SciTokens and Credential Management

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HTCondor Week 2019

This material is based upon work supported by the National Science Foundation under Grant No. 1738962. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

SciTokens Project

- The SciTokens project, started July 2017, aims to:
  - Introduce a ***capabilities-based*** **authorization infrastructure** for distributed scientific computing,
  - Provide a **reference platform**, combining CILogon, HTCondor, CVMFS, and XRootD, and
  - **Implement specific use cases** to help our science stakeholders (LIGO and LSST) better achieve their scientific aims.

Identity-based Authorization

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- At the core of today's grid security infrastructure is the concept of *identity* and *impersonation*.
  - A grid certificate provides you with a globally-recognized identification.
  - The grid proxy allows a third party to impersonate you, (ideally) on your behalf.
  - The remote service maps your identity to some set of locally-defined authorizations.
- We believe this approach is fundamentally wrong because it exposes too much global state: identity and policy should be kept locally!

Capability-based Authorization

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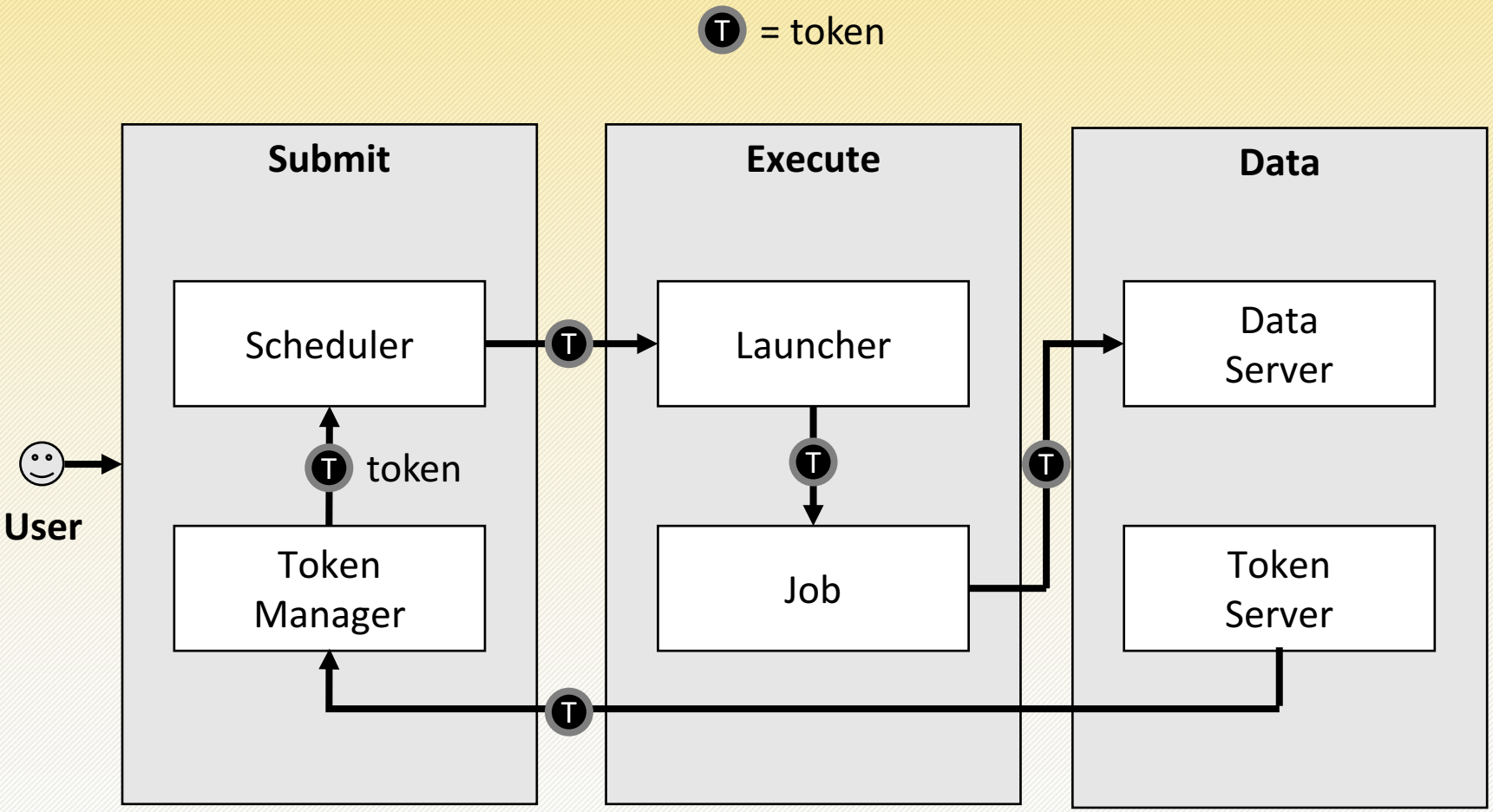
- We want to change the infrastructure to focus on *capabilities*!
  - The tokens passed to the remote service describe what authorizations the bearer has.
  - For traceability purposes, there may be an identifier that allows tracing of the token bearer back to an identity.
  - Identifier != identity. It may be privacy-preserving, requiring the issuer (VO) to provide help in mapping.
- Example: “The bearer of this piece of paper is entitled to write into /data/zmiller".

