“Getting Started Using the National Research Platform”

SoX Monthly Workshop
Remote Presentation
September 29, 2023

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

NRP NATIONAL RESEARCH PLATFORM

NRP Nautilus

The December 2022 Pacific Research Platform Video Highlights 3 Different Applications Out of 1000 Nautilus Namespace Projects



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

2015-2022: The Pacific Research Platform NSF Grants Were Built on the CENIC Regional Optical Network



NSF CC*DNI Grant
$7.3M 10/2015-10/2020
Extended 2 Years – Ended 10/2022



Source: John Hess, CENIC

2015-2022: 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

Software Specifications

Installation Instructions

Hardware Specifications

2023 – 2021 – 2020 – 2019 – 2018 – 2017 – 2016 – 2015

https://nationalresearchplatform.org/fiona/

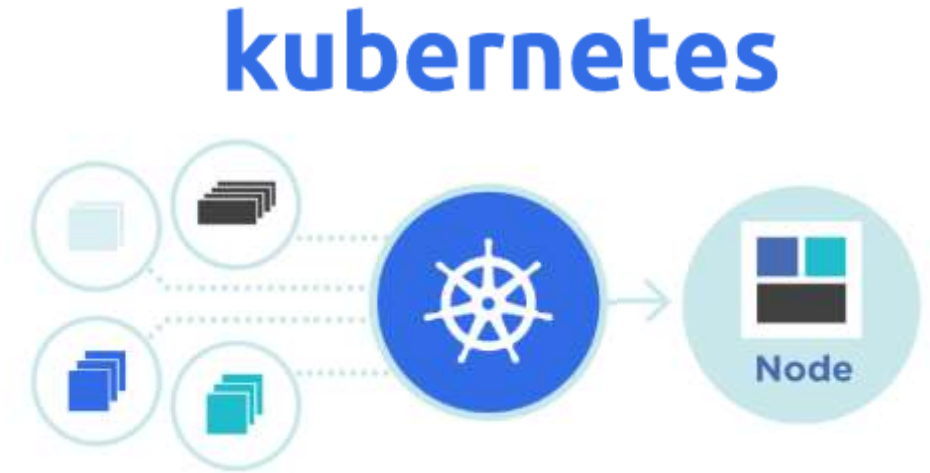


Add Up to 8 Nvidia GPUs Per 2U FIONA
To Add Machine Learning Capability
Up to 240TB Storage

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

2018/2019: PRP Game Changer!
Using Google's Kubernetes to Orchestrate Containers Across the PRP

