The globusworld TOUR

# Building on the Globus Platform

Rachana Ananthakrishnan
**rachana@globus.org**

Vas Vasiliadis
**vas@uchicago.edu**

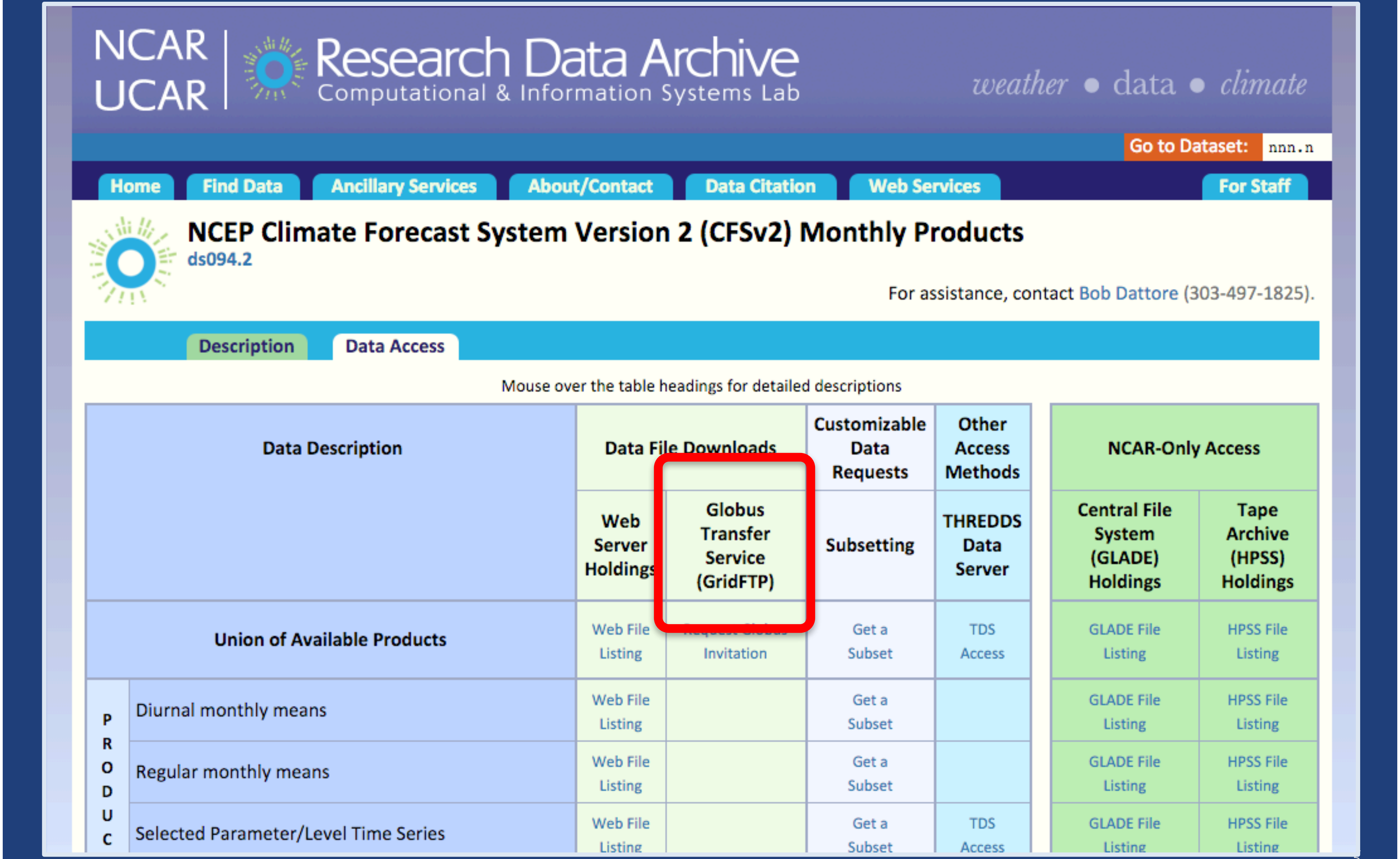
Penn State University — June 29, 2017

globus

# Platform Questions

- How do you leverage Globus services in your own applications?
- How do you extend Globus with your own services?
- How do we empower the research community to create an integrated ecosystem of services and applications?

# Example: NCAR RDA



NCAR UCAR | Research Data Archive
Computational & Information Systems Lab

*weather ● data ● climate*

Go to Dataset: nnn.n

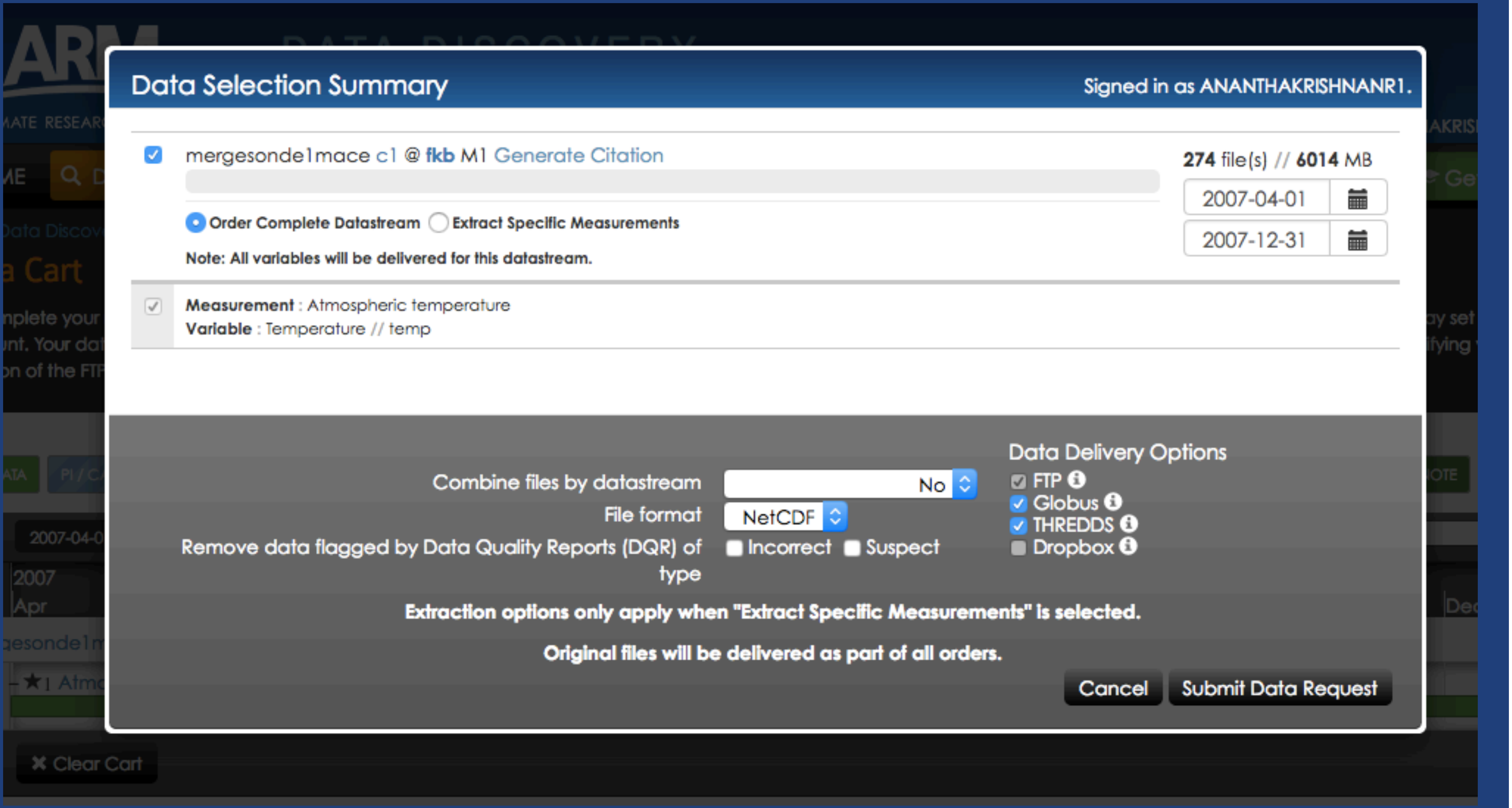
**NCEP Climate Forecast System Version 2 (CFSv2) Monthly Products**
ds094.2

For assistance, contact Bob Dattore (303-497-1825).

Mouse over the table headings for detailed descriptions

| Data Description | | Data File Downloads | | Customizable Data Requests | Other Access Methods | NCAR-Only Access | |
|---|---|---|---|---|---|---|---|
| | | Web Server Holdings | Globus Transfer Service (GridFTP) | Subsetting | THREDDS Data Server | Central File System (GLADE) Holdings | Tape Archive (HPSS) Holdings |
| Union of Available Products | | Web File Listing | Request Globus Invitation | Get a Subset | TDS Access | GLADE File Listing | HPSS File Listing |
| PRODUC | Diurnal monthly means | Web File Listing | | Get a Subset | | GLADE File Listing | HPSS File Listing |
| | Regular monthly means | Web File Listing | | Get a Subset | | GLADE File Listing | HPSS File Listing |
| | Selected Parameter/Level Time Series | Web File Listing | | Get a Subset | TDS Access | GLADE File Listing | HPSS File Listing |

# Example: 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

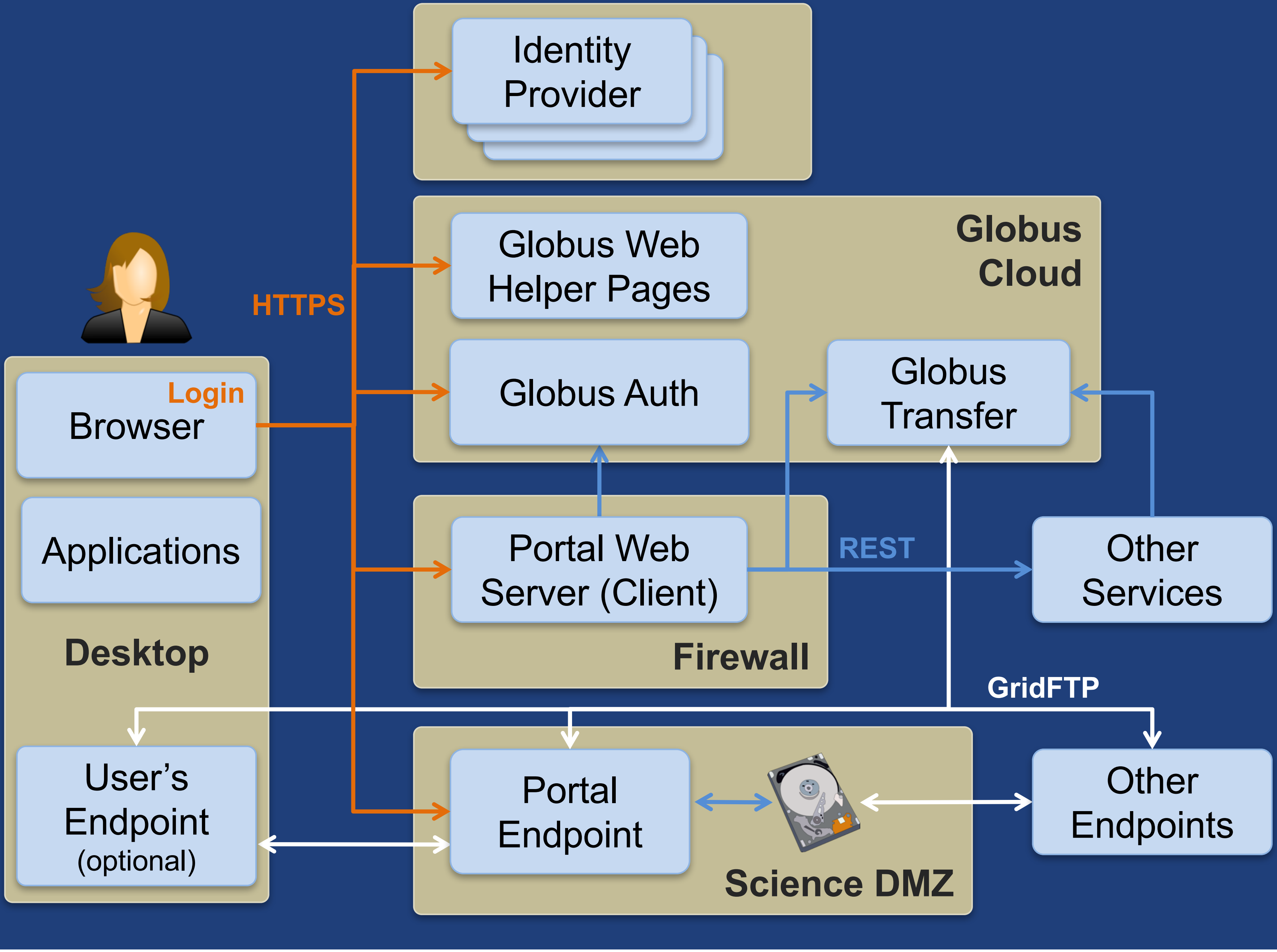
**Extraction options only apply when "Extract Specific Measurements" is selected.**

