

# **GT 5.0.0 User's Guide**

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## GT 5.0.0 User's Guide

### Abstract

You can download the [PDF version here](#)<sup>1</sup>. This page contains information for commonly performed tasks using GT components. This assumes a default installation and covers the more basic tasks using common tools. Due to size, all GT command line clients are listed [here](#).

Note that GT itself is typically used as middleware and not necessarily intended to be used directly by end-users. Instead, grid developers tend to use GT to develop higher-level services and systems that are then used by end-users (where GT is essentially the plumbing). However, GT Release Manuals include User's Guides for each established component that describe how the public interfaces are intended to be used - whether it is by a human or a program.

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<sup>1</sup> [gtUserGuide.pdf](#)

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# Chapter 1. Setting up your environment

This step is usually a prerequisite for using GT commands. Make sure you have set `GLOBUS_LOCATION` to the location of your Toolkit installation. There are two environment scripts called `$GLOBUS_LOCATION/etc/globus-user-env.sh` and `$GLOBUS_LOCATION/etc/globus-user-env.csh`. You should read in whichever one corresponds to the type of shell you are using.

For example, in `csh` or `tcsh`, you would run:

```
source $GLOBUS_LOCATION/etc/globus-user-env.csh
```

In `sh`, `bash`, `ksh`, or `zsh`, you would run:

```
. $GLOBUS_LOCATION/etc/globus-user-env.sh
```

Set Globus location:

```
$ export GLOBUS_LOCATION='/opt/globus/apps/globus-5.0.0'
```

Source it..

```
source $GLOBUS_LOCATION/etc/globus-user-env.sh
        source $GLOBUS_LOCATION/etc/globus-devel-env.sh
```

---

# Chapter 2. Security

This chapter provides information about basic security tasks in GT 5.0.0.

## 1. Obtaining certificates

Security is at the heart of Globus, and unless you are running without security (only recommended for testing), you will not be able to use most of Globus unless you have obtained a certificate for yourself. (Note that you may use GridFTP without certificates if you are only using `ftp://` or `http://` protocols.)

For basic information about obtaining certificates, see [Obtaining host certificates](#) in the Installation Guide.

### Important

Remember to keep track of when your certificates expire. If your certificates expire, you may not be able to use your services until they are refreshed.

## 2. Authenticating (who are you?)

### 2.1. Generate a valid proxy certificate

Before using many of the tools in GT, a user must generate a valid user proxy. Use [grid-proxy-init](#). The following is an example:

```
% $GLOBUS_LOCATION/bin/grid-proxy-init
Your identity: /O=Grid/OU=GlobusTest/OU=simpleCA.mymachine/OU=mymachine/CN=John Doe
Enter GRID pass phrase for this identity:
Creating proxy ..... Done
Your proxy is valid until: Tue Oct 26 01:33:42 2004
```

## 3. Authorizing (what are you allowed to do?)

Basic authorization in GT is enforced via a grid map file, a file that contains mappings of certificate subject names to local user names, like the following:

```
"/O=Grid/O=Globus/OU=your.domain.edu/CN=Your Name"    youruser
```

For more information about gridmaps see [Section 4, “Add authorization”](#), [Section 4, “Configuring Credential Mappings”](#) and [Globus Toolkit Gridmap Processing](#)<sup>1</sup>.

## 4. Basic procedure for using GSI C

In most cases, an individual will do the following:

- Acquire a *user certificate* from a certification authority (CA) with [grid-cert-request](#). This certificate will typically be valid for a year or more and will be stored in a file in the individual's home directory.

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<sup>1</sup> <http://dev.globus.org/wiki/Gridmap>

It is important to keep in mind when your cert will expire - after your user certificate expires, you may not be able to use secure services in GT!

- Use the end-user certificate to create a *proxy certificate* using `grid-proxy-init`. This will be used to authenticate the individual to grid services. Proxy certificates typically have a much shorter lifetime than end-user certificates (usually 12 hours). Once your proxy certificate expires, simply rerun `grid-proxy-init`.

## 5. Troubleshooting Certificates and GridMap Files

For common errors, see [Certificates](#) and [Gridmap](#) errors.

### 5.1. Some tools to validate certificate setup

#### 5.1.1. grid-cert-diagnostics

The `grid-cert-diagnostics` program checks prints diagnostics about the user's certificates, and host security environment.

```
% grid-cert-diagnostics -p
```

#### 5.1.2. Check that the user certificate is valid

```
openssl verify -CApath /etc/grid-security/certificates  
-purpose sslclient ~/.globus/usercert.pem
```

#### 5.1.3. Connect to the server using `s_client`

```
openssl s_client -ssl3 -cert ~/.globus/usercert.pem -key  
~/.globus/userkey.pem -CApath /etc/grid-security/certificates  
-connect <host:port>
```

Here `<host:port>` denotes the server and port you connect to.

If it prints an error and puts you back at the command prompt, then it typically means that the *server* has closed the connection, i.e. that the server was not happy with the client's certificate and verification. Check the SSL log on the server.

If the command "hangs" then it has actually opened a telnet style (but secure) socket, and you can "talk" to the server.

You should be able to scroll up and see the subject names of the server's verification chain:

```
depth=2 /DC=net/DC=ES/O=ESnet/OU=Certificate Authorities/CN=ESnet Root CA 1  
verify return:1  
depth=1 /DC=org/DC=DOEGrids/OU=Certificate Authorities/CN=DOEGrids CA 1  
verify return:1  
depth=0 /DC=org/DC=doegrids/OU=Services/CN=wiggum.mcs.anl.gov  
verify return:1
```

In this case, there were no errors. Errors would give you an extra line next to the subject name of the certificate that caused the error.

## 5.1.4. Check that the server certificate is valid

Requires root login on server:

```
openssl verify -CApath /etc/grid-security/certificates -purpose sslserver  
/etc/grid-security/hostcert.pem
```

---

# Chapter 3. Data Management

## 1. File transfers with GridFTP

### 1.1. Basic procedure for using GridFTP (globus-url-copy)

If you just want the "rules of thumb" on getting started (without all the details), the following options using `globus-url-copy` will normally give acceptable performance:

For a single file transfer:

```
globus-url-copy -vb -tcp-bs 1048576 -p 4 source_url destination_url
```

where:

`-vb` specifies verbose mode and displays:

- number of bytes transferred,
- performance since the last update (currently every 5 seconds), and
- average performance for the whole transfer.

`-tcp-bs` specifies the size (in bytes) of the TCP buffer to be used by the underlying ftp data channels. This is critical to good performance over the WAN.

How do I pick a value?

`-p` Specifies the number of parallel data connections that should be used. This is one of the most commonly used options.

How do I pick a value?

For a directory transfer:

```
globus-url-copy -vb -tcp-bs 1048576 -p 4 -r -cd - cc 4 source_url destination_url
```

where:

`-vb` specifies verbose mode and displays:

- number of bytes transferred,
- performance since the last update (currently every 5 seconds), and
- average performance for the whole transfer.

`-tcp-bs` specifies the size (in bytes) of the TCP buffer to be used by the underlying ftp data channels. This is critical to good performance over the WAN.

How do I pick a value?

`-p` Specifies the number of parallel data connections that should be used. This is one of the most commonly used options.

### How do I pick a value?

- cc Specifies the number of concurrent FTP connections to use for multiple transfers.
- cd Creates destination directories, if needed.
- r Copies files in subdirectories.

The source/destination URLs will normally be one of the following:

- *file:///path/to/my/file* if you are accessing a file on a file system accessible by the host on which you are running your *client*.
- *gsiftp://hostname/path/to/remote/file* if you are accessing a file from a GridFTP *server*.

## 1.1.1. Putting files

One of the most basic tasks in GridFTP is to "put" files, i.e., moving a file from your file system to the server. So for example, if you want to move the file `/tmp/foo` from a file system accessible to the host on which you are running your client to a file name `/tmp/bar` on a host named `remote.machine.my.edu` running a GridFTP server, you would use this command:

```
globus-url-copy -vb -tcp-bs 2097152 -p 4 file:///tmp/foo gsiftp://remote.machine.my.edu/tmp
```



### Note

In theory, `remote.machine.my.edu` could be the same host as the one on which you are running your client, but that is normally only done in testing situations.

## 1.1.2. Getting files

A get, i.e. moving a file from a server to your file system, would just reverse the source and destination URLs:



### Tip

Remember *file:* always refers to your file system.

```
globus-url-copy -vb -tcp-bs 2097152 -p 4 gsiftp://remote.machine.my.edu/tmp/bar file:///tm
```

## 1.1.3. Third party transfers

Finally, if you want to move a file between two GridFTP servers (a *third party transfer*), both URLs would use `gsiftp:` as the protocol:

```
globus-url-copy -vb -tcp-bs 2097152 -p 4 gsiftp://other.machine.my.edu/tmp/foo gsiftp://re
```

## 1.1.4. For more information

If you want more information and details on URLs and the command line options, the Key Concepts gives basic definitions and an overview of the GridFTP protocol as well as our implementation of it.

## 2. Mapping replicas with Replica Location Service (RLS)

### 2.1. Ping the server

To check whether your server is active you may use the `globus-rls-admin(1) ping` command.

```
% $GLOBUS_LOCATION/sbin/globus-rls-admin -p rls://localhost
ping rls://localhost: 0 seconds
```

### 2.2. Creating replica location mappings

When the RLS server is first installed its database of replica location information will be empty, as expected. To create a replica location mapping, use the `globus-rls-cli(1) create` command. Replica information in RLS is represented as mappings from logical names to target names. Typically, the logical name will be a unique identifier for a given replicated data set and the target name will be a URL identifying a particular replica of the data set.

```
% $GLOBUS_LOCATION/bin/globus-rls-cli create my-logical-name-1 url-for-target-name-1 rls://lo
```



#### Note

The create command is intended for creating the initial replica mapping entry for a given logical name. If the user attempts to create another entry using an existing logical name, RLS will report a user error. To map additional target names to an existing logical name, see [Section 4, “Adding replica location mappings”](#).