Capabilities versus Impersonation

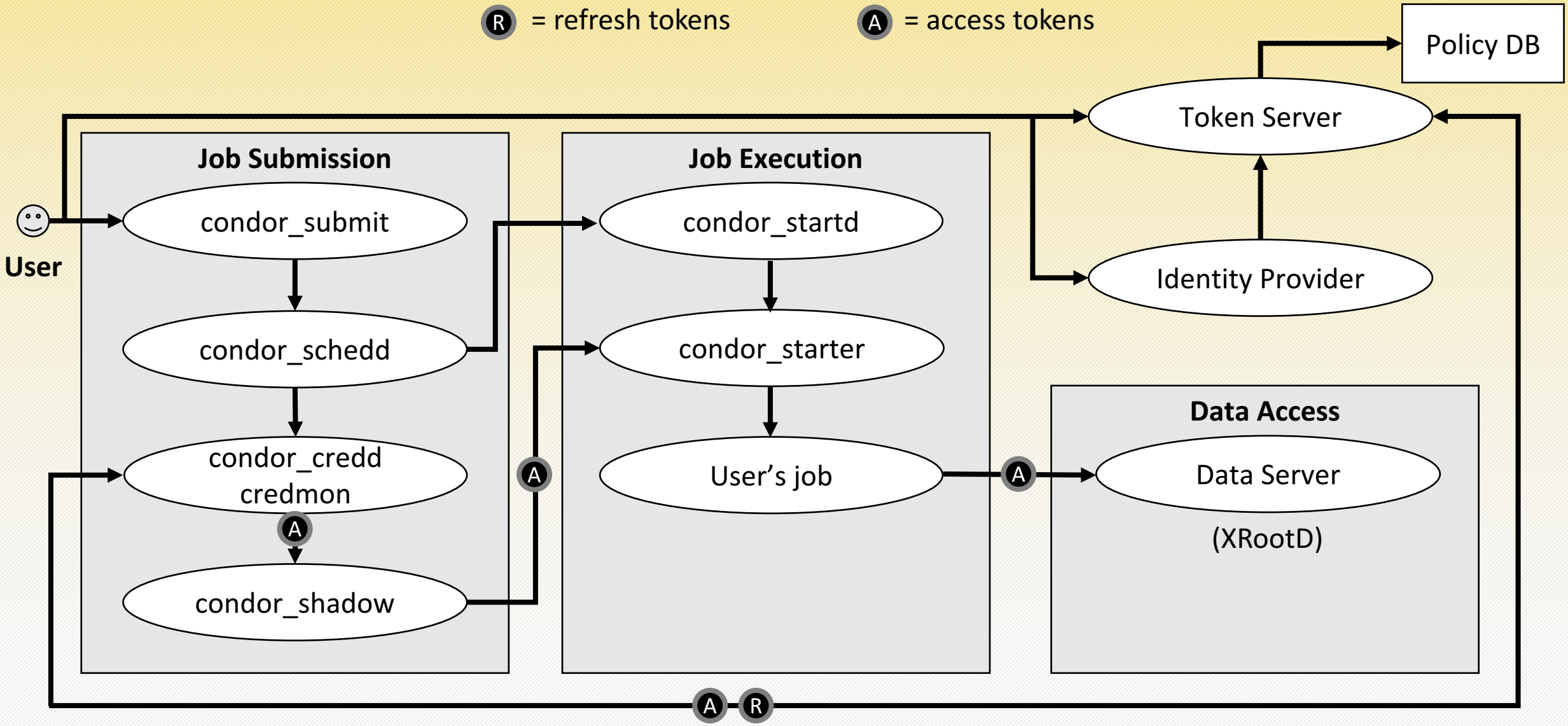
- If GSI took over the world, an attacker could use a stolen grid proxy to make withdrawals from your bank account.
- With capabilities, a stolen token only gets you access to a specific authorization (“stageout to /data/zmiller at Wisconsin”).
- SciTokens is following the **principle of least privilege** for distributed scientific computing.

