Ohio Supercomputer Center

An OH·TECH Consortium Member

The Ohio Supercomputer Center provides high performance computing services and computational science expertise to assist Ohio researchers making discoveries in a vast array of scientific disciplines, and engineers seeking innovations for businesses small and large.

SUG Meeting

Spring 2018

Agenda

- Service Utilization
- Collaboration Opportunities in Service Development
- Upcoming Services
- Fee Structure Update
- National Business Models

Service Utilization

Brian Guilfoos, HPC Client Services Manager

"Our client service team is here to help you get the most out of OSC services."

Client Services

CY2017

23 academic institutions

48 companies

2,202 clients

256 awards made

23 training opportunities

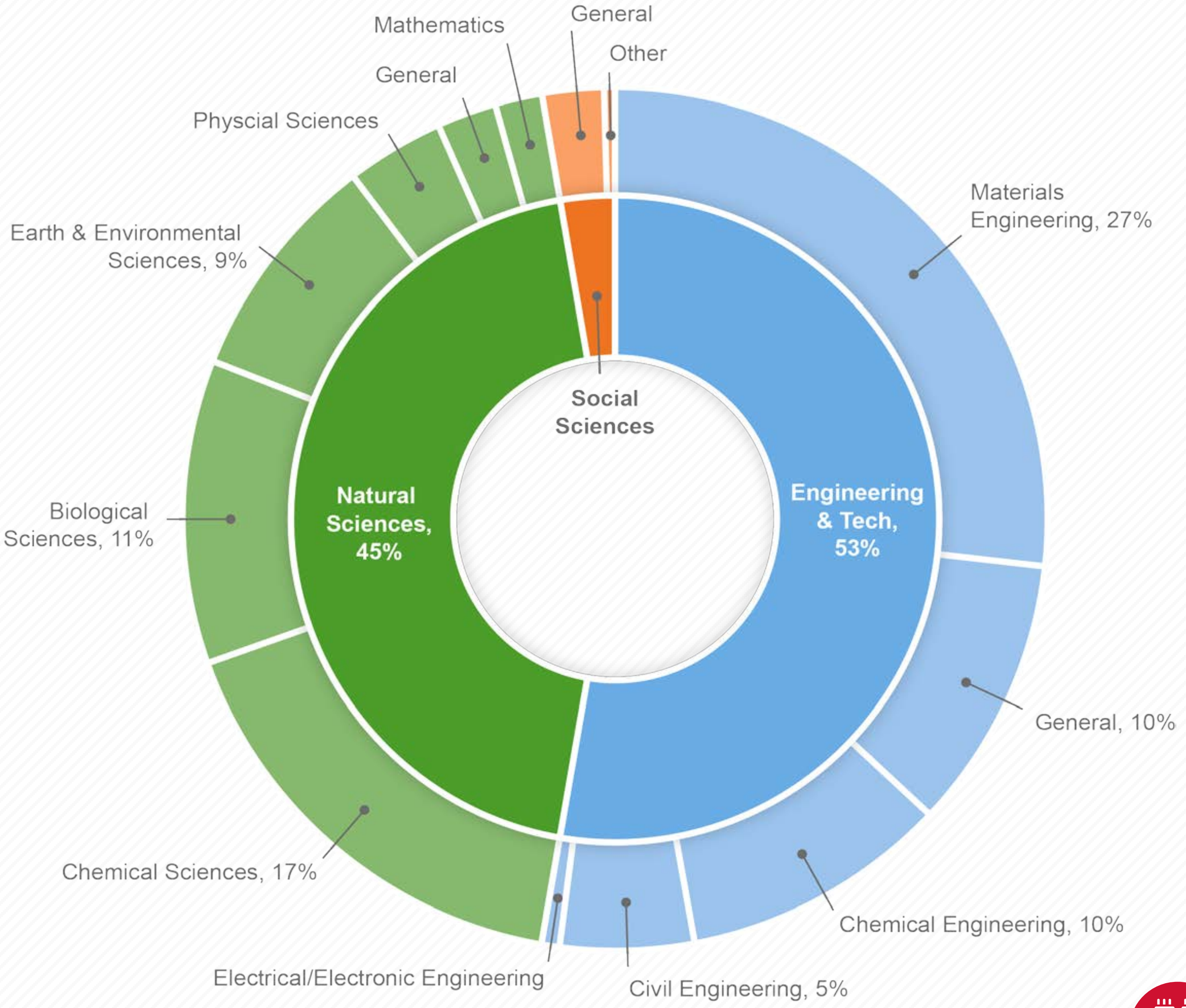
461 trainees

604 projects served

33 courses used OSC

Usage by Field of Science

CY2017



Recent and Planned Campus Visits

University of Cincinnati (October)

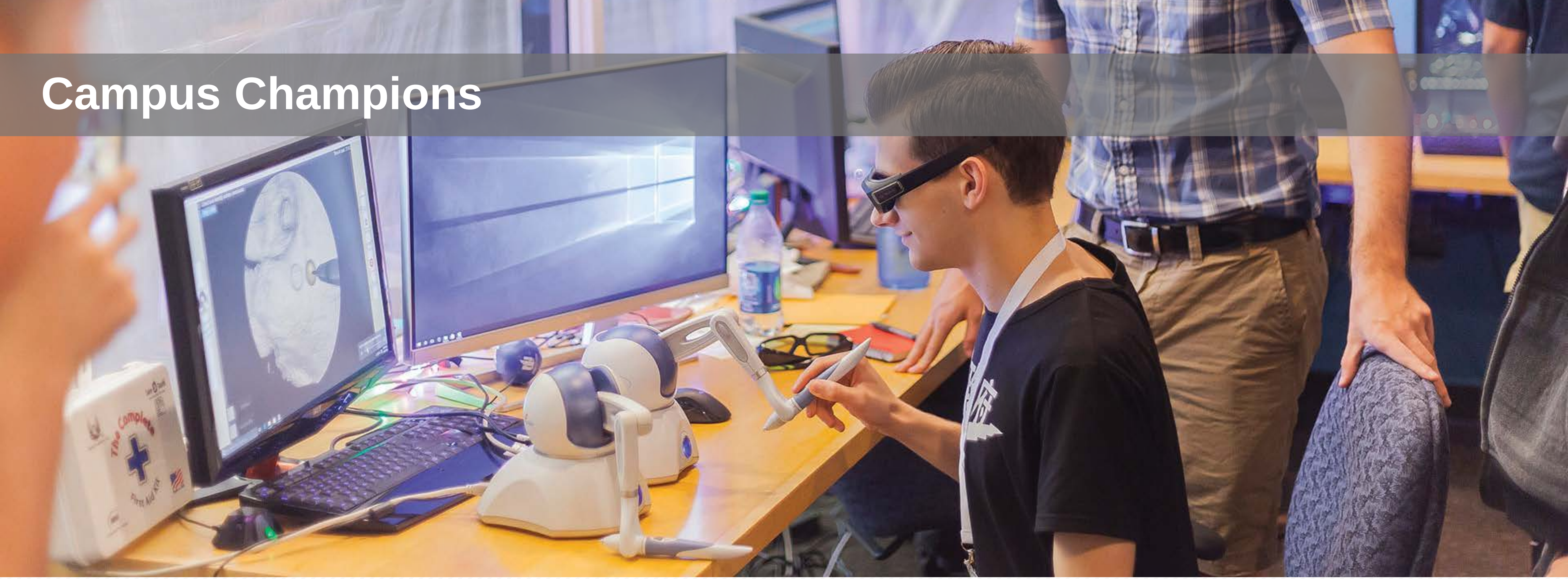
- Attended Data Day on March 6
- Workshop on March 13 (24 attendees)