User Applications



Containers

PRP
PACIFIC RESEARCH PLATFORM

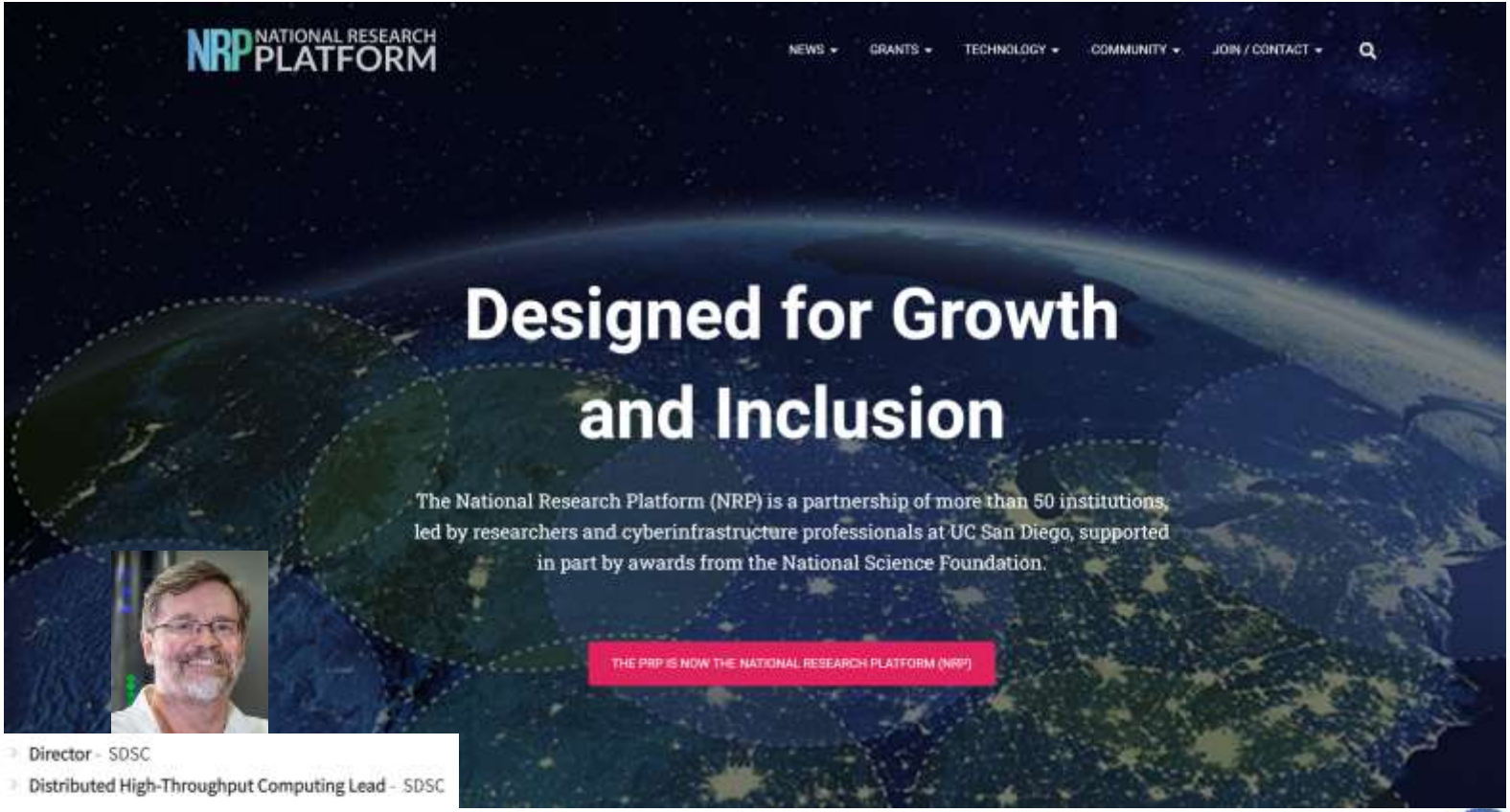
Clouds

NRP NATIONAL RESEARCH PLATFORM

CLOUD NATIVE COMPUTING FOUNDATION

NRP Nautilus

2023 - The National Research Platform Unifies The Previous 8 Years of NSF Grants



2023: NRP's *Nautilus* is a Multi-Institution Hypercluster Which Creates a "Cyberinfrastructure Commons"

Sept. 29, 2023

docker kubernetes Nautilus

~200 FIONAs on 30 Partner Campuses
Networked Together at 10-100Gbps

NSF

Installed CPU Cores	Installed GPUs	Rotating Storage
19970	1249	10,000 TB

CENIC THE QUILT INTERNET2

NRP NATIONAL RESEARCH PLATFORM

NRP Nautilus

The PRP→NRP Has Emphasized Expanding Diversity and Inclusion

The Expansion from PRP in 2015 to the NRP in 2023:

- 6 States ➡ Now 45 States
- 19 Campuses ➡ Now 135 Campuses
- 9 Minority Serving Institutions ➡ Now 24 MSIs
- 2 NSF EPCoR States ➡ Now 20 EPSCoR States, 2 Territories, and Wash DC

The Key Role of Regional Optical Network Meetings to Engage More Campuses in Using NRP



Jen Leasure
President & CEO,
The Quilt



See https://nationalresearchplatform.org/events/fourth-national-research-platform-4nrp/
for slides and videos of all 4NRP presentations

