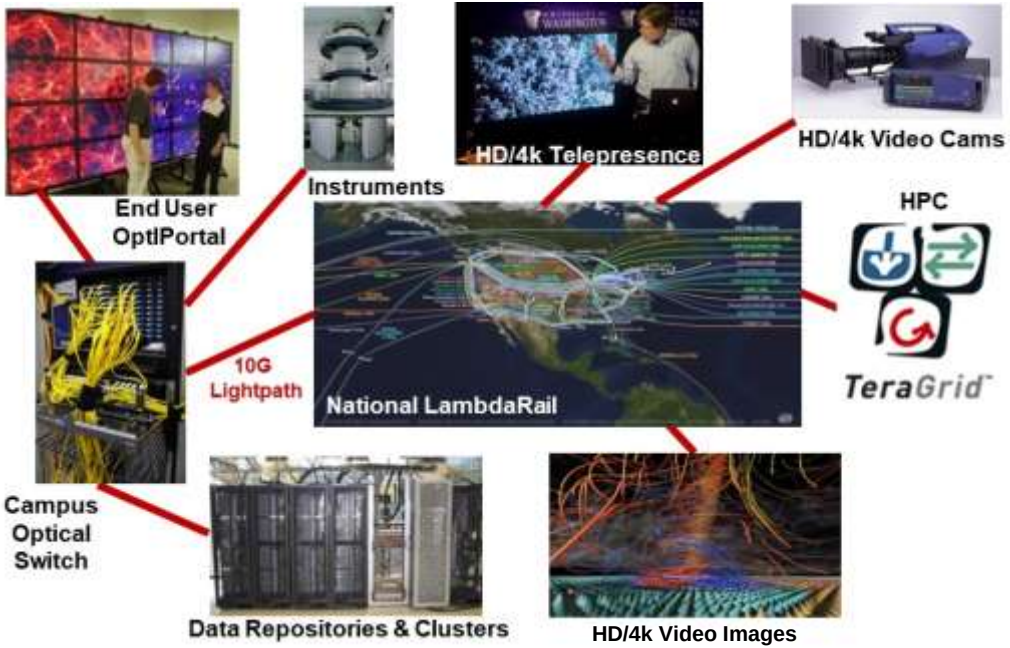
"The NSF Grants Leading Up to CHASE-CI ENS"

Zoom Presentation to
The NSF CHASE-CI ENS Grant Advisory Board
July 8, 2022

Dr. Larry Smarr
Founding Director Emeritus, California Institute for Telecommunications and Information Technology;
Distinguished Professor Emeritus, Dept. of Computer Science and Engineering
Jacobs School of Engineering, UCSD
http://lsmarr.calit2.net

Nautilus

The NSF-Funded OptIPuter Grant
Developed The Optical Fiber Connected Distributed System



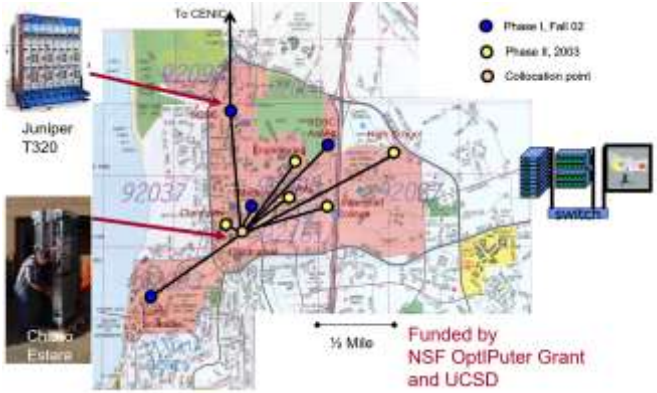
The OptIPuter
Exploits a New World
in Which
the Central Architectural Element
is Optical Networking,
Not Computers.

Demonstrating That
Wide-Area Bandwidth
Can Equal
Local Cluster Backplane Speeds

OptIPuter
$13.5M
PI Smarr,
Co-PIs DeFanti, Papadopoulos, Ellisman, UCSD
Project Manager Maxine Brown, EVL
2002-2009