### 2.3. Adding replica location mappings

To map additional target names to a logical name created by the previously described create command, use the `globus-rls-cli(1) add` command.

```
% $GLOBUS_LOCATION/bin/globus-rls-cli add my-logical-name-1 url-for-target-name-2 rls://lo
```

### 2.4. Querying replica location mappings

Once your RLS server is populated with replica location mappings, you can query the server for useful information using the `globus-rls-cli(1) query` command.

```
% $GLOBUS_LOCATION/bin/globus-rls-cli query lrc lfn my-logical-name-1 rls://localhost
my-logical-name-1: url-for-target-name-1
my-logical-name-1: url-for-target-name-2
```

## 2.5. Deleting replica location mappings

To remove unwanted replica location mappings from your RLS server, use the `globus-rls-cli(1) delete` command. The delete operation works *directly* on the mapping and *indirectly* on the logical and target names. When the delete operation is performed by the RLS server the association between the specified logical name and the specified target name is eliminated. However, there may still be other target names associated with the logical name, and there could still be other logical names associated with the target name, though the latter scenario is less likely. Only when all mapping associations for a given logical name (or a given target name) are eliminated (i.e., the specified logical name has no target names associated with it) will the logical (or target) name be deleted from the RLS server.

```
% $GLOBUS_LOCATION/bin/globus-rls-cli delete my-logical-name-1 url-for-target-name-1 rls:/
% $GLOBUS_LOCATION/bin/globus-rls-cli query lrc lfn my-logical-name-1 rls://localhost
my-logical-name-1: url-for-target-name-2
% $GLOBUS_LOCATION/bin/globus-rls-cli delete my-logical-name-1 url-for-target-name-2 rls:/
% $GLOBUS_LOCATION/bin/globus-rls-cli query lrc lfn my-logical-name-1 rls://localhost
globus_rls_client: LFN doesn't exist: my-logical-name-1
```

## 2.6. Using bulk operations

The `globus-rls-cli(1)` supports a variety of bulk operations that enhance productivity for users and reduce network connection overhead from making multiple, separate invocations of the client. The general pattern for bulk operation support as implemented by the client is a parameter list consisting of `bulk command-name [command-modifiers] param-1 param-2 param-N`, such as `bulk query lrc lfn my-logical-name-1 my-logical-name-2 my-logical-name-3`.

```
% $GLOBUS_LOCATION/bin/globus-rls-cli bulk create my-logical-name-1 url-for-target-name-1-1
% $GLOBUS_LOCATION/bin/globus-rls-cli bulk add my-logical-name-1 url-for-target-name-1-2 m
% $GLOBUS_LOCATION/bin/globus-rls-cli bulk query lrc lfn my-logical-name-1 my-logical-name
my-logical-name-3: LFN doesn't exist
my-logical-name-2: url-for-target-name-2-1
my-logical-name-2: url-for-target-name-2-2
my-logical-name-1: url-for-target-name-1-1
my-logical-name-1: url-for-target-name-1-2
```

## 2.7. Using interactive mode

The `globus-rls-cli(1)` supports an interactive mode in addition to the general command-line mode. To enter the interactive mode, simply invoke the client without any command.

```
% $GLOBUS_LOCATION/bin/globus-rls-cli rls://localhost
rls> query lrc lfn my-logical-name-2
my-logical-name-2: url-for-target-name-2-1
my-logical-name-2: url-for-target-name-2-2
rls> query lrc lfn my-logical-name-1
my-logical-name-1: url-for-target-name-1-1
my-logical-name-1: url-for-target-name-1-2
rls> bulk delete my-logical-name-1 url-for-target-name-1-1 my-logical-name-1
url-for-target-name-1-2 my-logical-name-2 url-for-target-name-2-1
```

```
my-logical-name-2 url-for-target-name-2-2  
rls> bulk query lrc lfn my-logical-name-2 my-logical-name-1  
my-logical-name-1: LFN doesn't exist  
my-logical-name-2: LFN doesn't exist  
rls> exit
```

---

# Chapter 4. Submitting jobs to a job scheduler

## 1. Preparing to use GRAM

The first step to being able to use GRAM5 after installation is to acquire a temporary Grid credential to use to authenticate with the GRAM5 service and any file services your job requires. Normally this is done via either [grid-proxy-init](#) or via the [MyProxy](#) service.

### 1.1. Proxy credentials with grid-proxy-init

To generate a proxy credential using the **grid-proxy-init** program, execute the command with no arguments. By default, it will generate an impersonation proxy with a lifetime of 12 hours.

#### Example 4.1. Generating a proxy with grid-proxy-init

This example creates a 12 hour impersonation proxy to use to authenticate with grid services such as GRAM5:

```
% bin/grid-proxy-init
Your identity: /O=Grid/OU=Example/CN=Joe User
Enter GRID pass phrase for this identity:
Creating proxy ..... Done
Your proxy is valid until: Tue Oct 26 01:33:42 2010
```

#### Important

In order to generate a proxy credential, you must have first been issued an identity credential by some certificate authority that is trusted by the GRAM5 resource you want to use. To learn more about certificates and Grid security in general, please read [Security Key Concepts](#).

## 2. Delegating credentials

The credential created in the previous section is used to authenticate with the GRAM5 service as well as to delegate a limited proxy of that credential to the service so that it can process the job. This credential delegation occurs when the **globus-gatekeeper** service is first contacted when a job is to be submitted. By default, the tools provided with GT 5.0.0 delegate a *limited proxy*. This limited proxy can be used to authenticate with other services on the client's behalf, but with the services knowing that the proxy is not under direct control by the user.

### 2.1. Delegated Credential Usage

The delegated proxy can be used by the GRAM5 service and the job in a few different ways:

1. The GRAM5 service uses the credential to send job state notification messages to clients which have registered to receive them.
2. The GRAM5 service uses the credential to contact GASS and GridFTP file servers to stage files to and from the execution resource
3. The job executed by the GRAM5 service can use the delegated credential for application-specific purposes.

 **Note**

In GRAM5, the Job Manager may manage multiple jobs simultaneously. It will use the delegated proxy with the most time left for authentication. Individual GRAM5 jobs will have separate proxies.

**globusrun globus-job-run**, and **globus-job-submit** commands delegate credentials automatically when submitting a job. Additionally, **globusrun** can refresh the credentials used by the job and job manager, after the job manager is started.

## 3. Submitting jobs

This section describes the steps needed to submit jobs to resources managed by GRAM5 services. It describes how resources are named, tools for submitting and monitoring jobs, and the RSL language which describes requirements for jobs.

### 3.1. Resource Names

In GRAM5, a *Gatekeeper Service Contact* contains the host, port, service name, and service identity required to contact a particular GRAM service. For convenience, default values are used when parts of the contact are omitted. An example of a full gatekeeper service contact is `grid.example.org:2119/jobmanager:/C=US/O=Example/OU=Grid/CN=host/grid.example.org`.

The various forms of the resource name using default values follow:

- *HOST*
- *HOST:PORT*
- *HOST:PORT/SERVICE*
- *HOST/SERVICE*
- *HOST:/SERVICE*
- *HOST:PORT:SUBJECT*
- *HOST/SERVICE:SUBJECT*
- *HOST:/SERVICE:SUBJECT*
- *HOST:PORT/SERVICE:SUBJECT*

Where the various values have the following meaning:

*HOST*        Network name of the machine hosting the service.

*PORT*        Network port number that the service is listening on. If not specified, the default of 2119 is used.

*SERVICE*   Path of the service entry in `$(GLOBUS_LOCATION)/etc/grid-services`. If not specified, the default of `jobmanager` is used.

*SUBJECT*    X.509 identity of the credential used by the service. If not specified, the default of `host@HOST` is used.

### Example 4.2. Gatekeeper Service Contact Examples

The following strings all name the service `grid.example.org:2119/jobmanager:/C=US/O=Example/OU=Grid/CN=host/grid.example.org` using the formats with the various defaults described above.

- `grid.example.org`
- `grid.example.org:2119`
- `grid.example.org:2119/jobmanager`
- `grid.example.org/jobmanager`
- `grid.example.org:/jobmanager`
- `grid.example.org:2119:/C=US/O=Example/OU=Grid/CN=host/grid.example.org`
- `grid.example.org/jobmanager:/C=US/O=Example/OU=Grid/CN=host/grid.example.org`
- `grid.example.org:/jobmanager:/C=US/O=Example/OU=Grid/CN=host/grid.example.org`
- `grid.example.org:2119/jobmanager:/C=US/O=Example/OU=Grid/CN=host/grid.example.org`

## 3.2. Running Jobs with `globus-job-run`

The **`globus-job-run`** provides a simple blocking command-line interface to the GRAM service. The **`globus-job-run`** program submits a job to a GRAM5 resource and waits for the job to terminate. After the job terminates, the output and error streams of the job are sent to the output and error streams of **`globus-job-run`** as if the job were run interactively. Note that input to the job must be located in a file prior to running the job; true interactive I/O is not supported by GRAM5.

The **`globus-job-run`** program has command-line options to control most aspects of jobs run by GRAM5. However, certain behaviors must be specified by definition of an RSL string containing various job attributes. A more detailed description about the RSL language is included on the section on running jobs with **`globusrun`** below.

The following examples show some of the common command-line options to **`globus-job-run`**. Full **`globus-job-run`** [documentation](#) is available in the [GRAM5 public interface guide](#).