**Original files will be delivered as part of all orders.**

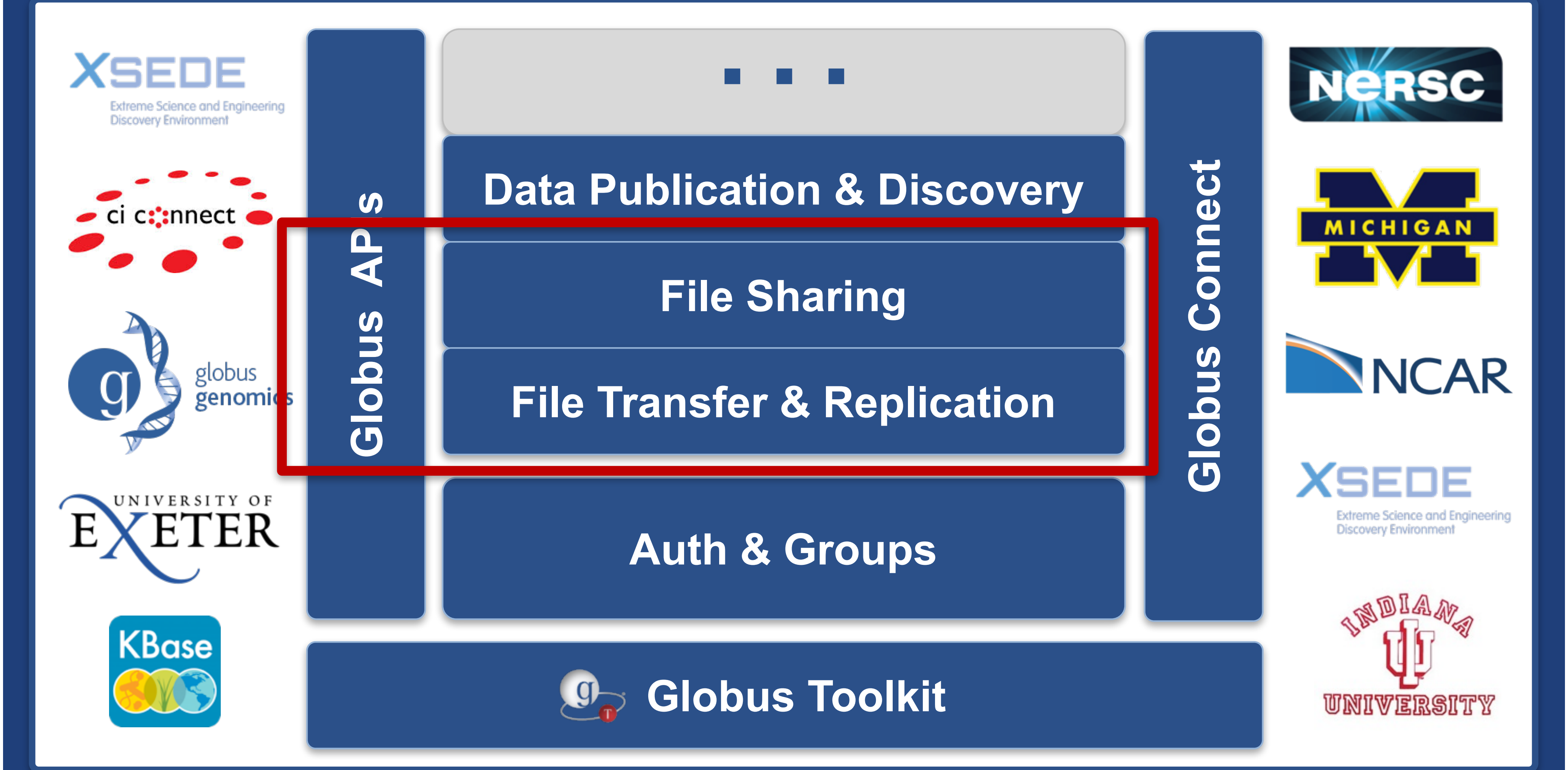
Demo

# Sample
# Research Data Portal

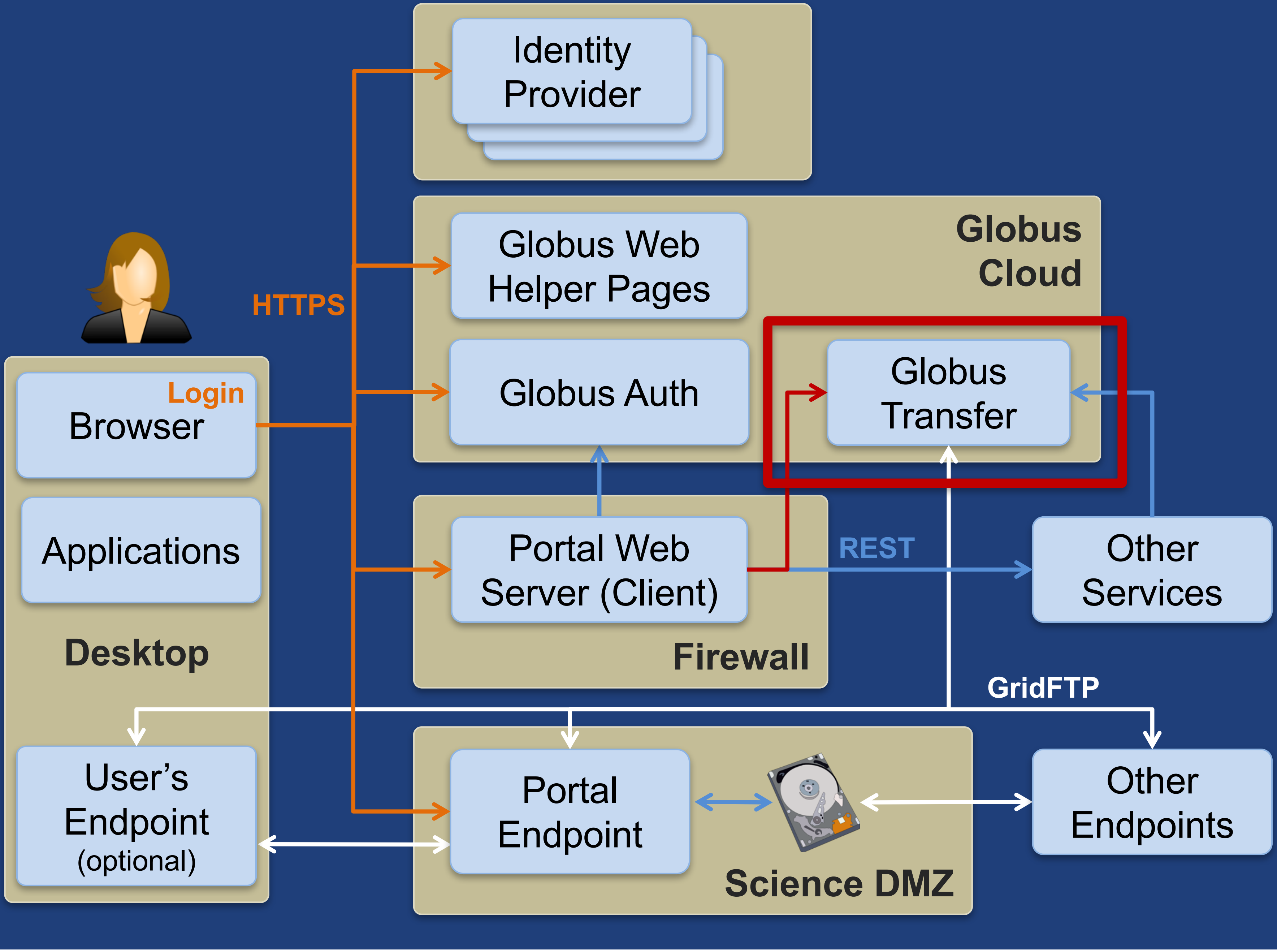
# Prototypical research data portal



# Globus PaaS


. . .
Data Publication & Discovery
File Sharing
File Transfer & Replication
Auth & Groups
Globus APIs
Globus Connect
Globus Toolkit
XSEDE Extreme Science and Engineering Discovery Environment
ci connect
globus genomics
University of Exeter
KBase
NERSC
Michigan
NCAR
XSEDE Extreme Science and Engineering Discovery Environment
Indiana University

# Prototypical research data portal



# Introduction to REST APIs

- **Remote operations on resources via HTTPS**
  - – POST ~= Create (or other operations)
  - – GET ~= Read
  - – PUT ~= Update
  - – DELETE ~= Delete
- **Globus APIs use JSON for documents and resource representations**
- **Resource named by URL**
  - – Query params allow refinement (e.g., subset of fields)
- **Requests authorized via OAuth2 access token**
  - – Authorization: Bearer asdflkqhafsdafeawk

# Globus Transfer API

- **Nearly all Globus Web App functionality implemented via public Transfer API**

**docs.globus.org/api/transfer**

- **Fairly stable**
- **Deprecation policy**

# Globus Python SDK

- **Python client library for the Globus Auth and Transfer REST APIs**

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

# TransferClient class

- globus_sdk.TransferClient **class**

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

- **Handles connection management, security, framing, marshaling**

# 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 for response object, overrides the client's default_response_class
- Returns: GlobusHTTPResponse object

# TransferClient higher-level calls

- **One method for each API resource and HTTP verb**
- **Largely direct mapping to REST API**

```
endpoint_search(filter_fulltext=None,
                filter_scope=None,
                num_results=25,
                **params)
```

# Python SDK Jupyter notebook

- Jupyter (iPython) notebook demonstrating use of Python SDK

github.com/globus/globus-jupyter-notebooks

- Overview
- Open source, enjoy

# Walk-through

# Jupyter Notebook

# 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: Jupyter notebook

**Install Jupyter notebook either locally or on EC2 instance**

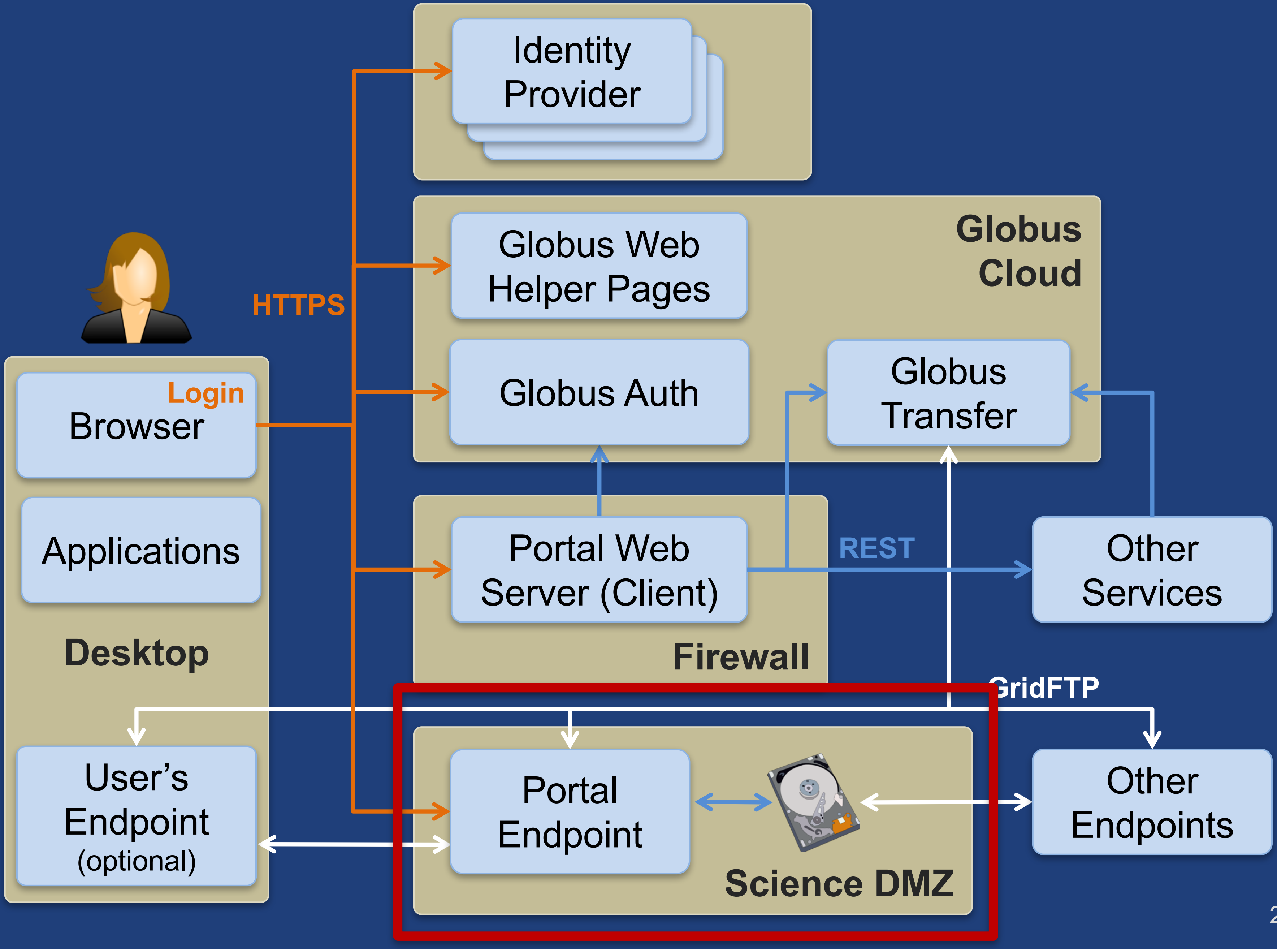
**github.com/globus/globus-jupyter-notebooks.git**