Ohio State University (September, October)

- Consultation hours at Research Commons every other Tuesday
- Workshop on March 15 (11 attendees)

WebEx meetings and asynchronous web tutorials also available!

Campus Champions



Purpose of Campus Champions

- Deepens outreach to Ohio universities
- Empowers local support staff to work directly with clients
- OSU: Lee-Arng Chang, Sandy Shew, Keith Stewart
- UC: Brett Kottman CWRU: Cindy Martin Miami: Jens Mueller

Production Capacity

CY2017

221,400,000+ core-hours consumed

78% average HPC system utilization

4,400,000+ computational jobs

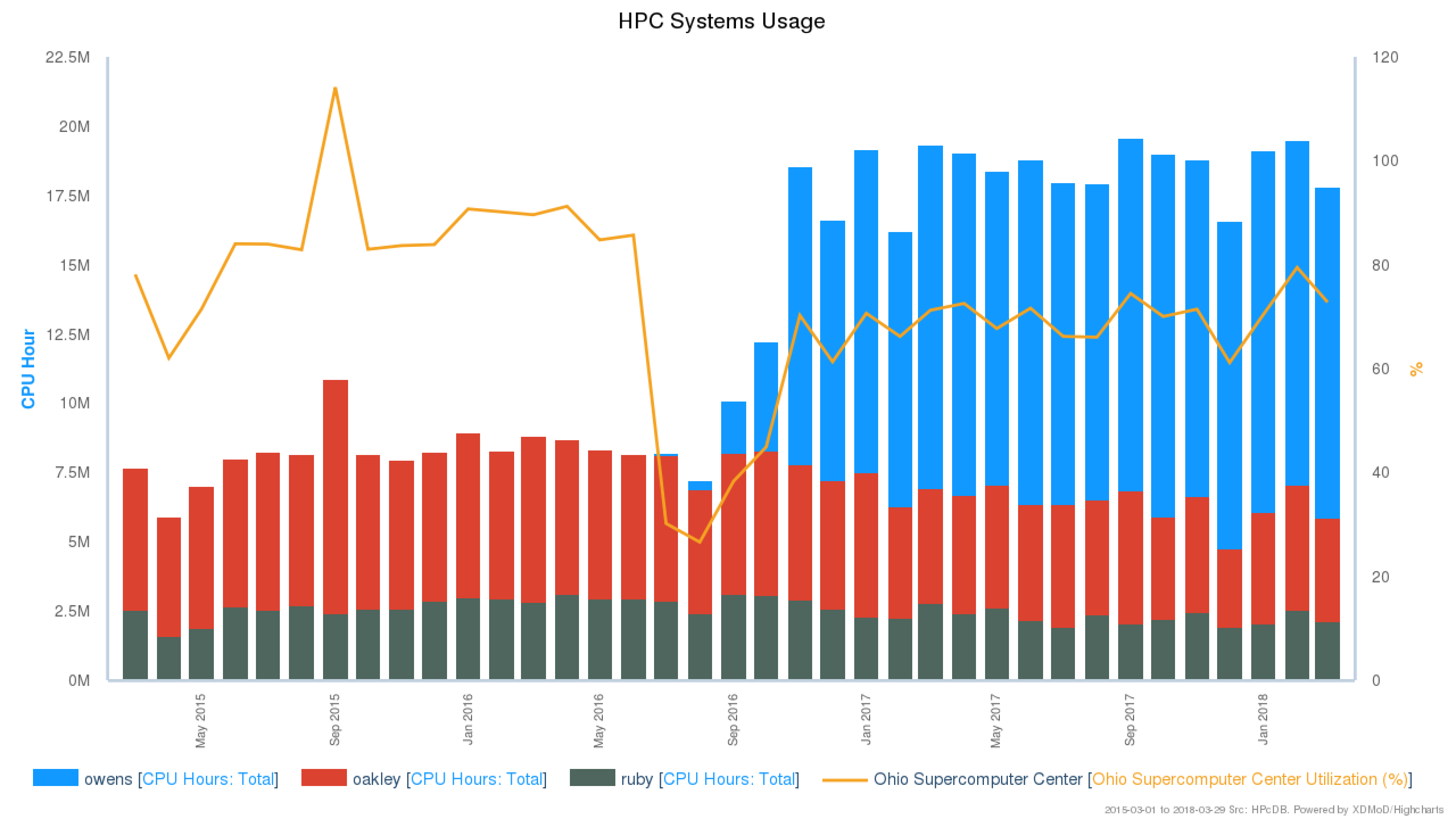
98% up-time

44% average storage system utilization

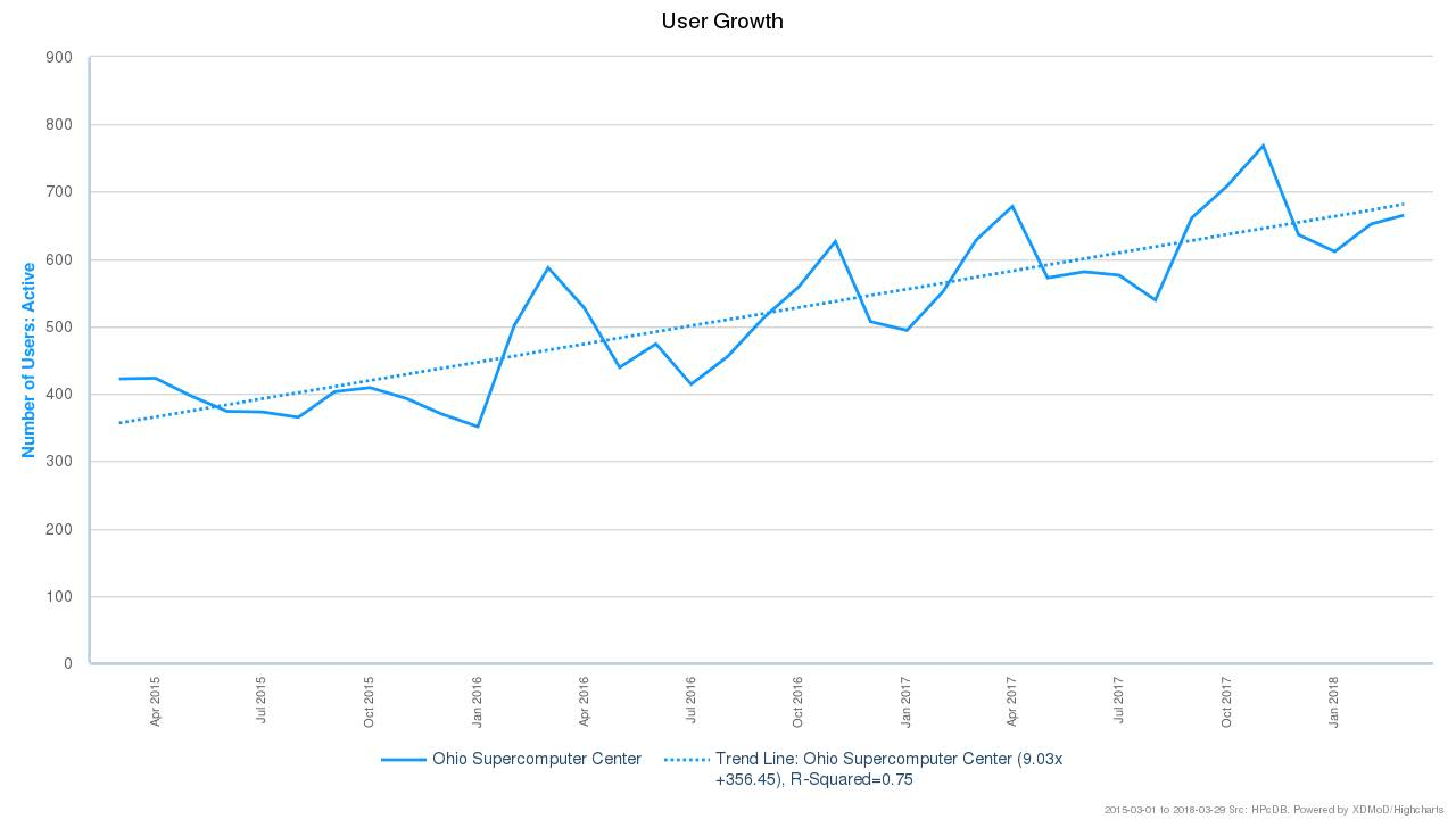
1.5 PB data stored

2 PB data transferred

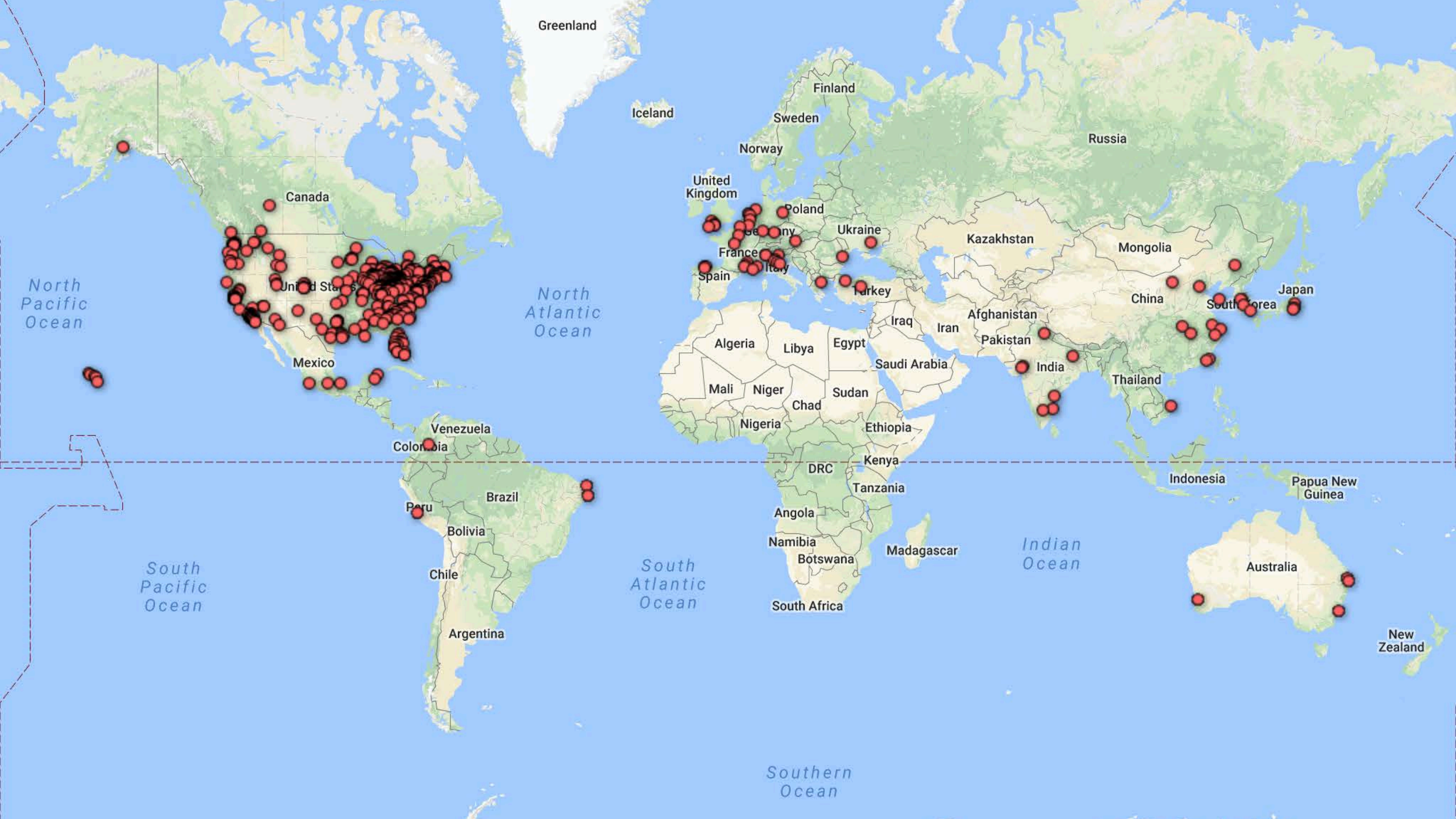
79% jobs started within one hour



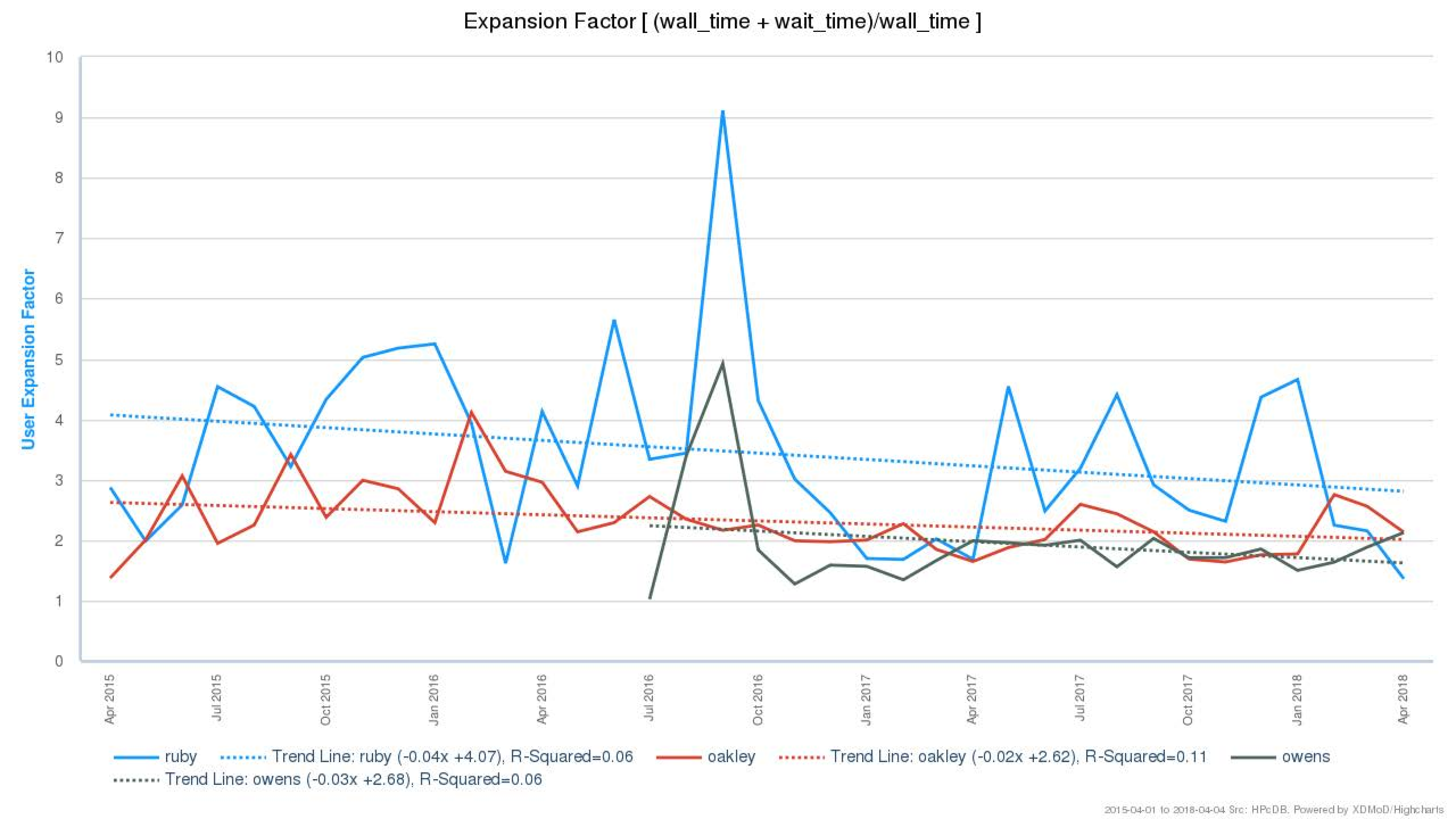
HPC Systems Usage
CPU Hour
%
0M
2.5M
5M
7.5M
10M
12.5M
15M
17.5M
20M
22.5M
0
20
40
60
80
100
120
May 2015
Sep 2015
Jan 2016
May 2016
Sep 2016
Jan 2017
May 2017
Sep 2017
Jan 2018
owens [CPU Hours: Total]
oakley [CPU Hours: Total]
