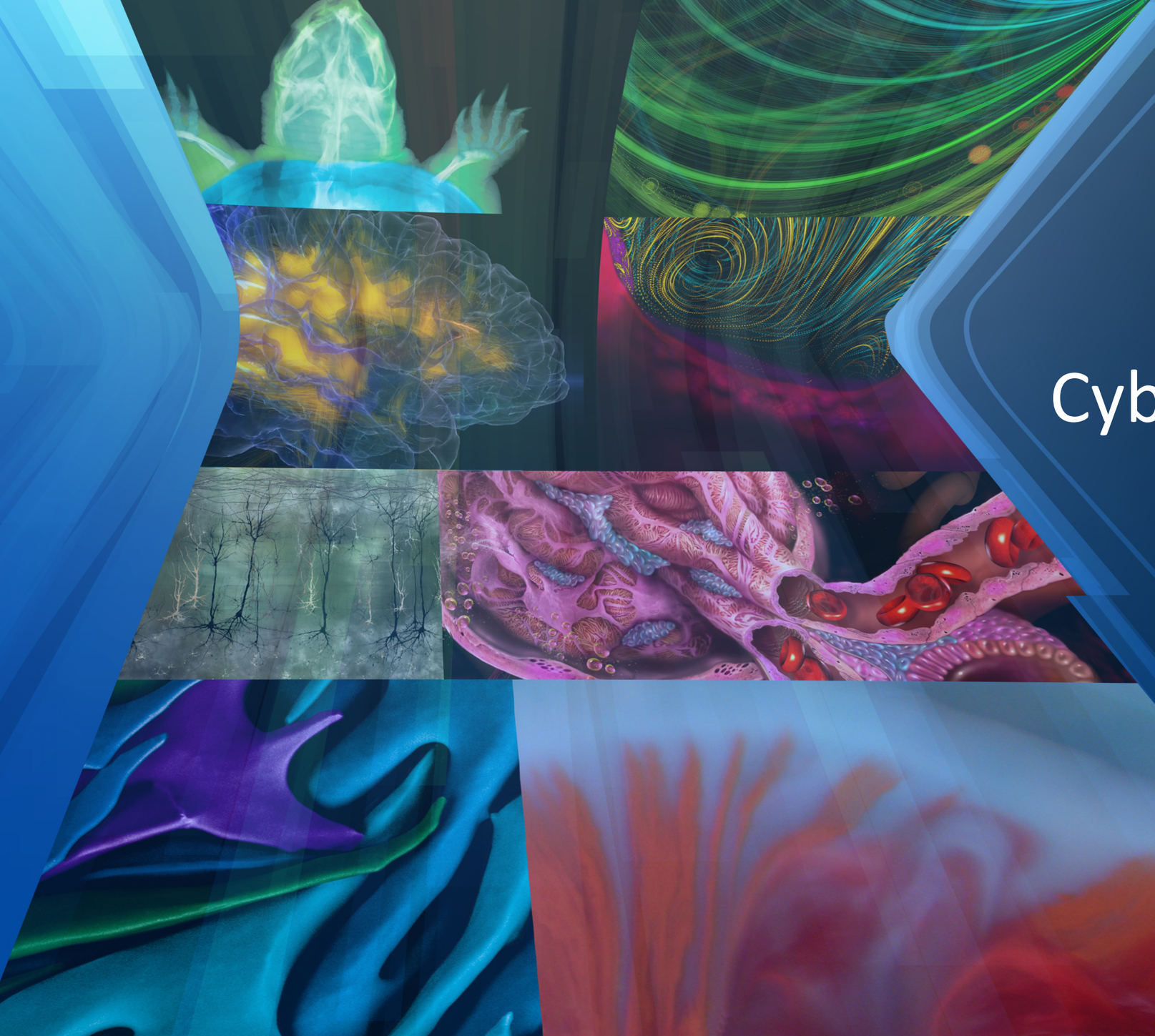


Large Facilities Cybersecurity Summit

IRENE QUALTERS
DIVISION DIRECTOR, NSF/ACI

AUGUST, 2016

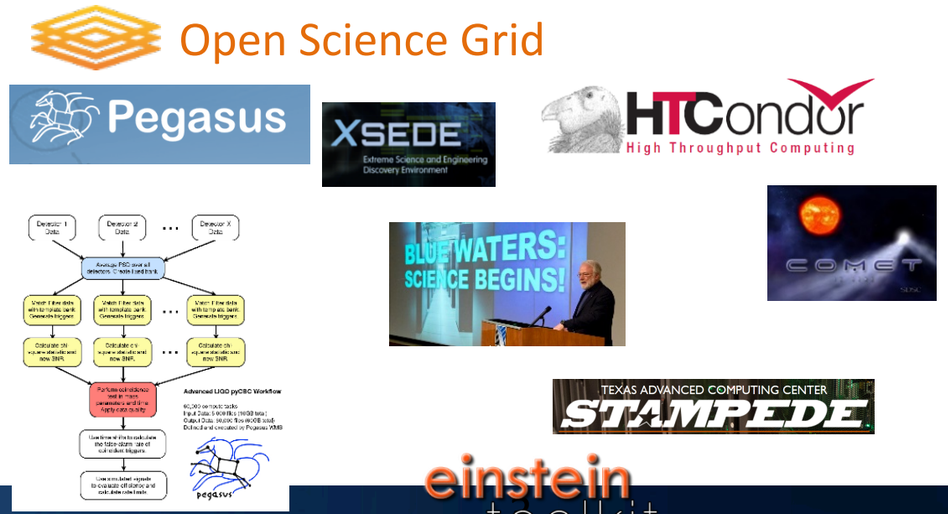
Overview

- **Hors D’oeuvres**
- FY 2017 and beyond

NSF investments in shared research cyberinfrastructure enabled LIGO detection of gravitational waves

