

---

## **A Regional Perspective: CENIC's Role in Supporting the Pacific Research Platform**

October 5, 2017  
Albuquerque



---

*LOUIS FOX*  
*PRESIDENT & CEO*

**CENIC**

# Pacific Research Platform (PRP) and \*RP



**INGREDIENTS**



**OUR ROLE(S)**



**FIRST ANNUAL NRP MEETING  
& NEXT STEPS TOWARDS  
\*RP(s) and an NRP**



# Biomedical Sciences

## Cancer Genomics:

UCSC, UCSD/SDSC; UChicago

## Microbiome and Integrative 'Omics:

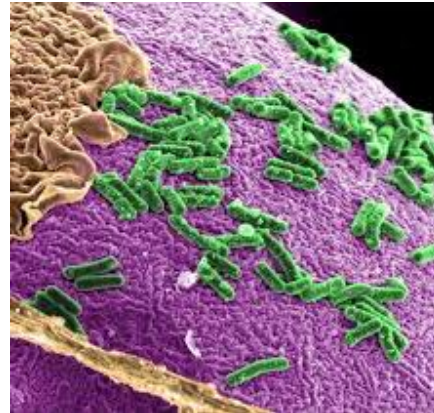
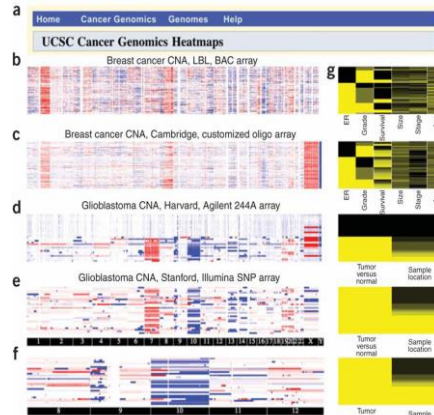
UCSD, Caltech, UCD, UCSF

## Integrative Structural Biology:

UCSF, UCSD/SDSC, LBNL/NERSC

## Microscopy Data Wormhole:

UCSD, UCR, NSCC



# Earth Sciences

## Data Analysis and Simulation for Earthquakes and Natural Disasters:

Pacific Earthquake Engineering Research Center (PEER) – UCB, UCSD, UCSC, UCD, UCLA, UCI, USC, Stanford, OSU, & UW

## Climate Modeling:

NCAR/UCAR

## California/Nevada Regional Climate Data Analysis:

NCAR/UCAR, UCSD/SIO

## CO2 Subsurface Modeling:

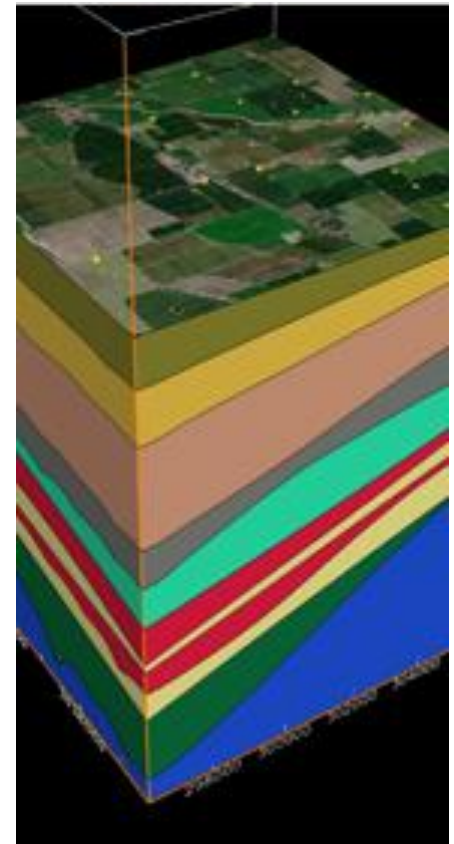
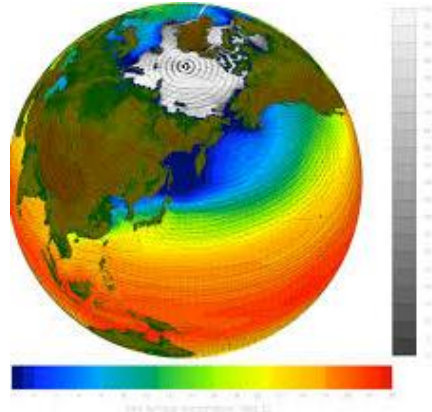
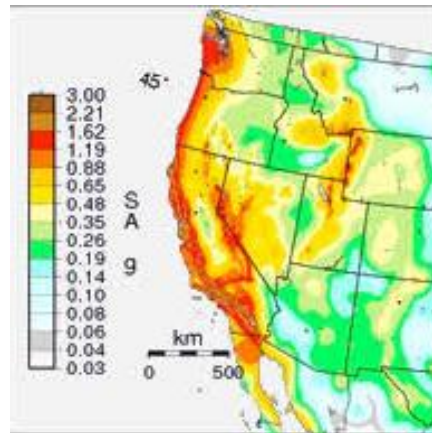
SDSU, UCSD/SDSC

