Pacific Research Platform and The Pacific Rim

Presenter: Tom DeFanti, Research Scientist, QI, Co-PI

Larry Smarr, Calit2 Director and PI

Ilkay Altintas, Camille Crittenden, Ken Kreutz-Delgado, Phil Papadopoulos, Tajana Rosing, Frank Wuerthwein, co-PIs

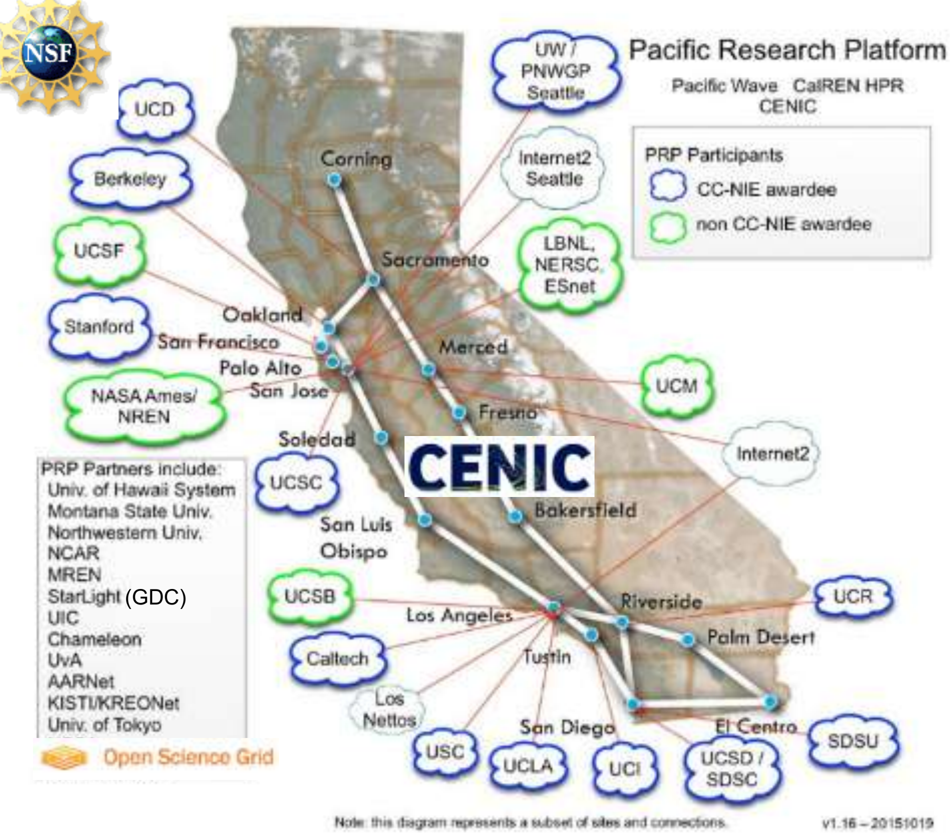
John Graham, Senior Development Engineer

Dima Mishin, Isaac Nealey, Joel Polizzi, Mark Yashar, Programmers

UC San Diego and UC Berkeley

PRP
PACIFIC RESEARCH PLATFORM

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



Source: John Hess, CENIC

NSF CC*DNI Grant
$6.3M 10/2015-10/2020
Year 5 Starts in 3 Weeks!

PI: Larry Smarr, UC San Diego Calit2

Co-PIs:

- **Camille Crittenden, UC Berkeley CITRIS,**
- **Tom DeFanti, UC San Diego Calit2/QI,**
- **Philip Papadopoulos, UCI**
- **Frank Wuerthwein, UCSD Physics and SDSC**

Letters of Commitment from:

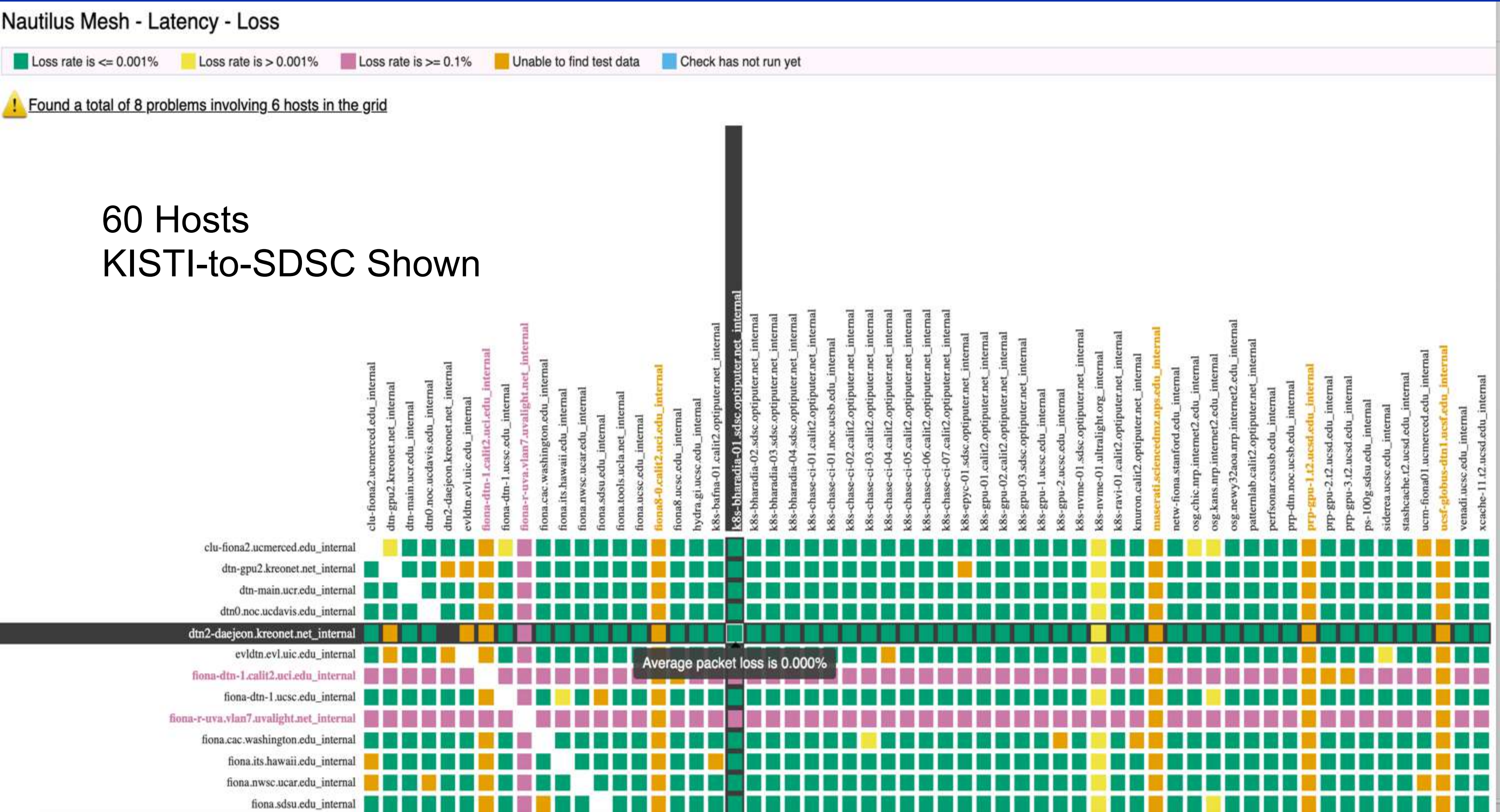
- **50 Researchers from 15 Campuses**
- **32 IT/Network Organization Leaders**

ESnet: Given Fast Networks, Need DMZs and Fast/Tuned DTNs

PACIFIC RESEARCH PLATFORM

PRP Technical Deliverables
2015 - 2017

- **Phase 0: Tested Layer2 CENIC Networks and FIONAs—early 2015**
- **Phase 1: A Scalable Network for Optimizing Data Transfer—2015-2017**
  - **Layer 3 Data Transfer & Measurement Network**
  - **Tested, Debugged, Measured, Optimized, and MaDDash'ed Layer 3**
  - **Supported Rates up to 9.7/10, 37/40 Gb/s in 10GB Bursts**
  - **Included UvAmsterdam and Korea (KISTI)**
  - **Showed Full Bandwidth Utilization**
  - **Essentially No TCP Backoff on Long Distance Best-Efforts Networks**
- **This is What Most Other Research Platforms are Focusing on—Big Data Transfer**



Nautilus Mesh - Latency - Loss

🟩 Loss rate is <= 0.001%
🟨 Loss rate is > 0.001%
🟪 Loss rate is >= 0.1%
🟧 Unable to find test data
🟦 Check has not run yet

⚠ Found a total of 8 problems involving 6 hosts in the grid

60 Hosts
KISTI-to-SDSC Shown

Average packet loss is 0.000%

clu-fiona2.ucmerced.edu_internal
dtn-gpu2.kreonet.net_internal
dtn-main.ucr.edu_internal
dtn0.noc.ucdavis.edu_internal
dtn2-daejeon.kreonet.net_internal
evldtn.evl.uic.edu_internal
fiona-dtn-1.calit2.uci.edu_internal
fiona-dtn-1.ucsc.edu_internal
fiona-r-uva.vlan7.uvalight.net_internal
fiona.cac.washington.edu_internal
fiona.its.hawaii.edu_internal
fiona.nwsc.ucar.edu_internal
fiona.sdsu.edu_internal

clu-fiona2.ucmerced.edu_internal
dtn-gpu2.kreonet.net_internal
dtn-main.ucr.edu_internal
dtn0.noc.ucdavis.edu_internal
dtn2-daejeon.kreonet.net_internal
evldtn.evl.uic.edu_internal
fiona-dtn-1.calit2.uci.edu_internal
fiona-dtn-1.ucsc.edu_internal
fiona-r-uva.vlan7.uvalight.net_internal
fiona.cac.washington.edu_internal
fiona.its.hawaii.edu_internal
fiona.nwsc.ucar.edu_internal
fiona.sdsu.edu_internal
fiona.tools.ucla.net_internal
fiona.ucsc.edu_internal
fiona8-0.calit2.uci.edu_internal
fiona8.ucsc.edu_internal
hydra.gi.ucsc.edu_internal
k8s-bafna-01.calit2.optiputer.net_internal
k8s-bharadia-01.sdsc.optiputer.net_internal
k8s-bharadia-02.sdsc.optiputer.net_internal
k8s-bharadia-03.sdsc.optiputer.net_internal
k8s-bharadia-04.sdsc.optiputer.net_internal
k8s-chase-ci-01.calit2.optiputer.net_internal
k8s-chase-ci-01.noc.ucsb.edu_internal
k8s-chase-ci-02.calit2.optiputer.net_internal
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k8s-chase-ci-07.calit2.optiputer.net_internal
k8s-epyc-01.sdsc.optiputer.net_internal
k8s-gpu-01.calit2.optiputer.net_internal
k8s-gpu-02.calit2.optiputer.net_internal
k8s-gpu-03.sdsc.optiputer.net_internal
k8s-gpu-1.ucsc.edu_internal
k8s-gpu-2.ucsc.edu_internal
k8s-nvme-01.sdsc.optiputer.net_internal
k8s-nvme-01.ultralight.org_internal
k8s-ravi-01.calit2.optiputer.net_internal
knuron.calit2.optiputer.net_internal
maserati.sciencedmz.nps.edu_internal
netw-fiona.stanford.edu_internal
osg.chic.nrp.internet2.edu_internal
osg.kans.nrp.internet2.edu_internal
osg.newy32aoa.nrp.internet2.edu_internal
patternlab.calit2.optiputer.net_internal
perfsonar.csusb.edu_internal
prp-dtn.noc.ucsb.edu_internal
prp-gpu-1.t2.ucsd.edu_internal
prp-gpu-2.t2.ucsd.edu_internal
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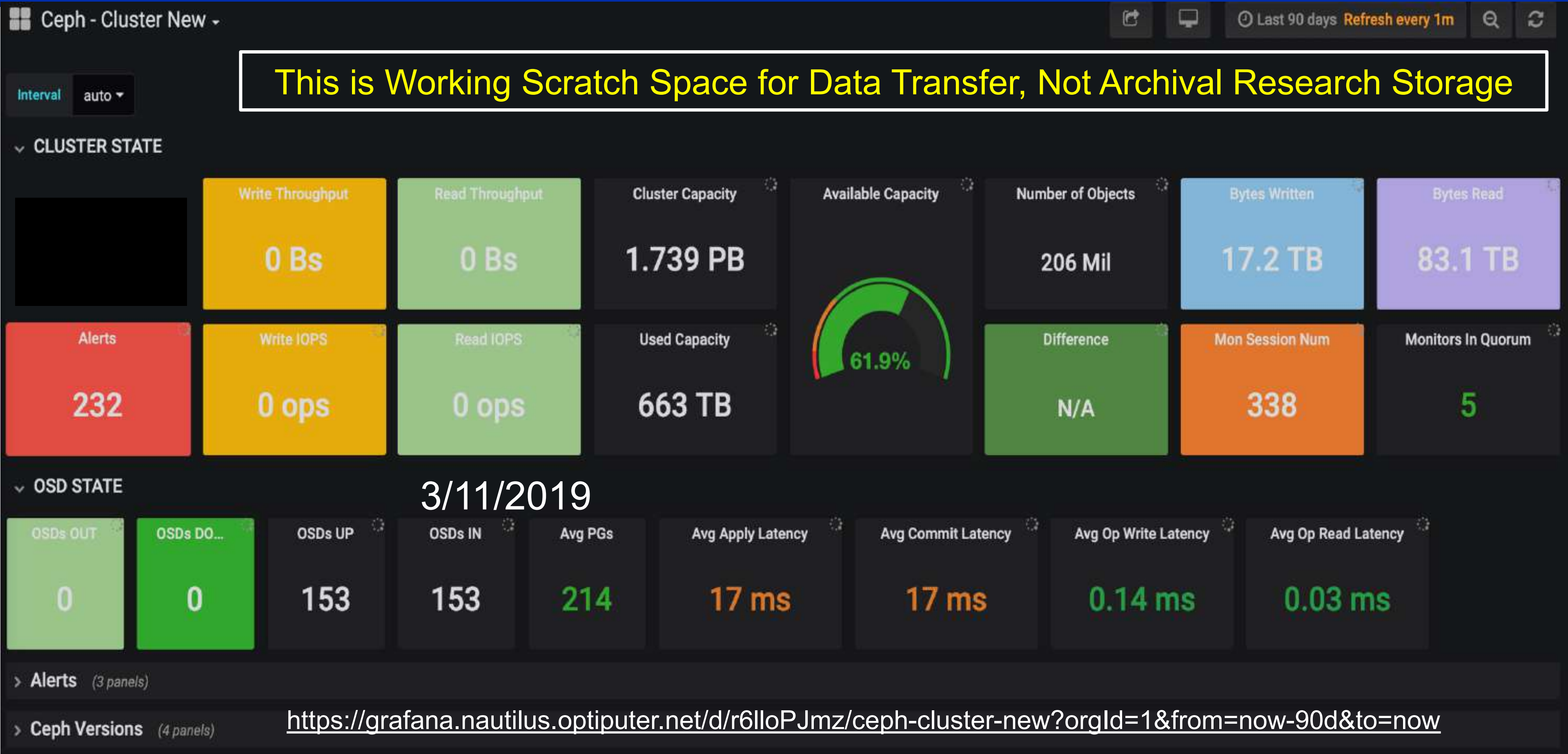
stashcache.t2.ucsd.edu_internal
ucm-fiona01.ucmerced.edu_internal
ucsf-globus-dtn1.ucsf.edu_internal
venadi.ucsc.edu_internal
xcache-11.t2.ucsd.edu_internal