SciTokens Model

- Integrating an OAuth2 client on the HTCondor submit host
- Enhancing HTCondor to manage token refresh and delivery to jobs
- Enhancing data services (e.g. Xrootd) to allow read/writes using tokens instead of grid proxies



Architecture



CredD

- Runs under the condor_master like all other HTCondor daemons

- Manages credentials stored in a special “credential directory” with restricted permissions. Regular users cannot read or write within this directory, but the CredD can.

CredD

SCI TOKENS

- Has two “modes”
  - Kerberos mode, which I talked about last year
  - OAuth mode, which I am talking about now
- Currently the two modes cannot coexist due to different conventions for layouts of the credential directory
- Future work includes merging these modes so both can be used at the same time

CredD

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- In the old “Kerberos Mode”, the CredD would only hold one credential per user.
- The CredD in “OAuth Mode” can now hold multiple credentials per user
- I’m skipping the internals for this talk and focusing more on the higher-level concepts, but please come talk to me if you are curious or have questions.

CredD

- Okay… back to OAuth mode!
- The CredD in “OAuth Mode” can now hold multiple credentials per user
- These can be tokens from different services:
  - scitokens
  - box.com
- There can be different scopes (permissions) for the same service:
  - scitokens_uw_read_zmiller
  - scitokens_uw_write_jpatton

CredD

SCI TOKENS

- The user defines the tokens they need and the names (handles) and scopes in their submit file