## Drones & 3D Terrestrial Modeling:

UCSD, UCM

## Wildfire Simulations & Situational Awareness

UCSD, NCAR/UCAR





# Particle Physics, Astronomy and Astrophysics

## Particle Physics:

UCSD/SDSC, UCI, UCR, UCSB, UCSC, UCD, Caltech, OSG

## Telescope Surveys:

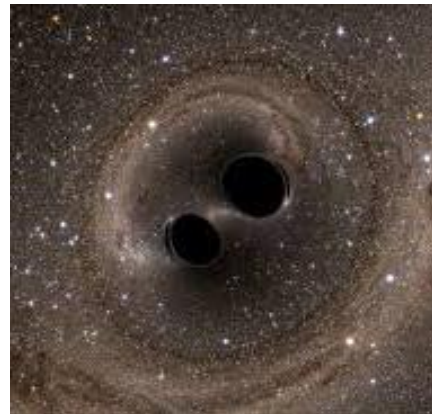
LBNL/NERSC, LLNL, UCB, UCI, UCSC, Caltech/IPAC/JPL, Stanford/SLAC, UW

## Galaxy Evolution:

UCI, UCSD, UCLA, UCSB, UCR, UCSC, LBNL/NERSC, NASA Ames, UW

## Gravitational Wave Astronomy:

Caltech, LIGO Laboratory; UCSD, OSG



## Other Application Drivers

### Scalable Visualization, Virtual Reality, and Ultra-Resolution Video

UCSD, UCI, UCLA, UCSC, UCB, UCD, UCM, USC, UIC, UHM, Jackson State U, UvA

### High Performance Wireless R&E Network

UCSD, SDSU, UCI, UCR, UCSC, UCM

### JupyterHub/Machine Learning

UCSD/SDSC, UCI, UCB, LBNL, LLNL, UIC

### Cryo-electron Microscopy (cryo-EM)

NERSC, SDSC, UCSC, UCLA, UCD, LBNL, UCSF, Stanford, MSU

### HPWREN: Environmental and Disaster (Fire/Earthquake) Observation

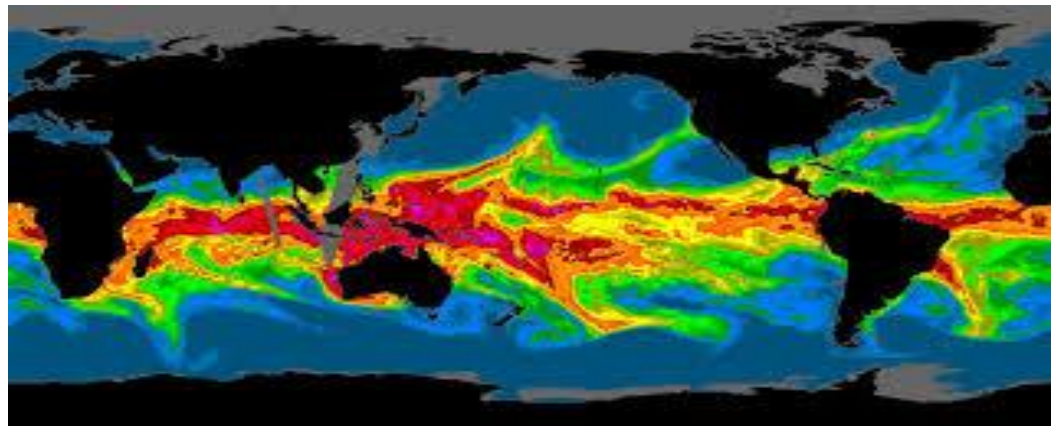
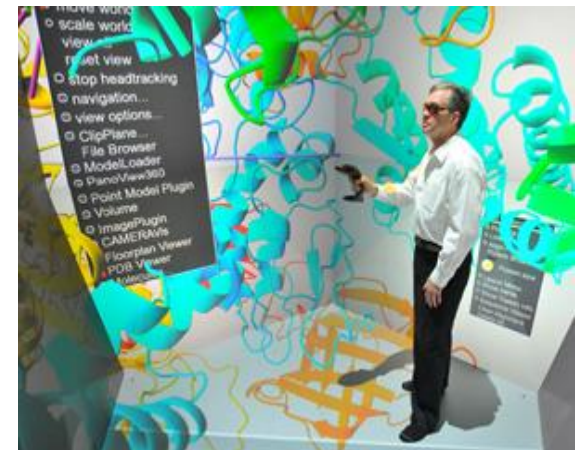
UCSD, UCI, SDSC, UCR