PRPv1 to PRPv2: The Transition from Network Diagnosing to Application Support

- PRPv1 Designed, Built, and Installed ~40 Purpose-built FIONAs, Tuned to Measure and Diagnose End-to-End 10G, 40G and 100G
- But, Our PRP NSF Funding Requires Showing Use of the PRP by Scientists and Engineers—It's a Data Grant, not a Networking Grant
- Note: Our Scientists Clearly Need More than Bandwidth Tests
  - Teams of Scientists Want to Share Their Data at High Speed and Compute on It
  - They Need to Interoperate with Commercial and University Clouds
- So PRPv2 Added DMZ-Distributed Temporary Storage
  - 1.7PB total in 14 ~200GB previous PRPv1 FIONAs in Campus DMZs

PACIFIC RESEARCH PLATFORM

Detailed Real-Time Monitoring of PRP Nautilus:
UCD, UCSD, UCI, UCSB, UCLA, UCR, Stanford, UCAR, UCM, UCSC, UHM Ceph



Ceph - Cluster New ▾

Last 90 days Refresh every 1m

Interval auto ▾

This is Working Scratch Space for Data Transfer, Not Archival Research Storage

⌄ CLUSTER STATE

[redacted]

Write Throughput	0 Bs
Read Throughput	0 Bs
Cluster Capacity	1.739 PB
Available Capacity	61.9%
Number of Objects	206 Mil
Bytes Written	17.2 TB
Bytes Read	83.1 TB
Alerts	232
Write IOPS	0 ops
Read IOPS	0 ops
Used Capacity	663 TB
Difference	N/A
Mon Session Num	338
Monitors In Quorum	5

⌄ OSD STATE

3/11/2019

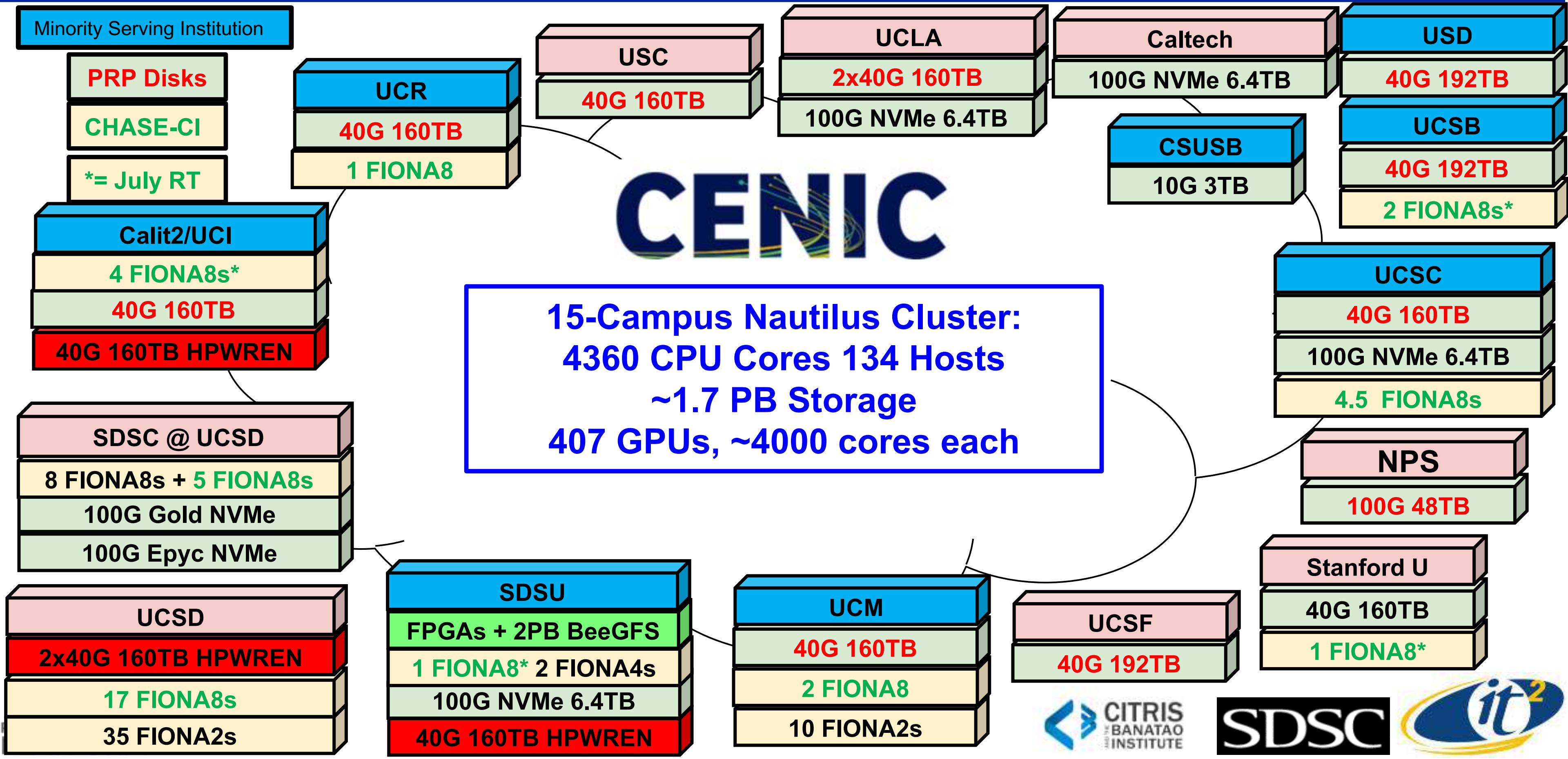
OSDs OUT	0
OSDs DO...	0
OSDs UP	153
OSDs IN	153
Avg PGs	214
Avg Apply Latency	17 ms
Avg Commit Latency	17 ms
Avg Op Write Latency	0.14 ms
Avg Op Read Latency	0.03 ms

› Alerts (3 panels)

› Ceph Versions (4 panels)

https://grafana.nautilus.optiputer.net/d/r6lloPJmz/ceph-cluster-new?orgId=1&from=now-90d&to=now

Regional Scale Cluster: Connected by PRP's Use of CENIC 100G Network
PRP's Nautilus Hypercluster



Minority Serving Institution

PRP Disks

CHASE-CI

*= July RT

UCR
40G 160TB
1 FIONA8

USC
40G 160TB

UCLA
2x40G 160TB
100G NVMe 6.4TB

Caltech
100G NVMe 6.4TB

USD
40G 192TB

UCSB
40G 192TB
2 FIONA8s*

CSUSB
10G 3TB

Calit2/UCI
4 FIONA8s*
40G 160TB
40G 160TB HPWREN

UCSC
40G 160TB
100G NVMe 6.4TB
4.5 FIONA8s

NPS
100G 48TB

SDSC @ UCSD
8 FIONA8s + 5 FIONA8s
100G Gold NVMe
100G Epyc NVMe

Stanford U
40G 160TB
1 FIONA8*

UCSD
2x40G 160TB HPWREN
17 FIONA8s
35 FIONA2s

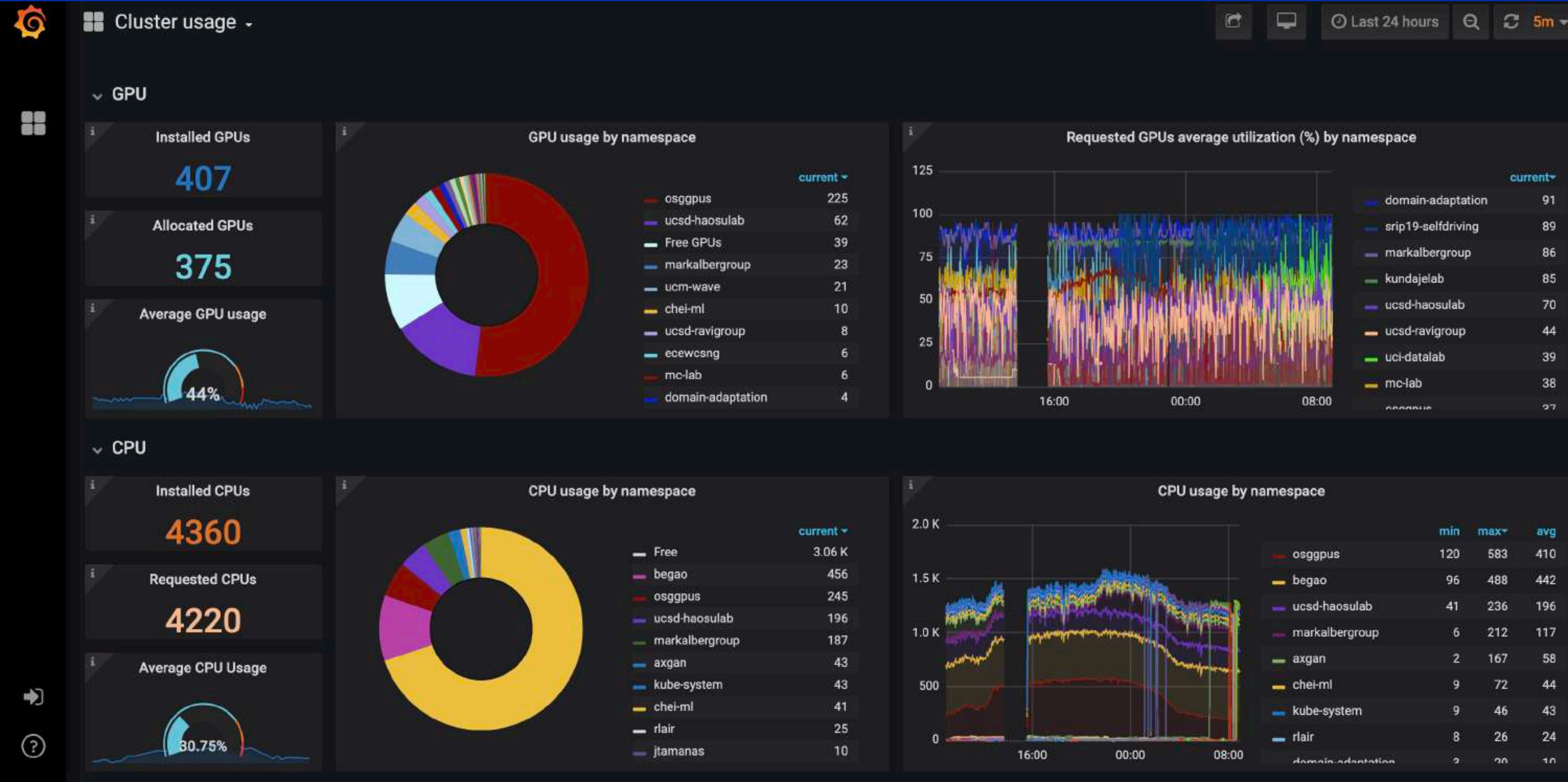
SDSU
FPGAs + 2PB BeeGFS
1 FIONA8* 2 FIONA4s
100G NVMe 6.4TB
40G 160TB HPWREN