PRP Was Built on 15 Years of NSF Awards: OptIPuter, Quartzite, & Prism

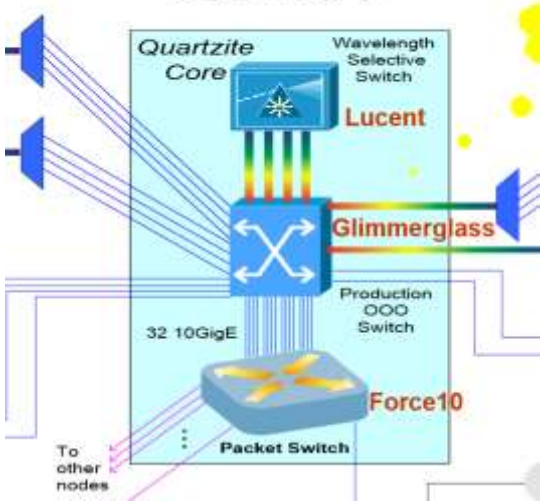
Precursors to DOE Defining DMZ in 2010



PI Smarr, 2002-2009

OptIPuter

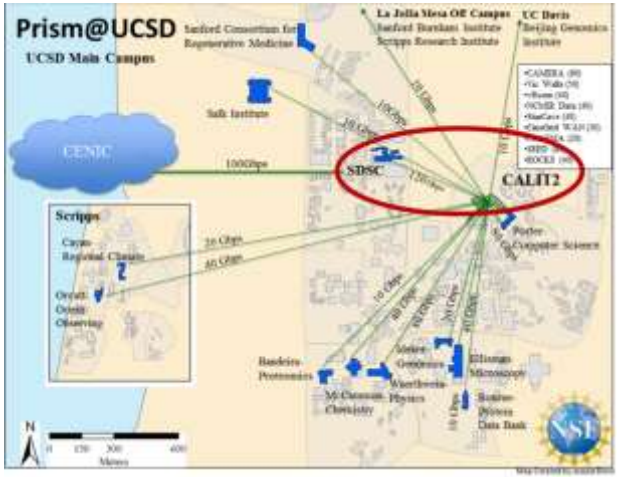
Quartzite Communications Core Year 3



Goals by 2008:
- >= 50 endpoints at 10 GigE
- >= 32 Packet switched
- >= 32 Switched wavelengths
- >= 300 Connected endpoints