LIGO relied on advances in computational science, software, hardware, and expert services throughout the research infrastructure.*

- Access to Large, Diverse and Interoperable CI:
  - Massive, parallel event searches and validation;
  - High performance simulations
  - Open Science Grid (OSG): Comet (SDSC) and Stampede (TACC); Blue Waters; Networking & security
  - Expertise : XSEDE, TACC, BW
- Computational Science Advances:
  - Numerical relativity and magnetohydrodynamics
  - Visualizations
- Workflow and dataflow: Pegasus and HTCondor
- Networking: upgrades from 10Gbps to 100Gbps WAN



*NSF programs: Data Building Blocks (DIBBs), Software Infrastructure (SI2), Campus Cyberinfrastructure Network Infrastructure and Engineering (CC*NIE, DNI), HPC, and others. Many also co-supported by the US. DOE and Int'l Partners

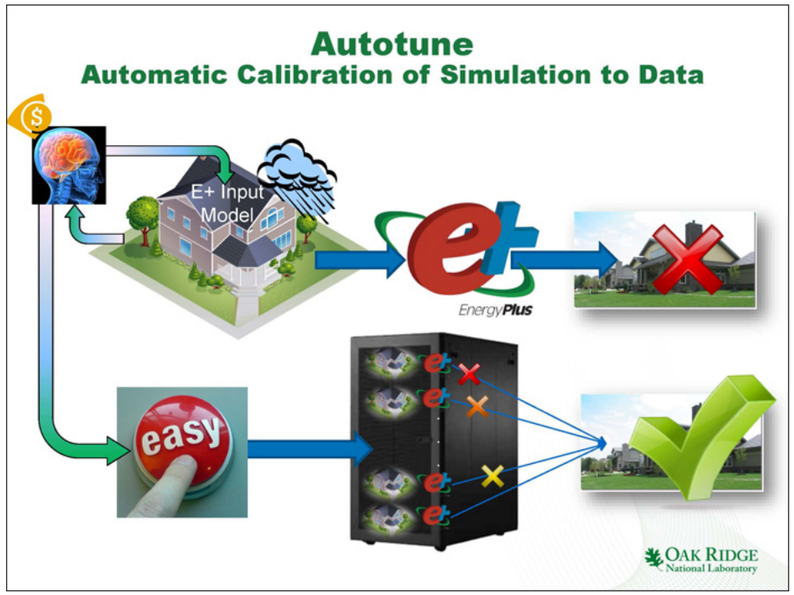
Wrangler/UT Austin (PI Stanzione)

A Transformational Data Intensive Resource for the Open Science Community

The Hobby-Eberly Telescope will collect 200 gigabytes of galaxy spectra data each night for three years, which will be preserved and analyzed on the Wrangler data-intensive supercomputer.

Credit: Ethan Tweedie Photography.

Available to users through XSEDE
Deployed in 2015



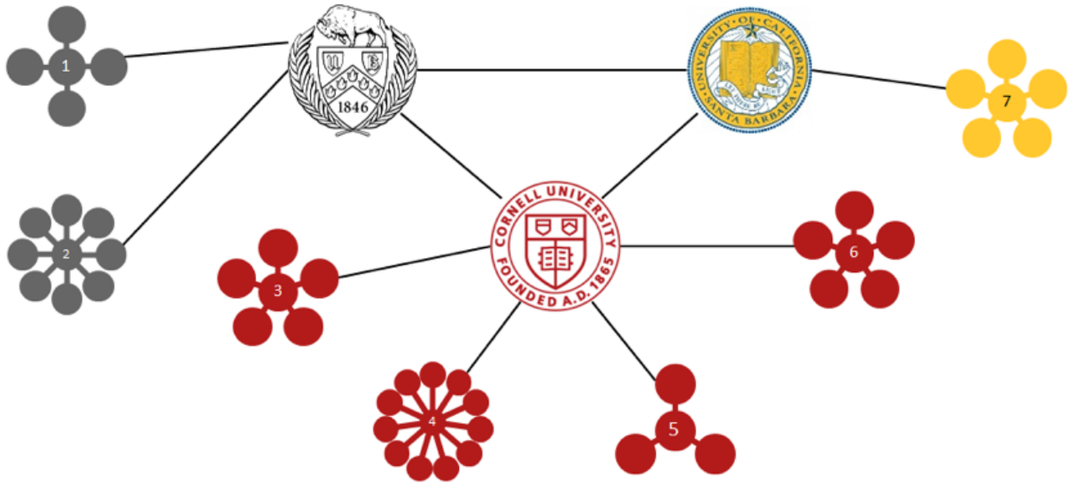
Autotune is a set of automated calibration techniques for tuning residential and commercial building energy efficiency software models (Energy Plus) to match measured data. Credit: Joshua New, ORNL

Aristotle: Federated Cloud

Data Analysis and Management Building Blocks for Multi-Campus

Cornell University/PI Lifka [Award #ACI-1541215]

- Cornell and partners (SUNY Buffalo and UC Santa Barbara) create a federated cloud
- Metric: 'time to science'
- "Informed Bursting" via *qbets*
  - Private, commercial Clouds