- Jason will describe and demo that later…
  - w00t! DEMO! ☺

CredD

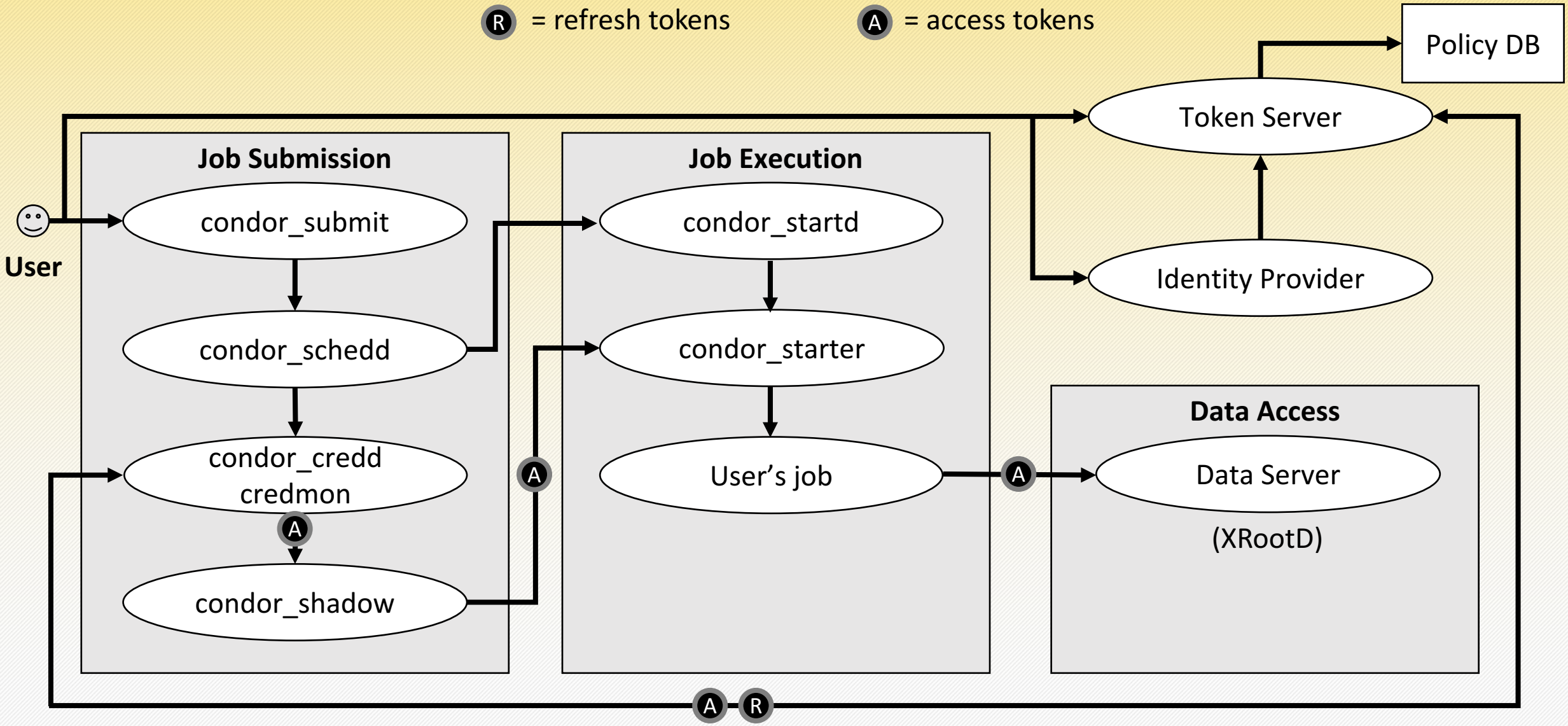
- The CredD itself deals with the secure storage and retrieval of the the credentials
- It does NOT know or understand the contents of the credentials – they are opaque to the CredD
- Another component is in charge of understanding and manipulating OAuth tokens: the **CredMon**

CredMon

SCI TOKENS

- Responsible for obtaining tokens by talking to the various services
- Monitors the existing tokens and knows how to refresh them
- Receives signals from the CredD when there is potentially new work for it do do

Architecture



Credential Flow

SCI TOKENS

- User specifies in their submit file what credentials they need.
- Run condor_submit:

```
Hello, zmiller.
Please visit:
        https://baphomet.cs.wisc.edu/key/f40740d...34a0eebac1
```

- User does so and follows directions
  - That's Jason's demo and I'm not going to steal his thunder!

Credential Flow

- User specifies in their submit file what credentials they need.
- Run condor_submit:

```
Submitting job(s).
1 job(s) submitted to cluster 39033.
```

- This time it worked because condor_submit checked with the CredD and all the tokens were present. Thus, the job can now run!

