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 27 2017
University of Oklahoma
Use Our Ugly Symposium Website!

Our ugly Symposium website

http://symposium2017.oscer.ou.edu/

has a 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 2017

- **Organizations**: 63 preregistered (or speaking)
  - **Academic**: preregistered 26 institutions in 10 states (KS, LA, MN, MO, MS, NE, OK, SC, SD, TX)
    - Includes 21 institutions in 7 EPSCoR states (KS, LA, MS, NE, OK, SC, SD)
  - **Industry**: preregistered 23 private companies
  - **Government**: preregistered 10 agencies (federal, state)
  - **Non-governmental**: preregistered 4 organizations

- **Demographics**: 300 preregistered (and/or speaking)
  - 28% OU, 72% non-OU (or unknown)
  - 67% Oklahoma, 33% non-Oklahoma (or unknown)
  - 78% from EPSCoR states, 22% non-EPSCoR (or unknown)
  - 66% academic, 34% non-academic (or unknown)
Attendee Profile 2002-2016

- Over 3500 attendees at the previous 15 Symposia
  - 69 in 2002, 225-350 per year thereafter, usually 275±50
- Organizations: 330 through 2016
  - **Academic**: from 119 institutions in 27 US states & territories
    - 64 institutions in 12 EPSCoR jurisdictions
    - 33 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 155 firms
  - **Government**: attendees from 35 agencies (federal, state, municipal, foreign)
  - **Non-governmental/nonprofit**: attendees from 21 organizations
Symposium 2017 Sponsors: Thank You!

- Sponsors (16)
  - Platinum (1): Hewlett-Packard Enterprise
  - Gold (3): Dell EMC, Microsoft, Storbyte
  - Silver (5): DDN Storage, Intel, Lenovo, NVIDIA, Pure Storage
  - Snack Breaks: Lenovo, Silicon Mechanics

Thank you all! Without you, the Symposium couldn’t happen.

Over the past 15 Symposia, we’ve had a total of 91 companies as sponsors – and almost half have repeated (or were acquired by/merged with other sponsors).
Thanks!

- OU IT
  - OU Interim CIO/VPIT Eddie Huebsch
  - Symposium committee: Dana Brunson (OSU), Debi Gentis (OU)
  - Symposium coordinator: Debi Gentis
  - Sponsorship coordinator: Chance Grubb
  - OSCER Operations Team: Dave Akin, Patrick Calhoun, Kali McLennan, Jason Speckman, Brett Zimmerman
  - OSCER Research Computing Facilitators: Jim Ferguson, Horst Severini
  - 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

- Dan Stanzione, Texas Advanced Computing Center, University of Texas at Austin
- Spiros Liolis, Hewlett-Packard Enterprise (Platinum)
- Panelists
  - Dana Brunson, Oklahoma State University
  - Jeremy Evert, Southwestern Oklahoma State University
  - Franklin Fondjo Fotou, Langston University
  - Karl Frinkle, Southeastern Oklahoma State University
  - Evan Lemley, University of Central Oklahoma
  - George Louthan, Oklahoma Innovation Institute
Thanks: Gold Sponsor Speaker

- Kent Altena, Microsoft
- Garima Kochhar, Dell
- Diamond Lauffin, Storbyte
Thanks: Breakout Speakers

1. Dan Andresen, Kansas State University
2. Dana Brunson, Oklahoma State University
3. James Deaton, OneNet/GPN
4. James Ferguson, University of Oklahoma
5. Karl Frinkle, Southeastern Oklahoma State University
6. Kyle Hutson, Kansas State University
7. Carroll Jenkins, University of Oklahoma
8. Mike Morris, Southeastern Oklahoma State University
9. Robert Nordmark, OneNet
10. Richard Reif, Northeastern State University
11. Horst Severini, University of Oklahoma
12. Neal N. Xiong, Southwestern Oklahoma State University
13. Matt Younkins, University of Oklahoma
Thanks!

To all of your for participating, and to those many of you who’ve shown us so much loyalty over the past 15 years.
Outline

- OU
  - Resources
  - Accomplishments
- OCII/OneOCII
Resources
Dell Intel Haswell HPC Cluster

Peak speed: 391 TFLOPs*
*TFLOPs: trillion calculations per second
621 compute nodes
1248 Intel Xeon “Haswell” and “Sandy Bridge” CPU chips
12,796 CPU cores
30.7 TB RAM
378 TB global public disk
1+ PB global “condominium” disk
Mellanox FDR10 Infiniband
(3:1 oversubscribed, 13.33 Gbps, ~1 microsec latency)
Dell N-series Gigabit/10G Ethernet
CentOS 7
~30% of the nodes are “condominium” (owned by individual research teams).

schooner.oscer.ou.edu

Photo: Jawanza Bassue
Schooner: non-condominium nodes

- Compute nodes, non-condominium
  - 266 x R430, dual E5-2650v3 10-core 2.3/2.0 GHz, 32 GB RAM
  - 72 x R430, dual E5-2660v3 10-core 2.6/2.2 GHz, 32 GB RAM
  - 48 x R430, dual E5-2670v3 12-core 2.3/2.0 GHz, 64 GB RAM

- Accelerator-capable nodes, non-condominium
  - 28 x R730, dual E5-2650v3 10-core 2.3/2.0 GHz, 32 GB RAM
  - 5 x R730, dual E5-2670v3 12-core 2.3/2.0 GHz, 64 GB RAM

- Large RAM node, non-condominium
  - 1 x R930, quad E7-4809v3 8-core 2.0/1.8 GHz, 1024 GB RAM

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

- Subtotal peak CPU speed, non-condominium: 280.4 TFLOPs
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, 32 GB RAM

- **Accelerator-capable nodes, condominium, old**
  - 6 x R720, dual E5-2650, oct core, 2.0 GHz, 32 GB RAM

- **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: 20.2 TFLOPs**
Schooner: New Condominium

- **Compute nodes, condominium, new**
  - 7 x R630, dual E5-2640v3, 8-core 2.6/2.2 GHz, 32 GB RAM
  - 6 x R430, dual E5-2650Lv3, 12-core 1.8/1.5 GHz, 64 GB RAM
  - 84 x R430, dual E5-2670v3, 12-core 2.3/2.0 GHz, 64 GB RAM
  - 5 x R430, dual E5-2670v3, 12-core 2.3/2.0 GHz, 128 GB RAM
  - 14 x R430, dual E5-2650v4, 12-core 2.2/1.8 GHz, 64 GB RAM

- **Accelerator-capable nodes, condominium, new**
  - 1 x R730, dual E5-2650v3, 10-core 2.3/2.0 GHz, 32 GB RAM
  - 3 x R730, dual E5-2670v3, 12-core 2.3/2.0 GHz, 64 GB RAM

- **Large RAM node, non-condominium**
  - 1 x R930, quad E7-4809v3, 8-core 2.0/1.8 GHz, 3072 GB RAM
  - 1 x R930, quad E7-4830v4, 14-core 2.0/1.6 GHz, 2048 GB RAM

- **Accelerators**
  - 8 x NVIDIA K20M

- **Subtotal peak CPU speed, new condominium: 90.7 TFLOPs**
Schooner: non-condominium other

- Interconnects
  - Infiniband: Mellanox FDR10 3:1 oversubscribed (40 Gbps native, 13.33 Gbps oversubscribed)
  - Ethernet: GigE downlinks to nodes, 10GE uplinks to core

- Storage (user-accessible)
  - DataDirect Networks SFA7700X w/70 x 6 TB = ~305 TB useable
  - 6 x home/scratch 12 x 6 TB = ~60 TB useable
Schooner: Peak Speed

- Subtotal peak CPU speed, non-condominium: 280.4 TFLOPs
- Subtotal peak CPU speed, old condominium: 20.2 TFLOPs
- Subtotal peak CPU speed, new condominium: 90.7 TFLOPs
- Total peak CPU speed, public + old condominium + new condominium: 391 TFLOPs
- Schooner condominium: 28% of peak speed, 32% of nodes.
OUR Research Cloud
(virtualized server pool)
Draft 4/23/2013

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

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.