ruby [CPU Hours: Total]
Ohio Supercomputer Center [Ohio Supercomputer Center Utilization (%)]
2015-03-01 to 2018-03-29 Src: HPcDB. Powered by XDMoD/Highcharts



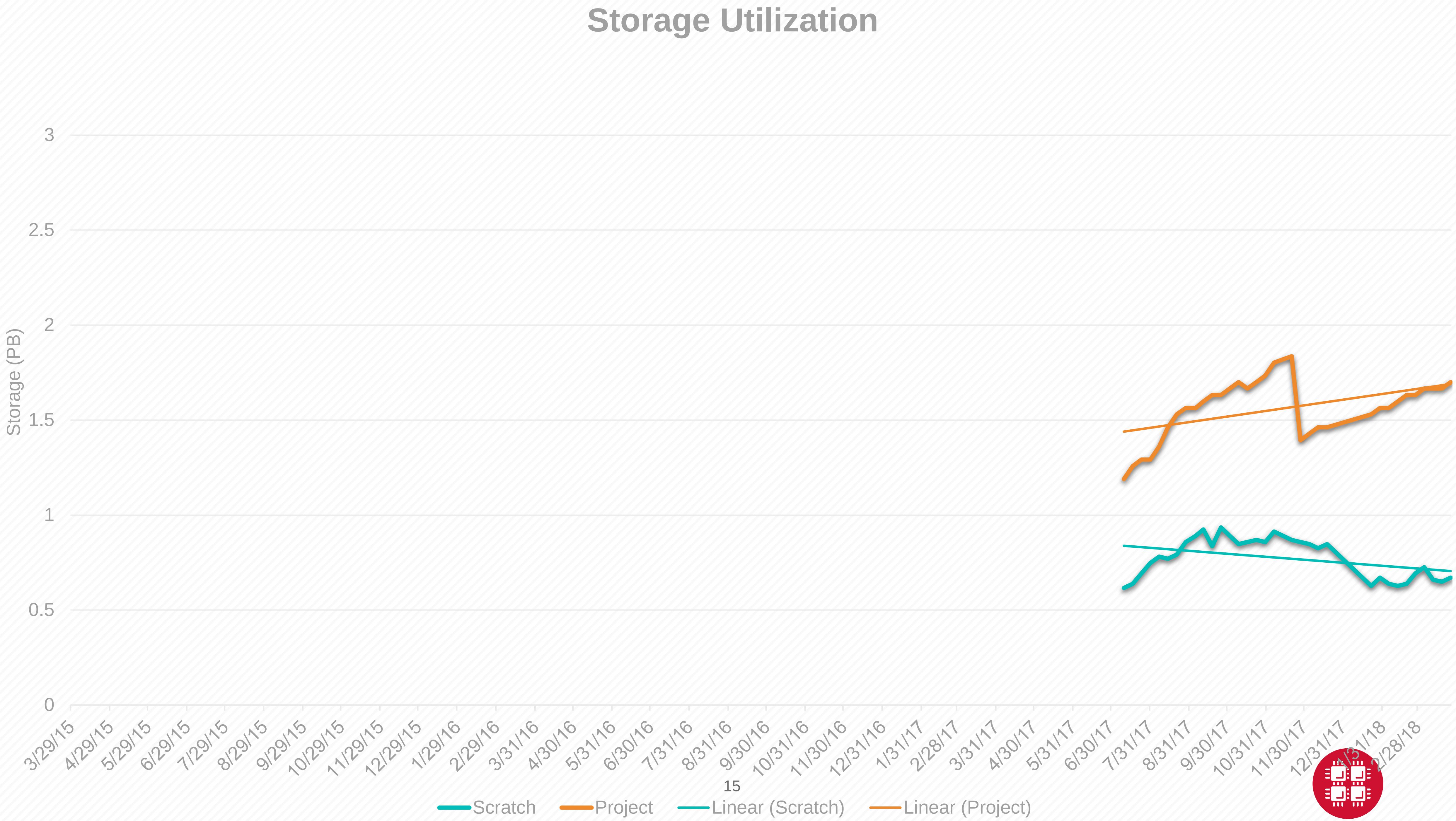
User Growth
Number of Users: Active
900
800
700
600
500
400
300
200
100
0
Apr 2015
Jul 2015
Oct 2015
Jan 2016
Apr 2016
Jul 2016
Oct 2016
Jan 2017
Apr 2017
Jul 2017
Oct 2017
Jan 2018
Ohio Supercomputer Center
Trend Line: Ohio Supercomputer Center (9.03x +356.45), R-Squared=0.75
2015-03-01 to 2018-03-29 Src: HPcDB. Powered by XDMoD/Highcharts