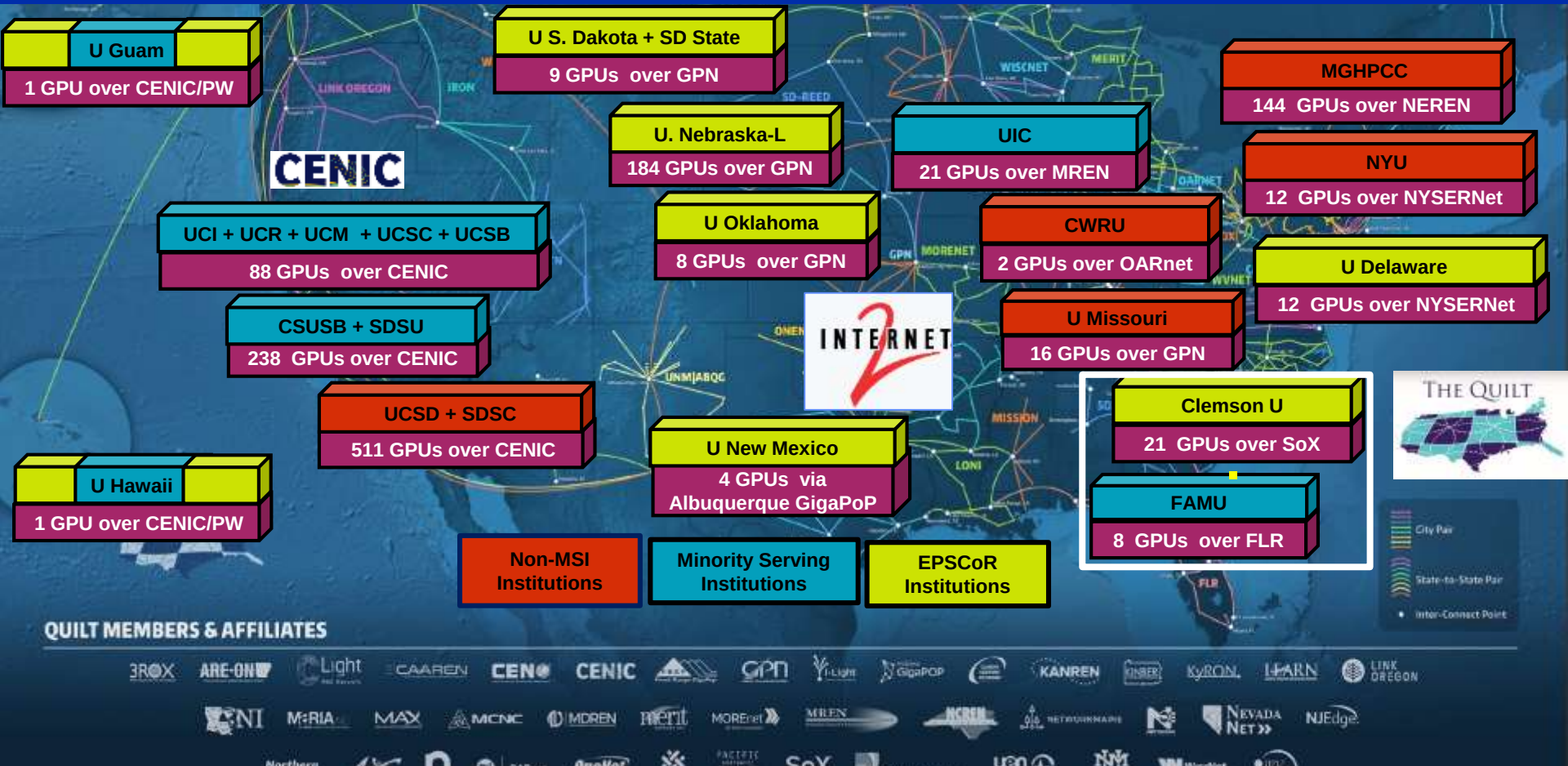


www.thequilt.net/quilt-circle/snapshot-scaling-a-national-research-platform/

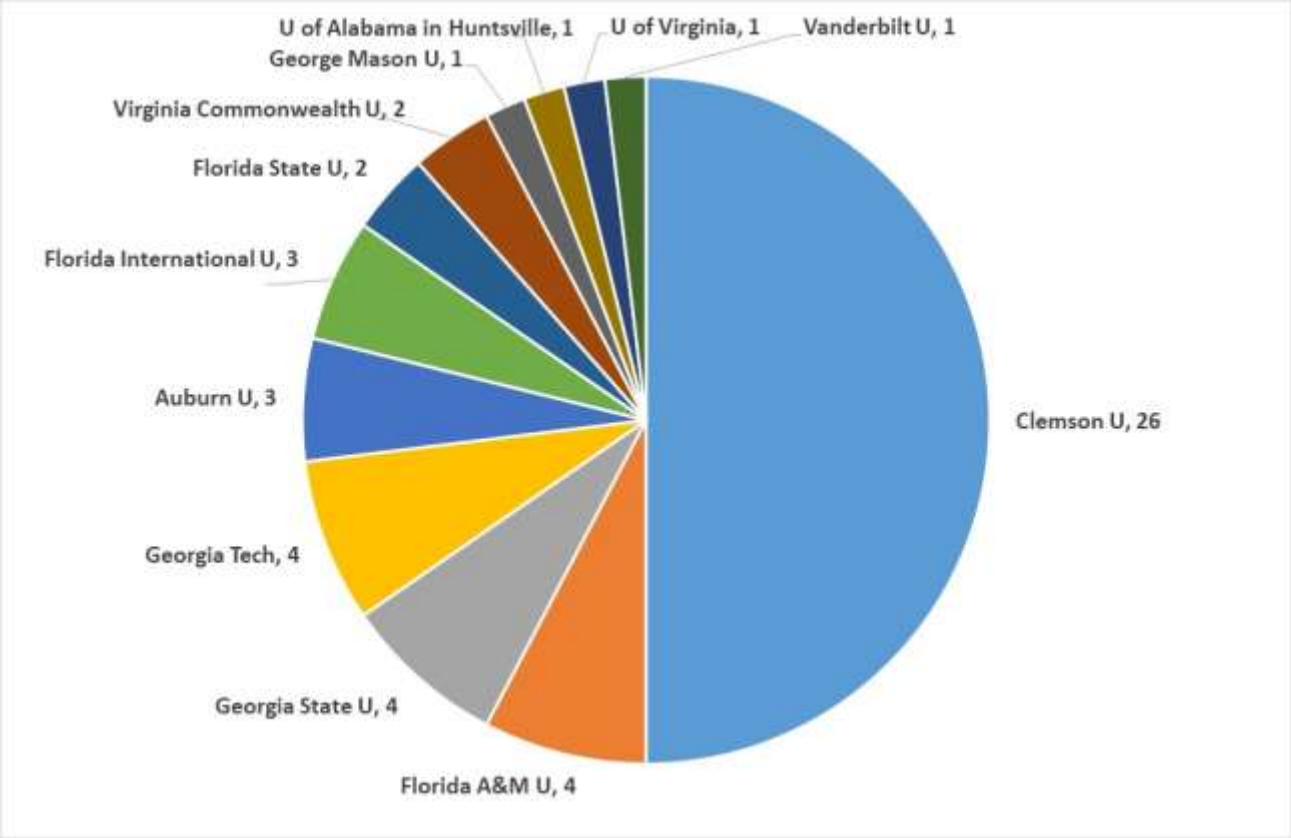
NRP NATIONAL RESEARCH PLATFORM

NRP Nautilus

NRP's Nautilus Hypercluster Is Hosted On Campuses Across the United States Interconnected By Quilt and I2



