Enhancing and Supporting GridFTP: An Essential Component of DOE High-speed Networking – (10/2011 – 9/2014)
PI: Steven Tuecke – Argonne National Laboratory

GridFTP is the de facto standard workhorse for large data movement in distributed science projects across DOE and worldwide

Project Goals:

- Leverage next-generation Terabit networks and multi-core processors
- Improve support for firewalls and NATs
- Simplify ease of use and administration
- Support DOE facilities and scientists

Current Accomplishments:

- 1 Petabyte transferred per day
- Security and firewall enhancements
- Native packaging and simple installer, dramatically reducing install time
- Improved mass storage system support
- Six releases since project start, with dozens of fixes and requested features

Impacts on DOE's Mission:

- Support DOE big data transfer needs of:
  - exascale computers: e.g., ALCF, OLCF
  - scientific facilities e.g., NERSC, APS
  - science projects, e.g., LHC, ESG
- Higgs discovery "only been possible because of the extraordinary achievements of … grid computing"—Rolf Heuer, CERN DG [July 2012]
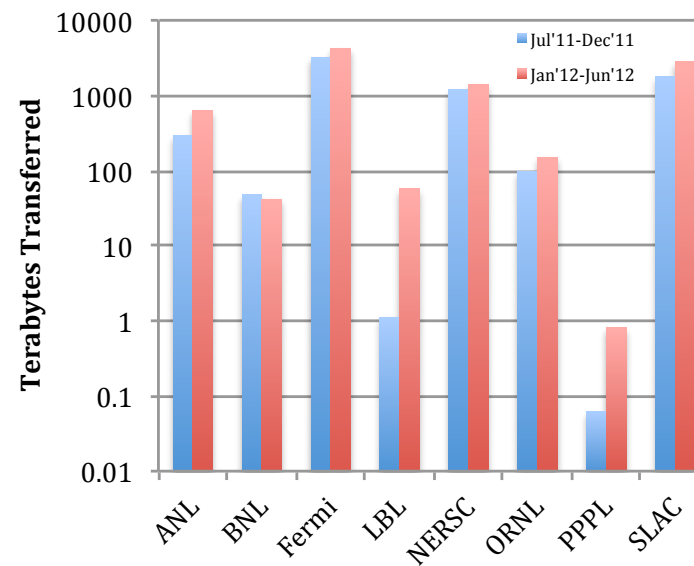
Enhancing and Supporting GridFTP: An Essential Component of DOE High-speed Networking

Steven Tuecke

Deputy Director, Computation Institute
Argonne National Laboratory and University of Chicago

Project Overview

- **Project title:**
  Enhancing and Supporting GridFTP:
  An Essential Component of DOE High-speed
  Networking

- **PI:** Steven Tuecke

- **Project start:** October 2011

- **Duration**: 3 years

- **Objectives:**
  – Enhancements to GridFTP protocol & Globus GridFTP
  – Support Globus GridFTP for DOE community

What is GridFTP?

- **Standard workhorse for large data movement in distributed science projects across DOE and worldwide**
  - February 2013: 3,761 GridFTP servers reported 382 million operations and 29.2 petabytes moved

- **GridFTP protocol extends FTP for:**
  - High-performance
  - Strong security
  - Reliability

- **Globus GridFTP server**
  - Mature, widely used implementation of GridFTP

DOE use cases driving GridFTP

- **Globus Online driving GridFTP transfers**
  - NERSC: Recommended method for transferring files to/from GPFS file systems and HPSS
  - ALCF: User remote file transfer to/from GPFS
  - Advanced Photon Source: Distributed instrument data to users worldwide
  - ESnet DTNs
  - Etc.
- **Science communities with custom clients**
  - E.g. HEP, ESG
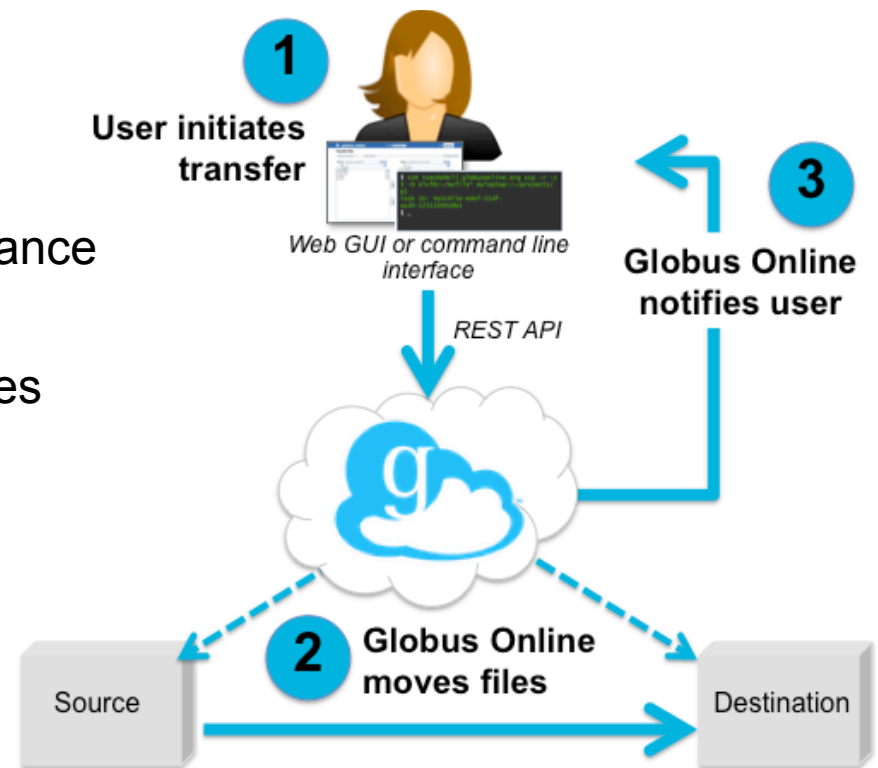
Globus Online