The world-facing
switches will be
the Science DMZ
S4810s.
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
- Managing Director, Research IT Services: Ashish Pai
- **Manager of Operations: Kyle Dudgeon**
- Senior System Administrators: Dave Akin, Brett Zimmerman
- Petascale Storage Administrator: Patrick Calhoun
- System Administrators: Kali McLennan, Jason Speckman
- Research IT Coordinator: Debi Gentis
- Associate Director for Remote & Heterogeneous Computing, **Research Computing Facilitator**: Horst Severini
- **Research Computing Facilitator**: Jim Ferguson
Accomplishments
OneOCII Outcomes: Research

- External research funding to OK institutions facilitated by OneOCII lead institutions (Fall 2001- Summer 2013): $275M+
- Funded projects facilitated: 450+
- OK faculty and staff: 200+ in 30+ academic disciplines
- Specifically needed OneOCII just to be funded: ~$44M (necessary but far from sufficient)
  - NSF EPSCoR RII Track-1 (2008-13, OU+OSU): $15M
  - NSF EPSCoR RII Track-1 (2013-18, OU+OSU+Noble)): $20M
  - NSF EPSCoR RII Track-2 (OU+OSU+KU+KSU): $6M ($3M to OU+OSU)
  - NSF EPSCoR RII C2 (OU+OSU+TU+LU+Noble+OneNet): $1.17M
  - NSF CC-NIE (OU+OSU+LU+OII+UCO+OneNet): $500K
  - NSF CC*IIE (OU): $400K
  - NSF CC*IIE (OneNet+GPN): $350K
  - NSF MRI (OU): $793K
  - NSF MRI (OSU): $908K
  - NSF MRI (OSU): $950K
  - NSF MRI (Langston U): $250K
  - NSF MRI (UCO): $304K
  - NSF MRI (TU): $180K
  - DOD DURIP (TU): $200K
  - NSF CC* (NSU/SWOSU/SE/RSU): $334K

- Publications facilitated: 2300+
OneOCII Outcomes: Education

Teaching: 9 institutions including 3 MSIs

- Taught parallel computing using OneOCII resources:
  - Cameron U – multiple times
  - East Central U (NASNI)
  - Oklahoma City U – multiple times

- Taught parallel computing via LittleFe baby supercomputer and OneOCII resources:
  - Southeastern Oklahoma State U (NASNI) – 3 semester sequence, multiple times

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

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

7 institutions including 2 MSIs, plus C2 institutions

- NSF Major Research Instrumentation grants: $2.9M
  - OU: Oklahoma PetaStore, $793K (in production)
  - Oklahoma State U: Cowboy cluster, $909K (in production), Pistol Pete cluster, $950K (new award)
  - Langston U: cluster, $250K (in production)
  - U Central Oklahoma: cluster, $304K (in production)
  - U Tulsa: clusters, $180K + $200K

- Defense University Research Instrumentation Program
  - U Tulsa: cluster, $200K

- LittleFe baby supercomputer grants ($2520 each)
  - OU: Ron Barnes
  - Oklahoma City U: Larry Sells & John Goulden
  - Southeastern Oklahoma State U: Mike Morris & Karl Frinkle

- Networking
  - NSF EPSCoR RII C2 grant: $1.17M
  - NSF CC-NIE grant: $500K
  - NSF CC*IIE grant: $400K
  - NSF CC* grant: $334K
OCII/OneOCII CI Grants

COMPLETED
1. Grant No. EPS-0919466, “A cyberCommons for Ecological Forecasting,” OU+OSU+KU+KSU, $6M, COMPLETED
3. Grant No. OCI-10310029, “MRI: Acquisition of Extensible Petascale Storage for Data Intensive Research,” OU, $793K
4. Grant No. OCI-1126330, “Acquisition of a High Performance Compute Cluster for Multidisciplinary Research,” OSU, $908K
5. Grant No. ACI-1229107, “Acquisition of a High Performance Computing Cluster for Research and Education,” LU, $250

ONGOING
1. Grant No. ACI-1341028, “OneOklahoma Friction Free Network,” OU+OSU+LU+OII+UCO+OneNet, $500K
2. Grant No. ACI-1440783, “A Model for Advanced Cyberinfrastructure Research and Education Facilitators,” OU, $400K
4. Grant No. ACI-1531128, “MRI: Acquisition of Shared High Performance Compute Cluster for Multidisciplinary Computational and Data-Intensive Research,” OSU, $304K
5. Grant No. ?, “DURIP-ARO: Heterogeneous Cluster for Cyber-Physical System Security Analytics,” TU, $200K
7. Grant No. OAC-1659235, “CC* Network Design: Multiple Organization Regional One Oklahoma Friction Free Network (MORe OFFN),” NSU/SWOSU/SE/RSU, $334K

TOTAL to OK under OCII/OneOCII: Sep 2008-Aug 2017:
$9.1M in 13 CI grants to 12 OK institutions (OU, OSU, TU, LU, UCO, OII, Noble, OneNet, NSU, SWOSU, SE, RSU)
(average of $1M per year in new CI grants to OK institutions)

Comparison: 2001-2008: $722K (3 grants) TOTAL (1/12 as much)

OSCER State of the Center Address
Wed Sep 27 2017
Grants That Needed OCII/OneOCII

**COMPLETED**
- Grant No. EPS-0814361, “Building Oklahoma's Leadership Role in Cellulosic Bioenergy,” OU+OSU, $15M

**ONGOING**
- Grant No. EPS-1301789, “Adapting Socio-ecological Systems to Increased Climate Variability,” OU+OSU+TU+Noble, $20M

**TOTAL under OCII/OneOCII**: $35M in 2 grants that needed OCII/OneOCII to be fundable, to 4 OK institutions since Sep 2008
NEW! MORE OFFN

Oklahoma Supercomputing Symposium 2017

OFFN and MORE OFFN

OSCER State of the Center Address
Wed Sep 27 2017
Papers About Pieces of OneOCII


HPC Capacity

- 2002: 1.2 TFLOPs statewide, 1 Service Provider
- 2005: 6.5 TFLOPs statewide, 1 Service Provider
- 2008: 40 TFLOPs statewide, 2 Service Providers
- 2012: 200+ TFLOPs statewide, 4 Service Providers
- 2015: 400+ TFLOPs statewide, 5 Service Providers
- 2016: 400+ TFLOPs statewide, 6 Service Providers
- 2017: 500+ TFLOPs statewide, 6 Service Providers
External Research Grants


OSCER-FACILITATED FUNDING TO DATE:
$653M total, $273M to OU

OSCER State of the Center Address
Wed Sep 27 2017

19. M. Biggerstaff, “Impact of cloud dynamics on chemical and electrical properties of storms observed during DC3,” NSF, $661K

20. K. Nicholas, “Deoxygenation and Reductive Coupling of Alcohols Catalyzed by Oxo-Metal Complexes,” NSF, $405K

21. S. Schroeder, N. Sloat, “Blue Water Student Internship Program,” $5K

22. S. Schroeder, “Protein and Metal Ion Binding in Viral RNA, HIV Accessory and Regulatory Complexes (HARC),” NIH, $25K


24. L. Ding, “Development of Imaging and EEG Biomarkers to Refine Neuromodulation Treatment Targets in MdDS,” LIBR via NdDS, subaward PI, $55K

25. L. Ding, “Development of the EEG Neuroergonomics Toolbox or EEGNT,” FAA, $243K


31. D. LaDue, “REU Site: Real-World Research Experiences at the National Weather Center,” NSF, $885K


34. S. Cavallo, “Multi-scale Predictability with a New Coupled Non-hydrostatic global model over the Arctic,” DOD-ONR, $273K

OSCER-FACILITATED FUNDING TO DATE: $653M total, $273M to OU
External Research Grants (cont’d)

