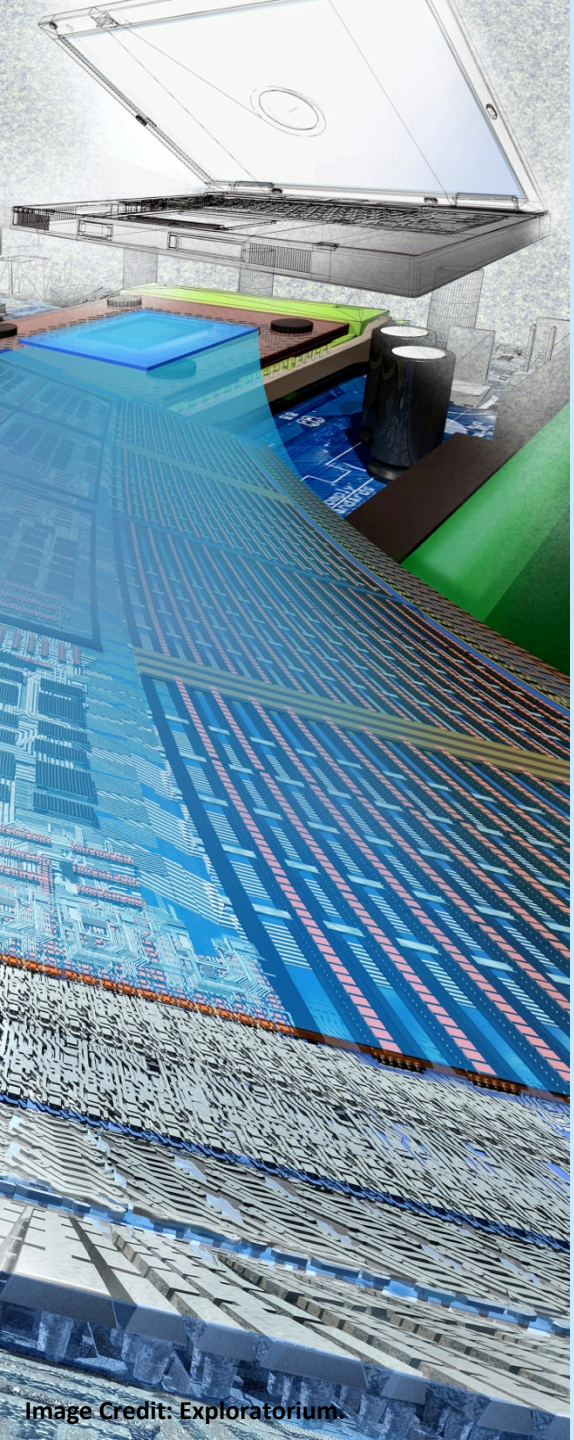


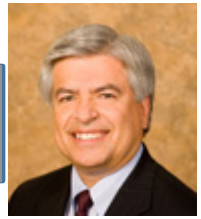
Presentation to BDEC

Division of Advanced Cyberinfrastructure (ACI)
Irene Qualters/Acting Division Director
February 26, 2014

NSF is the only federal agency dedicated to the support of basic research and education across all fields of science and engineering

FY 2014 Budget Appropriation	**$7.2 billion**
Colleges, universities, and other institutions receiving NSF funding	**1,895**
Proposals evaluated through a competitive merit review process	**48,600**
Competitive awards funded	**11,500**
Proposal reviews conducted	**236,000**
Estimated number of people NSF supports directly (researchers, postdoctoral fellows, trainees, teachers, and students)	**319,000**
Students supported by NSF Graduate Research Fellowships since 1952	**45,800**

In 2013, NSF's Office of Cyberinfrastructure joined CISE (Computing and Information Science and Engineering) as the division of Advanced Cyberinfrastructure (ACI)

