Grid-Enabling Applications in a Heterogeneous Environment with Globus and Condor

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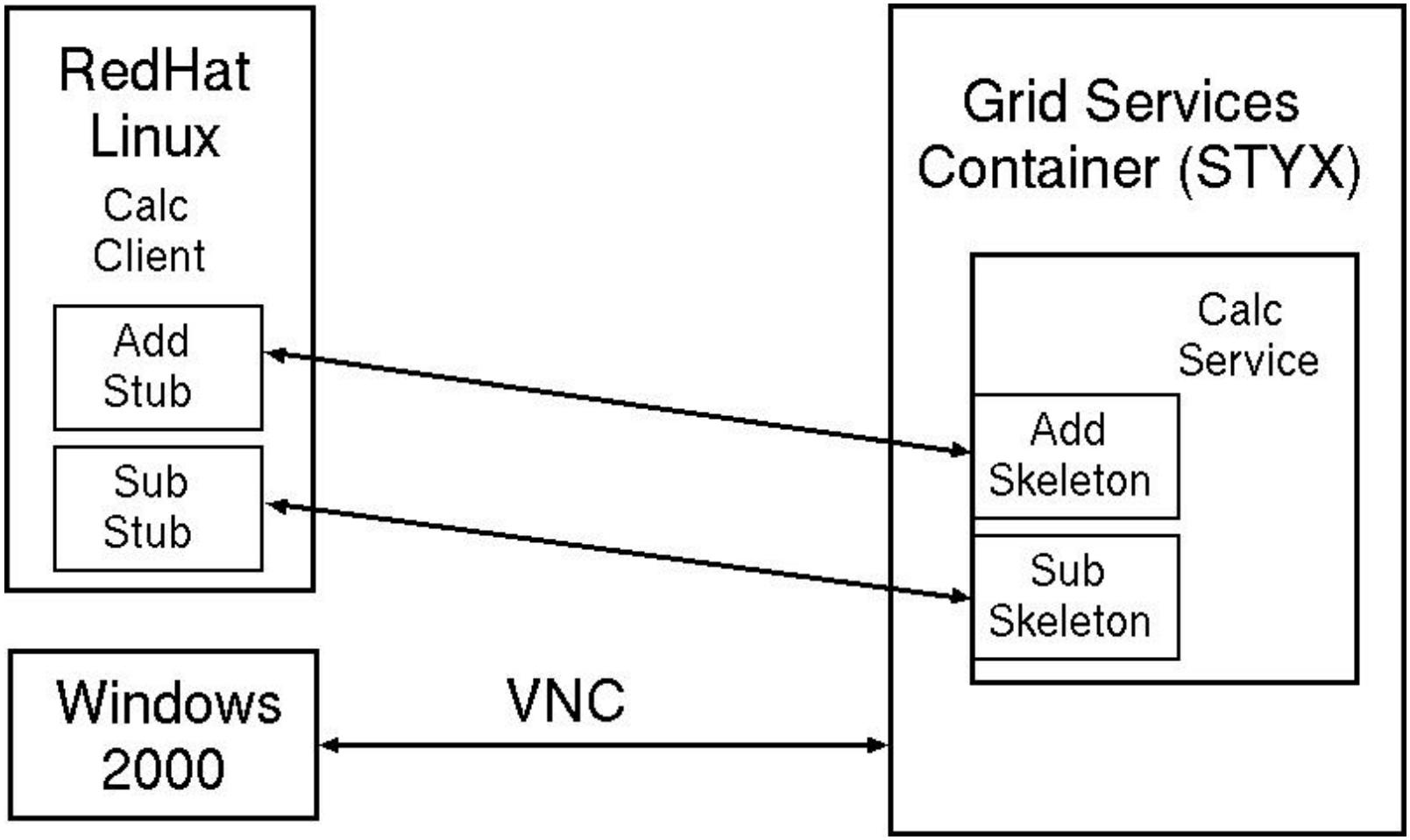
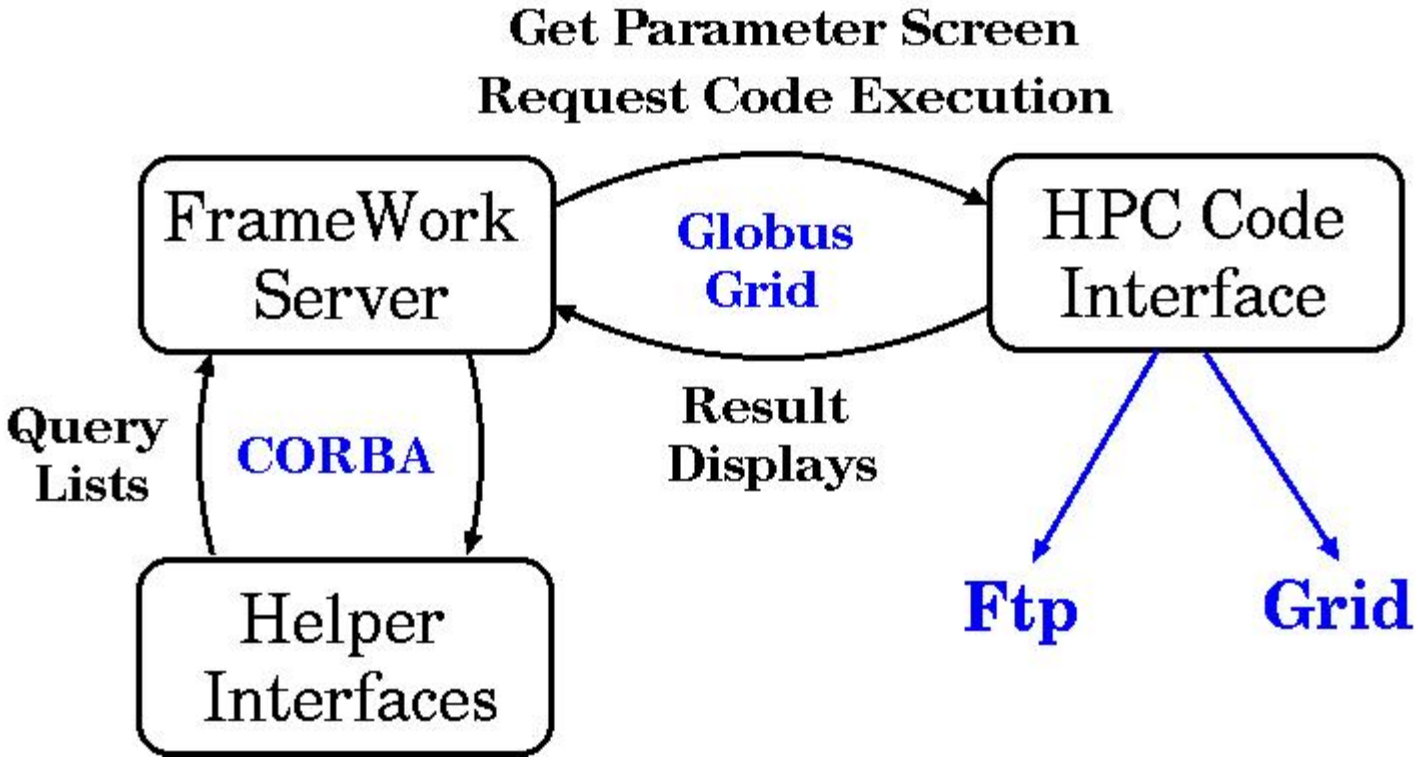
Test Environment