### Example 4.3. Minimal job using `globus-job-run`

The following command line submits a single instance of the `/bin/hostname` executable to the resource named by `grid.example.org:2119/jobmanager-pbs`.

```
% globus-job-run grid.example.org:2119/jobmanager-pbs /bin/hostname  
node1.grid.example.org
```

#### Example 4.4. Multiprocess job using globus-job-run

The following command line submits ten instances of an executable `a.out`, staging it from the client host to the service node using GASS. The `a.out` program prints the name of the host it is executing on.

```
% globus-job-run grid.example.org:2119/jobmanager-pbs -np 10 -s a.out
node1.grid.example.org
node3.grid.example.org
node2.grid.example.org
node5.grid.example.org
node4.grid.example.org
node8.grid.example.org
node6.grid.example.org
node9.grid.example.org
node7.grid.example.org
node10.grid.example.org
```

#### Example 4.5. Canceling an interactive job

This example shows how using the **Control+C** (or other system-specific mechanism for sending the SIGINT signal) can be used to cancel a GRAM job.

```
% globus-job-run grid.example.org:2119/jobmanager-pbs /bin/sleep 90
Control-C
GRAM Job failed because the user cancelled the job (error code 8)
```

#### Example 4.6. Setting job environment variables with globus-job-run

The following command line submits one instances of the executable `/usr/bin/env`, setting some environment variables in the job environment beyond those set by GRAM5.

```
% globus-job-run grid.example.org:2119/jobmanager-pbs -env TEST=1 -env GRID=1 /usr/bin/env
HOME=/home/juser
LOGNAME=juser
GLOBUS_GRAM_JOB_CONTACT=https://client.example.org:3882/16001579536700793196/5295612977485
GLOBUS_LOCATION=/opt/globus-5.0.0
GLOBUS_GASS_CACHE_DEFAULT=/home/juser/.globus/.gass_cache
TEST=1
X509_USER_PROXY=/home/juser/.globus/job/mactop.local/16001579536700793196.5295612977485997
GRID=1
```

#### Example 4.7. Using custom RSL clauses with globus-job-run

The following command line submits an mpi job using **globus-job-run**, setting the `jobtype` RSL attribute to `mpi`. Any RSL attribute understood by the LRM can be added to a job via this method.

```
% globus-job-run grid.example.org:2119/jobmanager-pbs -np 5 -x '&(jobtype=mpi)' a.out
Hello, MPI (rank: 0, count: 5)
Hello, MPI (rank: 3, count: 5)
Hello, MPI (rank: 1, count: 5)
Hello, MPI (rank: 4, count: 5)
Hello, MPI (rank: 2, count: 5)
```

### Example 4.8. Constructing RSL strings with `globus-job-run`

The `globus-job-run` program can also generate the RSL language description of a job based on the command-line options given to it. This example combines some of the features above and prints out the resulting RSL. This RSL string can be passed to tools such as `globusrun` to be run later.

```
% globus-job-run -dumprsl grid.example.org:2119/jobmanager-pbs -np 5 -x '&(jobtype=mpi)' -
&(jobtype=mpi)
  (executable="a.out")
  (environment= ("GRID" "1") ("TEST" "1"))
  (count=5)
```

## 3.3. Submitting Jobs with `globus-job-submit`

A related tool to `globus-job-run` is `globus-job-submit`. This command submits a job to a GRAM5 service then exits without waiting for the job to terminate. Other tools (`globus-job-cancel`, `globus-job-clean`, and `globus-job-get-output`) allow further interaction with the job.

### Important

When using `globus-job-submit`, the job output and state will remain on disk on the GRAM resource until one of `globus-job-clean` or `globus-job-cancel` is run for that job. Be sure to clean up your jobs!

The `globus-job-submit` program has most of the same command-line options as `globus-job-run`. When run, instead of displaying the output and error streams of the job, it prints the job contact, which is used with the other `globus-job` tools to interact with the job.

### Example 4.9. globus-job-submit

This example shows the interaction of submitting a job via **globus-job-submit**, checking its status with **globus-job-status**, getting its output with **globus-job-get-output**, and then cleaning the job with **globus-job-clean**.

```
% globus-job-submit grid.example.org:2119/jobmanager-pbs /bin/hostname
https://grid.example.org:38843/16001600430615223386/5295612977486013582/
% globus-job-status https://grid.example.org:38843/16001600430615223386/529561297748601358
PENDING
% globus-job-status https://grid.example.org:38843/16001600430615223386/529561297748601358
ACTIVE
% globus-job-status https://grid.example.org:38843/16001600430615223386/529561297748601358
DONE
% globus-job-get-output -r grid.example.org:2119/jobmanager-fork \
  https://grid.example.org:38843/16001600430615223386/5295612977486013582/
node1.grid.example.org
% globus-job-clean -r grid.example.org:2119/jobmanager-fork \
  https://grid.example.org:38843/16001600430615223386/5295612977486013582/

WARNING: Cleaning a job means:
  - Kill the job if it still running, and
  - Remove the cached output on the remote resource

Are you sure you want to cleanup the job now (Y/N) ?
```

y

Cleanup successful.

## 3.4. Using the globusrun tool

The **globusrun** tool provides a more flexible tool for submitting, monitoring, and canceling jobs. With this tool, most of the functionality of the GRAM5 APIs are made available.

One major difference between **globusrun** and the other tools described above is that **globusrun** uses the [RSL language](#) to provide the job description, instead of multiple command-line options to describe the various aspects of the job. The section on **globus-job-run** contained a brief example RSL in the `-dump_rsl` example above.

The following sections show examples of the different modes that **globusrun** can run in. Full information about **globusrun** command-line options is available in the public interface guide.

### 3.4.1. Checking RSL Syntax

This example shows how to check that an RSL document contains a syntactically correct job description. Note that this mode does not do semantic validation of the RSL, so an RSL document that passes this test may not work when submitted to a GRAM5 service.

### Example 4.10. Checking RSL Syntax

```
% globusrun -p "&(executable=a.out)"  
  
RSL Parsed Successfully...  
  
% globusrun -p "&/executable=a.out)"  
  
ERROR: cannot parse RSL &/executable=/adfadf/adf /adf /adf)  
  
Syntax: globusrun [-help] [-f RSL file] [-s][[-b][[-d][...]] [-r RM] [RSL]
```

Use `-help` to display full usage

### 3.4.2. Checking Service Contacts

This example shows how to check that a **globus-gatekeeper** is running at a particular contact and that the client and service have mutually-trusted credentials.

### Example 4.11. GRAM Authentication test

```
% globusrun -a -r grid.example.org:2119/jobmanager-pbs  
GRAM Authentication test successful  
% globusrun -a -r grid.example.org:2119/jobmanager-lsf  
GRAM Authentication test failure: the gatekeeper failed to find the requested service  
% globusrun -a -r grid.example.org:2119/jobmanager-pbs:host@not.example.org  
GRAM Authentication test failure: an authorization operation failed  
globus_xio_gsi: gss_init_sec_context failed.  
GSS Major Status: Unexpected Gatekeeper or Service Name  
globus_gsi_gssapi: Authorization denied: The name of the remote host  
(host@not.example.org), and the expected name for the remote host  
(grid.example.org) do not match. This happens when the name in the host  
certificate does not match the information obtained from DNS and is often a DNS  
configuration problem.
```

#### Note

The DNS configuration problem was a common issue in GRAM2, but GRAM5 will not depend on DNS to resolve names for mutual authentication.

### 3.4.3. Checking GRAM service version

This example shows how to determine what software version of GRAM5 is deployed at a particular service contact.

**Example 4.12. GRAM version check**

```
% globusrun -j -r grid.example.org:2119/jobmanager-pbs:host@not.example.org
Toolkit version: 4.3.0-HEAD
Job Manager version: 10.5 (1256257907-0)
```

**Note**

This example shows the version number for an unreleased development version of GRAM5. The actual numbers returned will be different.

**Note**

This feature is new in GRAM5. When contacting a GRAM2 service, **globusrun** will display the following error message:

```
GRAM version check failed : an incoming HTTP message did not contain the expected inf
```

**3.4.4. Basic Interactive job with globusrun**

This example shows how to submit interactive job with **globusrun**. When the `-s` is used, the output of the job command is returned to the client and displayed as if the command ran locally. This is similar to the behavior of the **globus-job-run** program described above.

**Example 4.13. Basic Interactive Job**

```
% globusrun -s -r example.grid.org/jobmanager-pbs "&(executable=/bin/hostname)(count=5)"
node03.grid.example.org
node01.grid.example.org
node02.grid.example.org
node05.grid.example.org
node04.grid.example.org
```

**3.4.5. Basic batch job with globusrun**

This example shows how to submit, monitor, and cancel a batch job using **globusrun**. This method is useful for the case where the job may run for a long time, the job may be queued for a long time, or when there are network reliability issues between the client and service.

**Example 4.14. Basic Batch Job**

```
% globusrun -b -r grid.example.org:2119/jobmanager-pbs "&(executable=/bin/sleep)(arguments
globus_gram_client_callback_allow successful
GRAM Job submission successful
https://grid.example.org:38824/16001608125017717261/5295612977486019989/
GLOBUS_GRAM_PROTOCOL_JOB_STATE_PENDING
% globusrun -status https://grid.example.org:38824/16001608125017717261/529561297748601998
PENDING
% globusrun -k https://grid.example.org:38824/16001608125017717261/5295612977486019989/
%
```

### 3.4.6. Refreshing a GRAM5 Credential

The following example shows how to refresh the credential used by a job manager and a job.

#### Example 4.15. Refreshing a Credential

```
% globusrun -refresh-proxy https://grid.example.org:38824/16001608125017717261/52956129774
% echo $?
0
```



#### Note

In GT 5.0.0, **globusrun** does not print any diagnostics when given the `-refresh-proxy` command-line option. Therefore, check the exit code as above to ensure that the refresh is successful.