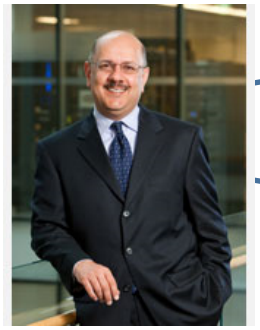


Office of Inspector General

National Science Board

Office of the Director

Offices



Biological Sciences Directorate

Mathematical & Physical Sciences Directorate

Computer and Information Science and Engineering Directorate

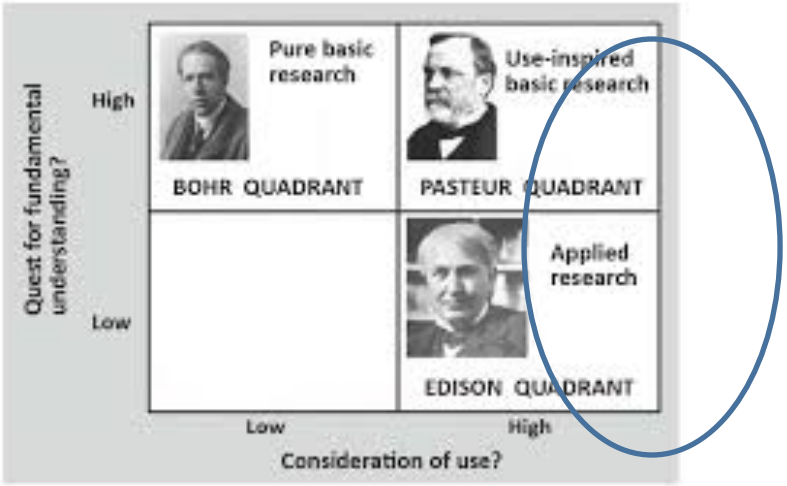
Social, Behavioral & Economic Sciences Directorate

Education & Human Resources Directorate

Geosciences Directorate

Engineering Directorate

ACI Mission: To support advanced cyberinfrastructure to accelerate discovery and innovation across all disciplines



- Use-inspired Cyberinfrastructure
  - Research and Education
  - Science and Engineering
- Inherently multidisciplinary with strong ties to all disciplines/ directorates

Biological Sciences Directorate

Computer and Information Science and Engineering Directorate

Education & Human Resources Directorate

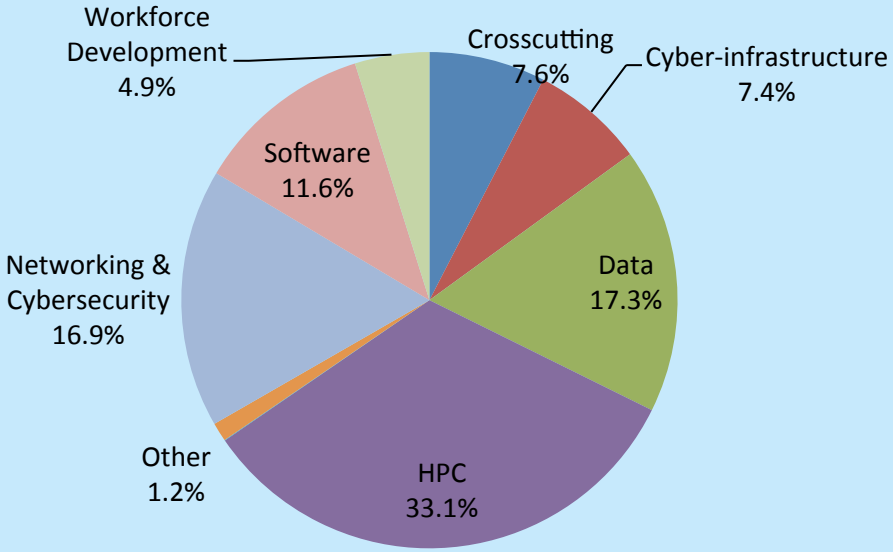
Engineering Directorate

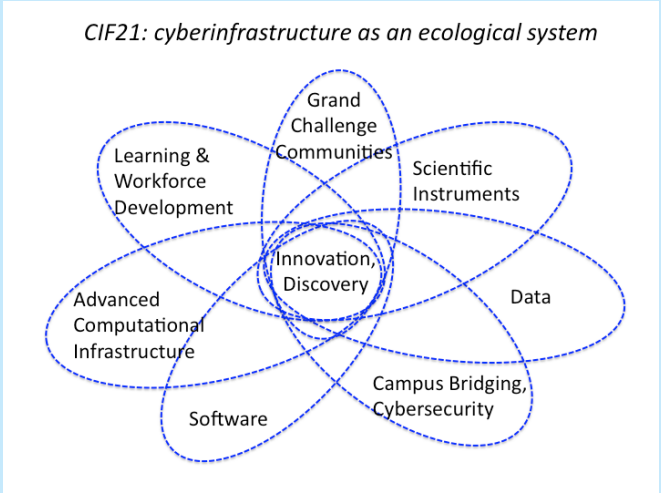
Mathematical & Physical Sciences Directorate

