Introduction to Globus.org

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July 2010

Outline

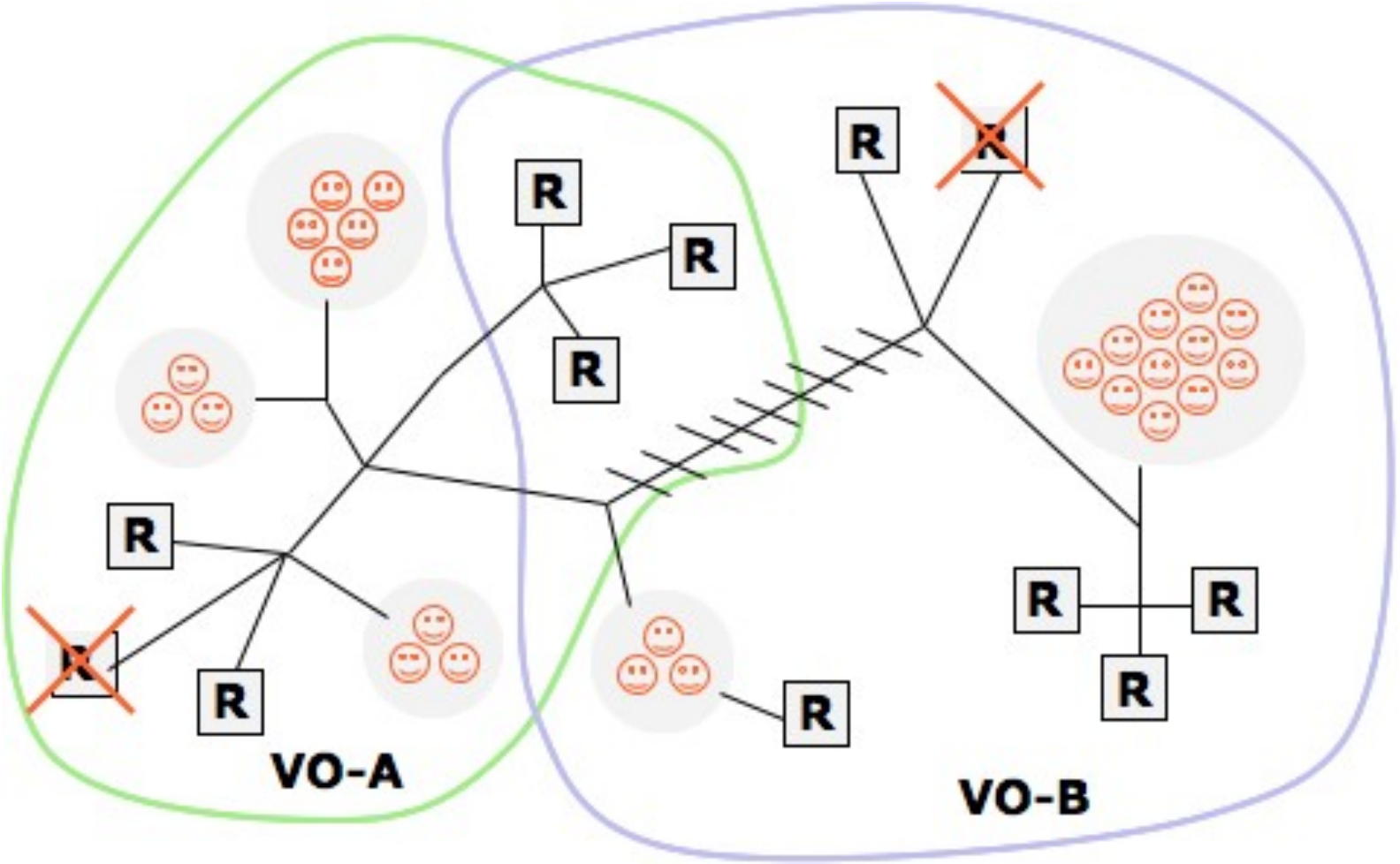
- **Key problems and requirements**
- The Globus.org approach
- Wrap-up

Problems & Requirements Topics

- Problem explanation
- Requirements summary
- Real world examples

Problem #1:
Facilitate cross-administrative domain interactions while at the same time protecting local autonomy

Facilitate The Work Of Virtual Organizations



Support Heterogeneity and Local Control

- Local sites have their own
  - User policies
  - Authorization mechanisms
  - Data privacy policies
  - Hardware
  - Software stacks
  - Service and network configurations
- The sites should be able to share their resources without losing control over them

Key Requirements

- Globus.org should strive to be compatible with the resource owner's preferred software stack
  - Support existing security mechanisms
  - Avoid imposing new software requirements

Real World Examples

- Site-specific security requirements
  - Many resource owners, such as OLCF, require the use of a one-time password security token to access their resources
- Site-specific software stack controls
  - Many resource owners, such as GFDL, do not allow end-users to run 3rd-party applications on their transfer nodes

Problem #2:
Most users lack the time and inclination to become experts in distributed computing technology

Overview of Reported User Goals

Perspectives on Distributed Computing User Interviews

http://www.mcs.anl.gov/~childers/perspectives/

Key Requirements

- Implement familiar user interfaces
  - Technology interactions should require no special expertise
- Minimize end-user software installation requirements
- Ease the infrastructure providers' support burden

Real World Examples: Science Goals

- To provide theoretical underpinnings for observations from instruments such as the Hubble space telescope and the James Webb space telescope
- To understand the interactions of quarks and gluons and apply that understanding to the discovery of new, fundamental parameters of elementary particles
- To identify contamination sources in water distribution environments

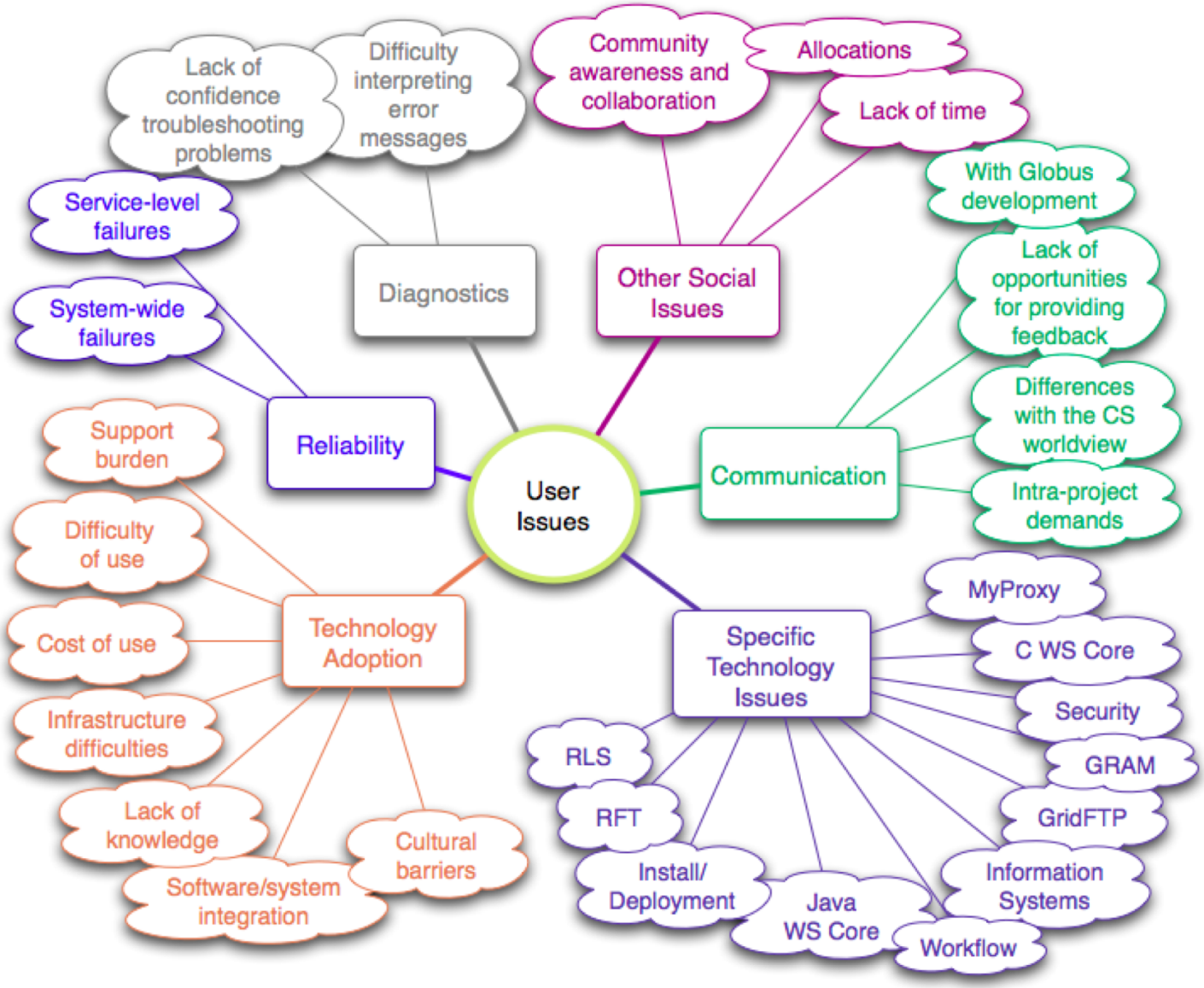
Real World Examples: Infrastructure Provider Goals