UCM
40G 160TB
2 FIONA8
10 FIONA2s

UCSF
40G 192TB

15-Campus Nautilus Cluster:
4360 CPU Cores 134 Hosts
~1.7 PB Storage
407 GPUs, ~4000 cores each

Grafana Showing State of Nautilus 9-10-19



Cluster usage

GPU

Installed GPUs

407

Allocated GPUs

375

Average GPU usage

44%

GPU usage by namespace

	current
osggpus	225
ucsd-haosulab	62
Free GPUs	39
markalbergroup	23
ucm-wave	21
chei-ml	10
ucsd-ravigroup	8
ecewcsng	6
mc-lab	6
domain-adaptation	4

Requested GPUs average utilization (%) by namespace

	current
domain-adaptation	91
srip19-selfdriving	89
markalbergroup	86
kundajelab	85
ucsd-haosulab	70
ucsd-ravigroup	44
uci-datalab	39
mc-lab	38
osggpus	37

CPU

Installed CPUs

4360

Requested CPUs

4220

Average CPU Usage

30.75%

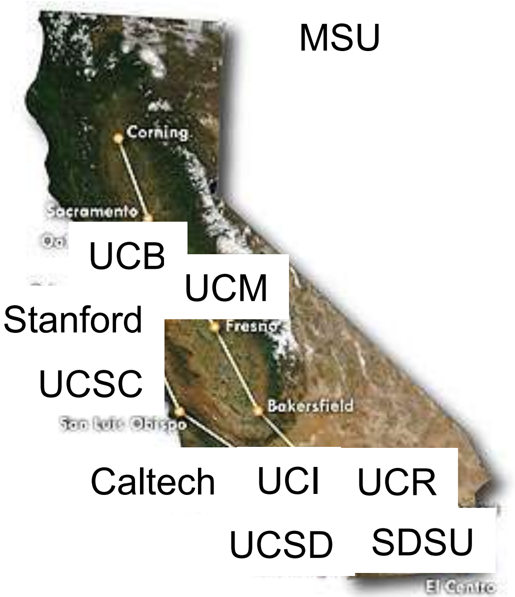
CPU usage by namespace

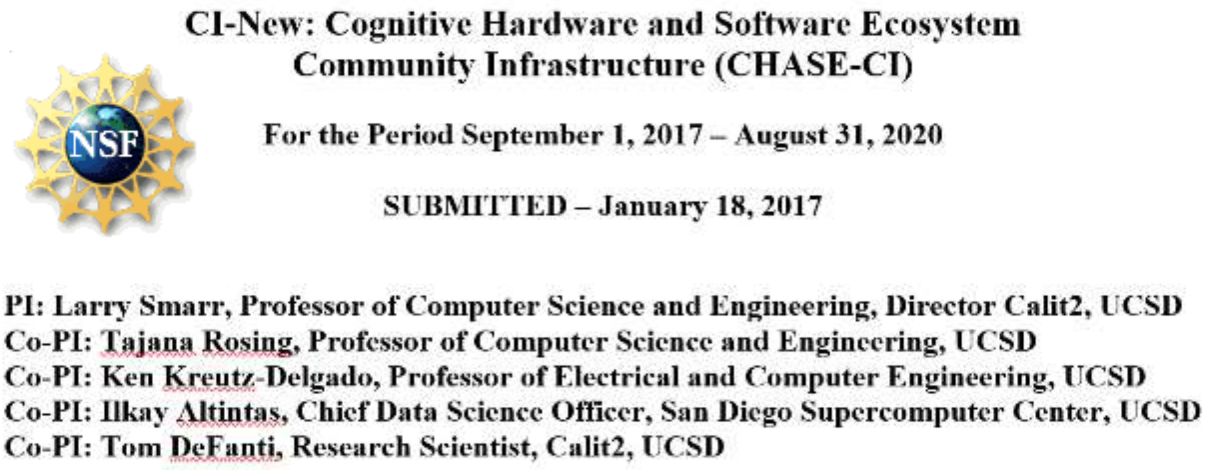
	current
Free	3.06 K
begao	456
osggpus	245
ucsd-haosulab	196
markalbergroup	187
axgan	43
kube-system	43
chei-ml	41
rlair	25
jtamanas	10

CPU usage by namespace

	min	max	avg
osggpus	120	583	410
begao	96	488	442
ucsd-haosulab	41	236	196
markalbergroup	6	212	117
axgan	2	167	58
chei-ml	9	72	44
kube-system	9	46	43
rlair	8	26	24
domain-adaptation	3	20	10

2017-2020: CHASE-CI Adds Machine-Learning to the Data-Science Community Cyberinfrastructure





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

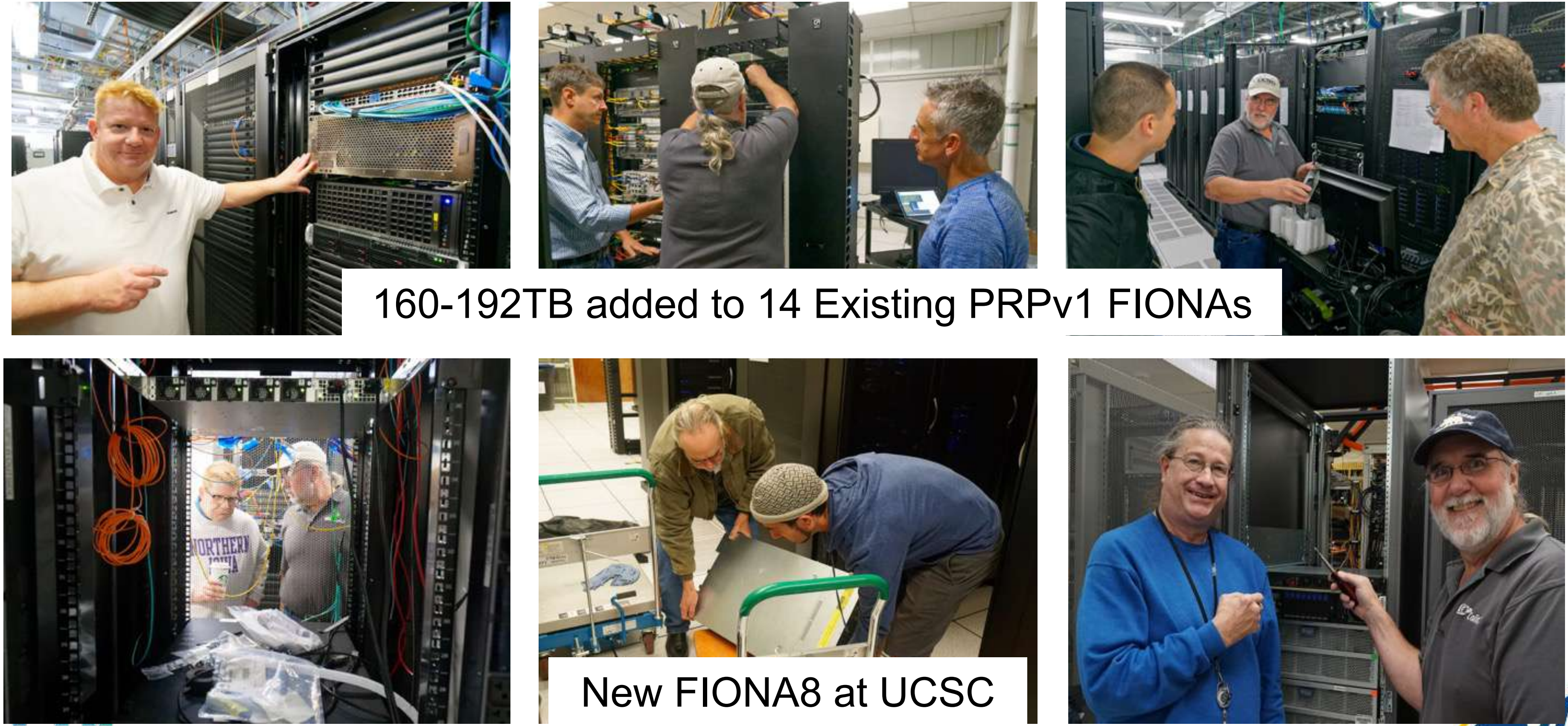
For the Period September 1, 2017 – August 31, 2020

SUBMITTED – January 18, 2017

PI: Larry Smarr, Professor of Computer Science and Engineering, Director Calit2, UCSD
Co-PI: Tajana Rosing, Professor of Computer Science and Engineering, UCSD
Co-PI: Ken Kreutz-Delgado, Professor of Electrical and Computer Engineering, UCSD
Co-PI: Ilkay Altintas, Chief Data Science Officer, San Diego Supercomputer Center, UCSD
Co-PI: Tom DeFanti, Research Scientist, Calit2, UCSD

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

Road Trip! Installing Community Shared Storage and GPUs in June, December & January at UC Merced, UC Santa Cruz, UC Riverside, and Stanford



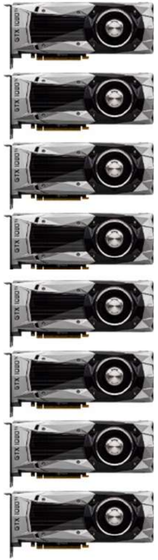
160-192TB added to 14 Existing PRPv1 FIONAs

New FIONA8 at UCSC

PRP Engineers Designed and Built Several Generations of Optical-Fiber Big-Data Flash I/O Network Appliances (FIONAs)

