset of OneOCII.
  - Not all parts of OneOCII advance at the same time.
  - Everyone works together on everything.
OCII Service Methodologies Part 1

- **Access (A):** to supercomputers and related technologies (20 OK academic institutions to date).

- **Dissemination (D):** Oklahoma Supercomputing Symposium – annual advanced computing conference (25 OK academic institutions to date).

- **Education (E):** “Supercomputing in Plain English” (SiPE) workshop series: 11 talks about advanced computing, taught with stories, analogies and play rather than deep technical jargon. Have reached 248 institutions (academic, government, industry, nonprofit) in 47 US states and territories and 10 other countries (14 OK academic institutions to date).
OCII Service Methodologies Part 2

- **Faculty/Staff Development (F):** Workshops held at OU and OSU on advanced computing and computational science topics, sponsored by the National Computational Science Institute, the SC supercomputing conference series, the Linux Clusters Institute, the Virtual School for Computational Science & Engineering. Oklahoma is the only state to have hosted multiple events sponsored by each of these (18 OK academic to date).

- **Outreach (O):** “Supercomputing in Plain English” (SiPE) overview talk (24 OK academic to date).

- **Proposal Support (P):** Letters of commitment for access to OCII resources; collaborations with OCII lead institutions (4 OK academic, 1 nongovernmental).
OCII Service Methodologies Part 3

- **Technology (T)**: Got or helped get technology (e.g., network upgrade, mini-supercomputer, hi def video camera for telepresence) for that institution (14 OK academic to date).

- **Workforce Development (W)** – (36 OK academic)
  - Oklahoma Information Technology Mentorship Program (OITMP)
  - “A Day in the Life of an IT Professional” presentations to courses across the full spectrum of higher education.
  - Job shadowing opportunities and direct mentoring of individual students.
  - Institution Types: high schools, career techs, community colleges, regional universities, PhD-granting universities.

- Special effort to reach underrepresented populations: underrepresented minorities, non-PhD-granting, rural
OCII Institution Profile

To date, OCII has served 100 Oklahoma institutions, agencies and organizations:

- 52 OK academic (2 more booked this semester)
- 48 OK non-academic
OCII Institution Profile

To date, OCII has served 100 Oklahoma institutions, agencies and organizations:

- 52 OK academic
  - Universities & Colleges
    - 3 comprehensive PhD-granting
    - 20 regional non-PhD-granting
  - Community Colleges: 10
  - Career techs: 13
  - Secondary schools: 4
  - Public school systems: 2
- 48 OK non-academic
OCII Institution Profile

So far, OCII has served:

- 52 OK academic
  - 9 Minority Serving Institutions
  - 15 other institutions with above state average and national average for one or more underrepresented minorities
- 48 OK non-academic

Minority Serving Institutions

- Oklahoma’s only Historically Black College or University
  - Langston U (Langston)
- Native American Serving Non-tribal Institutions
  - East Central U (Ada)
  - Northeastern Oklahoma A&M College (Miami)
  - Northeastern State U (Tahlequah)
  - Southeastern Oklahoma State U (Durant)
- Tribal Colleges
  - College of the Muscogee Nation (Okmulgee)
  - Comanche Nation College (Lawton)
  - Pawnee Nation College (Pawnee)
- Other Minority Serving Insititution
  - Bacone College (Muskogee)
OCII Institution Profile

To date, OCII has served 100 Oklahoma institutions, agencies and organizations:

- 52 OK academic institutions
- 48 OK non-academic organizations
  - 16 commercial
  - 19 government
  - 2 military
  - 11 non-governmental
OCII Academic Institutions

1. Bacone College (MSI, 25.0% AI, 29.8% AA): T
2. Cameron U (16.6% AA): A, D, E, F, O, T, W
   Taught advanced computing course using OSCER’s supercomputer (multiple times).
3. Canadian Valley Tech Center: W
4. Chisholm Trail Tech Center: W
5. College of the Muscogee Nation (Tribal): O, T
6. Comanche Nation College (Tribal): D, O, T
7. DeVry U Oklahoma City: D, F, O
8. East Central U (NASNI, 16.9% AI, rural): A, D, E, F, O, P, T, W
   Taught advanced computing course using OSCER’s supercomputer.
9. Eastern Oklahoma State College (24.9% AI): W
10. Eastern Oklahoma County Tech Center: W
11. Elgin Middle School: O (tour only)
12. Francis Tuttle Tech Center: D, T, W
13. Gordon Cooper Tech Center (13.5% AI, nonmetro): D, O, W
14. Great Plains Tech Center (11.5% AI): W
15. Kiamichi Tech Center (18.5% AI): T, W
16. Langston U (HBCU, 77.2% AA):
    A, D, E, F, O, P, T, W
    NSF Major Research Instrumentation grant for supercomputer awarded in 2012.

Note: Langston U (HBCU), East Central U (NASNI) and U Central Oklahoma are the only non-PhD-granting institutions to have benefited from every category of service that OCII provides.