**Modify Jupyter notebook to:**

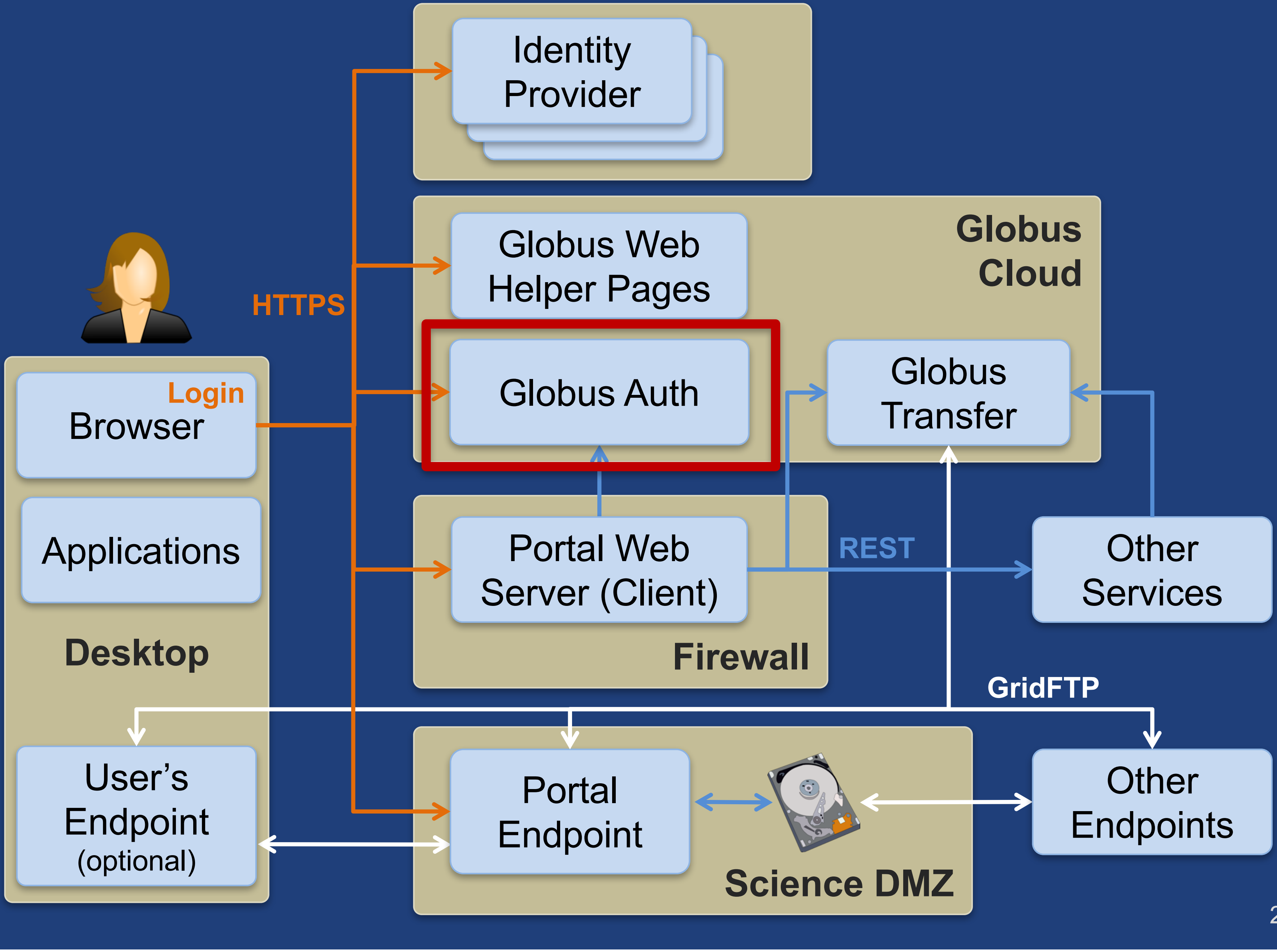
1. **Find the endpoint id for XSEDE Comet**
2. **Set all the metadata fields on your shared endpoint**
3. **Set permissions to allow your neighbor to access your shared endpoint**
4. **Transfer all files *.txt from the tourexercise directory on the Globus Vault endpoint to any other endpoint.**

# Maximizing the value of the Science DMZ

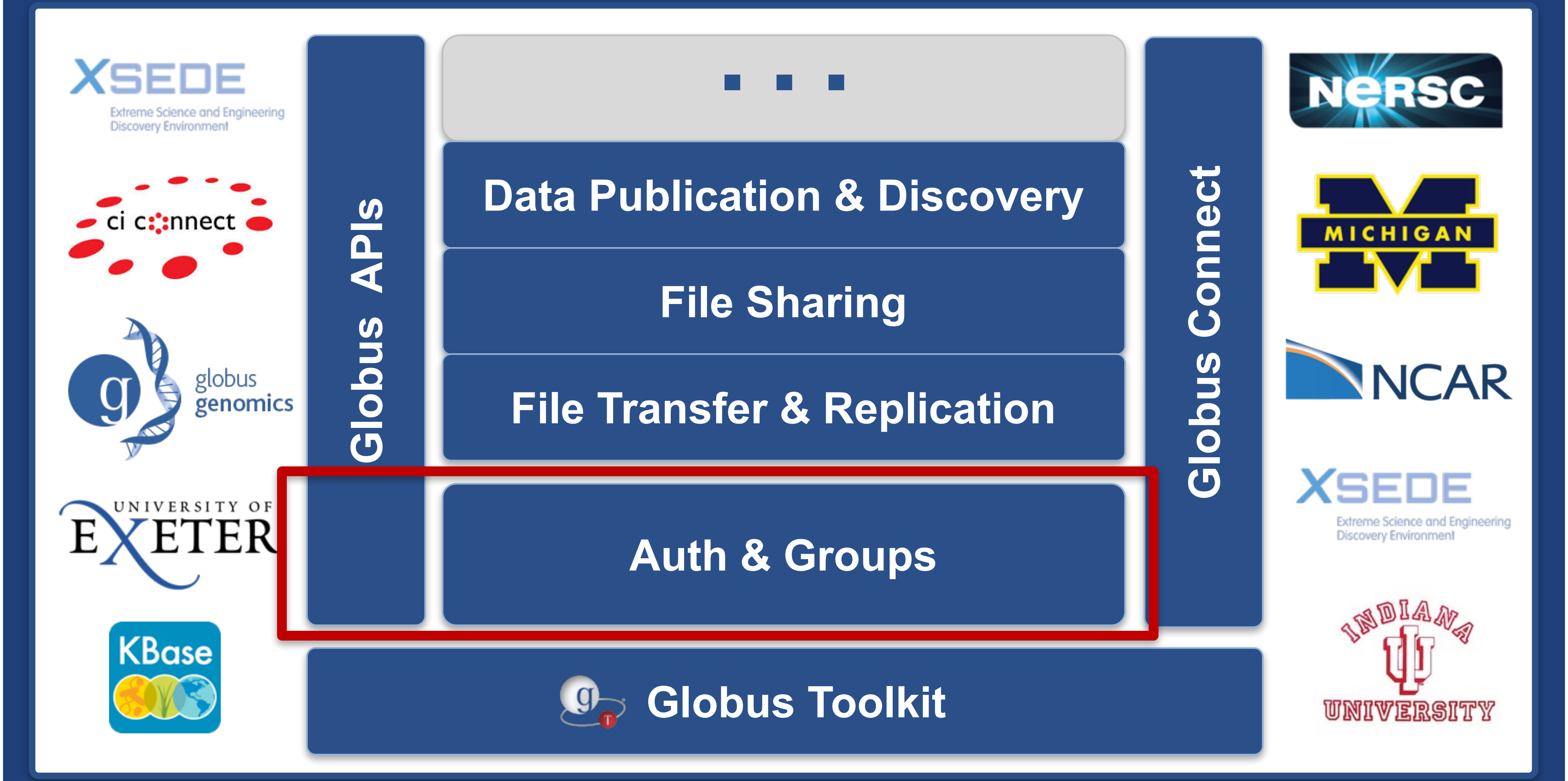
# Prototypical research data portal



# Prototypical research data portal



# Globus PaaS



. . .

Data Publication & Discovery

File Sharing

File Transfer & Replication

Auth & Groups

Globus APIs

Globus Connect

Globus Toolkit

XSEDE
Extreme Science and Engineering Discovery Environment
ci connect
globus genomics
UNIVERSITY OF EXETER
KBase
NERSC
MICHIGAN
NCAR
XSEDE
Extreme Science and Engineering Discovery Environment
INDIANA UNIVERSITY

# Challenge

- **How to provide:**
  - Login to apps
    - Web, mobile, desktop, command line
  - Protect all REST API communications
    - App → Globus service
    - App → non-Globus service
    - Service → service
- **While:**
  - Not introducing even more identities
  - Providing least privileges security model
  - Being agnostic to programming language and framework
  - Being web friendly
  - Making it easy for users and developers

# Globus Auth

- **Foundational identity and access management (IAM) platform service**
- **Simplify creation and integration of advanced apps and services**
- **Brokers authentication and authorization interactions between:**
  - end-users
  - identity providers: InCommon, XSEDE, Google, portals
  - services: resource servers with REST APIs
  - apps:  web, mobile, desktop, command line clients
  - services acting as clients to other services

# Globus Auth

- Identity and access management PaaS

docs.globus.org/api/auth

- Specification
- Developer Guide
- API Reference

# Based on widely used web standards

- **OAuth 2.0 Authorization Framework**
  - aka OAuth2
- **OpenID Connect Core 1.0**
  - aka OIDC
- **Use various OAuth2 and OIDC libraries**
  - Google OAuth Client Libraries (Java, Python, etc.), Apache mod_auth_openidc, etc.
  - Globus Python SDK

# Scopes

- **APIs that client is requesting access to**
- **Scope syntax:**
  - – OpenID Connect: openid, email, profile
  - – urn:globus:auth:scope:<service-name>:<scope-name>
- **If client requests multiple scopes**
  - – Token response has tokens for first scope
  - – other_tokens field in response has list of token responses for other scopes
  - – Client must use correct token with each request

# Consent

- **Resource owner authorization that a client can request access to a service scope on the resource owner's behalf within a limited scope**
  - If service has dependent scopes, they are part of the consent
- **User can rescind a consent at any time**
  - Invalidates all access, dependent, and refresh tokens originating from the client

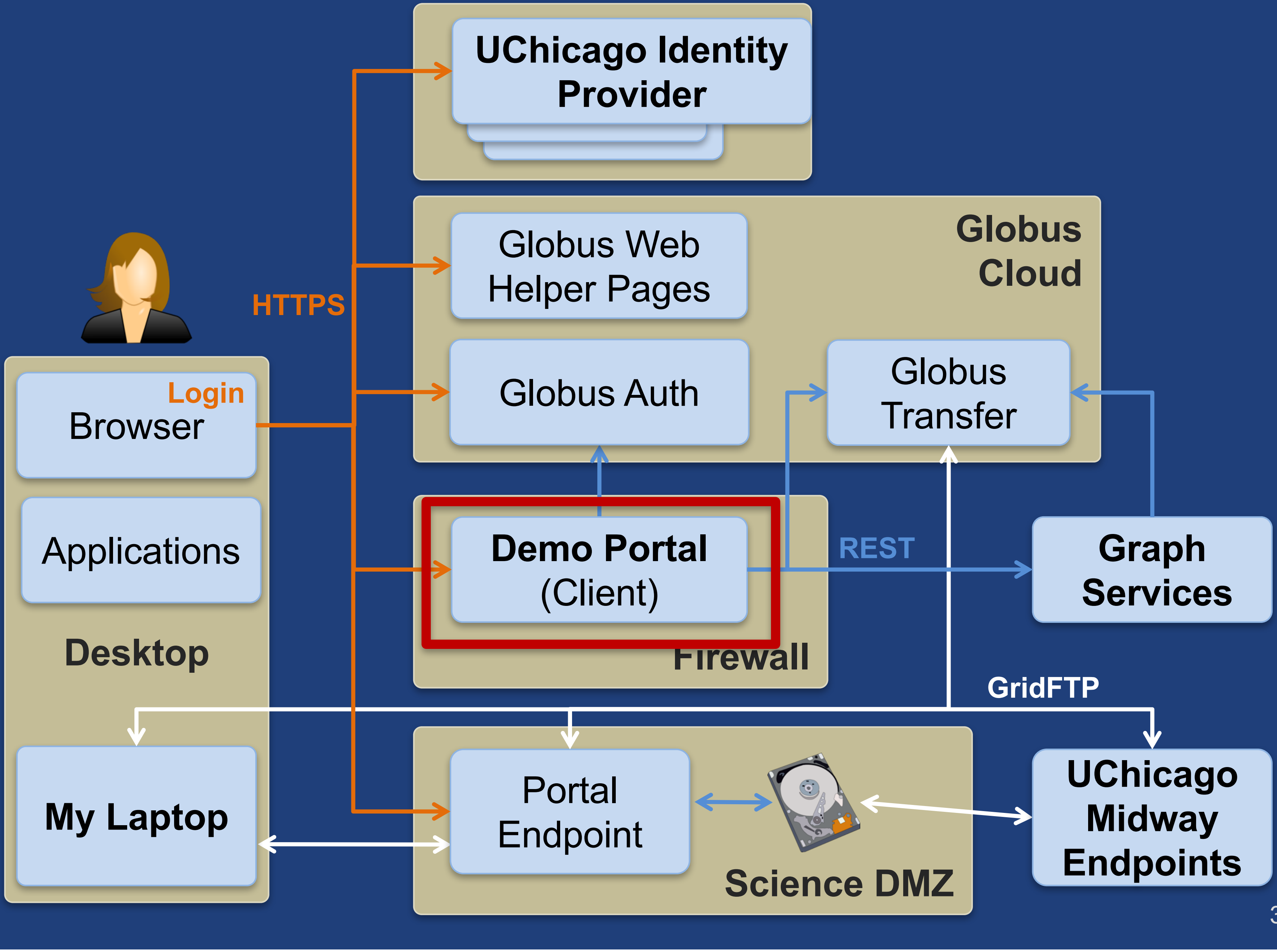
# Globus account

- **A Globus account is a set of identities**
  - A *primary identity*
    - Identity can be primary of only one account
  - One or more *linked identities*
    - Identity can (currently) 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