12 Campuses Connected by SoX, FLR, or MARIA Have 1 or More Users Who Have Logged Onto Nautilus

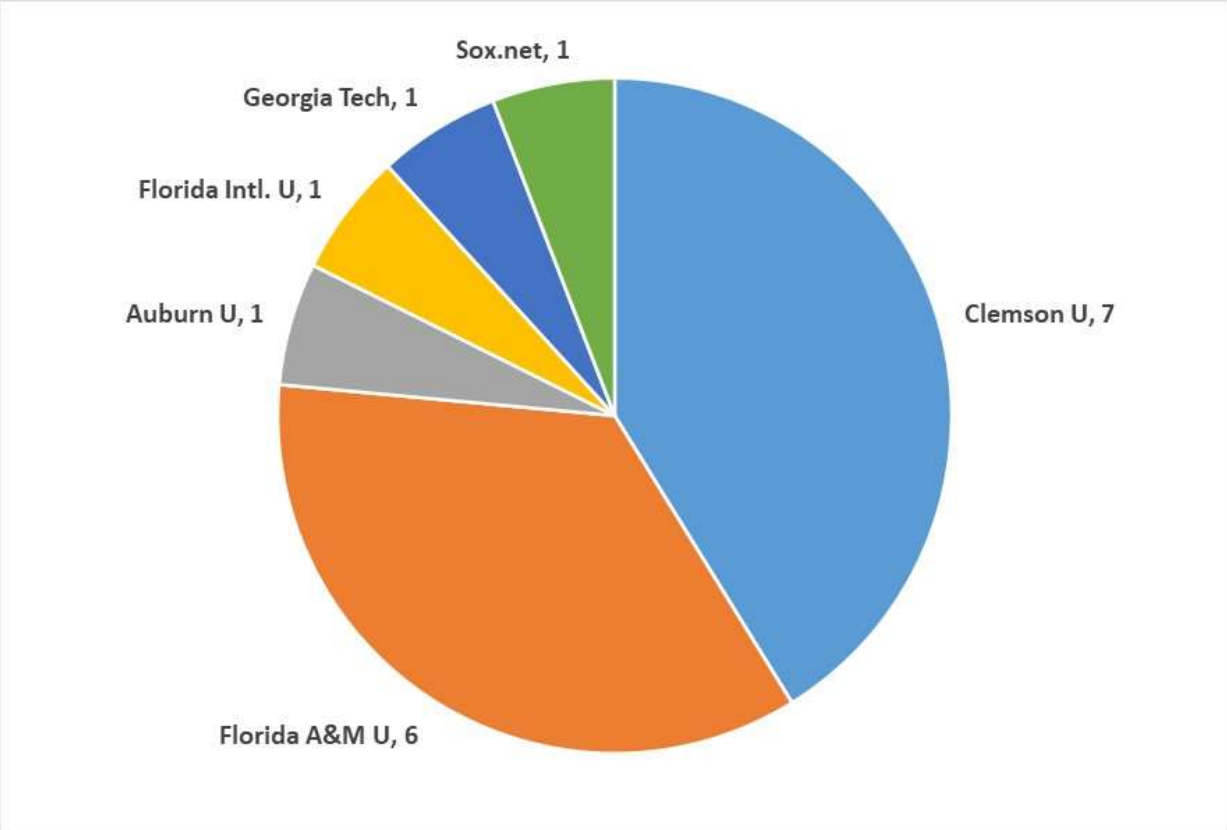


Total: 52 Nautilus Users

NRP NATIONAL RESEARCH PLATFORM

NRP Nautilus

6 Campuses Connected by SoX, FLR, or MARIA Have Created 1 or More Nautilus Namespaces



Total: 17 Nautilus Namespaces

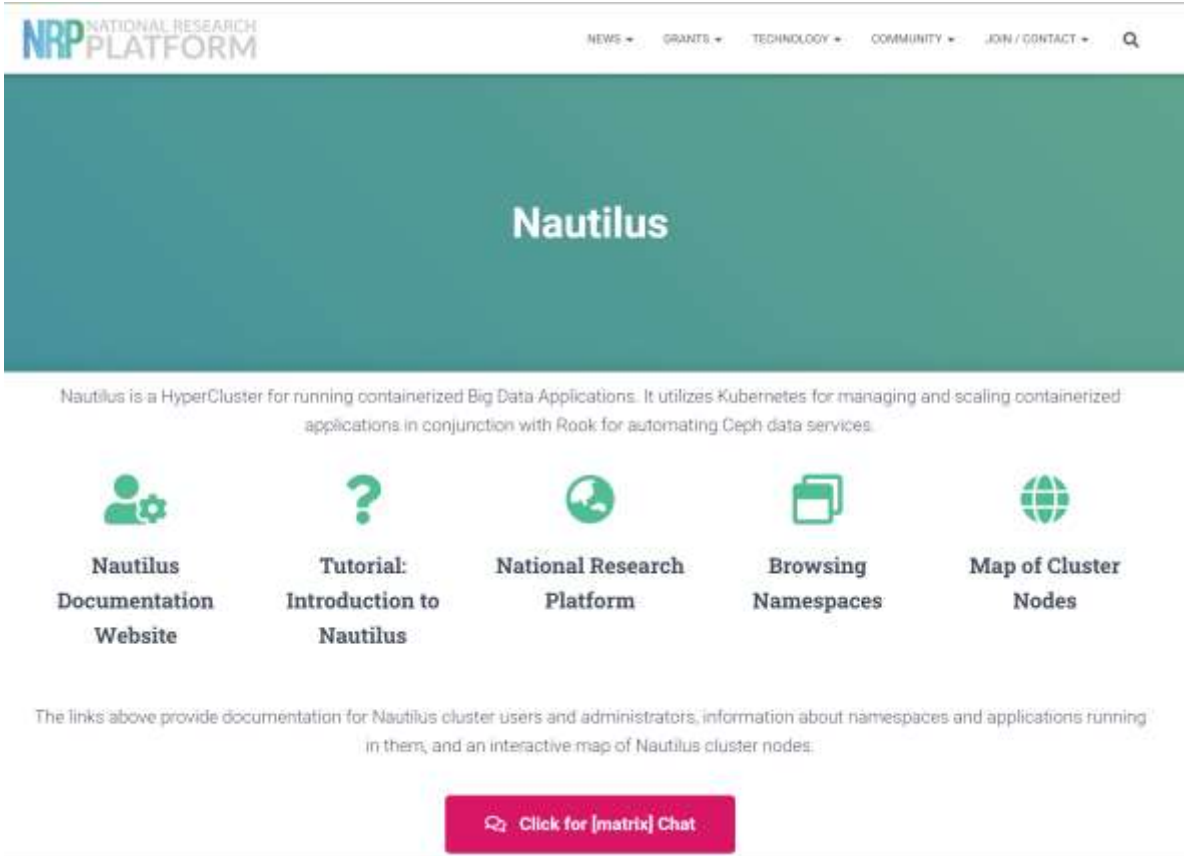
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NRP Nautilus

In the Last 12 Months, Only 2 Campuses Connected by SoX, FLR, or MARIA Have Used Nautilus GPUs or CPUs

	GPU-hrs	CPU Core-hrs
Florida A&M U	252	72
Clemson U	0	26
Total Nautilus	6M	25M

The NRP Web Site Helps Users Get Started Using NRP's Nautilus



https://nationalresearchplatform.org/nautilus/

NRP NATIONAL RESEARCH PLATFORM

NRP Nautilus

California State University San Bernardino is an Excellent Example of How to Help Your Faculty and Students Use NRP



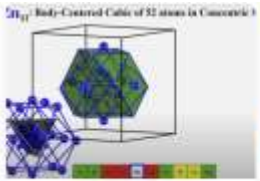
Their Campus HPC Program
Enabled CSUSB Faculty & Students
to Use More NRP GPU-Hours
In the Last 12 Months
Than 8 of the 10 UC Campuses!