- To provide stable computing facilities for people to do cutting-edge science
- To bring new users to the system
- To add redundancy so the system has no single point of failure
- To share resources that would otherwise not be available to ordinary researchers. They don't have to buy their own equipment; they can get their research done even if they don't have lots of money

Problem #3:
Both end-users and infrastructure providers struggle mightily with wide-area technology failures

Overview of Reported User Issues

Perspectives on Distributed Computing User Interviews



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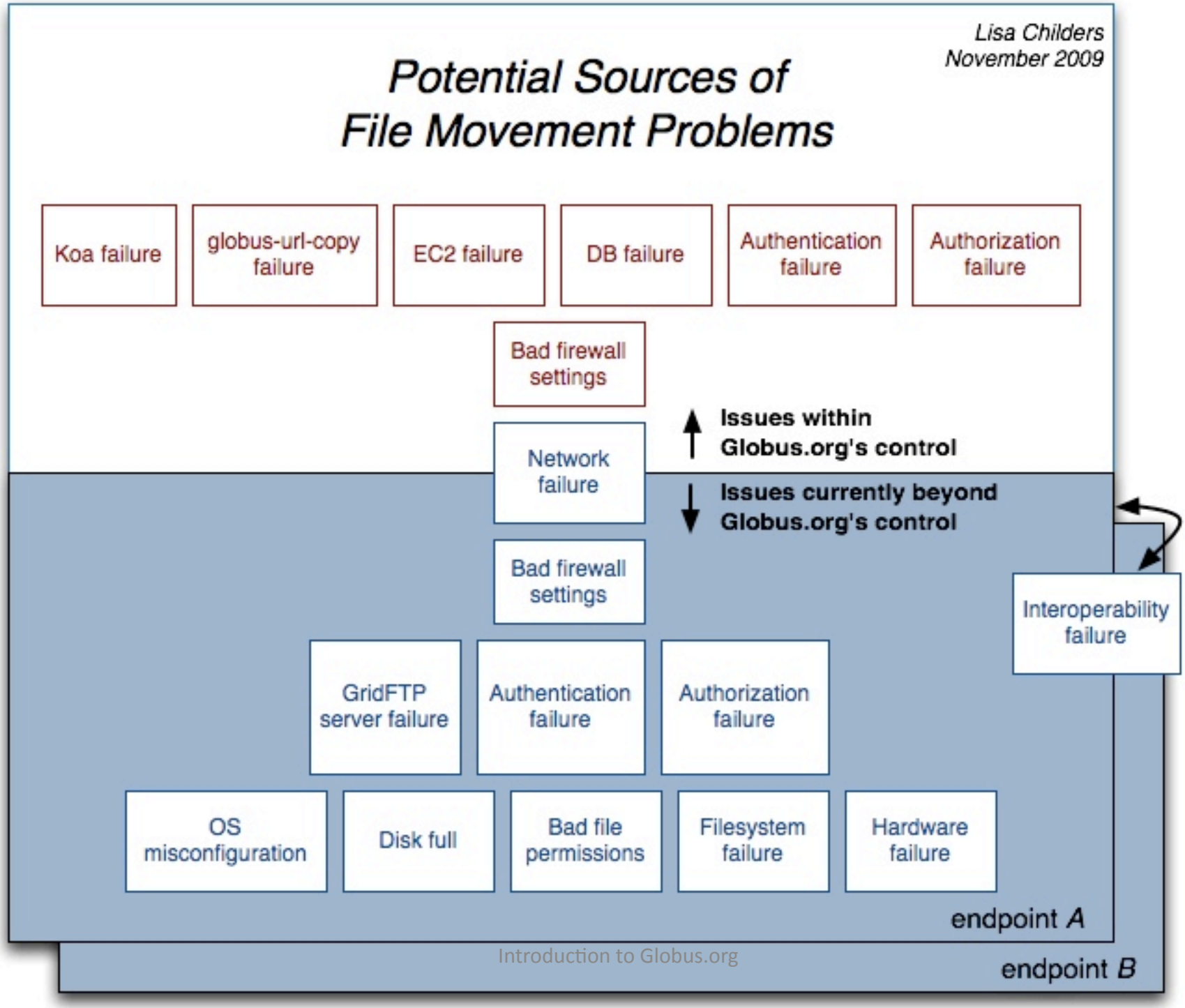

Lisa Childers
November 2009
Potential Sources of File Movement Problems
Koa failure
globus-url-copy failure
EC2 failure
DB failure
Authentication failure
Authorization failure
Bad firewall settings
Issues within Globus.org's control
Network failure
Issues currently beyond Globus.org's control
Bad firewall settings
Interoperability failure
GridFTP server failure
Authentication failure
Authorization failure
OS misconfiguration
Disk full
Bad file permissions
Filesystem failure
Hardware failure
endpoint A
endpoint B

Key Requirements

- Manage an increasing number of technology failures on behalf of the user
- Provide users and resource owners with enough information (in words they can understand) to efficiently resolve problems
- Send notifications of interesting events
  - Now: send an email when a transfer completes
  - Some day: Give end-users and resource providers a heads-up about potential problems

Real World Examples

Errors recorded by Globus.org during the 3rd CEDPS data challenge:

Unable to open destination file: permission denied
Failure to establish a secure connection
Stale NFS file handle on the source filesystem
Disk quota exceeded
Expired host certificate on the destination endpoint
SSLv3 handshake problems
GSSAPI authentication error
The transfer timed out

Problem #4:
More Data Is Coming

Anticipated ALCF Bandwidth Requirements *

- 0-2 years: 10s of TB/day
- 2-5 years: 100s of TB/day
- 5+ years: PBs/day

* Office of Advanced Scientific Computing Research Network Requirements Workshop, April 15-16, 2009

Near-Term Requirements

- Meet the upcoming CEDPS challenges
  - Just recently met a 100k file, 200MB challenge
  - Start moving 40TB/day of GFDL data next year, eventually supporting 80TB/day