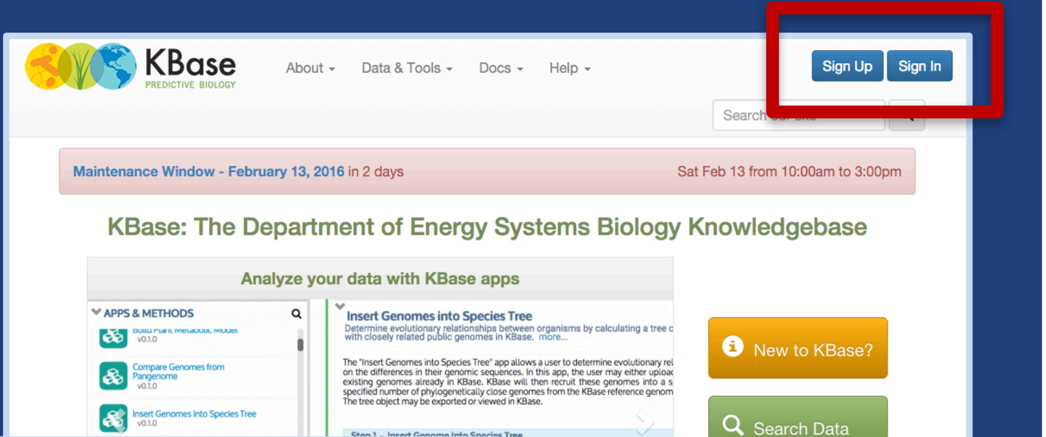
- **Identity id:**
  - Guaranteed unique among all Globus Auth identities, and will never be reused
  - UUID
  - Always use this to refer to an identity
- **Identity username:**
  - Unique at any point in time
    - May change, may be re-used
  - Case-insensitive user@domain
  - Can map to/from id, for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

# Sample Research Data Portal



# Use case: Log in with Globus

- Similar to:
  "Log in with Google"
  "Log in with Facebook"
- Using existing identities
- Providing access to community services



Maintenance Window - February 13, 2016 in 2 days Sat Feb 13 from 10:00am to 3:00pm

KBase: The Department of Energy Systems Biology Knowledgebase

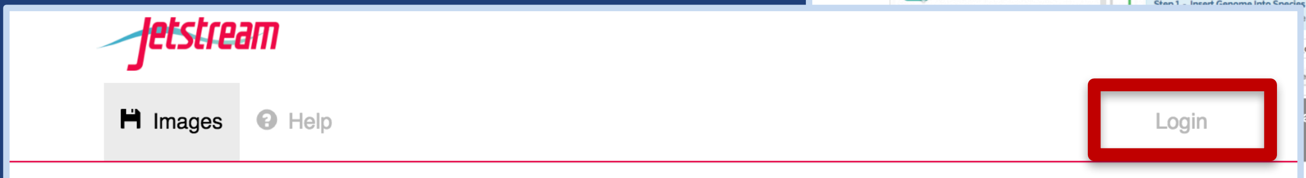
Analyze your data with KBase apps

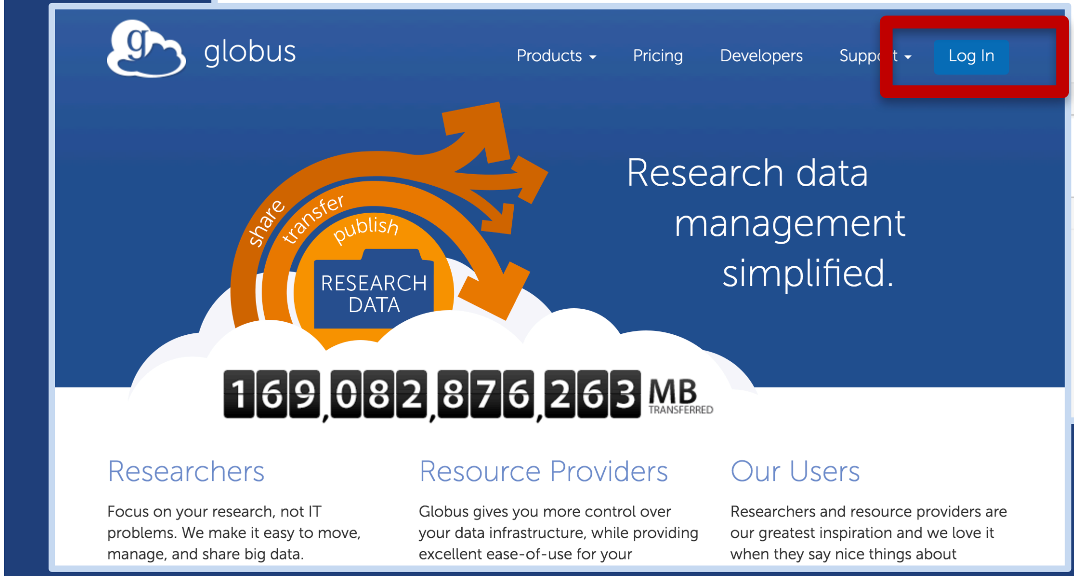
APPS & METHODS
Compare Genomes from Pangenome
Insert Genomes into Species Tree

Insert Genomes into Species Tree

Determine evolutionary relationships between organisms by calculating a tree c with closely related public genomes in KBase. more...

…l genomics and systems biology for microbes, …s and methods with other scientists.





Research data management simplified.

**Researchers**

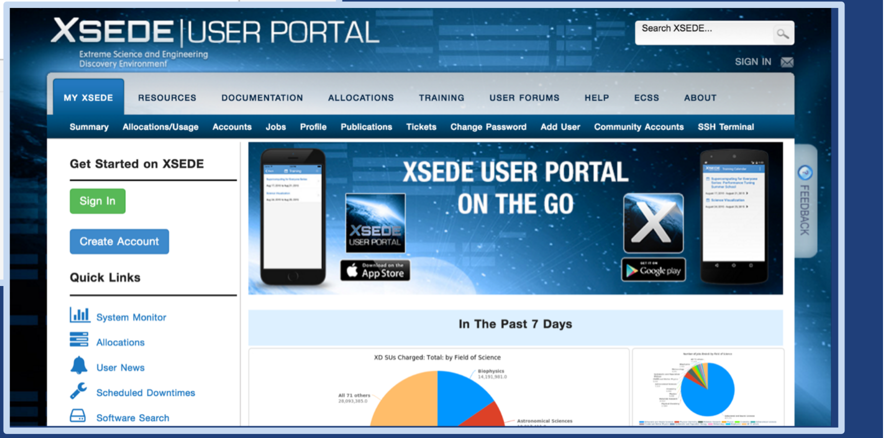
Focus on your research, not IT problems. We make it easy to move, manage, and share big data.

**Resource Providers**

Globus gives you more control over your data infrastructure, while providing excellent ease-of-use for your

**Our Users**

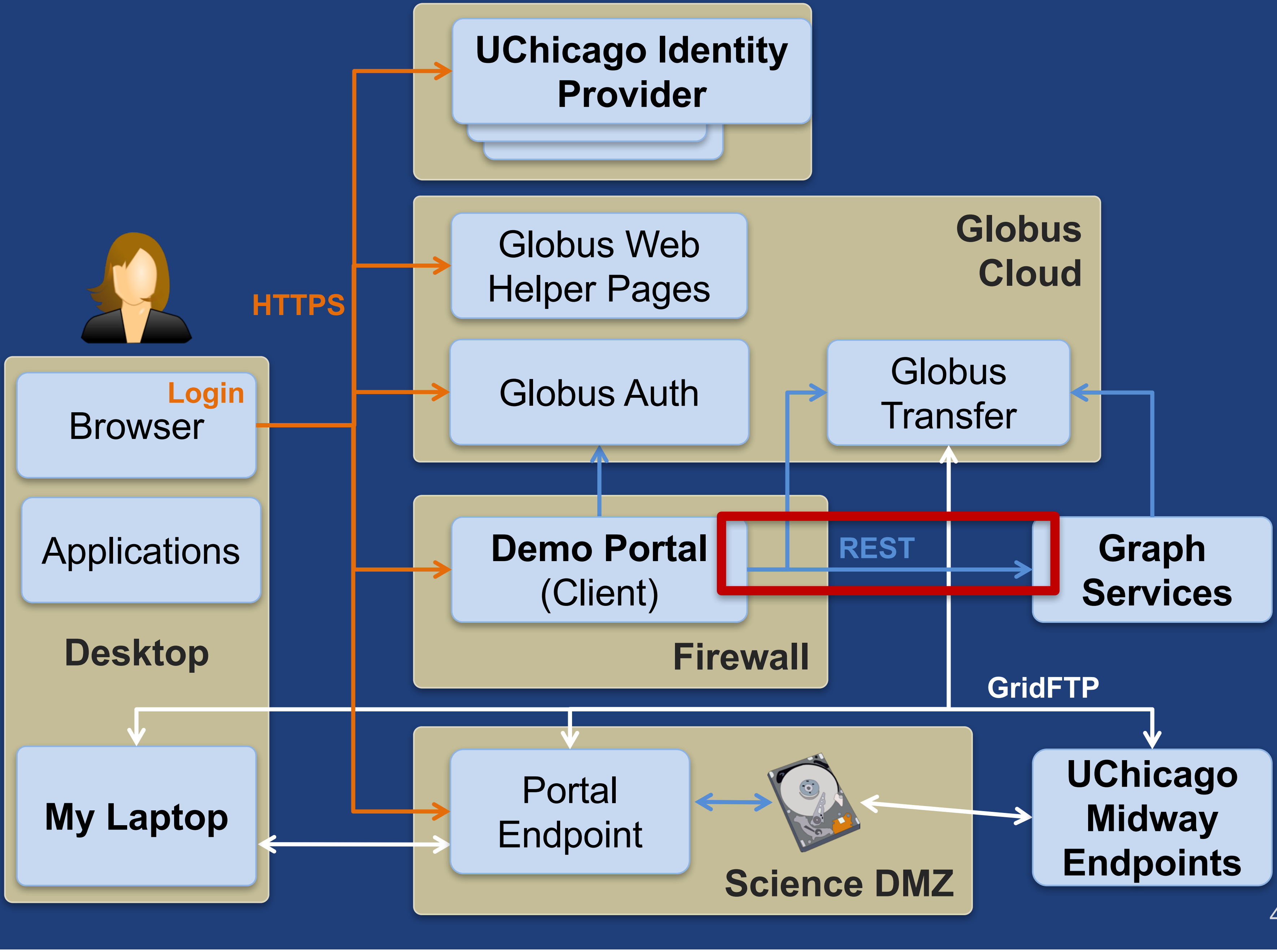
Researchers and resource providers are our greatest inspiration and we love it when they say nice things about