35. X. Chen, “Multi-scale validation of earthquake source parameters to resolve any spatial, temporal or magnitude-dependent variability at Parkfield, CA,” NSF, $224K
37. J. Ruyle, “Two-Dimensionality for Conformal Multi-Platform Use,” DARPA, $499K
38. X. Wang, “Ensemble Kalman Filter and Hybrid Data Assimilation for Convective-Scale,” $73K
40. X. Wang, “Hybrid Data Assimilation for Convective-Scale,” NOAA, $99K
41. X. Wang, “Improving Global and Hurricane Prediction by Using Minimum-Cost Large Ensemble in GFS 4DVar Hybrid Data Assimilation System,” NOAA, $389K
42. X. Wang, “Tzero Revolution,” Weathernews Americas, Inc., $59K
43. X. Wang, “Improving the Understanding and Prediction of Nocturnal Convection through Advance Data Assimilation and Ensemble Simulation in PECAN,” NSF, $602K
44. J. Dyer, “Heart Rate Variability Assessment as an Indicator of Health,” OUHSC, $121K
45. M. Zaman, “Southern Plains Transportation Center (SPTC),” USDOT, $7.7M
48. E. Baron, “Models of Interacting Supernovae: Probing the Circumstellar Environment,” NASA, $381K
51. M. Xue, F. Kong, Y. Jung, N. Snook, “Improving Initial Conditions and their Perturbations through Ensemble-Based Data Assimilation for Optimized Storm-Scale Ensemble Prediction in Support of HWT Severe Weather Forecasting,” NOAA, $249K

OSCER-FACILITATED FUNDING TO DATE:
$653M total, $273M to OU
External Research Grants (cont’d)

52. M. Xue, K. Brewster, F. Kong, “Storm-Scale Ensemble Prediction Optimized for Heavy Precipitation Forecasting in Support of the Hydrometeorological Testbed (HMT),” NOAA, $236K

53. J. Kelly, E. Bridge, P. Chilson, A. McGovern, K. deBeurs, J. Reedy, L. Jervis, “NRT: Aeroecology as a testbed of interdisciplinary STEM training,” $2.95M

54. F. Carr, J. Brotzge, “National Mesonet Program”, GST and Earth Networks, $50K

55. F. Carr, K. Brewster, “National Mesonet Program,” $100K

56. F. Carr, J. Brotzge, K. Brewster, “Network of Networks: Preliminary Study,” NOAA/NWS Office of Science and Technology, $210K

OSCER-FACILITATED FUNDING TO DATE:
$653M total, $273M to OU
60. J. Straka, “Challenges in understanding tornadogenesis and associated phenomena (supplement),” NSF, $29K
63. K. Nicholas, “Catalytic Deoxydehydration,” DOE, $438K
64. M. Libault, “CAREER: Exploring the Transcriptional Regulatory Networks Controlling the Early Stages of Legume Nodulation,” NSF, $1.1M
68. B. Wawrik, A. Callaghan, “Development of Techniques for the Quantification of Functional Gene Expression Associated with Biocorrosion,” OU Biocorrosion Center, $37K

**OSCER-FACILITATED FUNDING TO DATE:**

$653M total, $273M to OU
External Research Grants (cont’d)

75. A. Striolo et al, “ShaleXenvironmenT,” European Commission, €3M
78. A. Striolo, “Hydrates Inhibitor Research,” Halliburton, £69K
79. A. Striolo, “Fraccing Fundamentals,” Marie Curie Career Integration Grant, €100K
80. J. Li, “Targeting Mosquito FREP1 Protein for Malaria Control,” NIH, $424K
81. J. Li, “CAREER: Genetic and Molecular Mechanisms of Parasite Infection in Insects,” NSF, $783K
82. D. Atkins, J. Li, “Memory T cell-mediated protecting against malaria,” NIH, $76K
83. J. Li, “Genomics analysis of Anopheles gambiae mosquitoes to Plasmodium falciparum parasite Infection,” OCAST, $135K
86. B. Capogrosso-Sansone, “Multi-Worm Algorithm for Path Integral Quantum Monte Carlo in Ultracold Dipolar Gases, NSF, $293K
88. U. Hansmann, “Modeling the molecular mechanism of amyloid oligomer and fibril self assembly,” OCAST, $90K

OSCER-FACILITATED FUNDING TO DATE:
$653M total, $273M to OU
External Research Grants (cont’d)

89. J. Wicksted, A. Knoedler et al, “Adapting Socio-ecological Systems to Increased Climate Variability,” NSF, $20M + $4M Regents (total), $7.0M + $1.9M Regents (OU)

90. 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)


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


97. 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)


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


OSCER-FACILITATED FUNDING TO DATE:

$653M total, $273M to OU

OSCER State of the Center Address
Wed Sep 27 2017
### External Research Grants (cont'd)

<table>
<thead>
<tr>
<th>Grant Number</th>
<th>Project Title</th>
<th>Agency/Institution</th>
<th>Award Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>103</td>
<td>R. Kolar, “Dynamic Integration of Natural, Human, and Instructure Systems for Hurricane Evacuation and Sheltering,“</td>
<td>NSF, $456K</td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>L. Ding, “Neuroimaging Study of Mental Fatigue,” FAA, $430K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>106</td>
<td>L. Ding, “Large-Scale Computational Neuroimaging of Brain Electrical Activity,” NSF CAREER, $400K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>107</td>
<td>P. Attar, “Optimal Spatiotemporal Reduced Order Modeling for Nonlinear Structural Dynamics,” NSF, $360K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>M. Xue, K. Brewster, F. Kong, “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),” NOAA, $310K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>111</td>
<td>E. Bridge, J. Kelly, X. Xiao, “Enhancing and disseminating miniaturized tracking technology for widespread use on small migratory songbirds,” NSF, $302K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>J. Kelly, L. Gruenwald, P. Chilson, V. Lakshmanan, E. Bridge, “Advancing Biological Interpretations of Radar Data,” NSF EAGER, $299K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>113</td>
<td>L. Ding, “High-Resolution Noninvasive Computational Neuroimaging,” OCAST, $283K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>115</td>
<td>R. Slatt, Consortium from 14 oil and gas company, $245K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>116</td>
<td>J. Brotzge, F. Carr, “Prootyping and Evaluating Key Network-of-Networks Technologies: Project Extension,” NOAA, $210K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>118</td>
<td>J. Ruyle, “BRIGE: Investigation of Slot Antenna Reconfig figuration Mechanisms,” NSF, $175K</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**OSCER-FACILITATED FUNDING TO DATE:**

$653M total, $273M to OU

OSCER State of the Center Address
Wed Sep 27 2017

121. J. Brotzge, F. Carr, “Prototyping and Evaluating Key Network-of-Networks Technologies,” NOAA, $145K


124. L. Ding, “Neurophysiological Assessment of Mental Fatigue and Cognitive Performance,” FAA, $115K

125. K. Dresback, R. Kolar, "Next Generation ADCIRC Tidal Database: Phase 2 - West Coast," DOD, $75K

126. K. Dresback, R. Kolar, "Next Generation ADCIRC Tidal Database,” NOAA, $75K

127. P. Risser, J. Duckles, J. Bratton, NSF I-Corps, $50K


129. 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

OSCER-FACILITATED FUNDING TO DATE:
$653M total, $273M to OU

OSCER State of the Center Address
Wed Sep 27 2017
| 122. | J. P. Shaffer, T. Pfau, “A Rydberg Atom Electric Field Sensor,” DARPA-ARO, $1.18M (total), $1.06M (OU) |
| 123. | Y. Luo, “Data Synthesis and Data Assimilation at Global Change Experiments and Fluxnet toward Improving Land Process Models,” DOE, $1.05M |
| 128. | J. P. Shaffer, “Interactions in Cold Rydberg Gases,” NSF, $422K |