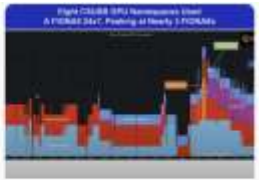


JupyterHub, NRP



ACCESS


Projects


2023 Faculty Showcase

www.csusb.edu/academic-technologies-innovation/xreal-lab-and-high-performance-computing/high-performance-computing

NRP NATIONAL RESEARCH PLATFORM

NRP Nautilus

The CSUSB HPC Team Is the Major Reason For CSUSB Having the Largest NRP Utilization of 23 CSUs

- **Dr. Sam Sudhakar**
  - Chief Financial Officer and Vice President, Finance, Technology, & Operations
- **Gerard Au**
  - Chief Information Officer
- **Dr. Bradford Owen**
  - AVP for Faculty Development, Chief Academic Technologies Officer
- **Dr. Dung Vu**
  - HPC Consultant, Analyst/Programmer
- **James MacDonell**
  - HPC Consultant, Information Security Analyst
- **Prof. Youngsu Kim**
  - HPC Faculty Fellow, Asst. Prof. of Mathematics

A Key Reason CSUSB Has The Largest CSU Nautilus Usage: They Installed and Publicized the JupyterHub "Easy Button"



https://csusb-jupyter.nrp-nautilus.io/hub/login

Over 150 Total Users!

Slide Adapted from Prof. Youngsu Kim



CSUSB Provides Human and On-Line Support For Faculty, Students, and Staff to Easily Use JupyterHub to Access NRP

www.csusb.edu/faculty-center-for-excellence/idat/high-performance-computing/jupyterhub-nrp

CSUSB JupyterHub

- Accessible to anyone with a CoyoteID
- Each user is provided with 50 GB of dedicated storage, expandable upon request
- Resources include large RAM and storage and multiple CPUs and GPUs
- Pre-installed software includes Linux desktop, Python, Matlab, R, Scipy, Pyspark, Tensorflow, a data science package, and SageMath
- Other software can be installed upon request
- Can be used for research and classes

CSUSB JupyterHub for faculty research

- Dedicated to faculty research
- Contact Youngsu Kim or Dung Vu to access this server

National Research Platform

- National Research Platform (NRP) Nautilus Cluster
- Petabyte of distributed Ceph storage
- CPU and GPU computing distributed across 150+ nodes
- Our JupyterHubs are hosted on the PRP server





NRP NATIONAL RESEARCH PLATFORM

CSUSB WE DEFINE THE Future

NRP Nautilus

University of Missouri's Grant Scott
Has Built a Model Program for Data Intensive Computing and ML/AI Using NRP