### Digital Archeology and Cultural Preservation

UCSD, UCB, UCR, UCLA

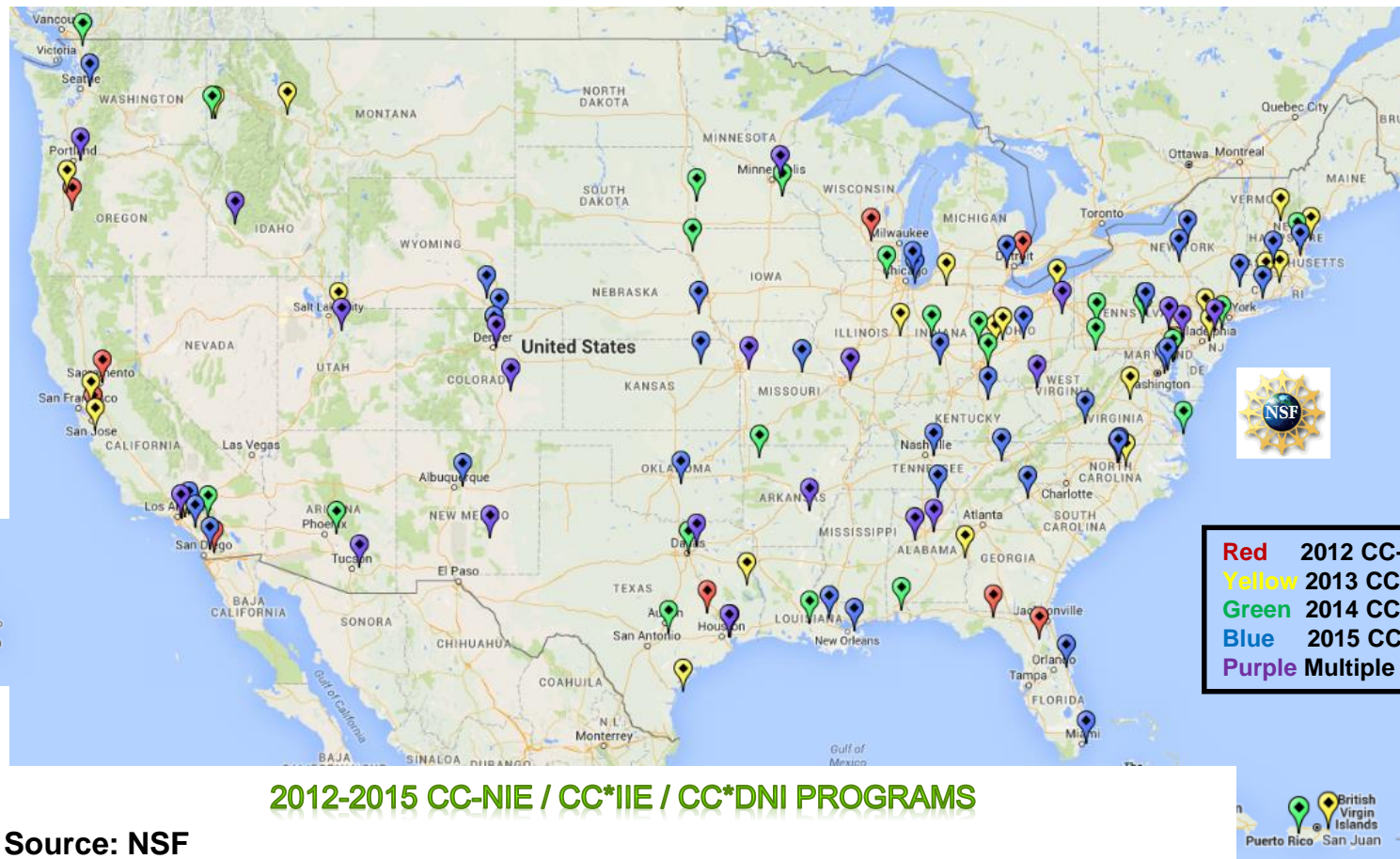
### Atmospheric Water in the West

UCSD, UCI





# Based on Community Input and on ESnet's Science DMZ Concept, NSF Has Funded Over 100 Campuses to Build Local Big Data Freeways





Pacific Research Platform  
NSF CC\*DNI Grant  
\$5,000,000  
10/2015 – 10/2020

Principal Investigator:

Larry Smarr, UC San Diego, Calit2

Co-Principal Investigators:

Camille Crittenden, UCB, CITRIS

Tom DeFanti, UCSD, Calit2

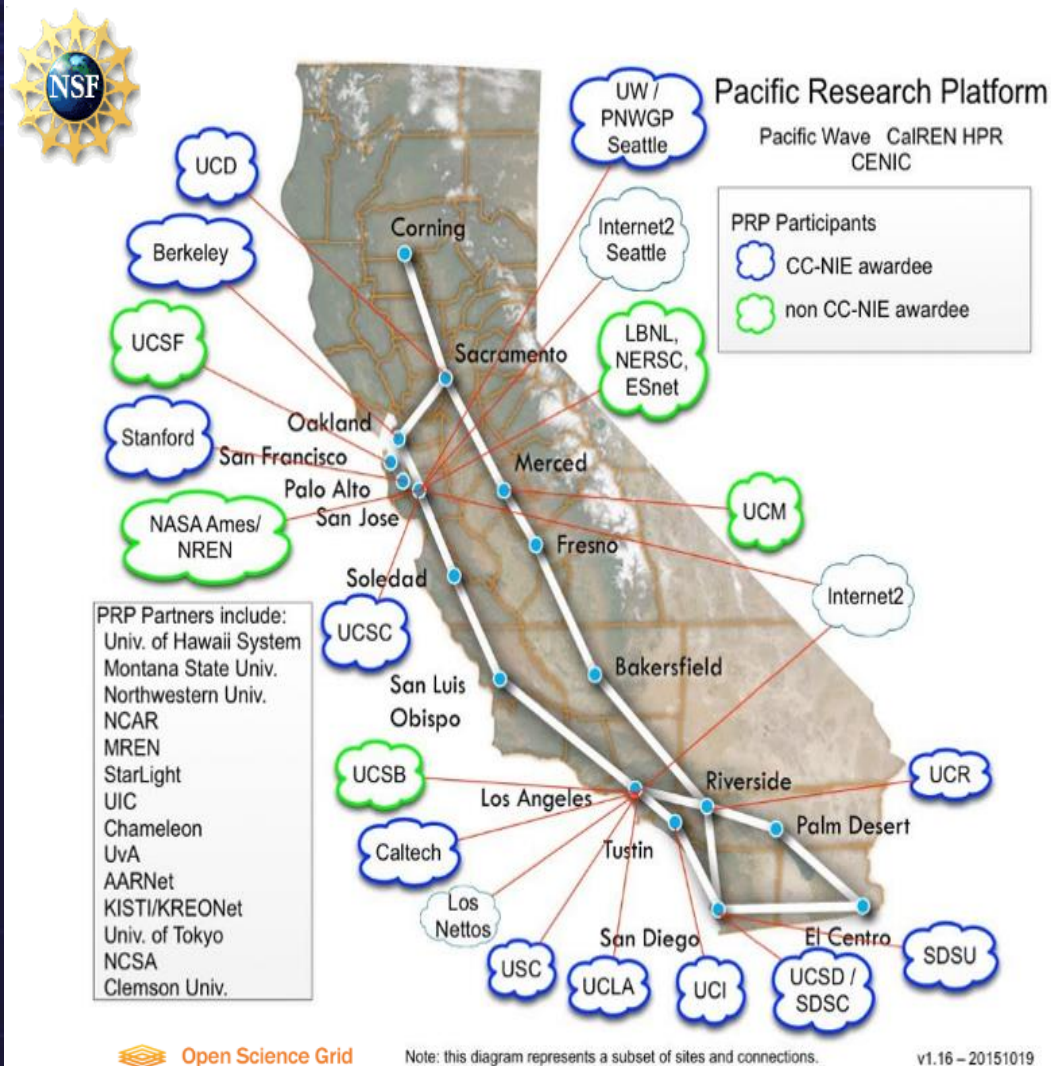
Phil Papadopoulos, UCSD, SDSC

Frank Weurthwein, UCSD Physics &  
SDSD

Letters of Support from

50 researchers from 15 campuses

32 IT/network organization leaders









# Thirty Years After NSF Adopts DOE Supercomputer Center Model NSF Adopts DOE ESnet's Science DMZ for High Performance Applications

A Science DMZ integrates 4 key concepts into a unified whole:

- A network architecture designed for high-performance applications, with the science network distinct from the general-purpose network
- The use of dedicated systems as data transfer nodes (DTNs)
- Performance measurement and network testing systems that are regularly used to characterize and troubleshoot the network
- Security policies and enforcement mechanisms that are tailored for high performance science environments

Science DMZ  
Coined 2010

