Large Facilities Cybersecurity Summit
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
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
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

Windows on the Universe

HIV Capsid

LIGO Detection

iPlant/CyVerse
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.
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

Software interface

Linking domain and CI experts
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

NSF-wide CIF21 Initiative Sunsets in FY17
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/nscl/
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
- Secure, Collaboration networks
- National and local computing, data resources
- Community portals and software
A vision for research cyberinfrastructure

A national research CI architecture

Increasing interdisciplinary sharing

Increasing disciplinary emphasis

Governance, policy, sustainability

Science APIs, portals, gateways

Science APIs, portals, gateways

Science APIs, portals, gateways

iRODS
federated storage

OSG
HPC access, community

XSEDE
Open system software

single sign-on

international

private, commercial cloud

NSF-supported CI ecosystem

National/International Research and Education Network
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*

  - 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

- NSCI website
  - Workshops, RFIs, Reports, Plan

- NSF Advisory Committee on Cyberinfrastructure (ACCI)
  - Co-chairs: Thom Dunning, Victoria Stodden
  - Working Groups: LWD, Data, Software

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

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