Greenland
Iceland
Finland
Sweden
Norway
Russia
United Kingdom
Poland
Ukraine
Kazakhstan
Mongolia
Canada
France
Spain
China
Japan
North Pacific Ocean
North Atlantic Ocean
Afghanistan
Iraq
Iran
Pakistan
Algeria
Libya
Egypt
Saudi Arabia
India
Mexico
Mali
Niger
Sudan
Chad
Thailand
Venezuela
Nigeria
Ethiopia
Kenya
DRC
Tanzania
Indonesia
Papua New Guinea
Brazil
Angola
Bolivia
Namibia
Madagascar
Indian Ocean
Botswana
South Pacific Ocean
Chile
South Atlantic Ocean
Australia
South Africa
New Zealand
Argentina
Southern Ocean



Expansion Factor [(wall_time + wait_time)/wall_time]
User Expansion Factor
10
9
8
7
6
5
4
3
2
1
0
Apr 2015
Jul 2015
Oct 2015
Jan 2016
Apr 2016
Jul 2016
Oct 2016
Jan 2017
Apr 2017
Jul 2017
Oct 2017
Jan 2018
Apr 2018
ruby
Trend Line: ruby (-0.04x +4.07), R-Squared=0.06
oakley
Trend Line: oakley (-0.02x +2.62), R-Squared=0.11
owens
Trend Line: owens (-0.03x +2.68), R-Squared=0.06
2015-04-01 to 2018-04-04 Src: HPcDB. Powered by XDMoD/Highcharts



Storage Utilization
Storage (PB)
3
2.5
2
1.5
1
0.5
0
3/29/15
4/29/15
5/29/15
6/29/15
7/29/15
8/29/15
9/29/15
10/29/15
11/29/15
12/29/15
1/29/16
2/29/16
3/31/16
4/30/16
5/31/16
6/30/16
7/31/16
8/31/16
9/30/16
10/31/16
11/30/16
12/31/16
1/31/17
2/28/17
3/31/17
4/30/17
5/31/17
6/30/17
7/31/17
8/31/17
9/30/17
10/31/17
11/30/17
12/31/17
1/31/18
2/28/18
Scratch
Project
Linear (Scratch)
Linear (Project)

Upcoming Services

- AWS Pilot
  - Any OSU user interested in working with OSC to explore how we might be able to supplement OSC on-prem clusters with AWS resources?
- Protected Data Environment
  - OSC is meeting with OSU and NCH about HIPAA data services at OSC
  - Other institutions who would be interested in meeting with OSC about requirements?

Career Opportunities

- OSC is hiring! We are replacing some departed staff with targeted hires to add or bolster certain skillsets
- Scientific Applications Engineer
  - The individual in this position will perform software installations, license server administration, adhere to and make improvements to OSC’s software deployment processes and infrastructure, and create user-facing documentation.
- HPC Security Engineer
  - This engineer will ensure security best practices are followed; deploy security policy implementations uniformly using configuration management; develop plans for security incident response; maintain secure environments for HIPAA, ITAR, and EAR data; develop and maintain authentication and authorization mechanisms for HPC and web based services; and balance between security concerns and client usability.

Upcoming Services

Doug Johnson, Chief Architect

System Status

SYSTEMS	Oakley	Ruby	Owens
Date	2012	2014	2016
Cost	$4 million	$1.5 million	$7 million
Theoretical Perf.	~154 TF	~144 TF	~1600 TF
Nodes	692	240	824
CPU Cores	8304	4800	23392
RAM	~33.4 TB	~15.3 TB	~120 TB
GPUs	128 NVIDIA Tesla M2070	20 NVIDIA Tesla K40	160 NVIDIA Pascal P100
	Total compute: ~1900 TF		

STORAGE	Home	Project	Scratch	Tape Library
Capacity	0.8 PB	3.4 PB	1.1 PB	7+ PB
Current utilization Feb, 18	47%	48%	59%	47%

Active Capital Projects (FY17-18 Capital Biennium)

New HPC cluster "C18"

- **Goals**
  1. Complement existing systems
  2. Replace Oakley with a petaflop class system

- **Timeline**
  - RFP responses received January 19, 2018
  - Vendor selection recommendation forwarded to ODHE
  - System delivery July 2018
  - Full production October 2018
  - Oakley decommissioning November 2018

Active Capital Projects (FY17-18 Capital Biennium)

New HPC cluster “C18”

- Approximately 10k processor cores, ~1.2 petaflop peak
- Standard compute nodes (192 – 236 total nodes)
  - 40 processor cores
  - 192GB memory
- GPU nodes (24 – 37 total nodes)
  - 40 processor cores
  - 2 NVIDIA V100 GPUs per node
  - 384GB memory
- Four large memory nodes with 3TB memory
- Latest generation 100Gb InfiniBand
- Warm water cooling to support high density, increase performance and efficiency

