The Grid according to OSG and XSEDE

Tuesday afternoon, 1:30pm

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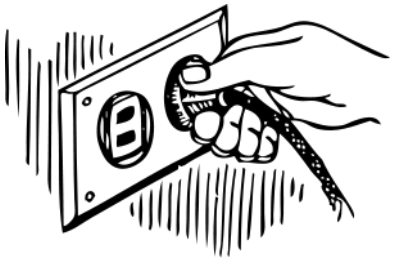
Logistical reminder

- It is OK to ask questions
  - During the lecture
  - During the demos
  - During the exercises
  - During the breaks
- If I don't know the answer,
  I will find someone who likely does

What is a Grid?

- The “Grid computing” concept was coined around year 2000
- It was supposed to be DHTC with
  - Uniform security mechanism, and
  - Uniform access mechanism
- i.e. using DHTC should be as easy as using the electricity



We ended with many Grids

- The world could not agree on a single "Grid standard"
  - Mostly due to politics
  - But there were also legitimate technical reasons why different technologies are better for different use cases
- Three major Grid infrastructures
  - OSG (Open Science Grid)
  - XSEDE

  } Mostly USA
  - EGI

  } Mostly Europe

We ended with many Grids

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  …technical
  re… …nologies are
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- Three major Gri… …rastructures
  - OSG (Open Science Grid)
  - XSEDE
  - EGI

There were some attempts
by commercial entities to create
"Commercial Grid Infrastructures"
but they did not catch up
(instead, the Cloud was born)

Scientific Grids

Mostly USA

Mostly Europe

OSG type Grid

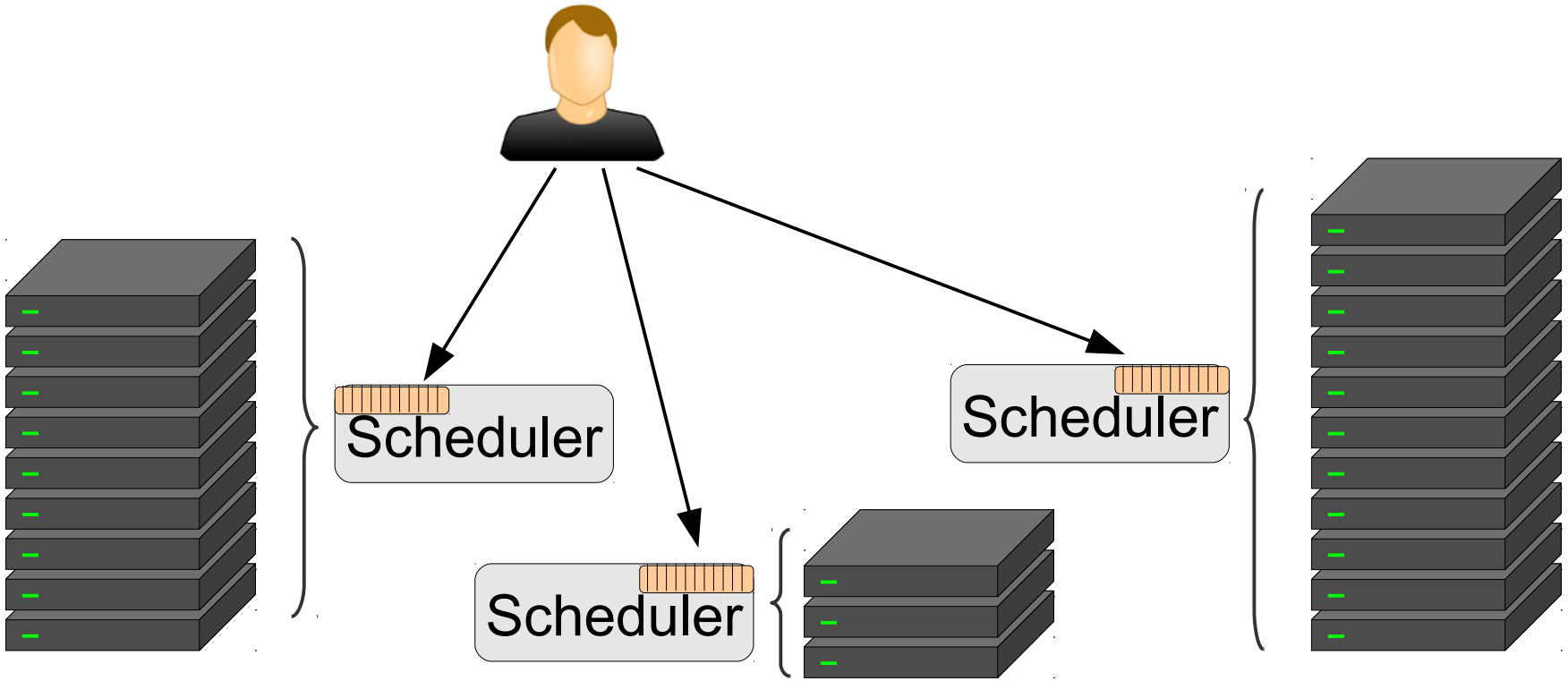
- For now, let's focus on the Grid as defined by the Open Science Grid
  - Although EGI is very similar from the user point of view