**External Research Grants (cont’d)**

**OSCER-FACILITATED FUNDING TO DATE:**

$653M total, $273M to OU
<table>
<thead>
<tr>
<th></th>
<th>Grant Description</th>
<th>Sponsor</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>139</td>
<td>X. Wang, M. Xue, “Improving High Resolution Tropical Cyclone Prediction using GSI-based Hybrid Ensemble-Variational Data Assimilation System for HWRF,” NOAA</td>
<td>$150K</td>
<td></td>
</tr>
<tr>
<td>140</td>
<td>I. Y. Akkutlu, “Molecular Theory of Capillarity in Kerogen - A Multi-component Approach to Predict Shale Gas/Liquid In-place and Transport in Nanopores,” Devon Energy</td>
<td>$150K</td>
<td></td>
</tr>
<tr>
<td>141</td>
<td>S. Dhall, L. Gruenwald, “Autonomous Database Partitioning using Data Mining for High End Computing,” NSF</td>
<td>$150K</td>
<td></td>
</tr>
<tr>
<td>142</td>
<td>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</td>
<td>$126K</td>
<td></td>
</tr>
<tr>
<td>143</td>
<td>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</td>
<td>$94K</td>
<td></td>
</tr>
<tr>
<td>144</td>
<td>K. Brewster, M. Xue, “High Resolution Data Assimilation for Trajectory Improvement,” DOD-Air Force</td>
<td>$79K</td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>F. Kong, “CAPS support to the WRF Lightning Forecast Algorithm for the NOAA R3 effort,” NOAA GOES-R/Universities Space Research Assn</td>
<td>$48K</td>
<td></td>
</tr>
<tr>
<td>146</td>
<td>R. McPherson, M. Shafer, Y. Hong, “Utilization of Regional Climate Science Programs in Reservoir and Watershed Impact Assessments,” OSU Water Resources Responses to Climate Change: Pilot Study</td>
<td>$43K</td>
<td></td>
</tr>
<tr>
<td>147</td>
<td>P. Attar, “Numerical Simulation of a Membrane Micro Air Vehicle in a Gust Field, Ohio Aerospace Institute</td>
<td>$35K</td>
<td></td>
</tr>
<tr>
<td>149</td>
<td>J.R. Cruz, “Equalization, Detection, and Coding Algorithms for Bit Patterned Media Recording,” Advanced Storage Technology Consortium</td>
<td>$17K</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>L. Sells, J. Goulden, H. Aboudja, “LittleFe grant,” LittleFe project</td>
<td>$2.5K</td>
<td></td>
</tr>
<tr>
<td>151</td>
<td>L. Sells, J. Goulden, “Early Adopter Grant,” NSF/TCPP</td>
<td>$2.5K</td>
<td></td>
</tr>
</tbody>
</table>

**OSCER-FACILITATED FUNDING TO DATE:**

$653M total, $273M to OU
External Research Grants (cont’d)

152. B. Moore III et al, “Department of the Interior South-Central Regional Climate Science Center,” US Dept of the Interior, $3.5M (total), $1.4M (OU)
153. A. Striolo, D. Resasco et al, “Center for Application of Single-Walled Carbon Nanotubes,” DOE, $1M
155. Y. Kogan, “Parameterization of cumulus convective cloud systems in mesoscale forecast models,” ONR, $594K
158. B. Grady, A. Striolo, “Novel Supramolecular Structures of Laterally Confined Amphiphilic Molecules,” NSF, $335K
161. J. Shen, “Electrostatic Modulation of Protein Stability and Folding,” NIH, $1.4M
163. F. Kong, M. Xue, “Further Enhancement to the Hourly Assimilation and Prediction System (HAPS) for Shenzhen Meteorological Bureau.” Shenzhen Institute of Advanced Technology, Chinese Academy of Science, $228K
166. A. Striolo, “Mixed-Volatile Fluids Relevant to Subsurface Energy Systems,” DOE, $120K
167. P. Skubic, M. Strauss, “OU Contribution to the ATLAS Southwest Tier 2 Computing Center (Supplement),” NSF, $110K
169. P. Skubic, M. Strauss, “OU Contribution to the ATLAS Southwest Tier 2 Computing Center (Supplement),” NSF, $50K

OSCER-FACILITATED FUNDING TO DATE: $653M total, $273M to OU

OSCER State of the Center Address
Wed Sep 27 2017
External Research Grants (cont’d)

171. P. Attar, “Computational Model Development and Experimental Validation Measurements for Membrane-Batten Wing,” Ohio Aerospace Institute, $43K.
172. A. Striolo, “Reduced Carbon in Earth’s Crust and Mantle I,” Alfred P. Sloan Foundation, $39K.
176. P. Attar, P. Vedula, “High-Fidelity Computational Aeroelastic Models in Support of Certification Airworthiness of Control Surfaces with Freeplay and Other Nonlinear Features,” Advanced Dynamics, $9K.

OSCER-FACILITATED FUNDING TO DATE:
$653M total, $273M to OU
External Research Grants (cont’d)

177. 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


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


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

184. 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


OSCER-FACILITATED FUNDING TO DATE: $653M total, $273M to OU
External Research Grants (cont’d)

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


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

197. 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


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


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

OSCER-FACILITATED FUNDING TO DATE:

$653M total, $273M to OU

OSCER State of the Center Address

Wed Sep 27 2017
## External Research Grants (cont’d)

<table>
<thead>
<tr>
<th>Grant Number</th>
<th>Principal Investigator(s)</th>
<th>Project Description</th>
<th>Funding Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>206</td>
<td>K. Brewster, M. Xue, F. Kong</td>
<td>Meteorology project</td>
<td>$211K</td>
</tr>
<tr>
<td>207</td>
<td>M. Xue</td>
<td>Meteorology project</td>
<td>$120K</td>
</tr>
<tr>
<td>208</td>
<td>A. McGovern</td>
<td>“Learning to guide search in large state spaces,” IBM DARPA</td>
<td>$95K</td>
</tr>
<tr>
<td>209</td>
<td>J. Straka, K. Kanak</td>
<td>“Supplement: Challenges in tornadogenesis and associated phenomena (VORTEX2),” NSF</td>
<td>$87K</td>
</tr>
<tr>
<td>211</td>
<td>J. Straka</td>
<td>“Improved Understanding/Prediction of Severe Convective Storms and Attendant Phenomena through Advanced Numerical Simulation,” NSF</td>
<td>$58K</td>
</tr>
<tr>
<td>212</td>
<td>M. Xue</td>
<td>“Assimilation of NEXRAD Radial Winds in a Regional Mesoscale Model,” Miss State U</td>
<td>$79K</td>
</tr>
<tr>
<td>213</td>
<td>J. Cruz, R. Todd</td>
<td>“Medium-Density Parity-Check Codes for Tape Systems,” INSIC</td>
<td>$36K</td>
</tr>
<tr>
<td>214</td>
<td>M. Xue, D. Stensrud, J. Gao</td>
<td>“Advancing Warn on Forecast – Storm-scale Analysis of Vortex 2 Thunderstorms,” NSSL</td>
<td>$70K</td>
</tr>
<tr>
<td>215</td>
<td>P. Attar</td>
<td>“High-Fidelity Computational Aeroelastic Solver Research,” Ohio Aerospace Institute</td>
<td>$60K</td>
</tr>
<tr>
<td>216</td>
<td>J. Straka, K. Kanak</td>
<td>“Development of Unmanned Aircraft System for Research in a Severe Storm Environment and Deployment within the VORTEX 2,” NSF</td>
<td>$44K</td>
</tr>
<tr>
<td>218</td>
<td>J. Cruz, R. Todd</td>
<td>“Signal Processing for Magnetic Recording Channels,” private company</td>
<td>$30K</td>
</tr>
<tr>
<td>219</td>
<td>P. Attar, P. Vedula</td>
<td>“Deterministic and Statistical Characterization of the Impact of Control Surface Freepay on Flutter and Limit-Cycle Oscillation (LCO) using Efficient Computational Modeling,” Advanced Dynamics</td>
<td>$30K</td>
</tr>
<tr>
<td>220</td>
<td>P. Attar, P. Vedula</td>
<td>“Novel Reduced Order in time Models for Problems in Nonlinear Aeroelasticity,” Advanced Dynamics</td>
<td>$29K</td>
</tr>
<tr>
<td>221</td>
<td>F. Carr, J. Straka</td>
<td>“Severe storm research,” Jonathon Merage Foundation</td>
<td>$21K</td>
</tr>
<tr>
<td>222</td>
<td>F. Carr, J. Straka</td>
<td>“Severe storm research,” Jonathon Merage Foundation</td>
<td>$20K</td>
</tr>
</tbody>
</table>