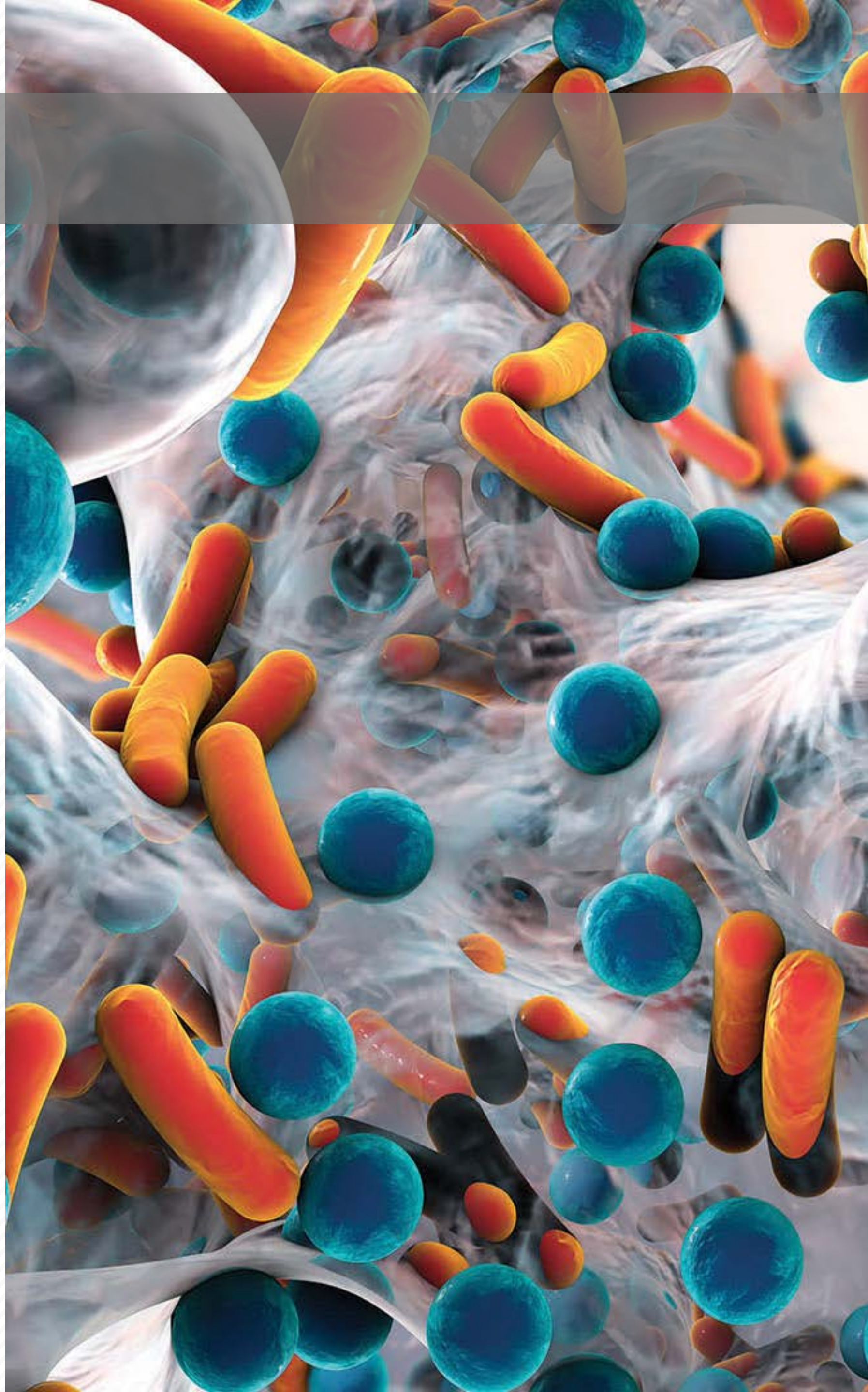
C18 Comparisons

New capabilities in areas like:

- Machine learning, artificial intelligence (AI)
- Molecular biology
- Modeling and simulation for industry

Characteristics relative to Oakley

- Eight times the processing power
- Costs 15% less
- Uses 20% less power



Active Capital Projects (FY17-18 Capital Biennium)

Upgrade tape library for backups capacity/performance, and future data archive project

- New library installed in December, 2017
- Data migration complete
- Scale Out Backup And Restore (SOBAR) implementation, finish in March, 2018
- Backup servers, and disk storage pools upgrade 1st half 2018

Network firewall, and Ethernet network expansion for C18

- Controlling board approved in January, 2018, deploy summer 2018

• Project file system expansion

- Increase space for metadata, 2-3B files/directories (1B today)
- Slower tier of storage for infrequently accessed files

FY19-20 Capital Budget Request

Total Request: $6.105M

- Production Infrastructure refresh
- Protected Data Environment (Unique resource supporting HIPAA, ITAR, or other sensitive data sets)
  - Initial requirements gathering (OSU Wexner Medical Center, Nationwide Children's Hospital)
- Research Data Archive
  - Meet data management plans for sponsored research
  - Provide publishing and other abstraction capabilities

Fee Structure Update

Alan Chalker, Director of Strategic Programs

Sustainability Update

FY19 Plan details

- FY19 rate of $0.075 / RU for cycles > 10K RUs per project; no storage charges
- OSC intends to contract with each institution, not individual faculty clients
- OSC is beginning to provide monthly invoices detailing institutional level usage
- **Starting with six (6) institutions; others to be added in future years**
  - Akron, Bowling Green, Case Western Reserve, Cincinnati, Ohio, Ohio State

Initial Finance Committee meeting March 12th discussion

- **Six (6) Universities represented**
- Faculty communication
- Subsidized threshold
- Allocations and contracting processes

Communications

- Chancellor Carey sent letters to 5 Provosts detailing the plan
- OSC working with universities to develop faculty message

Sustainability Future Steps

Implementation Questions to be Addressed

- Policies for active faculty with insufficient current funding
- Support for faculty including OSC charges in proposals
- Updated allocation process
  - *Incorporation of University Administrators in allocation process*
  - *Expiration policy on allocated Rus*
- Invoicing / reporting frequency for University Administrators
- Charging threshold for other universities with less resource usage

FY20 and beyond details to be collaboratively developed based on:

- FY19 lessons related to usage and payment of new fees
- OSC's FY20/21 budget operating request (asking for increase)
- Implementation of OSC budget efficiencies
- Discussions with client community regarding current/future services OSC provides

National Business Models

Alan Chalker, Director of Strategic Programs

National Discussion on Academic Center ROI and Cloud

How to price commercial clouds relative to academic computing costs

How to estimate ROI on the academic systems

Chronicle of Higher Education Article on Cloud


Comput Softw Big Sci
DOI 10.1007/s41781-017-0001-9

ORIGINAL ARTICLE

HEPCloud, a New Paradigm for HEP Facilities: CMS Amazon Web Services Investigation