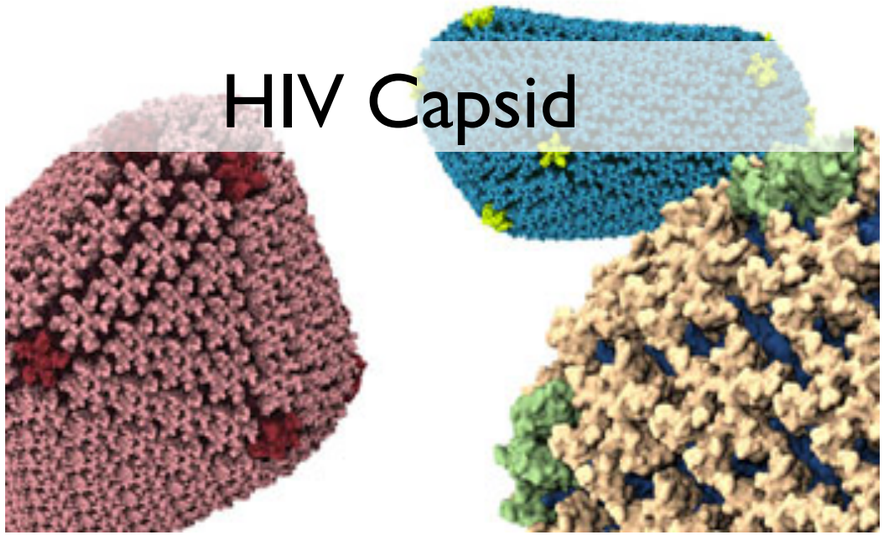


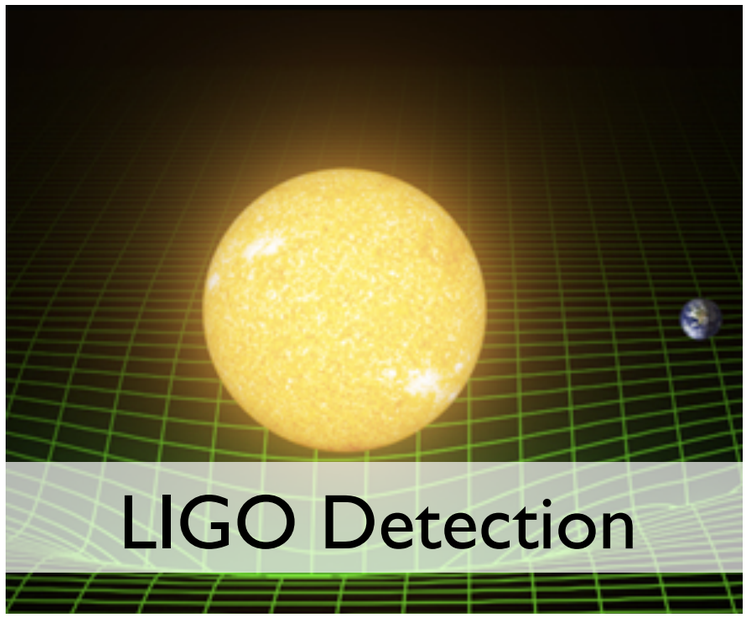
- Includes diverse usage modalities:
  - Seven science use cases
  - An allocation model that provides a fair exchange mechanism between and across multiple institutions
- Explores model for sharing institutional cyberinfrastructure.