**OSCER-FACILITATED FUNDING TO DATE:**

$653M total, $273M to OU
External Research Grants (cont’d)


225. D. Cole (ORNL), A. Striolo, “Structure and Dynamics of Earth Materials, Interfaces and Reactions,” DOE, $1.5M ($75K OU)


231. Y. Hong, Baski (OSU), “Proactive approach to transportation resource allocation under severe winter weather emergencies,” OK-DOT/OTC, $261K ($101K OU)


OSCER-FACILITATED FUNDING TO DATE: $653M total, $273M to OU

OSCER State of the Center Address
Wed Sep 27 2017
External Research Grants (cont’d)

238. P. Attar, “High Fidelity Computational Aeroelastic Analysis of a Flexible Membrane Airfoil Undergoing Dynamic Motion,” Ohio Aerospace Institute, $35K

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


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

244. Y. Luo, D. Schimmel (NEON), J. Clark (Duke U.), Kiona Ogle (U. Wyoming), S. LaDeau (Cary Institute of Ecosystem Study), “RCN: Forecasts Of Resource and Environmental Changes: Data Assimilation Science and Technology (FORECAST),” NSF, $500K


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


OSCER-FACILITATED FUNDING TO DATE: $653M total, $273M to OU
External Research Grants (cont’d)


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


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

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

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

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


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


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


OSCER-FACILITATED FUNDING TO DATE: $653M total, $273M to OU

OSCER State of the Center Address
Wed Sep 27 2017
External Research Grants (cont’d)

267. 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

268. M. Xue, “Contribution to Model Development and Enhancement Research Team by the Center for Analysis and Prediction of Storms,” DOC-NOAA, $620,000

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

270. S. Schroeder, "Discovering Satellite Tobacco Mosaic Virus Structure," OCAST, $85K

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


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


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


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


OSCER-FACILITATED FUNDING TO DATE: $653M total, $273M to OU
External Research Grants (cont’d)

282. K. Droegemeier et al., “Linked Environments for Atmospheric Discovery (LEAD),” NSF, $11.25M (total), $2.5M (OU)
283. M. Strauss, P. Skubic et al., “Oklahoma Center for High Energy Physics”, DOE EPSCoR, $3.4M (total), $1.6M (OU)
287. J. Levit, D. Ebert (Purdue), C. Hansen (U Utah), “Advanced Weather Data Visualization,” NSF, $300K
290. R. Wheeler, “Principal mode analysis and its application to polypeptide vibrations,” NSF, $385K

OSCER-FACILITATED FUNDING TO DATE:
$653M total, $273M to OU
External Research Grants (cont’d)


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


304. 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.


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


310. 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:
$653M total, $273M to OU
<table>
<thead>
<tr>
<th>Grant Number</th>
<th>Principal Investigator(s)</th>
<th>Project Title</th>
<th>Funding Agency</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>312</td>
<td>Neeman, Severini</td>
<td>Cyberinfrastructure for Distributed Rapid Response to National Emergencies</td>
<td>NSF</td>
<td>$132K</td>
</tr>
<tr>
<td>313</td>
<td>Neeman, Roe, Severini, Wu et al.</td>
<td>Cyberinfrastructure Education for Bioinformatics and Beyond</td>
<td>NSF</td>
<td>$250K</td>
</tr>
<tr>
<td>314</td>
<td>K. Milton, C. Kao</td>
<td>Non-perturbative Quantum Field Theory and Particle Theory Beyond the Standard Model</td>
<td>DOE</td>
<td>$150K</td>
</tr>
<tr>
<td>315</td>
<td>J. Snow</td>
<td>&quot;Oklahoma Center for High Energy Physics&quot;</td>
<td>DOE EPSCoR</td>
<td>$3.4M (total), $169K (LU)</td>
</tr>
<tr>
<td>316</td>
<td>M. Xue, F. Kong</td>
<td>OSSE Experiments for airborne weather sensors</td>
<td>Boeing</td>
<td>$90K</td>
</tr>
<tr>
<td>317</td>
<td>M. Xue, K. Brewster, J. Gao, A. Shapiro</td>
<td>Storm-Scale Quantitative Precipitation Forecasting Using Advanced Data Assimilation Techniques: Methods, Impacts and Sensitivities</td>
<td>NSF</td>
<td>$835K</td>
</tr>
<tr>
<td>318</td>
<td>Y. Kogan, D. Mechem</td>
<td>Improvement in the cloud physics formulation in the U.S. Navy Coupled Ocean-Atmosphere Mesoscale Prediction System</td>
<td>ONR</td>
<td>$889K</td>
</tr>
<tr>
<td>319</td>
<td>G. Zhang, M. Xue, P. Chilson, T. Schuur</td>
<td>Improving Microphysics Parameterizations and Quantitative Precipitation Forecast through Optimal Use of Video Disdrometer, Profiler and Polarimetric Radar Observations</td>
<td>NSF</td>
<td>$464K</td>
</tr>
<tr>
<td>322</td>
<td>T. Ibrahim et al.</td>
<td>A Demonstration of Low-Cost Reliable Wireless Sensor for Health Monitoring of a Precast Prestressed Concrete Bridge Girder</td>
<td>OK Transportation Center</td>
<td>$80K</td>
</tr>
<tr>
<td>323</td>
<td>T. Ibrahim et al.</td>
<td>Micro-Neural Interface</td>
<td>OCAST</td>
<td>$135K</td>
</tr>
<tr>
<td>324</td>
<td>J. Snow</td>
<td>Langston University High Energy Physics</td>
<td>LU</td>
<td>$155K</td>
</tr>
</tbody>
</table>

**OSCER-FACILITATED FUNDING TO DATE:**

$653M total, $273M to OU
## External Research Grants (cont’d)

<table>
<thead>
<tr>
<th>Grant Number</th>
<th>Principal Investigator</th>
<th>Title</th>
<th>Funding Agency</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>328</td>
<td>E. Chesnokov</td>
<td>“Fracture Prediction Methodology Based On Surface Seismic Data,”</td>
<td>Devon Energy</td>
<td>$1M</td>
</tr>
<tr>
<td>329</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>
</tr>
<tr>
<td>330</td>
<td>M. Xue, K. Brewster, J. Gao</td>
<td>&quot;Study of Tornado and Tornadic Thunderstorm Dynamics and Predictability through High-Resolution Simulation, Prediction and Advanced Data Assimilation,&quot;</td>
<td>NSF</td>
<td>$780K</td>
</tr>
<tr>
<td>331</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>
</tr>
<tr>
<td>332</td>
<td>D.V. Papavassiliou</td>
<td>“Turbulent Transport in Anisotropic Velocity Fields,”</td>
<td>NSF</td>
<td>$292.5K</td>
</tr>
<tr>
<td>333</td>
<td>D. Oliver</td>
<td>software license grant,</td>
<td></td>
<td>$1.5M</td>
</tr>
<tr>
<td>334</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>
</tr>
<tr>
<td>335</td>
<td>A. Fagg</td>
<td>“Development of a Bidirectional CNS Interface or Robotic Control,”</td>
<td>NIH</td>
<td>$600K</td>
</tr>
<tr>
<td>336</td>
<td>M. Xue, J. Gao</td>
<td>&quot;An Investigation on the Importance of Environmental Variability to Storm-scale Radar Data Assimilation,&quot;</td>
<td>NSSL</td>
<td>$72K</td>
</tr>
<tr>
<td>337</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:

- **Total Funding:** $653M
- **Funding to OU:** $273M
External Research Grants (cont’d)


348. R. McPherson, E. White, M. Shafer, D. Rosendahl, M. Richman, "Trends in cold temperature extremes and winter weather for the SPTC region," USDOT, $132K


350. M. J. McInerney, L. Krumholz, Bioremediation of Chromium and Arsenic from Industrial Wastewater,” Nat’l Academies of Science, $162K

351. M. Coniglio (PI), C. Doswell III, R. J. Trapp

352. "Improved understanding of convective-storm predictability and environment feedbacks from observations during the Mesoscale Predictability Experiment (MPEX),“ NSF, $272K