Real World Examples

Outline

- Key problems and requirements
- **The Globus.org approach**
- Wrap-up

The Globus.org Approach
Topics

- Design overview
- Feature highlights
  - Command-line interface
  - Deadline model
  - Attempts
  - Fair use

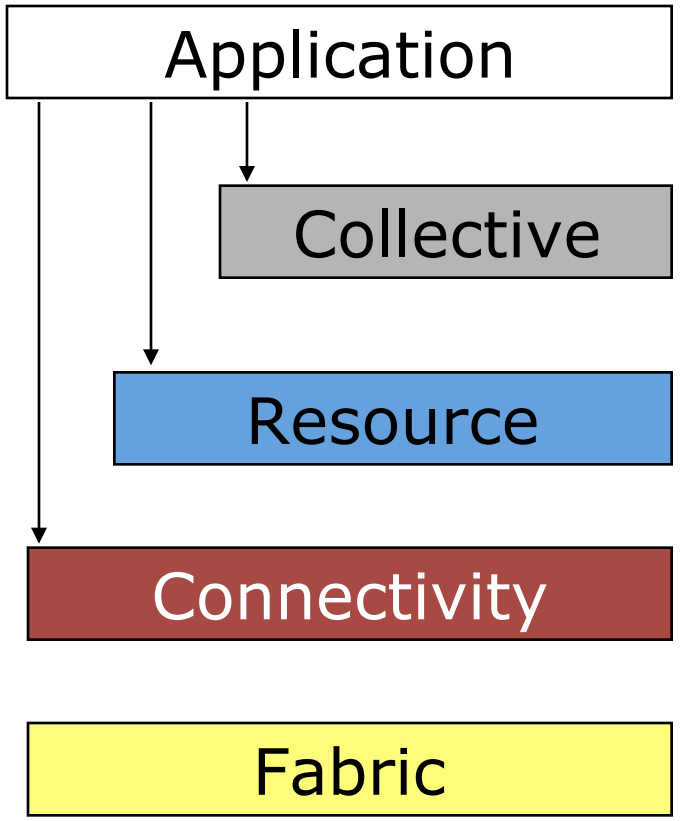
Grid Architecture

"Coordinating multiple resources": ubiquitous infrastructure services, app-specific distributed services

"Sharing single resources": negotiating access, controlling use

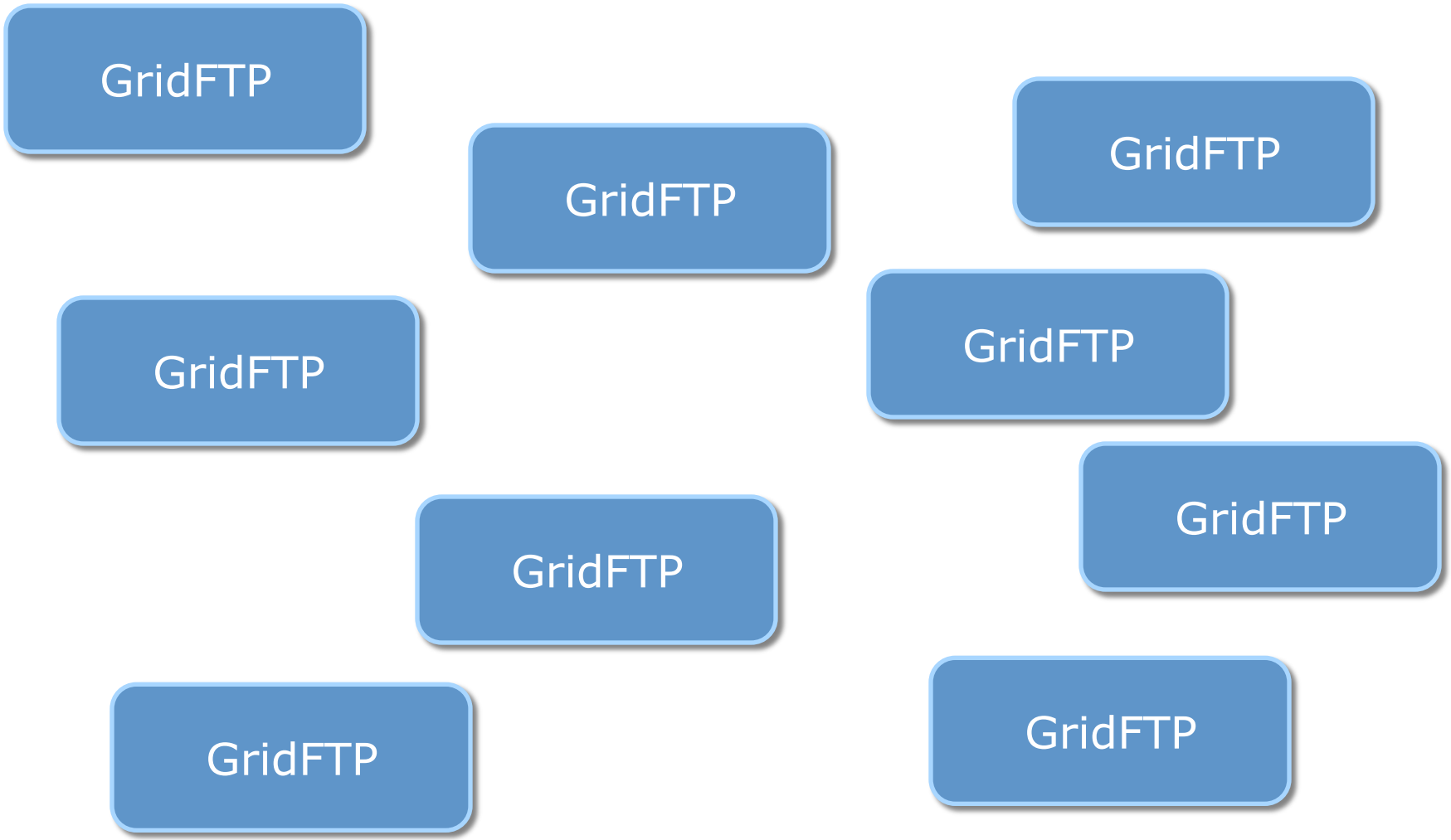
"Talking to things": communication (Internet protocols) and security