https://www.opensciencegrid.org/

- Will describe XSEDE later in the lecture

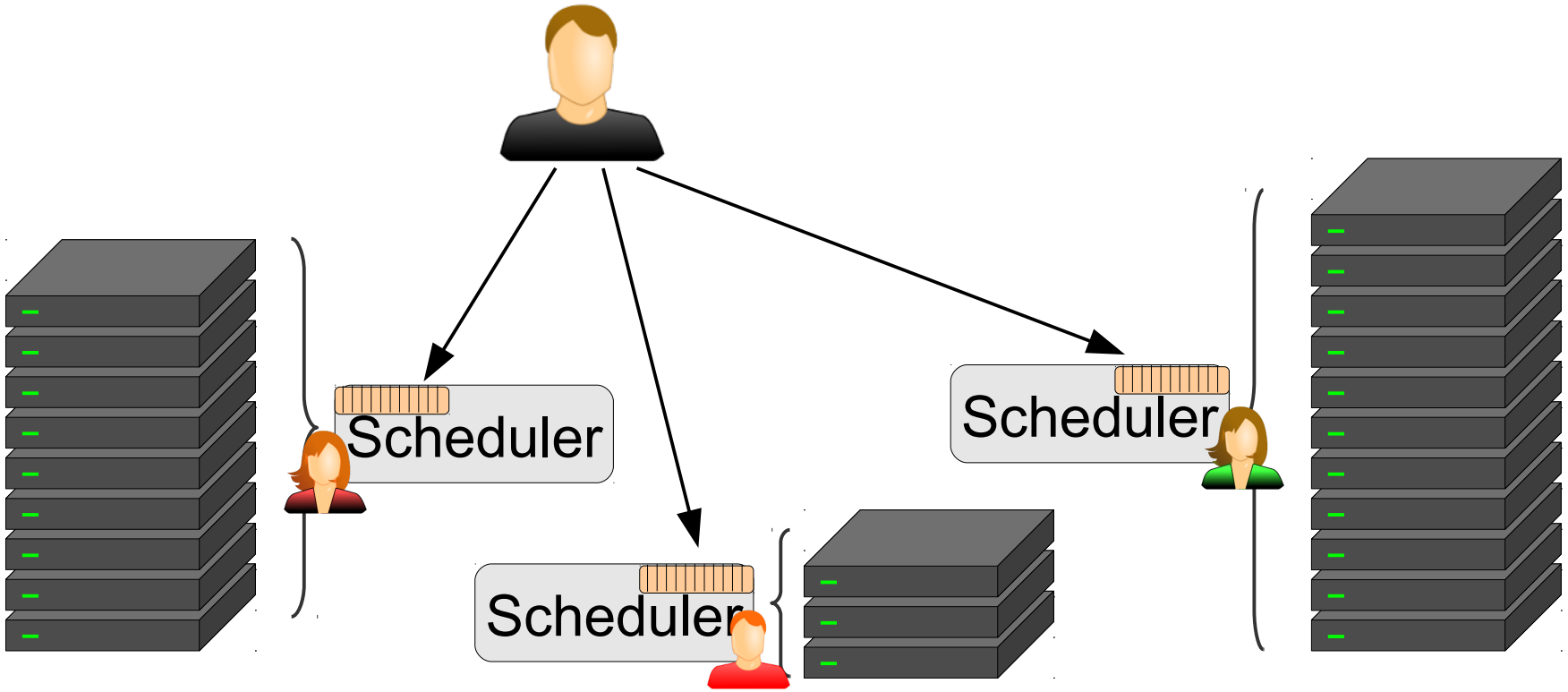
Grid and DHTC

- Grid is a form of DHTC, it is computing on more than one cluster



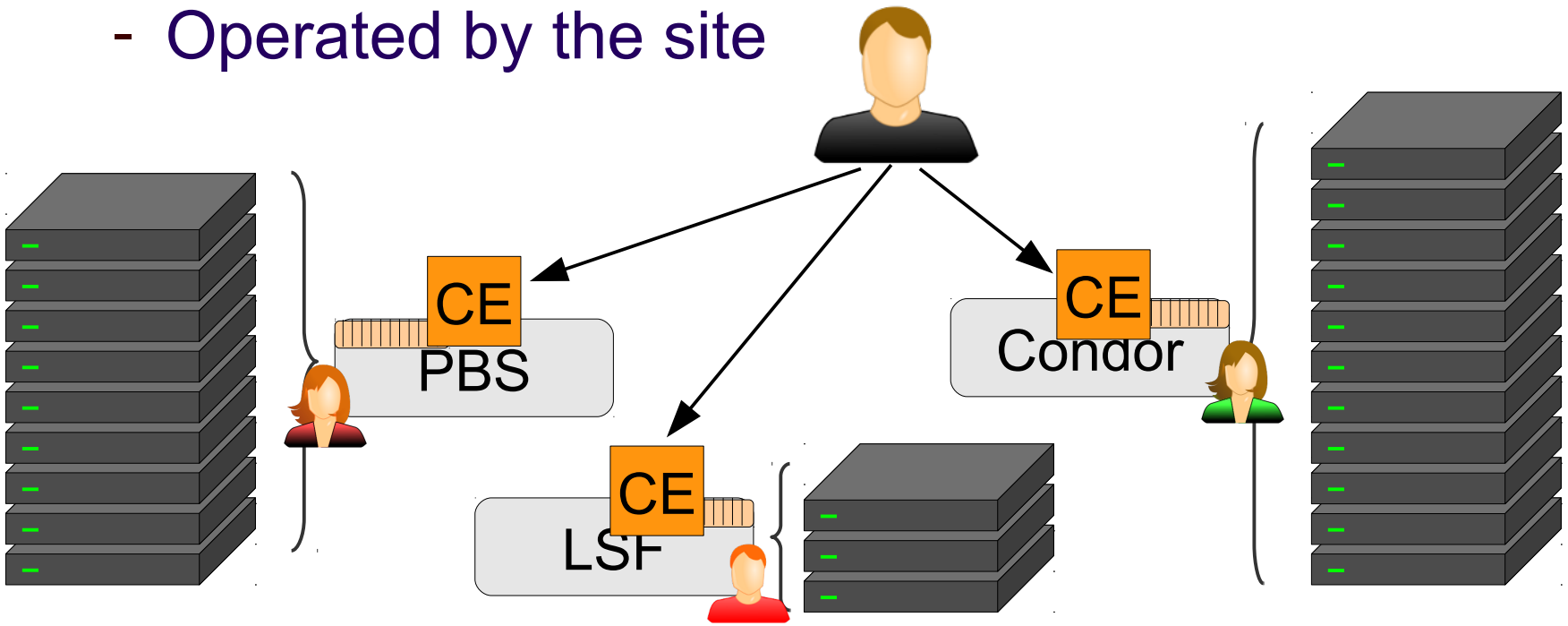
Distributed ownership

- Each cluster has its owners
  - Who are free to set their own rules



Abstraction layer

- The Grid adds an abstraction layer
  - So sites can use their preferred technology