Credential Flow

- Job matches and starts running
- After the sandbox directory is created, but BEFORE any files are transferred, the condor_starter calls back to the condor_shadow to fetch tokens
- Only the tokens for THAT job are sent
- Only the ACCESS tokens are sent
- HTCondor ensures the communication channel is encrypted, or it refuses to send the tokens.

Credential Flow

- The access tokens are placed into the job sandbox in the `.condor_creds` directory
- Environment variable within the job `_CONDOR_CREDS` points to the full path for that directory
- Tokens are refreshed periodically while job continues running
- Tokens are cleaned up automatically when job exits since they are in the job sandbox

```
my_prog --token=$_CONDOR_CREDS/scitokens.use
```

Configuration

- Get a certificate for their submit server
- Configure box.com
  - You need a developer account
  - Create a new app
- Register your submit server
- Configure HTCondor
- This will appear in more and complete detail on the HTCondor Wiki:
  - https://htcondor-wiki.cs.wisc.edu/index.cgi/wiki

Configuration

- One fairly straightforward way to get a certificate is by using the Let's Encrypt service and certbot

- https://letsencrypt.org/

Let's Encrypt

certbot

Automatically enable HTTPS on your website with EFF's Certbot, deploying Let's Encrypt certificates.

Configuration

- Create a custom box.com app that uses OAuth

box Developers

My Apps

REFERENCE

SDKs

API Docs

Support

ACCOUNT

My Files

Settings

My Apps

Create New App

Custom App

Build a standalone app with Box's content services, such as managing and rendering files and enabling end-user collaboration.

For developers using Box's content services without requiring Box user accounts.

Standard OAuth 2.0 (User Authentication)

Requires Box users to log in with a username and password to authorize your app to access content in their account.

Back

Next

Configuration

- Register submit machine

box Developers

My Apps

SCITOKENZ2

General

Configuration

Webhooks

Integrations

App Gallery

REFERENCE

SDKs

API Docs

Support

Configuration

Save Changes

Configure the authentication and permissions for your app to begin using the Box APIs. Check out our Getting Started Guide for a walkthrough of these settings.

OAuth 2.0 Credentials

Credentials for using OAuth 2.0 as your Authentication type.

Client ID

wluxtsxho2c4vabn3xs6n8lh0c0fznwu COPY

Client Secret

•••••••••••••••••••••••••••••••• COPY

Reset

OAuth 2.0 Redirect URI

The redirect URI is the URL within your application that will receive OAuth 2.0 credentials.

Redirect URI

https://baphomet.cs.wisc.edu/return/box

Configuration

- Example configuration for the submit machine to interface with box.com

```
# Box.com client
BOX_CLIENT_ID = wluxtsxho2c4vabn3xs6n8lh0c0fznwu
BOX_CLIENT_SECRET_FILE = /etc/condor/.secrets/box
BOX_RETURN_URL_SUFFIX = /return/box
BOX_AUTHORIZATION_URL =
      https://account.box.com/api/oauth2/authorize
BOX_TOKEN_URL = https://api.box.com/oauth2/token
BOX_USER_URL = https://api.box.com/2.0/users/me
```

