Introduction to Open Science Grid (OSG)

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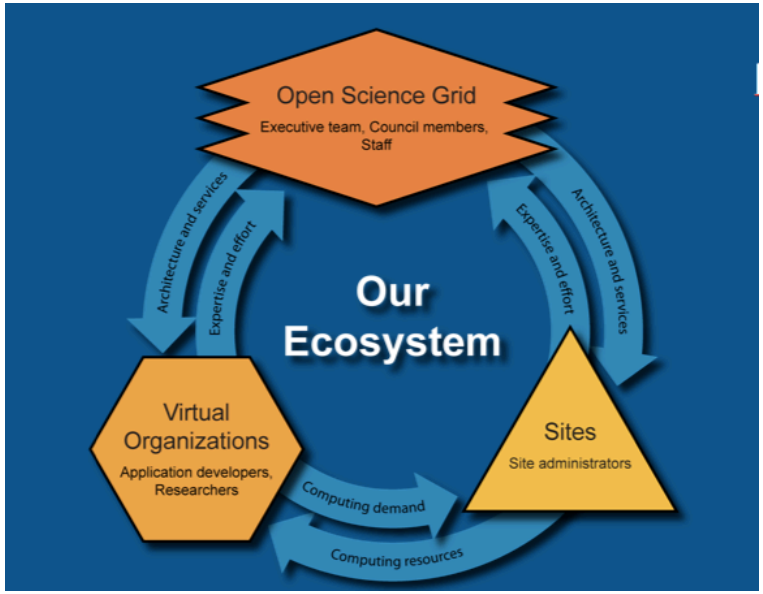
Open Science Grid Ecosystem

Consortium
Infrastructures
Project
Satellites

Services:
- Consulting
- Production
- Software



Mission: *The Open Science Grid aims to promote discovery and collaboration in data-intensive research by providing a computing facility and services that integrate distributed, reliable and shared resources to support computation at all scales.*

http://www.opensciencegrid.org/

Introduction to OSG

Resources accessible through the OSG are contributed by the community. Their autonomy is retained.

Resources can be distributed locally as a campus infrastructure.

>30 research communities
>100 sites
>70,000 cores accessible

https://oim.grid.iu.edu/oim/home

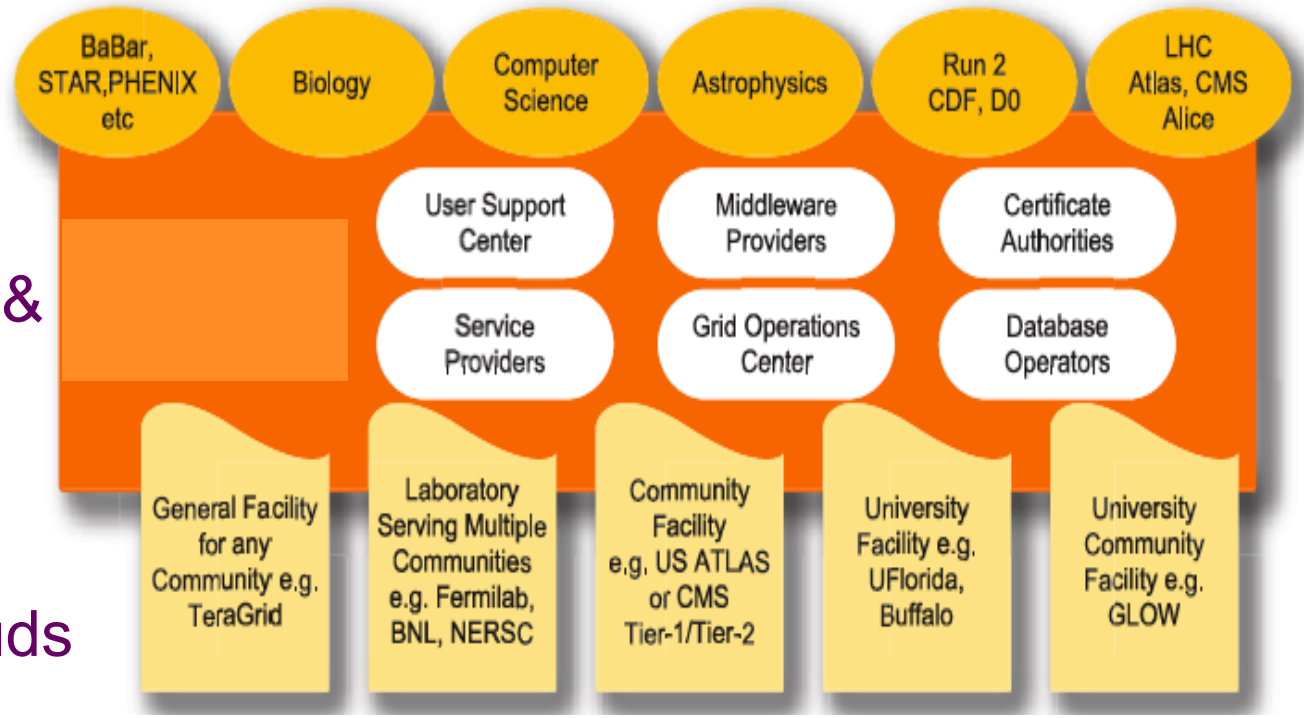
Users communities (aka VOs) and Campus Infrastructures bring:
1) Users, and/or 2) Resources