- AFRL Globus Grid Testbed
- AFRL Grid-Enabled FrameWork
- Regional VPN Based Grid
- Condor Globus Case Studies
- Heterogeneous Grid
  - Corning Community College contains a Condor Submit/Execute and Globus toolkit in a Debian network.
  - SUNY Geneseo contains a Globus toolkit in a Debian network.
  - SUNYIT contains a Condor Scheduler, Submit/Execute and Globus toolkit in a Linux network.

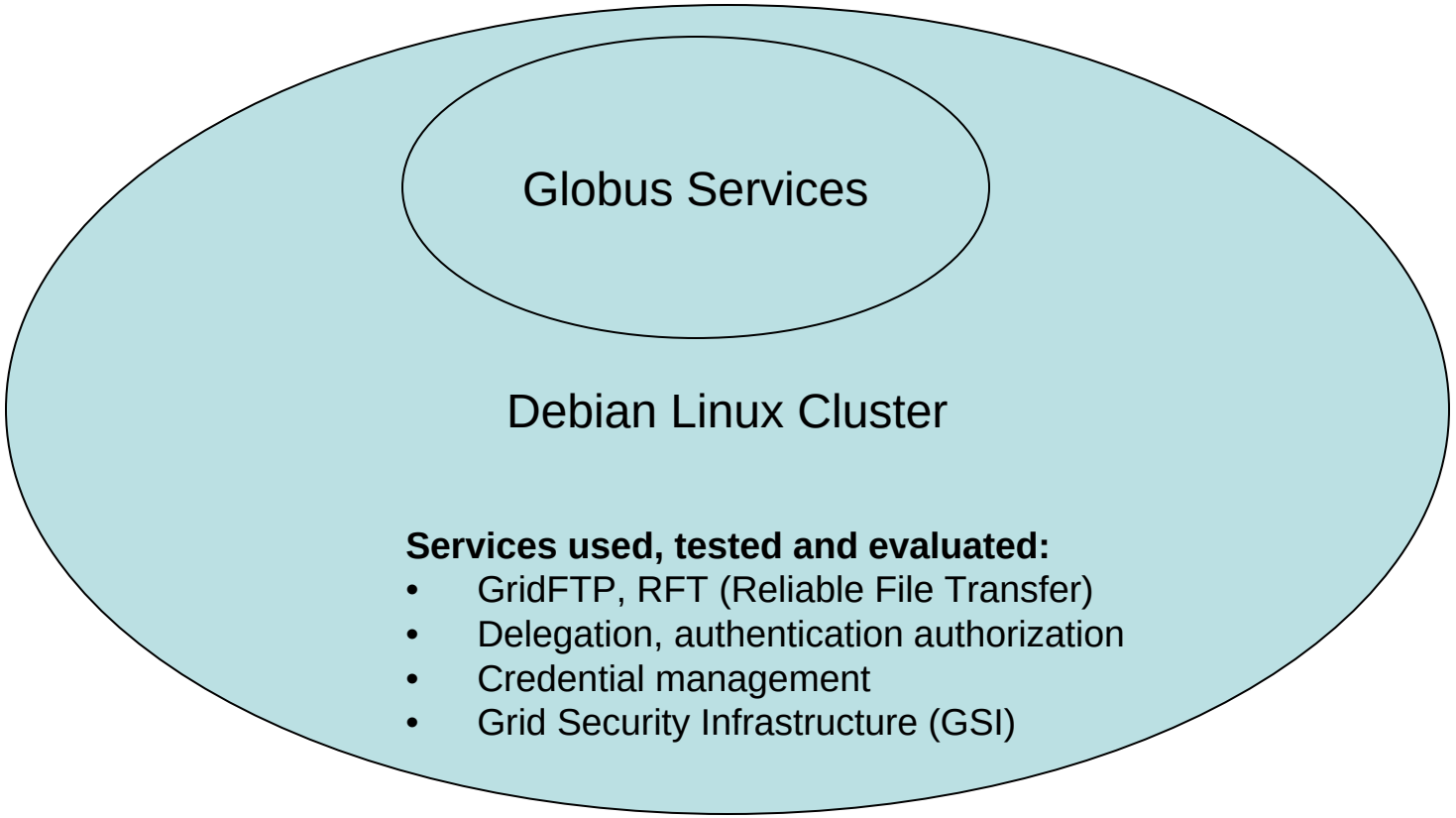