- In OSG it is called a CE (Compute Element)
  - Operated by the site

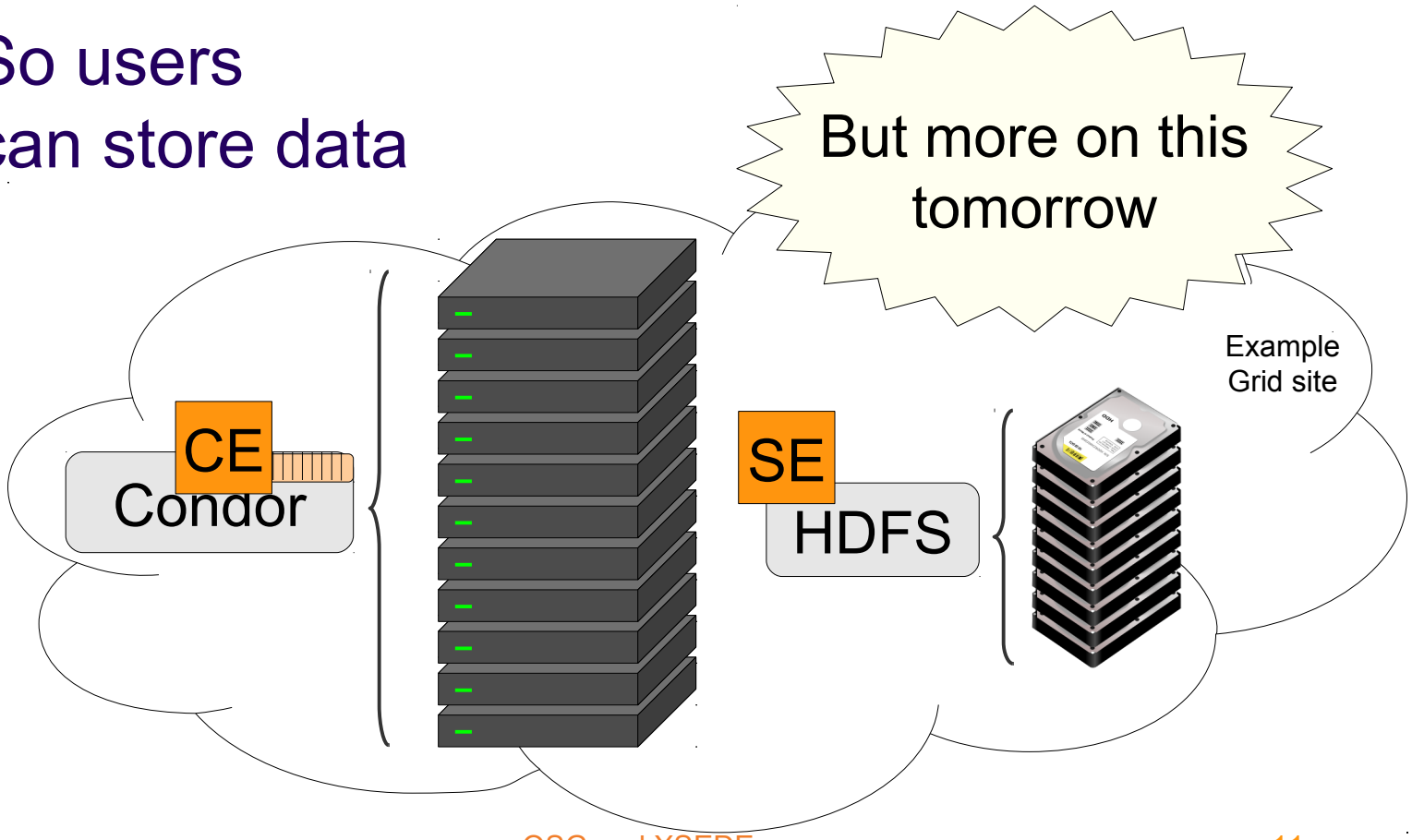


The CE

- The CE performs a few roles
  - Does user authentication and authorization
  - Converts submission and monitoring requests into site-specific commands
  - Provides accounting information to OSG
- Sites thus can manage their local clusters (mostly) ignoring the Grid part
  - Without affecting the way users interact with them