353. Y. Kogan, "Parameterization of Cumulus Convective Cloud Systems in Mesoscale Forecast Models,“ ONR, $267K

354. S. Schroeder, "Predicting Viral RNA Structures, Function, and Drug Targets from Sequence,“ OCAST, $145K

**OSCER-FACILITATED FUNDING TO DATE:**

$653M total, $273M to OU

OSCER State of the Center Address

Wed Sep 27 2017
External Research Grants (cont’d)

355. L. Ding, "NRI-Small: Robot Assistants for Promoting Crawling and Walking in Children at Risk of Cerebral Palsy,“ NSF, $1.135M


357. E. Baron, "Collaborative Research: Three-Dimensional Simulations of Type Ia Supernovae Constraining Models with Observations,“ NSF, $26K


359. E. Lemley, G. Qian, "MRI: Acquisition of a High Performance Computing Cluster for Research at a Predominantly Undergraduate Institution,“ NSF, $305K

360. R. Floyd, J. Pei, "Understanding the Behavior of Prestressed Concrete Girders after Years of Service,“ OK DOT, $327K


363. U. Hansmann, "Folding, Mis-folding and Aggregation of Proteins,“ NIH, $887K


366. M. Soe (RSU), "Unitary Qubit Lattice Algorithms for Quantum Turbulence with Non-Abeliam Vortices,“ NSF, $75K,

OSCER-FACILITATED FUNDING TO DATE: $653M total, $273M to OU

OSCER State of the Center Address
Wed Sep 27 2017

OSCER-FACILITATED FUNDING TO DATE:
$653M total, $273M to OU
OSCER State of the Center Address

Wed Sep 27 2017

OSCER-FACILITATED FUNDING TO DATE:
$653M total, $273M to OU

External Research Grants (cont’d)

369. R. Sani (SDSMT), L. Krumholz, “Building Genome-to-Phenome Infrastructure for Regulating Methane in Deep Environments (BuG ReMaDE),” NSF, $6M (total), $1.4M (OU)

370. A. Striolo (U College London), “Science 4 Clean Energy,” European Commission, €12M (not to OU)

371. A. Striolo, D. Blankschtein, “Hydrates Growth and Coalescence: From Molecular Understanding to Useful Models,” Royal Society, £12K (not to OU)

372. A. P. Khain (Hebrew U), A. V. Ryzhkov, “Coupling of polarimetric radar and cloud model,” BSF, $102K


378. X. Wang, “GSI based Dual Resolution EnVar Data Assimilation for Convective-Scale 'Warn-on-Forecast','’ NOAA, $100K

379. X. Wang, “"MPAR targeting observation research for WoF,” NOAA, $362K


381. X. Wang, A. Johnson, T. Jones, “Assimilation of high resolution GOES-R ABI infrared water vapor and cloud sensitive radiances using the GSI-based hybrid ensemble-variational data assimilation system to improve convection initiation forecast,” NOAA, $368K

382. X. Wang, “Further Advancement of HWRF Self-Consistent Ensemble-Variational Hybrid Data Assimilation System to Improve High Resolution Hurricane Vortex Initialization,” NOAA, $377K
External Research Grants (cont’d)

383. X. Wang, “Advancing the Assimilation of Airborne Hurricane Observations using the GSI-based Hybrid Ensemble-Variational Data Assimilation System for HWRF,” NOAA, $294K

384. X. Wang, L. Leslie, “Understanding the Impact of Outflow on Hurricane Intensification through Ensemble-based Data Assimilation and Ensemble Simulation with Multiple Models,” ONR, $376K

385. J. P. Shaffer, “Atom Surface Interactions and Hybrid Quantum Systems for Quantum Engineering Applications,” AFOSR, $750K

386. J. P. Shaffer, “SBIR,” DARPA-SBIR, $15K

387. J. P. Shaffer, “High Sensitivity Absolute Electric Field Sensing with Atoms,” NRO, $309K

388. J. P. Shaffer, “US -Brazil Professorship and Lectureship,” American Physical Society, $4K

389. J. P. Shaffer, “Control of Rydberg Interactions and Exotic States of Matter,” NSF, $473K

390. L. Ding, “Neurophysiological Assessment of Thresholds of Audibility and Loudness in Healthy Persons and Cochlear Implants Users,” Hearts for Hearing, $100K

391. D. Myers (ECU), C. Crittell (ECU), “STEM-Double Bridge,” NSF via UCO, $335K

392. B. Moore, S. Crowell, “(EVM-2) The geoCARB Mission, NASA, $161M (total), $39M (OU)


394. T. Gamble (Marquette U), C. Siler (OU), J. Daza (Sam Houston State U), M. Heinicke (U Michigan - Dearborn), “From Exaptation to Key Innovation - Evolutionary Insights from Gliding Geckos,” NSF, $1.1M (total), $323K (OU)


396. K. Brewster, X. Wang, F. Carr, “Prototyping and Evaluating Key Network-of-Networks Technologies,” NOAA, $192K

397. B. Moore, K. Brewster, F. Carr, “CASA DFW Testbed Operations and Data Impacts,” Global Science Technology, $97K

OSCER-FACILITATED FUNDING TO DATE: $653M total, $273M to OU

OSCER State of the Center Address
Wed Sep 27 2017


403. B. Moore, M. Xue, A. Bamzai, R. McPherson, “Very-high resolution dynamic downscaling of regional climate for use in long-term hydrologic planning along the red river valley system,” DOI-USG, $127K


OSCER-FACILITATED FUNDING TO DATE:
$653M total, $273M to OU

OSCER State of the Center Address
Wed Sep 27 2017
External Research Grants (cont’d)


418. J. Zhao, L. Xiang, “Photoacoustic Imaging of Myeloproliferative Neoplasms and Associated Vascular Complications,” PHF Team Science, $100K

419. L. Xiang, K. Stratton, “Photoacoustic Imaging for Prostate Cancer Detection,” OU COE, $10K


OSKER-FACILITATED FUNDING TO DATE:
$653M total, $273M to OU

OSKER State of the Center Address
Wed Sep 27 2017


413. W. Freeman, A. Richardson, “High throughput single cell analysis of hippocampus with Alzheimer’s Disease,” National Institute on Aging. $148K


415. D. Parsons, H. Bluestein, “Investigation into the mechanisms for the maintenance of nocturnal convective systems,” NSF, $599K


418. N. Nakata, “Ambient Field Analysis of Earthquake Ground Motion at Groningen Gas Field, Stanford University & Shell Oil Company, $47K


OSCER-FACILITATED FUNDING TO DATE: $653M total, $273M to OU

OSCER State of the Center Address
Wed Sep 27 2017
External Research Grants (cont’d)

422. S. Schroeder, “Metal Ion Interactions in RNA Shapeshifters,” Burroughs Wellcome Fund Collaborative Research Travel Grant, $9K
423. E. Baron, “Modeling the Atmosphere of Solar and Other Stars Radiative Transfer with PHOENIX/3D,” NASA, $478K
426. C. Lewis, P. Lawson, C. Warinner, “Microbial Ecologies of Indigenous Communities,” NIH, $743K
428. X. Wang, “Further Advancement of HWRF Self-Consistent Ensemble-Variational Hybrid Data Assimilation System to Improve High Resolution Hurricane Vortex Initialization,” NOAA, $292K
429. X. Wang, “Development of NWS convective scale ensemble forecasting capability through improving GSI-based hybrid ensemble-variational data assimilation and evaluating multi-dynamic core approach,” NOAA, $449K
430. B. Holt, “NF-Y Transcription Factor Roles in Far Red Light Signaling - A First Look,” OCAST, $100K
432. S. Cavallo, “Polar predictability and dynamics through multi-scale atmospheric vortices,” DOD-ONR, $105K

OSCER-FACILITATED FUNDING TO DATE:
$653M total, $273M to OU
External Research Grants (cont’d)


442. N. Kaib, “Exploring the Evolution and Characterizing the Chaos of the Terrestrial Planets,” U Illinois at Urbana-Champaign Blue Waters Grad Fellowship, $50K

443. A. Shapiro, C. Potvin, “Improving vertical velocity retrievals from Doppler radar observations of convection,” NSF, $599K