"Controlling things locally": Access to, and control of resources

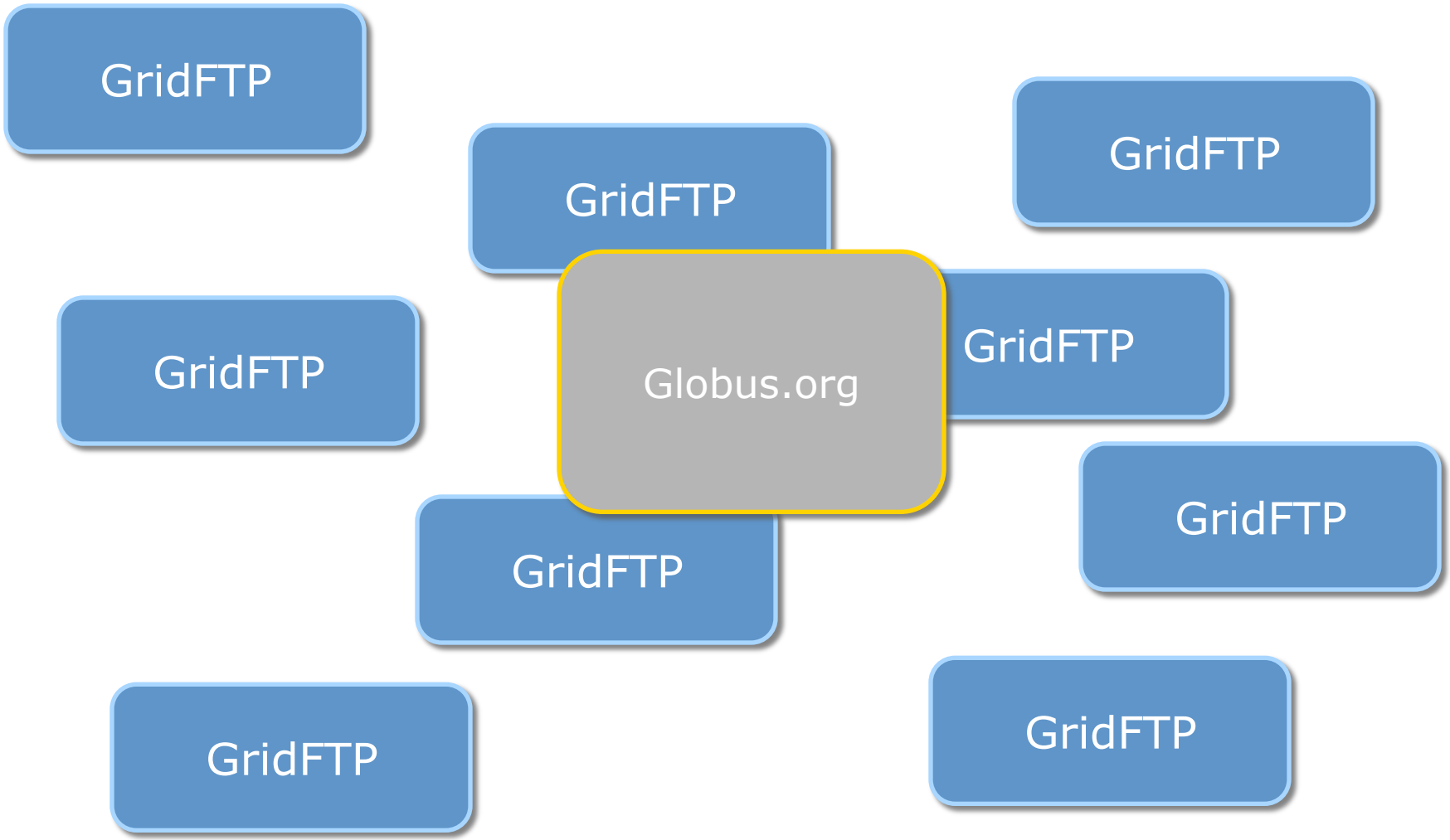


"The Anatomy of the Grid: Enabling Scalable Virtual Organizations", Foster, Kesselman, Tuecke, Intl Journal of High Performance Computing Applications, 15(3), 2001.

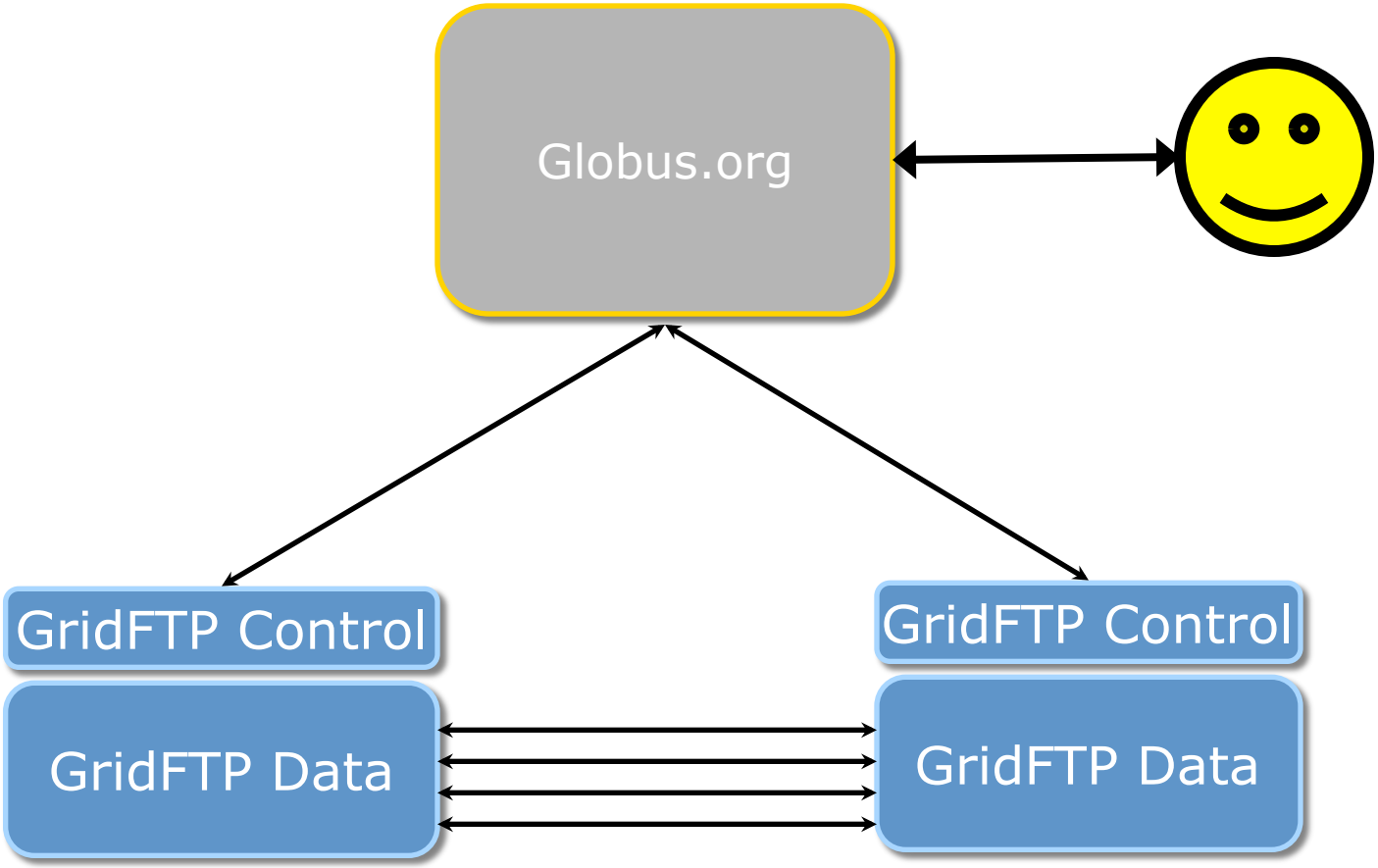
Distributed Data Nodes At The Resource Layer