PI Papadopoulos, 2004-2007

Led to NSF CC* Award in 2013



PI Papadopoulos, 2013-2015

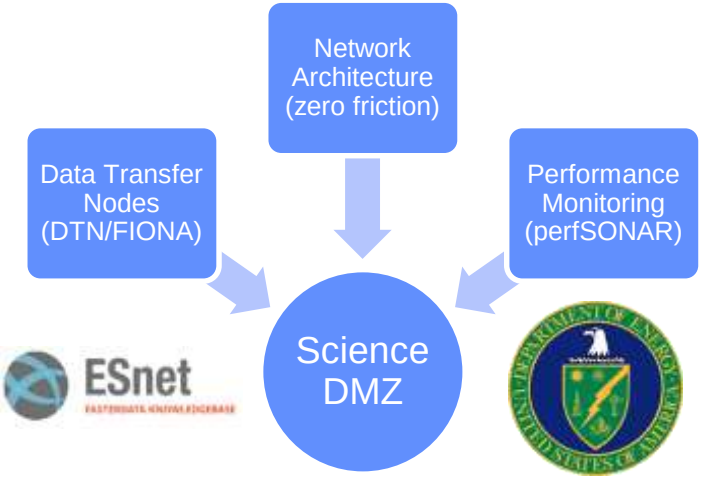
Nautilus

SDSC

20 YEARS
QUALCOMM INSTITUTE

2010-2022:
NSF Adopted a DOE High-Performance Networking Model

ScienceDMZ Coined in 2010 by ESnet



http://fasterdata.es.net/science-dmz/

Slide Adapted From Inder Monga, ESnet

DOE

NSF

NSF Campus Cyberinfrastructure Program
2012-2022



Has Made Over 340 Awards:
Across 50 States and Territories

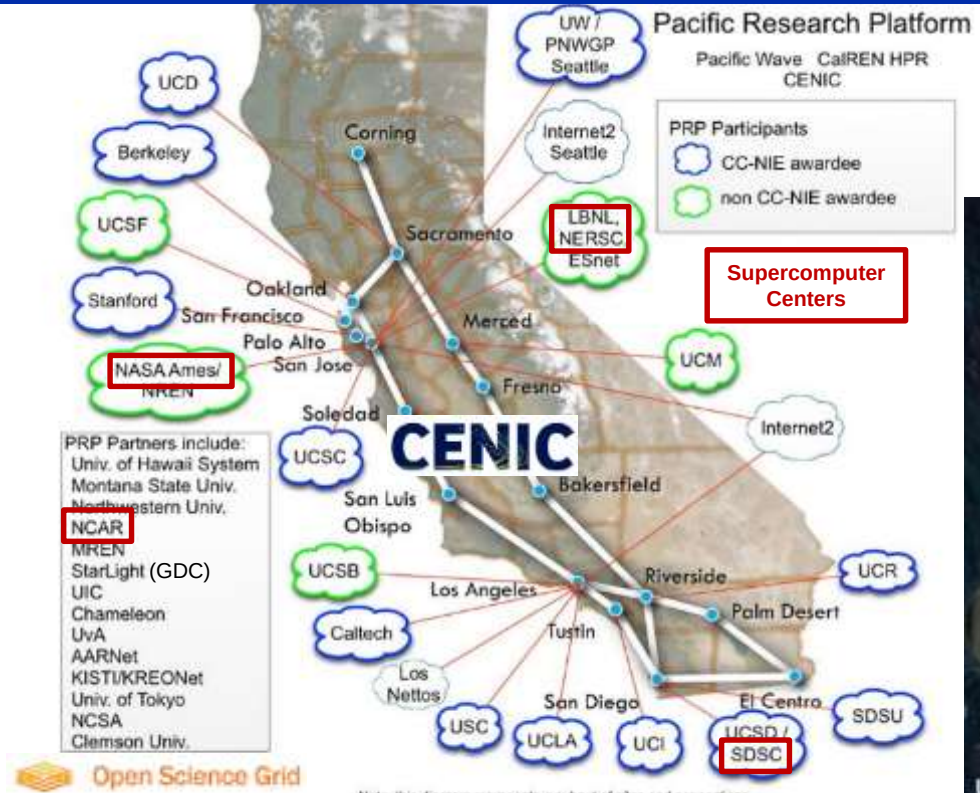
Slide Adapted From Kevin Thompson, NSF

Quartzite

Prism

Nautilus

2015 Vision: The Pacific Research Platform Will Connect Science DMZs Creating a Regional End-to-End Science-Driven Community Cyberinfrastructure



NSF CC*DNI Grant
$6.3M 10/2015-10/2020
Extended - In Year 7 Now



Source: John Hess, CENIC

2015-2021: UCSD Designs PRP Data Transfer Nodes (DTNs) -- Flash I/O Network Appliances (FIONAs)

FIONAs Solved the Disk-to-Disk Data Transfer Problem at Near Full Speed on Best-Effort 10G, 40G and 100G

FIONA

(Flash Input/Output Network Appliance) FIONAs are rack-mounted PCs designed by our PRP team. They are Science DMZ Data Transfer Nodes (DTNs), optimized for 10-100Gbps data transfers and large data storage, and are also capable of holding up to eight GPUs or FPGA add-in boards or up to 256TB of disk each.

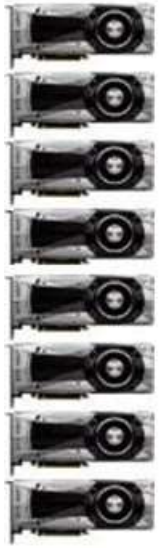
Software Specifications

Installation Instructions

Hardware Specifications

2021 – 2020 – 2019 – 2018 – 2017 – 2016 – 2015

www.pacificresearchplatform.org





Add Up to 8 Nvidia GPUs Per 2U FIONA
To Add Machine Learning Capability

Up to 192 TB Rotating Storage

FIONAs Designed by UCSD's Phil Papadopoulos, John Graham, Joe Keefe, and Tom DeFanti

2018/2019: Installing Community Shared FIONA CPU/GPU/Storage Systems on Campuses and Working With Campus CIOs on DMZs