- **Move, sync, share files**
  - Easy "fire-and-forget" transfers
  - Share with any Globus user or group
  - Automatic fault recovery & high performance
  - Across multiple security domains
  - Web, command line, and REST interfaces

- **Minimize IT costs**
  - Software as a Service (SaaS)
    - No client software installation
    - New features automatically available
  - Consolidated support & troubleshooting
  - Simple endpoint installation with Globus Connect and GridFTP

- **>7,000 registered users, >12PB moved**

- **Recommended by ESnet, NERSC, ALCF, XSEDE, Blue Waters, NCAR, many Universities**

1 User initiates transfer
Web GUI or command line interface
REST API

3 Globus Online notifies user

2 Globus Online moves files
Source
Destination

Enhancing and Supporting GridFTP Project Objectives

- **Leverage next-generation Terabit networks and multi-core processors**
  - Support big data transfer needs of exascale computers and scientific instruments
  - Not just big files, but lots of small files (LOSF), and end-to-end checksum verification
- **Improve support for firewalls and NATs**
- **Simplify ease of use and administration**
- **Support DOE facilities and scientists**

Proposed Work

- **Performance improvements**
  - Parallel command execution (checksums and LOSF)
  - Enable multiplexed transfers
  - Efficient recursive directory transfers

- **New firewall friendly data channel mode(s)**
  - Fix mode E connection directionality limitation
  - Single port GridFTP; no ephemeral ports
  - TCP simultaneous open, UDP with NAT traversal

- **Simplify installation and configuration**
- **Native Windows implementation**
- **Better UDT support**

www.globustoolkit.org

Highlights during last year

- **Performance study of multi-threaded, secure transfers**
  - Gayane Vardoyan, Rajkumar Kettimuthu, Michael Link, Steven Tuecke, "Characterizing Throughput Bottlenecks for Secure GridFTP Transfers", *Proceedings of the International Conference on Computing, Networking and Communications*, January 2013.

- **Fixed various multi-threading bugs**

- **Prototype of single-port GridFTP server**

- **Alpha of UDT over UDP with NAT traversal with STUN & ICE**

- **Beta sharing support (with Globus Online)**

- **HPSS 7 integration**

- **Hybrid independent/striped server configuration**

- **Allow clients to authenticate without delegating**

- **Configure IPv6 through environment variable**

- **3 releases supporting >15 OS distributions**

- **Dozens of bug fixes and small enhancements**

www.globustoolkit.org

UDT over UDP with NAT traversal

Source

SITE UPAS 0

200 tGpe prsJ1JkvZgn60w1PeCgYOX
1,2013266431,10.1.1.128,58646,host

    [foundation,priority,address,port,type]

    [HOST->"host"]

    [SERVER REFLEXIVE->"srflx"]

    [PEER REFLEXIVE->"prflx"]

    [RELAYED->"relay"]

SITE UPRT
fOW8 65yXCLBY4r/6/Y9mmYtMb/
1,2013266431,192.168.1.10,54003,host

200 OK

PORT 192.168.1.10,210,243

200 PORT Command successful.

[transfer as usual]

Destination

SITE UPAS 1

200 fOW8 65yXCLBY4r/6/Y9mmYtMb/
1,2013266431,192.168.1.10,54003,host

SITE UPRT

tGpe prsJ1JkvZgn60w1PeCgYOX
1,2013266431,10.1.1.128,58646,host

200 OK

PASV

227 Entering Passive Mode
(192.168.1.10,210,243)

[transfer as usual]

Plans for remainder of project

- **Release single-port GridFTP server**
- **Release UDT over UDP with NAT traversal**
- **Release sharing support**
- **OGF standards submissions for extensions**
- **Native, multi-user implementation on Windows**
- **Optimizations for lots of small files, checksum calculation, parallel file systems**
- **Continue simplifying installation, configuration, operations and update**
- **Explore TCP simultaneous open**
- **Continue supporting DOE users and facilities**