Storage Elements

- Similarly, a site will have a SE (Storage Element) to handle their storage arrays
  - So users can store data



OSG as an organization

- OSG **does not** own hardware
  - With very limited exceptions
- OSG **provides**
  - Grid software distribution
    - For both users and sites to install and use
  - Common services
    - e.g. security team, meta-schedulers, accounting
- OSG **does not** write software, instead
  - Selects and packages existing software
  - Provides guidance to software providers

OSG structure

- OSG is organized as a Consortium
  - With scientific communities as main stakeholders
- The hardware is thus provided by the scientific communities themselves
  - Often through partnerships, e.g. universities
- OSG does employ some staff
  - But it is only a small number of people

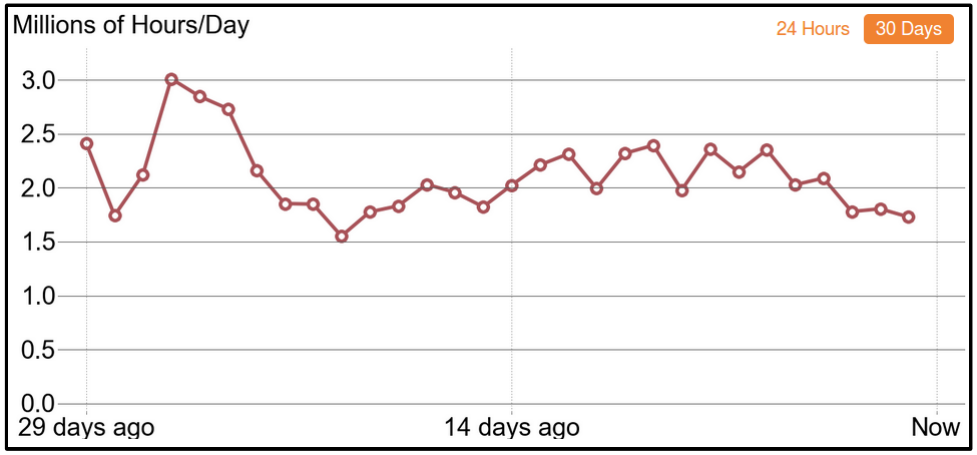
OSG vision and goals

- OSG vision is to create a persistent, production quality DHTC infrastructure for use by its stakeholders
- OSG goals are
  - Facilitate sharing of resources for resource providers, and
  - Facilitate access to participating sites by the scientific users

OSG in numbers

- ~120 participating sites
- ~100k CPU cores

From the OSG Display
http://display.grid.iu.edu/



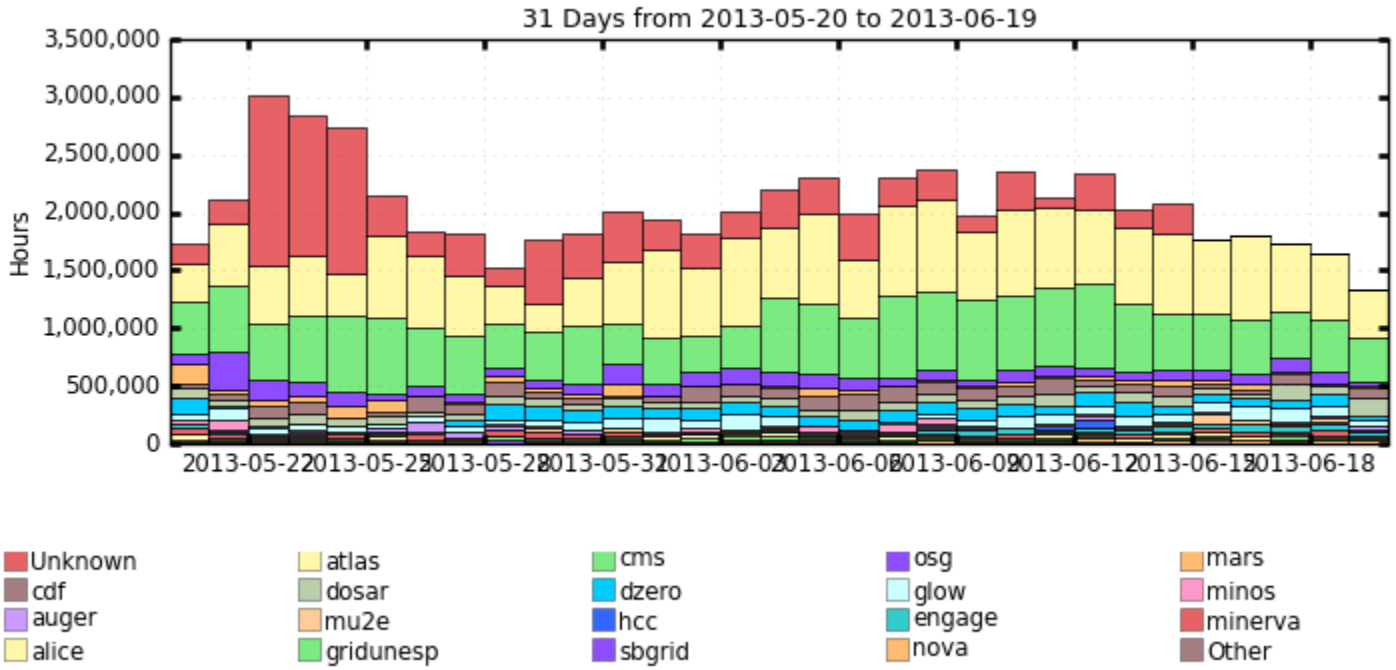
In the last 24 Hours	
422,000	Jobs
1,603,000	CPU Hours
2,352,000	Transfers
1,368	TB Transfers
In the last 30 Days	
15,223,000	Jobs
63,229,000	CPU Hours
43,286,000	Transfers
33,084	TB Transfers
In the last 12 Month	
170,169,000	Jobs
770,610,000	CPU Hours
678,971,000	Transfers
372,000	TB Transfers