UC Santa Cruz



UC Irvine



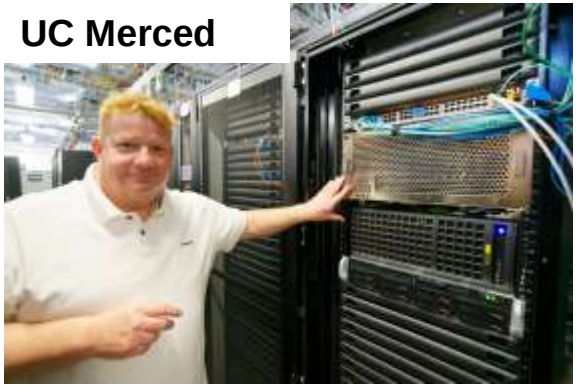
UC Santa Barbara



Stanford



UC Merced



UC Riverside



Nautilus

PRP's Nautilus is a Multi-Institution Hypercluster Connected by Optical Networks



As of July 6, 2022

140 FIONAs on 25 Partner Campuses Networked Together at 10-100Gbps

Installed CPUs	Installed GPUs	Rotating Storage
8074	568	4000 TB





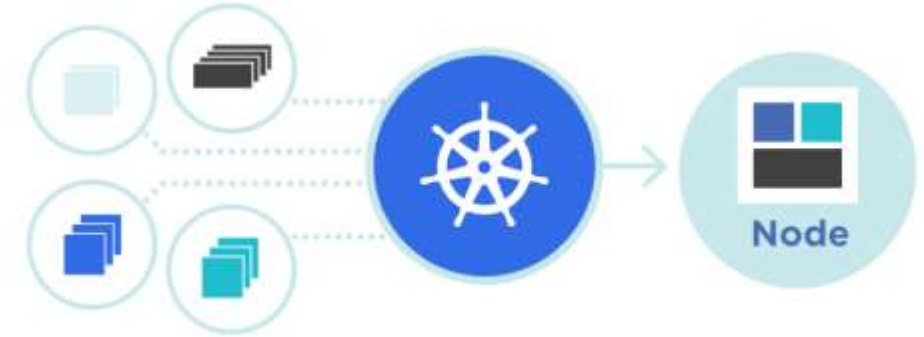




2018/2019: PRP's Nautilus Hypercluster Adopted Kubernetes to Orchestrate Software Containers and Manage Storage

kubernetes

User Applications



Containers

PRP
PACIFIC RESEARCH PLATFORM

Clouds

ceph

ROOK
Open source file, block and object storage for your cloud-native environment.

CLOUD NATIVE COMPUTING FOUNDATION

Nautilus

The New Pacific Research Platform Video Highlights 3 Different Applications Out of 600 Nautilus Namespace Projects



Pacific Research Platform Video:
https://pacificresearchplatform.org/media/pacific-research-platform-video/

Nautilus

CITRIS and the BANATAO INSTITUTE

Once a Wildfire is Spotted, PRP Brings High-Resolution Weather Data to Fire Modeling Workflows in WIFIRE



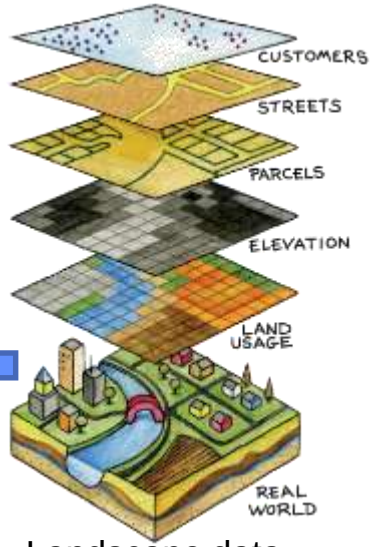
Real-Time Meteorological Sensors



Source: Ilkay Altintas, SDSC

WIFIRE

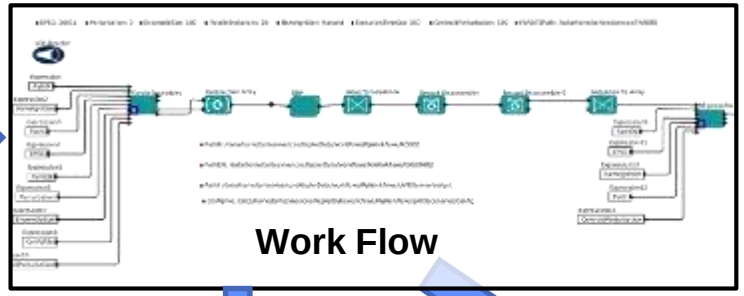




Landscape data

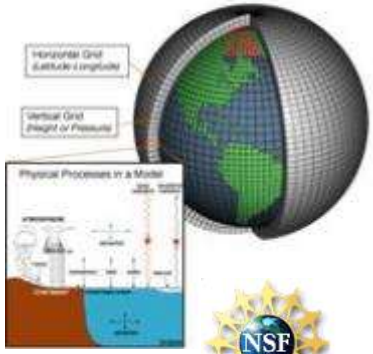
PRP





Work Flow

Weather Forecast









NSF

Nautilus

2017: PRP 20Gbps Connection of UCSD SunCAVE and UCM WAVE
2018-2019: Added Their 90 GPUs to PRP for Machine Learning Computations



UC Merced WAVE (20 Screens, 20 GPUs)

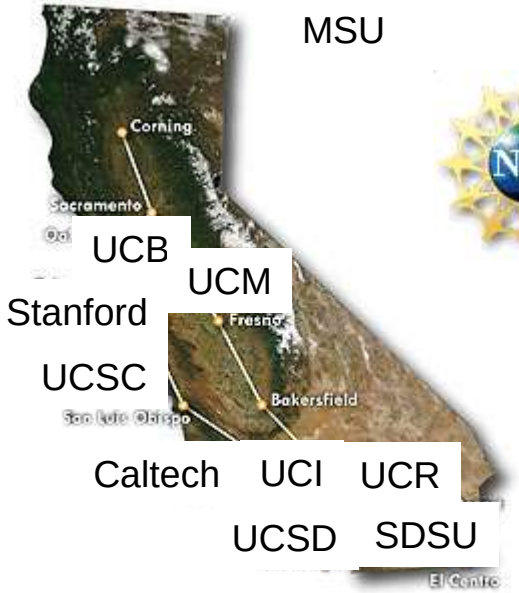


UCSD SunCAVE (70 Screens, 70 GPUs)