Social, Behavioral & Economic Sciences Directorate

Geosciences Directorate

ACI FY2013 investments reflect a balance across Cyberinfrastructure categories consistent with NSF's CI strategy (CIF21)

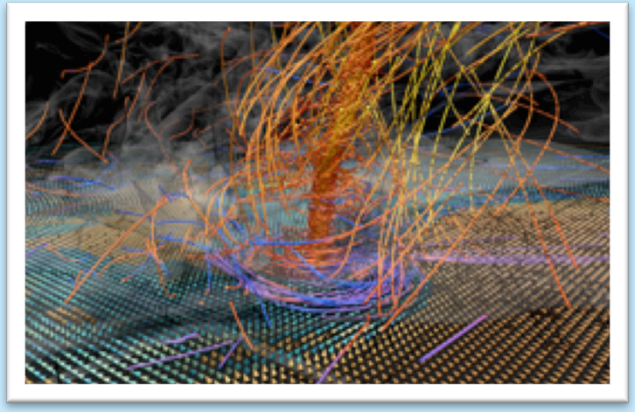




Total ACI FY 2013 funding = $210,772,572

NSF's computational infrastructure – two key strategies

Vision: Support a comprehensive portfolio of advanced computing infrastructure, programs and other resources to facilitate cutting-edge foundational research in Computational and Data Enabled Science and Engineering (CDS&E) and its applications to all disciplines.

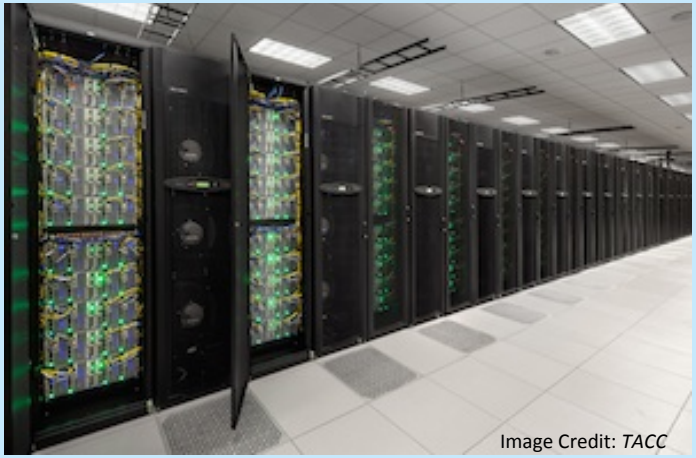


Forecasting Tornadoes: Parallel computing, data mining, and meteorology are being used to determine tornado formation and more reliable tornado forecasting. (Amy McGovern and Kelvin Droegemeier, University of Oklahoma)

- Anticipate and invest in diverse and innovative national scale shared resources, outreach and education complementing campus and other national investments
- Leverage and invest in collaborative flexible "fabrics" dynamically connecting scientific communities with computational resources and services at all scales (campus, regional, national, international)

Advanced Computing Cyberinfrastructure: three major deployments in 2013

Blue Waters, UIUC



Stampede, UT Austin

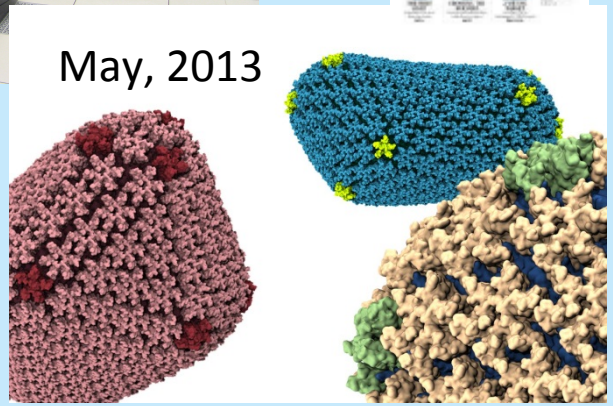
NCAR/ Wyoming Supercomputing Center

Blue Waters: Grand Challenge Computational Science and Engineering through Sustained Petascale Performance