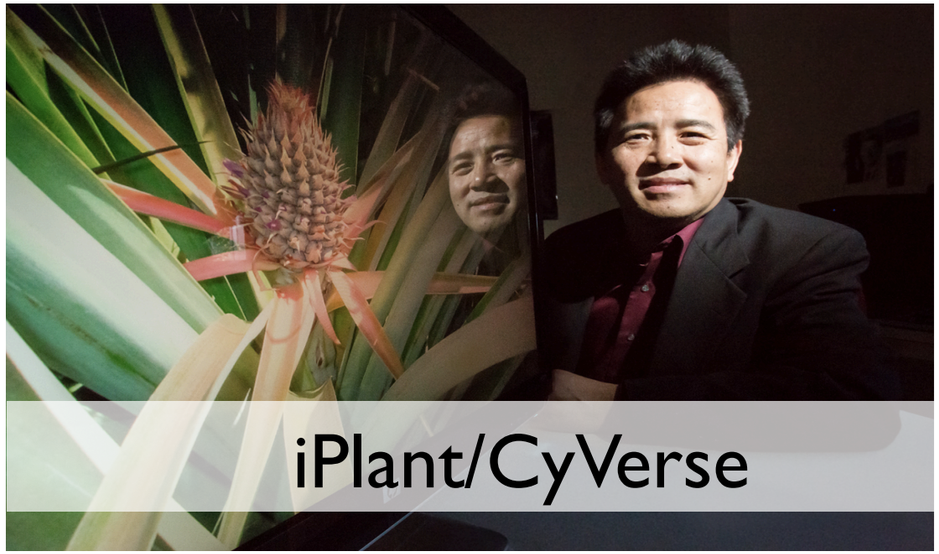
Overview

- **Hors D’oeuvres**
- FY 2017 and beyond

ACI supported research infrastructure enables discoveries

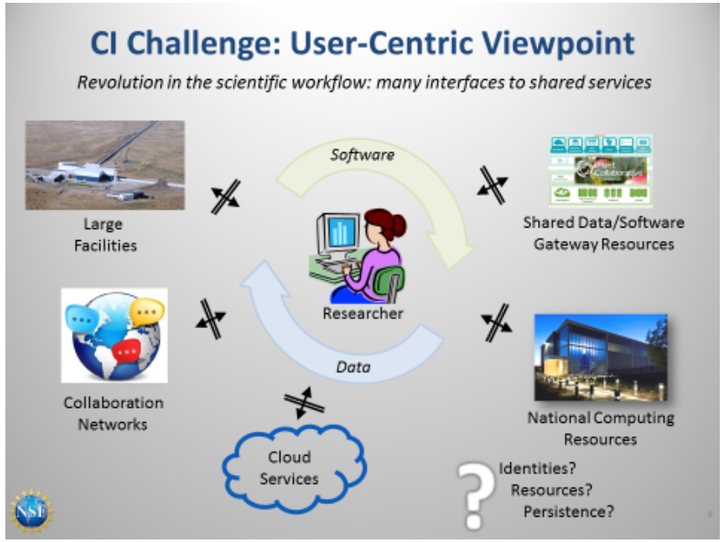




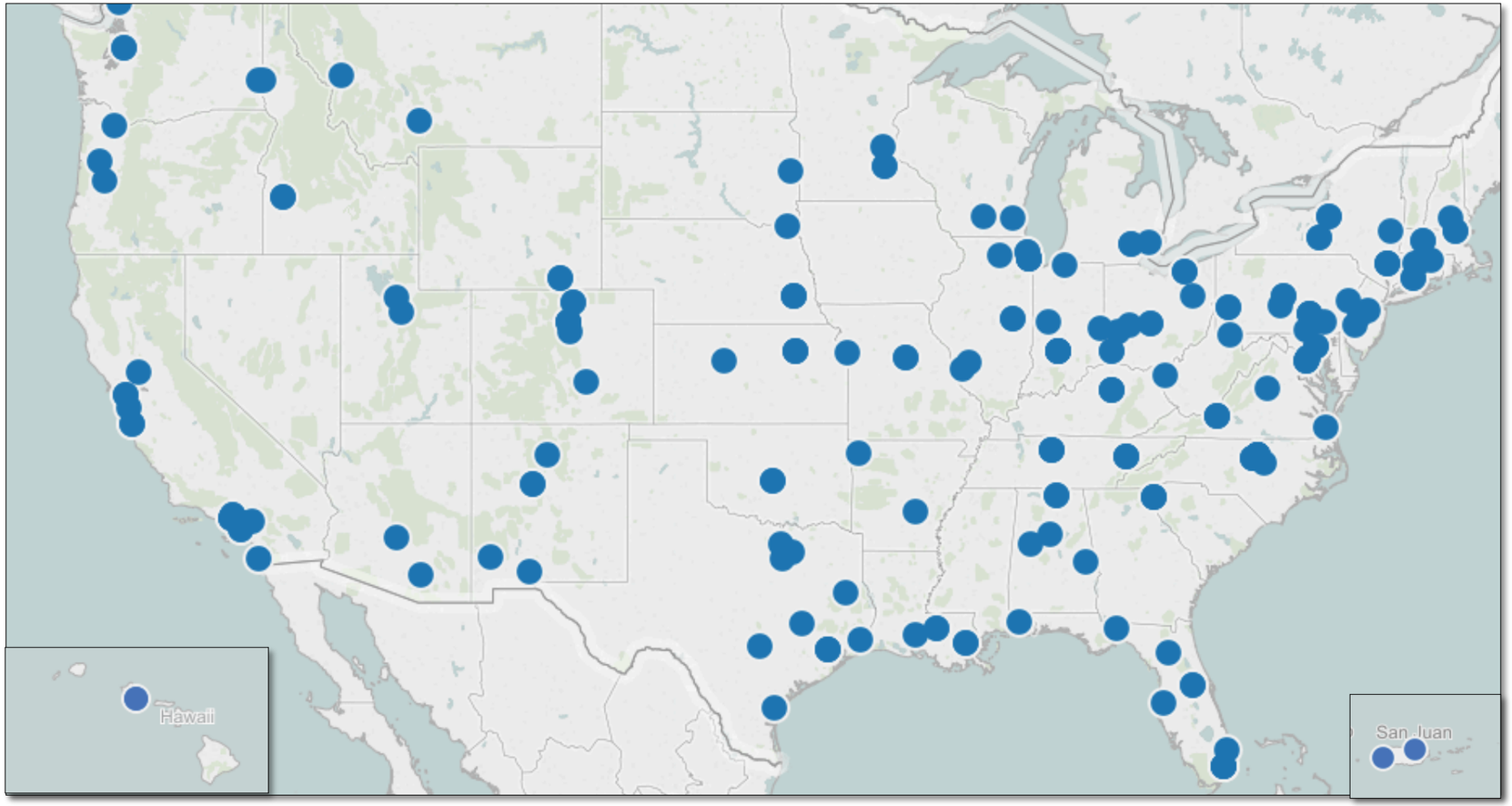


What makes NSF support for Research Cyberinfrastructure unique?

- Research frontiers and communities are vast, dynamic, and multidisciplinary
  - Interoperability critical
  - Deep community engagement essential
  - Dynamic & diverse technology required
  - Fiduciary responsibilities for efficiency and sustainability
- Research (Cyber)infrastructure investments
  - Universities
  - Federal, state and local agencies
  - International funders
  - Private and public entities, profit and non-profit
  - …….and NSF