Burt Holzman[1] · Lothar A. T. Bauerdick[1] · Brian Bockelman[2] · Dave Dykstra[1] · Ian Fisk[3] · Stuart Fuess[1] · Gabriele Garzoglio[1] · Maria Girone[4] · Oliver Gutsche[1] · Dirk Hufnagel[1] · Hyunwoo Kim[1] · Robert Kennedy[1] · Nicolo Magini[1] · David Mason[1] · Panagiotis Spentzouris[1] · Anthony Tiradani[1] · Steve Timm[1] · Eric W. Vaandering[1]

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Abstract Historically, high energy physics computing has been performed on large purpose-built computing systems. These began as single-site compute facilities, but have evolved into the distributed computing grids used today. Recently, there has been an exponential increase in the capacity and capability of commercial clouds. Cloud resources are highly virtualized and intended to be able to be flexibly deployed for a variety of computing tasks. There is a growing interest among the cloud providers to demonstrate the capability to perform large-scale scientific computing. In this paper, we discuss results from the CMS experiment using the Fermilab HEPCloud facility, which utilized both local Fermilab resources and virtual machines in the Amazon Web Services Elastic Compute Cloud. We discuss the planning, technical challenges, and lessons learned involved in performing physics workflows on a large-scale set of virtualized resources. In addition, we will discuss the economics and operational efficiencies when executing workflows both in the cloud and on dedicated resources.

Keywords High energy physics · Computing · Cloud · Amazon web services

Overview

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2 University of Nebraska, Lincoln, NE, USA
3 Simons Foundation, New York, NY, USA
4 CERN, Geneva, Switzerland

Published online: 29 September 2017

"It's hard to compare costs because we don't know the detailed cost analysis of running on campus"

Courtesy of Amy Apon (Clemson)

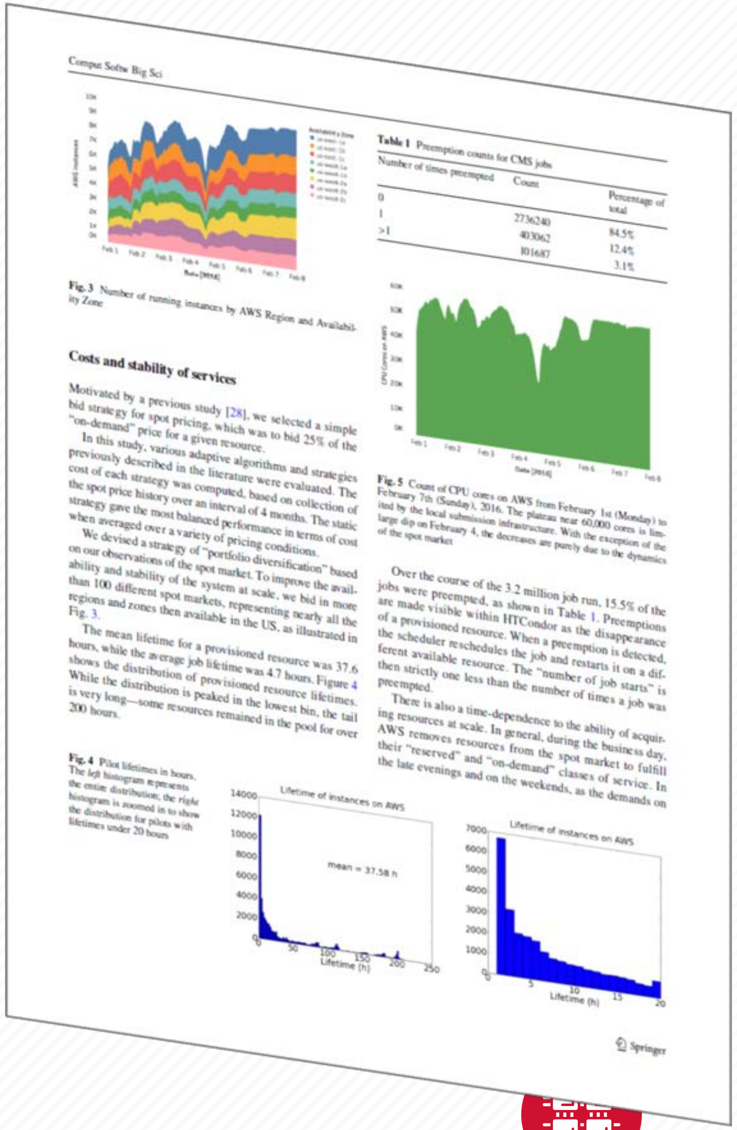

Comput Softw Big Sci

Fig. 3 Number of running instances by AWS Region and Availability Zone

Table 1 Preemption counts for CMS jobs

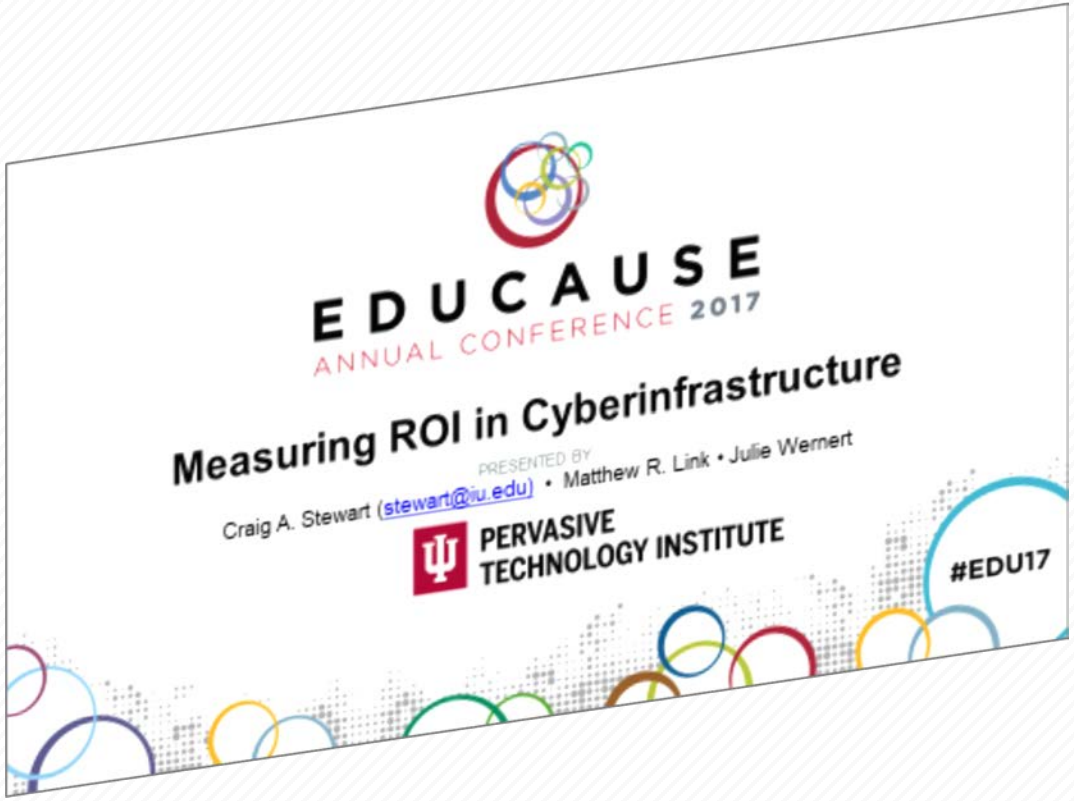
Number of times preempted	Count	Percentage of total
0	2736240	84.5%
1	403062	12.4%
>1	101687	3.1%