SDSC

Nautilus Leveraging UCM Campus Funds and NSF CNS-1456638 & CNS-1730158 at UCSD

2017-2023: CHASE-CI Grant Adds a Machine Learning Layer Built on Top of the Pacific Research Platform for CISE Researchers



CI-New: Cognitive Hardware and Software Ecosystem Community Infrastructure (CHASE-CI)

2017 to 2021

NSF Grant for 256 High Speed "Cloud" GPUs
For 32 ML Faculty & Their Students at 10 Campuses
To Train AI Algorithms on Big Data

PI: Larry Smarr
Co-PIs:

- Tajana Rosing
- Ken Kreutz-Delgado
- Ilkay Altintas
- Tom DeFanti

NSF Funded Two Extensions:
CHASE-CI ABR and ENS
6/2021 - 10/2023

Nautilus

SDSC

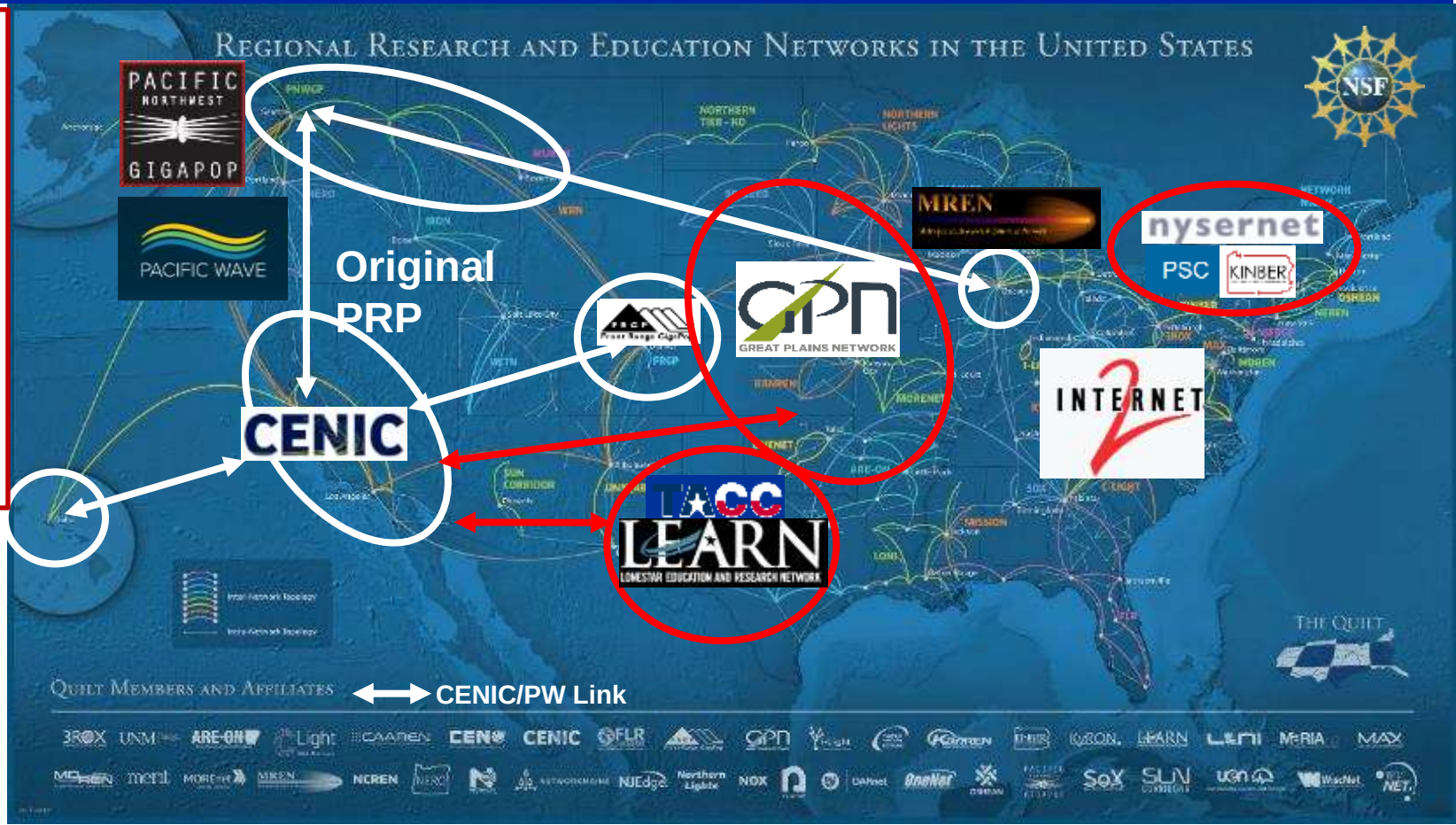
UC San Diego

20 YEARS
QUALCOMM INSTITUTE

2018-2021: Toward the National Research Platform (TNRP) - Using CENIC & Internet2 to Connect Quilt Regional R&E Networks