Basic Architecture

Virtual Organizations

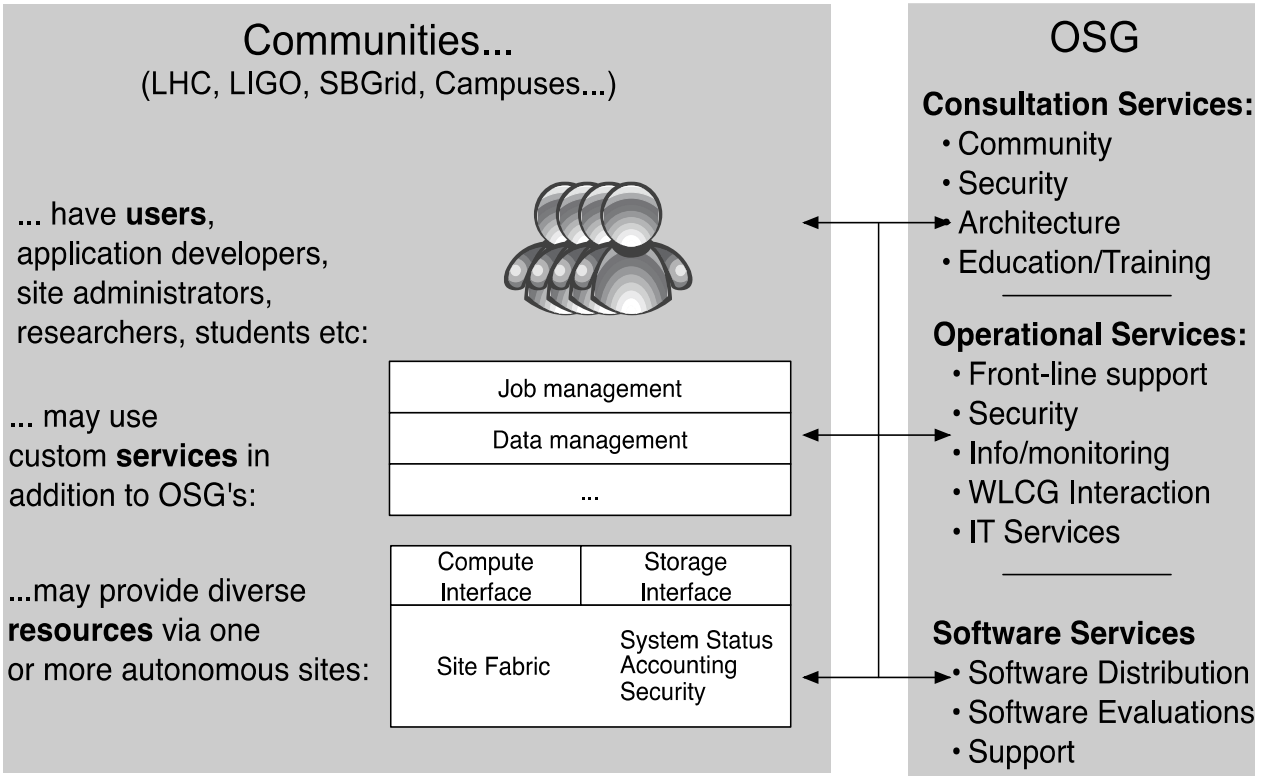
Common Services & Software

Resources: Sites, Campuses, Clouds



OSG Architecture

Architecture is driven by principles of Distributed High Throughput Computing (DHTC) captured in our Blueprint.