Average: ~3 (mean 3.5, median 3, mode 1)

AA = African American (7.7% OK population, 13.2% US population)
AI = American Indian (9.0% OK, 1.2% US)
H = Hispanic (9.6% OK, 17.1% US)
ALL = 26.3% OK, 31.5% US

HBCU: Historically Black College or University
NASNI = Native American Serving Non-Tribal Institution
MSI = Minority Serving Institution

OSCER State of the Center Address
Wed Sep 23 2015
17. Lawton Christian School (high school): W
18. Metro Tech Centers (29.3% AA): D
19. Mid-America Tech Center: D, W
20. Mid-Del Public Schools: D
21. Moore Norman Tech Center: D, W
22. Northeast Tech Center (21.5% AI): W
23. Northeastern Oklahoma A&M College (NASNI, 22.6% AI): T, W
24. Northeastern State U (NASNI, 22.4% AI, nonmetro): A, D, E, F, O, T, W
Taught computational chemistry course using OSCER's supercomputer (multiple).
25. Northwestern Oklahoma State U: A, F, O
27. Oklahoma Christian U: O, W
28. Oklahoma City Community College: O, T, W
29. Oklahoma City U: A, D, E, F, O, T, W
Educational Alliance for a Parallel Future mini-supercomputer proposal funded in 2011.
Taught advanced computing course using OSCER’s supercomputer (multiple).
30. Oklahoma Panhandle State U (rural): A, D, O, W
31. Oklahoma School of Science & Mathematics (high school): A, D, E, O, W
32. Oklahoma State U (PhD): A, D, E, F, O, P, T, W
NSF Major Research Instrumentation proposal for supercomputer funded in 2011.
33. Oklahoma State U Institute of Technology (community college, 19.9% AI): W
Average: ~3 (mean 3.5, median 3, mode 1)

AA = African American (7.7% OK population, 13.2% US population)
AI = American Indian (9.0% OK, 1.2% US)
H = Hispanic (9.6% OK, 17.1% US)
ALL = 26.3% OK, 31.5% US
HBCU: Historically Black College or University
NASNI = Native American Serving Non-Tribal Institution
MSI = Minority Serving Institution

OSCER State of the Center Address
Wed Sep 23 2015
34. Oklahoma State U OKC (16.0% AA, community college): O, T, W
35. Oral Roberts U (17.7% AA): A, F, O, W
36. Panola Public Schools: D
37. Pawnee Nation College (Tribal): T
38. Pontotoc Tech Center (41.6% AI): T, W
39. Rogers State U (12.9% AI): A, D, F, O
   Taught computational chemistry course using OSCER’s supercomputer.
40. Rose State College (18.0% AA): F, W
41. Sequoia High School (Tribal): W
42. St. Gregory’s U (nonmetro): A, D, F, O
43. Southeastern Oklahoma State U (NASNI, 21.0% AI, nonmetro): A, D, E, F, O, T, W
   Educational Alliance for a Parallel Future mini-supercomputer grant funded in 2011.
44. Southern Nazarene U (16.0% AA): A, D, F, O, P, T, W
   Taught computational chemistry course using OSCER’s supercomputer.
45. Southern OK Tech Center (10.7% AI): T, W
46. Southwestern Oklahoma State U (rural): A, D, E, F, O, T, W
   Taught advanced computing course using OSCER’s supercomputer (multiple).
47. Tulsa Community College: F, W
49. U Oklahoma (PhD): A, D, E, F, O, P, T, W
   NSF Major Research Instrumentation grant for large scale storage funded in 2010.
50. U Phoenix: D
51. U of Science & Arts of Oklahoma (11.7% AI): A, O
52. U Tulsa (PhD): A, D, E, F, O, P, T, W
   Taught bioinformatics course using OSCER’s supercomputer.
   Average: ~3 (mean 3.5, median 3, mode 1)

AA = African American (7.7% OK population, 13.2% US population)
AI = American Indian (9.0% OK, 1.2% US)
H = Hispanic (9.6% OK, 17.1% US)
ALL = 26.3% OK, 31.5% US
HBCU: Historically Black College or University
NASNI = Native American Serving Non-Tribal Institution
MSI = Minority Serving Institution

OSCER State of the Center Address
Wed Sep 23 2015
OCII Non-academic

Commercial (16)
1. Andon Corp : D, F
2. Chesapeake Energy Corp : D
3. Creative Consultants : D
4. Fusion Geophysical: D
5. Indus Corp: D, E
6. Information Techknologic: D
7. KANresearch: D
8. KeyBridge Technologies: D
9. Lumenate: D
10. OGE Energy Corp: D
11. Perfect Order (now defunct): D
12. PowerJam Production Inc: D
13. Versatile: D
14. Visage Production Inc: D, E
15. Weather Decision Technologies Inc : A
16. Weathernews Americas Inc.: A, D