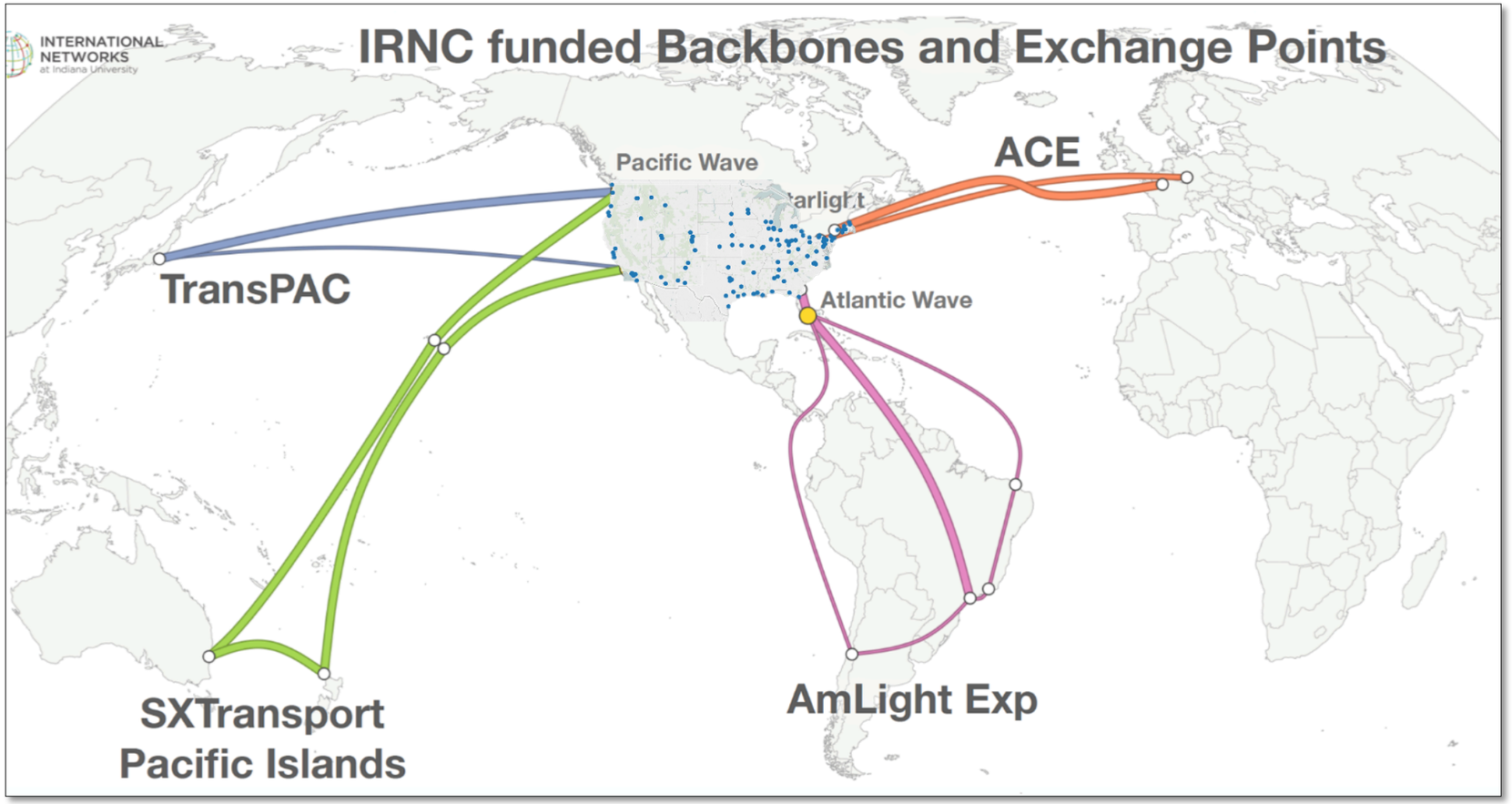


Network connections stimulate links across U.S. campuses and facilitate international research coordination



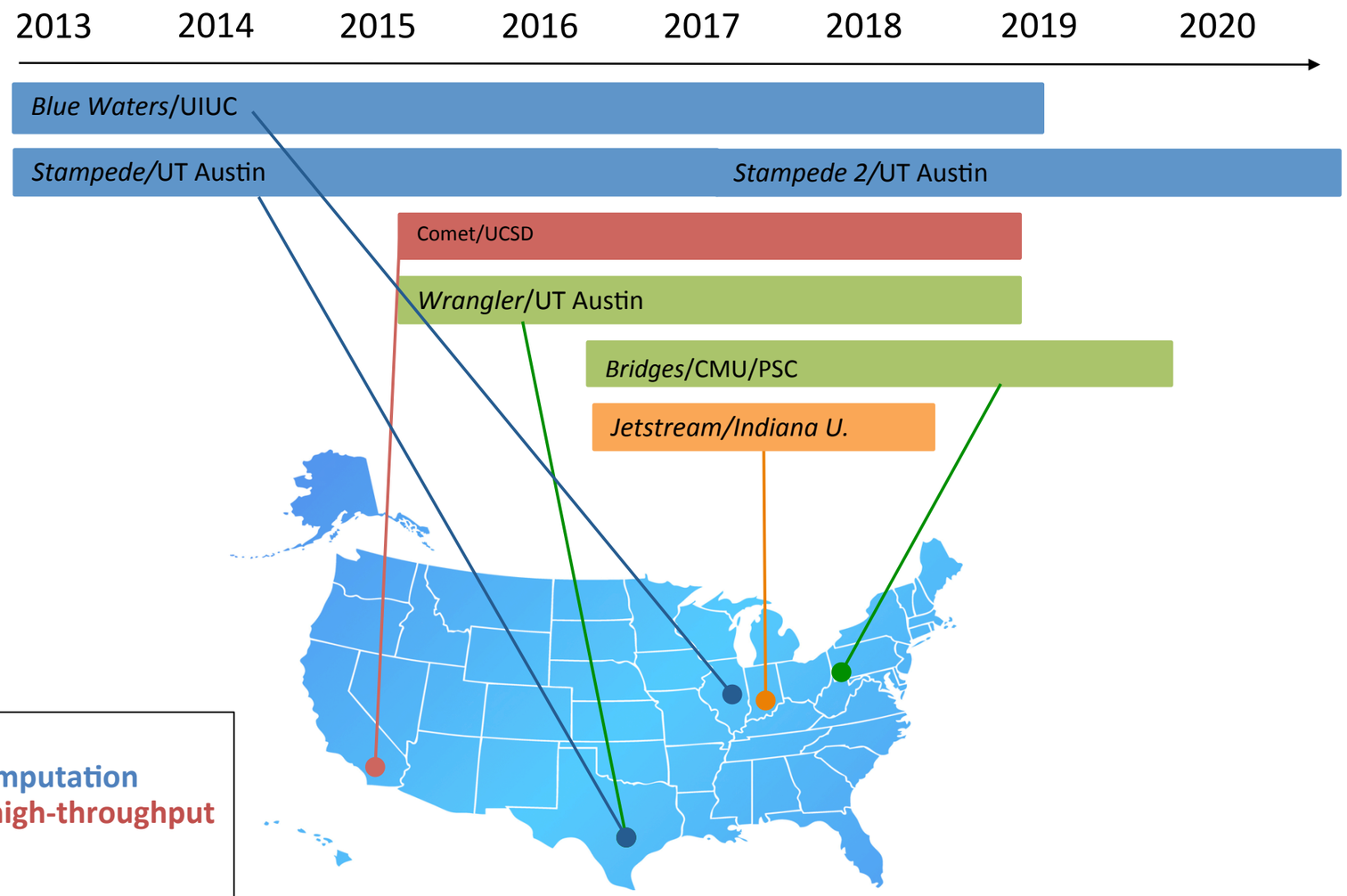
CAMPUS CYBERINFRASTRUCTURE (CC*): Upgrades networking capabilities for >200 campuses