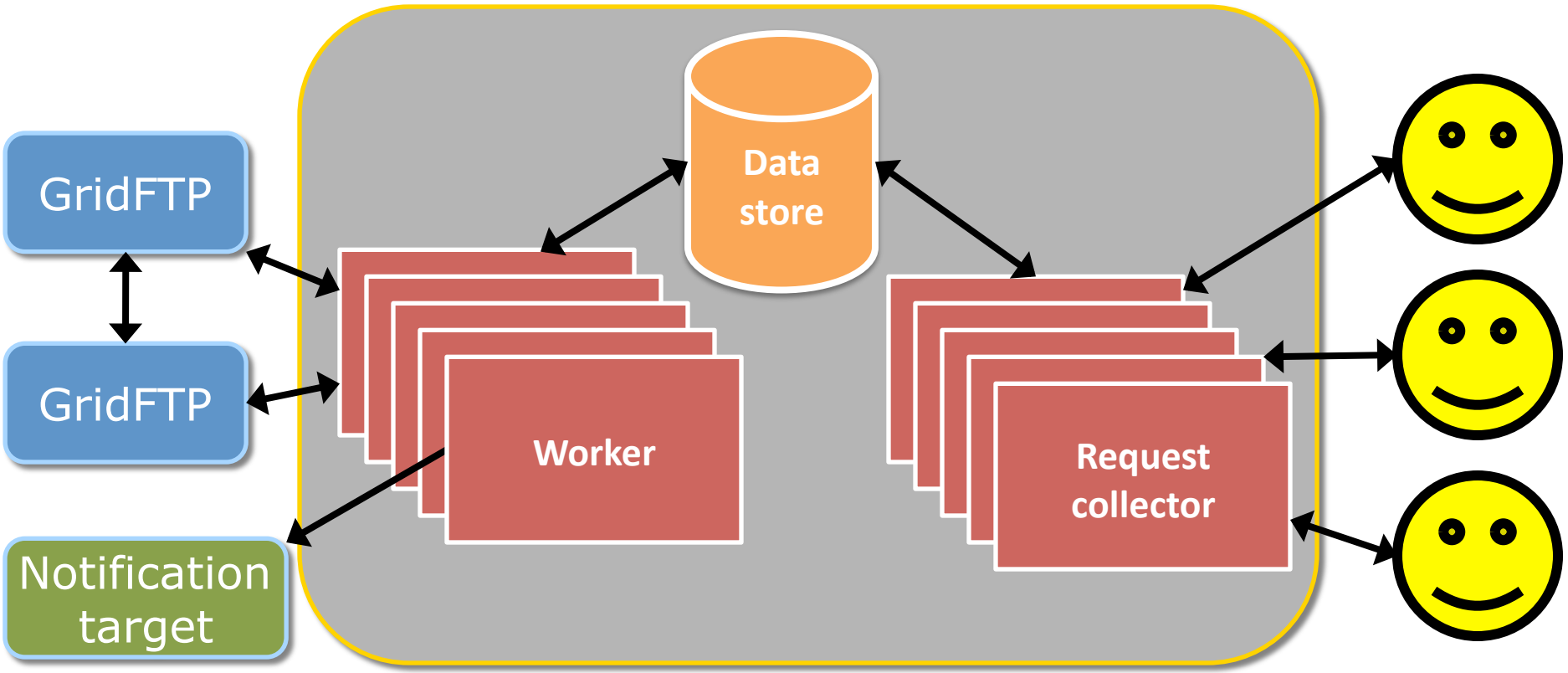
Globus.org Operates At The Collective Layer