"Towards The NRP"
3-Year Grant Funded by NSF
$2.5M
October 2018
Award #1826967

PI Smarr
Co-PIs Altintas, Papadopoulos, Wuerthwein, Rosing



Nautilus

Community Building Though Inclusion and Diversity: Workshops With Minority Serving Universities

2NRP Montana State University





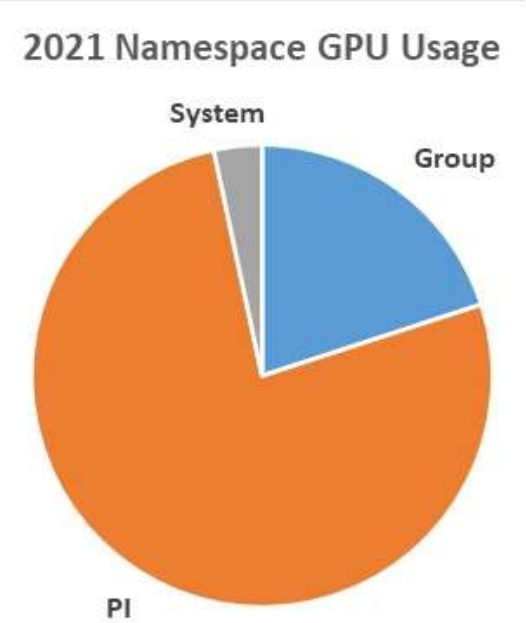


Nautilus

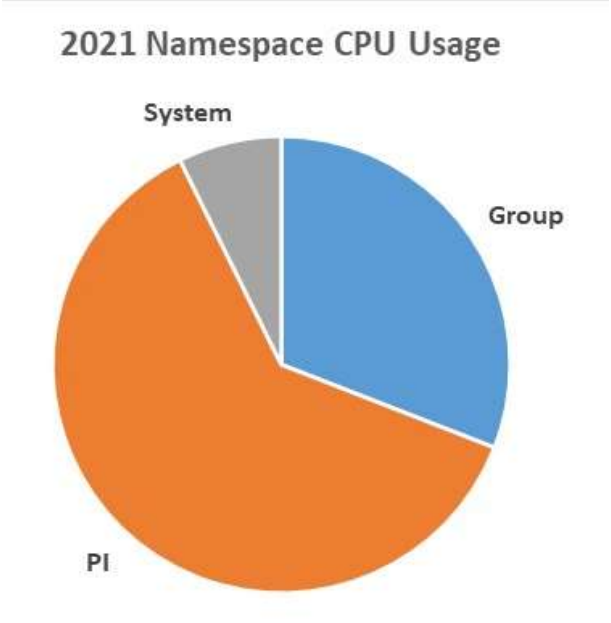
CITRIS BANATAO INSTITUTE

Calendar 2021 GPU & CPU Namespace Usage By Type

~200 Active Nautilus Namespaces



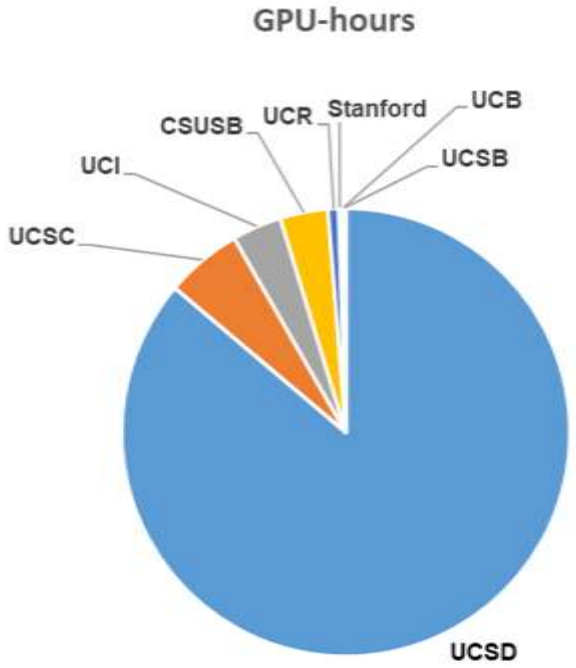
2,999,817 GPU-hours



14,923,987 CPU core-hours

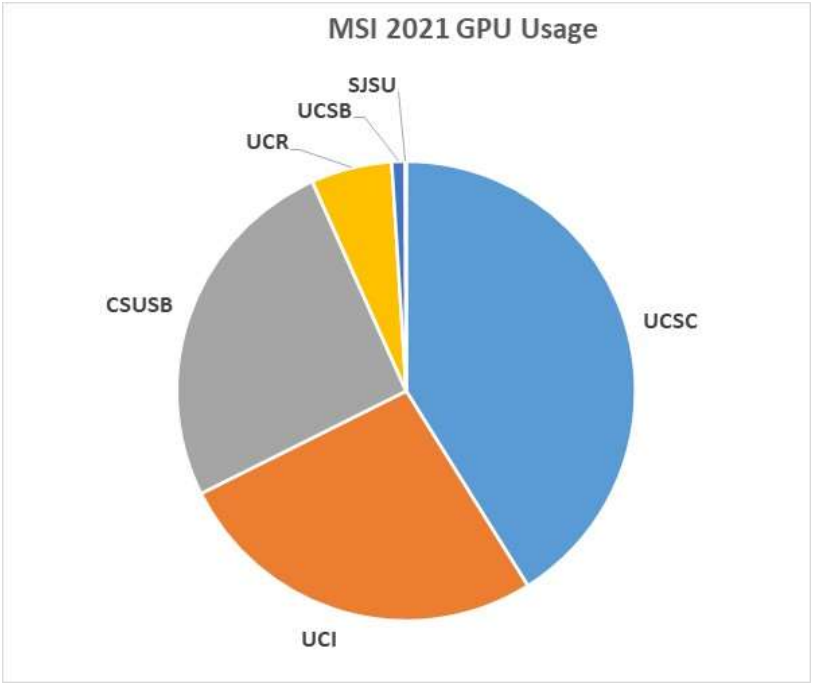
Nautilus

PRP Nautilus 2021 PI Namespace-California Campuses: GPU Usage



2,378,401 GPU-hours

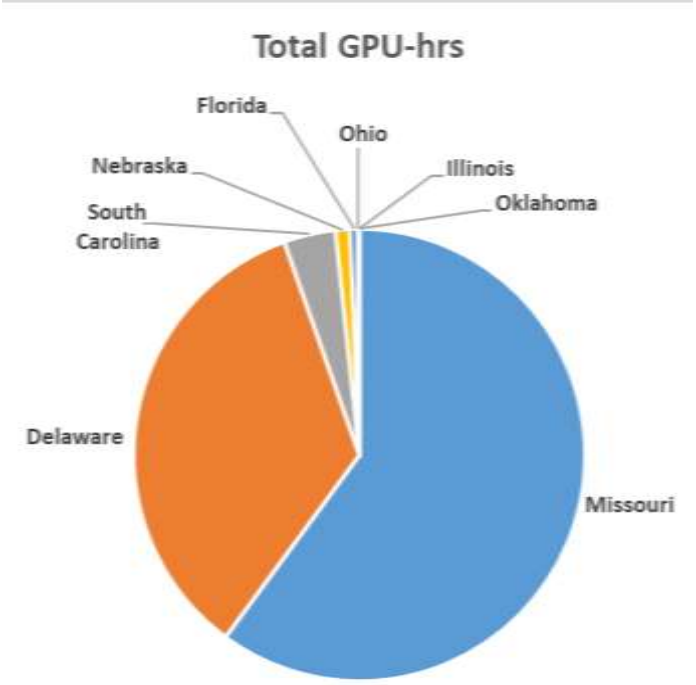
Minority Serving Institutions



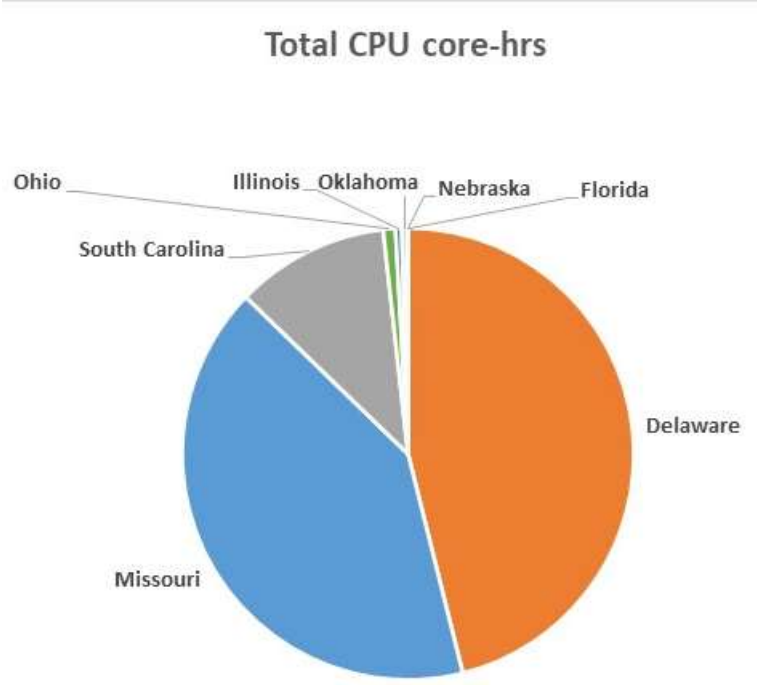
320,111 GPU-hours

Nautilus

Non-California Nautilus 2021 PI Namespace Usage by State



17,217 GPU-hrs



28,088 CPU core-hrs

Nautilus

July 2022 Nautilus Users Across the Country: West

West

California

- California Institute of Technology
- California State Polytechnic U., Pomona (MSI)
- California State U. San Bernardino (MSI)
- California State U., Northridge (MSI)
- Harvey Mudd College
- Naval Postgraduate School
- San Diego State U. (MSI)
- San Jose State U. (MSI)
- Stanford U.
- U. of California, Berkeley
- U. of California, Merced (MSI)
- U. of California, Davis (MSI)