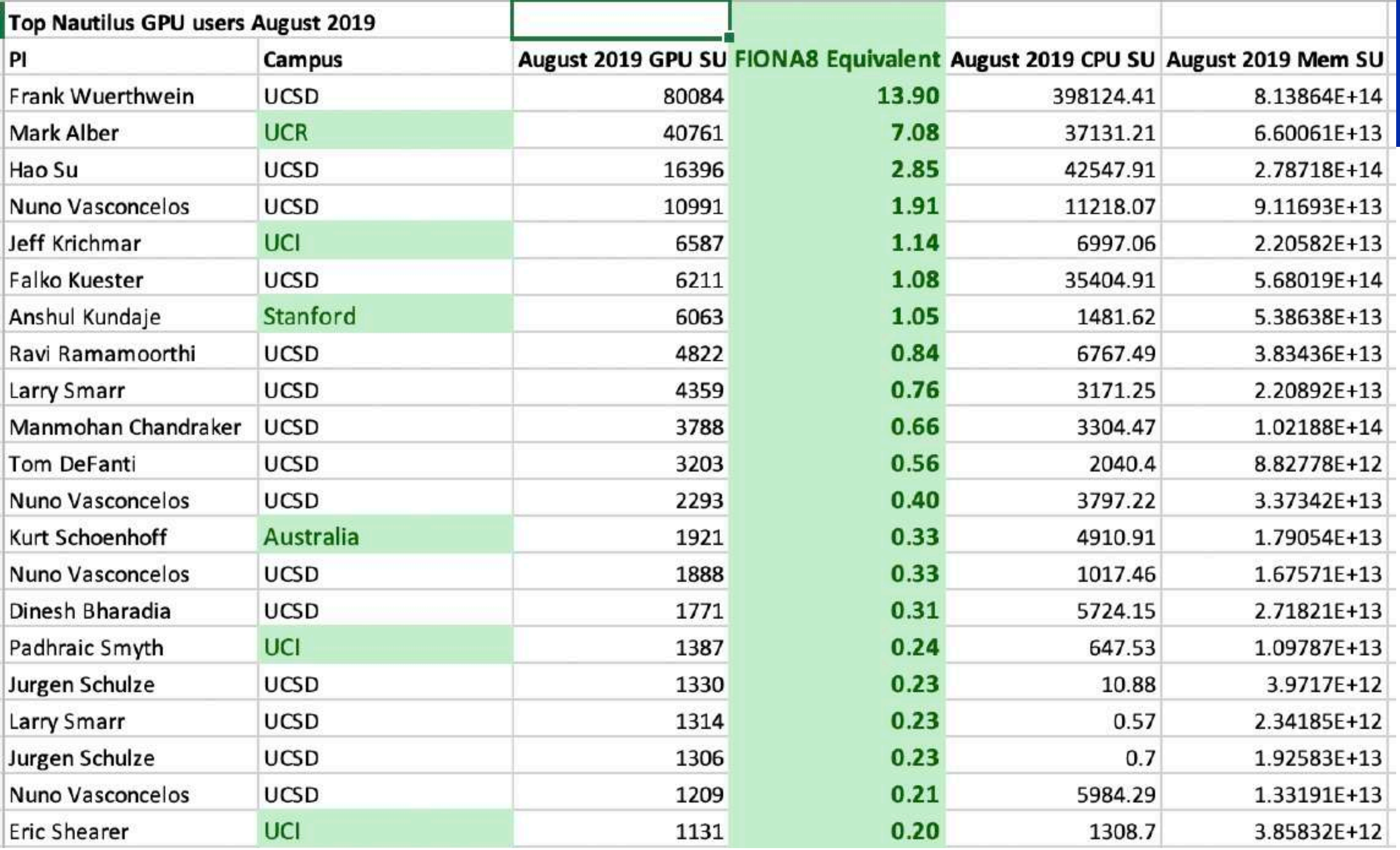
UCSD-Designed FIONAs Solved the Disk-to-Disk Data Transfer Problem *at Near Full Speed* on Best-Effort 10G, 40G and 100G Networks

Two FIONA DTNs at UC Santa Cruz: 40G & 100G
Up to 192 TB Rotating Storage



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

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



Top Nautilus GPU users August 2019					
PI	Campus	August 2019 GPU SU	FIONA8 Equivalent	August 2019 CPU SU	August 2019 Mem SU
Frank Wuerthwein	UCSD	80084	13.90	398124.41	8.13864E+14
Mark Alber	UCR	40761	7.08	37131.21	6.60061E+13
Hao Su	UCSD	16396	2.85	42547.91	2.78718E+14
Nuno Vasconcelos	UCSD	10991	1.91	11218.07	9.11693E+13
Jeff Krichmar	UCI	6587	1.14	6997.06	2.20582E+13
Falko Kuester	UCSD	6211	1.08	35404.91	5.68019E+14
Anshul Kundaje	Stanford	6063	1.05	1481.62	5.38638E+13
Ravi Ramamoorthi	UCSD	4822	0.84	6767.49	3.83436E+13
Larry Smarr	UCSD	4359	0.76	3171.25	2.20892E+13
Manmohan Chandraker	UCSD	3788	0.66	3304.47	1.02188E+14
Tom DeFanti	UCSD	3203	0.56	2040.4	8.82778E+12
Nuno Vasconcelos	UCSD	2293	0.40	3797.22	3.37342E+13
Kurt Schoenhoff	Australia	1921	0.33	4910.91	1.79054E+13
Nuno Vasconcelos	UCSD	1888	0.33	1017.46	1.67571E+13
Dinesh Bharadia	UCSD	1771	0.31	5724.15	2.71821E+13
Padhraic Smyth	UCI	1387	0.24	647.53	1.09787E+13
Jurgen Schulze	UCSD	1330	0.23	10.88	3.9717E+12
Larry Smarr	UCSD	1314	0.23	0.57	2.34185E+12
Jurgen Schulze	UCSD	1306	0.23	0.7	1.92583E+13
Nuno Vasconcelos	UCSD	1209	0.21	5984.29	1.33191E+13
Eric Shearer	UCI	1131	0.20	1308.7	3.85832E+12

Top Nautilus GPU Users in August 2019

FIONA8 equivalent: running an 8-GPU machine 24x7x30

Top User is IceCube in OSG background mode

Others are ML

PACIFIC RESEARCH PLATFORM

2017: PRP Connected 70 UCSD SunCAVE and 20 UCM WAVE 4K Screens to Share VR
2018: Added their 90 Game GPUs to PRP/OSG for Machine Learning Computations

UC Merced WAVE 20 Screens 20 GPUs

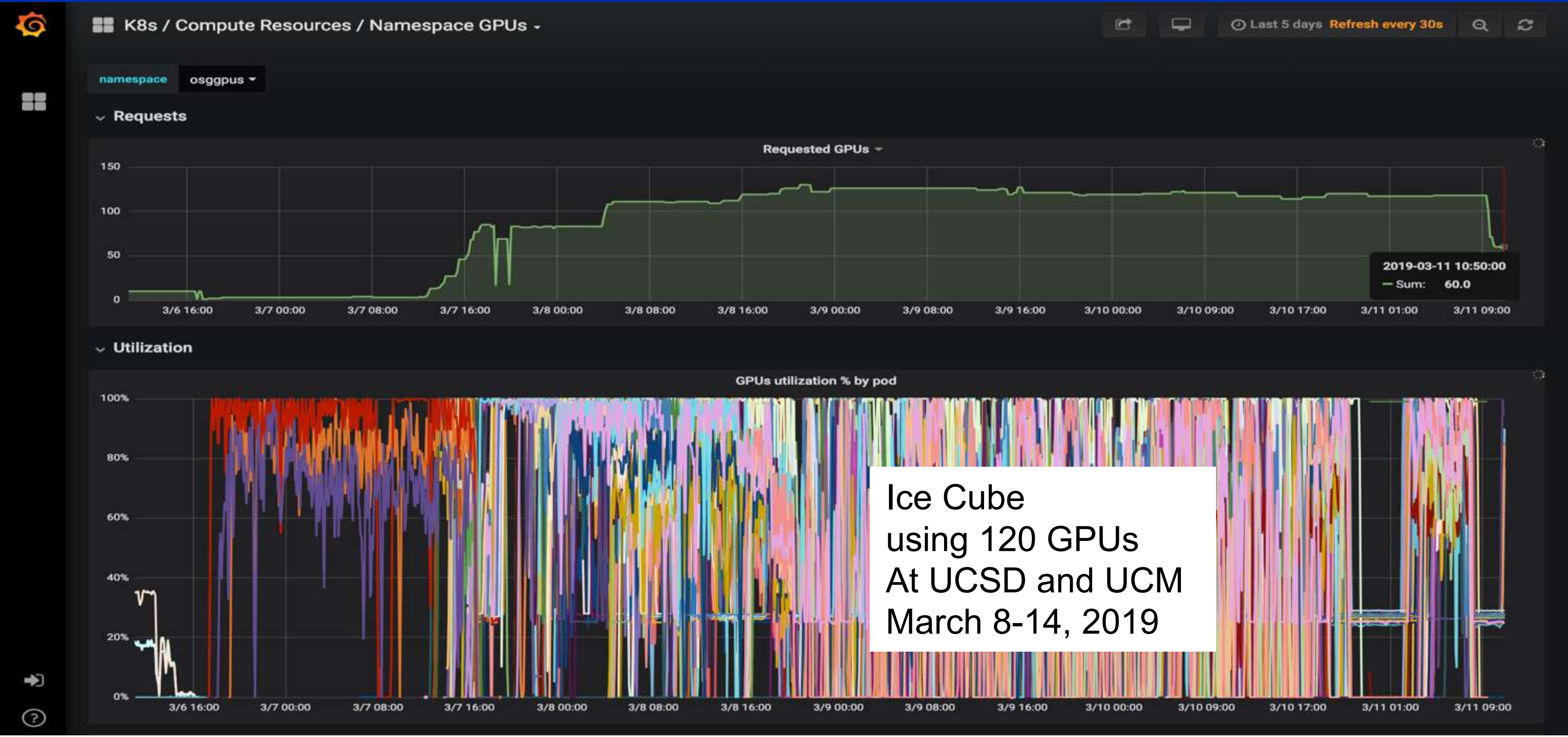
UCSD SunCAVE 70 Screens 70 GPUs

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

By Amble - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=8773726

- IceCube Neutrino Observatory has been using 120 Nautilus GPUs since March 8
- This would cost $2,880/day in a commercial cloud (at $1/hr) or ~$20,000/week
- An 8-GPU FIONA8 for Nautilus costs $20,000 to buy

GPU Simulations are Needed *to Improve Ice Model*.
=> Results in Significant Improvement in Pointing Resolution
for Multi-Messenger Astrophysics



Ice Cube
using 120 GPUs
At UCSD and UCM
March 8-14, 2019

March 13, 2019: “This morning there was a big demo in the SunCAVE. The IceCube pods were kicked out automatically when the SunCAVE GPUs were in use, and restarted when the demo was over. **No admin intervention needed**.”—Igor Sfiligoi, SDSC

Very Cost-Effective for Academic Machine Learning and Data Sharing

- Data science researchers need DTNs with lots of storage, encryption and lots of GPUS
- One UC spends $40,000 in cloud GPU per published grad student paper
- Another spends $20,000 for undergrad ML AWS access in just one course
- Instead, add to our Nautilus hypercluster (or clone it & federate):
  - UCSD ECE Department bought 4 FIONA8s, buying 4 more
  - UCSD Physics Department. bought 6 FIONA8s
  - UCSD CSE researchers bought 4 FIONA8s to add to Nautilus, buying 20 more
  - UCSD Instructional IT has 13 FIONA8s for Machine Learning/AI class labs
- Working Storage on Nautilus FIONAs is
  - very inexpensive (12TB drives are ~$430 each—16 per FIONA. FISA encrypted drives @ same cost)
  - and very high speed (most FIONAs are 40/100G and are located in ScienceDMZs)

Clemson’s Alex Feltus: “I cannot wait to add a node to the Nautilus compute fabric!” (He didn’t wait)

PRP
PACIFIC RESEARCH PLATFORM

UCSD's Information Technology Services Adapted PRP FIONA8s To Support Data Science Courses

Instructional Data Science Machine Learning Platform:

Instead of Spending ~$20,000/Quarter/Course on Commercial Clouds:
97 Courses over 6 Quarters →
$4M vs. $240K over 12 Quarters
At least 20,000 Students

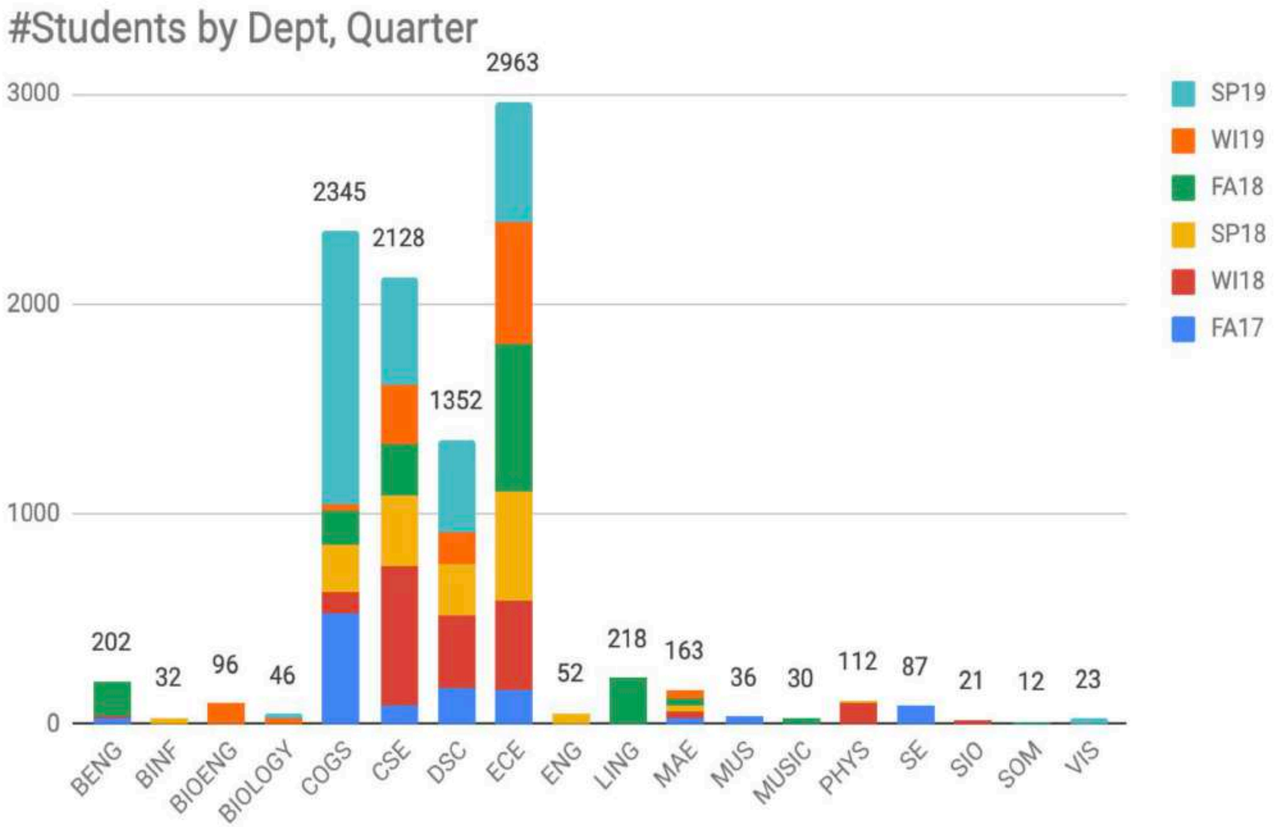
Adam Tilghman, ITS

- 104 GPUs
  - ○ 80 GTX 1080Ti
  - ○ 16 RTX 2080Ti
  - ○ 1.05 Petaflops
- 28 nodes
  - ○ 544 CPU cores
  - ○ 6.5TB RAM
- 40TB Flash Storage
- 10G networking