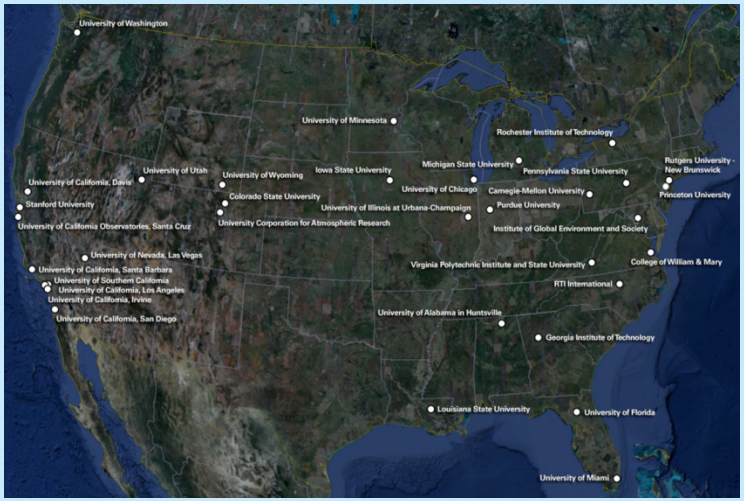
UIUC Data Center

Cray XE6/XK7 accepted December, 2012

May, 2013



Petascale Application Projects



Credit: *Theoretical and Computational Biophysics Group (www.ks.uiuc.edu), Beckman Institute for Advanced Science and Technology, UIUC*

Stampede is both innovative and highly capable, doubling the resource pool for XRAC/XSEDE allocations

A YEAR WITH STAMPEDE

Stampede, one of the most powerful supercomputers in the world for open science research, celebrated its first birthday on January 7, 2014, by completing more than 75,000 years of scientific computations – not bad for a one-year-old. Here are some facts, figures & science highlights that capture the comprehensive impact of the system.

Funded by the National Science Foundation Grant ACI-1134872 and built in partnership with Intel, Dell and Mellanox, Stampede and its academic partners will continue to enable promising computational research in 2014 and beyond.

WORLD RANKING 7th MOST POWERFUL
www.top500.org

1247 PROJECTS

2,196,848 COMPLETED JOBS

3400 RESEARCHERS

9.6 QUADRILLION Floating Point Operations per second

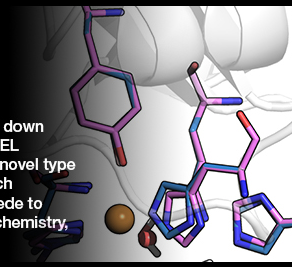
SCIENCE FIELDS

- 41% MATHEMATICAL AND PHYSICAL SCIENCES
- 25% BIOLOGICAL, BEHAVIORAL, AND SOCIAL SCIENCES
- 12% GEOSCIENCES
- 11% ENGINEERING
- 8% COMPUTER AND INFORMATION SCIENCE AND ENGINEERING
- 2% OTHER

SCIENCE HIGHLIGHTS

Stampede supports the largest number of open science projects in the world across science and engineering domains. Below are three recent highlights:

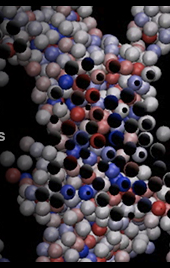
BIOFUEL PRODUCTION



Researcher: Gregg Beckham
National Renewable Energy Laboratory (NREL)

Stampede is helping to determine how enzymes break down cellulose to improve biofuel production. A group of NREL researchers used the supercomputer to predict how a novel type of oxidative enzyme can speed up the process by which cellulose breaks down. The group is also using Stampede to design catalysts for high-temperature deoxygenation chemistry, which is important to convert biomass to fuel.

BIOMEDICINE AND SMART MATERIALS



Researcher: Roseanna Zia
Cornell University

Colloidal gels have huge promise in biomedicine. Comprised of microscopic particles suspended in a solvent, these gels form networks of particles that support their weight under gravity. For this reason, these soft solids can be used as injectable pharmaceuticals and artificial tissue scaffolds; however, they are beset by stability problems. Stampede enabled Cornell researchers to conduct the largest, longest simulation of a colloidal gel, which is answering important questions about the structure, dynamics, and stability of the particle network.