- U. of California, Riverside (MSI)
- U. of California, San Francisco
- U. of California, Santa Cruz (MSI)
- U. of California-Irvine (MSI)
- U. of California-Los Angeles
- U. of California-San Diego
- U. of California-Santa Barbara (MSI)
- U. of Southern California

Hawaii (EPSCoR)

- U. of Hawaii (MSI)

Oregon

- Oregon State U.
- Willamette U.

Washington

- U. of Washington
- Washington State U.

Montana (EPSCoR)

- Montana State U- Bozeman

Nevada (EPSCoR)

- U. of Nevada, Reno

Colorado

- Colorado School of Mines
- National Center for Atmospheric Sciences
- U. of Colorado at Boulder
- U. of Colorado Denver

Utah

- Brigham Young U.

New Mexico (EPSCoR)

- U. of New Mexico

Arizona

- U. of Arizona

Nautilus

July 2022 Nautilus Users Across the Country: Midwest

Midwest

Michigan

- Michigan State U.
- U. of Michigan

Wisconsin

- U. of Wisconsin-Madison

Missouri

- Missouri Western State U.
- U. of Missouri System
- Washington U. in St. Louis

Iowa

- Iowa State U.

Kansas (EPSCoR)

- Kansas State U.
- U. of Kansas

Nebraska (EPSCoR)

- U. of Nebraska at Kearney
- U. of Nebraska-Lincoln

Illinois

- U. of Chicago
- U. of Illinois at Chicago (MSI)

Indiana

- Purdue U. Main Campus
- U. of Notre Dame

Ohio

- Case Western Reserve U.
- U. of Akron
- U. of Cincinnati Main Campus

Tennessee

- Vanderbilt U.

South Dakota (EPSCoR)

- Black Hills State U.
- South Dakota School of Mines & Technology
- South Dakota State U.