OSG on the map

- Most of the USA covered
  - And we even have some abroad

OSG Communities

- Dominated by ATLAS and CMS (HEP)
  - But almost a third used by a significant number of smaller groups



About OSG resources

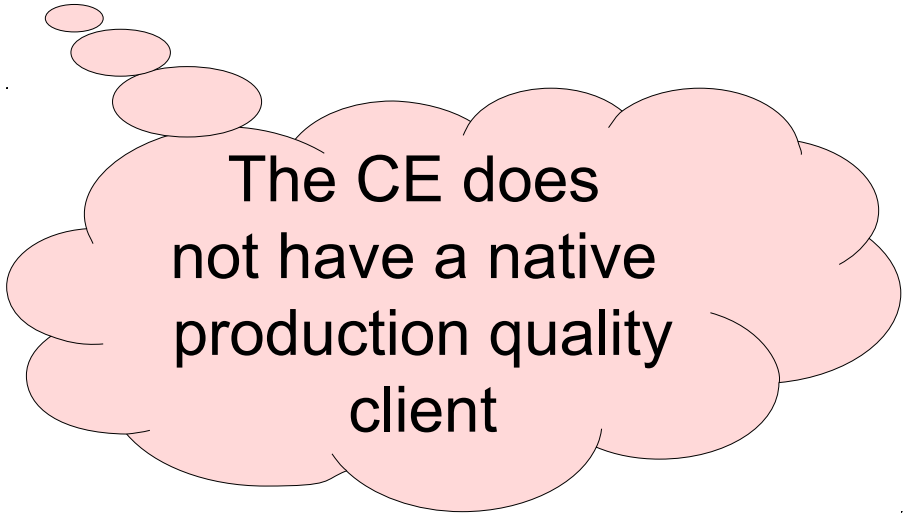
- OSG standardized on Red Hat Enterprise Linux (and alike, e.g. CentOS) on x86_64 CPUs
  - Versions 5 and 6
  - In theory other Linux distributions an option, but not supported out of the box
- Users thus should plan on building their software for this platform
  - At least in the short term

About OSG resources

- Each OSG job will be running on a single node
  - e.g. no multi-node MPI
- Most of the sites schedule one job per CPU core
  - So you don't even get a full node
- Typical job gets
  - 1 core + 2G of RAM + 10G of tmp disk

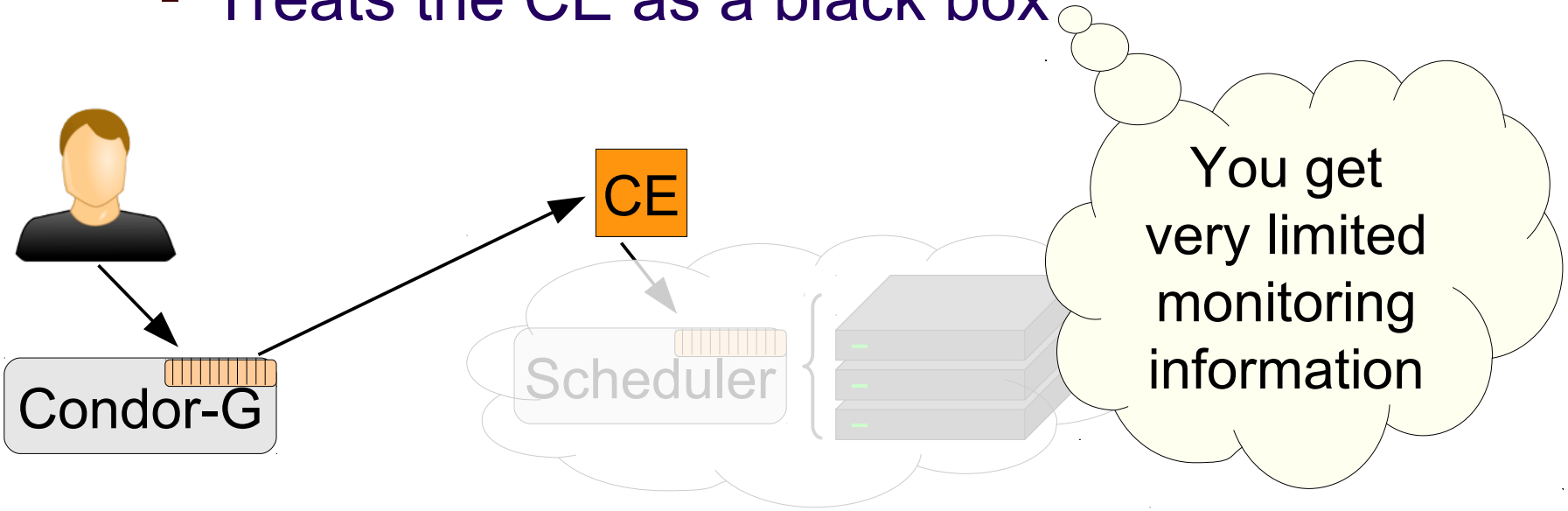
Accessing OSG resources

- The only way to get access to OSG resources is through the CE
  - e.g no login nodes or interactive access
- The recommended client is Condor-G
  - HTCondor supports "Grid universe" jobs