### 3.4.7. Dealing with credential expiration

When the Job Manager's credential is about to expire, it sends a message to all clients registered for `GLOBUS_GRAM_PROTOCOL_JOB_STATE_FAILED` notifications that the job manager is terminating and that the job will continue to run without the job manager.

Any client which receives such a message can (if necessary) generate a new proxy as described above and then submit a *restart request* to start a job manager with a new credential. This job manager will resume monitoring the jobs which were started prior to proxy expiration.

In this example, the **globusrun** displays an error message when the job manager's proxy is about to expire. The user creates a new proxy and resumes monitoring the job with **globusrun**.

#### Example 4.16. Proxy Expiration Example

```
% globusrun -r grid.example.org "&(executable=a.out)"
globus_gram_client_callback_allow successful
GRAM Job submission successful
GLOBUS_GRAM_PROTOCOL_JOB_STATE_ACTIVE
GLOBUS_GRAM_PROTOCOL_JOB_STATE_FAILED
GRAM Job failed because the user proxy expired (job is still running) (error code 131)
% grid-proxy-init
Your identity: /DC=org/DC=example/OU=grid/CN=Joe User
Enter GRID pass phrase for this identity:
Creating proxy .....
Your proxy is valid until: Tue Nov 10 04:25:03 2009
% globusrun -r grid.example.org "&(restart="https://grid.example.org:1997/1600170047757511"
globus_gram_client_callback_allow successful
GRAM Job submission successful
GLOBUS_GRAM_PROTOCOL_JOB_STATE_ACTIVE
GLOBUS_GRAM_PROTOCOL_JOB_STATE_DONE
```

### 3.4.8. File staging

In addition to the standard output and error stream output done by **globusrun**, GRAM5 can do basic file management tasks to stage files to the GRAM5 service node before submitting a job and to stage files from the GRAM5 service node to a file service after the job completes.

GRAM5 file staging supports four URL schemes: `ftp`, `gsiftp`, `http`, and `https`. Note, that for the `https` scheme, GRAM expects the file server to be running with the same identity as the client.

General file staging is controlled by three RSL attributes: `file_stage_in`, `file_stage_in_shared`, and `file_stage_out`. In addition, the files named by the RSL attributes `executable`, `stdin` may be staged in and the files named by the RSL attributes `stdout` and `stderr` may be staged out.

The `file_stage_in_shared` RSL attribute instructs GRAM to store a local copy of the resource named by the URL in the GASS cache. This is useful if multiple concurrent jobs will be accessing one or more common files. The GASS cache will manage a reference count for files in the cache and remove them when all jobs that refer to them complete.

The following example shows how to stage a few files from a GridFTP server to the GRAM node. It uses the `rsl_substitution` mechanism to define a substitution variable to reduce the amount of redundancy in the job description.

### Example 4.17. File stage in

```
% globusrun -s -r grid.example.org:2119/jobmanager-pbs \  
  "&(rsl_substitution = (GRIDFTP_SERVER gsiftp://gridftp.example.org)) \  
    (executable=/bin/ls) \  
    (arguments=/tmp/staged_file) \  
    (file_stage_in = ($(GRIDFTP_SERVER)/staged_file /tmp/staged_file))" \  
/tmp/staged_file
```

The next example uses the `file_stage_in_shared` RSL attribute to stage a file into the cache. The file is transferred from the client using the GASS `https` server embedded in the `globusrun` program when the `-s` option is used.

### Example 4.18. File stage in shared

```
% globusrun -s -r grid.example.org:2119/jobmanager-pbs \  
  "&(executable=/bin/ls) \  
    (arguments = -l /tmp/staged_file_link1 /tmp/staged_file_link1) \  
    (file_stage_in_shared = \  
      (\$(GLOBUSRUN_GASS_URL)/staged_file1 /tmp/staged_file_link1))" \  
lrwxr-xr-x 1 juser juser 120 Nov 11 20:37 /tmp/staged_file1 -> /home/juser/.globus/.ga
```

The final staging example uses the `file_stage_out` RSL attribute to transfer a file from the GRAM service to an FTP server using anonymous FTP

### Example 4.19. File stage out

```
% globusrun -r grid.example.org:2119/jobmanager-pbs \  
  "&(executable=a.out) \  
    (file_stage_out = (results.txt ftp://anonymous:nopass@ftp.example.org/incoming/resul" \  
%
```

### Note

In all of the above cases, multiple files may be staged using any combination of the supported URL schemes.

### 3.4.9. Temporary files and cleanup

GRAM5 supports creating a per-job scratch directory which can be used as a place to store files that will be automatically removed by GRAM when the job completes. It also supports an explicit list of files to remove when the job completes.

This example shows how to stage files into a scratch directory. It again uses the embedded GASS https server, stages to the GRAM service, then runs `/bin/ls` in the temporary directory. After the job completes, the contents of `$(SCRATCH_DIRECTORY)` and the directory itself are removed.

#### Example 4.20. Staging to scratch directory

```
% globusrun -s grid.example.org:2119/jobmanager-pbs \  
  "&(scratch_dir = \$(HOME)) \  
  (directory = \$(SCRATCH_DIRECTORY)) \  
  (file_stage_in = \  
    (\$(GLOBUSRUN_GASS_URL)/inputfile \$(SCRATCH_DIRECTORY)/inputfile)) \  
  (executable = /bin/ls)" \  
inputfile
```

This example shows how to explicitly remove a file that was created by the job.

#### Example 4.21. Cleaning up a file

```
% globusrun -s grid.example.org:2119/jobmanager-pbs \  
  "&(executable = /bin/touch) \  
  (arguments = temporary_file) \  
  (file_clean_up = temporary_file)" \  
%
```

### 3.4.10. Reliable job submit

The `globusrun` command supports a two-phase commit protocol to ensure that the client knows the contact of the job which has been created so that it can be monitored or canceled in the case of a client or service error. The two-phase commit affects both job submission and termination.

The two-phase protocol is enabled by using the `two_phase` RSL attribute, as in the next example. When this is enabled, job submission will fail with the error `GLOBUS_GRAM_PROTOCOL_ERROR_WAITING_FOR_COMMIT`. The client must respond to this signal with either the `GLOBUS_GRAM_PROTOCOL_JOB_SIGNAL_COMMIT_REQUEST` or `GLOBUS_GRAM_PROTOCOL_JOB_SIGNAL_COMMIT_EXTEND` signals to either commit the job to execution or delay the commit timeout. One of these signals must be sent prior to the two phase commit timeout, or the job will be discarded by the GRAM service.

A two phase protocol is also used at job termination if the `save_state` RSL attribute is used along with the `two_phase` attribute. When the job manager sends a callback with the job state set to `GLOBUS_GRAM_PROTOCOL_JOB_STATE_DONE` or `GLOBUS_GRAM_PROTOCOL_JOB_STATE_DONE` it will wait to clean up the job until the two phase commit occurs. The client must reply with the `GLOBUS_GRAM_PROTOCOL_JOB_SIGNAL_COMMIT_END` signal to cause the job to be cleaned. Otherwise, the job will be unloaded from memory until a client restarts the job and sends the signal.

### Example 4.22. Two phase commit example

In this example, the user submits a job with a `two_phase` timeout of 30 seconds and the `save_state` attribute. The client must send commit signals to ensure the job runs.

```
% globusrun -r grid.example.org:2119/jobmanager-pbs \  
  "&(two_phase = 30) \  
    (save_state = yes) \  
    (executable = a.out)"
```

```
globus_gram_client_callback_allow successful  
GRAM Job submission successful  
GLOBUS_GRAM_PROTOCOL_JOB_STATE_PENDING  
GLOBUS_GRAM_PROTOCOL_JOB_STATE_ACTIVE  
GLOBUS_GRAM_PROTOCOL_JOB_STATE_DONE  
%
```

### 3.4.11. Reconnecting to a job

If a job manager or client exits before a job has completed, the job will continue to run. The client can reconnect to a job manager and receive job state notifications and output using the `restart` RSL attribute.

### Example 4.23. Restart example

This example uses `globus-job-submit` to submit a batch job and then `globusrun` to reconnect to the job.

```
% globus-job-submit grid.example.org:2119/jobmanager-pbs /bin/sleep 90  
https://grid.example.org:38824/16001746665595486521/5295612977486005662/  
% globusrun -r grid.example.org:2119/jobmanager-pbs \  
  "&(restart = https://grid.example.org:38824/16001746665595486521/5295612977486005662/)"  
globus_gram_client_callback_allow successful  
GRAM Job submission successful  
GLOBUS_GRAM_PROTOCOL_JOB_STATE_DONE  
%
```

### 3.4.12. Submitting a Java job

To submit a job that runs a java program, the client must ensure that the job can find the Java interpreter and its classes. This example sets the default `PATH` and `CLASSPATH` environment variables and uses the shell to locate the path to the `java` program.

### Example 4.24. Java example

This example uses **globus-job-submit** to submit a java job, staging a jar file from a remote service.

```
% globusrun -r grid.example.org:2119/jobmanager-pbs \  
  "&(environment = (PATH '/usr/bin:/bin') (CLASSPATH \$(SCRATCH_DIRECTORY))) \  
  (scratch_dir = \$(HOME)) \  
  (directory = \$(SCRATCH_DIRECTORY)) \  
  (rsl_substitution = (JAVA_SERVER http://java.example.org)) \  
  (file_stage_in = \  
    (\$(JAVA_SERVER)/example.jar \$(SCRATCH_DIRECTORY)/example.jar) \  
    (\$(JAVA_SERVER)/support.jar \$(SCRATCH_DIRECTORY)/support.jar)) \  
  (executable=/bin/sh) \  
  (arguments=-c 'java -jar example.jar')" \  
globus_gram_client_callback_allow successful \  
GRAM Job submission successful \  
GLOBUS_GRAM_PROTOCOL_JOB_STATE_PENDING \  
GLOBUS_GRAM_PROTOCOL_JOB_STATE_ACTIVE \  
GLOBUS_GRAM_PROTOCOL_JOB_STATE_DONE \  
%
```

---

# Appendix A. Globus Toolkit 5.0.0 Public Interface Guides

This page contains links to each GT 5.0.0 component's Public Interfaces Guide.

