THE OPEN SCIENCE GRID (OSG)

And how it relates to PRAGMA

by Igor Sfiligoi, UCSD/SDSC

(isfiligoi@sdsc.edu)

PRAGMA 37 - SEPT 13TH, 2019

Premise – Not the Grid you were used to

- It is my understanding Grid has a negative connotation in PRAGMA

- While OSG has "Grid" in its name,
  I believe it is far from the "Grid" you experienced 15 years ago

- Please give me a chance to convince you of that

OSG evolution

- 10 years ago, OSG provided an integrated software stack that organizations had to deploy in order for their researchers to benefit from OSG.

  - **We learned the hard way that this is too high a bar to jump across for most researchers and institutions.**

- **Today, we offer to operate services** to the groups we serve in order to minimize the threshold to entry for everybody.

  - Leveraging work performed by the likes of PRP/NRP-P/TNRP (e.g. Kubernetes)

OSG Aspirational Goal

A campus Research IT Organization

should not have to learn anything "non-standard"

in order to have their researchers benefit from OSG,

or have their resources be available via OSG

Now …. Not there yet, but getting closer by the day…

OSG Mission

Advancing Open Science through distributed High Throughput Computing

Open Science

- All of open science irrespective of discipline

- Include the maximum possible dynamic range
  of science, groups, and institutions
  - From **individual undergraduates**
    to **international collaborations** with thousands of members.
  - From **small colleges, museums, zoos**,
    to **national scale centers** of open science.

What Sciences use OSG?

- Order here is from most active to least active.
  - Category is based on self-identification … i.e. people say what they do.

Legend listing:
- High Energy Physics — Astrophysics — Medical Sciences — Biological Sciences
- Neuroscience — Particle Physics — Nuclear Physics — Training — Gravitational Physics
- Bioinformatics — Physics — Engineering — Physical Chemistry — Economics
- Biophysics — Evolutionary Sciences — Statistics — Physics and astronomy — Chemistry
- Community Grid — Biochemistry — Ecological and Environmental Sciences — Zoology
- Fluid Dynamics — Computational Condensed Matter Physics
- Biological and Critical Systems — Computer and Information Science and Engineering
- Chemical Engineering — Earth Sciences — Mathematical Sciences — Medical Imaging
- Geographic Information Science — Educational Psychology — Biomedical research
- Technology — Plant Biology — Education — Genomics — Materials Science
- Astronomy — Information, Robotics, and Intelligent Systems — Multi-Science Community

Not all users are the same

- The **individual researchers** and small groups

- The **campus Research Support Organizations**

- **Multi-institutional Science Teams**
  - XENON, GlueX, SPT, Simons, and many many more
  - Collaborations between multiple campuses

- The 4 **"big science"** projects:
  - US-ATLAS, US-CMS, LIGO, IceCube

Used services change between different categories

OSG Mission

Advancing Open Science through distributed High Throughput Computing

distributed High Throughput Computing

(as opposed to e.g. HPC)

DRIVING PRINCIPLES:

- Maximize total compute, do not optimize for any single application

- Allow for resources coming from anywhere in the world

- Embrace heterogeneity

- Federated policy control

distributed High Throughput Computing

DRIVING PRINCIPLES:

- Maximize total compute, do not optimize for any single application

- Allow for resources coming from anywhere in the world

- Embrace heterogeneity

- Federated policy control

IMPLICATIONS:

- Expect high network latencies   (Although throughput should be high)

- Expect varying walltime between identical runs

- Job restarts are the norm

Thriving in dHTC

- The path to successful dHTC involves two aspects:
  - Separate a big computing problem in many individually schedulable small problems.
  - Minimize your requirements in order to maximize the raw capacity that you can effectively use.

- The infrastructure will transparently take care of job restarts

Ingenious Parallelism

dHTC is special

- dHTC scales by definition perfectly.

  - When a researcher understands how to partition their workflow into many individually schedulable compute problems they can scale out with ease to seemingly arbitrary scales of computing.

  - When we integrate all IT resources at Universities, National Labs, and the commercial cloud, we arrive at a near infinite resource pool.