Source: UCSD ITS

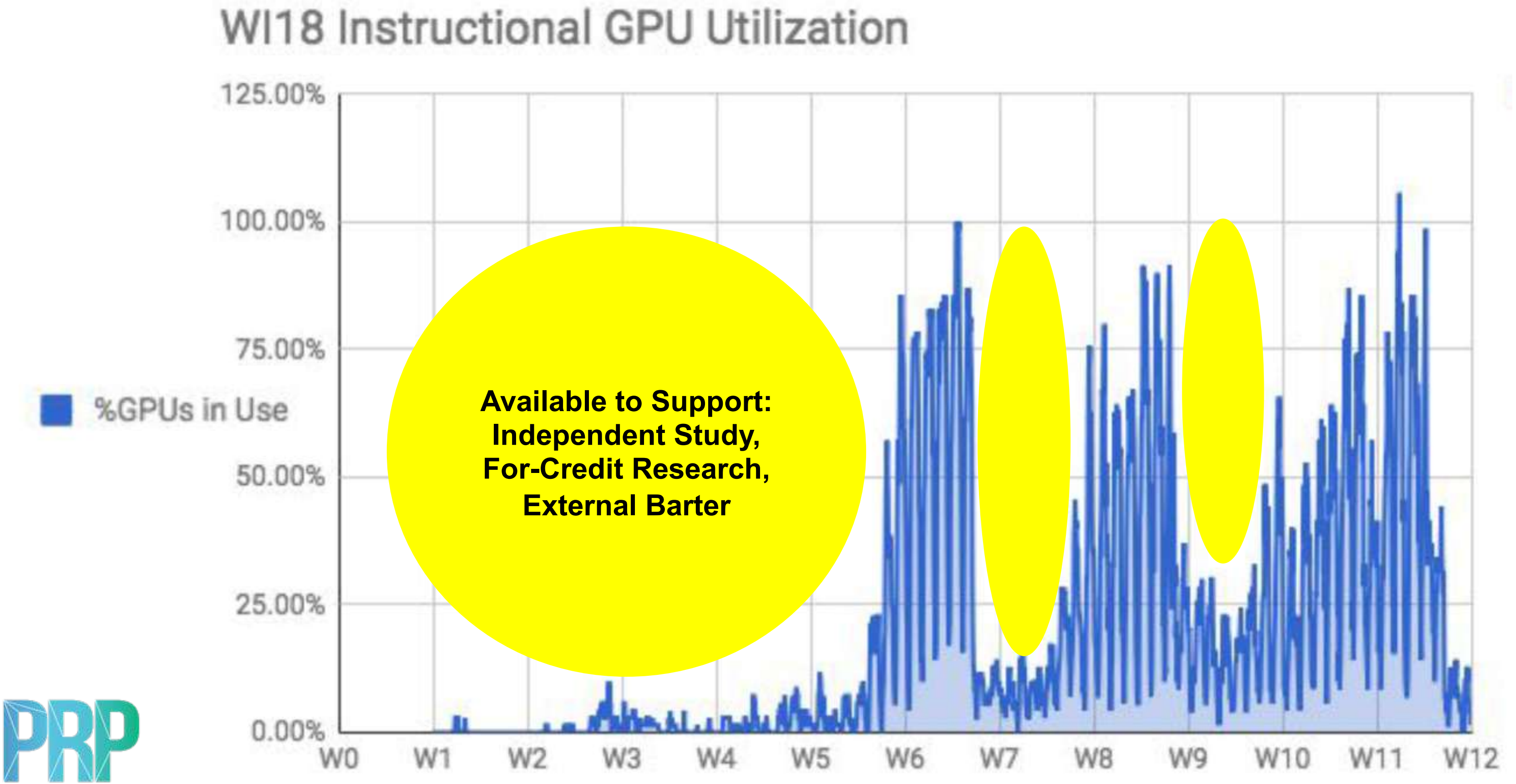
The Student GPUs
Have Supported Thousands of Students in Dozens of Courses

Source: UCSD ITS



PACIFIC RESEARCH PLATFORM

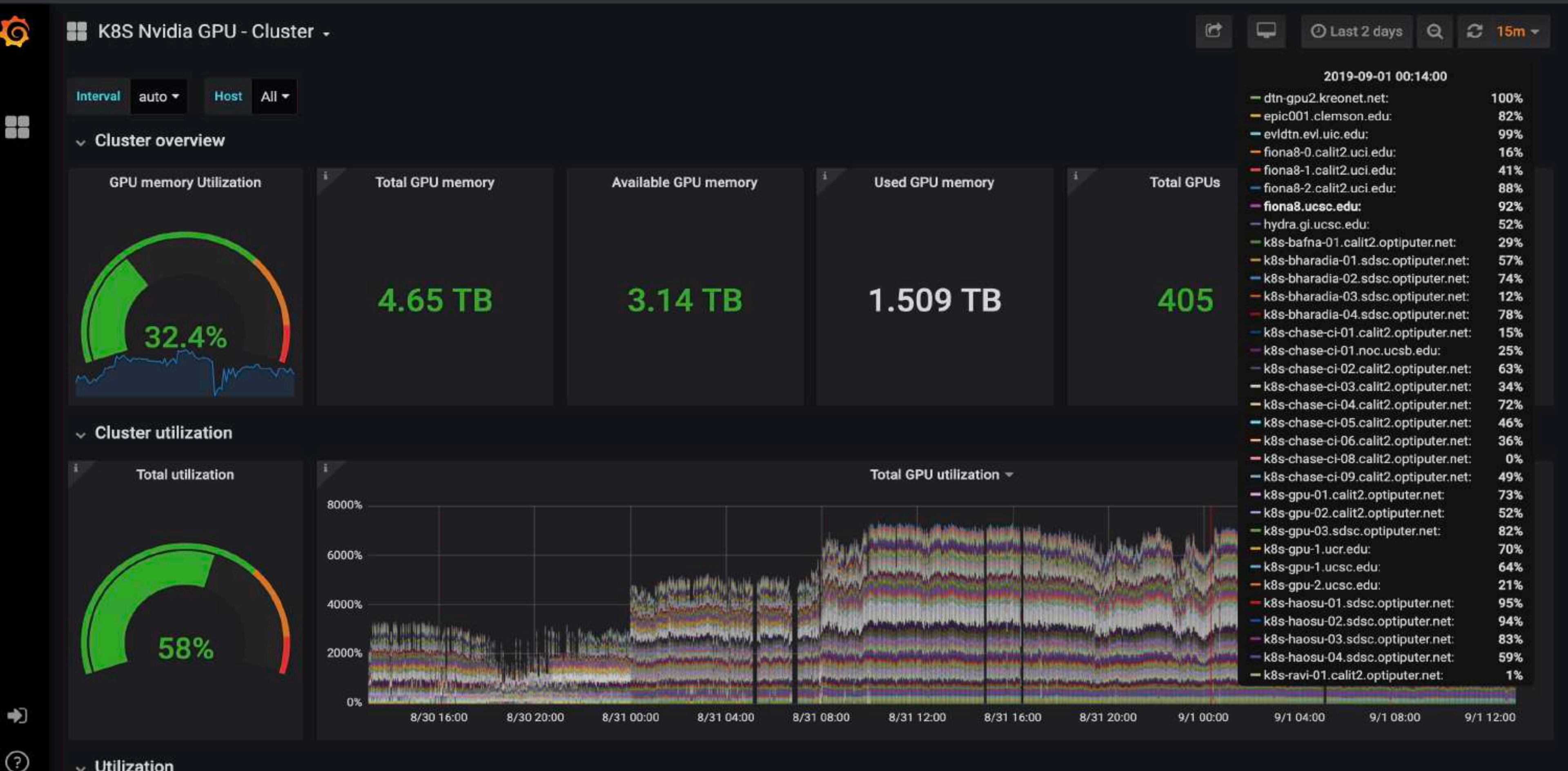
Student GPU Demand Is Variable
Allowing for Other Student Uses



Available to Support:
Independent Study,
For-Credit Research,
External Barter

Source: UCSD ITS

405 Research GPUs in Nautilus 9-10-2019



Cluster overview

GPU memory Utilization	Total GPU memory	Available GPU memory	Used GPU memory	Total GPUs
32.4%	4.65 TB	3.14 TB	1.509 TB	405

