The globusworld TOUR

Building Research Data Management Solutions with the Globus Platform

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globus

Useful developer links

> github.com/globus

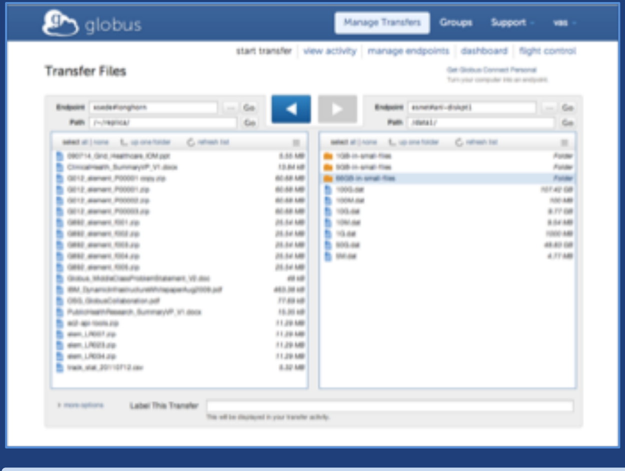
> docs.globus.org

Topics

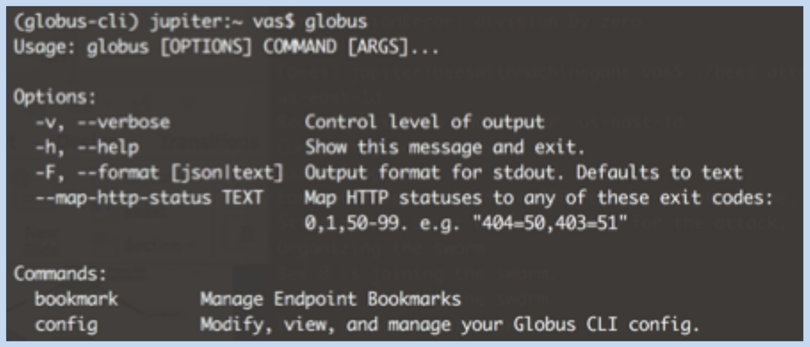
- Globus CLI and Platform Overview
- Globus Transfer and Globus Auth APIs
- Automating common data management tasks
- Integrating Globus into Science Gateways and Portals
- Open Discussion

How can I integrate Globus into my research workflows?

Use(r)-appropriate interfaces



Web App



```
(globus-cli) jupiter:~ vas$ globus
Usage: globus [OPTIONS] COMMAND [ARGS]...

Options:
  -v, --verbose              Control level of output
  -h, --help                 Show this message and exit.
  -F, --format [json|text]   Output format for stdout. Defaults to text
  --map-http-status TEXT     Map HTTP statuses to any of these exit codes:
                             0,1,50-99. e.g. "404=50,403=51"

Commands:
  bookmark        Manage Endpoint Bookmarks
  config          Modify, view, and manage your Globus CLI config.
```

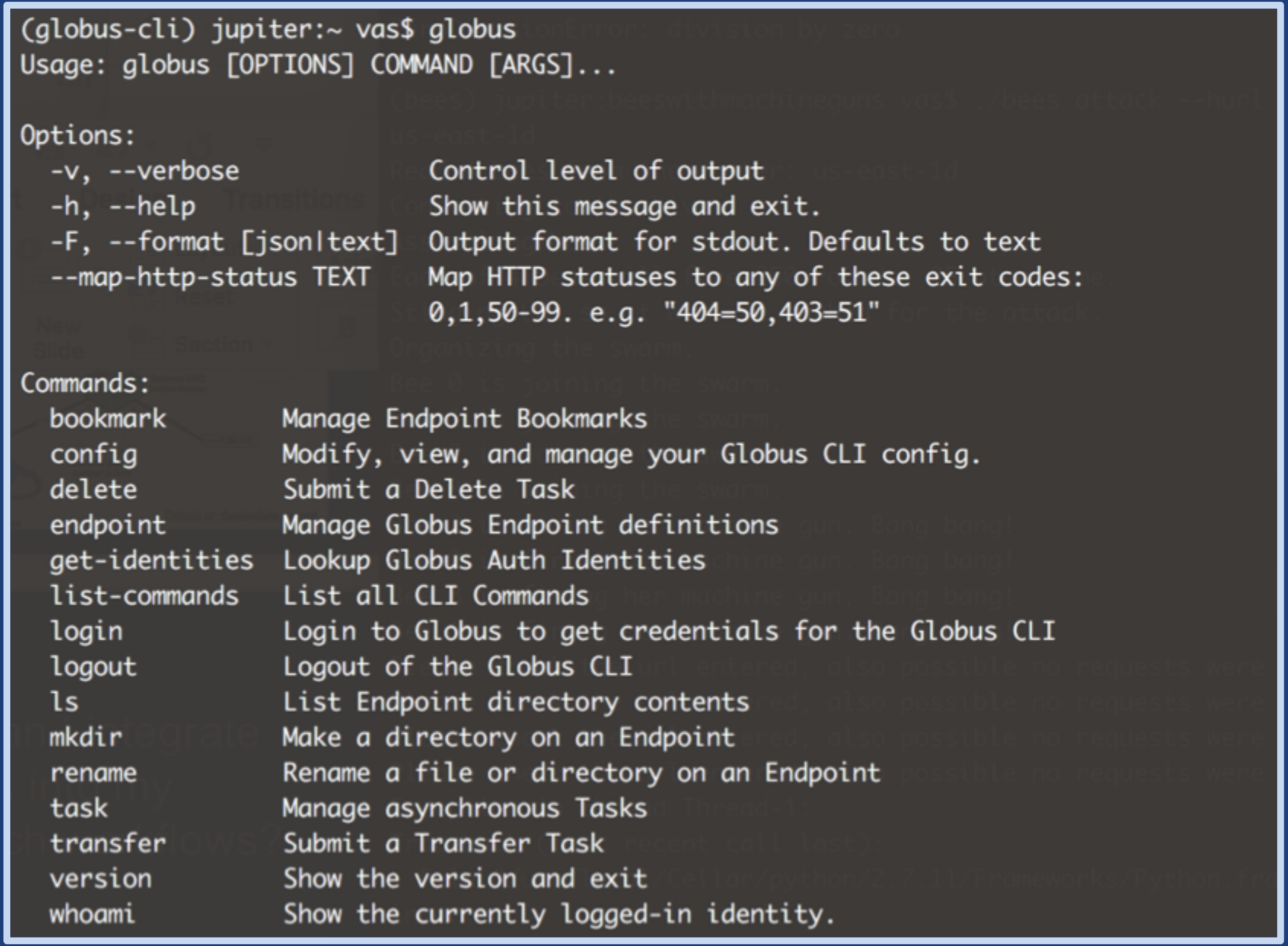
CLI

Globus service

```
GET /endpoint/go%23ep1
PUT /endpoint/vas#my_endpt
200 OK
X-Transfer-API-Version: 0.10
Content-Type: application/json
…
```

Rest API

Globus Command Line Interface



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  --map-http-status TEXT    Map HTTP statuses to any of these exit codes:
                            0,1,50-99. e.g. "404=50,403=51"

Commands:
  bookmark       Manage Endpoint Bookmarks
  config         Modify, view, and manage your Globus CLI config.
  delete         Submit a Delete Task
  endpoint       Manage Globus Endpoint definitions
  get-identities Lookup Globus Auth Identities
  list-commands  List all CLI Commands
  login          Login to Globus to get credentials for the Globus CLI
  logout         Logout of the Globus CLI
  ls             List Endpoint directory contents
  mkdir          Make a directory on an Endpoint
  rename         Rename a file or directory on an Endpoint
  task           Manage asynchronous Tasks
  transfer       Submit a Transfer Task
  version        Show the version and exit
  whoami         Show the currently logged-in identity.
```

Open source, uses Python SDK

docs.globus.org/cli

github.com/globus/globus-cli

Demonstration

Globus CLI

Install the Globus **Command Line Interface (CLI)**

(or access via user “globus” on EC2 instance)

docs.globus.org/cli/installation

Exercise: Transfer via the CLI

- **Join the Tutorial Users group**
- **Use the CLI to copy files in "/sometext/" on endpoint "Stanford Workshop" to "Globus Tutorial Endpoint 1"**
- **Later we will look at a more robust example:** `github.com/globus/automation-examples/blob/master/cli-sync.sh`

Solution: Transfer via the CLI

- **Get the source and destination endpoint IDs**

```
$ globus endpoint search "Stanford Workshop”