Stronger together

- For OSG VO, more than half of the compute comes from smaller sites (and this does not include any of the big sciences, that have their own pools)

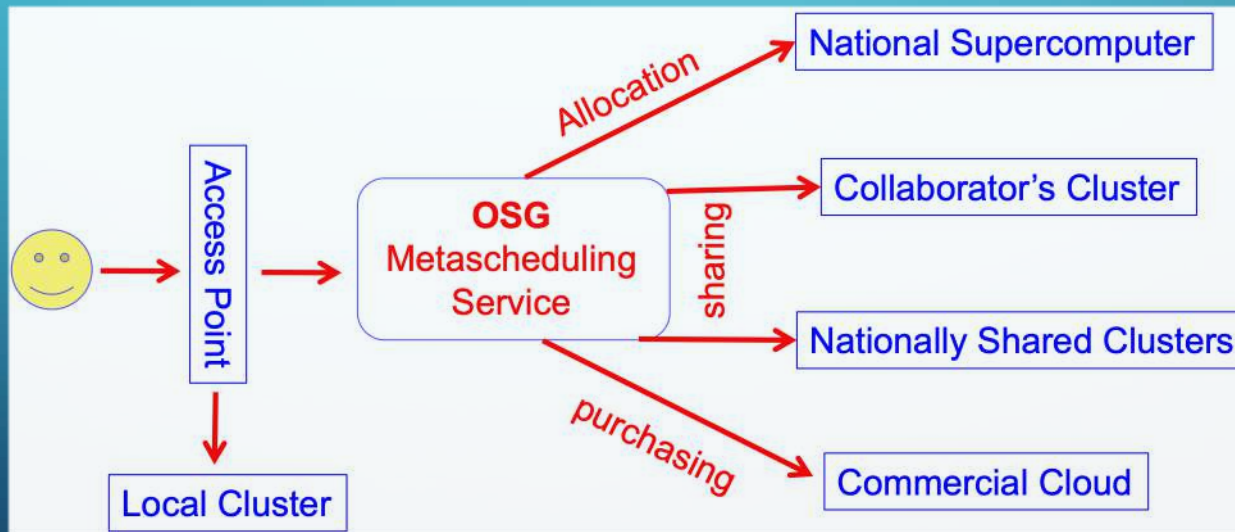
Wall Hours By Facility
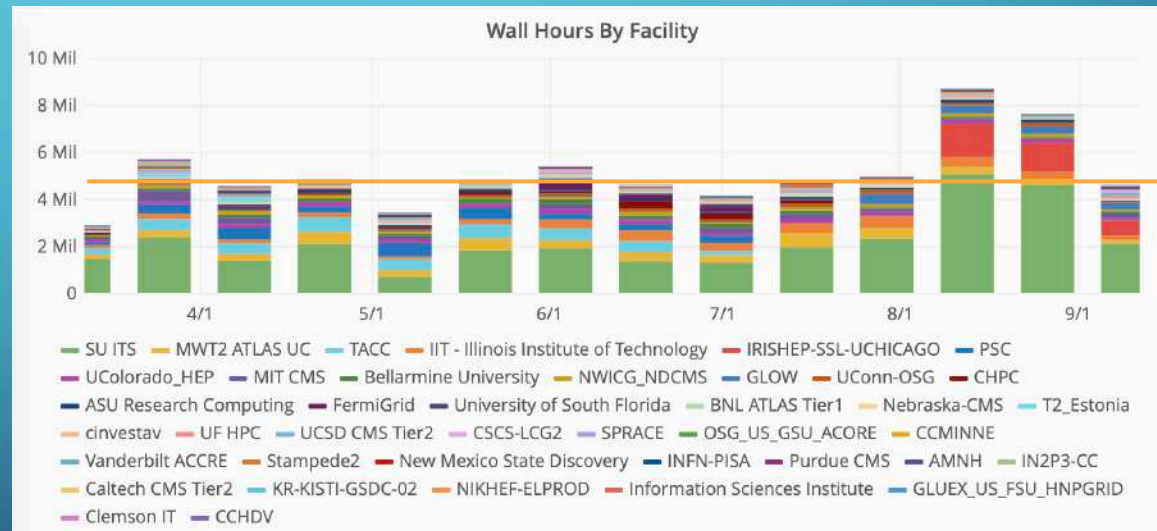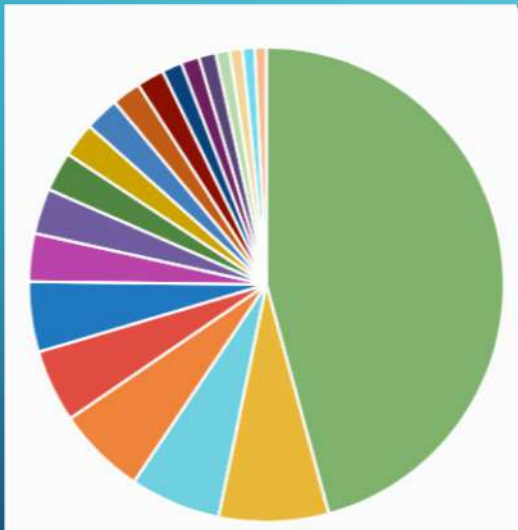
15k cores