There is a sharing of software, operational services, and knowledge between the communities and OSG in each of these areas.

http://osg-docdb.opensciencegrid.org/0000/000018/012/OSG%20Blueprint%20v2.0.pdf

Some Contacts

OSG Staff	Responsibility
Chander Sehgal (Fermilab)	User Support Lead and Project Manager
Gabriele Garzoglio (Fermilab)	User Support – new communities integration
Marco Mambelli (UofChicago)	Site Coordination
Rob Quick (Indiana)	Operations Lead
Dan Fraser (ANL/UofChicago)	Production and Campus Infrastructure lead
Lothar Bauerdick (Fermilab)	Executive Director
Miron Livny (U Wisconsin)	PI and Technical Director

Introduction to OSG:

http://osg-docdb.opensciencegrid.org/0008/000839/004/OSG%20Intro%20v23.pdf

General OSG User Documentation:

https://twiki.grid.iu.edu/bin/view/Documentation/WebHome

Central ticketing system at the Operations Center http://myosg.grid.iu.edu/about
Email lists for community discussions https://twiki.grid.iu.edu/bin/view/Documentation/ContactsMailingLists

Open Science Grid

OSG Software

- OSG Software is packaged, tested, distributed as RPMs by the OSG Software group. https://twiki.grid.iu.edu/bin/view/SoftwareTeam/WebHome
  - The OSG Koji-hub has over 200 RPM packages.
  - Older releases are packaged using Pacman and tarballs and use a grid middleware called Virtual Data Toolkit (VDT).
  - It also provides installation, configuration, administration tools for resources, VOs and Campus Infrastructures.
  - Alain Roy at the University of Wisconsin Madison is the Software Team Lead.
  - Software is added at the request of stakeholder needs.

Virtual Organizations (VOs)

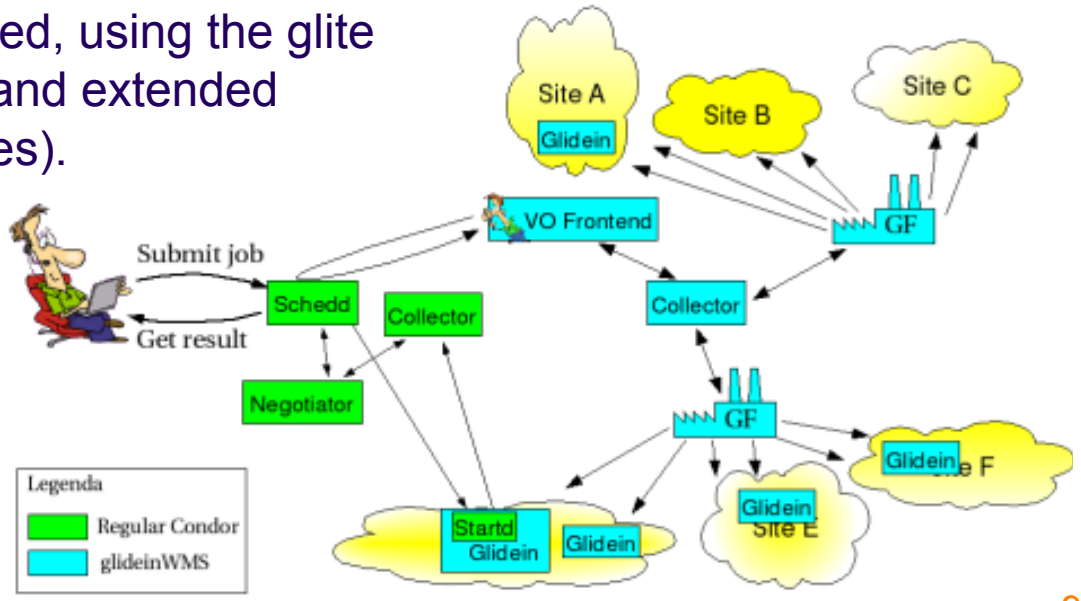
- The OSG environment is VO based.
  - VOs can be science communities (e.g. Belle, CMS) or
  - Multi-disciplinary Campus based [e.g. U-Nebraska(HCC), U-Wisconsin(GLOW)]
- OSG assumes VOs will register with, support and use multiple Grids as needed [e.g. EGI, UK National Grid Service (NGS)]
- Users can be members of multiple VOs
- Site resources are owned by one or more VOs.