$ globus endpoint search "Globus Tutorial Endpoint 1"
```

- **Submit the transfer request**

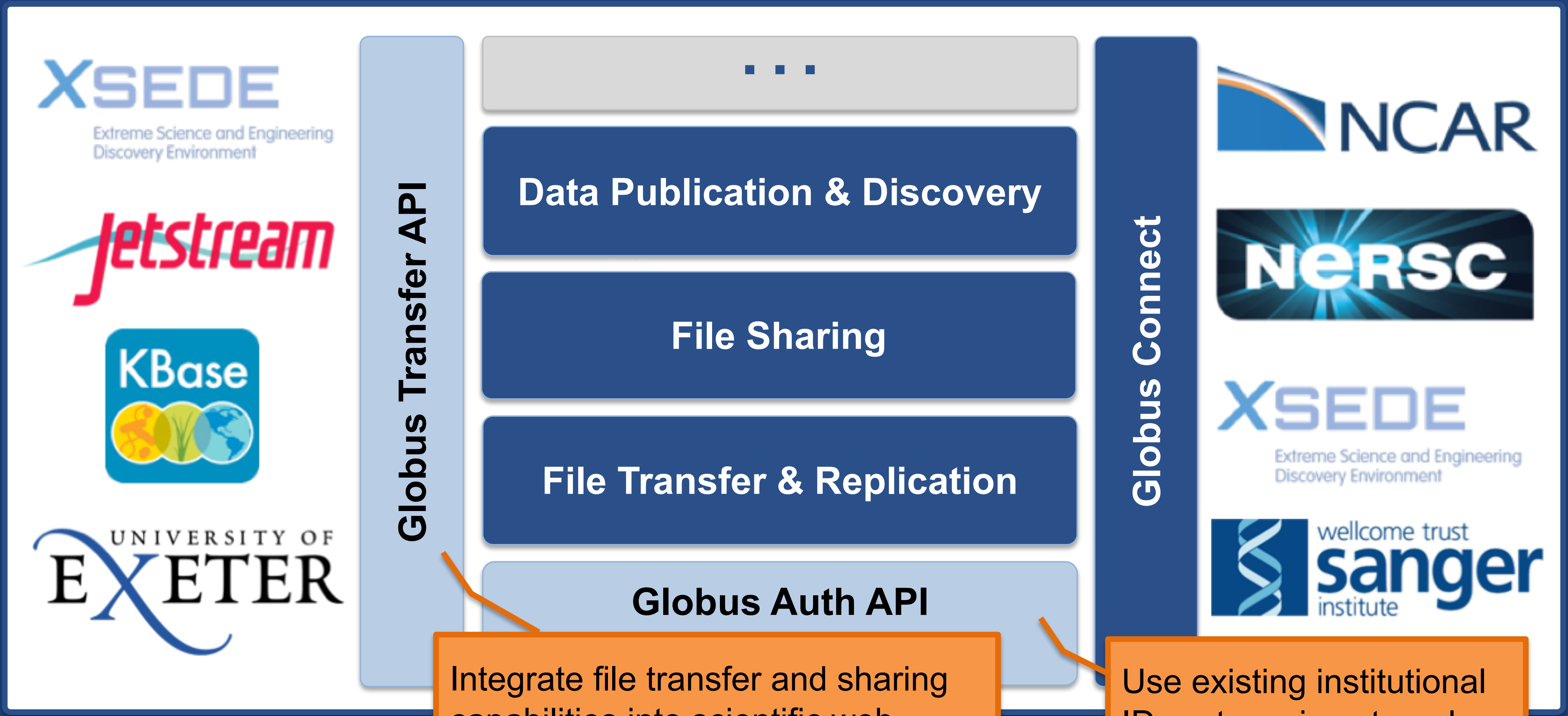
```
$ globus transfer --recursive
7026c6d4-0c84-11e8-a763-0a448319c2f8:/sometext/
ddb59aef-6d04-11e5-ba46-22000b92c6ec:/~/
```

How do I go beyond simple scripts?

Globus serves as…

A platform for building science gateways, portals and other web applications in support of research and education

Globus Platform-as-a-Service


XSEDE
Extreme Science and Engineering Discovery Environment
Jetstream
KBase
UNIVERSITY OF EXETER
Globus Transfer API
. . .
Data Publication & Discovery
File Sharing
File Transfer & Replication
Globus Auth API
Globus Connect
NCAR
NERSC
XSEDE
Extreme Science and Engineering Discovery Environment
wellcome trust sanger institute

Integrate file transfer and sharing capabilities into scientific web apps, portals, gateways, etc.

Use existing institutional ID systems in external web applications

Globus Platform

Transfer API

Globus Transfer API

- **Globus Web App consumes public Transfer API**
- **Globus APIs use JSON for documents and resource representations**
- **Resource named by URL (standard REST approach)**
  - – Query params allow refinement (e.g., subset of fields)
- **Requests authorized via OAuth2 access token**
  - – Authorization: Bearer asdflkqhafsdafeawk

docs.globus.org/api/transfer

Globus Python SDK

- **Python client library for the Globus Auth and Transfer REST APIs**
- `globus_sdk.TransferClient` **class handles connection management, security, framing, marshaling**

```
from globus_sdk import TransferClient
tc = TransferClient()
```

globus.github.io/globus-sdk-python

TransferClient low-level calls

- **Thin wrapper around REST API**
  - post(), get(), update(), delete()

```
get(path, params=None, headers=None, auth=None,
response_class=None)
```

  - path – path for the request, with or without leading slash
  - params – dict to be encoded as a query string
  - headers – dict of HTTP headers to add to the request
  - response_class – class response object, overrides the client's default_response_class
  - Returns: GlobusHTTPResponse object

Walkthrough
Jupyter Notebook

github.com/globus/globus-jupyter-notebooks

(install locally or run on EC2 instance)

Endpoint Search

- **Plain text search for endpoint**
  - Searches owner, display name, keywords, description, organization, department
  - Full word and prefix match
- **Limit search to pre-defined scopes**
  - `all, my-endpoints, recently-used, in-use, shared-by-me, shared-with-me`
- **Returns: List of endpoint documents**

Endpoint Management

- **Get endpoint (by id)**
- **Update endpoint**
- **Create & delete (shared) endpoints**
- **Manage endpoint servers**

Endpoint Activation

- **Activating endpoint means binding a credential to an endpoint for login**
- **Globus Connect Server endpoint that have MyProxy or MyProxy OAuth identity provider require login via web**
- **Auto-activate**
  - Globus Connect Personal and shared endpoints use Globus-provided credential
  - An endpoint that shares an identity provider with another activated endpoint will use credential
- **Must auto-activate before any API calls to endpoints**

File operations

- **List directory contents (ls)**
- **Make directory (mkdir)**
- **Rename**
- **Note:**
  - Path encoding & UTF gotchas
  - Don’t forget to auto-activate first

Task submission

- **Asynchronous operations**
  - Transfer
    - Sync level option
  - Delete
- **Get** `submission_id`**, followed by submit**
  - Once and only once submission

Task management

- Get task by id
- Get task_list
- Update task by id (label, deadline)
- Cancel task by id
- Get event list for task
- Get task pause info

Bookmarks

- **Get list of bookmarks**
- **Create bookmark**
- **Get bookmark by id**
- **Update bookmark**
- **Delete bookmark by id**

- **Cannot perform other operations directly on bookmarks**
  - Requires client-side resolution

Shared endpoint access rules (ACLs)

- **Access manager role required to manage permission/ACLs**
- **Operations:**
  - – Get list of access rules
  - – Get access rule by id
  - – Create access rule
  - – Update access rule
  - – Delete access rule

Management API

- **Allow endpoint administrators to monitor and manage all tasks with endpoint**
  - Task API is essentially the same as for users
  - Information limited to what they could see locally
- **Cancel tasks**
- **Pause rules**

Exercise: Transfer API - Data distribution

Modify Jupyter notebook to…

- Find the endpoint ID for the “Stanford Workshop” endpoint
- Bonus points: how many endpoints are associated with “Stanford“?
- Make a directory for your files: `/<your_globus_id>`
- Transfer some files to your directory
  - Get the ID of the “ESnet Read-Only Test DTN at Sunnyvale“ endpoint
  - Transfer the “/data1/5GB-in-small-files“ directory to your directory
- For overachievers: check if files were successfully transfered and delete them

Solution: Transfer API - Data distribution

- **Find ID for “Stanford Workshop” endpoint [29]***

```
r = tc.get("/endpoint_search",
      params=dict(filter_fulltext="Stanford Workshop", limit=1))
```

- **Make a directory for your files: /<your_globus_id> [36]**

```
endpoint_id = stanford_workshop_ep_id
endpoint_path = "/vas"
```

- **Transfer ESnet files to your directory [45]**

```
source_endpoint_id = "db57ddde-6d04-11e5-ba46-22000b92c6ec“
source_path = "/data1/5GB-in-small-files/“
dest_endpoint_id = stanford_workshop_ep_id
dest_path = "/vasv/5GB-in-small-files/“
```

* The number in brackets refers to the Jupyter notebook code block to be modified/extended

Solution: Transfer API - Data distribution

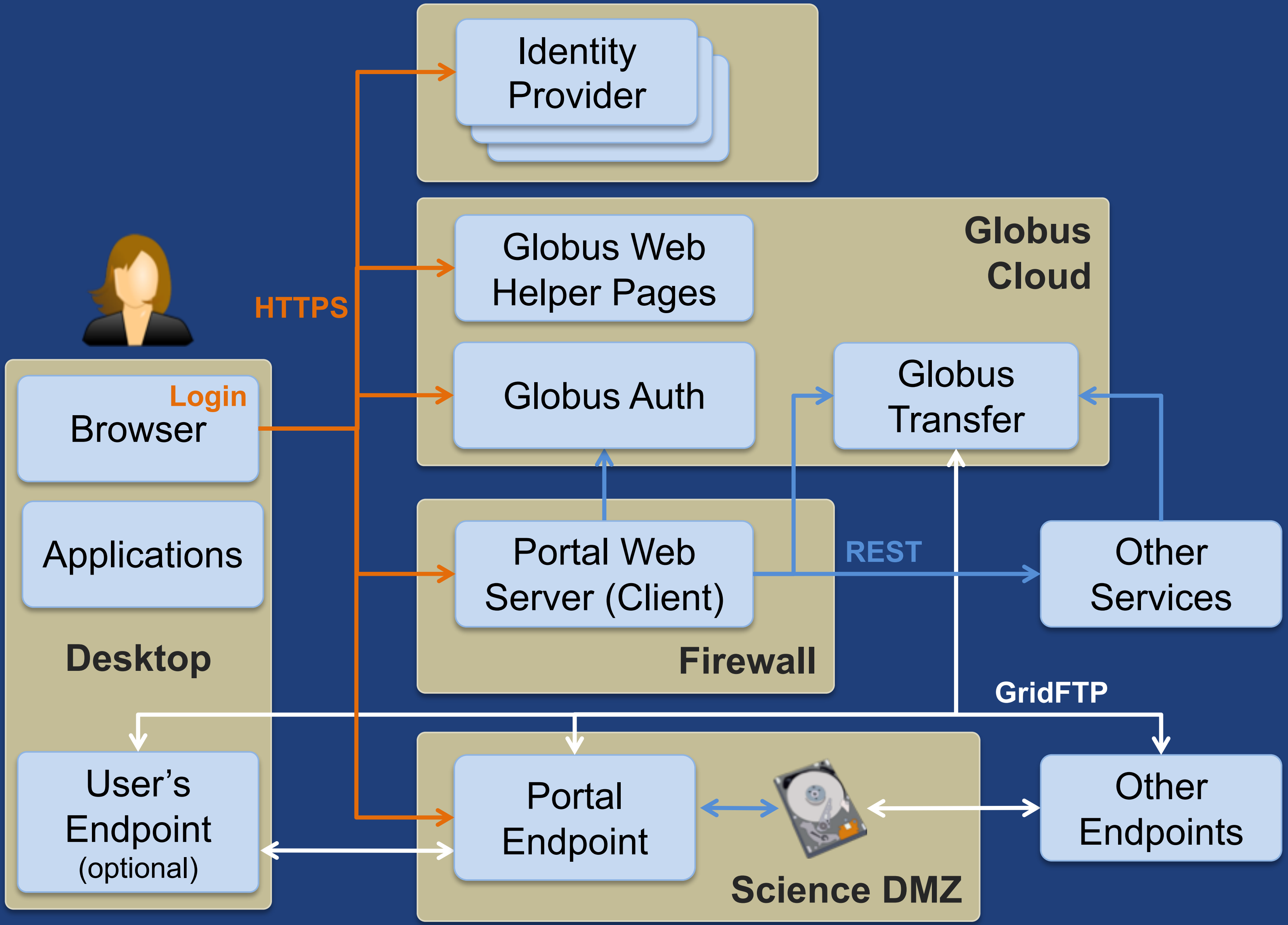
- **Check if successfully transfered and delete files [50]***