Demo

# Jetstream App use of Globus Auth

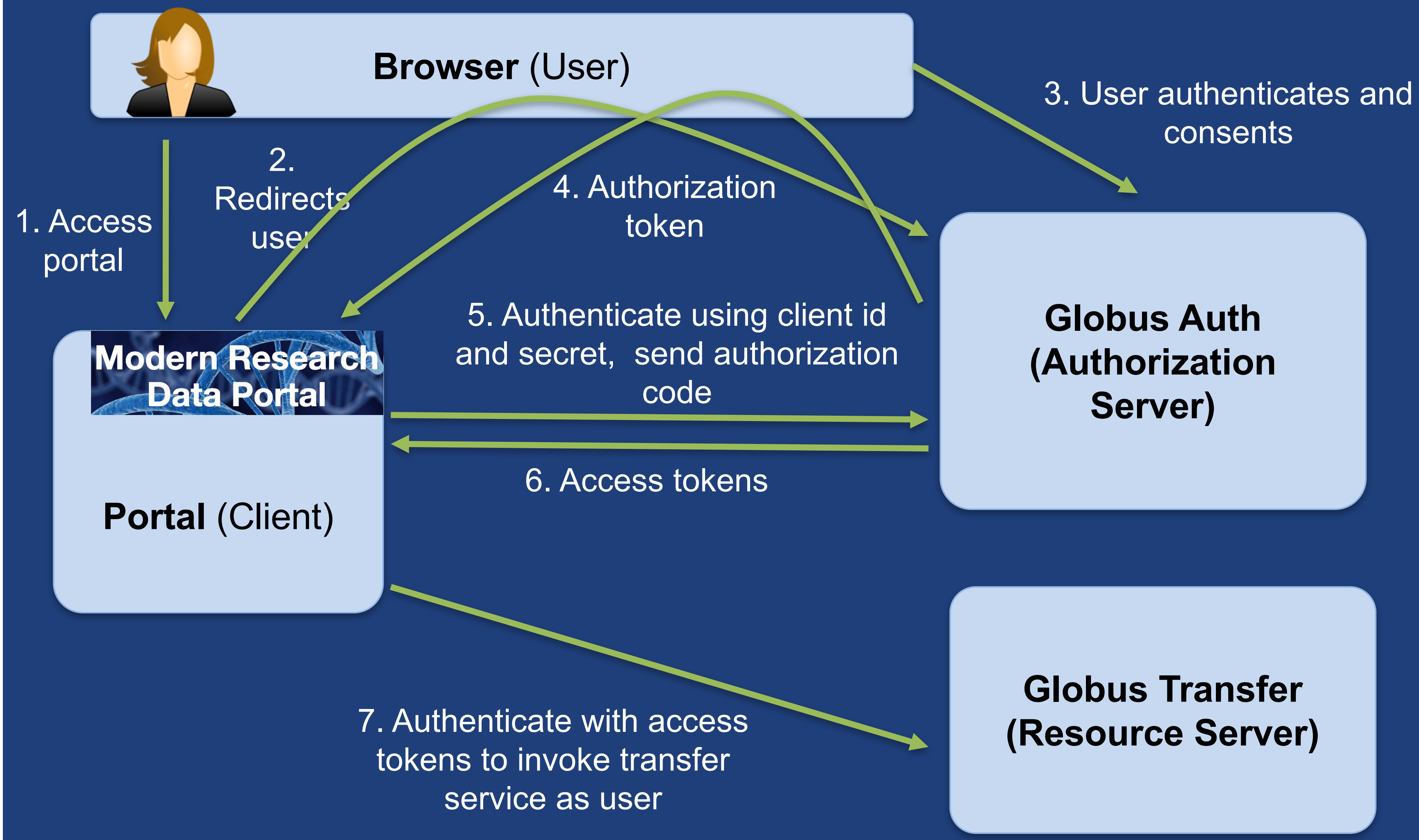
# Sample Research Data Portal



# 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

Modern Research Data Portal

**Portal** (Client)

**Globus Auth (Authorization Server)**

**Globus Transfer (Resource Server)**

# 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)**

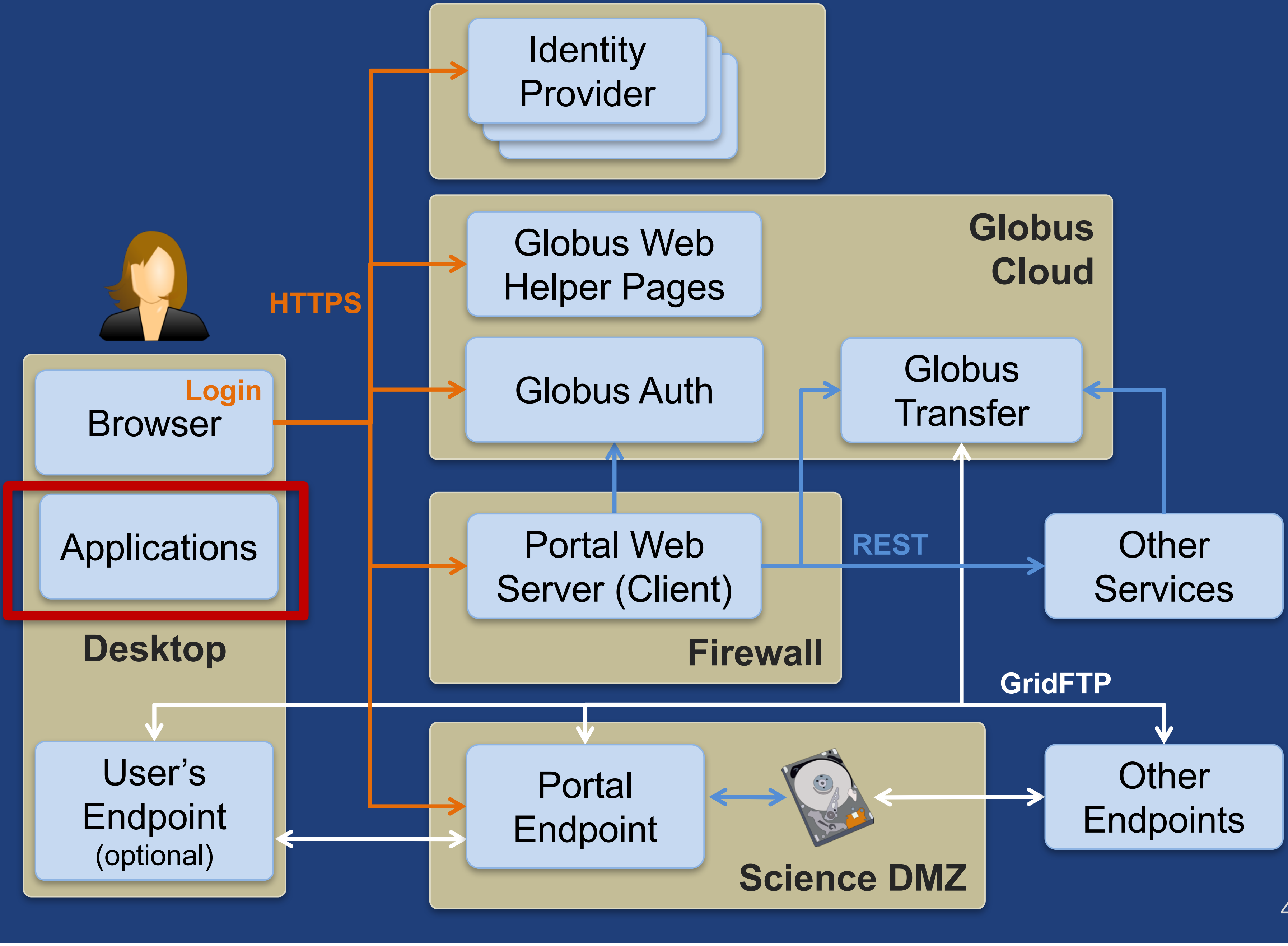
**developers.globus.org**

# Sample Research Data Portal

# Demo: Install and Register

# Code walk through

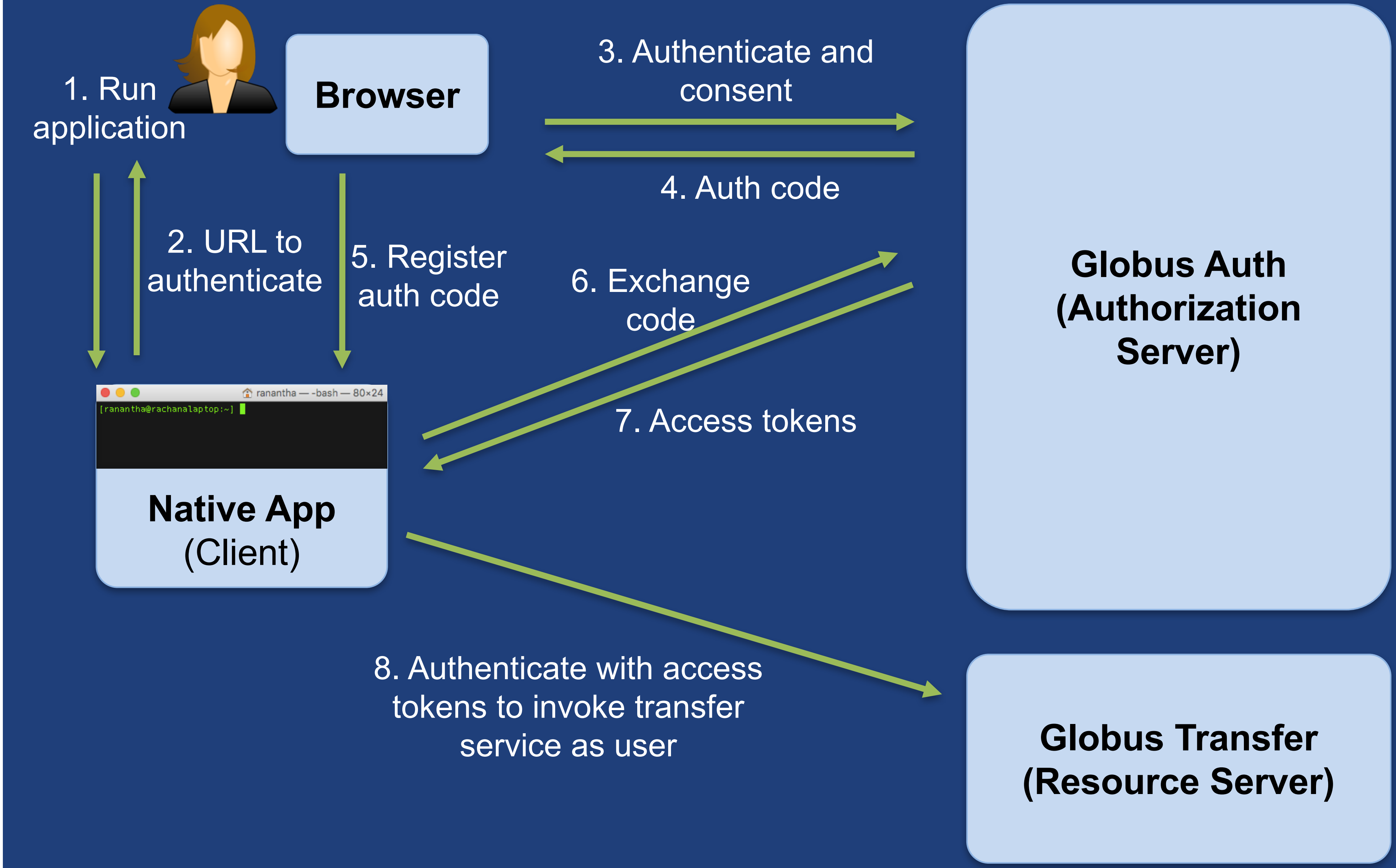
# Prototypical research data portal



# Use case: Native apps

- **Examples**
  - Command line, desktop apps
  - Mobile apps
  - Jupyter notebooks
  - Any client that cannot keep a secret (downloaded)
- **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



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

ranantha — -bash — 80×24

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

**Native App**
(Client)

**Globus Auth (Authorization Server)**

**Globus Transfer (Resource Server)**

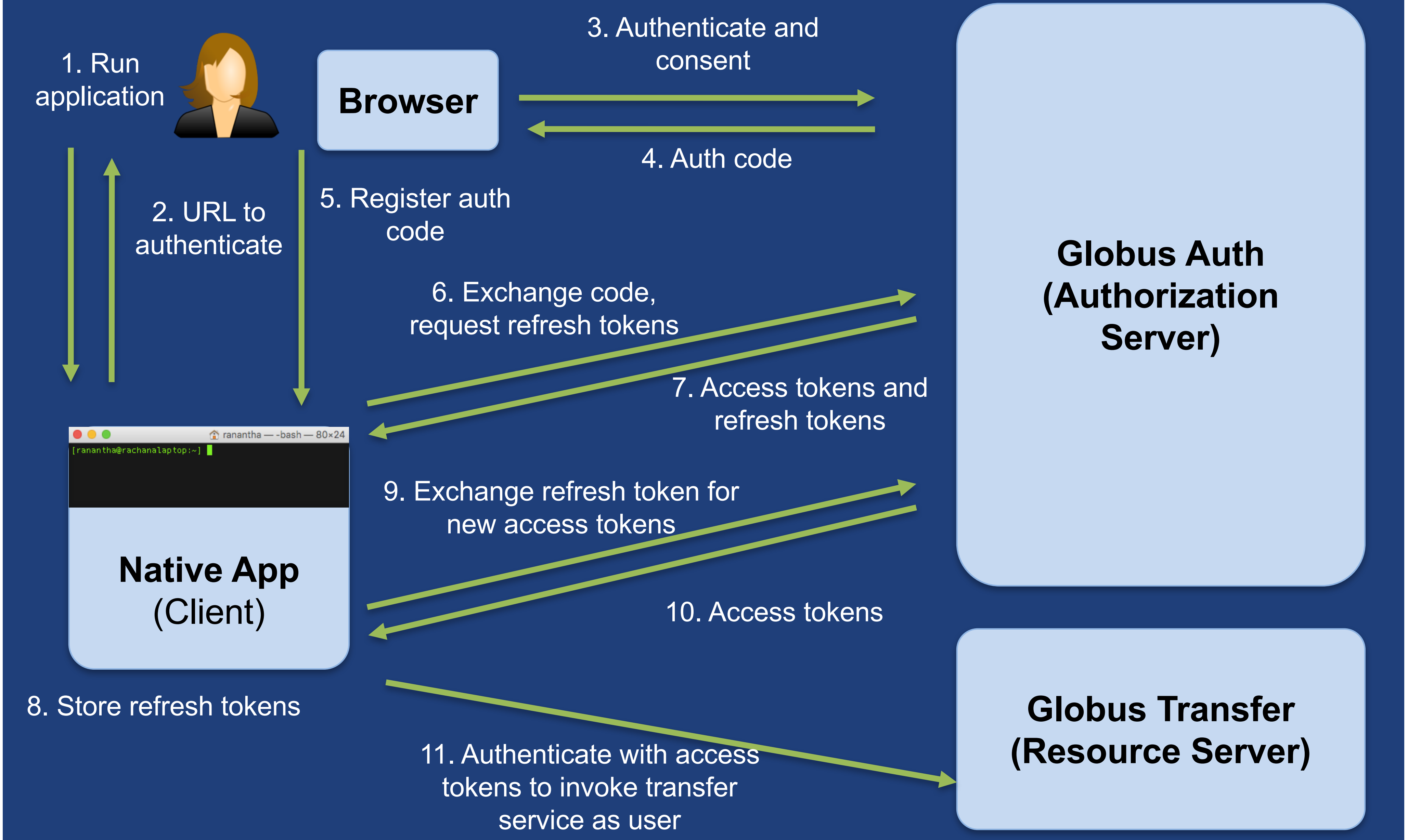
# Use case: Apps that need access tokens for long time

- **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

# Refresh tokens

- **For “offline services”**
  - E.g., Globus transfer service working on your behalf even when you are offline
- **Refresh tokens issued to a particular client for use with a 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

Browser

3. Authenticate and consent

4. Auth code

2. URL to authenticate

5. Register auth code

6. Exchange code, request refresh tokens

7. Access tokens and refresh tokens

ranantha — -bash — 80×24

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

Native App (Client)

9. Exchange refresh token for new access tokens

10. Access tokens

8. Store refresh tokens

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

Globus Auth (Authorization Server)

Globus Transfer (Resource Server)