Government (19)
1. City of Duncan: D
2. City of Edmond: D
3. City of Nichols Hills: D
4. City of Tulsa: E
5. NOAA National Severe Storms Laboratory: A, D, E, F
6. NOAA Storm Prediction Center: D
7. NOAA National Weather Service: D
8. NOAA Radar Operations Center: D
9. OK Climatological Survey: D
10. OK Department of Health: D, E
11. OK Department of Human Services: D, E
12. OK Department of Libraries: D
13. OK Department of Mental Health and Substance Abuse Services: D
14. OK Office of State Finance: D
15. Oklahoma State Chamber of Commerce: D
16. OK State Regents for Higher Education: A, D, T
17. OK State Supreme Court: D
18. OK Tax Commission: D
19. Tulsa County Court Services: D
Military (2)
1. Fort Sill Army Base: E
2. Tinker Air Force Base: A, D, E, F, O

Non-governmental/non-profit (11)
1. American Society of Mechanical Engineers, Oklahoma City chapter: O
2. Engineering Club of Oklahoma City: O
3. Lions Club of Norman OK: O
4. Lions Club of Shawnee OK: O
5. Norman Science Café: O
6. Oklahoma EPSCoR: D
7. Oklahoma Historical Society: D
8. Oklahoma Innovation Institute/Tulsa Research Partners: A, D, E, O, P
9. Oklahoma Medical Research Foundation: A, D, P
10. Oklahoma Nanotechnology Initiative: D
11. Samuel Noble Roberts Foundation (rural): A, D, E, F, T
OCII Outcomes: Research

- External research funding to OK institutions facilitated by OCII lead institutions (Fall 2001- Summer 2015): over $174M
- Funded projects facilitated: over 300
- OK faculty and staff: over 130 in ~20 academic disciplines
- Publications facilitated: over 1600
OCII Outcomes: Research

Specifically needed OCII just to be funded: over $43M
(OneOCII necessary but far from sufficient)

1. NSF EPSCoR RII Track-1 (2008-13): $15M to OK
2. NSF EPSCoR RII Track-1 (2013-18): $20M to OK (+$4M Regents)
3. NSF EPSCoR RII Track-2: $3M to OK
4. NSF EPSCoR RII C2: $1.17M to OK
5. NSF MRI (OU): $793K
6. NSF MRI (OSU): $908K, $951K
7. NSF MRI (Langston U): $250K
8. NSF CC-NIE (OU, OSU, LU, OII, OneNet): $500K
9. NSF MRI (UCO): $305K
10. NSF CC*IIE (OU): $400K
11. NSF CC*IIE (GPN, OneNet, others): $130K
12. NSF MRI (TU): $180K
OCII Outcomes: MRI Grants

- NSF Major Research Instrumentation for CI: over $2.5M
  - NSF MRI (UCO): $305K, 2014

- How do we stack up (since 2001 when OSCER was founded)?
  - **OK**: 15.5% of funding, 11% of PIs, 13% of awards
  - **OU**: 13.5% of funding
    - Among units, IT is 4th in number of awards, 4th in total funding.
    - Among PIs, Neeman is 1st in awards and 1st in funding (13.5%).
  - **OSU**: 18.5% of funding
  - **Langston U**: 100% of funding
  - **UCO**: 70% of funding; Lemley is 1st in funding
OCII Outcomes: Education

Teaching: 9 institutions including 3 MSIs

- Teaching/taught parallel computing using OneOCII resources:
  - Cameron U – multiple times
  - East Central U (NASNI)
  - Oklahoma City U – multiple times
  - Southwestern Oklahoma State U

- Taught parallel computing via LittleFe baby supercomputer and OneOCII resources:
  - Southeastern Oklahoma State U (NASNI) – multiple times

- Taught computational chemistry using OSCER resources:
  - Northeastern State U (NASNI) – multiple times
  - Southern Nazarene U
  - Rogers State U – multiple times

- Taught Bioinformatics using OCII resources:
  - U Tulsa – 2 semester sequence
OCII Outcomes: Resources

7 institutions including 2 MSIs, plus C2 institutions

- NSF Major Research Instrumentation grants: $1.95M
  - ** OU**: Oklahoma PetaStore, $793K (in production)
  - Oklahoma State U: Cowboy cluster, $909K (in production)
  - **Langston U**: cluster, $250K (recently deployed)
  - **U Central Oklahoma**: cluster, $305K (just awarded)
  - **NEW! U Tulsa**: cluster, $180K (just awarded)

- LittleFe baby supercomputer grants ($2500 each)
  - **OU**: Ron Barnes
  - Oklahoma City U: Larry Sells & John Goulden
  - Southeastern Oklahoma State U: Mike Morris & Karl Frinkle

- Networking: C2 grant: $1.17M, CC-NIE grant $500K
OK Optical Initiative (NSF EPSCoR C2)

- **Hardware**
  - **Statewide Ring upgrade**: replaced routed mux/demuxes with Reconfigurable Optical Add Drop Modules: much less expensive and much more straightforward to add new 10G circuits.
  - **Institutional upgrades**
    - **OU and OSU**: cluster upgraded to 10G shared from GigE (10X), then upgraded to 20G (2 x 10G) dedicated (20X), which is connected to Internet2’s 100G Innovation Platform backbone.
    - **OU**: mini-Science DMZ.
    - **U Tulsa**: upgraded to GigE from 200 Mbps (5X).
    - **Samuel Roberts Noble Foundation**: (private non-profit research institutions): upgraded to GigE from 45 Mbps for research (22X), 100 Mbps for commodity (2X)
OK Optical Initiative (NSF EPSCoR C2)