```
If status == "SUCCEEDED":
    source_endpoint_id = "db57ddde-6d04-11e5-ba46-22000b92c6ec"
    endpoint_id = stanford_wrokshop_ep_id
    path = "/vasv/5GB-in-small-files/"
    r = globus_sdk.DeleteData(tc, endpoint_id, recursive=True)
    ddata.add_item(path)
    tc.endpoint_autoactivate(endpoint_id)
    submit_result = tc.submit_delete(ddata)
    print("Task ID:", submit_result["task_id"])
```

* The number in brackets refers to the Jupyter notebook code block to be modified/extended

How can I do this in my [science gateway, data portal, web app, …]?

Prototypical research data portal

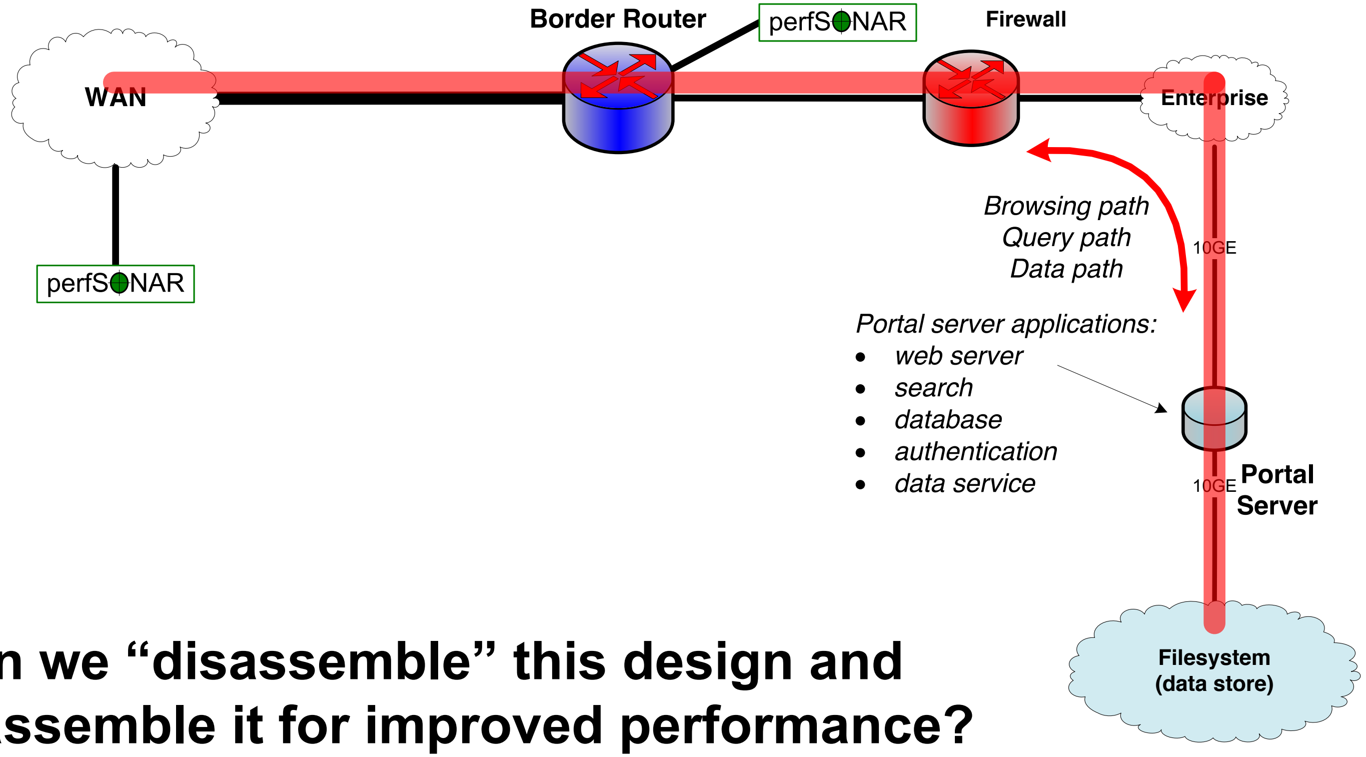


Demonstration

Modern Research Data Portal

Maximizing the value of the Science DMZ

Legacy data portal/science gateway design



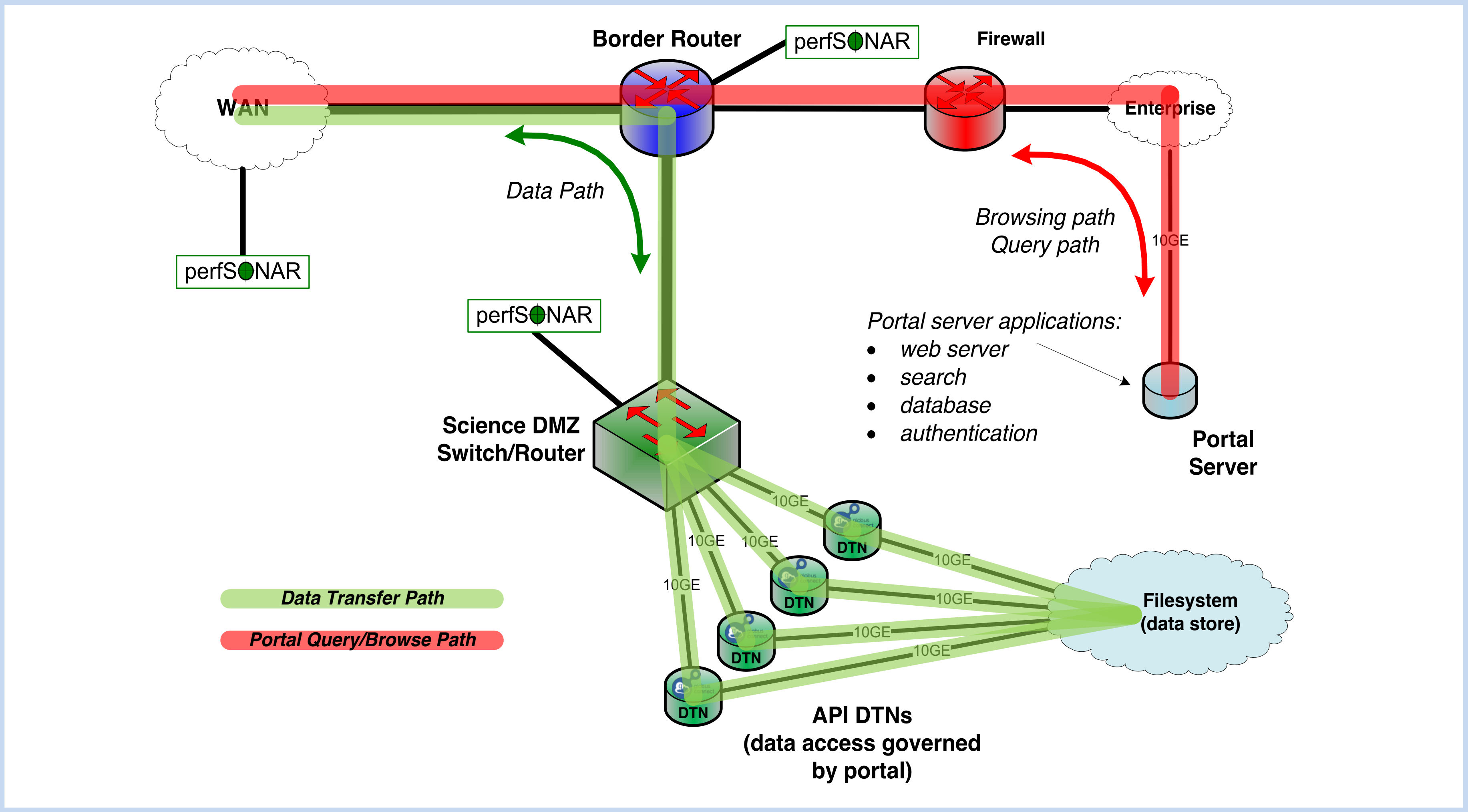
Browsing path
Query path
Data path

Portal server applications:

- *web server*
- *search*
- *database*
- *authentication*
- *data service*

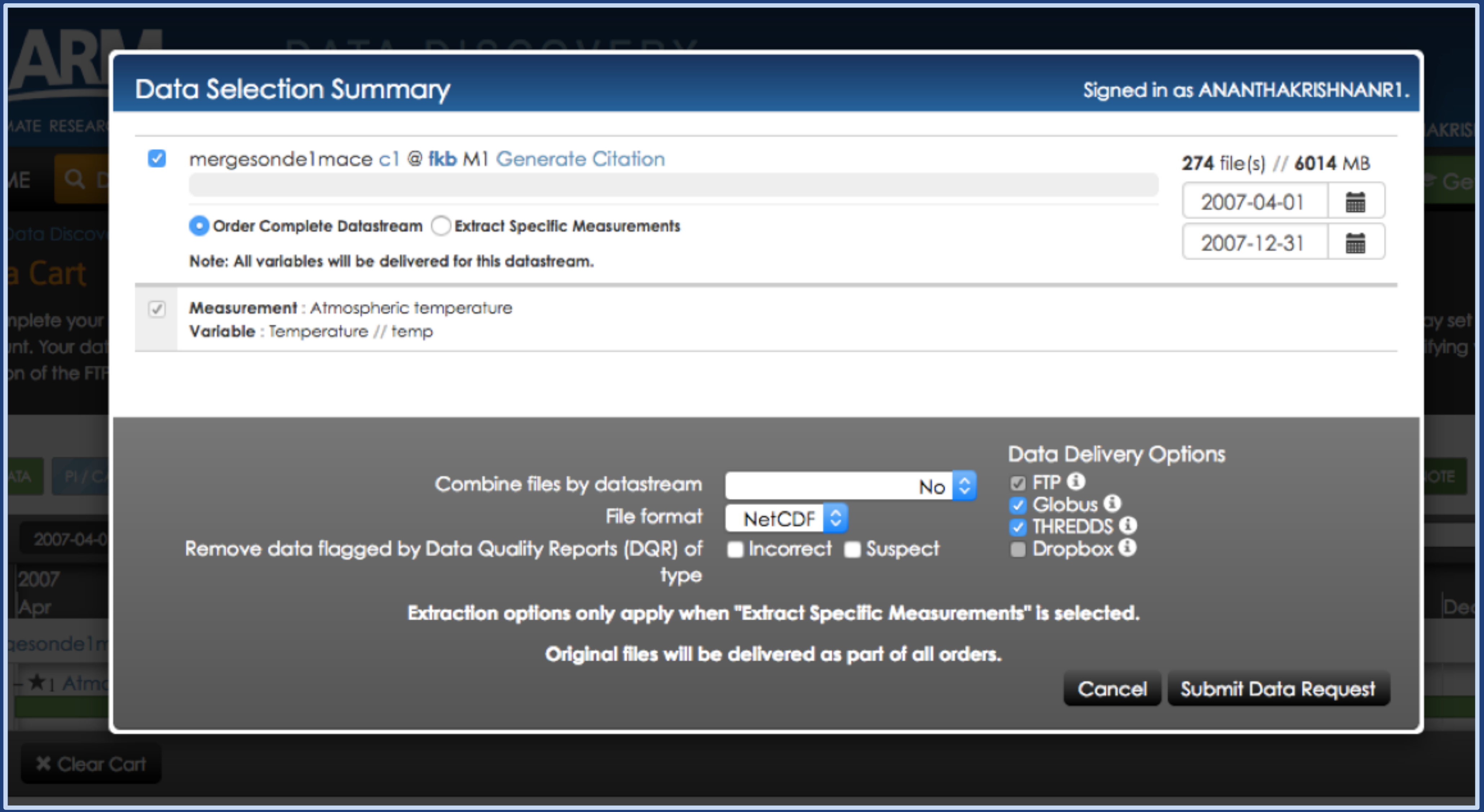
Can we “disassemble” this design and reassemble it for improved performance?

Modern data apps leverage the Science DMZ



fasterdata.es.net/

Data Distribution: ARM Climate Research Facility



Data Selection Summary

Signed in as ANANTHAKRISHNANR1.

☑ mergesonde1mace c1 @ fkb M1 Generate Citation

274 file(s) // 6014 MB

2007-04-01

2007-12-31

● Order Complete Datastream ○ Extract Specific Measurements

Note: All variables will be delivered for this datastream.

☑ **Measurement** : Atmospheric temperature
Variable : Temperature // temp

Combine files by datastream: No

File format: NetCDF

Remove data flagged by Data Quality Reports (DQR) of type: □ Incorrect □ Suspect

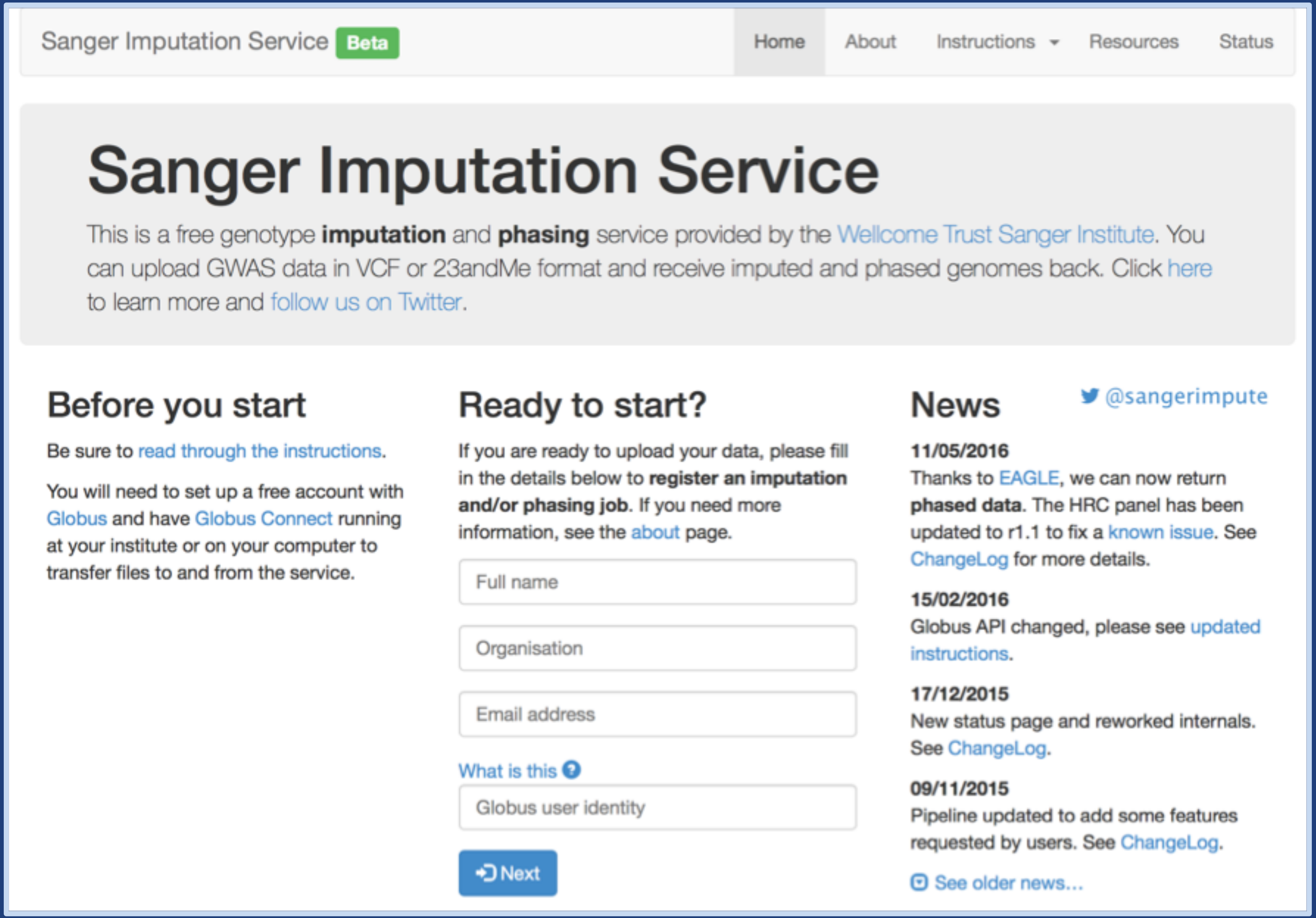
Data Delivery Options

- ☑ FTP
- ☑ Globus
- ☑ THREDDS
- □ Dropbox

Extraction options only apply when "Extract Specific Measurements" is selected.

Original files will be delivered as part of all orders.

Analysis Workflow Integration: Wellcome Sanger



Sanger Imputation Service

This is a free genotype **imputation** and **phasing** service provided by the Wellcome Trust Sanger Institute. You can upload GWAS data in VCF or 23andMe format and receive imputed and phased genomes back. Click here to learn more and follow us on Twitter.