AFRL Globus Grid Testbed



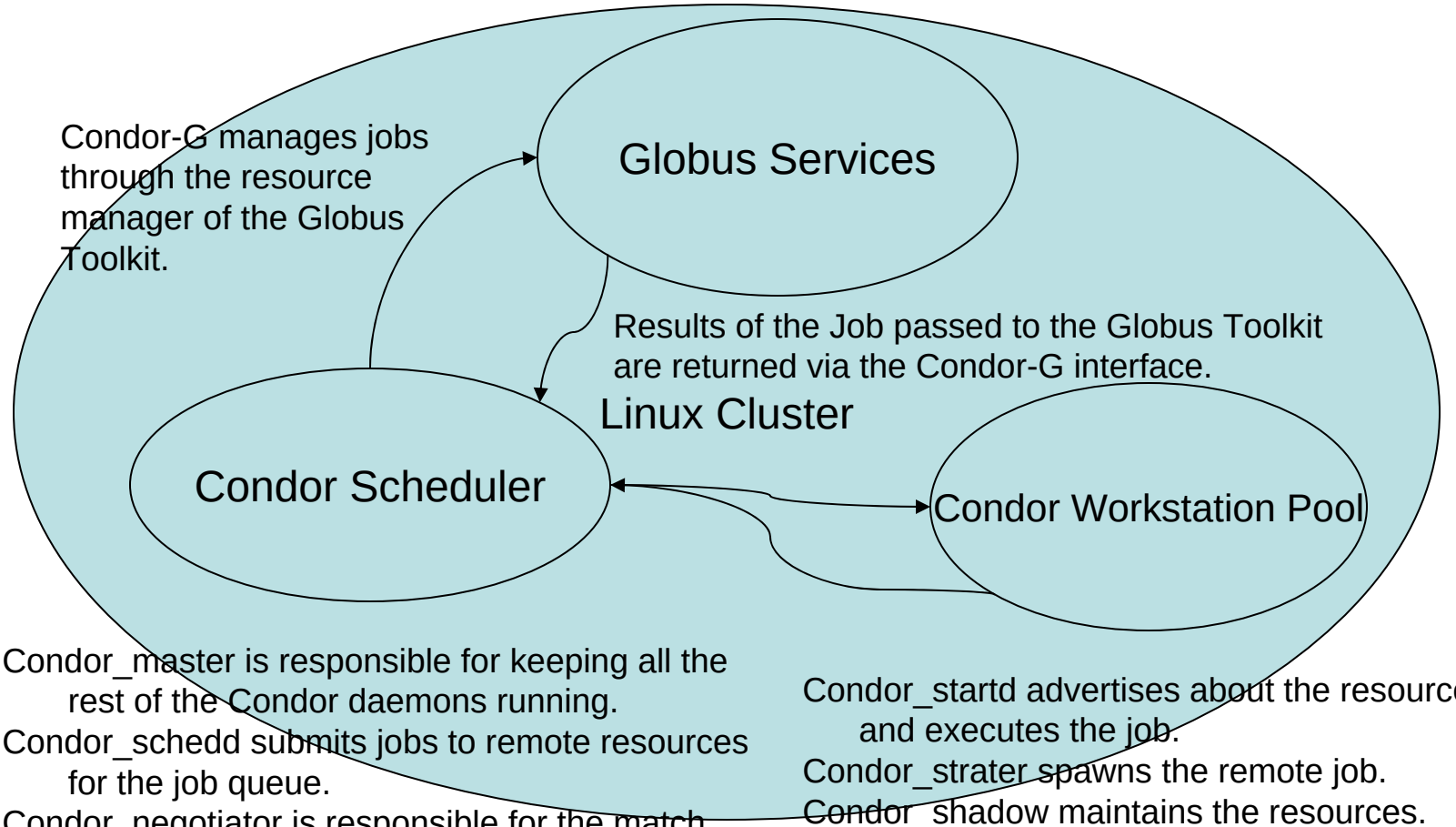
AFRL Grid-Enabled FrameWork



SUNY Geneseo



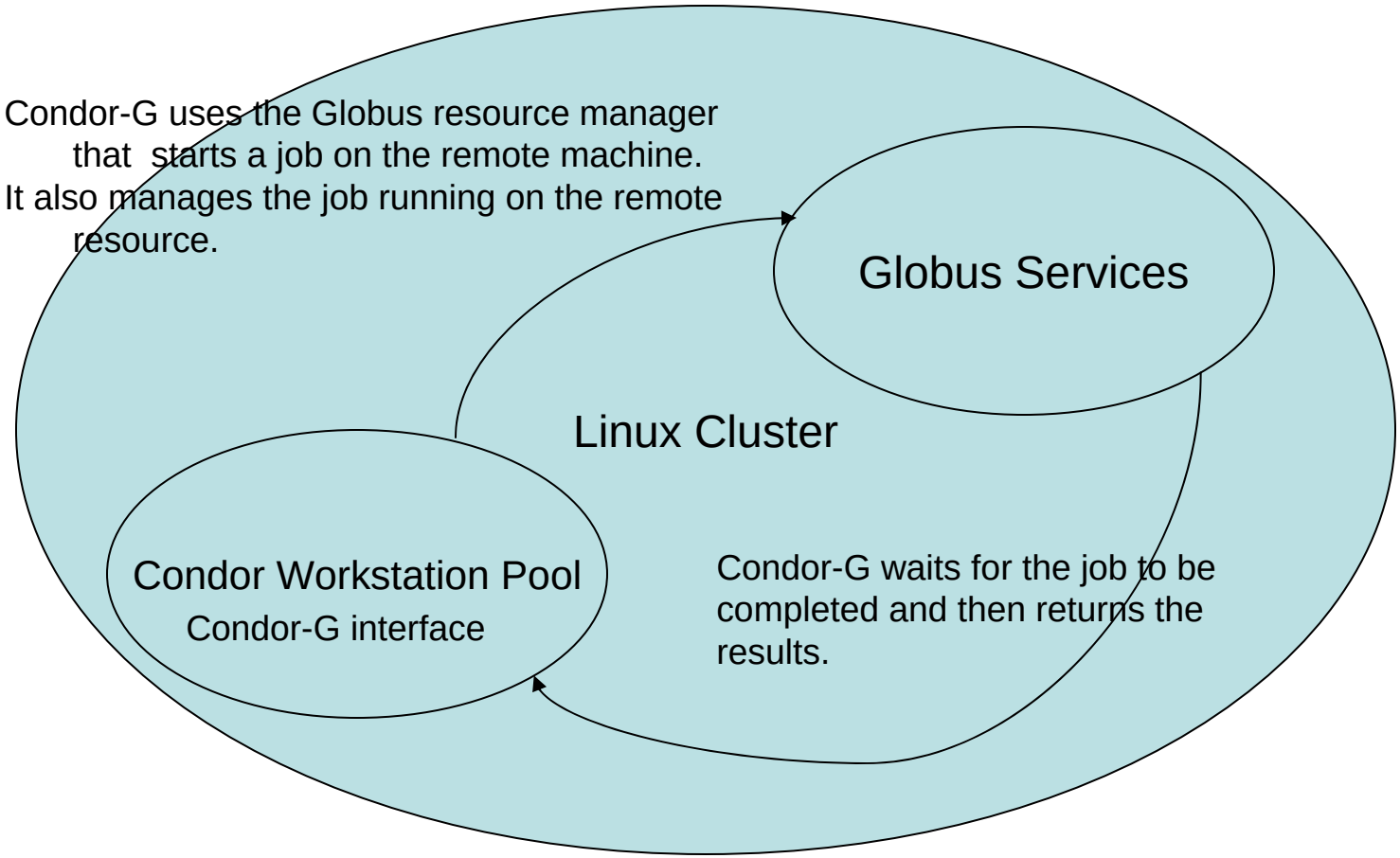
SUNY Institute of Technology



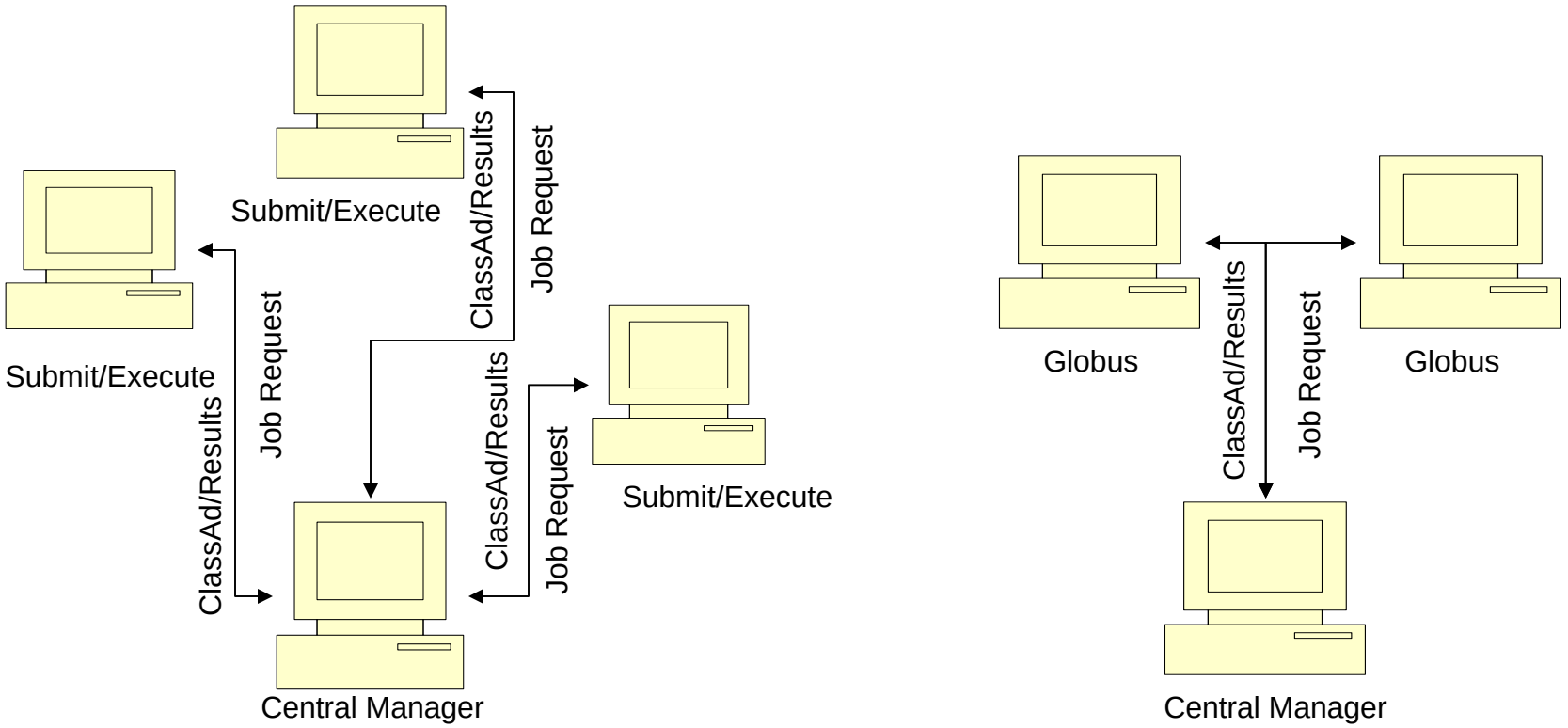
Condor_master is responsible for keeping all the rest of the Condor daemons running.
Condor_schedd submits jobs to remote resources for the job queue.
Condor_negotiator is responsible for the match making.