SUPERNOVA EXPLOSION

Researcher: Philipp Mösta and Christian D. Ott
California Institute of Technology (CalTech)

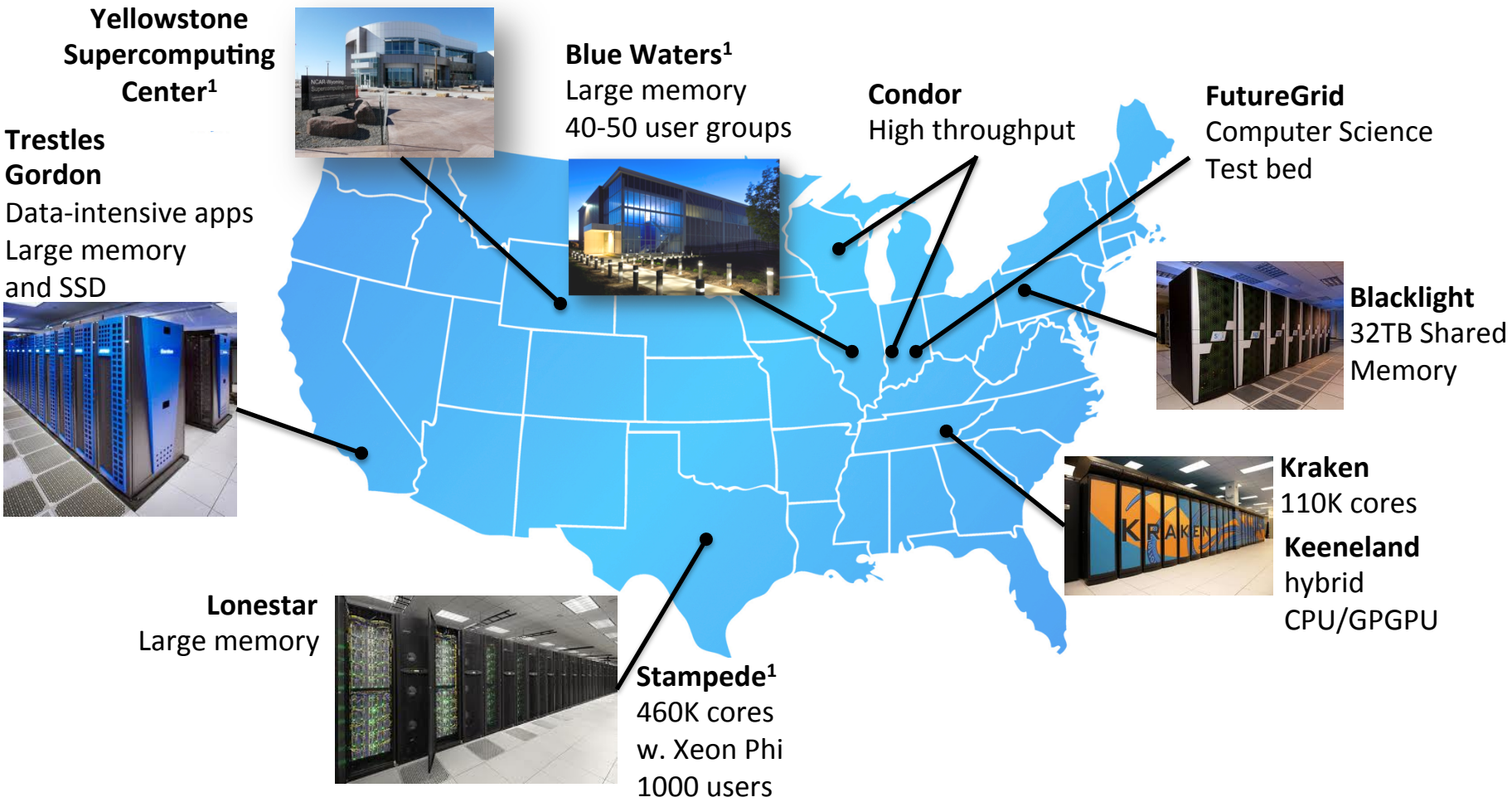
Using Stampede, astrophysicists succeeded in performing the first fully general-relativistic 3D MHD simulations of progenitor stars that are believed to lead to very energetic, jet-driven supernova explosions. The researchers found that the simulations behave very differently in full unconstrained 3D compared to the same model simulated with imposed symmetries. Stampede's per-core performance pushed these simulations to the limit.