Before you start

Be sure to read through the instructions.

You will need to set up a free account with Globus and have Globus Connect running at your institute or on your computer to transfer files to and from the service.

Ready to start?

If you are ready to upload your data, please fill in the details below to **register an imputation and/or phasing job**. If you need more information, see the about page.

Full name

Organisation

Email address

What is this

Globus user identity

Next

News

@sangerimpute

11/05/2016
Thanks to EAGLE, we can now return **phased data**. The HRC panel has been updated to r1.1 to fix a known issue. See ChangeLog for more details.

15/02/2016
Globus API changed, please see updated instructions.

17/12/2015
New status page and reworked internals. See ChangeLog.

09/11/2015
Pipeline updated to add some features requested by users. See ChangeLog.

See older news...

Globus Platform

Auth API

Globus Auth: Foundational IAM service

- Enables login for diverse app ecosystem
- Simplifies creation/integration of apps, services
- Outsources mundane feature development
- Brokers authentication and authorization interactions
- Protects REST API communications
- No new identity required
- Employs least privileges security model
- Programming language and framework agnostic

Globus Auth

docs.globus.org/api/auth

- **Specification**
- **Developer Guide**
- **API Reference**

Based on widely used web standards

- **OAuth 2.0 Authorization Framework (a.k.a. OAuth2)**
- **OpenID Connect Core 1.0 (a.k.a. OIDC)**
- **Access via OAuth2 and OIDC libraries of your choice**
  - Google OAuth Client Libraries (Java, Python, etc.), Apache mod_auth_openidc, etc.
  - Globus Python SDK

docs.globus.org/api/auth

Fundamental Concepts

- **Scopes: APIs that client is requesting access to**
  - Scope syntax: OpenID Connect: openid, email, profile
  - urn:globus:auth:scope:<service-name>:<scope-name>
- **Consents: authorization client to access a service, within limited scope, on the resource owner's behalf**

Globus account

- **Globus Account = Primary identity + Linked Identities**
  - An identity can be primary on only one account