- Common Runtime Components
  - [XIO](#)
  - [C Common Libraries](#)
- Security
  - [GSI C](#)
  - [MyProxy](#)
  - [GSI-OpenSSH](#)
- Data Management
  - [GridFTP](#)
  - [RLS](#)
- Execution Management
  - [GRAM5](#)

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# Appendix B. Globus Toolkit 5.0.0 Errors

- [XIO](#)
- [GSI credentials](#)
- [GSI gridmap](#)
- [MyProxy](#)
- [GSI-OpenSSH](#)
- [GridFTP](#)
- [Replica Location Service \(RLS\)](#)
- [GRAM5](#)

**Table B.1. XIO Errors**

<b>Error Code</b>	<b>Definition</b>	<b>Possible Solutions</b>
Operation was canceled	An I/O operation has been canceled by a close or a cancel	In most cases this will be intentionally performed by the application developer. In unexpected cases the application developer should verify that there is not a race condition relating to closing a handle.
Operation timed out	Occurs when the application developer associates a timeout with a handle's I/O operations. If no I/O is performed before the timeout expires this error will be triggered.	The remote side of connection might be hung and busy. The network could have higher latencies than expected. The filesystem might be over worked.
An end of file occurred	This occurs when and EOF is detected on the file descriptor	When doing file I/O this like means you read to the end of the file and thus you are finished and should now close it. On network connections however it means the socket was closed on the remote end. This can happen if the remote side suddenly dies (seg-fault is common here) or if the remote side chooses to close the connection.
Contact string invalid	A poorly formed contact string was passed in to open	Verify the format of the contact string with the documentation of the drivers in use.
Memory allocation failed on XXXX	malloc failed. The system is likely quite overloaded	Free up memory in your application
System error in XXXX	A low level system error occurred. The errno and errstring should indicate more information.	
Invalid stack	The requested stack does not meet XIO standards	Most likely a transport driver is not on the bottom of the stack, or 2 transport drivers are in the stack.
Operation already registered	With certain common drivers like TCP and FILE, only one specific operations can be registered at a time (1 read, 1 write). If another operation of the same type is posted to the handle before receiving the previous operations callback, this error can occur.	Restructure the application code so that it waits for the callback before registering the next IO operation.
Unexpected state	The internal logic of XIO came across a logical path that should not be possible. Often times this is due to application memory corruption or trying to perform an IO operation on a closed or otherwise invalid handle.	Use valgrind or some sort of memory management tool to verify there is no memory corruption. Try to recreate the problem in a small program. Submit the program and the memory trace at <a href="http://bugzilla.globus.org">bugzilla.globus.org</a>
Driver in handle has been unloaded	A driver associated with the offending operation has already been unloaded by the application code.	Verify that you are not unloading drivers until they are no longer in use.

<b>Error Code</b>	<b>Definition</b>	<b>Possible Solutions</b>
Module not activated	globus_module_activate(GLOBUS_XIO_MODULE); has not been called.	Call this before making any other XIO API calls.

**Table B.2. Credential Errors**

<b>Error Code</b>	<b>Definition</b>	<b>Possible Solutions</b>
Your proxy credential may have expired	Your proxy credential may have expired.	Use <a href="#">grid-proxy-info</a> to check whether the proxy credential has actually expired. If it has, generate a new proxy with <a href="#">grid-proxy-init</a> .
The system clock on either the local or remote system is wrong.	This may cause the server or client to conclude that a credential has expired.	Check the system clocks on the local and remote system.
Your end-user certificate may have expired	Your end-user certificate may have expired	Use <a href="#">grid-cert-info</a> to check your certificate's expiration date. If it has expired, follow your CA's procedures to get a new one.
The permissions may be wrong on your proxy file	If the permissions on your proxy file are too lax (for example, if others can read your proxy file), Globus Toolkit clients will not use that file to authenticate.	You can "fix" this problem by changing the permissions on the file or by destroying it (with <a href="#">grid-proxy-destroy</a> ) and creating a new one (with <a href="#">grid-proxy-init</a> ).  <b>Important:</b> However, it is still possible that someone else has made a copy of that file during the time that the permissions were wrong. In that case, they will be able to impersonate you until the proxy file expires or your permissions or end-user certificate are revoked, whichever happens first.
The permissions may be wrong on your private key file	If the permissions on your end user certificate private key file are too lax (for example, if others can read the file), <a href="#">grid-proxy-init</a> will refuse to create a proxy certificate.	You can "fix" this by changing the permissions on the private key file.  <b>Important:</b> However, you will still have a much more serious problem: it is possible that someone has made a copy of your private key file. Although this file is encrypted, it is possible that someone will be able to decrypt the private key, at which point they will be able to impersonate you as long as your end user certificate is valid. You should contact your CA to have your end-user certificate revoked and get a new one.
The remote system may not trust your CA	The remote system may not trust your CA	Verify that the remote system is configured to trust the CA that issued your end-entity certificate. See <a href="#">Installing GT 5.0.0</a> for details.
You may not trust the remote system's CA	You may not trust the remote system's CA	Verify that your system is configured to trust the remote CA (or that your environment is set up to trust the remote CA). See <a href="#">Installing GT 5.0.0</a> for details.
There may be something wrong with the remote service's credentials	There may be something wrong with the remote service's credentials	It is sometimes difficult to distinguish between errors reported by the remote service regarding your credentials and errors reported by the client interface regarding the remote service's credentials. If you cannot find anything wrong with your credentials, check for the same conditions on the remote system (or ask a remote administrator to do so) .

**Table B.3. Gridmap Errors**

<b>Error Code</b>	<b>Definition</b>	<b>Possible Solutions</b>
The content of the grid map file does not conform to the expected format	The content of the grid map file does not conform to the expected format	Run <a href="#"><u>grid-mapfile-check-consistency</u></a> to make sure that your gridmap file conforms to the expected format.
The grid map file does not contain a entry for your DN	The grid map file does not contain a entry for your DN	Use <a href="#"><u>grid-mapfile-add-entry</u></a> to add the relevant entry.

**Table B.4. MyProxy Errors**

Error Code	Definition	Possible Solutions
MyProxy server name does not match expected name	<p>This error appears as a mutual authentication failure or a server authentication failure, and the error message should list two names: the expected name of the MyProxy server and the actual authenticated name.</p> <p>By default, the MyProxy clients expect the MyProxy server to be running with a host certificate that matches the target hostname. This error can occur when running the MyProxy server under a non-host certificate or if the server is running on a machine with multiple hostnames.</p> <p>The MyProxy clients authenticate the identity of the MyProxy server to avoid sending passphrases and credentials to rogue servers.</p> <p>If the expected name contains an IP address, your system is unable to do a reverse lookup on that address to get the canonical hostname of the server, indicating either a problem with that machine's DNS record or a problem with the resolver on your system.</p>	<p>If the server name shown in the error message is acceptable, set the <code>MYPROXY_SERVER_DN</code> environment variable to that name to resolve the problem.</p>
Error in <code>bind()</code> : Address already in use	<p>This error indicates that the <code>myproxy-server</code> port (default: 7512) is in use by another process, probably another <code>myproxy-server</code> instance. You cannot run multiple instances of the <code>myproxy-server</code> on the same network port.</p>	<p>If you want to run multiple instances of the <code>myproxy-server</code> on a machine, you can specify different ports with the <code>-p</code> option, and then give the same <code>-p</code> option to the MyProxy commands to tell them to use the <code>myproxy-server</code> on that port.</p>
grid-proxy-init failed	<p>This error indicates that the <code>grid-proxy-init</code> command failed when <code>myproxy-init</code> attempted to run it, which implies a problem with the underlying Globus installation.</p>	<p>Run <code>grid-proxy-init -debug -verify</code> for more information.</p>
User not authorized	<p>An error from the <code>myproxy-server</code> saying you are "not authorized" to complete an operation typically indicates that the <code>myproxy-server.config</code> file settings are restricting your access to the <code>myproxy-server</code>. It is possible that the <code>myproxy-server</code> is running with the default <code>myproxy-server.config</code> file, which does not authorize any operations.</p>	<p>See <a href="#">Configuring MyProxy</a> for more information.</p>

<b>Error Code</b>	<b>Definition</b>	<b>Possible Solutions</b>
Unable to verify remote side's credentials	An error saying "Unable to verify remote side's credentials," "Couldn't verify the remote certificate," or "alert bad certificate" often indicates that the client or server's certificate is signed by an untrusted Certification Authority (CA). The client must have a CA certificate and signing policy file installed in <code>/etc/grid-security/certificates</code> for the CA that signed the server's certificate. Likewise, the server must have a CA certificate and signing policy file installed in <code>/etc/grid-security/certificates</code> for the CA that signed the client's certificate.	See <a href="#">Configuring Certificates</a> for more information.