- Hardware (continued)
  - Institutional Upgrades (continued)
    - **Langston U** (Oklahoma’s only Historically Black College or University): upgraded to 10G from 100 Mbps (100X) for research.
    - **Bacone College** (Minority Serving Institution): campus backbone upgraded to 100 Mbps with GigE core from 10 Mbps (10X upgrade).
    - **College of the Muscogee Nation** (Tribal): network core for new residence hall.
    - **Comanche Nation College** (Tribal) distance learning system.
    - **Pawnee Nation College** (Tribal) Internet radio station, distance learning system, campus backbone upgrade to GigE.

- **OK IT Mentorship Program**
OK Optical Initiative Side Effects

- 100G connection to Internet2’s Innovation Platform
- OU+OSU Shared Services initiative: leveraging C2 investments to create enterprise IT collaborations both within and between the institutions.
  - OU Virtual data center – highly robust
  - Virtualized services
  - Substantial savings from shared infrastructure and shared purchasing vehicles.
- NOT AT ALL FUNDED BY C2.
- But, leverages C2 capabilities – if not for the C2, Shared Services would have had to make the exact same investments in the state ring.
OCII HPC (2008-12)

Just over 40 TFLOPs of HPC capacity across the state:

- OU: 34.5 TFLOPs (internally funded)
- OSU: 6.3 TFLOPs (internally funded)
Education, Outreach, Training, etc

- **Education**
  - Supercomputing in Plain English (SiPE)

- **Outreach**
  - SiPE Overview Talk, Cyberinfrastructure tours

- **Training**
  - Various technology trainings (run by vendors)

- **Faculty/Staff Development**
  - Summer workshops

- **Workforce Development**
  - Oklahoma IT Mentorship Program
Supercomputing in Plain English

- FREE and OPEN TO ALL
- Provided every other spring (upcoming Spring 2015)
- Available LIVE via videoconferencing
- Topics

  1. Overview: What the Heck is Supercomputing?
  2. The Tyranny of the Storage Hierarchy
  3. Instruction Level Parallelism
  4. Stupid Compiler Tricks
  5. Shared Memory Multithreading
  6. Distributed Multiprocessing
  7. Application Types and Parallel Paradigms
  8. Multicore Madness
  9. High Throughput Computing
  10. GPGPU: Number Crunching in Your Graphics Card

http://www.oscer.ou.edu/education/
SiPE Participants

- 362 institutions, firms, agencies and organizations in 51 US states & territories and 17 other countries
  - Academic: 251 institutions in 51 US states & territories and 15 other countries
    - 88 institutions in 26 EPSCoR jurisdictions
    - 16 institutions in Oklahoma
  - Industry: 49 firms in the US and 4 other countries
  - Government: 44 – US federal and state plus 7 other countries
  - Non-Governmental: 18 (US and 1 other country)
- Missing US states & territories
  - EPSCoR states: RI, VT
  - EPSCoR territories: Guam (no PhD-granting)
  - Other territories: American Samoa, Northern Marianas Islands (community colleges only)
Outreach: Presentations & Tours

Courses at OU
2. Engineering Numerical Methods (U. Nollert)
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. Engineering Club of Oklahoma City
3. Association for Computing Machinery (ACM) Special Interest Group on Computer Science Education (SIGCSE) 2010
4. Oklahoma State Chamber of Commerce
6. Norman (OK) Lions Club
9. Shawnee (OK) Lions Club
10. Oklahoma Louis Stokes Alliance for Minority Participation (@ OSU) 2010 (Keynote)
11. Norman (OK) Science Café
12. Tech Forum Texas 2010
13. Texas Computer Education Association 2011
14. Tinker Air Force Base
15. Consortium for School Networking 2011
17. SC07-13

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. Comanche Nation College (OK)
7. DeVry University (OK)
8. East Central University (OK)
9. El Bosque University (Bogota Colombia)
10. Southwestern University (TX)
11. Langston University (OK)
12. Louisiana State University
13. Midwestern State University (TX)
14. Northeastern Oklahoma State University
15. Northwestern Oklahoma State University
16. Oklahoma Baptist University
17. Oklahoma City University
18. Oklahoma State University x 2
19. Oklahoma State University – OKC
20. Oral Roberts University (OK) x 2
21. Rogers State U (OK)
22. Philander Smith College (AR)
23. St. Gregory’s University (OK) x 2
24. Southeastern Oklahoma State University x 2
25. Southern Nazarene University (OK)
26. Northwestern Oklahoma State University x 2
27. Texas A&M-Commerce
28. University of Arkansas Fayetteville
29. University of Arkansas at Little Rock
30. University of Arkansas at Pine Bluff
31. University of Central Oklahoma
32. University of Oklahoma-Tulsa
33. University of Science & Arts of Oklahoma
34. University of Texas Brownsville
35. 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)
5. Elgin Middle School
Fac/Staff Dev: Summer Workshops