**The DOE ESnet Science DMZ and the NSF “Campus Bridging” Taskforce Report Formed the Basis for the NSF Campus Cyberinfrastructure Network Infrastructure and Engineering (CC-NIE) Program**



## Big Data Science Data Transfer Nodes (DTNs)- Flash I/O Network Appliances (FIONAs)

**UCSD Designed FIONAs  
To Solve the Disk-to-Disk  
Data Transfer Problem  
*at Full Speed*  
on 10G, 40G and 100G Networks**



FIONette—1G, \$1,000

**SDSC**

Source: Larry Smarr, Calit2

**CENIC**



John Graham, Calit2

FIONAS—10/40G, \$8,000

Phil Papadopoulos, SDSC &  
Tom DeFanti, Joe Keefe & John Graham, Calit2



# PRP DTNs: Software and Tools



perfSONAR

Health-monitoring: see

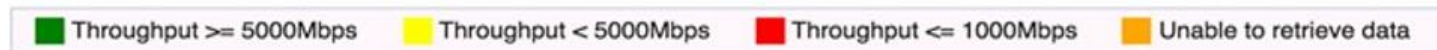
<http://prp-maddash.calit2.optiputer.net/maddash-webui/index.cgi>

In the future, DTN's to support specific workflows, using whatever software stack is used by the rest of the workflow: e.g. Aspera, bbcp, etc.