Globus.org Manages 3rd-Party Transfers



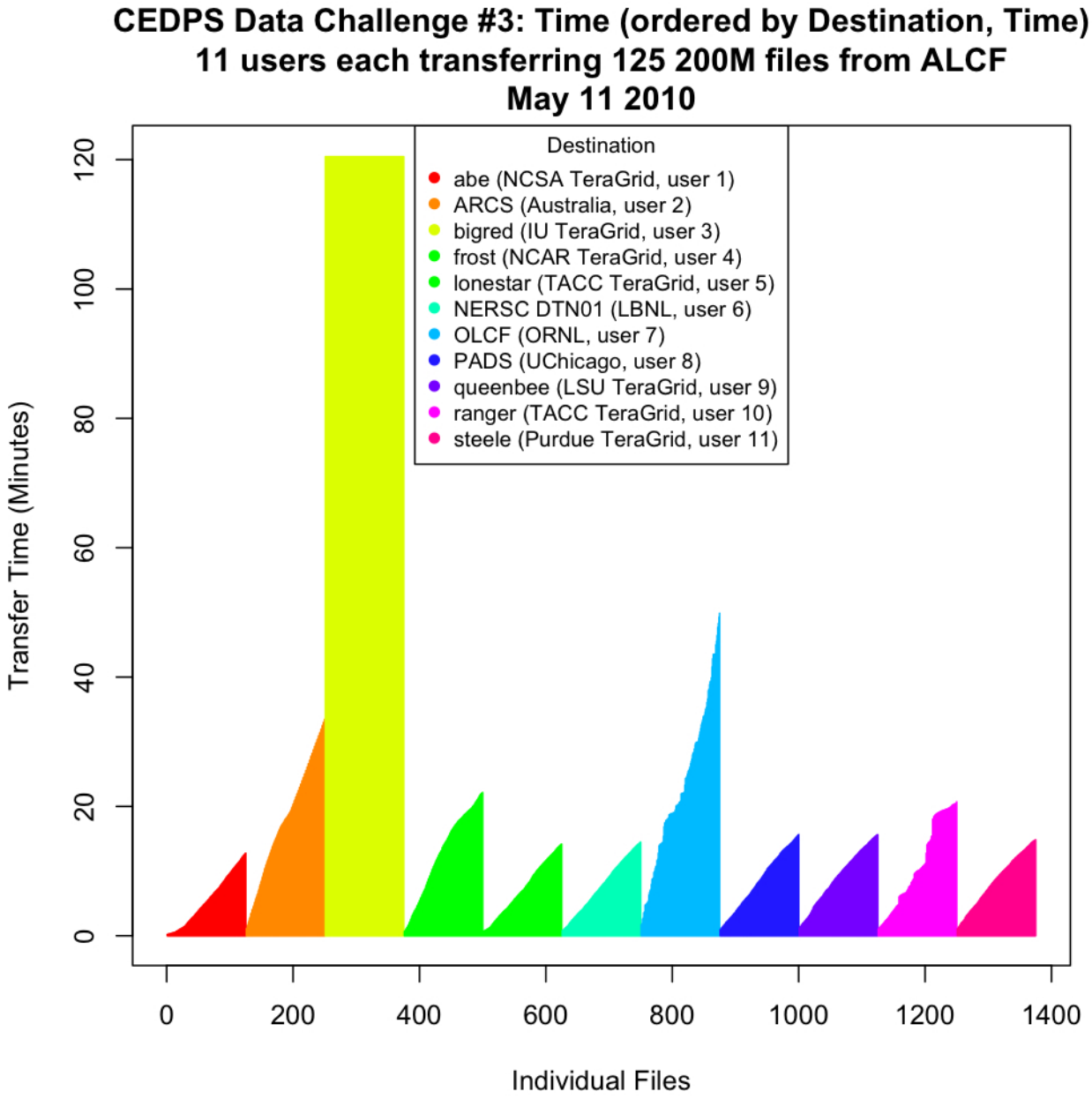
A Peek Inside Globus.org

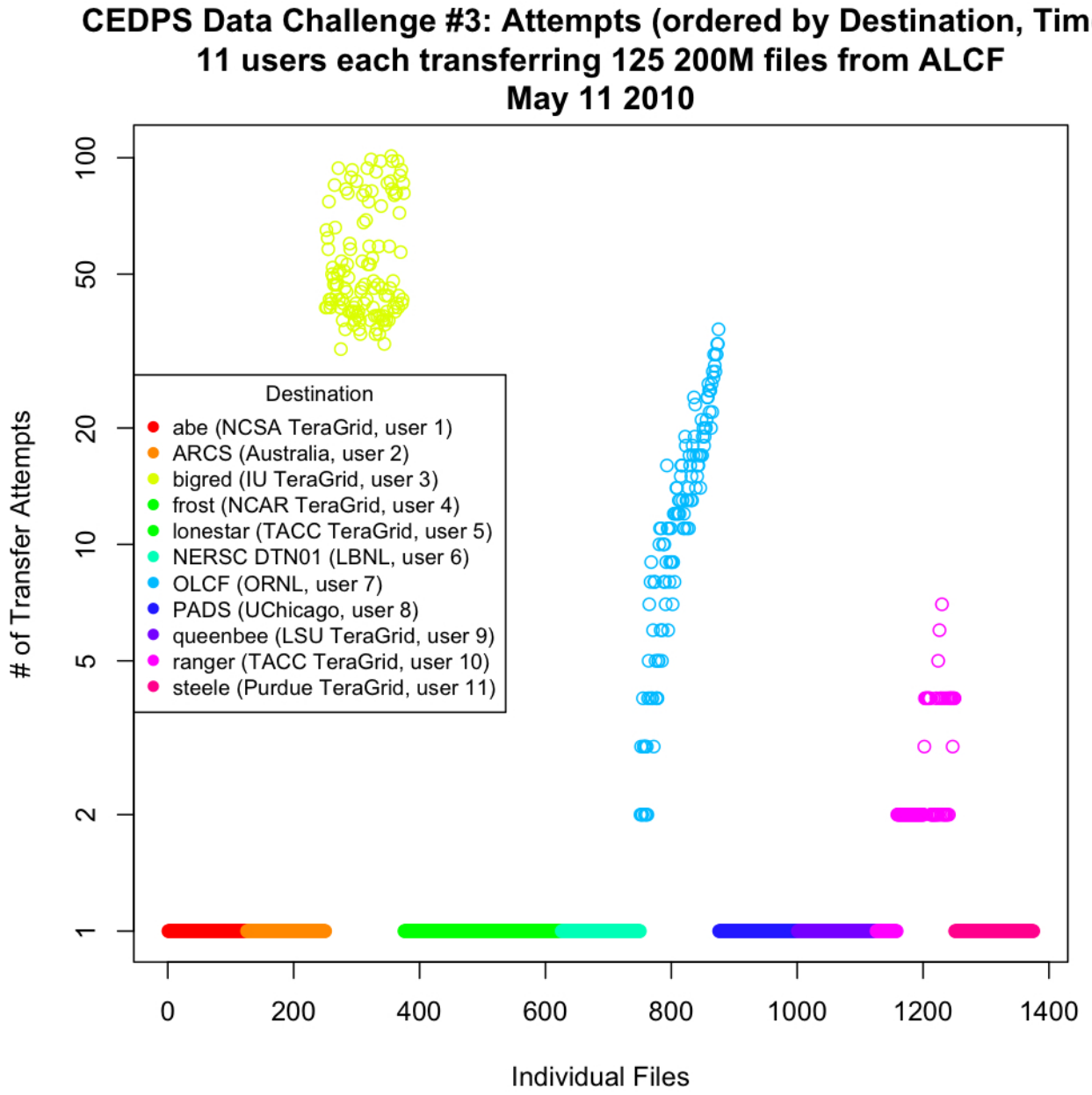


Command-Line Interface

Welcome to globus.org. You may run any of the following commands:

passwd
manage-endpoint
list-endpoints
activate
xfer
cancel
summary
status
event-logs
help


CEDPS Data Challenge #3: Time (ordered by Destination, Time)
11 users each transferring 125 200M files from ALCF
May 11 2010
Destination
abe (NCSA TeraGrid, user 1)
ARCS (Australia, user 2)
bigred (IU TeraGrid, user 3)
frost (NCAR TeraGrid, user 4)
lonestar (TACC TeraGrid, user 5)
NERSC DTN01 (LBNL, user 6)
OLCF (ORNL, user 7)
PADS (UChicago, user 8)
queenbee (LSU TeraGrid, user 9)
ranger (TACC TeraGrid, user 10)
steele (Purdue TeraGrid, user 11)
Transfer Time (Minutes)
0
20
40
60
80
100
120
0
200
400
600
800
1000
1200
1400
Individual Files