Condor-G in a nutshell

- I like to call Condor-G “a shovel”
  - It accepts jobs and “shovels” them into a remote HTC system
- Just a schedd, no startd
  - Treats the CE as a black box



XSEDE

- XSEDE is the other Grid infrastructure in the USA
- XSEDE is part of the XD program
  - XD == NSF's eXtreme Digital program
  - XSEDE == eXtreme Science and Engineering Discovery Environment

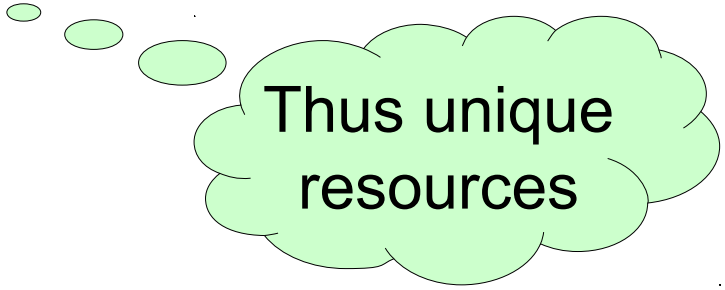
https://www.xsede.org/

XSEDE Grid

- XSEDE is composed of a set of very different resource providers
  - Typically one-of-a-kind supercomputers (but not only)
- Users thus typically have to tune/tweak their jobs for the resource they want to use
  - Due to the unique nature of the resource

XSEDE Resources

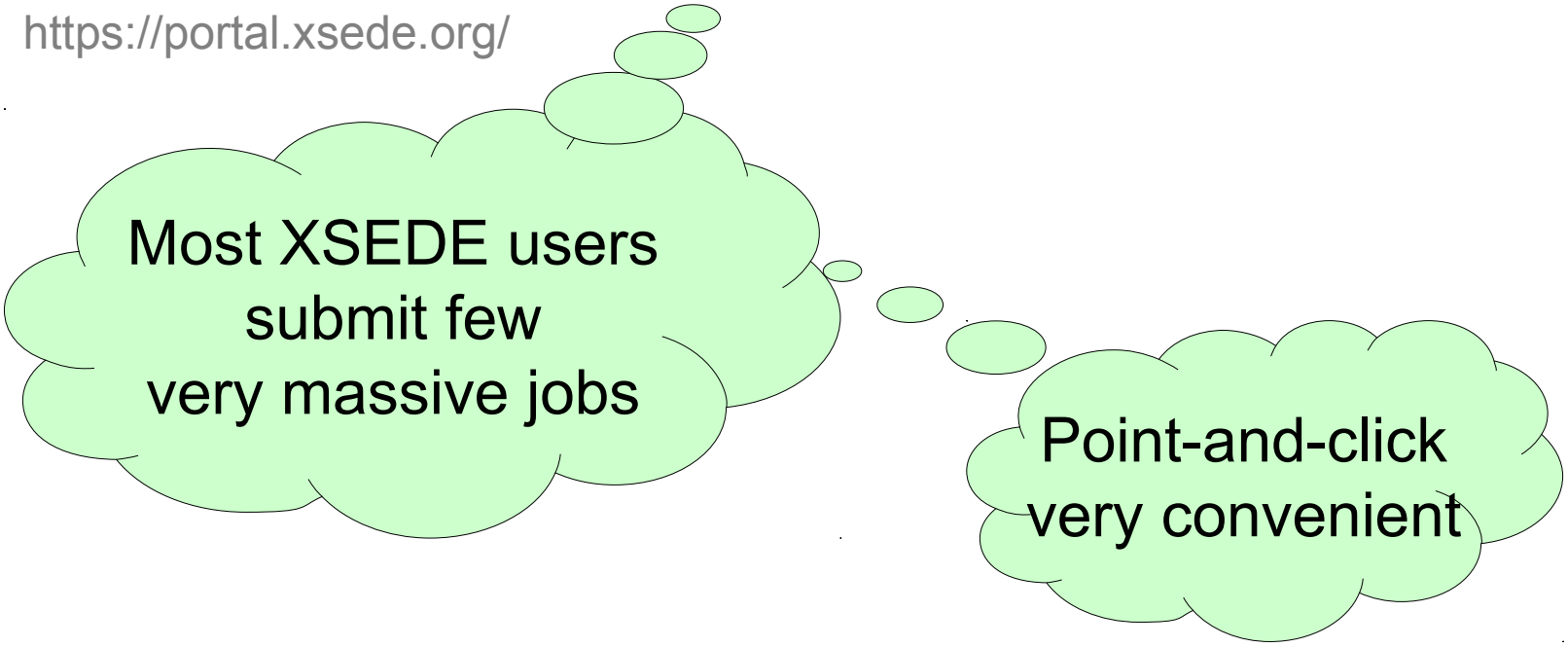
- XSEDE owns (most of) the hardware
- Its main focus is on **"new and innovative"** resources, e.g.
  - Multi-Petaflop systems
  - GPU computing
  - 100 Tbytes flash storage
  - Infiniband interconnects