Mavens and mavericks: John Graham (Calit2), Eli Dart (ESnet), Tom Defanti (Calit2), John Hess (CENIC)

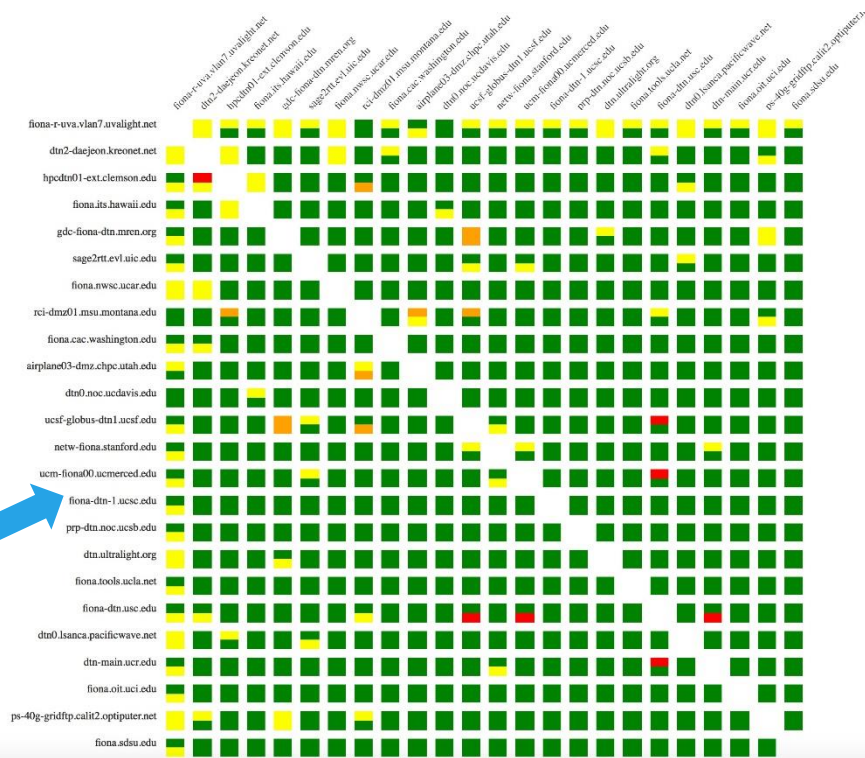
# We Measure Disk-to-Disk Throughput with 10GB File Transfer 4 Times Per Day in Both Directions for All PRP Sites

## PRPGridFTP



January 29, 2016

July 21, 2017



From Start of Monitoring 12 DTNs  
to 24 DTNs Connected at 10-40G  
in 1 ½ Years

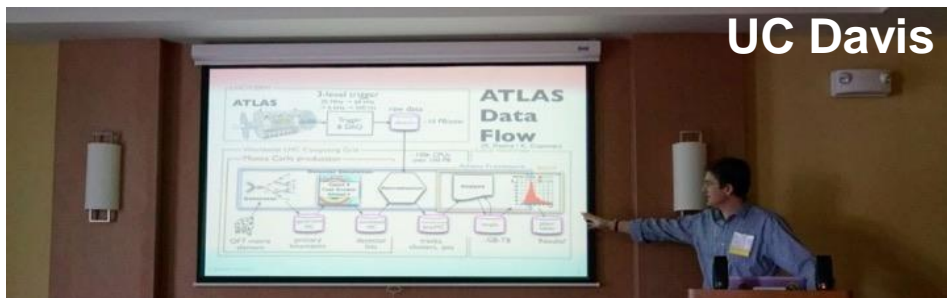
Source: John Graham, Calit2





# Increasing Participation Through PRP Science Engagement Workshops

UC Davis



UC Berkeley



UC San Diego

The panel discussion is titled 'PRP Astronomy & Astrophysics Panel'. The panelists are seated at a long table, and a large screen in the background displays the panel's content.

