Globus Procedures on LONI Systems

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& TECHNOLOGY

- Overview of HPC
- Introduction to vi
- LONI Programming Environment
- Ready to use LONI Systems

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- BUT WHICH ONE

LINUX

1. Eric
2. Louie
3. Oliver
4. Painter
5. Poseidon
6. Queenbee

AIX

1. Bluedawg
2. Ducky
3. Lacumba
4. Neptune
5. Zeke

- How do I manage data and jobs on the LONI systems?
- Do I need to login to all systems or
- Is there a tool to manage this

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- Globus Toolkit for building computing grids.
- Provides
  1. Grid Resource Allocation Manager (GRAM) for managing jobs
  2. GridFTP, a more reliable and high performance file transfer for Grid computing applications

```
http://www.cct.lsu.edu/~apacheco/tutorials/globus.php
http://www.cct.lsu.edu/~apacheco/tutorials/globus.pdf
```

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- Access to LONI Account
  - Apply for LONI accounts at **https://allocations.loni.org**
- Active LONI Grid Certificate
- Login to qb1.loni.org

```
apacheco@pacheco:~/Tutorials/Globus$ ssh qb1.loni.org
Password:
Last login: Mon Nov  1 09:49:17 2010 from 130.70.53.27
```

- Add `globus` to your environment and resoft

```
[apacheco@qb1 ~]$ soft add +globus-4.0.8-r2
[apacheco@qb1 ~]$ resoft
```

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- Request LONI Grid Certificate

```
[apacheco@qb1 ~]$ grid-cert-request
A certificate request and private key is being created.
You will be asked to enter a PEM pass phrase.
This pass phrase is akin to your account password,
and is used to protect your key file.
If you forget your pass phrase, you will need to
obtain a new certificate.

Generating a 1024 bit RSA private key
.................................++++++
............++++++
writing new private key to '/home/apacheco/.globus/userkey.pem'
Enter PEM pass phrase:
```

- To recreate a certificate

```
[apacheco@qb1 ~]$ grid-cert-request -force
```

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- .globus directory will be created in the home directory with three files: `usercert_request.pem`,`userkey.pem` and `usercert.pm`
- email `usercert_request.pem` file to **ca@loni.org**

```
[apacheco@qb1 ~]$ cat $HOME/.globus/usercert_request.pem | mail ca@loni.org
```

- Copy the signed certificate you receive from LONI administrator to `~/.globus/usercert.pem`

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- Certificate Information

```
[apacheco@qb1 ~]$ grid-cert-info
Certificate:
    Data:
        Version: 3 (0x2)
        Serial Number: 340 (0x154)
        Signature Algorithm: md5WithRSAEncryption
        Issuer: C=US, O=Louisiana Optical Network Initiative, OU=loni.org, CN=LONI CA
 blah blah blah
```

- Distinguished Name

```
[apacheco@qb1 ~]$ grid-cert-info -subject
/C=US/O=Louisiana Optical Network Initiative/OU=loni.org/OU=sys.loni.org/CN=Alexander P
```

- Issuer Hash

```
[apacheco@qb1 ~]$ grid-cert-info -issuerhash
a3bf9f3c
```

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- More Details/Help

```
[apacheco@qb1 ~]$ grid-cert-info -help
grid-cert-info [-help] [-file certfile] [-all] [-subject] [...]

    Displays certificate information. Unless the optional -file
    argument is given, the default location of the file containing the
blah blah blah
```

- Generating a valid proxy.

```
[apacheco@qb1 ~]$ grid-proxy-init
Your identity: /C=US/O=Louisiana Optical Network Initiative/OU=loni.org/OU=sys.loni.org/CN=Ale
Enter GRID pass phrase for this identity:
Creating proxy ............................................................ Done
Your proxy is valid until: Fri Oct 22 03:30:20 2010
```