TACC Texas Advanced Computing Center
www.tacc.utexas.edu
www.tacc.utexas.edu/stampede
#useTACC #UltimateScienceEnviroment

NSF XSEDE THE UNIVERSITY OF TEXAS AT AUSTIN

NSF

NSF Advanced Computing Infrastructure is increasingly diverse and collaborative

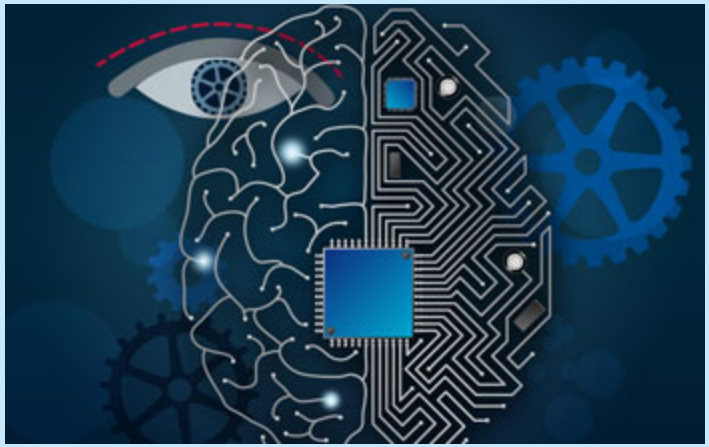


1. Launched in FY 2013

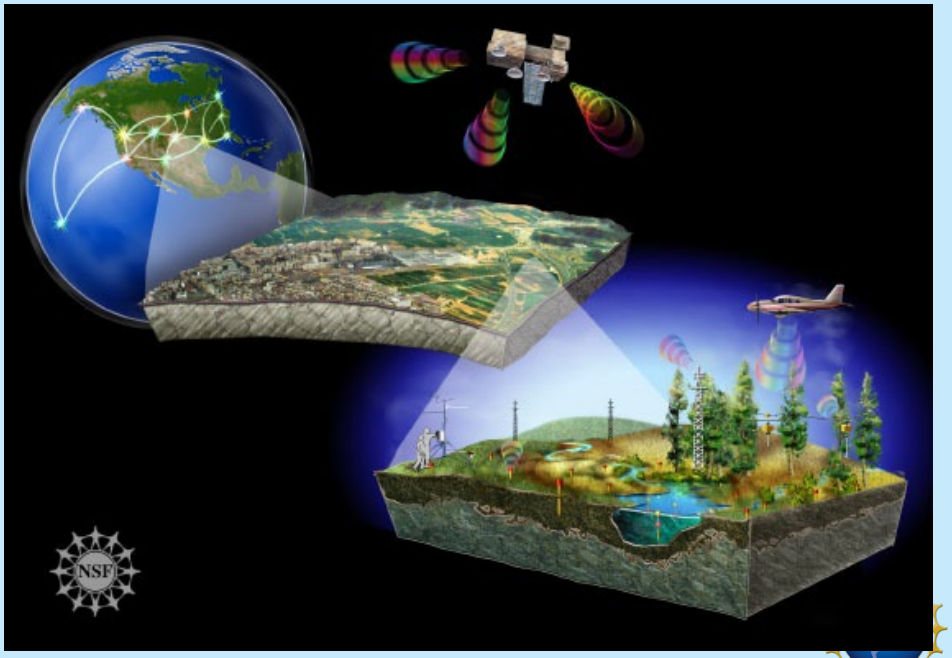
Next steps…

- Resource Solicitations (FY13 & FY14) to expand and diversify the reach of advanced computing
  - High Performance Computing System Acquisition: Building a More Inclusive Computing Environment for Science and Engineering
    - *Wrangler* at TACC: data analysis and management; Hadoop; NAND Flash
    - *Comet* at SDSC: "long tail science", high throughput; 2 PF; Xeon Phi
    - 1-2 new awards in FY14
  - Deployments in FY15, FY16
- Stampede Upgrade in FY15 of Intel Xeon Phi
- National Academies study: Future Directions for NSF Advanced Computing Infrastructure to support US Science in 2017-2020
  - contribution of high-end computing to U.S leadership/competitiveness in basic S&E and NSF role in sustaining this leadership
  - expected national-scale computing needs, both high-end and in support of full range of S&E
  - complementarities and tradeoffs among investments in computing, software, data, communications
  - range of operational models for delivering ACI for S&E and role of NSF in these models
  - expected technical challenges to affordably delivering the capabilities needed for worldleading S&E