  - Identities can be linked to only one account
- **Account does not have own identifier**
  - An account is uniquely identified using its primary identity

Identity *id* vs. *username*

- **Identity *id***
  - – Unique among all Globus Auth identities; will never be reused
  - – UUID
  - – Always use this to refer to an identity
- **Identity *username***
  - – Unique at any point in time; may change, may be re-used
  - – Case-insensitive user@domain
  - – Can map to/from id, for user experience
- **Auth API allows mapping back and forth**

App registration

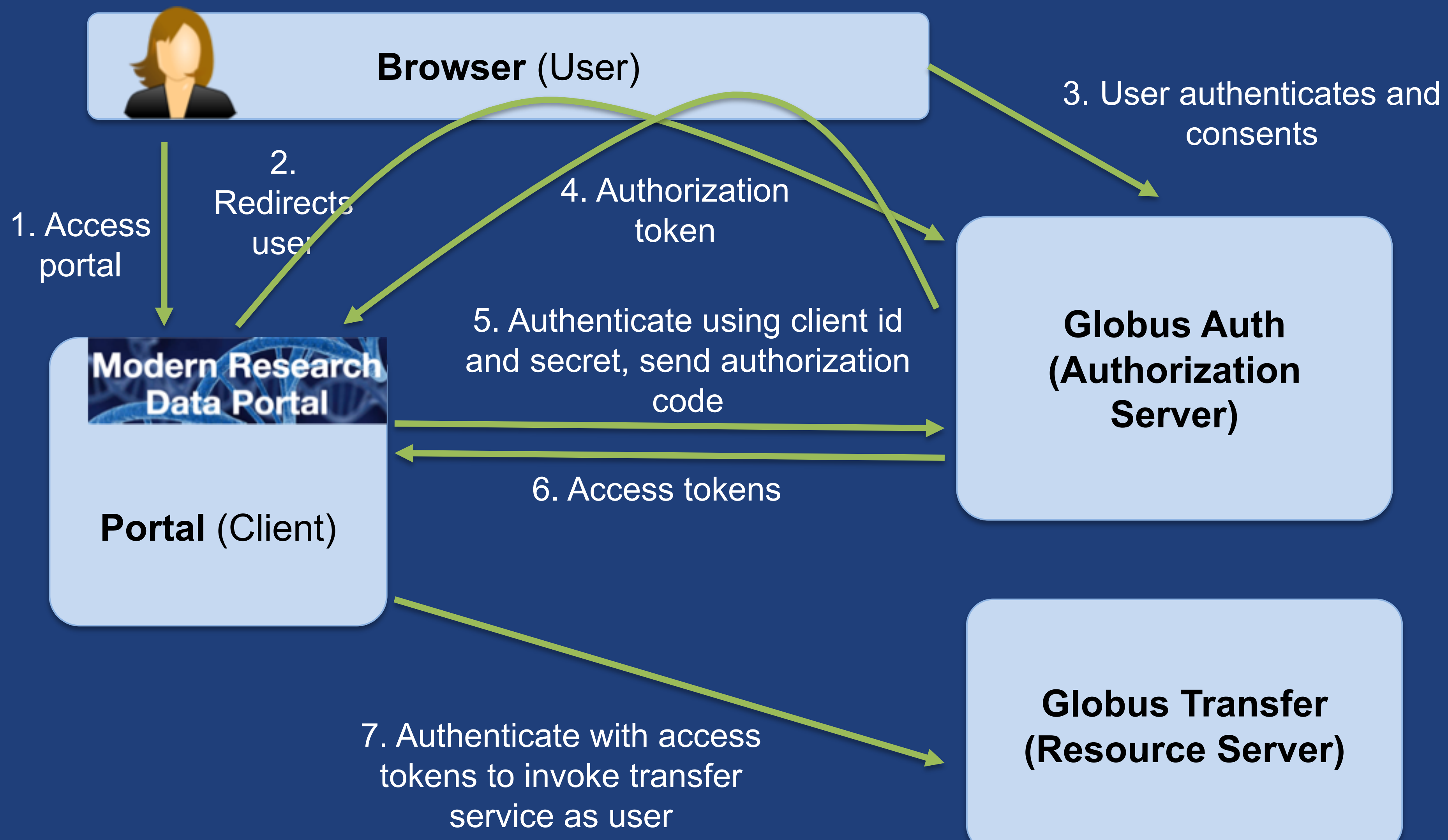
- **Client_id and client_secret for service**
- **App display name**
- **Declare required scopes**
  - Need long-term, offline refresh tokens?
  - May require authorization from scope admin
- **OAuth2 redirect URIs**
- **Links for terms of service & privacy policy**
- **Effective identity policy (optional)**

developers.globus.org

Use case: Portal calling services on user's behalf

- **Examples**
  - Portal starting transfer for user
- **Authorization Code Grant**
  - With service scopes
  - Can also request OIDC scopes
- **Confidential client**
- **Globus SDK:**
  - To get tokens: ConfidentialAppAuthClient
  - To use tokens: AccessTokenAuthorizer

Authorization Code Grant



Browser (User)

1. Access portal

2. Redirects user

3. User authenticates and consents

4. Authorization token

5. Authenticate using client id and secret, send authorization code

6. Access tokens

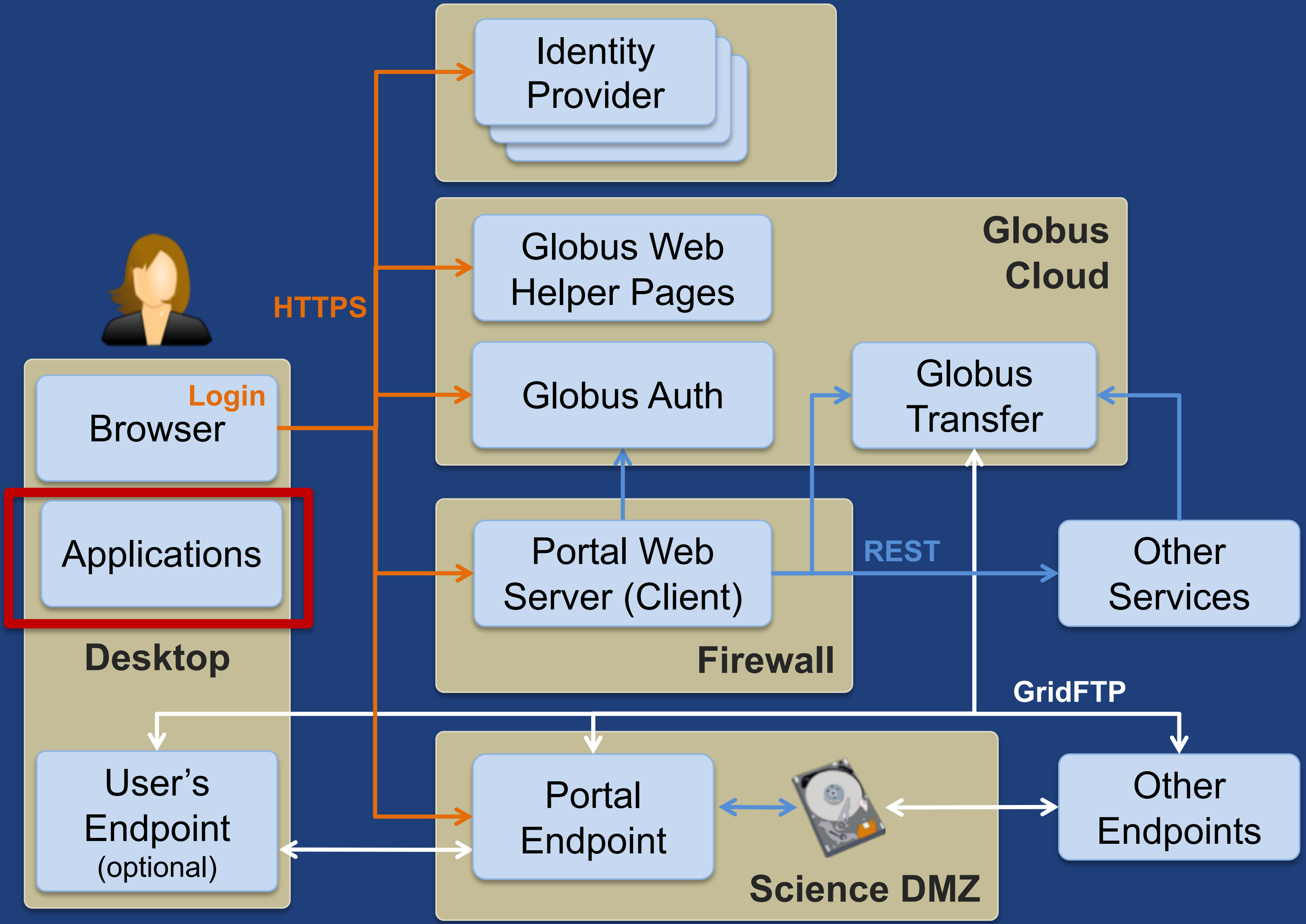
7. Authenticate with access tokens to invoke transfer service as user

Portal (Client)

Globus Auth (Authorization Server)

Globus Transfer (Resource Server)

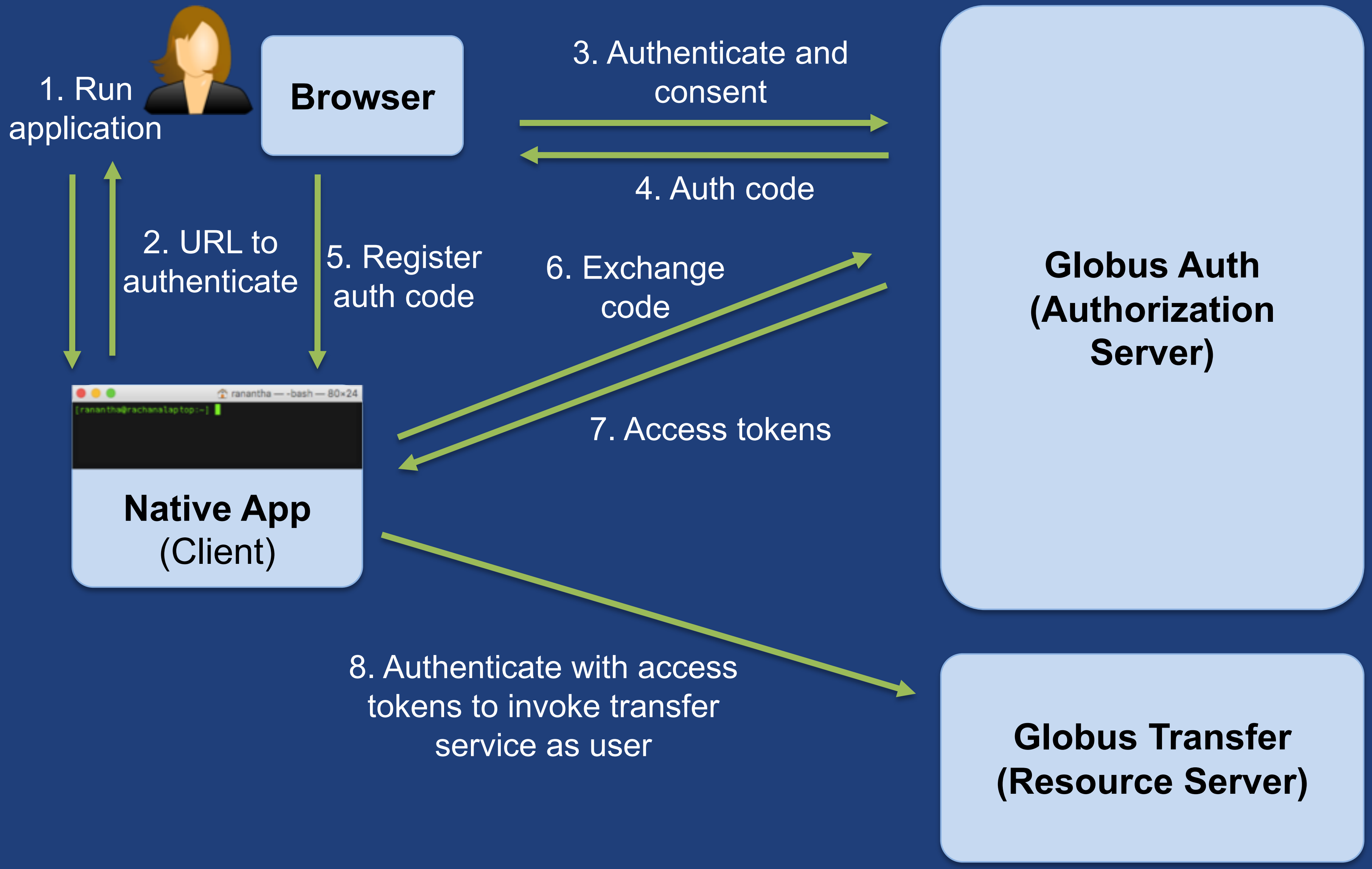
Prototypical research data portal



Use case: Native apps

- **Examples (any client that cannot keep a secret)**
  - Command line, desktop apps
  - Mobile apps
  - Jupyter notebooks
- **Native app is registered with Globus Auth**
  - Not a confidential client
- **Native App Grant is used**
  - Variation on the Authorization Code Grant
- **Globus SDK:**
  - To get tokens: NativeAppAuthClient
  - To use tokens: AccessTokenAuthorizer

Native App grant