# Demo: Native App/Refresh Tokens

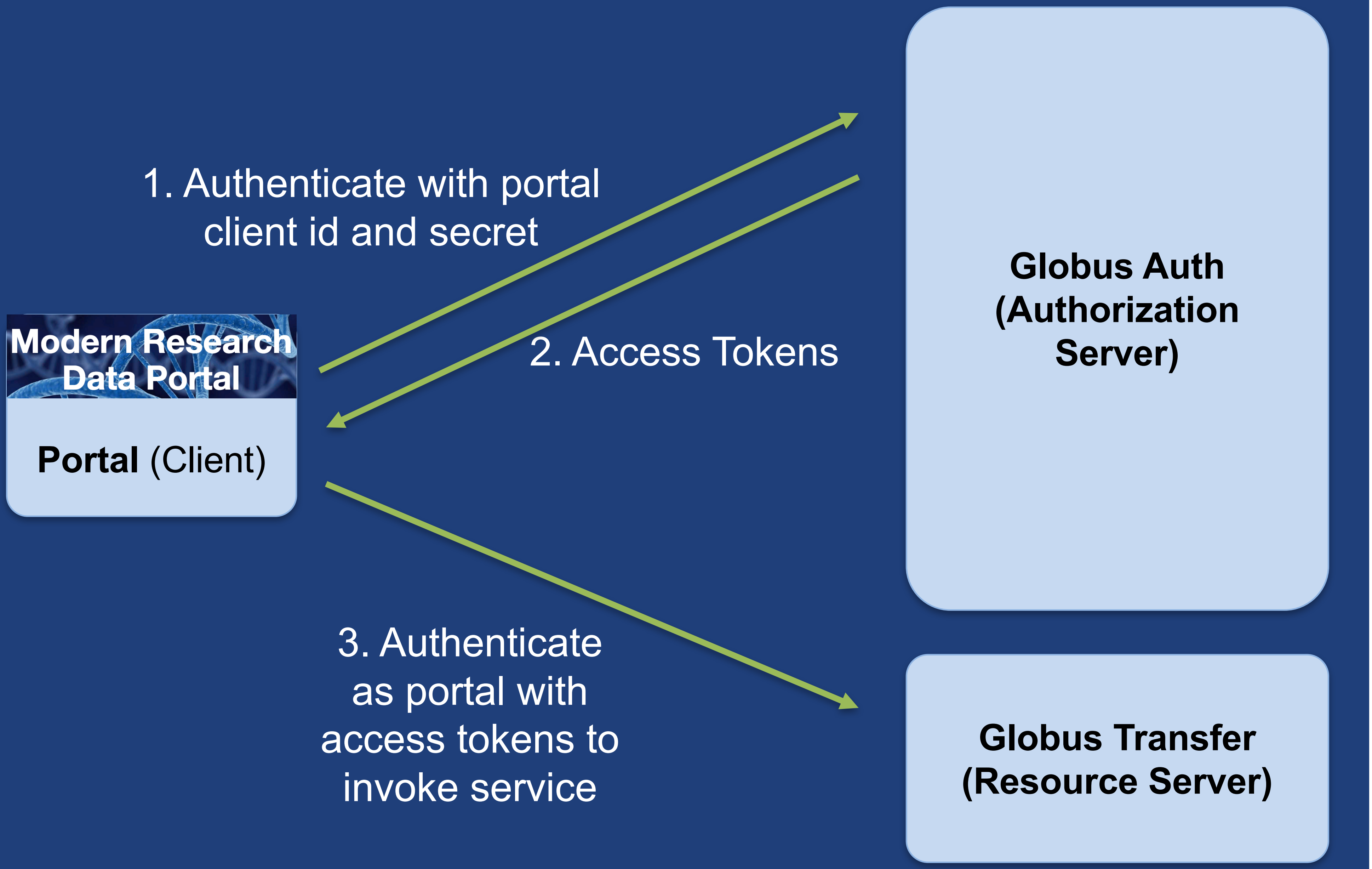
[https://github.com/globus/native-app-examples](https://github.com/globus/native-app-examples)

- **README for install instructions**
- **./example_copy_paste.py**
  - Copy paste code to the app
- **./example_local_server.py**
  - Local server to get the code
- **./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`)
- **Client Credential Grant is used**
- **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

# Client credential grant



1. Authenticate with portal client id and secret

2. Access Tokens

3. Authenticate as portal with access tokens to invoke service

Modern Research Data Portal

**Portal** (Client)

**Globus Auth (Authorization Server)**

**Globus Transfer (Resource Server)**

# User identity vs. portal identity

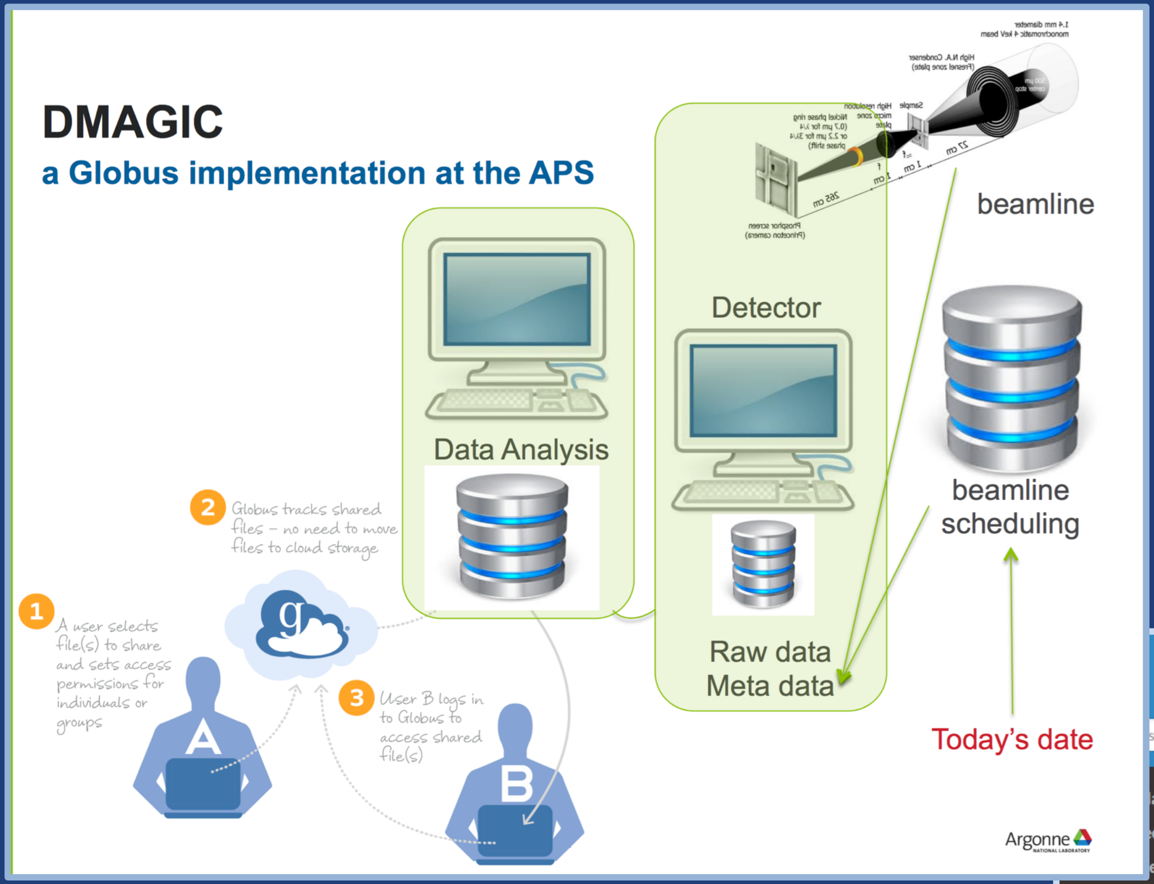
- **User logging into portal results in portal having user's identity and access token**
  - Used to make requests on the user's behalf
- **Portal may also need its own identity**
  - Access and refresh tokens for this identity
  - Used to make requests on its own behalf, e.g. set an ACL on a shared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

# Exercise: Using Client credential grant

- **Start with native app examples**
- **Register a new app to get client id and secret**
- **Globus SDK:**
  - ConfidentialClientApp
  - AccessTokenAuthorizer
- **Using the Globus webapp:**
  - Create a shared endpoint
  - Set Access Manager role for the new client id
- **List files on the shared endpoint as the client identity**
- **Change permissions on the shared endpoint as the client identity**
- **Hint: Look at Jupyter notebook for SDK calls for the transfer operations**

# Automating Common Tasks with Globus

# Example: APS data distribution



## DMAGIC

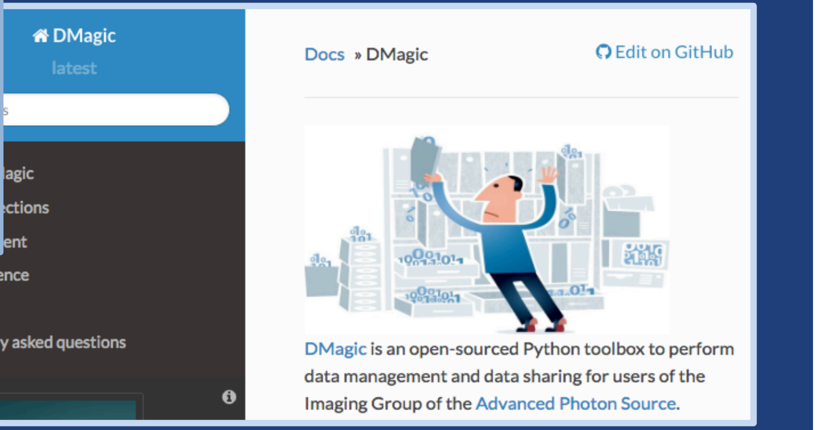
**a Globus implementation at the APS**

beamline
Detector
Data Analysis
beamline scheduling
Raw data
Meta data
Today's date
1 A user selects file(s) to share and sets access permissions for individuals or groups
2 Globus tracks shared files – no need to move files to cloud storage
3 User B logs in to Globus to access shared file(s)
A
B
Argonne

Courtesy of Francesco De Carlo, Argonne National Laboratory (2016)

## DMagic

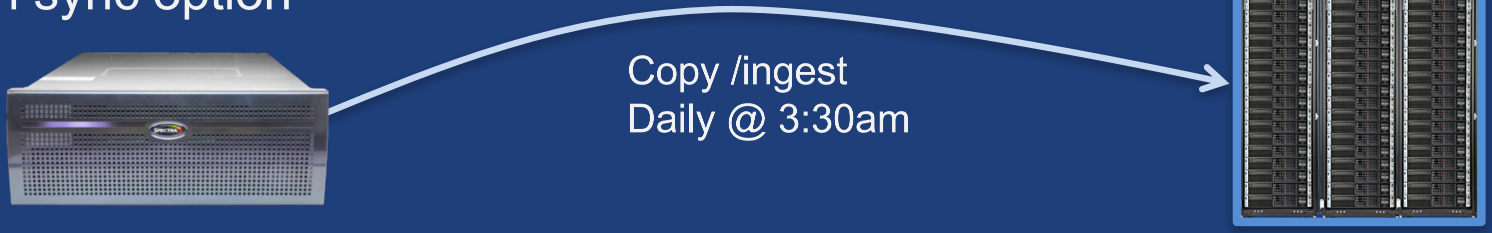
## ANL APS



DMagic is an open-sourced Python toolbox to perform data management and data sharing for users of the Imaging Group of the Advanced Photon Source.