- U. of South Dakota

Oklahoma (EPSCoR)

- Oklahoma State U. System
- Southwestern Oklahoma State U.
- U. of Oklahoma

Arkansas (EPSCoR)

- U. of Arkansas
- U. of Arkansas for Medical Sciences

Louisiana (EPSCoR)

- Louisiana Tech U.
- Southeastern Louisiana U.

Texas

- Southern Methodist U.
- U. of Texas at Austin
- U. of Texas at Dallas

July 2022 Nautilus Users Across the Country: East

East

Maine (EPSCoR)

- Colby College

New York

- Columbia U.
- New York U.
- Rochester Institute of Technology
- Syracuse U.
- The State U. of New York at Buffalo

Connecticut

- U. of Connecticut
- Yale U.

Delaware (EPSCoR)

- U. of Delaware

Massachusetts

- Massachusetts Institute of Technology
- Northeastern U.

Rhode Island (EPSCoR)

- Brown U.
- U. of Rhode Island

Pennsylvania

- Carnegie Mellon U.

New Jersey

- Rutgers U.

Maryland

- Johns Hopkins U.
- Morgan State U. (MSI)

West Virginia (EPSCoR)

- West Virginia U.

Virginia

- Virginia Commonwealth U.

District of Columbia

- American U.

North Carolina

- N. Carolina Agricultural & Technical State U. (MSI)
- U. of North Carolina at Chapel Hill

South Carolina (EPSCoR)

- Clemson U.

Georgia

- Georgia Institute of Technology
- Georgia State U. (MSI)

Florida

- Florida A&M U. (HBCU/MSI)
- Florida International U. (MSI)
- Florida State U.
- U. of Central Florida (MSI)
- U. of Miami

Puerto Rico (EPSCoR)

- Universidad de Puerto Rico (MSI)

Nautilus