Cluster utilization

Total utilization: 58%

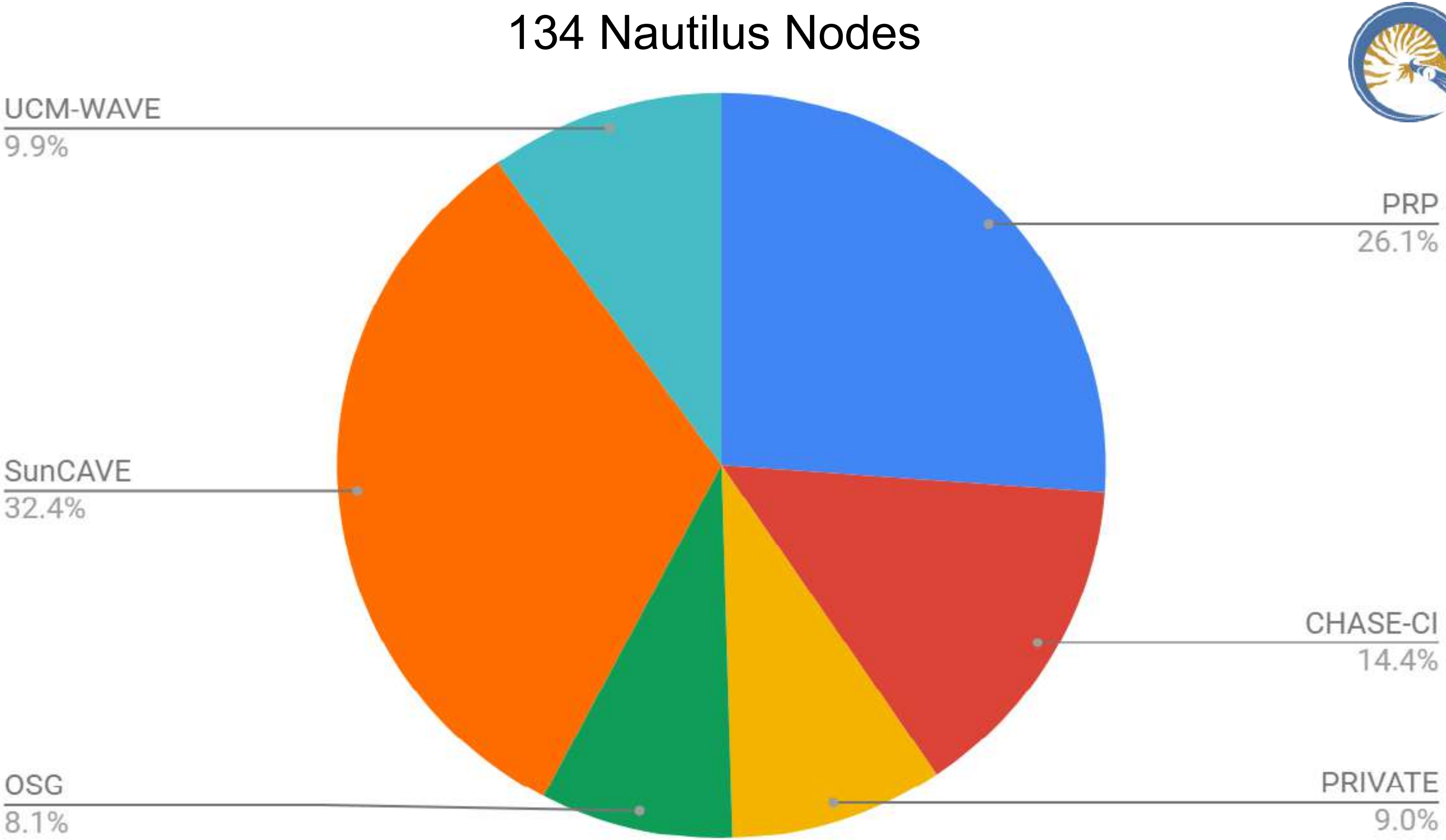
Total GPU utilization

2019-09-01 00:14:00

dtn-gpu2.kreonet.net:	100%
epic001.clemson.edu:	82%
evldtn.evl.uic.edu:	99%
fiona8-0.calit2.uci.edu:	16%
fiona8-1.calit2.uci.edu:	41%
fiona8-2.calit2.uci.edu:	88%
fiona8.ucsc.edu:	92%
hydra.gi.ucsc.edu:	52%
k8s-bafna-01.calit2.optiputer.net:	29%
k8s-bharadia-01.sdsc.optiputer.net:	57%
k8s-bharadia-02.sdsc.optiputer.net:	74%
k8s-bharadia-03.sdsc.optiputer.net:	12%
k8s-bharadia-04.sdsc.optiputer.net:	78%
k8s-chase-ci-01.calit2.optiputer.net:	15%
k8s-chase-ci-01.noc.ucsb.edu:	25%
k8s-chase-ci-02.calit2.optiputer.net:	63%
k8s-chase-ci-03.calit2.optiputer.net:	34%
k8s-chase-ci-04.calit2.optiputer.net:	72%
k8s-chase-ci-05.calit2.optiputer.net:	46%
k8s-chase-ci-06.calit2.optiputer.net:	36%
k8s-chase-ci-08.calit2.optiputer.net:	0%
k8s-chase-ci-09.calit2.optiputer.net:	49%
k8s-gpu-01.calit2.optiputer.net:	73%
k8s-gpu-02.calit2.optiputer.net:	52%
k8s-gpu-03.sdsc.optiputer.net:	82%
k8s-gpu-1.ucr.edu:	70%
k8s-gpu-1.ucsc.edu:	64%
k8s-gpu-2.ucsc.edu:	21%
k8s-haosu-01.sdsc.optiputer.net:	95%
k8s-haosu-02.sdsc.optiputer.net:	94%
k8s-haosu-03.sdsc.optiputer.net:	83%
k8s-haosu-04.sdsc.optiputer.net:	59%
k8s-ravi-01.calit2.optiputer.net:	1%

Utilization

Community Participation Allowed PRP-Paid Nautilus Nodes to be Quadrupled—*Pot Luck Supercomputing*™



Why PRPv2 Adopted Kubernetes

- PRP FIONAs Are Coupled by Kubernetes Into the “Nautilus Hypercluster”
  - Kubernetes “Pods” Encapsulate Application Container(s), Storage Resources, and Execution Options
  - Implements PRP Cooperative Research Groups Support with Policy-Based Scheduling by Use of CILogon and Kubernetes Namespaces—704 Users in Namespaces as of 7/15/19
  - Allows Cloud Native Storage Integration (e.g., Rook/Ceph/EdgeFS)
  - Enables Us to Update Overnight, without local assistance, a RP Scaling Necessity
  - Emerging Solutions for Sophisticated SDN Overlay Network, Firewall, and Network Policy Controls
- Allows Easy User Job Scaling to Heterogeneous Platforms:
  - Deskside, Rack-Mounted, Supercomputers, even IOT Gizmos like ML on Remote Cameras
  - Amazon Elastic Container Service for Kubernetes (Amazon EKS)
  - Google Kubernetes Engine (GKE) (TensorFlow)
  - Microsoft Azure Kubernetes Service (AKS)
  - Also Comet and other XSEDE assets

> “Kubernetes with Rook/Ceph Allows Us to Manage **Petabytes of Distributed Storage and GPUs for Data Science**,
> While We Measure and Monitor Network Use.”
> --John Graham, Calit2/QI UC San Diego

PACIFIC RESEARCH PLATFORM

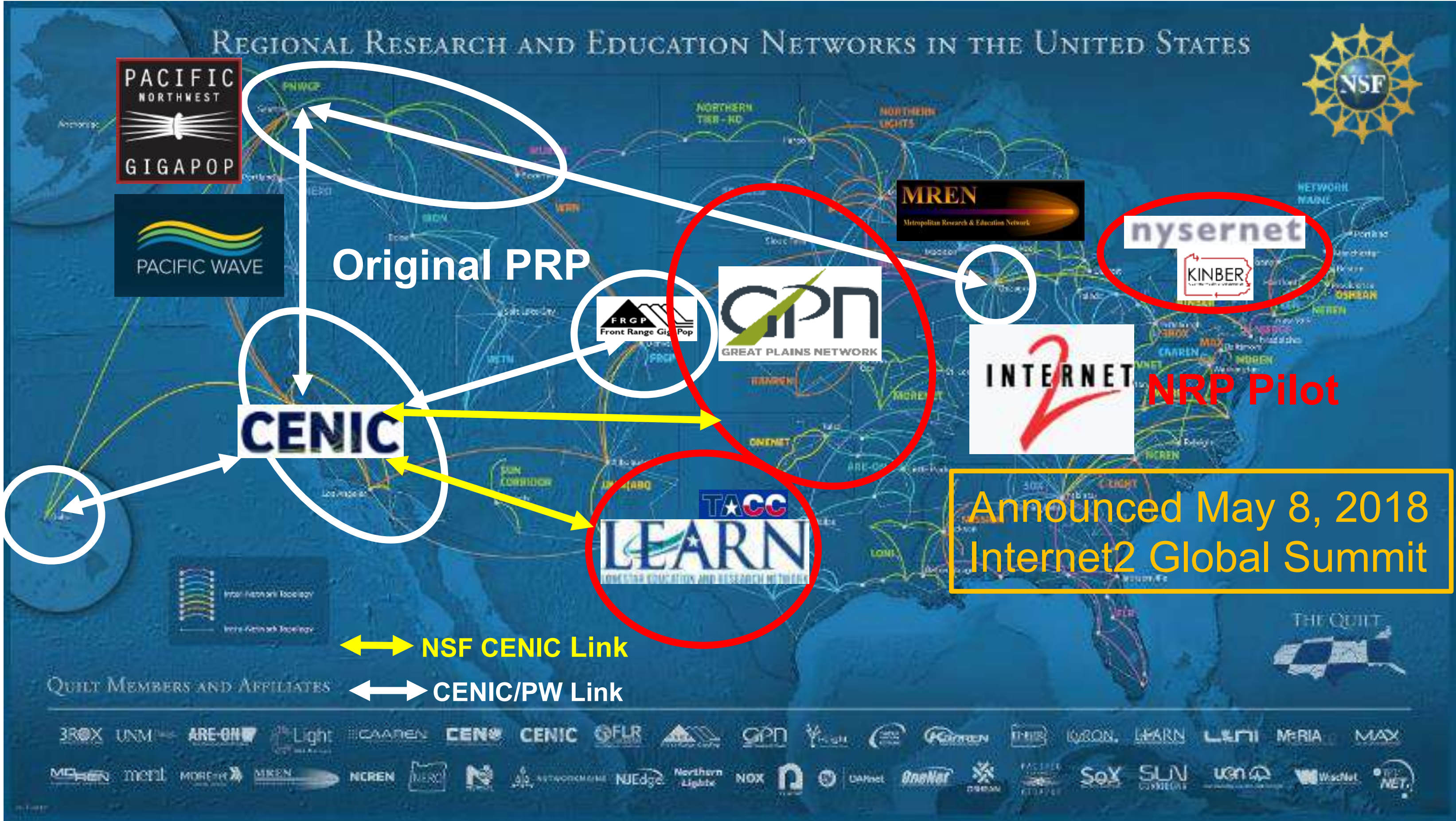
2018-2019: National-Scale Pilot - Using CENIC & Internet2 to Connect Quilt Regional R&E Networks

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

PI Smarr
Co-PIs Altintas
Papadopoulos
Wuerthwein
Rosing
DeFanti

SDSC

PRP
PACIFIC RESEARCH PLATFORM


Regional Research and Education Networks in the United States
NSF
PACIFIC NORTHWEST GIGAPOP
PACIFIC WAVE
CENIC
FRGP Front Range GigaPop
GPN GREAT PLAINS NETWORK
MREN Metropolitan Research & Education Network
nysernet
KINBER
INTERNET2
TACC
LEARN
The Quilt
Quilt Members and Affiliates

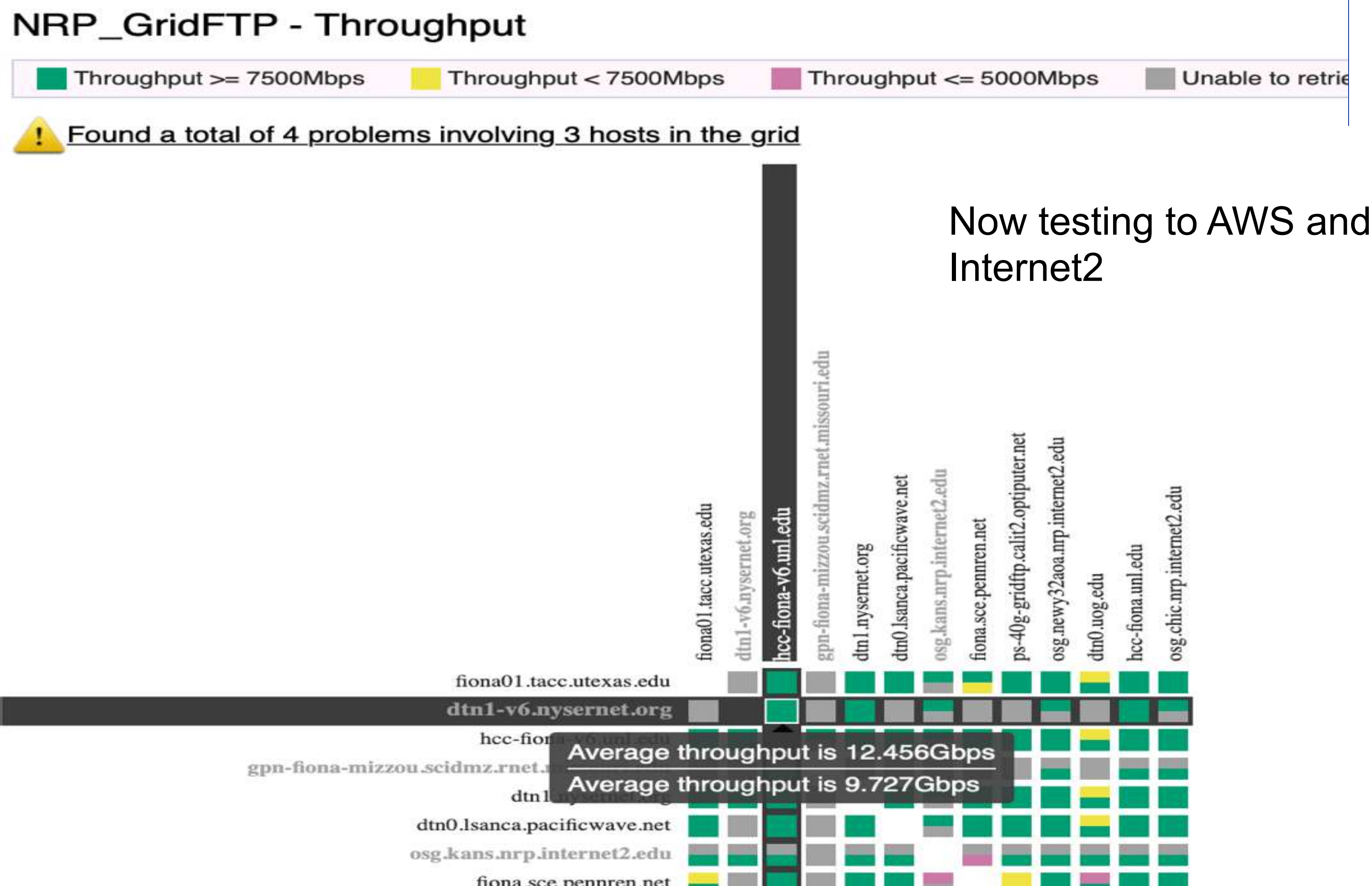
Original PRP

NRP Pilot

Announced May 8, 2018
Internet2 Global Summit

NSF CENIC Link

CENIC/PW Link



NRP_GridFTP - Throughput

🟩 Throughput >= 7500Mbps 🟨 Throughput < 7500Mbps 🟪 Throughput <= 5000Mbps ⬜ Unable to retrie