Access to resources

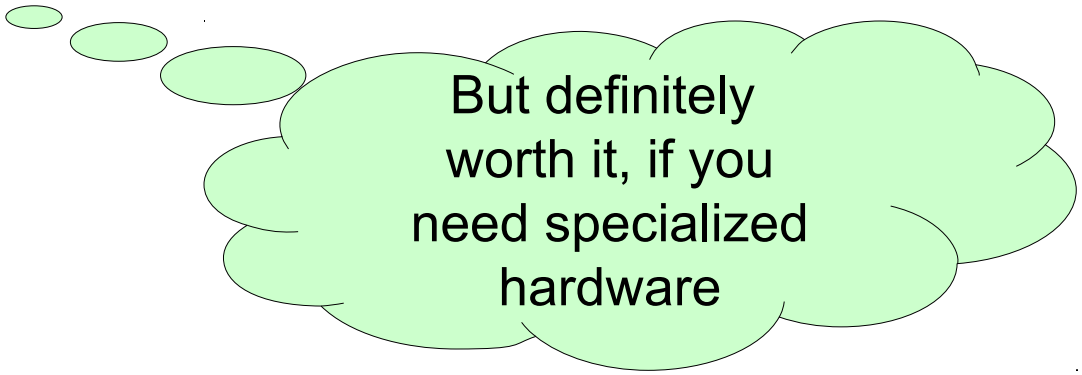
- XSEDE provides login access to their scheduler submitter nodes
  - To facilitate porting and debugging
- XSEDE also has a Web portal

https://portal.xsede.org/



Grant system

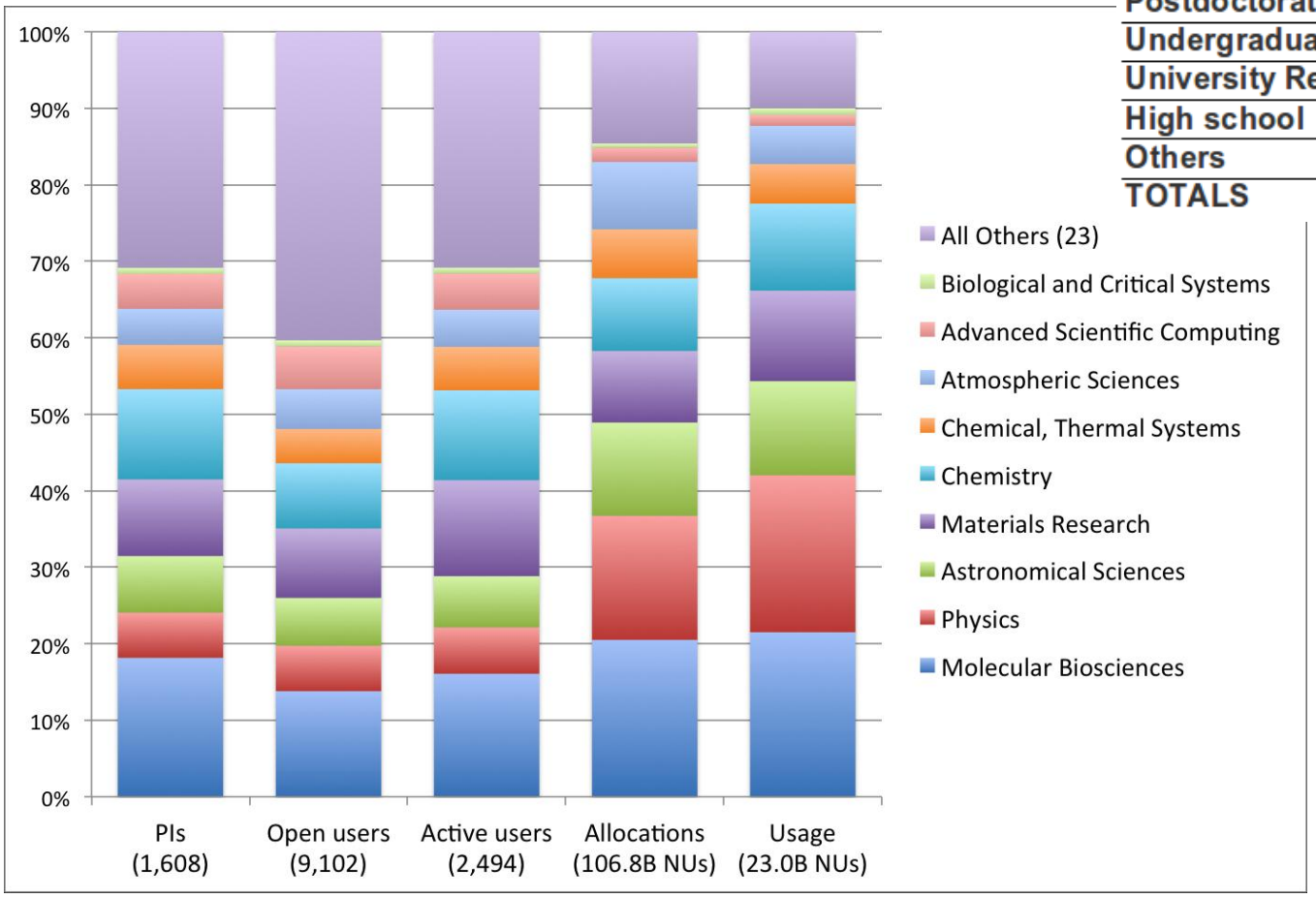
- Each user needs a Grant to use any XSEDE resources
  - So resources are not over-comitted
- Small grants easy to get
  - But getting a significant amount of resources takes serious paperwork