- National Computational Science Institute workshops
  - Intro to Parallel Programming & Cluster Computing daylong: fall 2003, fall 2007-11
    - LittleFe baby supercomputer buildout (summer 2011 – first ever anywhere; summer 2012)
  - Computational Chemistry for Chemistry Educators weeklong: summer 2009, summer 2011
  - Many of these were co-sponsored by Oklahoma EPSCoR (2008-2012) and/or the SC Education Program (2007-9, 2011)
Fac/Staff Dev: Summer Workshops

- Linux Clusters Institute workshops: June 2005, Feb 2007
  - Selected to host the next LCI workshop (2015)
- Virtual School for Computational Science & Engineering weeklong
  - 2012: Programming Heterogeneous Parallel Computing Systems; Proven Algorithmic Techniques for Many-core Processors (both on GPU computing)
  - 2013, 2015: Data Intensive Summer School (big data)
- Software Carpentry Bootcamp (2013): Python, scripting, version control etc
- Bioinformatics weeklong (2012, 2015)

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.

So far we’ve done over 100 events for 39 institutions.
OneOklahoma Cyberinfrastructure Initiative 2013-18
OneOklahoma Cyberinfrastructure Initiative

2013-18

Resource Providers: OU, OSU, TSC, Langston (HBCU, HEP)

- All OCII Services
- Informatics: Research facilitators (NOT researchers) who embed in specific research teams. Expands Informatics team from just OU to OSU, available to others statewide.
- Data Stewardship Initiative: collaboration among CI and Libraries.
- OK STEM Mentorship Program: extended OK IT Mentorship Program to other STEM disciplines.

So far:
- 52 OK academic
- 48 OK non-academic
NEW! OneOCII

All of OCII, plus:

- Informatics professionals: research facilitators embedded in specific research projects (and largely funded by them)
- CyberCommons (from old NSF EPSCoR RII Track-2 grant)
  - Software platform for end-to-end research workflow support
- Physical resources
  - Research Cloud: research teams can buy virtual servers
  - Hadoop cluster
- Data Stewardship Initiative (led by Libraries)
- Oklahoma STEM Mentorship Program (not just IT) – already 20 institutions signed up, including 3 new
NSF EPSCoR RII Track-1

- “Adapting Socio-ecological Systems to Increased Climate Variability”
- OU, OSU, U Tulsa, Noble Foundation
- $24M ($20M NSF, $4M State Regents) over 5 years
- Includes just under $1M for Informatics
  - OU: heavy in Year 1 and first half of Year 2, light thereafter
  - OSU: nothing in Year 1 and first half of Year 2, 1 FTE thereafter
- Sustainability plan, in place, guarantees at least through 2021
OneOCII HPC

Over 200 TFLOPs of HPC capacity across the state
(5X increase from 2008-12)

- **OU**: 110.6 TFLOPs, acquired 2012 (internally funded)
- **OSU**: 48.8 TFLOPs, acquired 2012 (NSF MRI)
- **Langston U**: 8 TFLOPs CPU, 18.72 TFLOPs GPU, acquired 2013 (NSF MRI)
- **Tandy Supercomputing Center** (Tulsa): 34.56 TFLOPs, acquired 2013 (independently of OCII/OneOCII)
- **UCO**: 30+ TFLOPs
OK STEM Mentorship Program

- Already have presenters signed up for:
  - Agriculture
  - Earth Sciences
    - Atmospheric Sciences: Meteorology
    - Geographical Sciences: Geography, Geographic Information Systems
  - Engineering: IT/CS
  - Libraries
  - Life Sciences: Plant Biology
  - Social Sciences: Anthropology, Economics, Political Science
Advanced
Cyberinfrastructure
Research & Education
Facilitators
2015-16
History

- March 2012: Clemson U creates “Condo of Condos” initiative.
- Apr 2013: Clemson U submits “Condo of Condos” proposal, including ACI-REFs and networking hardware:
  13 institutions, 4 years, $33M+
- March 2015: Proposal partially funded, ACI-REFs only:
  6 institutions (not OU), 2 years, $5.3M
- Apr 2015: OU submits ACI-REF CC*IIE proposal.
- Sep 2015: NSF announces OU ACI-REF grant.
  - 2 years of 1.0 FTE (Oct 2015 – Sep 2016)
  - 2 summer workshops (2015, 2016) on how to be an ACI-REF
What’s an ACI-REF?

- An Advanced Cyberinfrastructure – Research & Education Facilitator (ACI-REF) works directly with research teams to adopt advanced cyberinfrastructure into their research and education.
- OSCER personnel have been providing a low-intensity version of this service since the beginning.
- OU Informatics personnel have been providing a high intensity version since fall 2010.
- OU’s ACI-REF FTE focuses on high end networking, especially SDN via OFFN.
ACI-REF Grant Objectives #1

- **Data-Intensive Research Facilitation:** Via Software Defined Networking (SDN) across OFFN, facilitate end-to-end management, by researchers, of high bandwidth/high performance data flows through a distributed hierarchy of open standards tools, providing researchers with a new layer of transparency into network transport at OU, among OneOCII institutions, and with ACI-REF members.