Ubiquity in mobile devices, social networks, sensors and instruments have created a complex data-rich environment ripe for new scientific and engineering advances

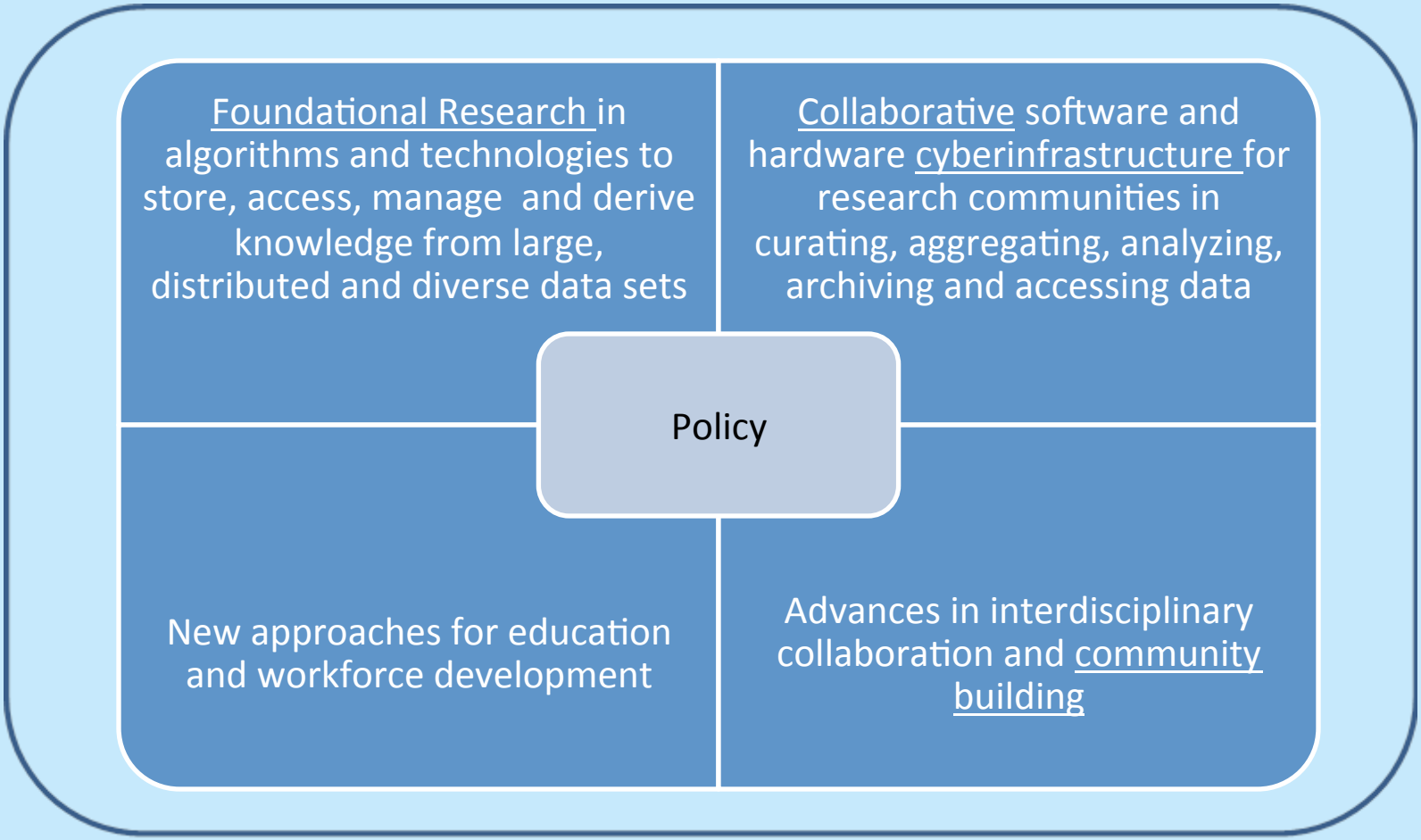


Credit: *Christine Daniloff/MIT*



An artist's conception of the National Ecological Observatory Network (NEON) depicting its distributed sensor networks, experiments and aerial and satellite remote sensing capabilities, all linked via cyberinfrastructure into a single, scalable, integrated research platform for conducting continental-scale ecological research. NEON is one of several National Science Foundation Earth-observing systems.
Credit: Nicolle Rager Fuller, National Science Foundation