- Data**
  - Data path
  - Data volume and rates over time
  - Data access and archiving over time
- Processing**
  - Workflow: what computers and where?
  - Size of data caches near processing
  - Data products distribution
- Collaboration**
  - How will network be used to enable collaboration?

SDSC Comet OSG, XRootD integration

UC Merced



Source: Camille Crittenden, UC Berkeley

# Pacific Research Platform Partners

- **West Coast Participants:**

Caltech  
CENIC  
ESnet  
LBNL/ NERSC  
NASA Ames/ NREN  
Naval Post Graduate School  
San Diego State Univ.  
Stanford  
UC Berkeley  
UC Davis  
UC Irvine  
UC Merced  
UC Riverside  
UC San Diego / SDSC  
UC San Francisco  
UC Santa Barbara  
UC Santa Cruz  
UCLA  
USC  
Univ. Washington/PNWGP

- **National & Global Participants:**

AARNet, Australia  
Clemson Univ.  
ESnet  
KISTI/KREONet, Korea  
Montana State Univ.  
MREN  
NCAR/UCAR  
Northwestern Univ.  
NSCC, Singapore  
Open Science Grid  
StarLight  
Univ. of Chicago  
Univ. of Hawaii System  
Univ. Illinois Chicago / EVL  
Univ. of Tokyo, Japan  
Utah University  
Univ. of Illinois CU/NCSA  
Univ. Amsterdam, Netherlands  
Univ. of Utah  
Jackson State Univ.



# From the CENIC Kitchen



- PRP is an expression of CENIC's core mission: the "R" in R&E
- Investments
  - 100G direct to 20 research universities and medical centers (and counting) to pre-position for CC\* and PRP (and other NSF/NIH/DoE)
  - Dedicated PRP staff to support innumerable volunteers from across California's (and partner's) research universities
- Science engagement
- Workshop support
- Extension of PRP approaches to other segments
- Integration of PRP with TACs, Board agendas, outreach, etc.
- Support for ways that PRP may help shape future agendas



## **The First National Research Platform Workshop: Toward A National Big Data Superhighway**

**Montana State University, Bozeman  
August 7-8, 2017**

Purpose:

- (1) to bring together representatives from PRP partners and outside interested institutions, including domain scientists, network and system administrators, campus CIOs, regional network leaders, and representatives of ESnet, Internet2, the Quilt, XSEDE, and the National Science Foundation
- (2) to discuss expansion of the PRP and address the potential challenges and benefits of scaling the Science DMZ model to a national level and creating a National Research Platform (NRP).

Chairs: Jim Bottum, Internet2, and Larry Smarr, Calit2, UCSD  
Program Chair: Tom DeFanti, Calit2, UCSD

Workshop report, slides, and videos at [www.pacificresearchplatform.org](http://www.pacificresearchplatform.org)

# NRP Workshop: Findings

## **The initiative**

- Socio-technical, with all elements of the ecology engaged
- Voluntary institutional and researcher commitment is critical
- NRP cyberinfrastructure is more than interconnected DMZs
- Tools and protocols should be developed and shared
- Trust is a key element for success
- The process must be organic, evolutionary

## **Domain sciences/scientists**

- NRP platform needs to be seamless, simple/intuitive
- Scientists want to do science, not IT
- Science engagement process is essential

## **Cyberinfrastructure elements can benefit by adoption of PRP model**

- National HPC facilities
- Instruments and facilities used by experiments
- Data repositories and data portals
- Campus computing centers
- Commercial cloud services



# What's next?

## Towards a \*RP and \*RPs

- **March 5-7, 2018**
- Monterey, California
- Held in conjunction with the CENIC Annual Conference



## Second Annual NRP Workshop

- **August 6-7, 2018**
- Bozeman, Montana
- Larry Smarr, Calit2 & Jim Bottom, Internet2, Co-Chairs