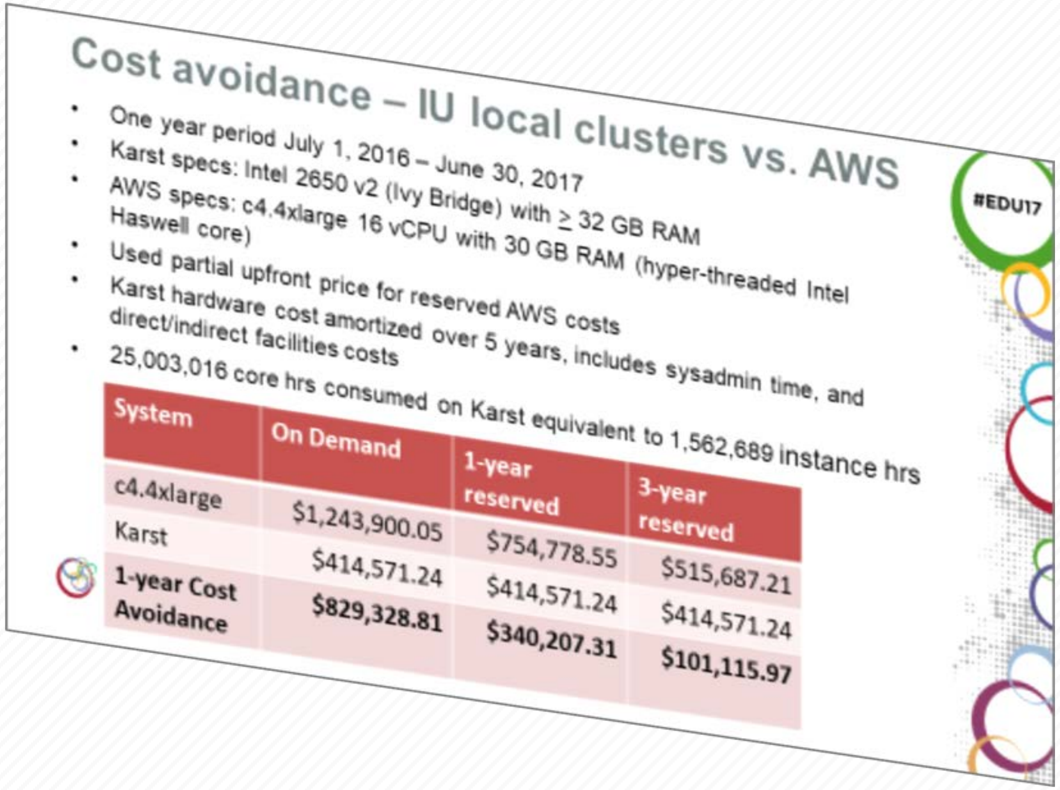
Costs and stability of services

Fig. 4 Pilot lifetimes in hours.

Fig. 5 Count of CPU cores on AWS from February 1st (Monday) to February 7th (Sunday), 2016.

EDUCAUSE Presentation on ROI

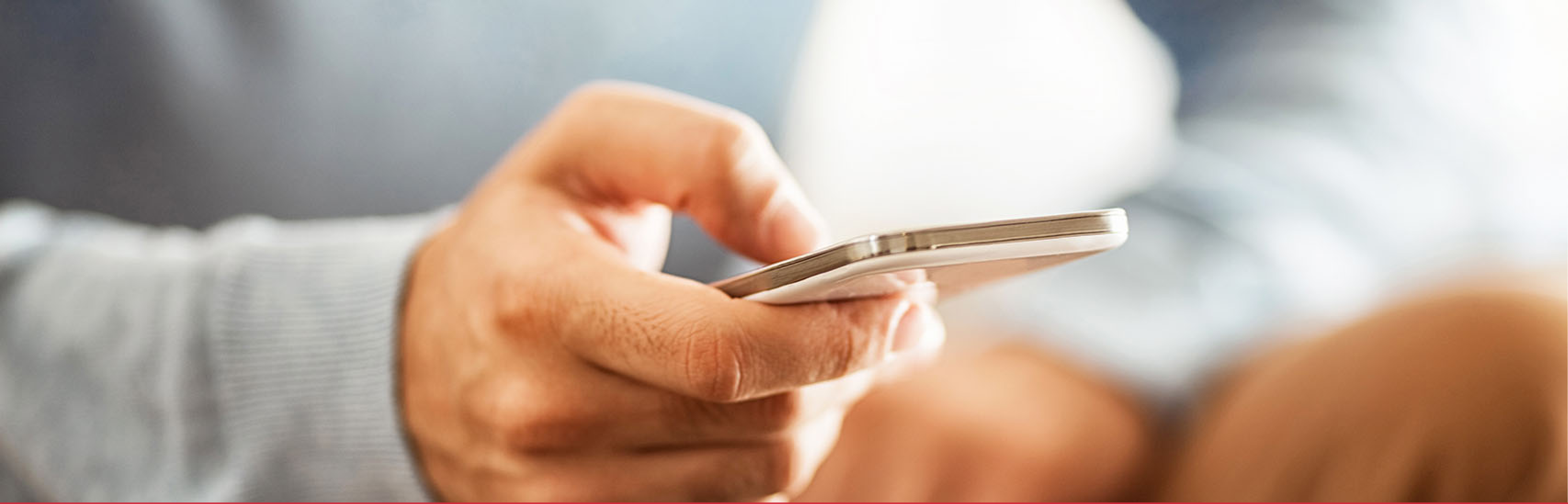




"Can we yet state that the ROI on IU's investment in cyberinfrastructure is > 1? Not quite yet."

Courtesy of Craig Stewart (PTI@IU)

Open Discussion



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