Network connections/exchange points link U.S. campuses and facilitate international research coordination



INTERNATIONAL RESEARCH NETWORK CONNECTIONS (IRNC):
International network services to advance global S&E research and education

A diversity of computational resources complement campus investments and support large scale computing



Legend:
Large-scale computation
Long-tail and high-throughput
Data Intensive
Cloud

XSEDE, OSG, ACI-REF are virtual organizations to connect people, services, and resources

Seamless access to national CI

Training and community building

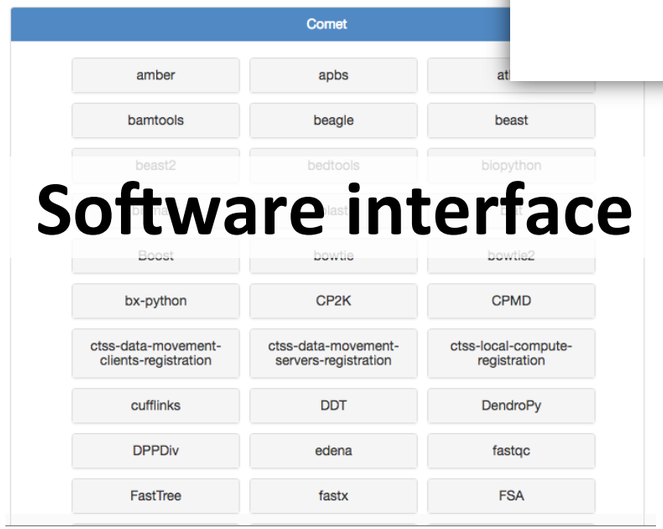
Open Science Grid

XSEDE

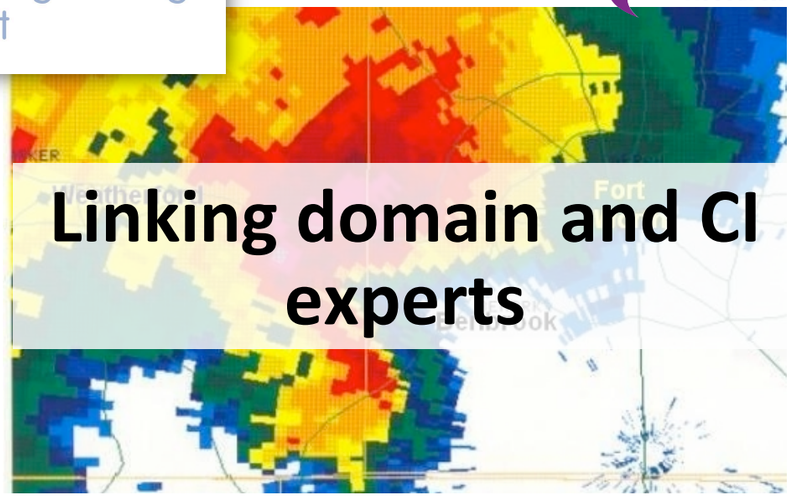
Extreme Science and Engineering Discovery Environment

ACI-REF

Advanced CyberInfrastructure Research & Education Facilitators

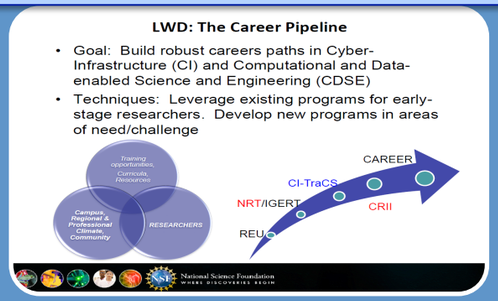


Software interface



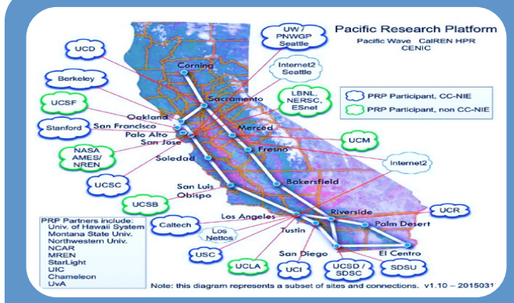
Linking domain and CI experts

NSF-wide CIF21 Initiative Sunsets in FY17

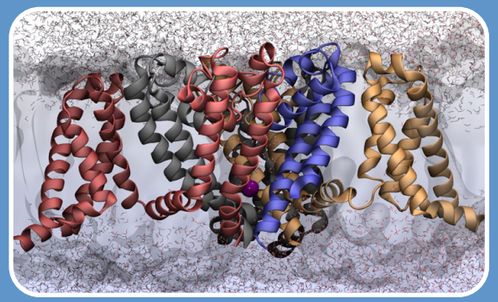


Learning and Workforce Development for Creators and Users of Research CI

Building robust career paths for CI and Computational and Data Enabled Science and Engineering(CDS&E)



Data Infrastructure Building Blocks ("DIBBs") and Data Science Pilots: Developing communities and infrastructure for using, sharing and reusing research data to advance science and engineering



Software Infrastructure for Sustained Innovation (SI²):

Transforming innovations in research and education into sustained software resources

National Strategic Computing Initiative (NSCI)

Maximizing HPC benefits for economic competitiveness and scientific discovery:

NSF will play a central role in scientific discovery advances, the broader HPC ecosystem for scientific discovery, and workforce development.