NSF Data Investment Framework

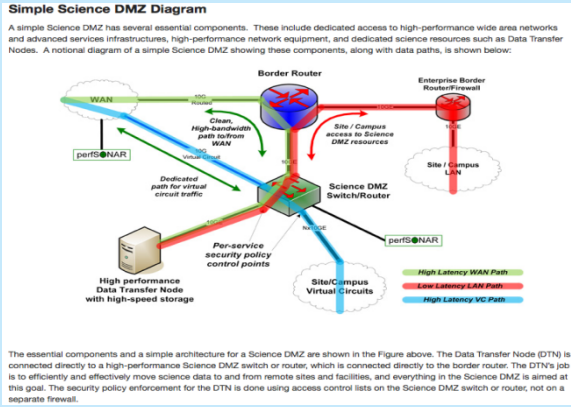


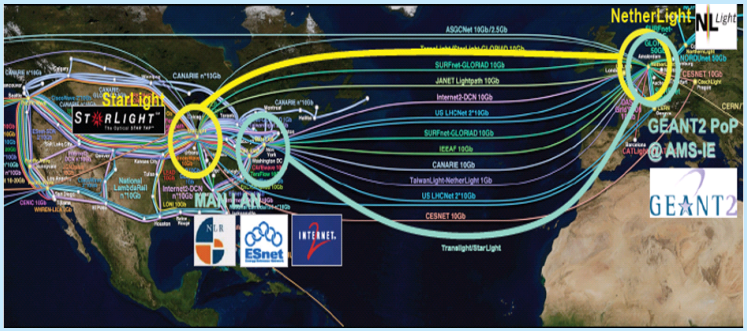
ACI Data Activities within this Framework

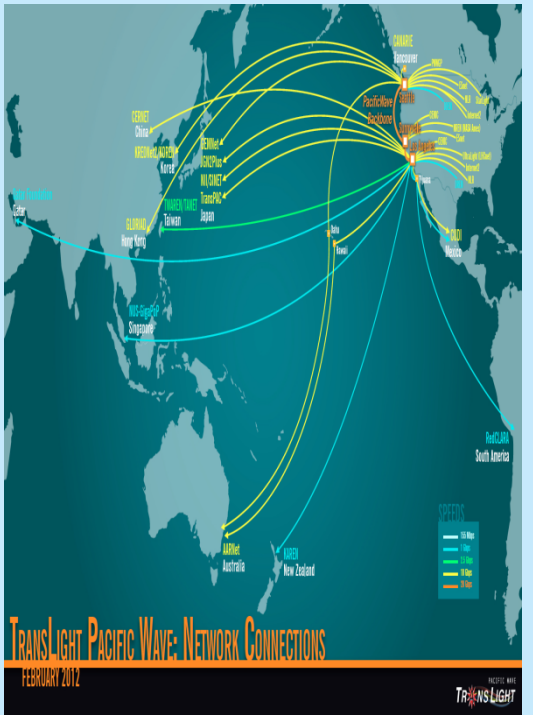
- **Developing data-focused CI usable by multiple scientific disciplines**
- **Addressing problems common to various communities**
- **Being responsive to differing scientific requirements & priorities**
- **Programmatic activities**
  - **Data Infrastructure Building Blocks (DIBBs)** – data-focused CI "building blocks" enabling science & engineering research;
  - **EarthCube** - engagements of multiple earth-centered science communities with each other and with technologists to create integrated geosciences focused infrastructure;
  - **DataWay** - focus on "science pull," creation of integrated data management structures for science-driven research;
  - **BigData** - Core Techniques & Technologies;
  - **DataNet** - portfolio of 5 early implementations and proof-of-concept" data projects offering suites of tools and other capabilities;
  - **Research Data Alliance** - multi-national communities combining to accelerate data-driven innovations and discoveries;

Networking and Cybersecurity – major network upgrades begun and continuing

- CC-NIE (Campus Cyberinfrastructure – Network Infrastructure and Engineering):
  - 43 awards made in FY 2013
  - FY2014 solicitation
- IRNC (International R&E Network Connections)
  - 100Gbps experimental awards, partners in Europe and Brazil
  - FY14 solicitation
- Cybersecurity
  - Continued participation in SaTC w/ Transition-to-Practice support







Thank you!