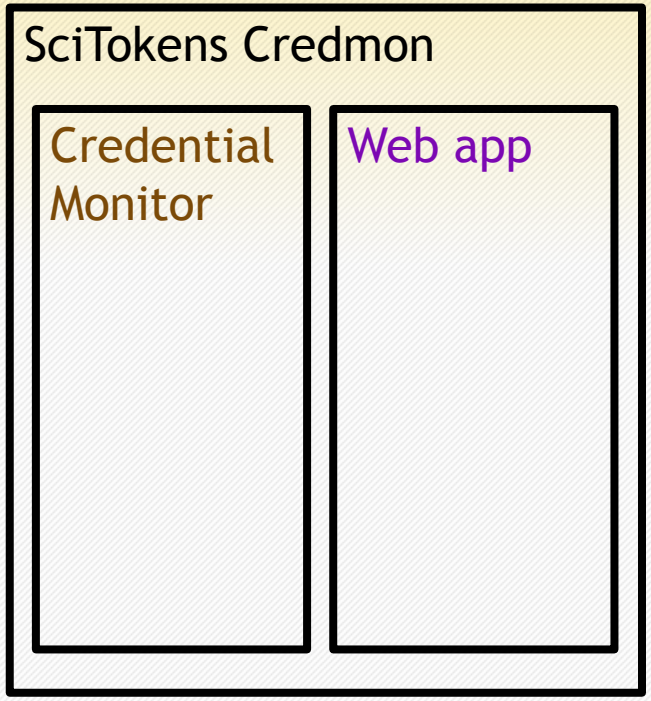
Configuration

- Many details were glossed over

SciTokens Credmon and Job Submission

SciTokens Credmon

- Two parts:
  - **Cred**ential **Mon**itor
  - Web app (Python Flask framework)
- Currently supports:
  - OAuth2-style tokens (including SciTokens)
  - Locally issued SciTokens (i.e. issue-on-submit)
- Separate package from HTCondor
  - Near future: `yum install python-scitokens-credmon`



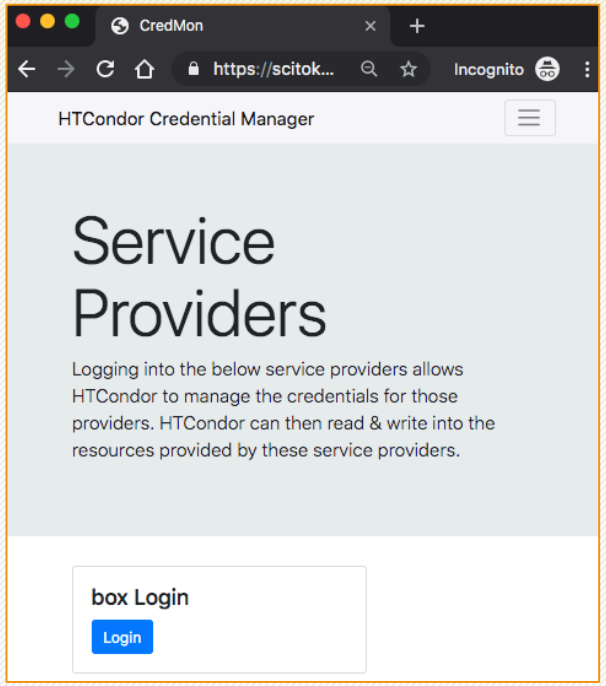
SciTokens Credmon – OAuth2 Support

Web app

Gathers initial tokens

1. Reads ”key” file with user’s and OAuth2 providers’ info.

```
[jcpatton@scitokens-dev box_example]$ condor_submit single_box.submit
Submitting job(s)
Hello, jcpatton.
Please visit: https://scitokens-dev.chtc.wisc.edu/key/03b075c528bc5ed
```