Objectives

- 100x performance increase in HPC simulations
- **Technical synergy in platform for modeling/data analytics**
- **Research into new devices, architectures to scale beyond current limits**
- **Increase capacity and capability of national HPC ecosystem**
- Public/private partnership

NSF Initial Activities (co-led by MPS, ACI)

- FY2016: Planning, Coordination, and Community Engagement (NSF-wide)
- FY2017: Pilot Activities ($30+M)
- FY2018+: Full scale Funding

http://nsf.gov/cise/nsci/

NSF big ideas for future investment

Research Ideas

- Harnessing Data for 21st Century Science and Engineering
- Shaping the Human – Technology Frontier
- Understanding the Rules of Life: Predicting Phenotype
- The Quantum Leap: Leading the Next Quantum Revolution
- Navigating the New Arctic
- Windows on the Universe: The Era of Multi-messenger Astrophysics

Process Ideas

- Growing Convergent Research at NSF
- Mid-scale Research Infrastructure
- NSF INCLUDES
- NSF 2050

A vision for research infrastructure

Reusable and agile scientific software and data with consistent user entrance into an evolving research infrastructure

CYBERINFRASTRUCTURE ECOSYSTEM

Large facilities, instruments

National and local computing, data resources

Software

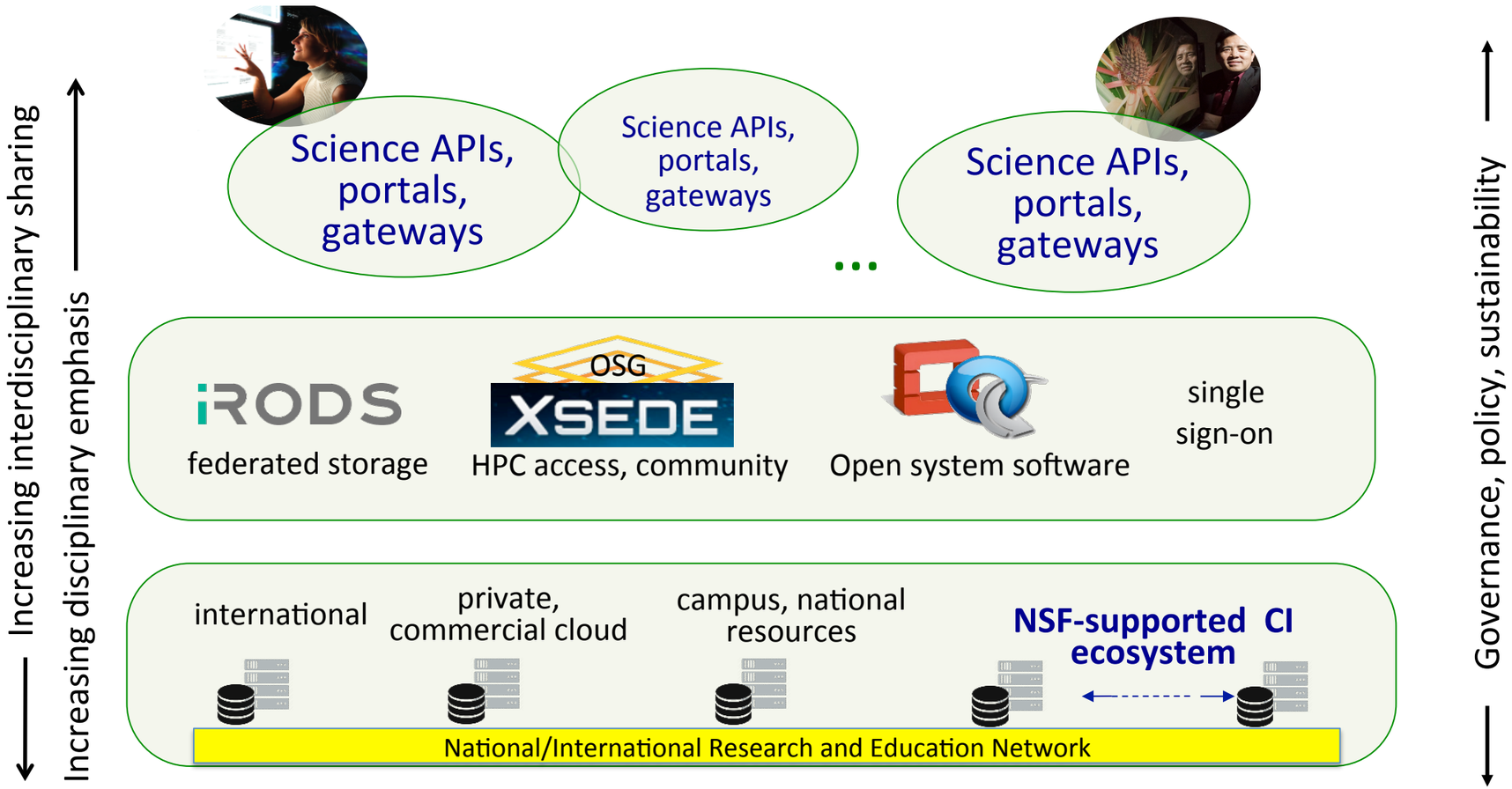
Data

Secure, Collaboration networks

Community portals and software

A vision for research cyberinfrastructure

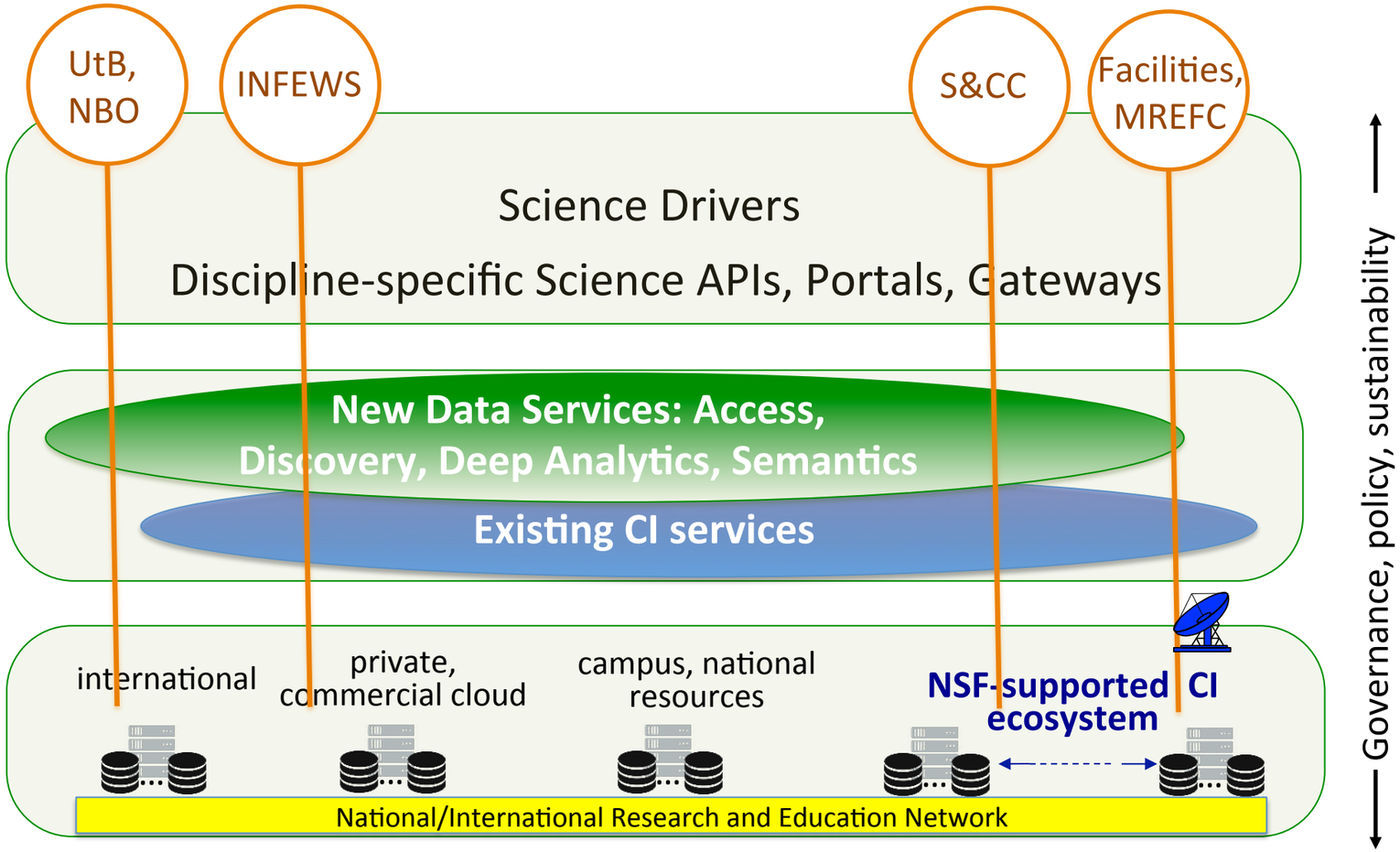
A national research CI architecture



A vision for research cyberinfrastructure