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- Globus provides `globus-url-copy`, a scriptable command line tool that can do multi-protocol data movement.
- Supports: gsiftp:// (GridFTP), ftp://, http://, https://, and file:///
- Usage:

```
globus-url-copy [-help | -usage] [-version[s]] [-vb] [-dbg] [-b | -a]
                [-q] [-r] [-rst] [-f <filename>]
                [-s <subject>] [-ds <subject>] [-ss <subject>]
                [-tcp-bs <size>] [-bs <size>] [-p <parallelism>]
                [-notpt] [-nodcau] [-dcsafe | -dcpriv]
                <sourceURL> <destURL>
```

- transfer a file from queenbee to oliver

```
[apacheco@qb1 globus-tutorial]$ globus-url-copy \
     gsiftp://qb1.loni.org/home/apacheco/globus-tutorial/100mbfile \
     gsiftp://oliver1.loni.org/home/apacheco/100mbfile
```

- create a 1GB file and transfer to zeke with verbose (-vb) option

```
[apacheco@qb1 globus-tutorial]$ dd count=1000 bs=1024k if=/dev/zero \
 of=/work/apacheco/1gbfile
```

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```
1000+0 records in
1000+0 records out


[apacheco@qb1 globus-tutorial]$ globus-url-copy -vb \
       file:///work/apacheco/1gbfile \
       gsiftp://zeke.loni.org/mnt/lpfs.nfs302/apacheco/1gbfile

Source: file:///work/apacheco/
Dest:   gsiftp://zeke.loni.org/mnt/lpfs.nfs302/apacheco/
  1gbfile
    1020264448 bytes        29.87 MB/sec avg        35.00 MB/sec inst
```

- Create a directory to store a filename

```
[apacheco@qb1 ~]$ globus-url-copy -vb -cd \
gsiftp://eric1.loni.org/home/apacheco/100mbfile \
gsiftp://qb1.loni.org/home/apacheco/createdirectory/100mbfile

Source: gsiftp://eric1.loni.org/home/apacheco/
Dest:   gsiftp://qb1.loni.org/home/apacheco/createdirectory/
  100mbfile
    104857600 bytes        58.82 MB/sec avg        58.82 MB/sec inst
```

- Transfer files from a directory recursively

```
 [apacheco@qb1 globus-tutorial]$ globus-url-copy -vb -r -cd \
gsiftp://qb1.loni.org/home/apacheco/globus-tutorial/ \
gsiftp://oliver1.loni.org/home/apacheco/createdirectory/
```

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```
Source: gsiftp://qb1.loni.org/home/apacheco/globus-tutorial/
Dest:   gsiftp://oliver1.loni.org/home/apacheco/createdirectory/
  200mbfile
    209715200 bytes        34.48 MB/sec avg        34.48 MB/sec inst
  100mbfile
    104857600 bytes        27.03 MB/sec avg        27.03 MB/sec inst
```

- You can adjust the tcp buffer size and buffer size using the options `-tcp-bs` and `-bs`
- Use parallel streams for transfer with `-p` option

```
[apacheco@qb1 globus-tutorial]$ globus-url-copy -p 4 -vb \
     file:///work/apacheco/1gbfile \
     gsiftp://zeke.loni.org/mnt/lpfs.nfs302/apacheco/1gbfile
```

- On the LONI machines, `-p 5 -tcp-bs 2097152` is recommended for a reasonable performance (not necessarily the most optimized set of option numbers).
- multiple transfers from a script file using the `-f` switch (example in job submission section)

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- Job Submission using `globus-job-run`.

```
[apacheco@qb1 ~]$ globus-job-run -help
Usage: globus-job-run
      [-help|-usage]                    print usage and exit
      [-version]                        print version and exit
```

- Run a simple command on a LONI machine

```
[apacheco@qb1 ~]$ globus-job-run louie1.loni.org /bin/date
Thu Oct 21 14:57:19 CDT 2010

[apacheco@qb1 ~]$ globus-job-run louie1.loni.org /bin/hostname
louie1.loni.org
```