- **Oklahoma ACI-REF project:** Lead and facilitate adoption of the ACI-REF approach across Oklahoma, leveraging extant and emerging capabilities within OneOCII.
ACI-REF Grant Objectives #2

- **National training regime**: Provide a “virtual residency” program for Campus CI Engineers and other ACI-REFs, open to not only CC*IIE awardees and ACI-REF members but any institution that needs.

- **Research Experiences for Undergraduates (REU) Sites/Supplements**: Foster undergraduate research at OU via a culture of integrating REU sites and supplements into STEM research, including by all research themes on the ACI-REF grant.
Research Projects Part 1

- High Energy Physics
  - also on DOE EPSCoR, C2, PetaStore, OFFN
  - 8 Gbps
  - $1.7M current, $1M pending/planned
  - 7 faculty, 2 staff, 4 postdocs, 9 grad students

- Spring Realtime Storm Forecasting Experiment (CAPS)
  - also on C2, PetaStore, OFFN
  - 12 Gbps
  - $2.5M current, $1M pending/planned
  - 6 faculty, 10 staff, 20 grad students

- Weather Radar (ARRC)
  - also on PetaStore, OFFN
  - 1.9 Gbps
  - $10M current, $30M pending/planned
  - 16 faculty, 7 staff, 16 postdocs, ~60 grad students, ~10 undergrads
Research Projects Part 2

- Tornado Models (IDEA)
  - also on EPSCoR RII Track-2, PetaStore, OFFN
  - 0.6 Gbps
  - $600K current, $500K pending/planned

- Warn on Forecast (CIMMS): NEW!
  - 0.5 Gbps
  - $677K current
  - 12 staff, 4 postdocs, 3 grad students

- Ecological Informatics (EOMF)
  - also on EPSCoR RII Track-2, OFFN
  - 0.2 Gbps
  - $5M current, $8M pending/planned
  - 1 faculty, 3 staff, 3 postdocs, 7 grad students, 1 undergrad
Research Projects Part 3

- Data Networks (CS)
  - also on OFFN
  - $720K current
  - 2 faculty, 3 grad students

- TOTALS
  - 23 Gbps
  - $21 current, $40M pending/planned
  - 33 faculty, 34 staff, 27 postdocs, ~108 grad students, ~14 undergrads
ACI-REF
Virtual Residency
ACI-REF Virtual Residency

- First week of June
- 50 participants (28 onsite, 22 videoconferenced)
  - 39 institutions
  - 26 states and territories
  - 21 institutions in 12 EPSCoR jurisdictions
  - 5 Minority Serving Institutions,
  - 5 non-PhD-granting institutions
Virtual Residency Structure

- Plenaries
- Breakout sessions in two tracks
  - Computational & Data-Enabled Science & Engineering
  - Software Defined Networking
- Practica
Plenary Topics

- Introduction to Research Cyberinfrastructure Consulting
- How to Give a Cyberinfrastructure Tour
- Effective Communication: How to Talk to Researchers About Their Research
- Cyberinfrastructure User Support (slides provided by Memo Belgin)
- Faculty: Tenure, Promotion, Reward System (Prof. Bruce Mason, OU Physics)
- Using Videoconferencing and Collaboration Technologies for Consulting (S. Patrick Calhoun, OSCER & JUB Sheriff, OU IT)
- Writing Grant Proposals (Linda Mason, Oklahoma State Regents for Higher Education)
Plenary Topics (cont’d)

- The Shifting Landscape of CI Funding Opportunities (Dr. J. Barr von Oehsen, Clemson U)
- So You Want to Write a Cyberinfrastructure Proposal
- Stories from the Trenches
CDS&E Breakout Track

- Deploying Community Codes (Josh Alexander, OSCER)
- Practicum: Real Users and Their CDS&E Research: Prof. Amy McGovern, OU Computer Science
- Benchmarking & Tuning (Brett Zimmerman, OSCER)
- Practicum: Real Users and Their CDS&E Research (Prof. Randy Kolar & Dr. Kendra Dresback, OU Civil Engr)
- “Speed Dating:” Real Users and Their CDS&E Research (multiple STEM research teams)
  - Two sessions (Tue & Thu)

OSCER State of the Center Address
Wed Sep 23 2015
CDS&E Breakout Track

- Finding and Provisioning Remote Resources
  - XSEDE: Jeff Pummill, University of Arkansas
  - Open Science Grid:
    - Horst Severini, OSCER/OU High Energy Physics
    - Elizabeth Prout, Indiana University (via video)
    - Rob Gardner, University of Chicago (via video)
SDN Track

- OpenFlow lecture
- OpenFlow lab
- Exploring Open Daylight lecture
- Exploring Open Daylight lab
- Practica: Real Users’ High Bandwidth Research (High Energy Physics, Warn on Forecast)
- The Software in SDN lecture
- The Software in SDN lab
Acknowledgements