⚠ Found a total of 4 problems involving 3 hosts in the grid

fiona01.tacc.utexas.edu
dtn1-v6.nysernet.org
hcc-fiona-v6.unl.edu
gpn-fiona-mizzou.scidmz.rnet.missouri.edu
dtn1.nysernet.org
dtn0.lsanca.pacificwave.net
osg.kans.nrp.internet2.edu
fiona.sce.pennren.net
ps-40g-gridftp.calit2.optiputer.net
osg.newy32aoa.nrp.internet2.edu
dtn0.uog.edu
hcc-fiona.unl.edu
osg.chic.nrp.internet2.edu

fiona01.tacc.utexas.edu
dtn1-v6.nysernet.org
hcc-fion
gpn-fiona-mizzou.scidmz.rnet.
dtn1
dtn0.lsanca.pacificwave.net
osg.kans.nrp.internet2.edu
fiona.sce.pennren.net

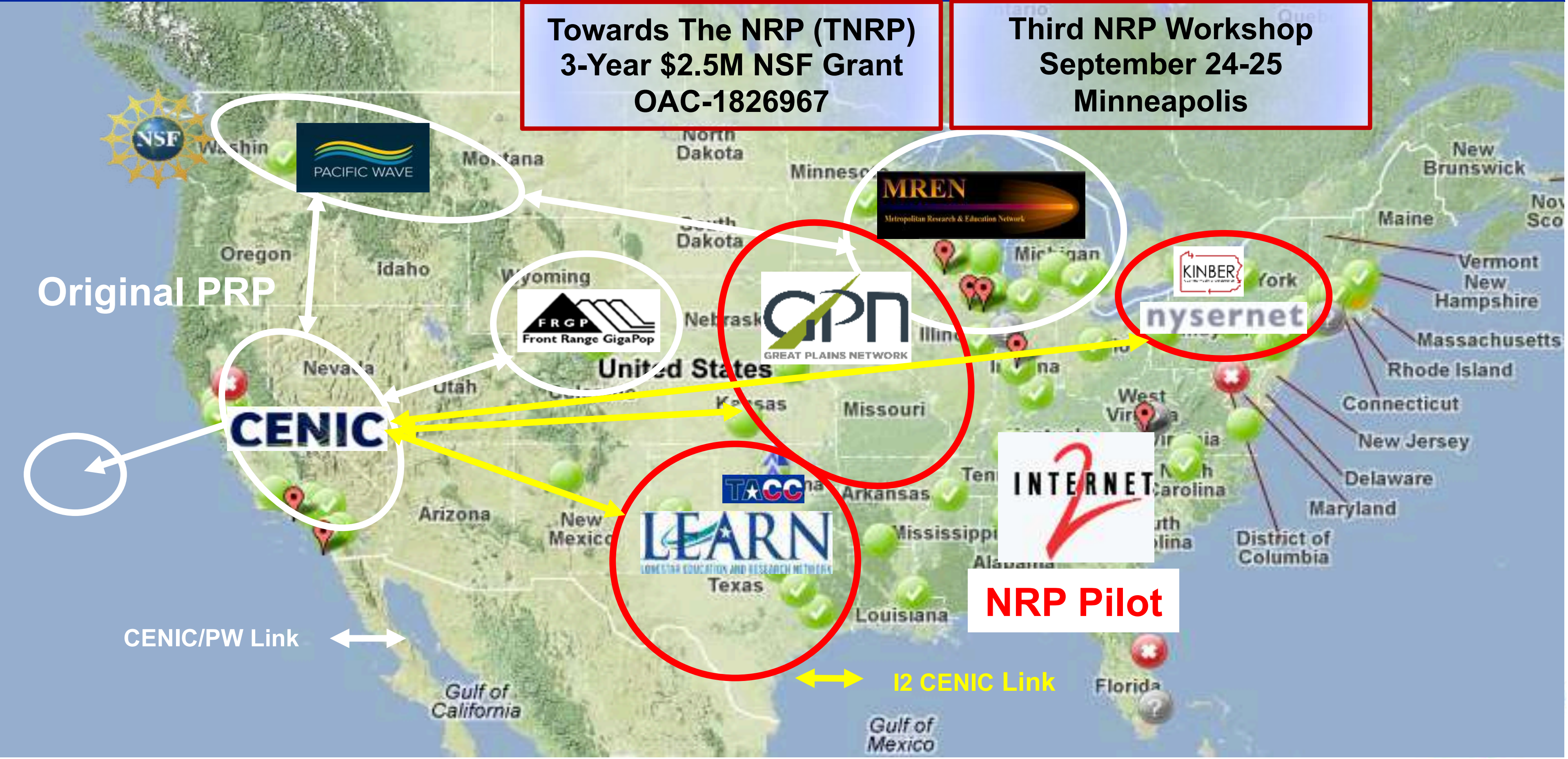
Average throughput is 12.456Gbps
Average throughput is 9.727Gbps

Now testing to AWS and Internet2

TNRP = PRP (CENIC, PNWGP, FRGP, HI, and MREN) + OSG + ESnet + Quilt + NRP Pilot (I2, KINBER, Learn, GPN, NYSERnet) + MCNC + NM Tribal + …

Towards The NRP (TNRP)
3-Year $2.5M NSF Grant
OAC-1826967

Third NRP Workshop
September 24-25
Minneapolis



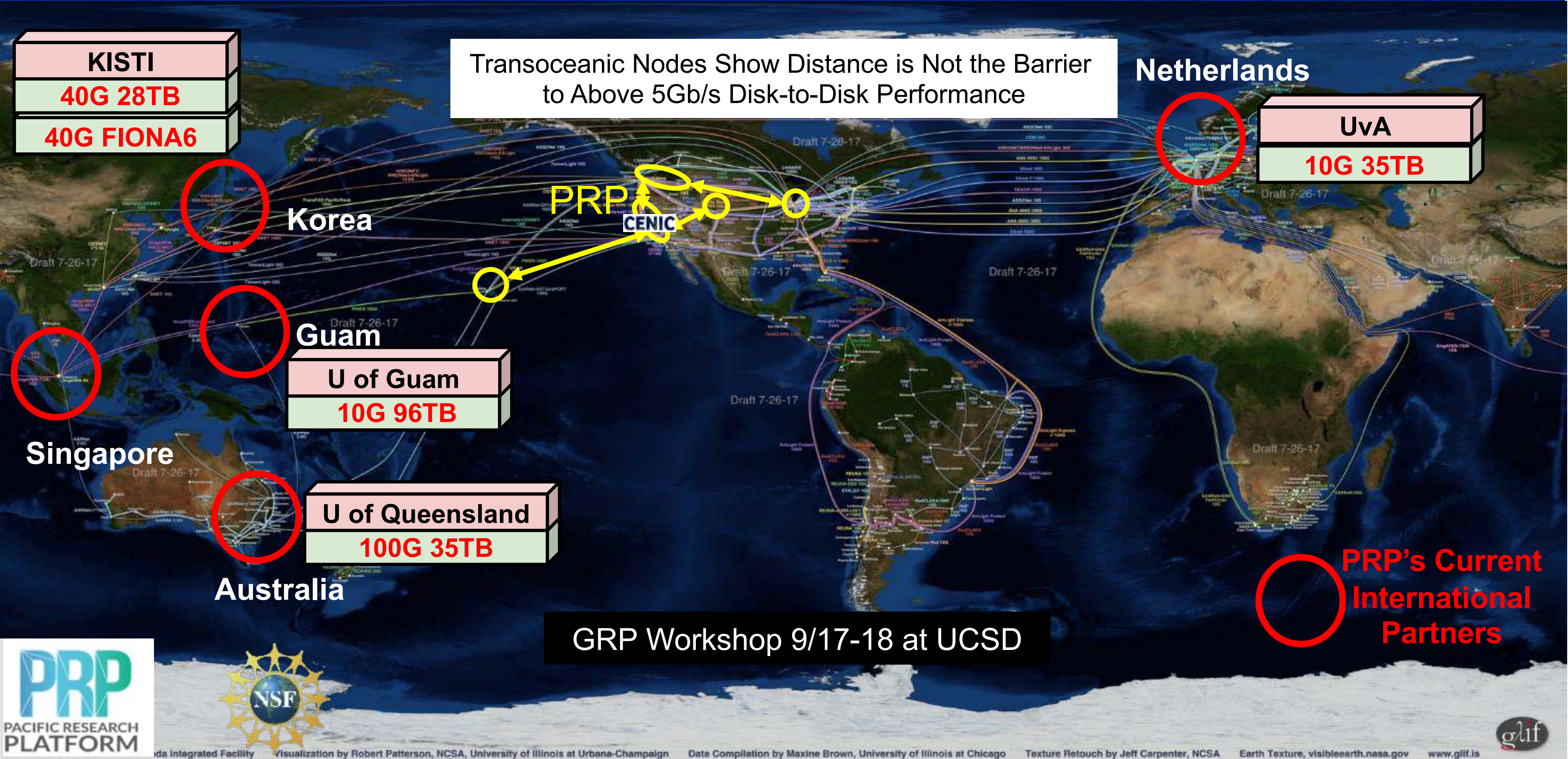
Original PRP

CENIC/PW Link

I2 CENIC Link

NRP Pilot

Nautilus Has International Nodes
The Global Research Platform is Emerging (1GRP Next Week Here!)



Transoceanic Nodes Show Distance is Not the Barrier to Above 5Gb/s Disk-to-Disk Performance