- Run a shell script with arguments using globus

```
[apacheco@qb1 ~]$ globus-job-run oliver1.loni.org -s random-generator.sh 4 7
2377875
2910657
8458138
1522082

[apacheco@qb1 ~]$ globus-job-run bluedawg.loni.org -s random-generator.sh 4 7
5138706
1757255
3086336
5345316
```

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- -np N : number of processing elements
- -stdin [-l|-s] file : standard input
- -stdout [-l|-s] file : standard output
- -l[ocal] : file is relative to working directory of job (DEFAULT)
- -s[tage] : file relative to job request is staged to job host
- -x rsl-clause : RSL extension capability

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- Execute commands on remote machine using input from staging machine

```
[apacheco@qb1 ~]$ globus-job-run louie1.loni.org -stdin -s /etc/hosts -l /bin/cat
# Do not remove the following line, or various programs
# that require network functionality will fail.
127.0.0.1       localhost.localdomain localhost
204.90.40.60    eta.hpc.lsu.edu eta
208.100.92.71   l6l1u01.sys.loni.org
.....
10.192.92.247    qbib20-1
10.192.92.248    qbib20-2
```

- Execute commands on remote machine using input from local machine

```
[apacheco@qb1 ~]$ globus-job-run louie1.loni.org -stdin -l /etc/hosts -l /bin/cat
# Do not remove the following line, or various programs
# that require network functionality will fail.
127.0.0.1       localhost.localdomain localhost
204.90.40.60    eta.hpc.lsu.edu eta
208.100.92.71   l6l1u01.sys.loni.org
208.100.92.72   l6l1u02.sys.loni.org
.....
172.17.73.227  louie127h
172.17.73.228  louie128h
```

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- Execute commands and write output on staging machine

```
[apacheco@qb1 ~]$ globus-job-run louie1.loni.org -stdout -s hellohosts \
-stdin -s /etc/hosts -l /bin/cat
[apacheco@qb1 ~]$ head -4 hellohosts ; tail -2 hellohosts
# Do not remove the following line, or various programs
# that require network functionality will fail.
127.0.0.1       localhost.localdomain localhost
204.90.40.60    eta.hpc.lsu.edu eta
10.192.92.247    qbib20-1
10.192.92.248    qbib20-2
```

- Job submission using `globus-job-submit`
- submit a job to the scheduling jobmanager

```
[apacheco@qb1 ~]$ globus-job-submit oliver1.loni.org/jobmanager /bin/date

https://oliver1.loni.org:50886/26507/1288375416/
```

- `globus-job-status` checks status of jobmanager

```
[apacheco@qb1 ~]$ globus-job-status https://oliver1.loni.org:50886/26507/1288375416/

DONE
```

- `globus-job-get-output` gets output of the job

```
[apacheco@qb1 ~]$ globus-job-get-output https://oliver1.loni.org:50886/26507/1288375416

Fri Oct 29 13:03:36 CDT 2010
```

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- Submit an openmp parallelized code on
  1. eric (PBS)

```
[apacheco@qb1 ~]$ globus-job-run eric1.loni.org/jobmanager-pbs \
-np 1 -m 10 -p loni_loniadmin1 -q single -stdin \
-s /home/apacheco/dft/flux-full.dat -stdout \
-s flux-eric1-parallel.dat -s /home/apacheco/dft/dft.parallel
```