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- Grant No. EPS-1301789, “Adapting Socio-ecological Systems to Increased Climate Variability”
- Grant No. ACI-1341028, “OneOklahoma Friction Free Network”
- Grant No. ACI-1429702, “Acquisition of a High Performance Computing Cluster for Research at a Predominantly Undergraduate Institution”
- Grant No. ACI-1440774, “Leveraging Partnerships Across the Great Plains to Build Advanced Networking and CI Expertise”
- Grant No. ACI-1440783, “A Model for Advanced Cyberinfrastructure Research and Education Facilitators”

OSCER State of the Center Address
Wed Sep 23 2015
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- **Academic sponsor (1)**
  - Great Plains Network

- **Industry sponsors (17/18)**
  - **Platinum (1):** Intel + HP
  - **Gold (7):** Arista Networks, Brocade/Lumenate, Dell, Mellanox Technologies, NVIDIA, Quantum, Qumulo
  - **Silver (4):** Cray, DataDirect Networks, SGI, Spectra Logic

Thank you all! Without you, the Symposium couldn’t happen. Over the past 14 Symposia, we’ve had a total of 84 companies as sponsors – and more than half have repeated (or were acquired by/merged with other sponsors).
Thanks!

- OU IT
  - OU CIO/VPIT Loretta Early
  - Symposium committee: Josh Alexander (OU), Dana Brunson (OSU), Debi Gentis (OU), George Louthan (OII), Franklin Fondjo Fotou (LU), Joel Snow (LU), Karl Frinkle (SE), Evan Lemley (UCO)
  - Symposium coordinator: Debi Gentis
  - Sponsorship coordinator: Chance Grubb
  - OSCER Operations Team: Dave Akin, Brett Zimmerman, Josh Alexander, Patrick Calhoun
  - All of the OU IT folks who helped put this together

- CCE Forum
  - Jake Maurer, Kristin Livingston
  - The whole Forum crew who helped put this together
Thanks: Plenary Speakers

- Jim Kurose, NSF Computer & Information Science & Engineering Directorate
- Carl Grant (OU), Adrian Alexander (TU), Jennifer Fitzgerald (Noble), Mark Laufersweiler (OU), Robin Leech (OSU), Habib Tabatabai (UCO)
- Monica Martinez-Canales, Intel & Stephen Wheat, HP (Platinum sponsors)
Thanks: Gold Sponsor Speakers

- Mickey Stewart, Arista Networks
- Dan DeBacker, Brocade Communications Systems Inc.
- DJ Spry, Dell
- Kashif Chauhan & D. Kent Snider, Mellanox Technologies
- Bob Crovella, NVIDIA
- Neal Wingenbach, Quantum
- Bob Collins, Qumulo
Thanks: Breakout Speakers

1. Kate Adams, GPN
2. Dan Andresen, KSU
3. Joseph Babb, Tinker AFB
4. Dana Brunson, OSU
5. Eduardo Colmenares, MWSU
6. Nick Davis, OU Tulsa
7. Jim Ferguson, NICS
8. Karl Frinkle & Mike Morris, SEOSU
9. John Hale, Peter Hawrylak, Andrew Kongs, TU
10. Utkarsh Kapoor, OSU
11. Scott Lathrop, XSEDE/Shodor
12. David Monismith
13. Mukundhan Selvam, WSU
14. Dan Stanzione, TACC
Thanks!

To all of you for participating, and to those many of you who’ve shown us so much loyalty over the past 14 years.
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Thanks for your attention!

Questions?
OneOklahoma Friction Free Network 2013-15
OneOklahoma Friction Free Network (OFFN)
- Multi-institutional Science DMZ
- Software Defined Networking
- Dedicated 10G among the participating sites
- Aggregate compute: just over 200 TFLOPs (peak)
Objectives

1. Deploy and maintain, at the four institutions, a research-only network consisting of institutional last mile components that are independent of enterprise networks, with its internal hub collocated with OneNet.

2. Apply Software Defined Networking (SDN) across OFFN, facilitating end-to-end management, by researchers, of high bandwidth/high performance data flows through a distributed hierarchy of open standards tools, giving researchers a new layer of transparency into network transport.

3. Provide these capabilities – OFFN's in particular and OneOCII's in general – to all relevant researchers and educators statewide, and facilitate their use.
Initial Science Drivers

- High Energy Physics (ATLAS, DØ): OU, LU, OSU
- Real Time Numerical Weather Prediction: OU
- Weather Radar: OU
- Bioinformatics: OSU
- Ecological Informatics: OU (added after grant started)
- … with more to come.