```
[ranantha@rachanalaptop:~]
```

1. Run application

Browser

2. URL to authenticate

3. Authenticate and consent

4. Auth code

5. Register auth code

6. Exchange code

7. Access tokens

8. Authenticate with access tokens to invoke transfer service as user

Native App
(Client)

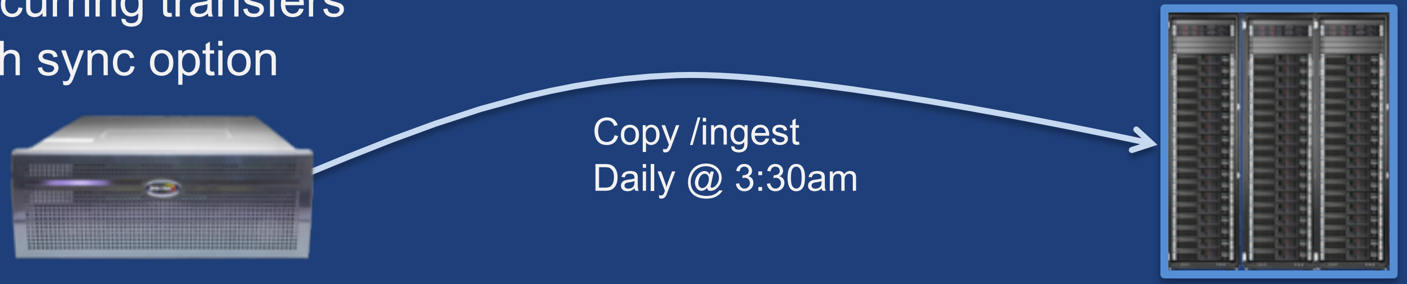
Globus Auth (Authorization Server)

Globus Transfer (Resource Server)

Use case: Apps that need long-lived access tokens

- **Examples**
  - Portal checks for transfer status when user is not logged in
  - Run command line app from script
- **App requests refresh tokens**
- **Globus SDK:**
  - To get token: ConfidentialAppClient or NativeAppClient
  - To use tokens: RefreshTokenAuthorizer

Automation Example: Repeated replication



Recurring transfers
with sync option

Copy /ingest
Daily @ 3:30am

- **Using Globus CLI or SDK**
- **Meant to be run via cron or other task manager**
- **Native app grant**

Exercise: Automation using the Globus CLI

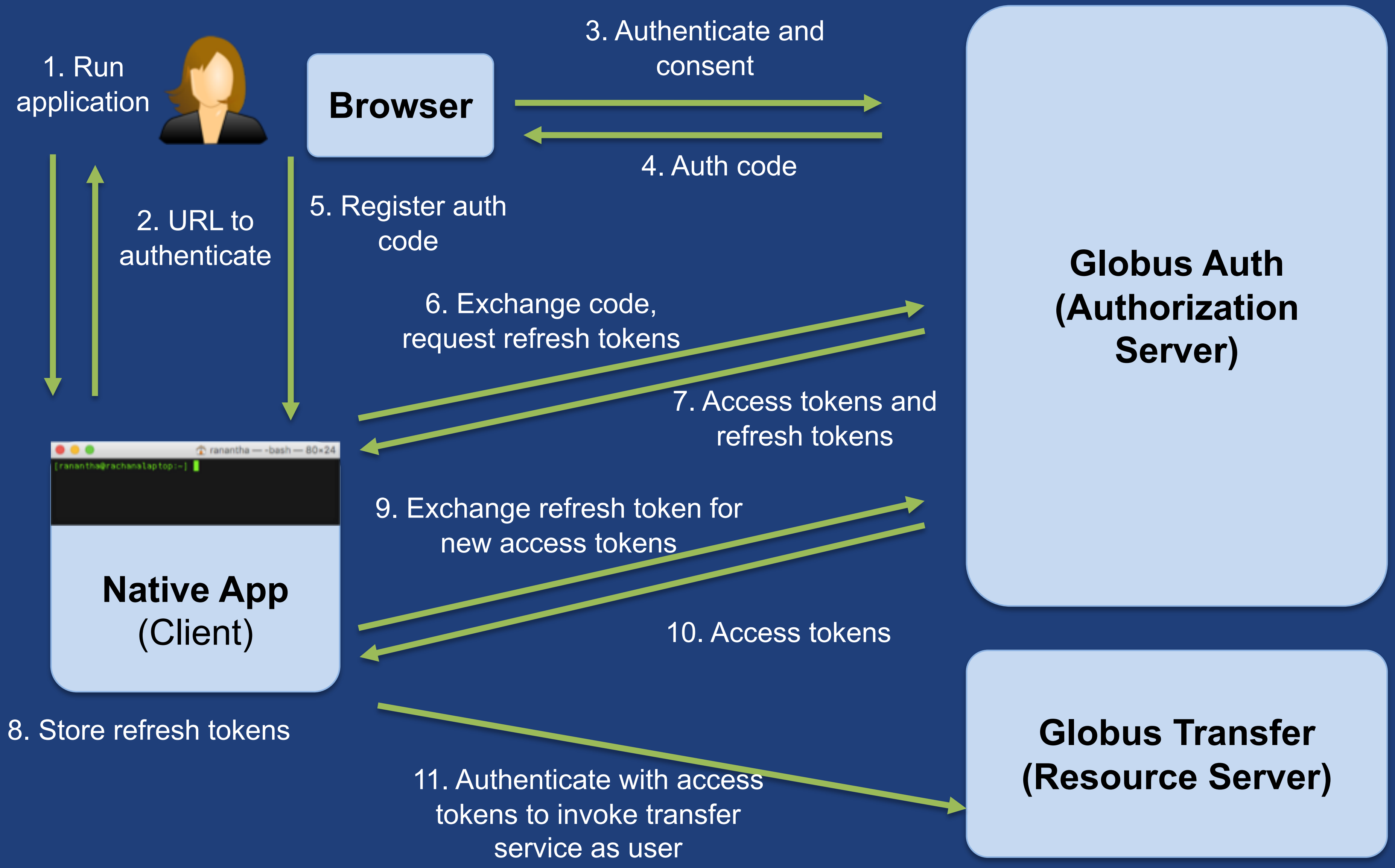
- **Use the cli-sync script to sync files between the ESnet test endpoint and your personal endpoint**
  - Find the respective endpoint IDs and update the script (or parameterize it, if you feel adventurous!)
  - Decide on a source and target directory and reflect this in the script – please use one of the small(er) datasets

https://github.com/globus/automation-examples/blob/master/cli-sync.sh

Refresh tokens

- **For “offline services”**
  - e.g., transfer working on your behalf even when you are offline
- **Refresh tokens issued to client, in particular scope**
- **Client uses refresh token to get access token**
  - Confidential client: client_id and client_secret required
  - Native app: client_secret not required
- **Refresh token good for 6 months after last use**
- **Consent rescindment revokes resource token**

Refresh tokens



1. Run application

2. URL to authenticate

3. Authenticate and consent

4. Auth code

5. Register auth code

6. Exchange code, request refresh tokens

7. Access tokens and refresh tokens

8. Store refresh tokens

9. Exchange refresh token for new access tokens

10. Access tokens

11. Authenticate with access tokens to invoke transfer service as user