Using the OSG

The prevalent OSG job submission mechanism is via Glide-ins which submit Pilot jobs to Gram gatekeepers, where the Pilots then create a Condor overlay environment across the sites and manage the user job queues and execution.

Sites also accept many other job submission mechanisms: gliteWMS*, Globus, PANDA.

Security is X509 PKI certificate based, using the glite VO Management System (VOMS) and extended attributes (including groups and roles).



* European Grid Infrastructure (EGI) Lightweight Middleware for Grid Computing

Open Science Grid

OSG Site

- An OSG Site (one or more Resources) provides one or more of the following:
  - Access to local computational resources using a batch queue
  - Local storage of and access to data using a distributed file system.
  - Remote access to data through the Storage Resource Management Interface (SRM)
  - Access to users to use external computing resources on the Grid.
  - The ability to transfer large datasets to and from remote sites.

- An OSG site offers access to these resources to grid users.
  - The policies and priority of use are determined locally by the site owners.
  - Typically the owner VO has highest priority, other “like” VOs have middle priority and the rest of the community has a lower “opportunistic” access.

What does a Site Owner Agree to?

- Offer services to at least one VO within OSG.
  - While fair access is encouraged, you need not offer services to all communities within OSG
- To advertise accessible services accurately
- To sign the “OSG Appropriate Usage Policy”
  - Do not knowingly interfere with the operation of other resources
  - Do not breach trust chains, be responsible and responsive on security issues

Requirements: System and Software

- There are no specific hardware requirements but there are recommendations as to the size of memory, local disk, server nodes depending on the expected usage.
- The VDT supports several different Linux flavors of operating system:
  - Scientific Linux5 is currently the most used.
  - We also support some packages in CentOS and Debian
  - Scientific Linux6 is on the horizon (already in use by LIGO, expected to be needed by US LHC soon).
- OSG Software Stack
  - The current software release is RPM based (OSG 3.0).
  - Previous software releases used Pacman for distribution and installation.
- Worker Nodes
  - No specific requirement
  - Expect site to install the OSG Worker Node Client which is in practice needed for most VO applications

Requirements: To support the Users

- Mapping from Grid credentials to local Unix accounts done using GUMS or Gridmapfile:
  - Some VO prefer group accounts, some require pool accounts
  - None are privileged
- Some sites use Glexec* to map the Pilot user to the actual User credentials.
  https://twiki.grid.iu.edu/bin/view/ReleaseDocumentation/InstallConfigureAndManageGUMS
- User and/or groups ids should be mapped to allow consistent file access

*https://www.nikhef.nl/pub/projects/grid/gridwiki/index.php/GLExec

Requirements: Storage

- These requirements are revisited and adjusted periodically by agreement to match current needs of the VOs.
  - Common locations provided using Environment Variables
- Provide persistent storage space for VO applications - $OSG_APP.
- Provide space for User/VO data
  - At least 10 GB per Worker Node
  - One of:
    - shared file system ($OSG_DATA),
    - special file systems ($OSG_READ, $OSG_WRITE),
    - Convenient/local Storage Element ($OSG_DEFAULT_SE)
  - Consistent data access across the resource (gatekeeper and all nodes)
- Provide local scratch space, $OSG_WN_TMP

https://twiki.grid.iu.edu/bin/view/Documentation/Release3/LocalStorageConfiguration

Requirements: Network Interfaces

- Grid Accessible Interfaces and Services
  - Public IP, name in DNS
  - Connection requirements specified in the installation and firewall documents
    - https://twiki.grid.iu.edu/bin/view/Documentation/Release3/FirewallInformation
    - https://twiki.grid.iu.edu/bin/view/Documentation/Release3/InstallRSV
- Worker nodes
  - No specific requirement, but must be able to access updates to the Certificate Revocation Lists.
  - VO are encouraged not to require persistent services on Worker Nodes
  - Most VOs use some outbound connectivity – but OSG supports sites that do not.