Identified aggregate bandwidth: 23+ Gbps (when everything is going full tilt at the same time)
Science Driver: High Energy Physics

- Senior Personnel
  - H. Severini (OU)
  - P. Skubic (OU)
  - J. Snow (LU)
  - M. Strauss (OU)

- Oklahoma Center for High Energy Physics (OCHEP)
- Funding: $1.7M current, $1M planned (NSF, DOE, Fermilab)
- 7 faculty, 2 staff, 4 postdocs, 3 graduate students
- Identified bandwidth need: up to 8 Gbps sustained
Science Driver: High Energy Physics

- OU and LU already do a lot of ATLAS computing (data analysis and Monte Carlo simulation).
- OU, LU and OSU constitute the Oklahoma Center for High Energy Physics (OCHEP).
  - OSU physicists aren’t doing computational.
- OU, LU and U Texas Arlington constitute the NSF’s ATLAS Southwest Tier2 Center (SWT2), which is consistently in the top 3 most productive US academic Tier2 sites (OU is consistently #6-#8 most productive US academic institution).
- OSU and TSC have agreed to provide their idle cycles for ATLAS jobs, but will kill them off in favor of local jobs.
Science Driver: Weather Prediction

- OU Center for Analysis & Prediction of Storms (CAPS)
- Senior Personnel
  - M. Xue (CAPS Director and faculty in OU’s School of Meteorology)
  - K. Brewster (CAPS Associate Director)
- Funding: $2.5M per year current, $1M per year planned (NSF, NOAA)
- 6 faculty, 10 staff, 20 graduate students
- Identified bandwidth need: 12 Gbps sustained (during the annual Spring Realtime Storm Forecasting Experiment, mid-March – mid-June)
Science Driver: Weather Radar

- Advanced Radar Research Center (ARRC)
- Senior Personnel: Tian-You Yu et al
- Funding: $10M current, $5M pending, $25M planned (NOAA, NSF, NASA, industry)
- 15 faculty, 2 staff, 11 postdocs, ~60 graduate students, ~10 undergraduates
- Identified bandwidth need: 1.9 Gbps sustained
OSU Bioinformatics program

Senior Personnel Elshahed (OSU), Hoyt (OSU)

Funding: $6.1M current, $4.4M pending (NSF, NIH, USDA, DOD, US Army, OCAST, OK Ag Experiment Station)

14 faculty, 6 postdocs, 35 graduate students

Identified bandwidth need: likely 1.6+ Gbps – lesser of (a) bandwidth of OSU HPC cluster disk or (b) bandwidth of Oklahoma PetaStore disk
Network Deployment Goals

- Provide a proven, commercial off-the-shelf (COTS) hardware platform backed with vendor support.
- Realize the Science DMZ goals through the use of a truly independent network at each campus site.
  - The network deployment will consist of dedicated optical pathways to the optical transport provider (OneNet), as well as to the local campus backbone where desired.
- Deploy a fully virtualized infrastructure, to be used simultaneously by multiple research entities, presented to each entity as a dedicated “slice” of the overall resource.
- Leverage federation to provide oversight and visibility into the operations of the virtualized platform.
Network Deployment Goals (cont’d)

- Realize the full potential of OFFN through awareness, training, site-specific hand-off, and communities of support for OFFN adopters.
State Diagram (Logical)
Institutional Design

- **SDN switches** provide a virtualized data plane resource, to effectively and efficiently forward Ethernet traffic based on rules configured on the SDN controller. (Note that TSC will use a 24-port SDN-capable Brocade linecard instead.)

- **Platform support switches** provide the connectivity required for out-of-band management functions, including server lights-out management, SDN switch component management, and Virtual Machine (VM) host management.
Institutional Design (cont’d)

- **Servers** provide multiple virtualized SDN controller resources, plus a virtualized platform for providing performance toolsets, management and monitoring utilities, and data transfer tools (e.g., perfSonar).

- **Software** (all Open Source and/or free)
  - OS virtualization platform (Xen, VirtualBox or Qemu)
  - Linux host and guest OS (Fedora or CentOS)
  - SDN controller (Beacon or Floodlight)
  - Performance testing (iPerf and the PSPerformance Toolkit)
  - Monitoring (Cacti or Nagios)
Institutional Diagram (Logical)
External Connectors

- **Innovation Platform**: OneNet has secured a 100G connection onto Internet2’s Innovation Platform (IP).
  - OSU has dedicated connectivity to connect to the IP at 100G.
  - OU is deploying 2 x 10G with Layer-2 and Layer-3 transport services, from OU to OneNet, connecting directly into the same OneNet chassis as the IP. Under OFFN, researchers statewide will straightforwardly be able to access the IP via OU and OSU.

- **DYNES**: OU hosts a “static” DYNES site deployment.
  - Primarily implemented as a dedicated path tool for OUHEP’s SWT2 cluster to receive large datasets from LHCOOne.
  - Can easily be migrated to the 4PP Science DMZ.
External Connectors (cont’d)

- **XSEDE**: OU’s already-funded plan to connect to the Innovation Platform can also facilitate connection to XSEDEnet at no additional charge, by OneNet simply setting aside 10 Gbps of the 100 Gbps connection into the Innovation Platform (subject to OneNet’s and XSEDE’s approval).

- **PlanetLab** provides an overlay services network that can be decomposed into tangible resource pools used for network experimentation. Both OU and OSU provide dedicated PlanetLab hardware resources.
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