CEDPS Data Challenge #3: Attempts (ordered by Destination, Time)
11 users each transferring 125 200M files from ALCF
May 11 2010
# of Transfer Attempts
1
2
5
10
20
50
100
0
200
400
600
800
1000
1200
1400
Individual Files
Destination
abe (NCSA TeraGrid, user 1)
ARCS (Australia, user 2)
bigred (IU TeraGrid, user 3)
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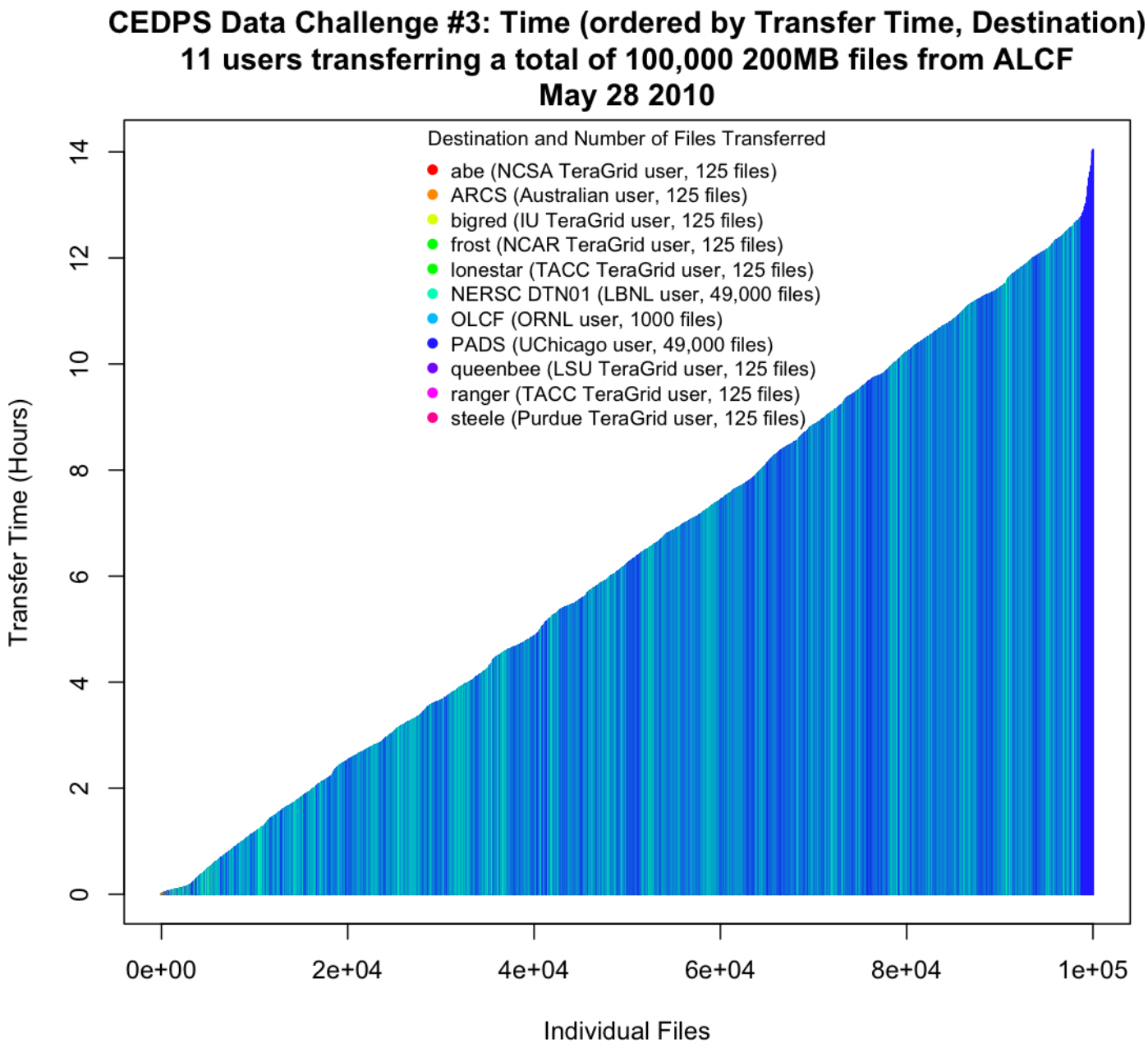
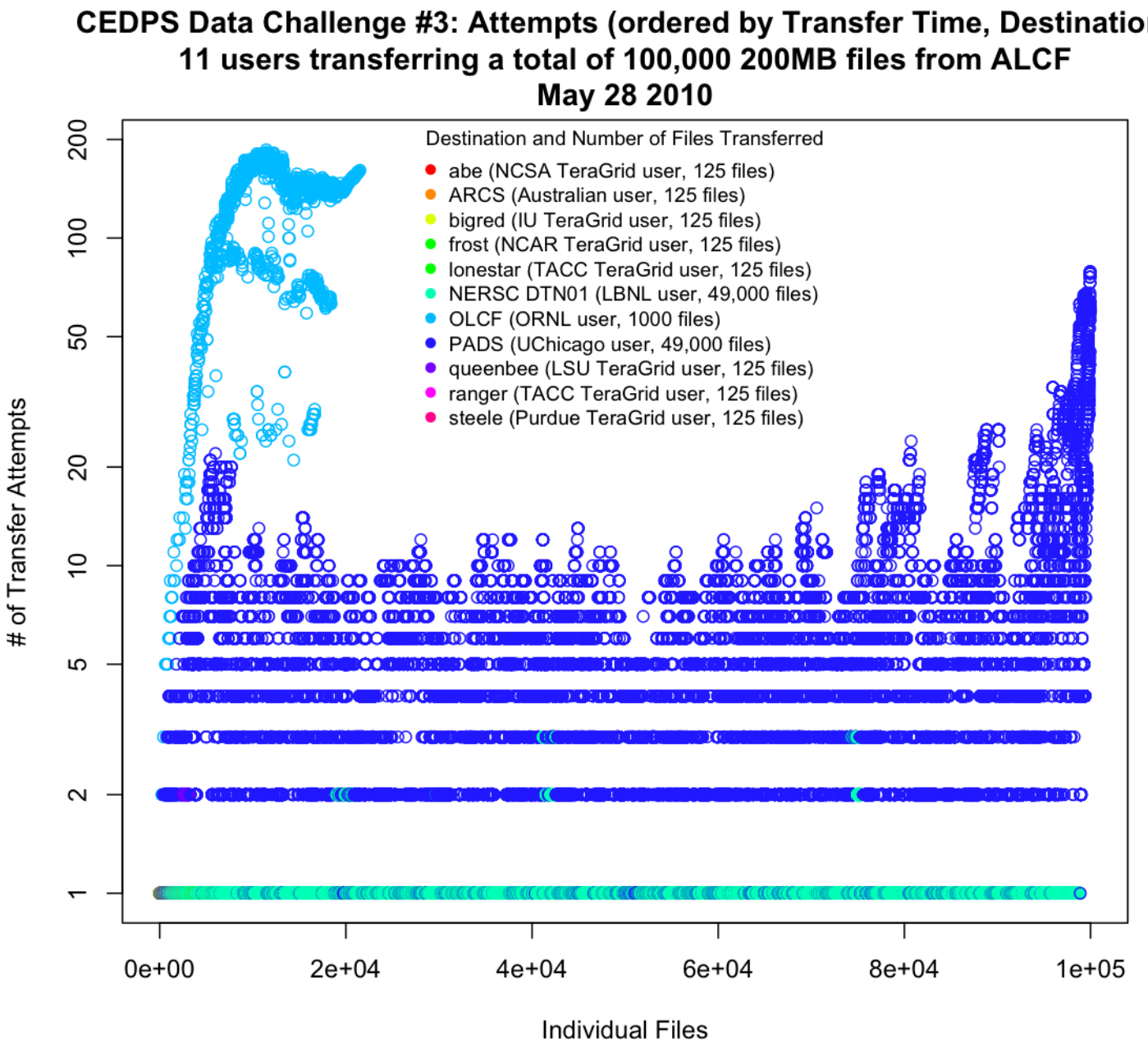