Additional Slides

Open Science Grid

$OSG_APP

- can be read-only mounted on the worker nodes in the cluster
- Clusters can allow installation jobs on all nodes, only on the gatekeeper, in a special queue, or not at all
- Only users with software installation privileges in their VO (if supported by the VO) should have write privileges to these directories.
- At least 10 GB of space should be allocated per VO.

How a typical GlideinWMS based job submission works

- For every user job slot, a pilot job process starts up.
- The pilot job sends outbound TCP traffic over HTTP to a Factory service (at UCSD or IU) and via HTTP to a host at the VO Frontend (submit site; typically each VO installs its own Frontend).
- The pilot job spawns a condor startd, which spawns a condor starter.
- The startd sends outbound UDP traffic to a single port on the frontend. This is randomly chosen (per pilot) from a range of 200 ports. This can be changed to TCP if necessary.
- The starter sends outbound TCP traffic to a port on the frontend. This is chosen randomly (per pilot) from the frontend's ephemeral ports.

- Example Hosts and ports:
  - VO Frontend glidein.unl.edu (129.93.239.145). Ports: 80, 9618-9820
  - OSG Factory is glidein-1.t2.ucsd.edu. Port 8319

Source: Derek Weitzel et al. HCC VO requirements for ATLAS sites
http://www.usatlas.bnl.gov/twiki/bin/view/Admins/SupportingHCC.htmll

Some pointers to OSG technical documentation (Twiki)

https://twiki.grid.iu.edu/bin/view/Documentation/WebHome

Open Science Grid

First of all

- We encourage users to contact us exchange suggestions (receive help, provide feedback)
  - https://twiki.grid.iu.edu/bin/view/Documentation/Release3/HelpProcedure
- Email
  - osg-sites@opensciencegrid.org
- Web chat
  - http://integrationcloud.campfirenow.com/6e62e
- Jabber chat room (IM)
  - osg@conference.indiana.edu

Getting started

- You will need a Grid certificate (x509 certificate signed by a recognized CA, e.g. DOEGrids)
  - https://twiki.grid.iu.edu/bin/view/Documentation/CertificateWhatIs
  - https://twiki.grid.iu.edu/bin/view/Documentation/CertificateUserGet
- You will need host certificates (linked to the host name or alias, not IP)
  - https://twiki.grid.iu.edu/bin/view/Documentation/Release3/GetHostServiceCertificates
- Temporarily you can join the OSG VO (as a user and as a site)

Common structure in install documents

- Requirements
  - Certificates: How many and which certificates you will need to request
  - Networking: which ports must be open in the Firewall
- Install, Configuration and Start/Stop
- Troubleshooting (log files, procedures, …): check here if things are not working smoothly

OSG Release 3

- RPMs for RHEL5 based OS
- https://twiki.grid.iu.edu/bin/view/Documentation/Release3/WebHome
- Plan for your site
  - https://twiki.grid.iu.edu/bin/view/Documentation/Release3/SitePlanning
- Prepare and install a Compute Element
  - https://twiki.grid.iu.edu/bin/view/Documentation/Release3/PreparingComputeElement
  - https://twiki.grid.iu.edu/bin/view/Documentation/Release3/InstallComputeElement
- Monitoring with RSV
  - https://twiki.grid.iu.edu/bin/view/Documentation/Release3/InstallRSV