dmagic.readthedocs.io

# 1. Scheduled replication

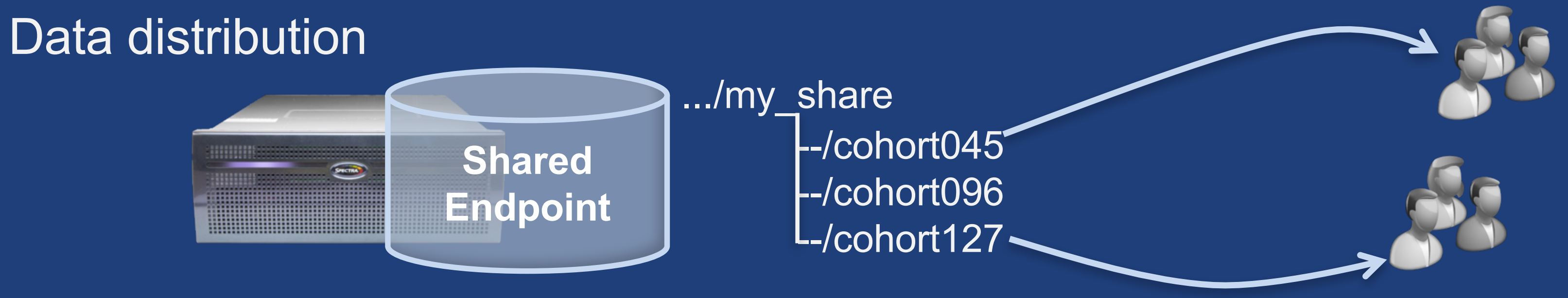


Recurring transfers
with sync option

Copy /ingest
Daily @ 3:30am

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

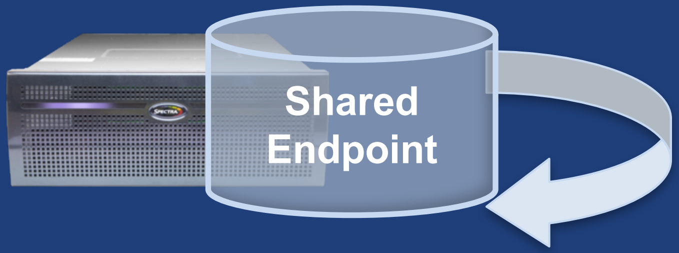
# 2. Data distribution using sharing



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

# 3. Monitor and clean up

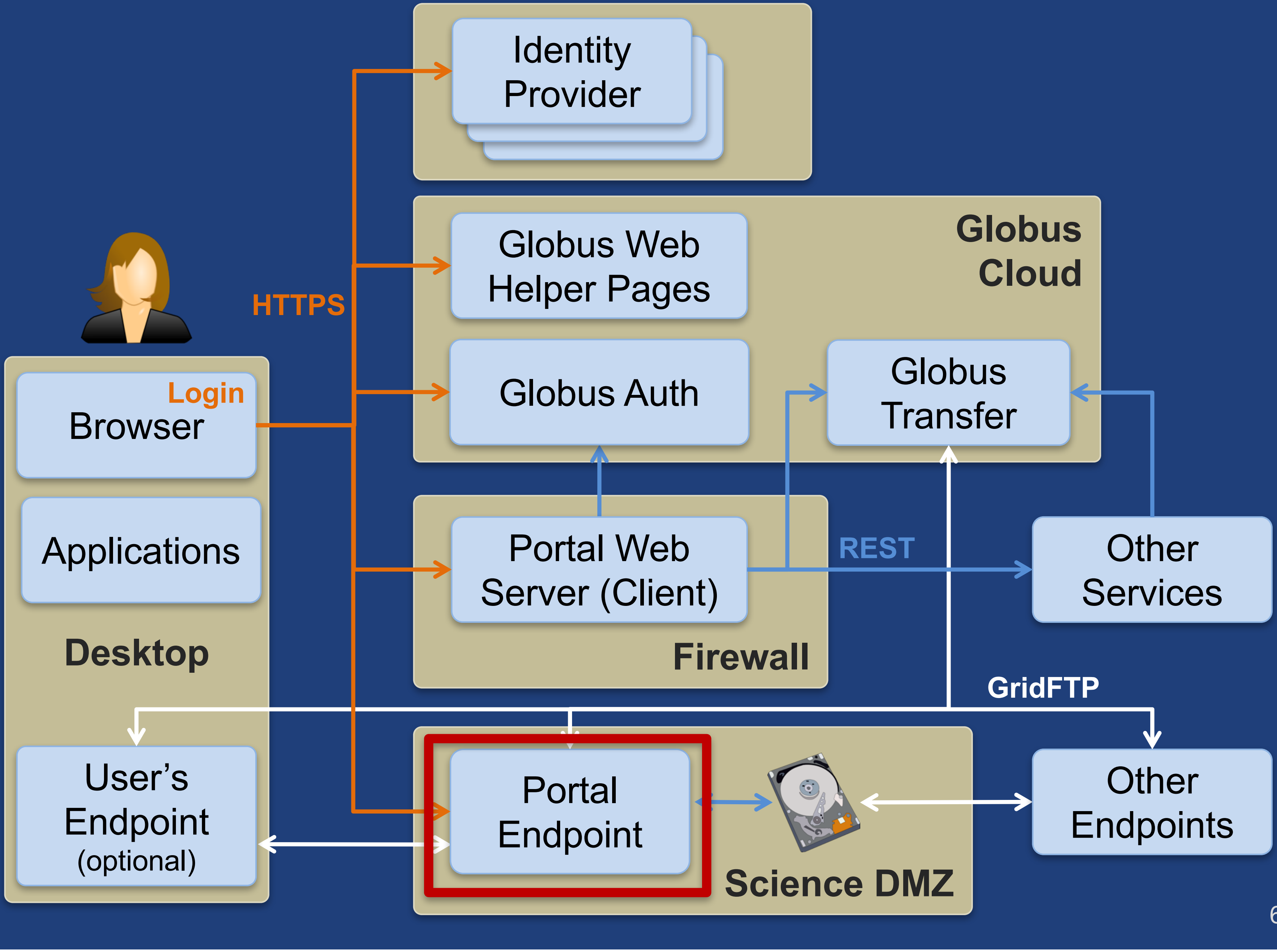
Staging
area
cleanup



1. Check if successful transfer
2. Delete data from staging area

- **Poll model to get status**
- **Delete files**

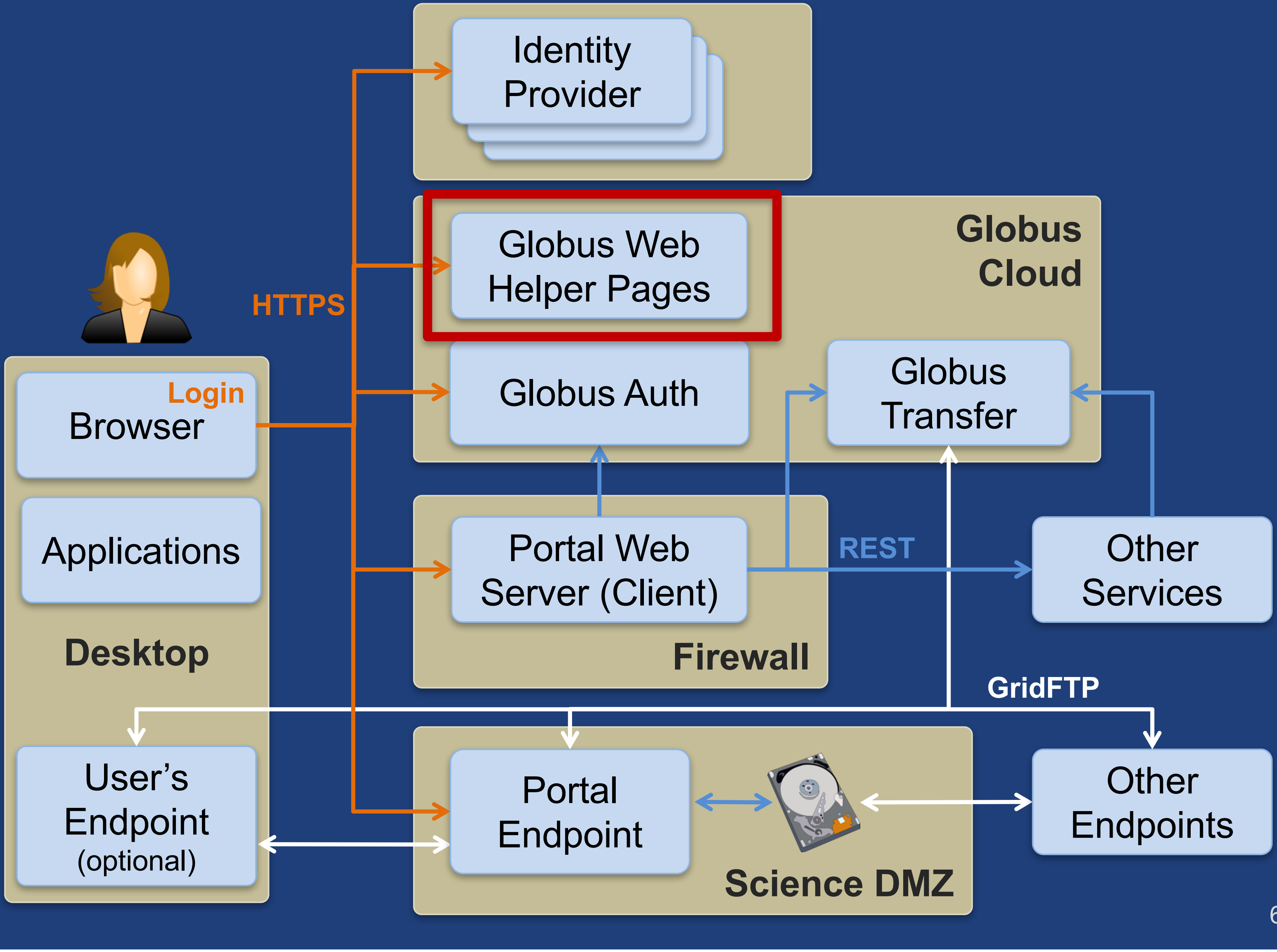
# Prototypical research data portal



# HTTPS to Endpoints

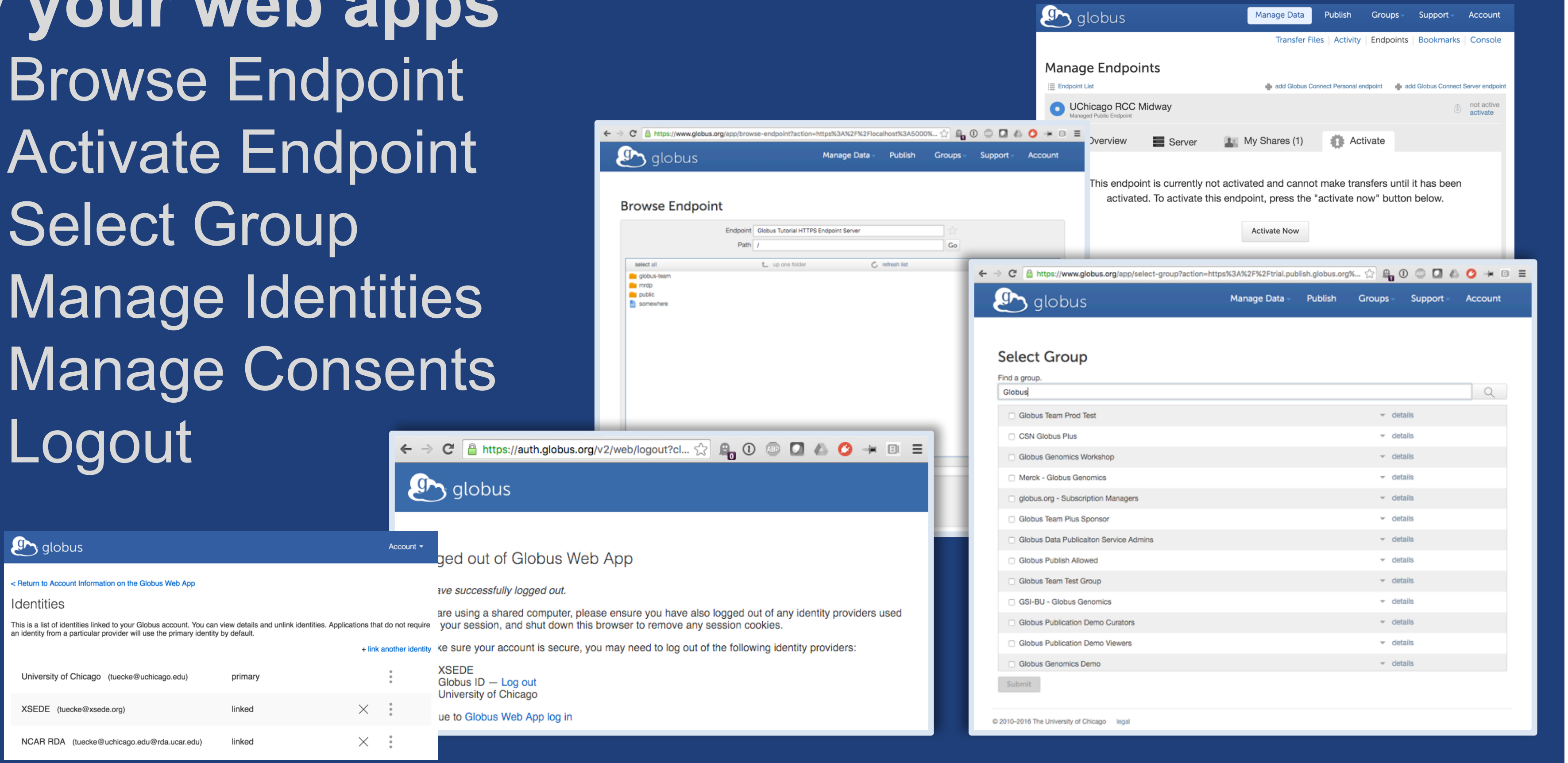
- **Each endpoint HTTPS server is a Globus Auth service (resource server)**
- **Web page can link to file on server**
  - Browser GET will cause HTTPS server to authorize request via Globus Auth (note SSO)
- **Portal (client) can request scope for endpoint resource server**
  - Use access token in requests

# Prototypical research data portal



# Globus Helper Pages

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


globus
Manage Data
Publish
Groups
Support
Account
Transfer Files | Activity | Endpoints | Bookmarks | Console

Manage Endpoints

Endpoint List
add Globus Connect Personal endpoint
add Globus Connect Server endpoint

UChicago RCC Midway
Managed Public Endpoint
not active
activate

Overview
Server
My Shares (1)
Activate

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.

https://www.globus.org/app/browse-endpoint?action=https%3A%2F%2Flocalhost%3A5000%...

Browse Endpoint

Endpoint: Globus Tutorial HTTPS Endpoint Server
Path: /

globus-team
mrdp
public
somewhere

https://www.globus.org/app/select-group?action=https%3A%2F%2Ftrial.publish.globus.org%...

Select Group

Find a group.
Globus

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

© 2010-2016 The University of Chicago legal

https://auth.globus.org/v2/web/logout?cl...

ged out of Globus Web App

*ave 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

< Return to Account Information on the Globus Web App

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.