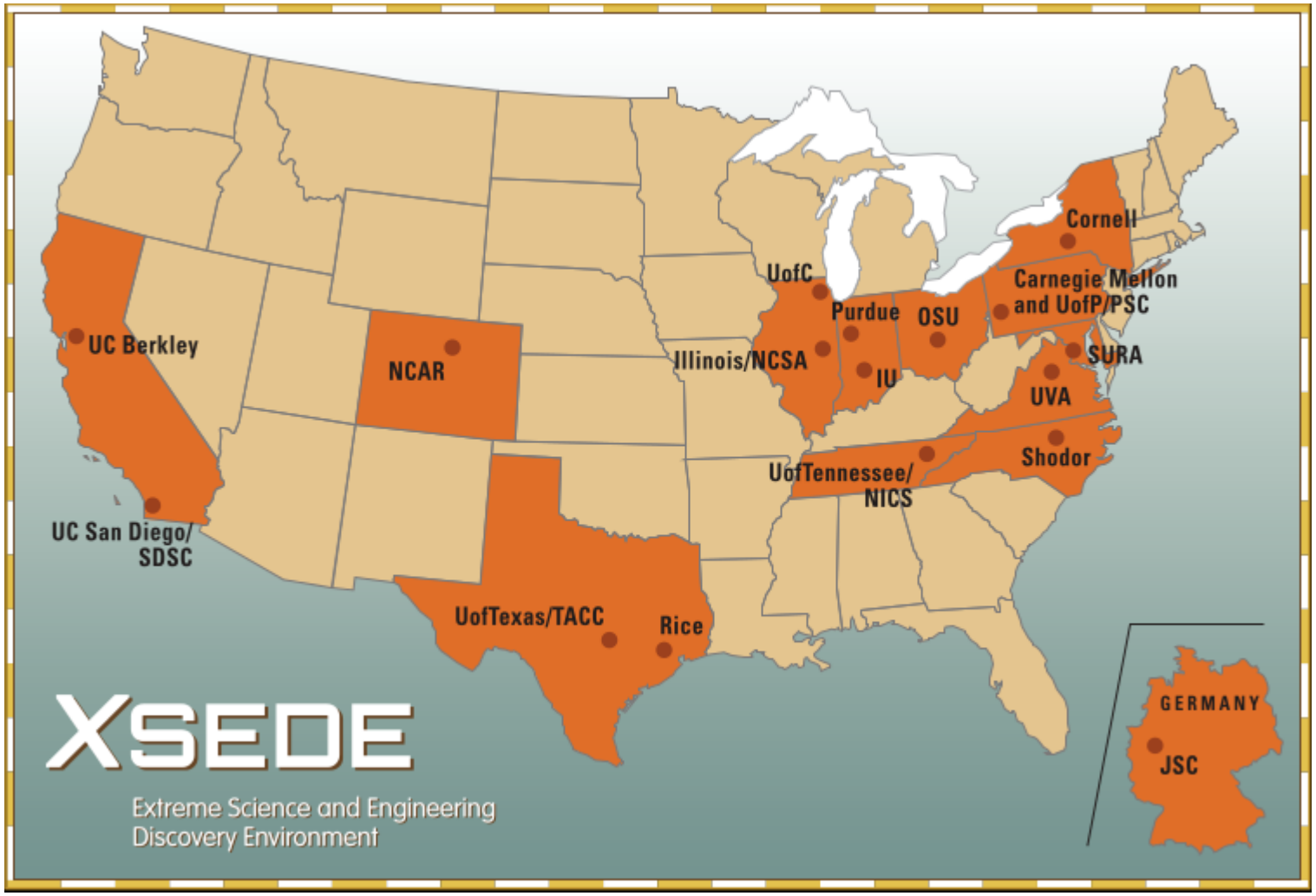
XSEDE User base

https://www.ideals.illinois.edu/handle/2142/44872

	Users
Graduate Student	2848
Faculty	1384
Postdoctorate	1028
Undergraduate Student	721
University Research Staff	528
High school	23
Others	510
TOTALS	7042



XSEDE on the map



Beyond HW resources

- XSEDE has a large number of people on its payroll
- XSEDE provides
  - Training, Education and Outreach
  - Coding support and advising
  - Software development
  - Hardware engineering

  https://www.xsede.org/what-we-do
- Aims at providing end-to-end support for enabling innovative science

Questions?

- Questions? Comments?
  - Feel free to ask me questions later:

    Igor Sfiligoi <isfiligoi@ucsd.edu>
- Upcoming sessions
  - Now – 3:00pm
    - Interactive session on security
  - 3:00pm – 3:15pm
    - Break
  - 3:15pm – 4:00pm
    - Lecture on Security

Logos

Open Science Grid