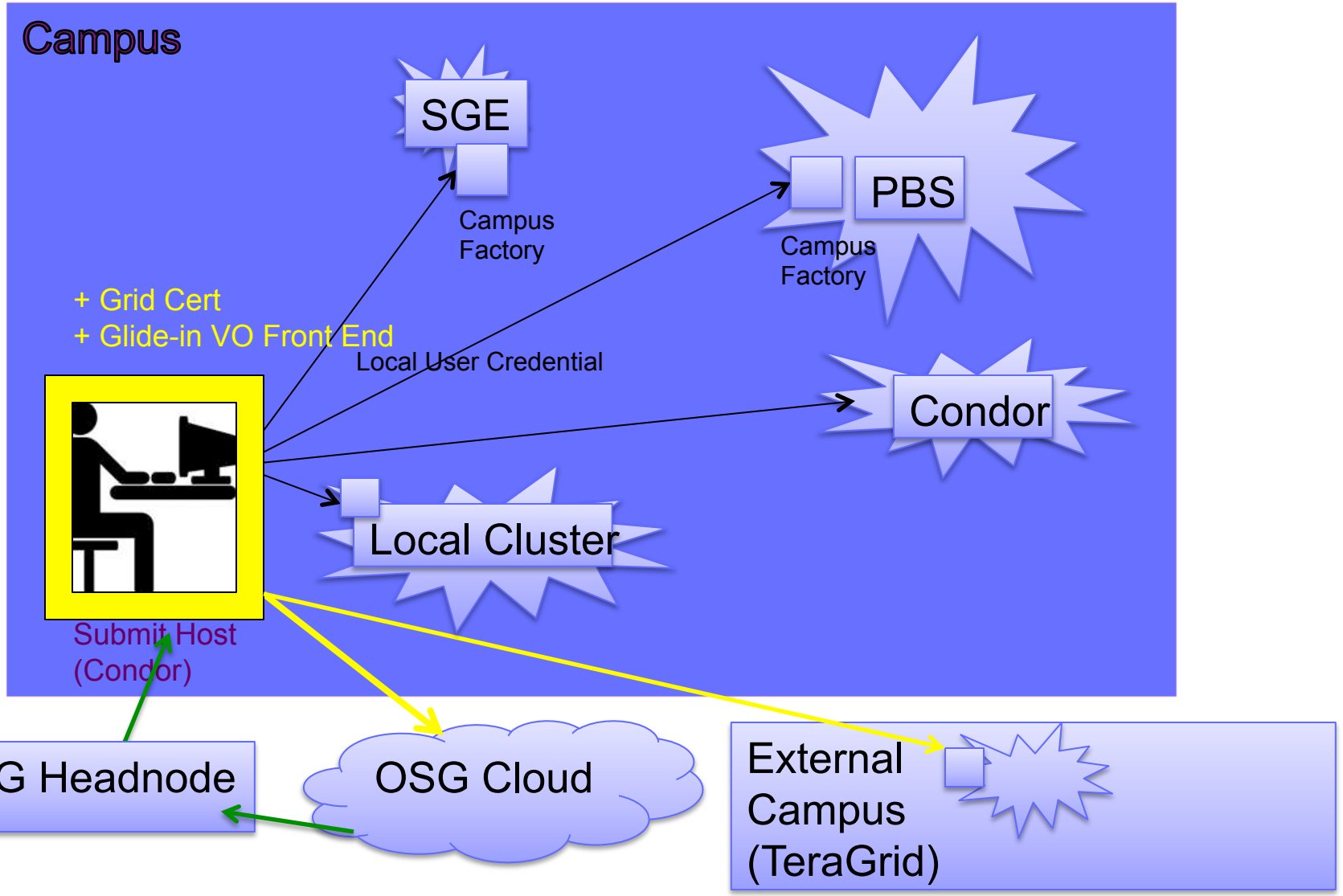
Share files with a Storage Element

- SRM to share your NFS file system
  - https://twiki.grid.iu.edu/bin/view/Documentation/Release3/InstallOSGBestmanSE
- GridFTP server only
  - https://twiki.grid.iu.edu/bin/view/Documentation/Release3/InstallOSGGridFTP

OSG Campus Grid

Sharing resources within a campus without using X509 authentication

Adding a Campus Grid



Open Science Grid

Campus grid

- Campus Factory
  - https://twiki.grid.iu.edu/bin/view/Documentation/CampusFactoryInstall
- BOSCO (single account solution)
  - https://twiki.grid.iu.edu/bin/view/CampusGrids/BoSCO