```
ranantha — -bash — 80×24
[ranantha@rachanalaptop:~]
```

Demo: Native App/Refresh Tokens

github.com/globus/native-app-examples

- **See README for installation**
- `./example_copy_paste.py`
  - Copy paste code to the app
- `./example_copy_paste_refresh_token.py`
  - Stores refresh token locally, uses it to get new access tokens

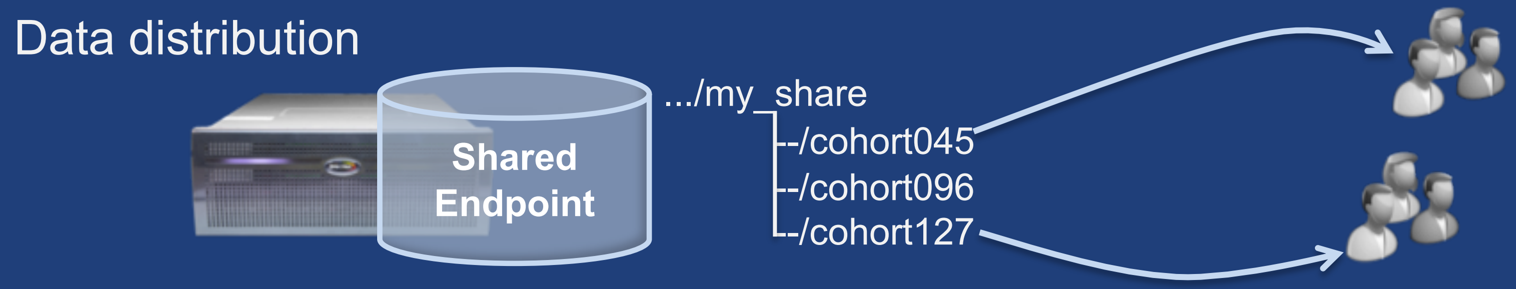
Use case: App invoking services as itself

- **Examples**
  - Sample portal invoking graph service and accessing endpoints as itself
  - Robots, agents, services
- **Every app is/has an identity in Globus Auth (<client_id>@clients.auth.globus.org)**
- **App registers with Globus to get client id/secret**
  - Native app cannot do this (no client_secret)
- **Uses Client Credential Grant**
- **Can use the client_id just like any other identity_id**
  - Sharing access manager role, permissions, group membership, etc.
- **Globus SDK:**
  - To get tokens: ConfidentialAppAuthClient
  - To use tokens: AccessTokenAuthorizer

User identity vs. portal identity

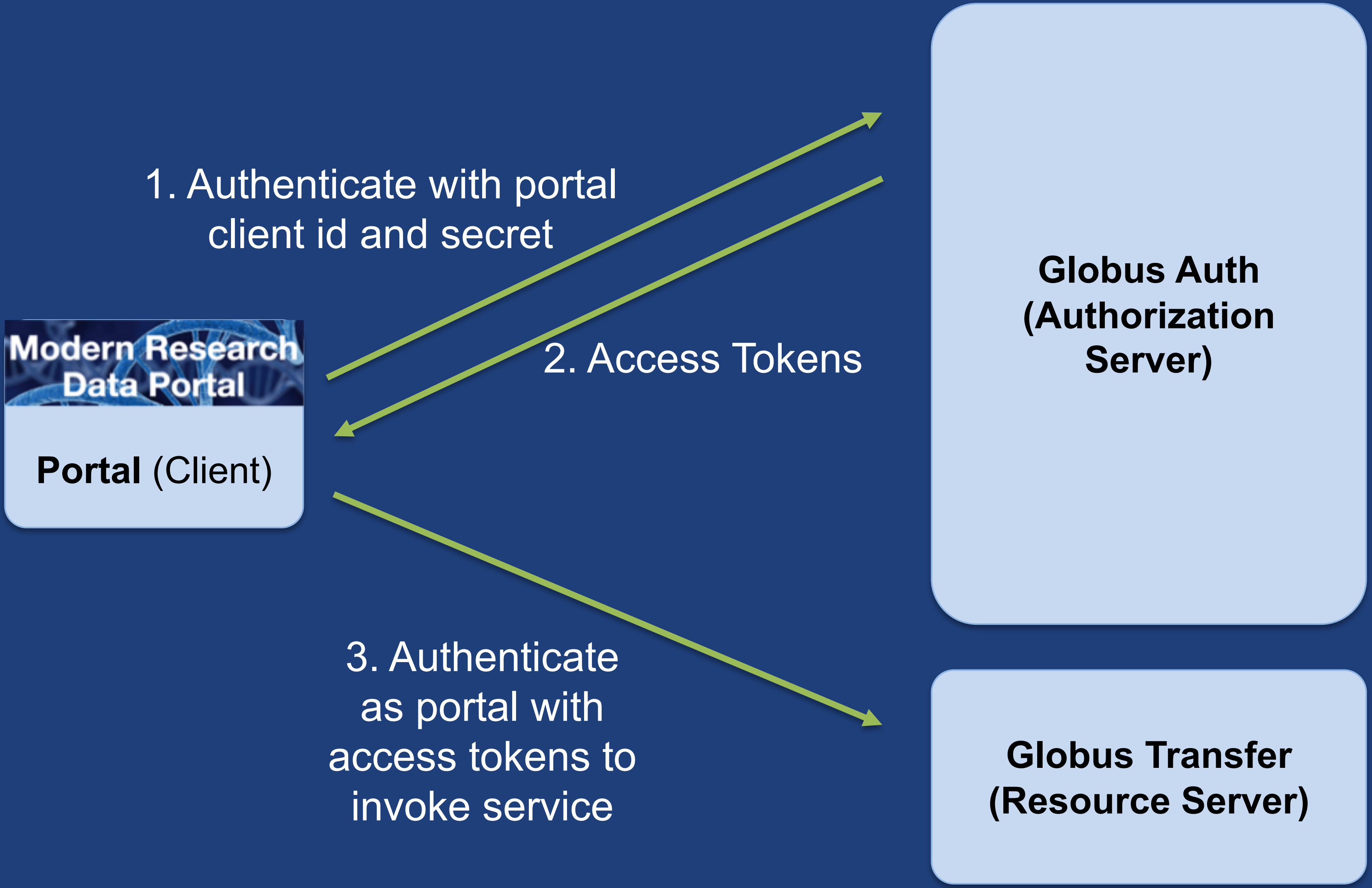
- **User logging into portal results in portal having user’s identity and access token**
  - Used to make requests on the user’s behalf
- **Portal may also need its own identity**
  - Access and refresh tokens for this identity
  - Used to make requests on its own behalf, e.g. set an ACL on a shared endpoint

Automation Example: Data distribution



- **Uses Auth and Transfer API via SDK**
- **Native app grant**
- **Client credential grant**
  - – Portal or service
  - – Permission for the client id

Client credential grant



Modern Research Data Portal

Portal (Client)

1. Authenticate with portal client id and secret

2. Access Tokens

3. Authenticate as portal with access tokens to invoke service

Globus Auth (Authorization Server)

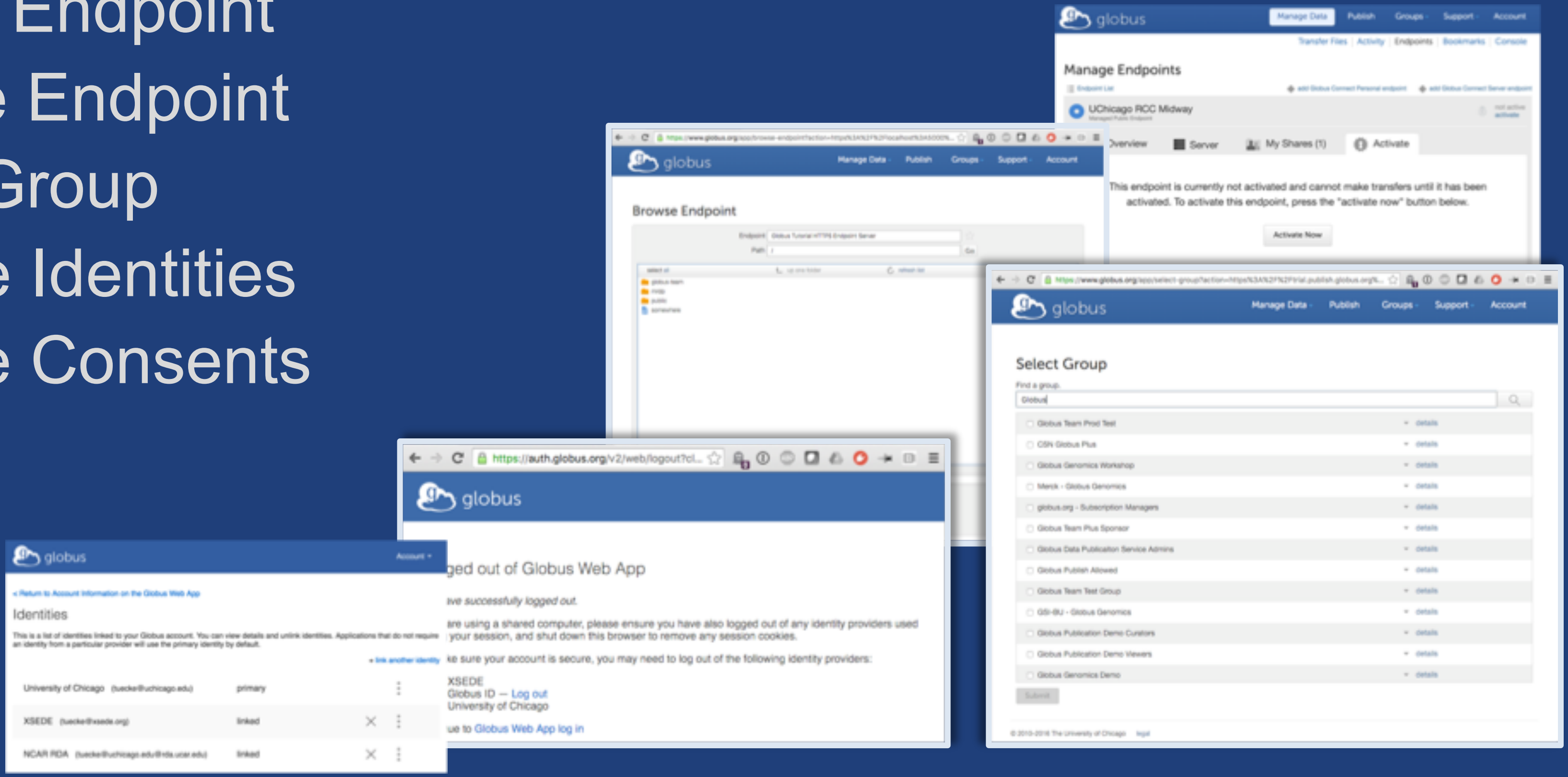
Globus Transfer (Resource Server)

Exercise: Automation using the REST API

- **Use the share_data Python script to share files with your neighbor**
  - Modify the script to:
    - Create a shared endpoint
    - Add access permissions to the shared endpoint for your neighbor
  - Move data to the shared endpoint
  - Check that your neighbor received the sharing notification

Globus Helper Pages

- **Globus pages designed for use by your web apps**
  - Browse Endpoint
  - Activate Endpoint
  - Select Group
  - Manage Identities
  - Manage Consents
  - Logout



Manage Endpoints

UChicago RCC Midway

This endpoint is currently not activated and cannot make transfers until it has been activated. To activate this endpoint, press the "activate now" button below.

Browse Endpoint

Select Group

Find a group.

Globus

- □ Globus Team Prod Test
- □ CSN Globus Plus
- □ Globus Genomics Workshop
- □ Merck - Globus Genomics
- □ globus.org - Subscription Managers
- □ Globus Team Plus Sponsor
- □ Globus Data Publication Service Admins
- □ Globus Publish Allowed
- □ Globus Team Test Group
- □ GSI-BU - Globus Genomics
- □ Globus Publication Demo Curators
- □ Globus Publication Demo Viewers
- □ Globus Genomics Demo

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Identities

This is a list of identities linked to your Globus account. You can view details and unlink identities. Applications that do not require an identity from a particular provider will use the primary identity by default.

University of Chicago	(tuecke@uchicago.edu)	primary
XSEDE	(tuecke@xsede.org)	linked
NCAR RDA	(tuecke@uchicago.edu@rda.ucar.edu)	linked

ged out of Globus Web App

ve successfully logged out.

are using a shared computer, please ensure you have also logged out of any identity providers used your session, and shut down this browser to remove any session cookies.

ke sure your account is secure, you may need to log out of the following identity providers:

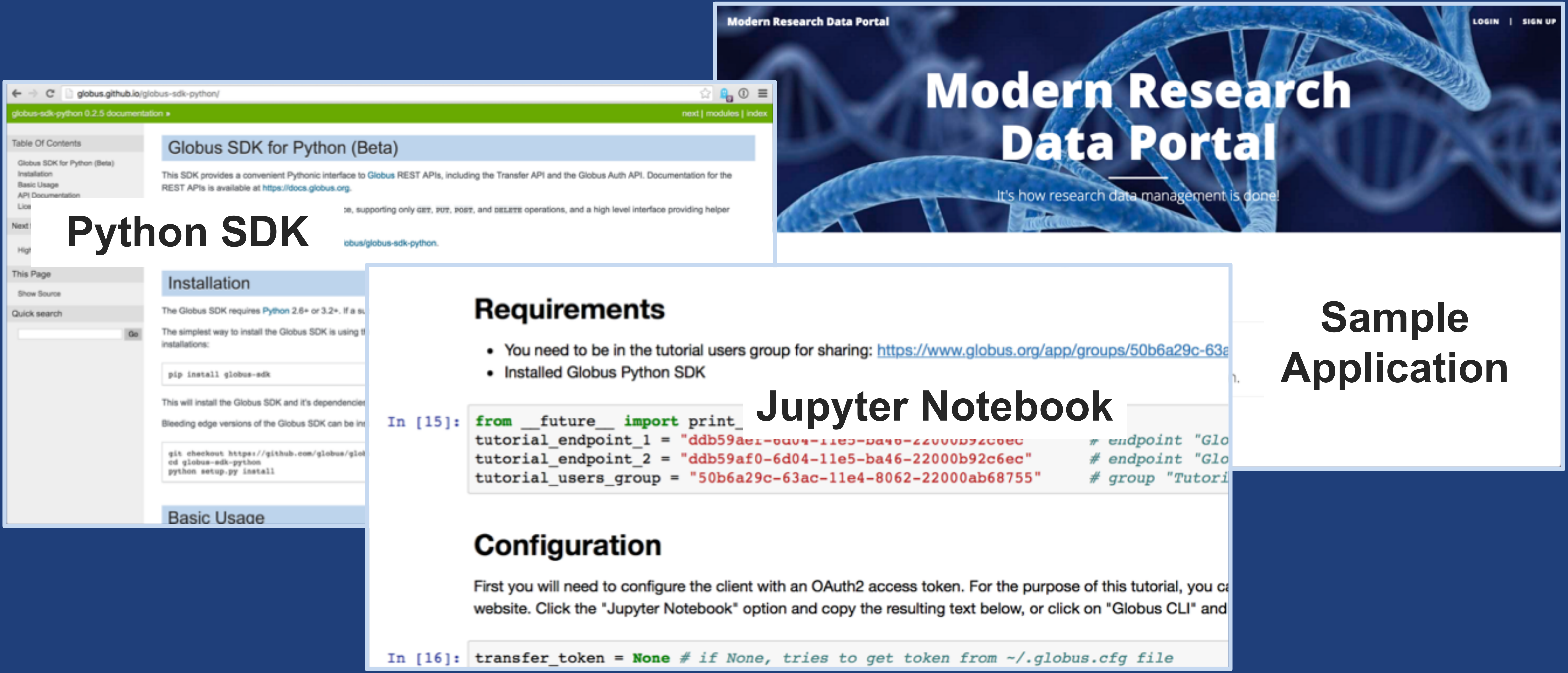
XSEDE
Globus ID — Log out
University of Chicago

ue to Globus Web App log in

globus
Manage Data
Publish
Groups
Support
Account
Transfer Files
Activity
Endpoints
Bookmarks
Console
Overview
Server
My Shares (1)
Activate
Activate Now
https://www.globus.org/app/select-group?action=https%3A%2F%2Ftrial.publish.globus.org%...
https://auth.globus.org/v2/web/logout?cl...
details
Submit
< Return to Account Information on the Globus Web App
+ link another identity

docs.globus.org/api/helper-pages

Globus PaaS developer resources



Python SDK

globus.github.io/globus-sdk-python/

globus-sdk-python 0.2.5 documentation »

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Globus SDK for Python (Beta)

This SDK provides a convenient Pythonic interface to Globus REST APIs, including the Transfer API and the Globus Auth API. Documentation for the REST APIs is available at https://docs.globus.org.

e, supporting only GET, PUT, POST, and DELETE operations, and a high level interface providing helper

obus/globus-sdk-python.

Installation

The Globus SDK requires Python 2.6+ or 3.2+. If a su

The simplest way to install the Globus SDK is using t installations:

```
pip install globus-sdk
```

This will install the Globus SDK and it's dependencie

Bleeding edge versions of the Globus SDK can be in

```
git checkout https://github.com/globus/glob
cd globus-sdk-python
python setup.py install
```

Basic Usage

Jupyter Notebook

Requirements

- You need to be in the tutorial users group for sharing: https://www.globus.org/app/groups/50b6a29c-63a
- Installed Globus Python SDK

```
In [15]: from __future__ import print_
         tutorial_endpoint_1 = "ddb59ae1-6d04-11e5-ba46-22000b92c6ec"      # endpoint "Glo
         tutorial_endpoint_2 = "ddb59af0-6d04-11e5-ba46-22000b92c6ec"      # endpoint "Glo
         tutorial_users_group = "50b6a29c-63ac-11e4-8062-22000ab68755"     # group "Tutori
```

Configuration

First you will need to configure the client with an OAuth2 access token. For the purpose of this tutorial, you ca website. Click the "Jupyter Notebook" option and copy the resulting text below, or click on "Globus CLI" and

```
In [16]: transfer_token = None # if None, tries to get token from ~/.globus.cfg file
```

Modern Research Data Portal

LOGIN | SIGN UP

Modern Research Data Portal

It's how research data management is done!

Sample Application

docs.globus.org/api

github.com/globus

Support resources

- **Globus documentation: docs.globus.org**
- **Helpdesk and issue escalation: support@globus.org**
- **Customer engagement team**
- **Globus professional services team**
  - Assist with portal/gateway/app architecture and design
  - Develop custom applications that leverage the Globus platform
  - Advise on customized deployment and integration scenarios

Join the Globus community

- Access the service: **globus.org/login**
- Create a personal endpoint: **globus.org/app/endpoints/create-gcp**
- Documentation: **docs.globus.org**
- Engage: **globus.org/mailing-lists**
- Subscribe: **globus.org/subscriptions**
- Need help? **support@globus.org**
- Follow us: **@globusonline**