445. M. Nanny, C. Mao, P. Hardre, S. Wu, A. Burgett, U. Hansmann,

446. L. Krumholz, S. Liu, L. Bartley, “RET Site: Rural Educators Engaged in Bioanalytical Engineering Research and Teaching,” NSF, $600K

OSCER-FACILITATED FUNDING TO DATE: $653M total, $273M to OU

OSCER State of the Center Address
Wed Sep 27 2017
External Funding Summary

- External research funding facilitated by OSCER (Fall 2001- Fall 2017): $653M total, $273M to OU (42%)
- Funded projects: OVER 440
- 197 OU faculty and staff in 29 academic departments and 11 non-academic units
- Comparison: Fiscal Year 2002-17 (July 2001 – June 2017): OU Norman externally funded research expenditure: $1.27B

Since being founded in fall of 2001, OSCER has enabled research projects comprising almost over 1 / 5 of OU Norman's total externally funded research expenditure, with an 11-to-1 return on investment.
Publications Facilitated by Research IT

- Publications facilitated by Research IT resources
  - **2017**: 258 (so far)
  - 2016: 237
  - 2015: 203
  - 2014: 249
  - 2013: 257
  - 2012: 291
  - 2011: 184
  - 2010: 144
  - 2009: 112
  - 2008: 114
  - 2007: 77
  - 2006: 96
  - 2005: 71
  - 2004: 32
  - 2003: 12
  - 2002: 10
  - 2001: 3

**TOTAL SO FAR: 2350 publications**

[http://www.oscer.ou.edu/papers_from_rounds.php](http://www.oscer.ou.edu/papers_from_rounds.php)

Includes 42 MS theses, 49 PhD dissertations.
Lead, Follow 
or Get Out of the Way
Taking Leadership

- Statewide
- Regional
- National
Statewide Leadership Examples

- The OneOklahoma Cyberinfrastructure Initiative is a volunteer, ad hoc collaboration among CI providers and users across our state.
- We’ve grown to 6 CI providers.
- We’re on e-mail multiple times a week and on a weekly phone call every Friday at 2:00pm CT, working together on a wide variety of projects.
- It’s helped us get CI grants, start a statewide HPC contest, help each other help our researchers, and so much more.
Regional Leadership Examples

- Within the Great Plains region, we’ve been building our leadership across the 6 member states of the Great Plains Network (Arkansas, Kansas, Missouri, Nebraska, Oklahoma and South Dakota).
- That’s now culminated with our OneNet CTO being selected as the new Executive Director of the GPN.
National Leadership Examples

- OneOCII institutional CI leads have, or have had, the following leadership roles:
  - XSEDE Campus Engagement joint co-managers (the umbrella over Campus Champions)
  - Founded the ACI-REF Virtual Residency
    - Trained 315 CI Facilitators so far
    - Proposal writing apprenticeship
  - Linux Clusters Institute steering committee
  - SC10-11 Education Program leadership
  - NSF Advisory Committee for Cyberinfrastructure
Acknowledgements

Portions of this material are based upon work supported by the National Science Foundation under the following grants:

- Grant No. EPS-0814361, “Building Oklahoma's Leadership Role in Cellulosic Bioenergy”
- Grant No. EPS-1006919, “Oklahoma Optical Initiative”
- Grant No. OCI-1039829, “MRI: Acquisition of Extensible Petascale Storage for Data Intensive Research”
- Grant No. OCI-1126330, “Acquisition of a High Performance Compute Cluster for Multidisciplinary Research”
- Grant No. ACI-1229107, “Acquisition of a High Performance Computing Cluster for Research and Education”
- 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”
Acknowledgements

Dell provided seed systems for the OU Research Cloud ("OURcloud") and the OU Science DMZ.
Symposium 2017 Sponsors: Thank You!

- Industry sponsors (16)
  - Platinum (1): Hewlett-Packard Enterprise
  - Gold (3): Dell EMC, Microsoft, Storbyte
  - Silver (5): DDN Storage, Intel, Lenovo, NVIDIA, Pure Storage
- Snack Breaks: Lenovo, Silicon Mechanics

Thank you all! Without you, the Symposium couldn’t happen.

Over the past 15 Symposia, we’ve had a total of 91 companies as sponsors – and almost half have repeated (or were acquired by/merged with other sponsors).
Thanks!

OU IT

- OU Interim CIO/VPIT Eddie Huebsch
- Symposium committee: Dana Brunson (OSU), Debi Gentis (OU)
- Symposium coordinator: Debi Gentis
- Sponsorship coordinator: Chance Grubb
- OSCER Operations Team: Dave Akin, Patrick Calhoun, Kali McLennan, Jason Speckman, Brett Zimmerman
- OSCER Research Computing Facilitators: Jim Ferguson, Horst Severini
- 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

- Dan Stanzione, Texas Advanced Computing Center, University of Texas at Austin
- Spiros Liolis, Hewlett-Packard Enterprise (Platinum)
- Panelists
  - Dana Brunson, Oklahoma State University
  - Jeremy Evert, Southwestern Oklahoma State University
  - Franklin Fondjo Fotou, Langston University
  - Karl Frinkle, Southeastern Oklahoma State University
  - Evan Lemley, University of Central Oklahoma
  - George Louthan, Oklahoma Innovation Institute
Thanks: Gold Sponsor Speakers

- Kent Altena, Microsoft
- Garima Kochhar, Dell
- Diamond Lauffin, Storbyte
### Thanks: Breakout Speakers

<table>
<thead>
<tr>
<th></th>
<th>Name</th>
<th>Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dan Andresen, Kansas State University</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Dana Brunson, Oklahoma State University</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>James Deaton, OneNet (outgoing)/GPN (incoming)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>James Ferguson, University of Oklahoma</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Karl Frinkle, Southeastern Oklahoma State University</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Kyle Hutson, Kansas State University</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Mike Morris, Southeastern Oklahoma State University</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Robert Nordmark, OneNet</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Richard Reif, Northeastern State University</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Horst Severini, University of Oklahoma</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Neal N. Xiong, Southwestern Oklahoma State University</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Matt Younkins, University of Oklahoma</td>
<td></td>
</tr>
</tbody>
</table>
Thanks!

To all of your for participating, and to those many of you who’ve shown us so much loyalty over the past 15 years.
Such a bargain!

- If you want your t-shirt and your OneOCII sticker, all you have to do is give us a completed evaluation form!
- It’s that easy!
- What a bargain!
To Learn More

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

http://oneocii.okepscor.org/
Thanks for your attention!

Questions?
Supplementary Materials
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).
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 Insitution
  - 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
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
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

OSCUR State of the Center Address
Wed Sep 27 2017
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
40. Taught computational chemistry course using OSCER’s supercomputer.
34. Rose State College (18.0% AA): F, W
35. Sequoia High School (Tribal): W
36. St. Gregory’s U (nonmetro): A, D, F, O
37. 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.
34. 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)
## 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 Technkologic: 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
OCII Non-academic (cont’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 2017): 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
  - NSF MRI (TU): $180K, 2017

■ 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).
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 2017)
- 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. Southwestern 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 (2017)
- 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, 2017: Data Intensive Summer School (big data)
- Software Carpentry Bootcamp (2013): Python, scripting, version control etc

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

OSCER State of the Center Address
Wed Sep 27 2017

OSCER State of the Center Address
Wed Sep 27 2017
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
Acknowledgements

Portions of this material are based upon work supported by the National Science Foundation under the following grants:

- Grant No. EPS-0814361, “Building Oklahoma's Leadership Role in Cellulosic Bioenergy”
- Grant No. EPS-1006919, “Oklahoma Optical Initiative”
- Grant No. OCI-1039829, “MRI: Acquisition of Extensible Petascale Storage for Data Intensive Research”
- Grant No. OCI-1126330, “Acquisition of a High Performance Compute Cluster for Multidisciplinary Research”
- Grant No. ACI-1229107, “Acquisition of a High Performance Computing Cluster for Research and Education”
- 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”
Dell provided seed systems for the OU Research Cloud ("OURcloud") and the OU Science DMZ.
Symposium 2017 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. 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.
Such a bargain!