  2. zeke (loadleveler)

```
[apacheco@qb1 ~]$ globus-job-run zeke.loni.org/jobmanager-loadleveler \
 -env "GBLL_NETWORK_MPI=sn_all,not_shared,US" -stdin \
-s /home/apacheco/dft/flux-full.dat -x  "&(jobType=mpi)(count=2)\
(maxWallTime=10)(queue=checkpt)(stdout=/mnt/lpfs.nfs302/apacheco/dft.out)\
(stderr=/mnt/lpfs.nfs302/apacheco/dft.err)(hostCount=1)" \
-s /home/apacheco/dft/dft.xlf
[apacheco@qb1 ~]$ cat dft.output
gsiftp://zeke.loni.org/mnt/lpfs.nfs302/apacheco/dft.out \
file:///home/apacheco/dft.out
gsiftp://zeke.loni.org/mnt/lpfs.nfs302/apacheco/dft.err \
file:///home/apacheco/dft.err

[apacheco@qb1 ~]$ globus-url-copy -vb -f dft.output

Source: gsiftp://zeke.loni.org/mnt/lpfs.nfs302/apacheco/
Dest:   file:///home/apacheco/
  dft.out

Source: gsiftp://zeke.loni.org/mnt/lpfs.nfs302/apacheco/
Dest:   file:///home/apacheco/
  dft.err
```

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- copy `helloworld.c` from `queenbee.loni.org:/home/apacheco/helloworld.c`
- compile on bluedawg/zeke/(any other P5 machine) using

```
mpcc helloworld.c -o helloworld
```

- Submit an MPI job
  1. on bluedawg/zeke/(any other P5 machine)

```
[apacheco@qb1 ~]$ globus-job-run bluedawg.loni.org/jobmanager-loadleveler \
-env "GBLL_NETWORK_MPI=sn_all,not_shared,US" -x  "&(jobType=mpi)(count=8)\
(maxWallTime=10)(queue=checkpt)(hostCount=1)" -l /home/apacheco/helloworld
Hello world from 0 out of 8
Hello world from 1 out of 8
Hello world from 2 out of 8
Hello world from 3 out of 8
Hello world from 4 out of 8
Hello world from 5 out of 8
Hello world from 6 out of 8
Hello world from 7 out of 8
ATTENTION: 0031-408  8 tasks allocated by LoadLeveler, continuing...
```

  2. on eric/oliver/(any other intel machine)

```
[apacheco@qb1 ~]$ globus-job-run eric1.loni.org/jobmanager-pbs \
-x "(jobType=mpi)(hostCount=1)(maxWallTime=10)(queue=checkpt)\
(stdout=/home/apacheco/gljobrun.out)" -s /home/apacheco/helloworld
```

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```
[apacheco@eric2 ~]$ cat gljobrun.out
---------------------------------------
Running PBS prologue script
---------------------------------------
User and Job Data:
---------------------------------------
Job ID:    262113.eric2
Username:  apacheco
Group:     loniadmin
Date:      27-Oct-2010 15:44
Node:      eric052 (7032)
---------------------------------------
PBS has allocated the following nodes:

eric052

A total of 4 processors on 1 nodes allocated
---------------------------------------------
Check nodes and clean them of stray processes
---------------------------------------------
Checking node eric052 15:44:34
Done clearing all the allocated nodes
------------------------------------------------------
Concluding PBS prologue script - 27-Oct-2010 15:44:34
------------------------------------------------------
Hello world from 0 out of 4
Hello world from 2 out of 4
Hello world from 1 out of 4
Hello world from 3 out of 4
```

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- Job submission using `globusrun` with Resource Specification Language (RSL) commands in a file

```
[apacheco@qb1 ~]$ cat eric.rsl

& (jobType=mpi)
(hostCount=1)
(maxWallTime=10)
(queue=checkpt)
(executable=/home/apacheco/helloworld)
(stdout=/home/apacheco/gljobrun.out)


[apacheco@qb1 ~]$  globusrun -r eric1.loni.org/jobmanager-pbs -f eric.rsl -b

globus_gram_client_callback_allow successful
GRAM Job submission successful
https://eric1.loni.org:50886/779/1288371858/
GLOBUS_GRAM_PROTOCOL_JOB_STATE_PENDING
```

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- **Globus Toolkit**
  `http://www.globus.org/toolkit/`
- **Loni Docs: Globus Tutorial using LONI resources**
  `https://docs.loni.org/wiki/Globus_Tutorial_using_LONI_resources`
- **Moodle: HPC105 - Getting Started with Globus Toolkit**
  `https://docs.loni.org/moodle/`

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