Architecting a national research infrastructure

Enabling and accelerating science drivers, including NSF initiatives & facilities



A vision for research cyberinfrastructure

Training and Robust Careers

Cyber Scientists
to explore new CI capabilities

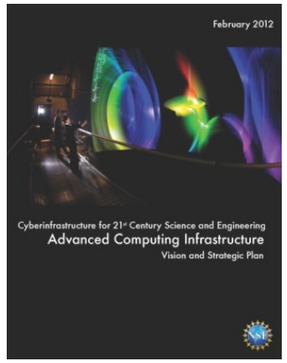
Expert Staff
to develop and sustain new capabilities

Computational and Data Scientists
to expand frontiers using new methods, algorithms and capabilities

Community input critical to NSF CI planning

Accelerating Science into the Future

- **NSF Advanced Computing Infrastructure for 21st Century Science and Engineering: Vision and Strategic Plan (Feb 2012)**
  - Position, support spectrum of NSF-funded communities at cutting edge of advanced computing technologies, hardware, software, services
- **Future Directions of NSF Advanced Computational Infrastructure to Support US Science in 2017 – 2022**
  - National Academy of Sciences (NAS) Final Report (2016)
  - http://www.nap.edu/catalog/21886/future-directions-for-nsf-advanced-computing-infrastructure-to-support-us-science-and-engineering-in-2017-2020
- **NSCI website**
  - Workshops, RFIs, Reports, Plan
  - http://nsf.gov/cise/nsci/
- **NSF Advisory Committee on Cyberinfrastructure (ACCI)**
  - Co-chairs: Thom Dunning, Victoria Stodden
  - Working Groups: LWD, Data, Software
  - http://www.nsf.gov/cise/aci/advisory.jsp



Final report Co-chairs:
W. Gropp/UIUC
R. Harrison/Stony Brook

Thanks!

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