- If you want your t-shirt and your power bank, all you have to do is give us a completed evaluation form!
- It’s that easy!
- What a bargain!
To Learn More

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

http://oneocii.okepscor.org/
Thanks for your attention!

Questions?
OneOklahoma Friction Free Network 2013-15
NSF CC-NIE Grant

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
Science Driver: Bioinformatics

- 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 (Conceptual)
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)
Institutional Diagram (Physical)
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 LHCOne.
  - 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.
Advanced Cyberinfrastructure Research & Education Facilitators 2015-17
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 2017 – Sep 2017)
  - 2 summer workshops (2017, 2017) 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 advance 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
Reviewer Comments

- “This energetic, detailed and ambitious proposal from the University of Oklahoma deserves the highest priority for support. … There are no major weaknesses in the proposal and many strengths. …”

- “The broader impacts are nicely defined in terms of … the idea of a residency program …. A residency program and enhancement of undergraduate research are strong enhancements to the proposal. …”

- “This is one of the better proposals regarding … additional outreach via the budgeted virtual residency program. …”
ACI-REF Virtual Residency: Why?

- CI Facilitators have strong experience within their discipline (often non-CS).
- Most CI Facilitators and CI Engineers haven’t been faculty.
- Sometimes little or no research experience (especially for SDN-focused CI Engineers).
- Even if strong research background, typically little or no experience with research outside their own discipline.
- When we started the Virtual Residency in 2015, there were no local, regional or national programs to teach people how to be an ACI-REF.
- In the olden days, you could take your time learning how to do this -- but not anymore ....
Lots of Interest

**Proposal**
- Polled CC-NIE awardees, MRI CI awardees, Minority Serving Institutions.
- Interest expressed from 33 institutions in 23 states & territories expressed interest, including 3 MSIs and 19 institutions in 13 EPSCoR jurisdictions, and 7 non-PhD-granting institutions.

**Applications**
- 2015: over 60 applicants from 49 institutions in over 30 states and territories.
- 2017: 90 applicants from 63 institutions in 34 US states plus 3 other countries (Canada, India, Nigeria).
Lots of Interest (cont’d)

- **Participants: 128 total**
  - 2015: 50 total from 38 institutions in 26 states and territories (28 onsite and 22 offsite via videoconferencing), including:
    - 21 institutions in 12 EPSCoR jurisdictions;
    - 5 Minority Serving Institutions;
    - 5 non-PhD-granting institutions.
  - 2017: 99 total from 68 institutions in 33 states plus Canada and Nigeria (43 onsite, 56 offsite), including:
    - 27 attendees from 20 institutions in 13 EPSCoR jurisdictions;
    - 10 Minority Serving Institutions;
    - 13 non-PhD-granting institutions.
What Did We Want to Teach?

- Teach how to work with researchers who are using CI.
  - Teach how to talk to them.
  - Teach how to help them.
- Teach how to contribute to, and ultimately to lead, grant proposals.
  - Some of them already knew how to do this, so their job was to help us help the rest.
- Science DMZ Track
  - Teach how to manage a Science DMZ.
- Computational Science & Engineering Track
  - Get some practice working with researchers.
What Weren’t We Trying to Do?

- On the Computational & Data-enabled Science & Engineering track, we WEREN’T trying to teach a lot of technical content.
  - People can learn that from other sources.
- Instead, our goal was to teach them the PROFESSION of ACI-REF.
- To get them thinking about this, we had each do a 5-minute mini-project/talk on something they were going to do at their home institution, based on what they’d gotten from the workshop.
What Was the Hidden Agenda?

- Our real goal was to prepare for an upcoming transition to:
  - more need for this kind of skilled workforce, but
  - fewer people who know how to do it, with
  - no mechanism to prepare a sufficiently large cohort.
- Some of the participants already knew how to do this.
  - But it took a very long time to learn on their own.
  - To keep up with demand, the community needs us to streamline the process so that new ACI-REFs can become fully productive quickly.
- Today’s ACI-REFs are tomorrow’s CI leaders.
ACI-REF Workshop Agenda 2015

- SUNDAY (evening pizza party)
  - Welcome and virtual residency overview
  - Introduction to Research Cyberinfrastructure consulting
  - How to Give a CI Tour
- MONDAY
  - Early AM: Effective Communication: How to Talk to Researchers about Their Research
  - Computational and Data-enabled Science & Engineering (CDS&E) Track
    - Mid AM: Deploying Community Codes
    - Early PM: Real user presents their CDS&E research
  - SCIENCE DMZ Track
    - Mid AM: OpenFlow - Lecture
    - Early PM: OpenFlow - Lab
  - Mid PM: CI User Support
- TUESDAY
  - Very Early AM: Project Guidelines
  - Early AM: Faculty: Tenure, Promotion, Reward System
  - CDS&E Track
    - Mid AM: Benchmarking & Tuning
    - Early PM: Real users present CDS&E research
    - Mid PM: Real users: CI consulting practicum (“speed dating”)
  - SCIENCE DMZ Track
    - Mid AM: Exploring Open Daylight - Lecture
    - Early PM: Exploring Open Daylight - Lab
    - Mid PM: Real users' high bandwidth research
- WEDNESDAY
  - Early AM: Using Videoconferencing and Collaboration Technologies for Consulting
  - Mid AM: Writing Grant Proposals
  - PM: BREAK (free time)

OSCER State of the Center Address
Wed Sep 27 2017
ACI-REF Workshop Agenda

THURSDAY
- Early AM: The Shifting Landscape of CI Funding Opportunities
- CDS&E Track
  - Mid AM: Finding and Provisioning Remote Resources (XSEDE, OSG)
  - Early PM: Real users present CDS&E research ("speed dating")
  - Mid PM: Catch-up on unfinished talks
- SCIENCE DMZ Track
  - Mid AM: The Software in SDN - Lecture
  - Early PM: The Software in SDN - Lab
  - Mid PM: Real users' high bandwidth research

FRIDAY
- Early AM: So You Want to Write a CI Proposal
- Mid AM: Panel: Stories from the Trenches
- Early PM: Project work time
- Mid PM: Project work time
- Late PM: Project presentations from early departers

SATURDAY
- AM: Project presentations

OSCER State of the Center Address
Wed Sep 27 2017
Theme #1

1. How to Understand and Work with Real Researchers
   - Introduction to Research Cyberinfrastructure consulting
   - How to Give a CI Tour
   - Effective Communication: How to Talk to Researchers about Their Research
   - Real User Presents Their Research
   - CI User Support
   - Faculty: Tenure, Promotion, Reward System
   - Real users: CI consulting practicum (“speed dating”)
   - Panel: Stories from the Trenches
Theme #2

2. Technical Content

- Deploying Community Codes
- Benchmarking & Tuning
- Using Videoconferencing and Collaboration Technologies for Consulting
- Science DMZ Content
  - OpenFlow
  - Exploring Open Daylight
  - The Software in Software Defined Networking
Themes #3-4

3. Proposal Writing
   - Writing Grant Proposals
   - The Shifting Landscape of CI Funding Opportunities
   - So You Want to Write a CI Proposal
   - The Cyberinfrastructure Milieu
     - Finding and Provisioning Remote Resources (XSEDE, OSG)
Newly Funded Workshop Grant!

(Just awarded last week)
Senior Cyberinfrastructure leaders are retiring and taking their knowledge, experience and wisdom with them. We need to capture this quickly.

Emerging midcareer CI leaders are excellent at responding to national needs and serving their institutions’ researchers, but need to learn how to shape the national CI agenda.

Goals of this workshop in bringing these two groups together:

- **Transfer knowledge, experience and especially wisdom** from senior CI leaders to emerging CI leaders, in order to enable emerging CI leaders to shape the national research CI landscape.
- **Initiate mentoring relationships** between senior CI leaders and emerging CI leaders, in order to foster longer term professional development.
- **Establish peer mentoring** among emerging CI leaders, in order to prepare and position them for national leadership, as senior CI leaders reduce their day to day engagement.

National Strategic Computing Initiative: This workshop focus is a key aspect of the NSF’s workforce development mission within NSCI.