Condor_startd advertises about the resource and executes the job.
Condor_strater spawns the remote job.
Condor_shadow maintains the resources.

Corning Community College



Condor Central Manager (Scheduler)



•Condor Central Manager (Scheduler) submits jobs either to a Condor Submit/Execute or Globus Machine.
•Each machine “advertises” via ClassAd to Central Manager its resources
•Central Manager matches up resource with submitted job requires
•Central Manger sends executable to remote resource that matches requirement.
•Once job is completed, Execute Machine reports back to Central Manager
•Central Manager reports final results.

Various Jobs Implemented

- Condor Jobs
  - Vanilla
  - Standard
  - Java
  - Parallel
  - Globus
- Globus Jobs
  - Forwarded a job to Condor machines
  - From a Condor scheduler to a Globus machine (Globus Job).

Job Examples

Condor Job and Globus Script

```
======================
==    Condor to Globus
==    test.submit
======================
universe = grid
executable = myscript.sh
arguments = TestJob 10
JobManager_type = Condor
grid_type = gt4
globusscheduler =
https://stengal.cs.sunyit.edu:8443/wsrf/services/
ManagedJobFactoryService/
log = test.log
output = test.output
error = test.error
should_transfer_files = YES
when_to_transfer_output = ON_EXIT
Queue

#! /bin/sh
echo "I'm process id $$ on" `hostname`
echo "This is sent to standard error" 1>&2date
echo "Running as binary $0" "$@"
echo "My name (argument 1) is $1"
echo "My sleep duration (argument 2) is $2"
sleep $2
echo "Sleep of $2 seconds finished.  Exiting"
echo "RESULT: 0 SUCCESS“
```

Condor Job and MPI Program

```
############################
# Submit description file
# for /bin/hostname
# (Parallel)
############################
universe = parallel
executable = /bin/hostname
machine_count = 2
log = parallellogfile
output = outfileMPI.$(NODE)
error = errfileMPI.$(NODE)
should_transfer_files = YES
when_to_transfer_output = ON_EXIT
queue

MPI Program
#include "mpi.h"
#include <stdio.h>
int main( int argc, char* argv[] )
{
        int rank, size;
        MPI_Init( &argc, &argv );
        MPI_Comm_rank( MPI_COMM_WORLD, &rank );
        MPI_Comm_size( MPI_COMM_WORLD, & size );
        printf( "I am %d of %d\n", rank, size );
        MPI_Finalize();
return 0;

t
```

Lessons Learned

- Basic Globus configuration and functionality, used in AFRL implementation, is mature, but can be tedious
- Mpiexe.py, mpdlib.py was modified so that ws-gram was able to send a distributed job to mpich2. Thanks to Dr. Ralph Butler of Middle Tennessee State University.
- Applications are changing and maturing faster than the documentation.
- Mail groups and lists are not always helpful nor do they respond to questions.
- Documentation is scarce on the MPI-2 and Globus Toolkit connection and is also outdated.
- Documentation on the Condor and Globus interface is outdated. Resolved by installing Condor and then Globus with Condor scheduler.

References

- 2006 - Ross, Virginia W.; Pryk, Zenon; Koziarz, Walter; Spetka, Scott; "Grid Computing for High Performance Computing (HPC) Data Centers", AFRL-IF-RS-TR-2007-91, Defense Technical Information Center, Technical Report, Accession Number : ADA458335, October, 2006
- 2005 - Spetka, S.E., Ramseyer, G.O., Linderman, R.W., "Using Globus Grid Objects to Extend a Corba-based Object-Oriented System", 20th Annual ACM Conference on Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA), ACM Special Interest Group on Programming Languages, Town and Country Resort & Convention Center San Diego, California, October 16-20, 2005.
- 2005 - Spetka, S.E., Ramseyer, G.O., Linderman, R.W., "Grid Technology and Information Management for Command and Control", 10th International Command and Control Research and Technology Symposium, The Future of C2, McLean, Virginia, VA, June 13-16, 2005.
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