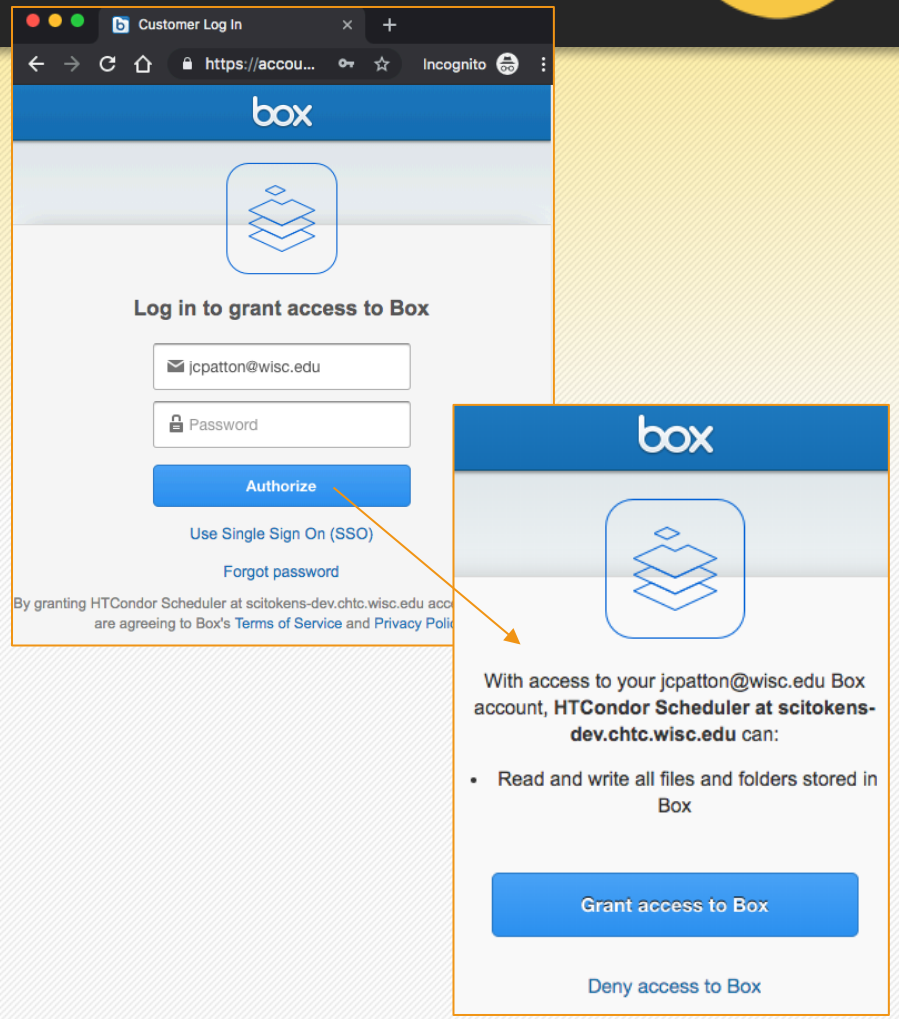
SciTokens Credmon – OAuth2 Support

SCI TOKENS

Web app

Gathers initial tokens

1. Reads ”key” file with user’s and OAuth2 providers’ info.
2. Sends user to OAuth2 providers for authentication and authorization.

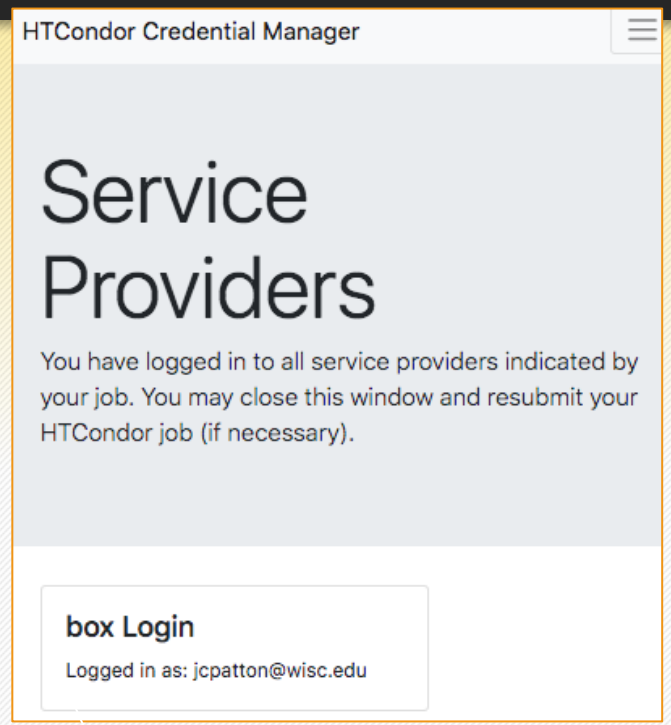


SciTokens Credmon – OAuth2 Support

Web app

Gathers initial tokens

1. Reads ”key” file with user’s and OAuth2 providers’ info.
2. Sends user to OAuth2 providers for authentication and authorization.
3. Stores refresh and access tokens in credential directory.




```
[jcpatton@scitokens-dev box_example]$ \
> sudo ls $(condor_config_val SEC_CREDENTIAL_DIRECTORY)/jcpatton
box.meta  box.top  box.use
```