CEDPS Data Challenge #3: Time (ordered by Transfer Time, Destination)
11 users transferring a total of 100,000 200MB files from ALCF
May 28 2010
Destination and Number of Files Transferred
abe (NCSA TeraGrid user, 125 files)
ARCS (Australian user, 125 files)
bigred (IU TeraGrid user, 125 files)
frost (NCAR TeraGrid user, 125 files)
lonestar (TACC TeraGrid user, 125 files)
NERSC DTN01 (LBNL user, 49,000 files)
OLCF (ORNL user, 1000 files)
PADS (UChicago user, 49,000 files)
queenbee (LSU TeraGrid user, 125 files)
ranger (TACC TeraGrid user, 125 files)
steele (Purdue TeraGrid user, 125 files)
Transfer Time (Hours)
0
2
4
6
8
10
12
14
0e+00
2e+04
4e+04
6e+04
8e+04
1e+05
Individual Files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May 28 2010
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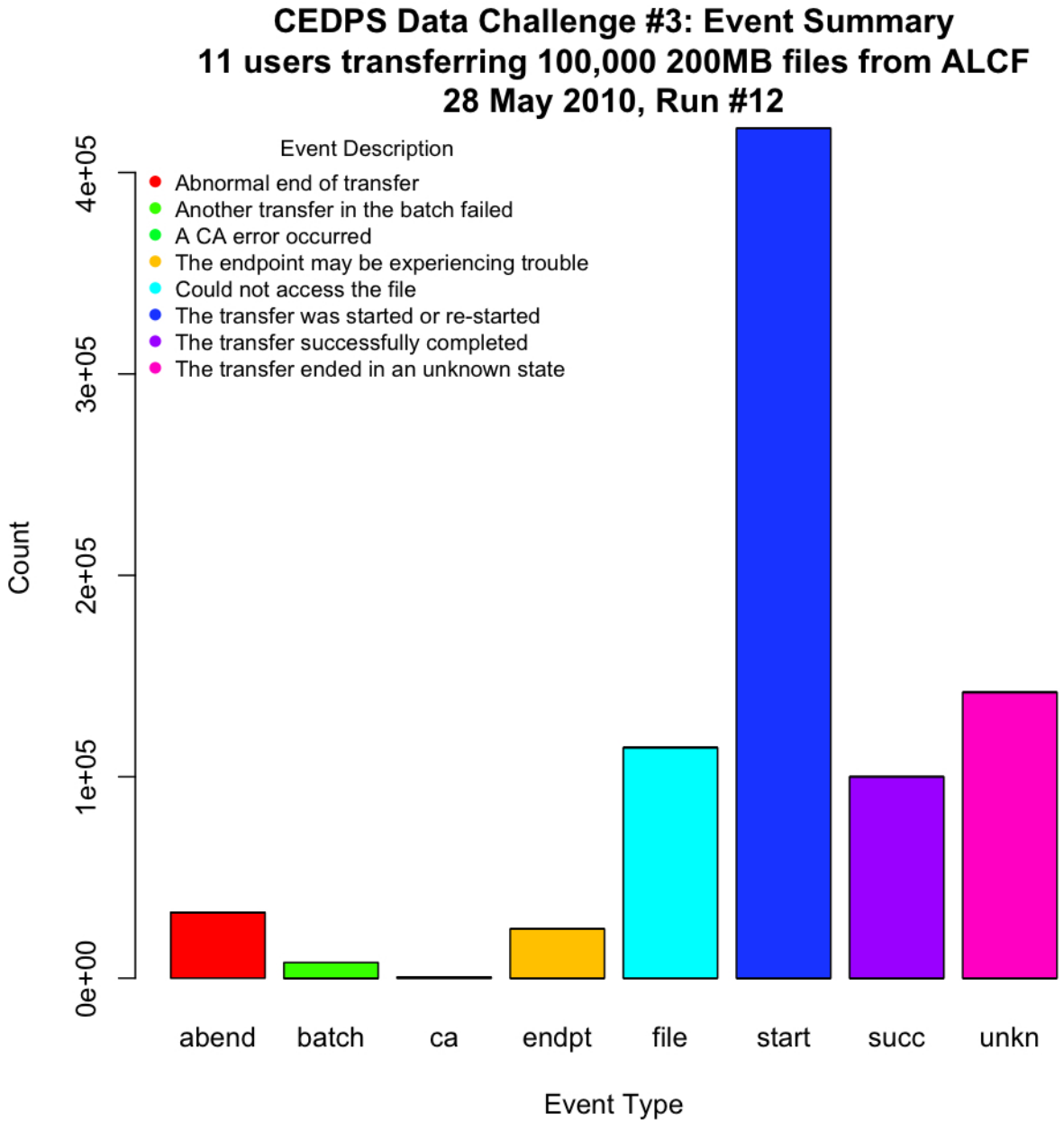
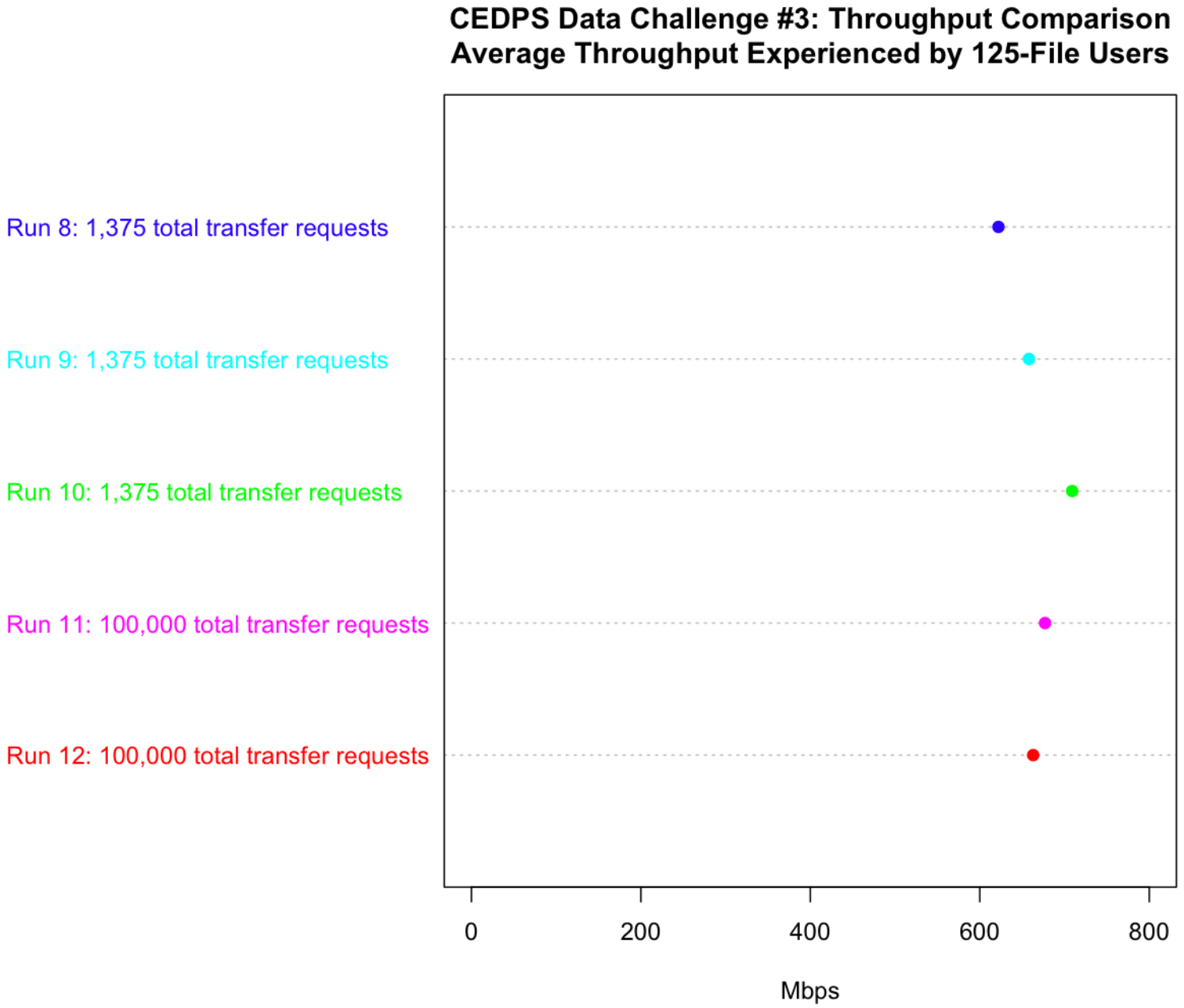
PADS (UChicago user, 49,000 files)
queenbee (LSU TeraGrid user, 125 files)
ranger (TACC TeraGrid user, 125 files)
steele (Purdue TeraGrid user, 125 files)
# of Transfer Attempts
1
2
5
10
20
50
100
200
0e+00
2e+04
4e+04
6e+04
8e+04
1e+05
Individual Files


CEDPS Data Challenge #3: Event Summary
11 users transferring 100,000 200MB files from ALCF
28 May 2010, Run #12
Event Description
Abnormal end of transfer
Another transfer in the batch failed
A CA error occurred
The endpoint may be experiencing trouble
Could not access the file
The transfer was started or re-started
The transfer successfully completed
The transfer ended in an unknown state
Count
0e+00
1e+05
2e+05
3e+05
4e+05
abend
batch
ca
endpt
file
start
succ
unkn
Event Type


CEDPS Data Challenge #3: Throughput Comparison
Average Throughput Experienced by 125-File Users
Run 8: 1,375 total transfer requests
Run 9: 1,375 total transfer requests
Run 10: 1,375 total transfer requests
Run 11: 100,000 total transfer requests
Run 12: 100,000 total transfer requests
0
200
400
600
800
Mbps

Outline

- Key problems and requirements
- The Globus.org approach
- **Wrap-up**

What is Globus.org?

- The latest iteration of Globus software
  - The same Globus vision, but an updated approach
- Hosted services
  - Data movement initially
  - Execution , information, and VO services to follow
- The Globus Toolkit isn't going away
  - Contains tools and services for resource owners
  - Compatible with Globus.org hosted services

Key Goals

- Provide scientists with easy access to advanced computing resources
  - Familiar user interfaces
  - Technology interactions requiring no special expertise
  - No software to install
  - Support for well-known community and international resources
  - Ability to customize working environment
- Enable users to focus on domain-specific work
  - Manage technology failures
  - Notifications of interesting events
  - Provide users with enough information to resolve problems

For More Information

- Email
  - childers@mcs.anl.gov
  - support@globus.org
- Globus.org quickstart guide
  - www.mcs.anl.gov/~childers/quickstart/
- Globus.org marketing overview
  - www.globus.org/service/
- Hub-and-spoke data movement study
  - www.mcs.anl.gov/~childers/CDC3/
- User study
  - www.mcs.anl.gov/~childers/perspectives/
- Anatomy of the Grid
  - www.globus.org/alliance/publications/papers/anatomy.pdf

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