**Table B.5. GSI-OpenSSH Errors**

Error Code	Definition	Possible Solutions
GSS-API error Failure acquiring GSSAPI credentials: GSS_S_CREDENTIALS_EXPIRED	This means that your proxy certificate has expired.	Run <code>grid-proxy-init</code> to acquire a new proxy certificate, then run <code>gsissh</code> again.
...no proxy credentials...	Failing to run <code>grid-proxy-init</code> to create a user proxy with which to connect will result in the client notifying you that no local credentials exist. Any attempt to authenticate using GSI will fail in this case.	Verify that your GSI proxy has been properly initialized via <code>grid-proxy-info</code> . If you need to initialize the proxy, use the command <code>grid-proxy-init</code> .
...bad file system permissions on private key; key must only be readable by the user...	The host key that the SSH server is using for GSI authentication must only be readable by the user which owns it. Any other permissions will cause this error.	Make sure that the host key's UNIX permissions are mode 400 (that is, it should only have mode readable for the user that owns the file, and no other mode bits should be set).
...gssapi received empty username; failed to set username from gssapi context; Failed external-keyx for <user> from <host> <port>...	If the server was passed an "implicit username" (i.e. requested to map the incoming connection to a username based on some contextual clues such as the certificate's subject), and no entry exists in the grid-mapfile for the incoming connection's certificate subject, the server should output a clue that states it is unable to set the username against which to authenticate.	Add an entry for the user to the <a href="#">Section 1.2, "Gridmap file"</a> .
...INTERNAL ERROR: authenticated invalid user xxx...	If the subject name given in the system's grid-mapfile points to a non-existent user, the server will give an internal error which is best caught when it is running in debugging mode.	Add a new account to the system matching the username pointed at by the user's subject in the grid-mapfile.
...gssapi received empty username; no suitable client data; failed to set username from gssapi context; Failed external-keyx for <user> from <host> <port>...	Should the user attempt to connect without first creating a proxy certificate, or if the user is connecting via a SSH client that does not support GSI authentication, the server will note that no GSSAPI data was sent to it. Verify that the client is able to connect through another GSI service (such as the gatekeeper) to make sure that the user's proxy has been created correctly.	Verify that you are using a GSI-enabled SSH client and that your GSI proxy has been properly initialized via <code>grid-proxy-info</code> . If you need to initialize this proxy, use the command <code>grid-proxy-init</code> .

**Table B.6. GridFTP Errors**

Error Code	Definition	Possible Solutions
<p>globus_ftp_client: the server responded with an error 530 530-globus_xio: Authentication Error 530-OpenSSL Error: s3_srvr.c:2525: in library: SSL routines, function SSL3_GET_CLIENT_CERTIFICATE: no certificate returned 530-globus_gsi_callback_module: Could not verify credential 530-globus_gsi_callback_module: Can't get the local trusted CA certificate: Untrusted self-signed certificate in chain with hash d1b603c3 530 End.</p>	<p>This error message indicates that the GridFTP server doesn't trust the certificate authority (CA) that issued your certificate.</p>	<p>You need to ask the GridFTP server administrator to install your CA certificate chain in the GridFTP server's trusted certificates directory.</p>
<p>globus_ftp_control: gss_init_sec_context failed OpenSSL Error: s3_clnt.c:951: in library: SSL routines, function SSL3_GET_SERVER_CERTIFICATE: certificate verify failed globus_gsi_callback_module: Could not verify credential globus_gsi_callback_module: Can't get the local trusted CA certificate: Untrusted self-signed certificate in chain with hash d1b603c3</p>	<p>This error message indicates that your local system doesn't trust the certificate authority (CA) that issued the certificate on the resource you are connecting to.</p>	<p>You need to ask the resource administrator which CA issued their certificate and install the CA certificate in the local trusted certificates directory.</p>

**Table B.7. Replica Locator Service (RLS) Errors**

Error Code	Definition	Possible Solutions
Error with credential: The proxy credential: <credential> with subject: <subject> expired <minutes> minutes ago	Expired proxy credential	Create a new proxy with <code>grid-proxy-init</code> .
Unable to connect to local-host:xxxx	Unable to connect to the local host. This can be due to a variety of reasons, including a wrong address or port number in the RLS connection URL or an issue with a firewall configuration.	<ul style="list-style-type: none"> <li>• Double-check the address and port number in the RLS connection URL. parameters are correct.</li> <li>• If a firewall configuration is preventing connections to the target host for a particular port, you may need to consult the system administrator.</li> </ul>
"connection timeout"	<p>At times, a client may experience a connection timeout when interacting with the RLS server due to a variety of reasons:</p> <ul style="list-style-type: none"> <li>• One reason could simply be due to wide-area network latency or congestion.</li> <li>• Another situation that users eventually encounter is due to scaling of the system. As the RLS server's database of replica location mappings grows in size, some query operations, such as bulk queries involving large quantities of mappings or wildcard queries that result in a large subset of mappings, will begin to take more time both to process the query and to return the large results set to the client over the network.</li> </ul>	If timeouts are experienced with increasing frequency, increase the RLS server's timeout configuration parameter found in the <code>\$GLOBUS_LOCATION/var/globus-rls-server.conf</code> file. You may also use the <code>-t</code> timeout option of the <code>globus-rls-cli</code> tool.

**Table B.8. GRAM5 Errors**

<b>Error Code</b>	<b>Reason</b>	<b>Possible Solutions</b>
1	one of the RSL parameters is not supported	Check RSL documentation
2	the RSL length is greater than the maximum allowed	Use RSL substitutions to reduce length of RSL strings
3	an I/O operation failed	Enable trace logging and report to <a href="mailto:gram-dev@globus.org">gram-dev@globus.org</a>
4	jobmanager unable to set default to the directory requested	Check that RSL <code>directory</code> attribute refers to a directory that exists on the target system.
5	the executable does not exist	Check that the RSL <code>executable</code> attribute refers to an executable that exists on the target system.
6	of an unused <code>INSUFFICIENT_FUNDS</code>	Unimplemented feature.
7	authentication with the remote server failed	Check that the contact string contains the proper X.509 DN.
8	the user cancelled the job	Don't cancel jobs you want to complete.
9	the system cancelled the job	Check RSL requirements such as maximum time and memory are valid for the job.
10	data transfer to the server failed	Check gatekeeper and/or job manager logs to see why the process failed.
11	the stdin file does not exist	Check that the RSL <code>stdin</code> attribute refers to a file that exists on the target system or has a valid ftp, gsiftp, http, or https URL.
12	the connection to the server failed (check host and port)	Check that the service is running on the expected TCP/IP port. Check that no firewall prevents contacting that TCP/IP port. Check <code>\$GLOBUS_LOCATION/var/globus-gatekeeper.log</code> for runtime configuration errors.
13	the provided RSL 'maxtime' value is not an integer	Check that the RSL <code>maxtime</code> value evaluates to an integer.
14	the provided RSL 'count' value is not an integer	Check that the RSL <code>count</code> value evaluates to an integer.
15	the job manager received an invalid RSL	Check that the RSL string can be parsed by using <b><code>globusrun -p RSL</code></b> .
16	the job manager failed in allowing others to make contact	Check job manager log.
17	the job failed when the job manager attempted to run it	Verify that the LRM is configured properly.
18	an invalid paradyn was specified	OBSOLETE IN GRAM2
19	the provided RSL 'jobtype' value is invalid	The RSL <code>jobtype</code> attribute is not indicated as supported by the LRM. Valid <code>jobtype</code> values are <code>single</code> , <code>multiple</code> , <code>mpi</code> , and <code>condor</code> .
20	the provided RSL 'myjob' value is invalid	OBSOLETE IN GRAM5

Error Code	Reason	Possible Solutions
21	the job manager failed to locate an internal script argument file	Check that <code>\$GLOBUS_LOCATION/libexec/globus-job-manager-script.pl</code> exists and is executable. Check that the LRM-specific perl module is located in <code>\$GLOBUS_LOCATION/lib/perl/Globus/GRAM/JobManager/</code> directory and is valid. The command <b>perl -I\$GLOBUS_LOCATION/lib/perl \$GLOBUS_LOCATION/lib/perl/Globus/GRAM/JobManager/LRM.pm</b> can be used to check if there are any syntax errors in the script.
22	the job manager failed to create an internal script argument file	Check that your home directory is writable and not full.
23	the job manager detected an invalid job state	Check job manager logs.
24	the job manager detected an invalid script response	Check job manager logs. This is likely a bug in the LRM script.
25	the job manager detected an invalid script status	Check job manager logs. This is likely a bug in the LRM script.
26	the provided RSL 'jobtype' value is not supported by this job manager	Check that the RSL <code>jobtype</code> attribute is implemented by the LRM script. Note that some job types require configuration
27	unused ERROR_UNIMPLEMENTED	LRM does not support some feature included in the job request.
28	the job manager failed to create an internal script submission file	Check that the user's home file system is not full. Check job manager log
29	the job manager cannot find the user proxy	Check that client is delegating a proxy when authenticating with the gatekeeper. Check that the user's home filesystem and the <code>/tmp</code> file system are not full.
30	the job manager failed to open the user proxy	Check that the user's home filesystem and the <code>/tmp</code> file system are not full.
31	the job manager failed to cancel the job as requested	Check that the user's home filesystem and the <code>/tmp</code> file system are not full.
32	system memory allocation failed	Check job manager log for details.
33	the interprocess job communication initialization failed	OBSOLETE IN GRAM5
34	the interprocess job communication setup failed	OBSOLETE IN GRAM5
35	the provided RSL 'host count' value is invalid	Check that the RSL <code>host_count</code> attribute evaluates to an integer.
36	one of the provided RSL parameters is unsupported	Check job manager log for details about invalid parameter.
37	the provided RSL 'queue' parameter is invalid	Check that the RSL <code>queue</code> attribute evaluates to a string that corresponds to an LRM-specific queue name.
38	the provided RSL 'project' parameter is invalid	Check that the RSL <code>project</code> attribute evaluates to a string that corresponds to an LRM-specific project name.