+ link another identity

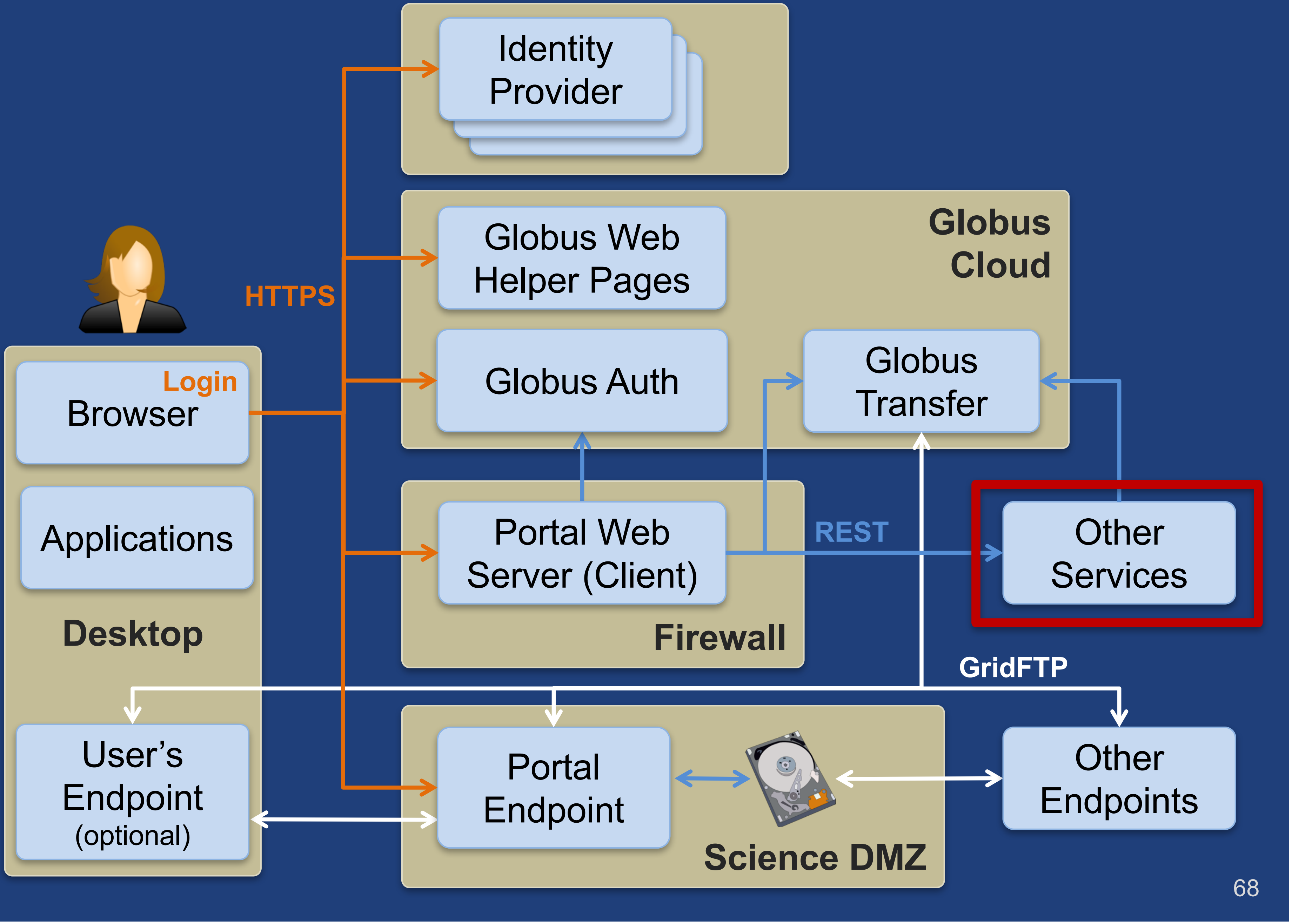
| | |
|---|---|
| University of Chicago (tuecke@uchicago.edu) | primary |
| XSEDE (tuecke@xsede.org) | linked |
| NCAR RDA (tuecke@uchicago.edu@rda.ucar.edu) | linked |

**docs.globus.org/api/helper-pages**

# Client Logout

- **Call token revocation on access tokens**
  - https://auth.globus.org/v2/oauth2/token/revoke
  - Doc: **docs.globus.org/api/auth/reference**
  - Note: Does not revoke dependent tokens
- **Delete access tokens**
- **Redirect to logout helper page**
  - https://auth.globus.org/v2/web/logout
  - Doc: **docs.globus.org/api/helper-pages**

# Prototypical research data portal



# Why create your own services?

- **Front-end / back-end within your portal**
  - Remote backend for portal
  - Backend for pure Javascript browser apps

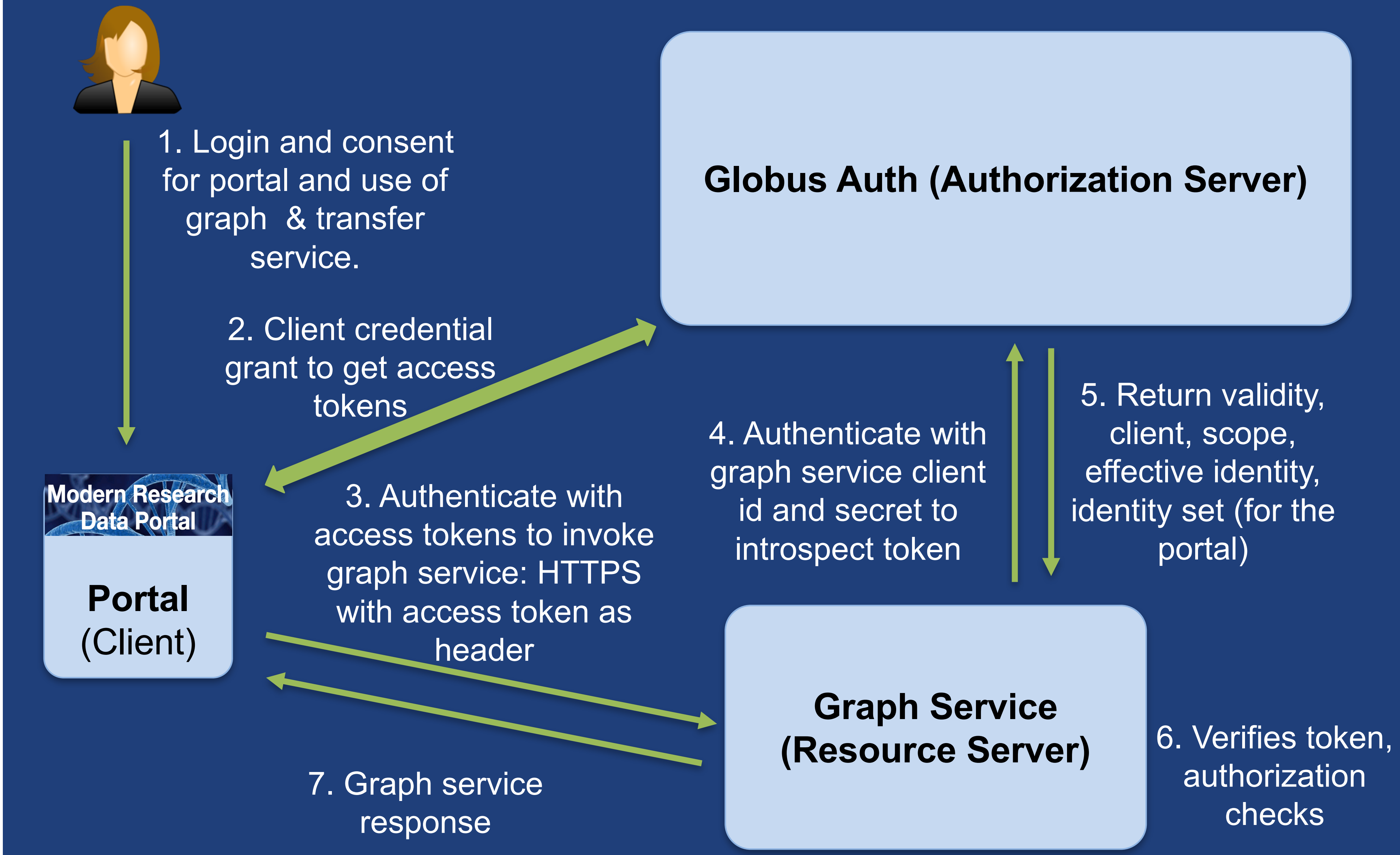
- **Extend your app/portal with a public REST API, so that other developers can integrate with and extend it**

# Why Globus Auth for your service?

- **Outsource all identity management and authentication**
  - Federated identity with InCommon, Google, etc.
- **Outsource your REST API security**
  - Consent, token issuance, validation, revocation
  - You provide service-specific authorization
- **Apps use your service like all others**
  - Its standard OAuth2 and OIDC
- **Your service can seamlessly leverage other services**
- **Other services can leverage your service**
- **Implement your service using any language and framework**

***Add your service to the science cyberinfrastructure platform***

# Portal to Graph service interaction



1. Login and consent for portal and use of graph & transfer service.

2. Client credential grant to get access tokens

3. Authenticate with access tokens to invoke graph service: HTTPS with access token as header

4. Authenticate with graph service client id and secret to introspect token

5. Return validity, client, scope, effective identity, identity set (for the portal)

6. Verifies token, authorization checks

7. Graph service response

Globus Auth (Authorization Server)
Modern Research Data Portal
Portal
(Client)
Graph Service
(Resource Server)

# Summary of how resource works

- **Registeration of resource servers**
  - Scopes
- **Dependent services**
- **Validation**

# Additional Features for Service Developers

# Service registration

- **Client_id and client_secret for service**
- **Service display name**
- **Validated DNS name for service**
- **One or more scopes**
- **Authorize clients to use each scope**
  - All clients (public API), or specific clients
- **Declare dependent scopes**
  - Need long-term, offline refresh tokens?
  - May require authorization from scope admin
- **Links for terms of service & privacy policy**
- **Effective identity policy (optional)**
- **Email: support@globus.org**

# Effective identity

- **App or service can choose to operate only with identities from a particular identity provider**
  - Globus Auth login will require an identity from that provider to be linked to user's account
  - OIDC id_token uses this "effective identity"
- **If app or service does not set an effective identity policy, then the primary identity of the account is used as the effective identity for that app**

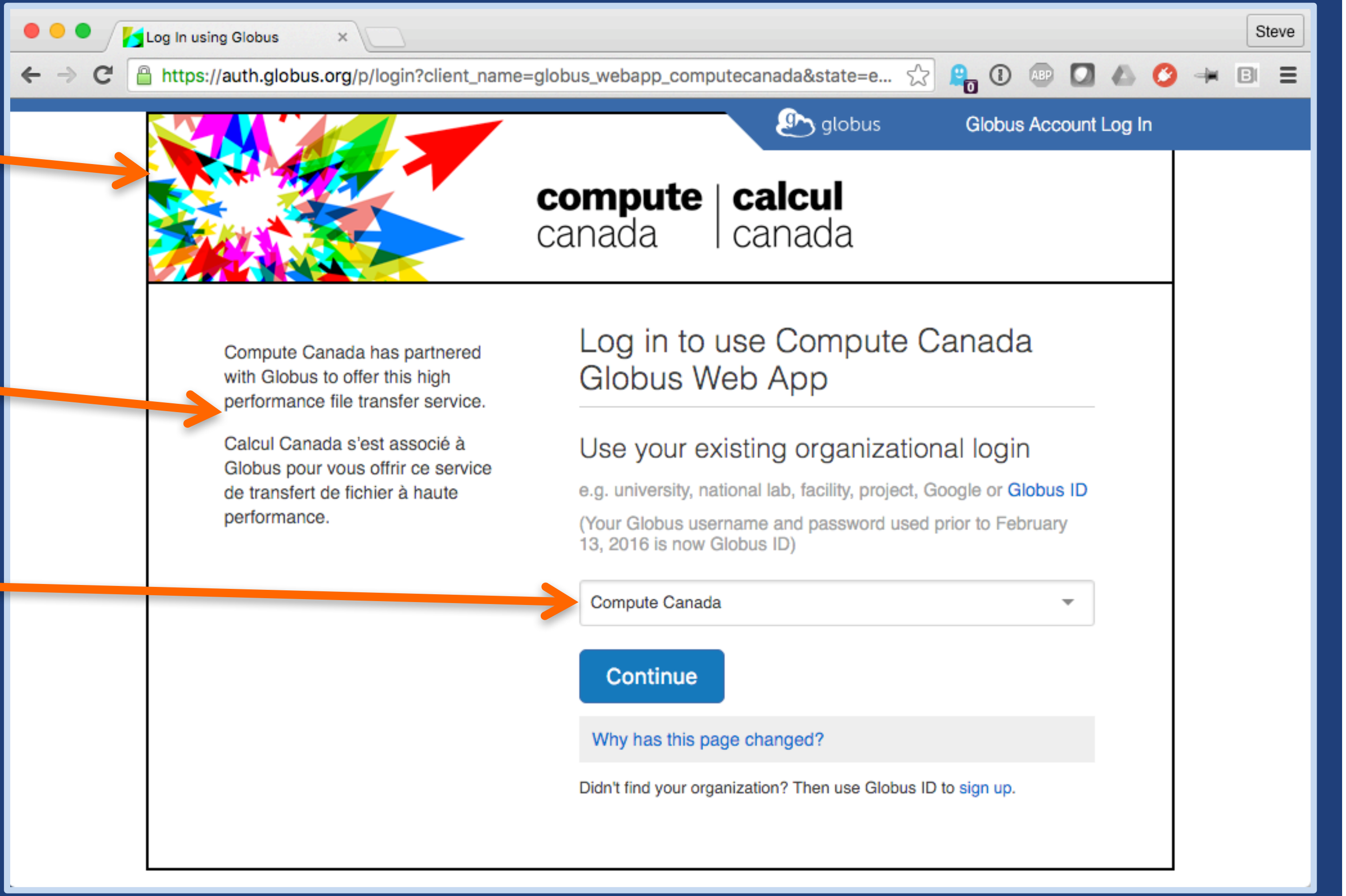
# Branding

- **Can skin Globus Auth pages**

Header

Text

Default IdP



Log In using Globus
Steve
https://auth.globus.org/p/login?client_name=globus_webapp_computecanada&state=e...
globus
Globus Account Log In
compute canada | calcul canada

Compute Canada has partnered with Globus to offer this high performance file transfer service.

Calcul Canada s'est associé à Globus pour vous offrir ce service de transfert de fichier à haute performance.

Log in to use Compute Canada Globus Web App

Use your existing organizational login

e.g. university, national lab, facility, project, Google or Globus ID

(Your Globus username and password used prior to February 13, 2016 is now Globus ID)

Compute Canada

Didn't find your organization? Then use Globus ID to sign up.

# Token caching

- **Service should cache tokens and related information**
  - Improves performance of service
  - Reduces load on Globus Auth
- **Access token -> introspect response**
  - Cache timeout: 1-30 seconds recommended
  - To improve performance and load related to bursty use of REST API
  - Validity: Timeout duration determines responsiveness to token revocation and rescinding consent
  - client, scope, effective_identity: these will never change for an access token
- **Refresh tokens**
  - For however long they are needed for specific operations.

# Join the Globus developer community

- **Join developer-discuss@globus.org mailing lists: globus.org/mailing-lists**
- **Python SDK is open source**
  - **github.com/globus/globus-sdk-python**
  - Submit issues, pull requests
  - Discussions on **developer-discuss@globus.org**
- **All tutorial materials are open source on github**
- **Documentation: docs.globus.org**