SciTokens Credmon – OAuth2 Support

Credential Monitor

Keeps active tokens refreshed

```
[jcpatton@scitokens-dev box_example]$ \
> sudo ls $(condor_config_val SEC_CREDENTIAL_DIRECTORY)/jcpatton
box.meta  box.top  box.use
```

1. Scans credential directory for valid refresh tokens.

SciTokens Credmon – OAuth2 Support

SCI TOKENS

Credential Monitor

Keeps active tokens refreshed

```
[jcpatton@scitokens-dev box_example]$ \
> sudo ls $(condor_config_val SEC_CREDENTIAL_DIRECTORY)/jcpatton
box.meta  box.top  box.use
```

1. Scans credential directory for valid refresh tokens.
2. Refreshes corresponding access tokens.

SciTokens Credmon – OAuth2 Support

SCI TOKENS

Credential Monitor

Keeps active tokens refreshed

1. Scans credential directory for valid refresh tokens.
2. Refreshes corresponding access tokens.
3. Writes `CREDMON_COMPLETE` (watched by CredD).

```
[jcpatton@scitokens-dev box_example]$ \
> sudo ls $(condor_config_val SEC_CREDENTIAL_DIRECTORY)
CREDMON_COMPLETE  jcpatton  pid  README.credentials  wsgi_session_key
```

Submitting OAuth2 Jobs

OAuth2 Submit Syntax

- `use_oauth_services = <service1, service2, …>`
  - **REQUIRED** list of requested OAuth2 service providers, which must match (case-insensitive) the provider names in the HTCondor config.

Minimal example - Single provider with no required scopes or resources:

```
executable = transfer_my_box_file.py
arguments = htcondor/testfile.txt

use_oauth_services = box

queue
```

```
$_CONDOR_CREDS/box.use
```

OAuth2 Submit Syntax

- `use_oauth_services = <service1, service2, …>`
  - **REQUIRED** list of requested OAuth2 service providers, which must match (case-insensitive) the provider names in the HTCondor config.

- `<SERVICE>_oauth_permissions[_<HANDLE>] = <scope1, scope2, …>`
  - List of requested token scopes. **OPTIONAL IF** the OAuth2 service provider does not require a scope. The user can provide a handle to give a unique name to the token.

- `<SERVICE>_oauth_resource[_<HANDLE>] = <resource>`
  - The resource that the token should request permissions for. **OPTIONAL IF** the OAuth2 provider does not require a resource (a.k.a. audience) to be defined.

Note that service providers are defined by the admin in the config and handles are user-defined (optional).

OAuth2 Submit Example

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Multiple scopes and resources:

```
executable = compute_stats
arguments = --in=https://mironlab.wisc.edu/shared/rawdata.zip
  --out=https://jpatton.wisc.edu/home/jpatton/analysis.txt

use_oauth_services = uwtokens

uwtokens_oauth_permissions_read = read:/shared
uwtokens_oauth_resource_read = https://mironlab.wisc.edu/

uwtokens_oauth_permissions_write = write:/home/jpatton
uwtokens_oauth_resource_write = https://jpatton.wisc.edu/

queue
```

```
$_CONDOR_CREDS/uwtokens_read.use
$_CONDOR_CREDS/uwtokens_write.use
```

Live Demo

Thank You!

jpatton@cs.wisc.edu
zmiller@cs.wisc.edu