<b>Error Code</b>	<b>Reason</b>	<b>Possible Solutions</b>
39	the provided RSL string includes variables that could not be identified	Check that all RSL substitutions are defined before being used in the job description.
40	the provided RSL 'environment' parameter is invalid	Check that the RSL <code>environment</code> attribute contains a sequence of <code>VARIABLE VALUE</code> pairs.
41	the provided RSL 'dryrun' parameter is invalid	Remove the RSL <code>dryrun</code> attribute from the job description.
42	the provided RSL is invalid (an empty string)	Include a non-empty RSL string in your job submission request.
43	the job manager failed to stage the executable	Check that the file service hosting the executable is reachable from the GRAM5 service node. Check that the executable exists on the file service node. Check that there is sufficient disk space in the user's home directory on the service node to store the executable.
44	the job manager failed to stage the stdin file	Check that the file service hosting the standard input file is reachable from the GRAM5 service node. Check that the standard input file exists on the file service node. Check that there is sufficient disk space in the user's home directory on the service node to store the standard input file.
45	the requested job manager type is invalid	OBSOLETE IN GRAM5
46	the provided RSL 'arguments' parameter is invalid	OBSOLETE IN GRAM2
47	the gatekeeper failed to run the job manager	Check the gatekeeper or job manager logs for more information.
48	the provided RSL could not be properly parsed	Check that the RSL string can be parsed by using <b>globusrun -p RSL</b> .
49	there is a version mismatch between GRAM components	Ask system administrator to upgrade GRAM service to GRAM2 or GRAM5
50	the provided RSL 'arguments' parameter is invalid	Check that the RSL <code>arguments</code> attribute evaluates to a sequence of strings.
51	the provided RSL 'count' parameter is invalid	Check that the RSL <code>count</code> attribute evaluates to a positive integer value.
52	the provided RSL 'directory' parameter is invalid	Check that the RSL <code>directory</code> attribute evaluates to a string.
53	the provided RSL 'dryrun' parameter is invalid	Check that the RSL <code>dryrun</code> attribute evaluates to either <code>yes</code> or <code>no</code> .
54	the provided RSL 'environment' parameter is invalid	Check that the RSL <code>environment</code> attribute evaluates to a sequence of <code>VARIABLE, VALUE</code> pairs.
55	the provided RSL 'executable' parameter is invalid	Check that the RSL <code>executable</code> attribute evaluates to a string value.
56	the provided RSL 'host_count' parameter is invalid	Check that the RSL <code>host_count</code> attribute evaluates to a positive integer value.
57	the provided RSL 'jobtype' parameter is invalid	Check that the RSL <code>jobtype</code> attribute evaluates to one of <code>single</code> , <code>multiple</code> , <code>mpi</code> , or <code>condor</code>

<b>Error Code</b>	<b>Reason</b>	<b>Possible Solutions</b>
58	the provided RSL 'maxtime' parameter is invalid	Check that the RSL <code>maxtime</code> attribute evaluates to a positive integer value.
59	the provided RSL 'myjob' parameter is invalid	OBSOLETE IN GRAM5.
60	the provided RSL 'paradyn' parameter is invalid	OBSOLETE IN GRAM2.
61	the provided RSL 'project' parameter is invalid	Check that the RSL <code>project</code> attribute evaluates to a string value.
62	the provided RSL 'queue' parameter is invalid	Check that the RSL <code>queue</code> attribute evaluates to a string value.
63	the provided RSL 'stderr' parameter is invalid	Check that the RSL <code>stderr</code> attribute evaluates to a string value or a sequence of <i>DESTINATION</i> URLs with optional <i>CACHE_TAG</i> string parameters.
64	the provided RSL 'stdin' parameter is invalid	Check that the RSL <code>stdin</code> attribute evaluates to a string value.
65	the provided RSL 'stdout' parameter is invalid	Check that the RSL <code>stdout</code> attribute evaluates to a string value or a sequence of <i>DESTINATION</i> URLs with optional <i>CACHE_TAG</i> string parameters.
66	the job manager failed to locate an internal script	Check job manager log for more details.
67	the job manager failed on the system call <code>pipe()</code>	OBSOLETE IN GRAM5
68	the job manager failed on the system call <code>fcntl()</code>	OBSOLETE IN GRAM2
69	the job manager failed to create the temporary stdout filename	OBSOLETE IN GRAM5
70	the job manager failed to create the temporary stderr filename	OBSOLETE IN GRAM5
71	the job manager failed on the system call <code>fork()</code>	OBSOLETE IN GRAM2
72	the executable file permissions do not allow execution	Check that the RSL <code>executable</code> attribute refers to an executable program or script.
73	the job manager failed to open stdout	Check that the RSL <code>stdout</code> attribute refers to one or more valid destination files or URLs.
74	the job manager failed to open stderr	Check that the RSL <code>stderr</code> attribute refers to one or more valid destination files or URLs.
75	the cache file could not be opened in order to relocate the user proxy	Check that the user's home directory is writable and not full on the GRAM5 service node.
76	cannot access cache files in <code>~/globus/gass_cache</code> , check permissions, quota, and disk space	Check that the user's home directory is writable and not full on the GRAM5 service node.
77	the job manager failed to insert the contact in the client contact list	Check job manager log

<b>Error Code</b>	<b>Reason</b>	<b>Possible Solutions</b>
78	the contact was not found in the job manager's client contact list	Don't attempt to unregister callback contacts that are not registered
79	connecting to the job manager failed. Possible reasons: job terminated, invalid job contact, network problems, ...	Check that the job manager process is running. Check that the job manager credential has not expired. Check that the job manager contact refers to the correct TCP/IP host and port. Check that the job manager contact is not blocked by a firewall.
80	the syntax of the job contact is invalid	Check the syntax of job contact string.
81	the executable parameter in the RSL is undefined	Include the RSL <code>executable</code> in all job requests.
82	the job manager service is misconfigured. <code>condor arch</code> undefined	Add the <code>-condor-arch</code> to the command-line or configuration file for a job manager configured to use the <code>condor</code> LRM.
83	the job manager service is misconfigured. <code>condor os</code> undefined	Add the <code>-condor-os</code> to the command-line or configuration file for a job manager configured to use the <code>condor</code> LRM.
84	the provided RSL 'min_memory' parameter is invalid	Check that the RSL <code>min_memory</code> attribute evaluates to a positive integer value.
85	the provided RSL 'max_memory' parameter is invalid	Check that the RSL <code>max_memory</code> attribute evaluates to a positive integer value.
86	the RSL 'min_memory' value is not zero or greater	Check that the RSL <code>min_memory</code> attribute evaluates to a positive integer value.
87	the RSL 'max_memory' value is not zero or greater	Check that the RSL <code>max_memory</code> attribute evaluates to a positive integer value.
88	the creation of a HTTP message failed	Check job manager log.
89	parsing incoming HTTP message failed	Check job manager log.
90	the packing of information into a HTTP message failed	Check job manager log.
91	an incoming HTTP message did not contain the expected information	Check job manager log.
92	the job manager does not support the service that the client requested	Check that the client is talking to the correct service
93	the gatekeeper failed to find the requested service	OBSOLETE IN GRAM2
94	the jobmanager does not accept any new requests (shutting down)	Execute queries before the job has been cleaned up.
95	the client failed to close the listener associated with the callback URL	Call <code>globus_gram_client_callback_disallow()</code> with a valid the callback contact.
96	the gatekeeper contact cannot be parsed	Check the syntax of the gatekeeper contact string you are attempting to contact.
97	the job manager could not find the 'poe' command	OBSOLETE IN GRAM2
98	the job manager could not find the 'mpirun' command	Configure the LRM script with <code>mpirun</code> in your path.

<b>Error Code</b>	<b>Reason</b>	<b>Possible Solutions</b>
99	the provided RSL 'start_time' parameter is invalid	OBSOLETE IN GRAM2
100	the provided RSL 'reservation_handle' parameter is invalid	OBSOLETE IN GRAM2
101	the provided RSL 'max_wall_time' parameter is invalid	Check that the RSL <code>max_wall_time</code> attribute evaluates to a positive integer.
102	the RSL 'max_wall_time' value is not zero or greater	Check that the RSL <code>max_wall_time</code> attribute evaluates to a positive integer.
103	the provided RSL 'max_cpu_time' parameter is invalid	Check that the RSL <code>max_cpu_time</code> attribute evaluates to a positive integer.
104	the RSL 'max_cpu_time' value is not zero or greater	Check that the RSL <code>max_cpu_time</code> attribute evaluates to a positive integer.
105	the job manager is misconfigured, a scheduler script is missing	Check that the administrator has configured the LRM by running its setup script.
106	the job manager is misconfigured, a scheduler script has invalid permissions	Check that the administrator has installed the <code>GLLOBUS_LOCATION/libexec/globus-job-manager-script.pl</code> script. Check that the file system containing that script allows file execution.
107	the job manager failed to signal the job	OBSOLETE IN GRAM2
108	the job manager did not recognize/support the signal type	Check that your signal operation is using the correct signal constant.
109	the job manager failed to get the job id from the local scheduler	OBSOLETE IN GRAM2
110	the job manager is waiting for a commit signal	Send a two-phase commit signal to the job manager to acknowledge receiving the job contact from the job manager.
111	the job manager timed out while waiting for a commit signal	Send a two-phase commit signal to the job manager to acknowledge receiving the job contact from the job manager. Increase the two-phase commit time out for your job. Check that the job manager contact TCP/IP port is reachable from your client.
112	the provided RSL 'save_state' parameter is invalid	Check that the RSL <code>save_state</code> attribute is set to <code>yes</code> or <code>no</code> .
113	the provided RSL 'restart' parameter is invalid	Check that the RSL <code>restart</code> attribute evaluates to a string containing a job contact string.
114	the provided RSL 'two_phase' parameter is invalid	Check that the RSL <code>two_phase</code> attribute evaluates to a positive integer.
115	the RSL 'two_phase' value is not zero or greater	Check that the RSL <code>two_phase</code> attribute evaluates to a positive integer.
116	the provided RSL 'stdout_position' parameter is invalid	OBSOLETE IN GRAM5
117	the RSL 'stdout_position' value is not zero or greater	OBSOLETE IN GRAM5