OSG IN DETAIL

OSG Compute Services

- OSG provides the means for operating a compute federation
  - Mostly in the form of Metascheduling Service
  - But also operates one access point itself for the smaller players

Federation i.e. Distributed control

- OSG works on three simple principles:
  - Resource Owners determine policy of use
    - This means that all policy of use is set locally by the clusters that join the federation.
  - Resource Consumers specify the types of resources they are willing to use.
    - How much RAM? How many cores per node? …
  - OSG submits HTCondor batch system as (pilot) payload into all local batch systems that match requirements, creating an overlay dHTC system
- Jobs are submitted locally, queue centrally, and execute anywhere that matches requirements after resource becomes available.

OSG Data Federation

- OSG operates a content delivery network (CDN)
  - Based on XRootD caching technology

- Data origins operated by Science communities
  - Data transparently published in our federated namespace.
  - Caches hide data access latencies and reduce network traffic.

Directory	Working Set	Total Read
/pnfs/fnal.gov/usr/dune	13.107GB	395.537TB
/pnfs/fnal.gov/usr/minerva	255.266GB	270.994TB
/gwdata/O1	169.585GB	258.341TB
/pnfs/fnal.gov/usr/des	193.57GB	120.993TB
/user/ligo	5.612TB	83.564TB
/pnfs/fnal.gov/usr/nova	162.632GB	18.841TB

30k
1k
15
100

Depending on community, files were read 10-30,000 times during a two month period.

OSG Software Distribution

- OSG can host and distribute community software on CVMFS

  - A CDN at heart, but based on Apache Squid technology

  - CVMFS provides a Read-Only POSIX interface

- OSG encourages the use of containerization

  - Encourages participating sites to provide Singularity

    - Which is optimized for use by unprivileged users (unlike Docker)

  - Containers can be distributed through CVMFS (for performance)

Facilitation Services

- Proactive, personalized guidance and support for:
  - Institution-specific submit points
  - Sharing institutional resources via OSG
  - Data federation across OSG sites
  - Individual researchers using the OSG submit infrastructure

- We also offer
  - Local workshops
  - OSG-hosted education and training
  - Learning from the OSG Facilitation Community

OSG AND PRAGMA

OSG AND PRAGMA

- OSG would be happy to facilitate any Open Science endeavor that has at least some of its members in the US
  - We are a NSF-funded project

- All OSG services are at your disposal
  - Compute federation
  - Data federation
  - Software distribution
  - Facilitation

Open Science Grid

OSG and International Setups

- All our major users are international
  - CMS, ATLAS, LIGO, IceCube, XENON, GlueX

- But, alas, we have been mostly collaborating with Europe

- **PRAGMA could help us engage more Science communities in the Pacific Rim**

Summary and Conclusion

- OSG's objective is to "Advance Open Science through distributed High Throughput Computing"
  - We are committed to help any Open Science community that has at least some members in the USA – Nice overlap with PRAGMA
- OSG can offer a wide variety of services
  - Both in terms of technology and facilitation
- We could use some help getting more involved in the Pacific Rim
- Contact us at: help@opensciencegrid.org

Open Science Grid