KISTI
40G 28TB
40G FIONA6

Korea

Guam

U of Guam
10G 96TB

Singapore

U of Queensland
100G 35TB

Australia

Netherlands

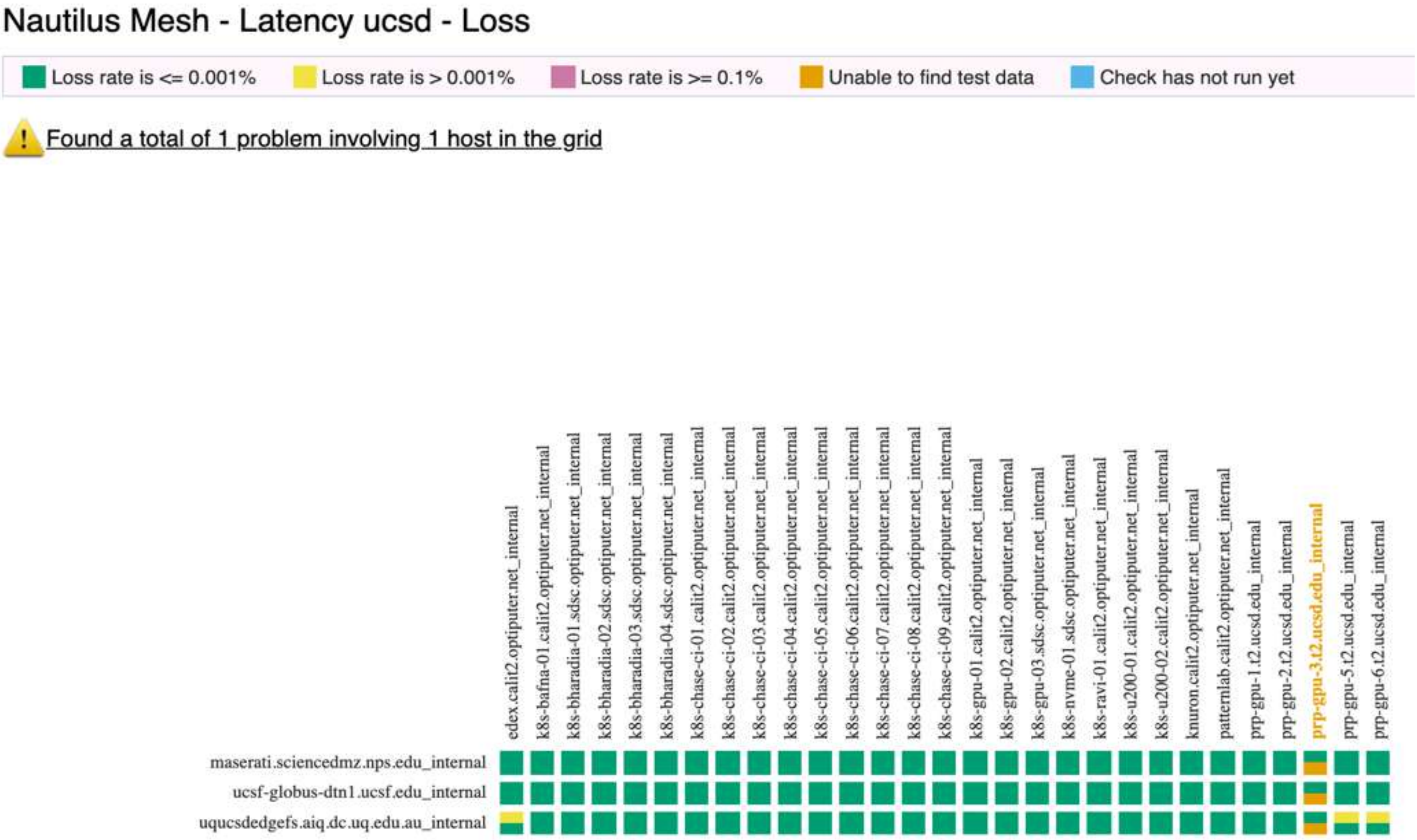
UvA
10G 35TB

PRP's Current International Partners

GRP Workshop 9/17-18 at UCSD

PACIFIC RESEARCH PLATFORM
NSF
..da Integrated Facility   Visualization by Robert Patterson, NCSA, University of Illinois at Urbana-Champaign   Data Compilation by Maxine Brown, University of Illinois at Chicago   Texture Retouch by Jeff Carpenter, NCSA   Earth Texture, visibleearth.nasa.gov   www.glif.is
glif

Excellent Performance California to UQ (100G)



Nautilus Mesh - Latency ucsd - Loss

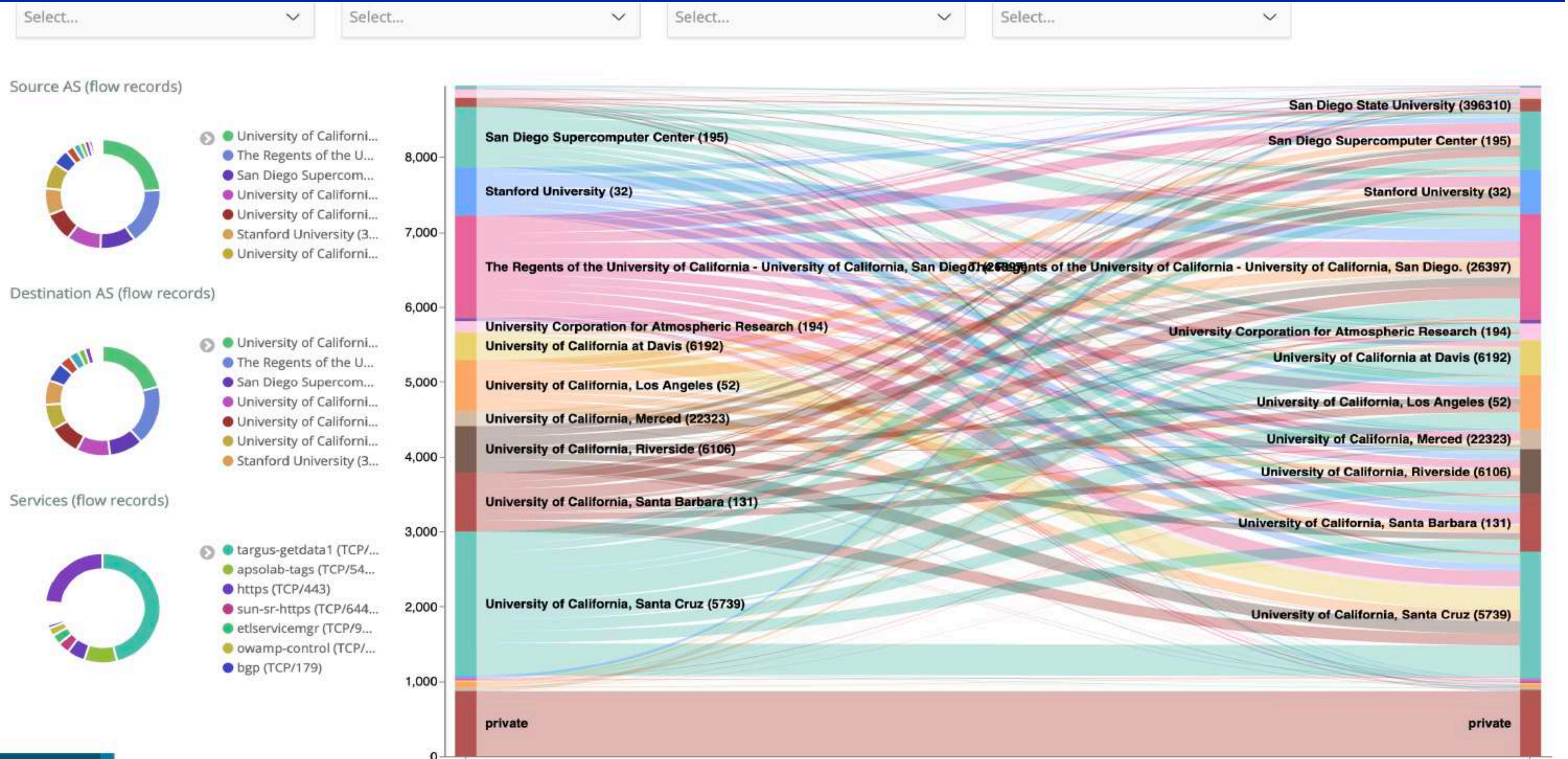
🟩 Loss rate is <= 0.001% 🟨 Loss rate is > 0.001% 🟪 Loss rate is >= 0.1% 🟧 Unable to find test data 🟦 Check has not run yet

⚠ Found a total of 1 problem involving 1 host in the grid

	edex.calit2.optiputer.net_internal	k8s-bafna-01.calit2.optiputer.net_internal	k8s-bharadia-01.sdsc.optiputer.net_internal	k8s-bharadia-02.sdsc.optiputer.net_internal	k8s-bharadia-03.sdsc.optiputer.net_internal	k8s-bharadia-04.sdsc.optiputer.net_internal	k8s-chase-ci-01.calit2.optiputer.net_internal	k8s-chase-ci-02.calit2.optiputer.net_internal	k8s-chase-ci-03.calit2.optiputer.net_internal	k8s-chase-ci-04.calit2.optiputer.net_internal	k8s-chase-ci-05.calit2.optiputer.net_internal	k8s-chase-ci-06.calit2.optiputer.net_internal	k8s-chase-ci-07.calit2.optiputer.net_internal	k8s-chase-ci-08.calit2.optiputer.net_internal	k8s-chase-ci-09.calit2.optiputer.net_internal
maserati.sciencedmz.nps.edu_internal	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
ucsf-globus-dtn1.ucsf.edu_internal	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩
uqucsdedgefs.aiq.dc.uq.edu.au_internal	🟨🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩

	k8s-gpu-01.calit2.optiputer.net_internal	k8s-gpu-02.calit2.optiputer.net_internal	k8s-gpu-03.sdsc.optiputer.net_internal	k8s-nvme-01.sdsc.optiputer.net_internal	k8s-ravi-01.calit2.optiputer.net_internal	k8s-u200-01.calit2.optiputer.net_internal	k8s-u200-02.calit2.optiputer.net_internal	knuron.calit2.optiputer.net_internal	patternlab.calit2.optiputer.net_internal	prp-gpu-1.t2.ucsd.edu_internal	prp-gpu-2.t2.ucsd.edu_internal	prp-gpu-3.t2.ucsd.edu_internal	prp-gpu-5.t2.ucsd.edu_internal	prp-gpu-6.t2.ucsd.edu_internal
maserati.sciencedmz.nps.edu_internal	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩🟧	🟩	🟩
ucsf-globus-dtn1.ucsf.edu_internal	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩🟧	🟩	🟩
uqucsdedgefs.aiq.dc.uq.edu.au_internal	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩🟧	🟨🟩	🟨🟩

ElastiFlow: See Inter-cluster Campus-Level Traffic Flow Grouped by AS



Select...
Select...
Select...
Select...
Source AS (flow records)
University of Californi...
The Regents of the U...
San Diego Supercom...
University of Californi...
University of Californi...
Stanford University (3...
University of Californi...
Destination AS (flow records)
University of Californi...
The Regents of the U...
San Diego Supercom...
University of Californi...
University of Californi...
University of Californi...
Stanford University (3...
Services (flow records)
targus-getdata1 (TCP/...
apsolab-tags (TCP/54...
https (TCP/443)
sun-sr-https (TCP/644...
etlservicemgr (TCP/9...
owamp-control (TCP/...
bgp (TCP/179)
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
San Diego Supercomputer Center (195)
Stanford University (32)
The Regents of the University of California - University of California, San Diego. (26397)
University Corporation for Atmospheric Research (194)
University of California at Davis (6192)
University of California, Los Angeles (52)
University of California, Merced (22323)
University of California, Riverside (6106)
University of California, Santa Barbara (131)
University of California, Santa Cruz (5739)
private
San Diego State University (396310)
San Diego Supercomputer Center (195)
Stanford University (32)
The Regents of the University of California - University of California, San Diego. (26397)
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University of California, Los Angeles (52)
University of California, Merced (22323)
University of California, Riverside (6106)
University of California, Santa Barbara (131)
University of California, Santa Cruz (5739)
private

PRP Tech Coming

- Support users with IoT/Robotics/Augmented Reality needs
  - Nvidia Jetson Xaviers and Nanos
- Also FPGA data-center boards (Xilinx U200s, Micron SB-852)
  - Compute: application acceleration (e.g.,TensorFlow)
    - Climate/weather segmentation
    - Inferencing
    - Satellite imagery ortho-rectification (align w/wildfire maps)
  - 100G SDX P4 build out (SDSU, USC, NU, FIU, UCSD, Caltech)
- And Tensor Flow Cores and TPUs
  - Nvidia 2080-Ti cards: 544 Tensor Cores each, 4,352 per FIONA8
  - Our Nautilus Users can Access Google Cloud TPUs
  - Google Edge TPU Coral Development Boards and USB-C Edge TPU Accelerator/co-Processor

PACIFIC RESEARCH PLATFORM

P2PRP: Pacific to Pacific Rim Platform!

- Top down Great Networking with 10-100Gbps Science DMZ Performance is a Necessary *but not Sufficient Condition* for Data-Driven Researchers
  - They need Science DMZs & DTNs with Lots of Low-Cost Storage, Encryption, Large RAM CPUs, GPUs, TPUs, FPGAs, and High-Availability Computing
- Measuring and Monitoring is Key to Better Usage and Security
- Compatibility with CloudBank, Google, Microsoft, and Amazon Clouds, and NSF/DOE Supercomputers Helps Ensure Scalability and Continuation
- Convergence with Open Science Grid/I2 Brings In Global Experience

PRP
PACIFIC RESEARCH PLATFORM

PRP/TNRP/CHASE-CI Support and Community:

- US National Science Foundation (NSF) awards to UCSD, NU, and SDSC
  - CNS-1456638, CNS-1730158, ACI-1540112, ACI-1541349, & OAC-1826967
  - OAC 1450871 (NU) and OAC-1659169 (SDSU)
- UC Office of the President, Calit2 and Calit2’s UCSD Qualcomm Institute
- San Diego Supercomputer Center and UCSD’s Research IT and Instructional IT
- Partner Campuses: UCB, UCSC, UCI, UCR, UCLA, USC, UCD, UCSB, SDSU, Caltech, NU, UWash UChicago, UIC, UHM, CSUSB, HPWREN, UMo, MSU, NYU, UNeb, UNC,UIUC, UTA/Texas Advanced Computing Center, FIU, KISTI, UVA, AIST
- CENIC, Pacific Wave/PNWGP, StarLight/MREN, The Quilt, Kinber, Great Plains Network, NYSERNet, LEARN, Open Science Grid
- Internet2, DOE ESnet, NCAR/UCAR and Wyoming Supercomputing Center

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