<b>Error Code</b>	<b>Reason</b>	<b>Possible Solutions</b>
118	the provided RSL 'stderr_position' parameter is invalid	OBSOLETE IN GRAM5
119	the RSL 'stderr_position' value is not zero or greater	OBSOLETE IN GRAM5
120	the job manager restart attempt failed	OBSOLETE IN GRAM2
121	the job state file doesn't exist	Check that the job contact you are trying to restart matches one that the job manager returned to you.
122	could not read the job state file	Check that the state file directory is not full.
123	could not write the job state file	Check that the state file directory is not full.
124	old job manager is still alive	Contact the returned job manager contact to manage the job you are trying to restart.
125	job manager state file TTL expired	OBSOLETE in GRAM2
126	it is unknown if the job was submitted	Check job manager log.
127	the provided RSL 'remote_io_url' parameter is invalid	Check that the RSL <code>remote_io_url</code> attribute evaluates to a string value.
128	could not write the remote io url file	Check that the user's home file system on the job manager service node is writable and not full.
129	the standard output/error size is different	Send a stdio update signal to redirect the job manager output to a new URL
130	the job manager was sent a stop signal (job is still running)	Submit a restart request to monitor the job.
131	the user proxy expired (job is still running)	Generate a new proxy and then submit a restart request to monitor the job.
132	the job was not submitted by original job-manager	OBSOLETE IN GRAM2
133	the job manager is not waiting for that commit signal	Do not send a commit signal to a job that is not waiting for a commit signal.
134	the provided RSL scheduler specific parameter is invalid	Check the LRM-specific documentation to determine what values are legal for the RSL extensions implemented by the LRM.
135	the job manager could not stage in a file	Check that the file service hosting the file to stage is reachable from the GRAM5 service node. Check that the file to stage exists on the file service node. Check that there is sufficient disk space in the user's home directory on the service node to store the file to stage.
136	the scratch directory could not be created	Check that the directory named by the RSL <code>scratch_dir</code> attribute exists and is writable. Check that the directory named by the RSL <code>scratch_dir</code> attribute is not full.
137	the provided 'gass_cache' parameter is invalid	Check that the RSL <code>gass_cache</code> attribute evaluates to a string.
138	the RSL contains attributes which are not valid for job submission	Do not use restart- or signal-only RSL attributes when submitting a job.

<b>Error Code</b>	<b>Reason</b>	<b>Possible Solutions</b>
139	the RSL contains attributes which are not valid for stdio update	Do not use submit- or restart-only RSL attributes when sending a stdio update signal to a job.
140	the RSL contains attributes which are not valid for job restart	Do not use submit- or signal-only RSL attributes when restarting a job.
141	the provided RSL 'file_stage_in' parameter is invalid	Check that the RSL <code>file_stage_in</code> attribute evaluates to a sequence of <i>SOURCE DESTINATION</i> pairs.
142	the provided RSL 'file_stage_in_shared' parameter is invalid	Check that the RSL <code>file_stage_in_shared</code> attribute evaluates to a sequence of <i>SOURCE DESTINATION</i> pairs.
143	the provided RSL 'file_stage_out' parameter is invalid	Check that the RSL <code>file_stage_out</code> attribute evaluates to a sequence of <i>SOURCE DESTINATION</i> pairs.
144	the provided RSL 'gass_cache' parameter is invalid	Check that the RSL <code>gass_cache</code> attribute evaluates to a string.
145	the provided RSL 'file_cleanup' parameter is invalid	Check that the RSL <code>file_clean_up</code> attribute evaluates to a sequence of strings.
146	the provided RSL 'scratch_dir' parameter is invalid	Check that the RSL <code>scratch_dir</code> attribute evaluates to a string.
147	the provided scheduler-specific RSL parameter is invalid	Check the LRM-specific documentation to determine what values are legal for the RSL extensions implemented by the LRM.
148	a required RSL attribute was not defined in the RSL spec	Check that the RSL <code>executable</code> attribute is present in your job request RSL. Check that the RSL <code>restart</code> attributes is present in your restart RSL.
149	the <code>gass_cache</code> attribute points to an invalid cache directory	Check that the RSL <code>gass_cache</code> attributes evaluates to a directory that exists or can be created. Check that the user's home file system is writable and not full.
150	the provided RSL 'save_state' parameter has an invalid value	Check that the RSL <code>save_state</code> attribute has a value of <code>yes</code> or <code>no</code> .
151	the job manager could not open the RSL attribute validation file	Check that <code>\$GLOBUS_LOCATION/share/globus_gram_job_manager/globus-gram-job-manager.rvf</code> is present and readable on the job manager service node. Check that <code>\$GLOBUS_LOCATION/share/globus_gram_job_manager/LRM.rvf</code> is readable on the job manager service node if present.
152	the job manager could not read the RSL attribute validation file	Check that <code>\$GLOBUS_LOCATION/share/globus_gram_job_manager/globus-gram-job-manager.rvf</code> is valid. Check that <code>\$GLOBUS_LOCATION/share/globus_gram_job_manager/LRM.rvf</code> is valid if present.
153	the provided RSL 'proxy_timeout' is invalid	Check that RSL <code>proxy_timeout</code> attribute evaluates to a positive integer.
154	the RSL 'proxy_timeout' value is not greater than zero	Check that RSL <code>proxy_timeout</code> attribute evaluates to a positive integer.

<b>Error Code</b>	<b>Reason</b>	<b>Possible Solutions</b>
155	the job manager could not stage out a file	Check that the source file being staged exists on the job manager service node. Check that the directory of the destination file being staged exists on the file service node. Check that the directory of the destination file being staged is writable by the user. Check that the destination file service is reachable by the job manager service node.
156	the job contact string does not match any which the job manager is handling	Check that the job contact string matches one returned from a job request.
157	proxy delegation failed	Check that the job manager service node trusts the signer of your credential. Check that you trust the signer of the job manager service node's credential.
158	the job manager could not lock the state lock file	Check that the file system holding the job state directory supports POSIX advisory locking. Check that the job state directory is writable by the user on the service node. Check that the job state directory is not full.
159	an invalid globus_io_clientattr_t was used.	Check that you have initialized the <code>globus_io_clientattr_t</code> attribute prior to using it with the GRAM client API.
160	an null parameter was passed to the gram library	Check that you are passing legal values to all GRAM API calls.
161	the job manager is still streaming output	OBSOLETE IN GRAM5
162	the authorization system denied the request	Check with your GRAM system administrator to allow a particular certificate to be authorized.
163	the authorization system reported a failure	Check with your system administrator to verify that the authorization system is configured properly.
164	the authorization system denied the request - invalid job id	Check with your system administrator to verify that the authorization system is configured properly. Use a credential which is authorized to interact with a particular GRAM job.
165	the authorization system denied the request - not authorized to run the specified executable	Check with your system administrator to verify that the authorization system is configured properly. Use a credential which is authorized to interact with a particular GRAM job.
166	the provided RSL 'user_name' parameter is invalid.	Check that the RSL <code>user_name</code> attribute evaluates to a string.
167	the job is not running in the account named by the 'user_name' parameter.	Ask with the GRAM system administrator to add an authorization entry to allow your credential to run jobs as the specified user account.

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# Glossary

## C

client A process that sends commands and receives responses. Note that in GridFTP, the client may or may not take part in the actual movement of data.

## P

proxy certificate A short lived certificate issued using a EEC. A proxy certificate typically has the same effective subject as the EEC that issued it and can thus be used in its place. GSI uses proxy certificates for single sign on and delegation of rights to other entities.

For more information about types of proxy certificates and their compatibility in different versions of GT, see <http://dev.globus.org/wiki/Security/ProxyCertTypes>.

## S

server A process that receives commands and sends responses to those commands. Since it is a server or service, and it receives commands, it must be listening on a port somewhere to receive the commands. Both FTP and GridFTP have IANA registered ports. For FTP it is port 21, for GridFTP it is port 2811. This is normally handled via inetd or xinetd on Unix variants. However, it is also possible to implement a daemon that listens on the specified port. This is described more fully in in the Architecture section of the GridFTP Developer's Guide.

## T

third party transfers In the simplest terms, a third party transfer moves a file between two GridFTP servers.

The following is a more detailed, programmatic description.

In a third party transfer, there are three entities involved. The client, who will only orchestrate, but not actually take place in the data transfer, and two servers one of which will be sending data to the other. This scenario is common in Grid applications where you may wish to stage data from a data store somewhere to a super-computer you have reserved. The commands are quite similar to the client/server transfer. However, now the client must establish two control channels, one to each server. He will then choose one to listen, and send it the PASV command. When it responds with the IP/port it is listening on, the client will send that IP/port as part of the PORT command to the other server. This will cause the second server to connect to the first server, rather than the client. To initiate the actual movement of the data, the client then sends the RETR "filename" command to the server that will read from disk and write to the network (the "sending" server) and will send the STOR "filename" command to the other server which will read from the network and write to the disk (the "receiving" server).

See Also [client/server transfer](#).

## U

user certificate

A EEC belonging to a user. When using GSI, this certificate is typically stored in `$HOME/.globus/usercert.pem`. For more information on possible user certificate locations, see [this](#).