GREAT PLAINS NETWORK

ENGINEERS SHARE EXPERTISE AROUND NAUTILUS WITH GREAT PLAINS NETWORK

June 12, 2023

University of Missouri

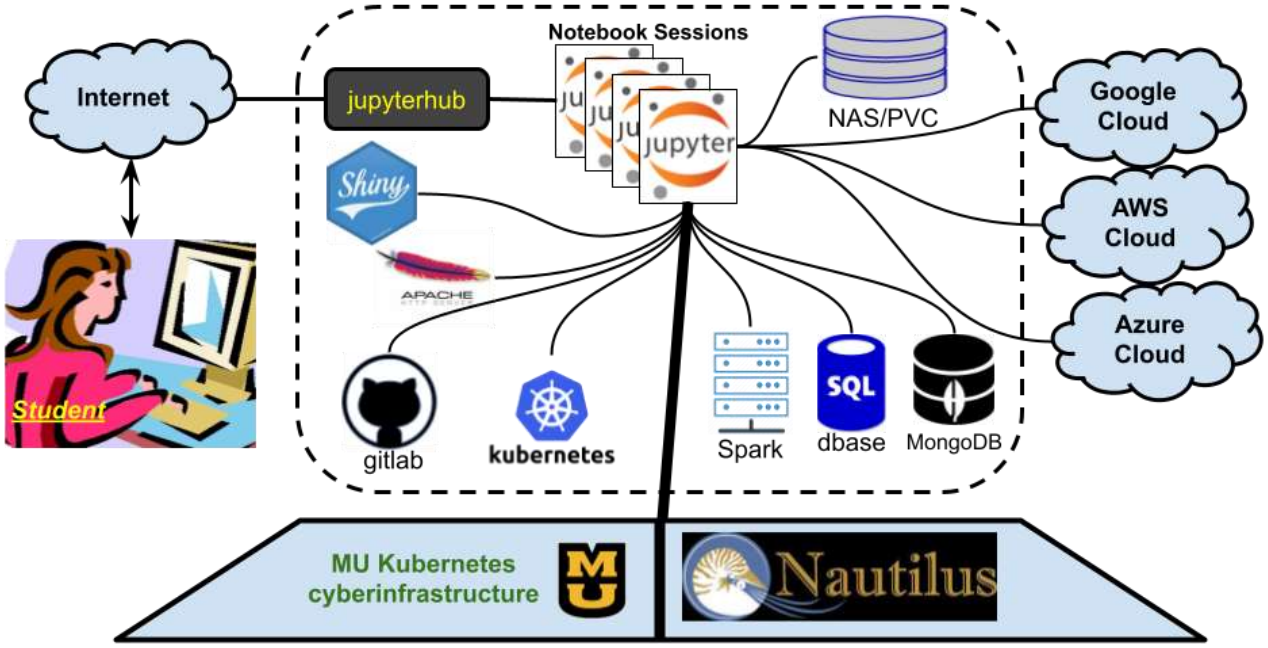


https://engineering.missouri.edu/2023/engineers-share-expertise-around-nautilus-with-great-plains-network/

NRP NATIONAL RESEARCH PLATFORM

NRP Nautilus

University of Missouri is Leveraging Jupyter Hubs on Nautilus for STEM & AI/ML Experiential Learning



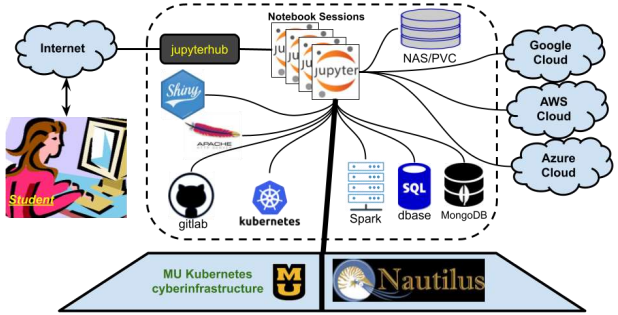
Has 16 GPUs On-Site Now -
Adding 44 with a New CC* Award

Grant Scott
https://scottgs.mufaculty.umsystem.edu/

NRP NATIONAL RESEARCH PLATFORM

University of Missouri

Customized Jupyter Hubs on Nautilus Support Multiple Courses and Certificates



- Computer Science Undergraduate Classes
- Computer Science HPC Classes
- Undergraduate Data Science
- HPC Emphasis Graduate Data Science
- State & Federal Government Training Programs

DEPARTMENT OF HIGHER EDUCATION & WORKFORCE DEVELOPMENT

NRP NATIONAL RESEARCH PLATFORM

Grant Scott
https://scottgs.mufaculty.umsystem.edu/

University of Missouri

UCSD Recently Submitted an NSF Proposal With FAMU and Mizzou's Scott Grant Driving Outreach

CIRC: Grand: The National Research Platform's Community Infrastructure for Research in Computer and Information Science and Engineering (NRP-CIRC)

For the Period 04/01/2024 - 03/31/2029

PI Tom DeFanti, UCSD

"Florida A&M University (FAMU) will host equipment, train CISE campus researchers and students, and design custom outreach mechanisms for the Southeast U.S."

NRP NATIONAL RESEARCH PLATFORM

NRP Nautilus

NRP Support and Community:

- US National Science Foundation (NSF) awards and subawards to UCSD
  --CNS-1456638, CNS-1730158, CNS-2100237, CNS-2120019
  --ACI-1540112, ACI-1541349, OAC-1826967, OAC-2029306, OAC-2112167
- DOD DURIP awards to UCSD
- UC Office of the President, Calit2 and Calit2's UCSD Qualcomm Institute
- San Diego Supercomputer Center and UCSD's Research IT and Instructional IT
- CENIC, Pacific Wave/PNWGP, StarLight/MREN, The Quilt, Great Plains Network, NYSERNet, Open Science Grid, Internet2, DOE ESnet, NCAR/UCAR & Wyoming Supercomputing Center, AWS, Google, Microsoft, Cisco, Juniper, Arista