

The SciTokens Authorization Model: JSON Web Tokens & OAuth

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- The SciTokens project, starting 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.

- 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



- 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 /castor/cern.ch/cms”.

Capabilities versus Impersonation

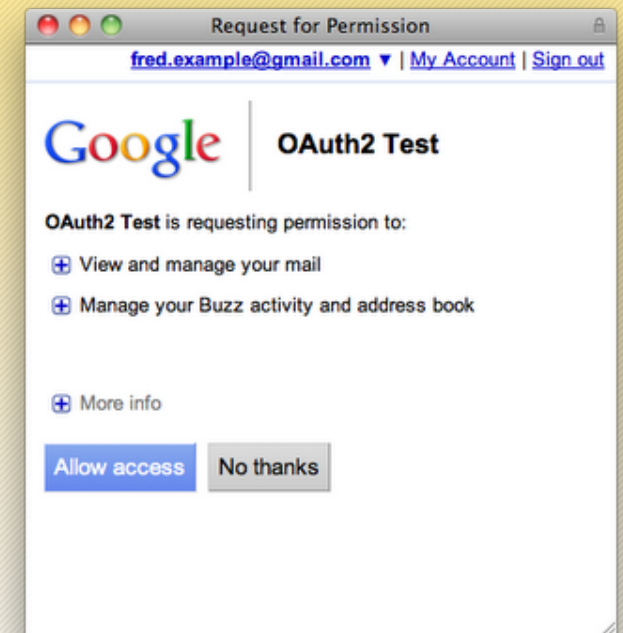


- If GSI took over the world, an attacker could use a stolen grid proxy to make withdrawals from your bank account.
- With capabilities, a stolen token only gets you access to a specific authorization (“stageout to /store/user at Nebraska”).
- SciTokens is following the **principle of least privilege**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

The World Uses Capabilities!



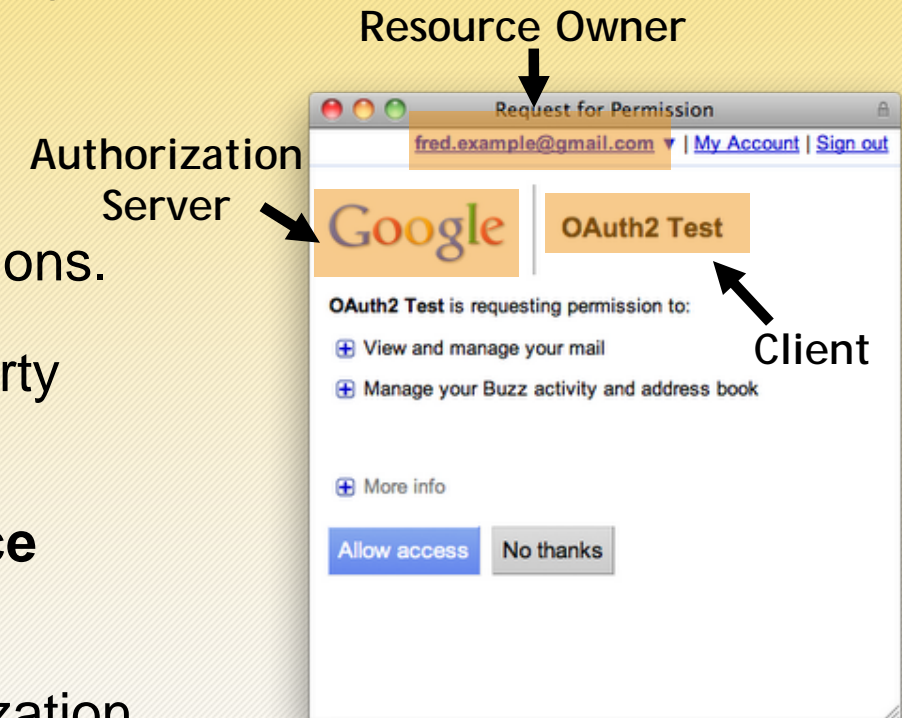
- The rest of the world uses capabilities for distributed services.
- The authorization service creates a token that describes a certain capability or authorization.
- Any bearer of that token may present it to a resource service and utilize the authorization.
- The primary way this is implemented is through OAuth2.
- When you click “allow access” on the right, the **client** at “OAuth2 Test” will receive a token. This token will permit it to access the listed subset of Google services for your account.
- OAuth2 is used by Microsoft, Facebook, Google, Dropbox, Box, Twitter, Amazon, GitHub, Salesforce (and more) to allow distributed access to their identity services.



Three-Legged Authorization



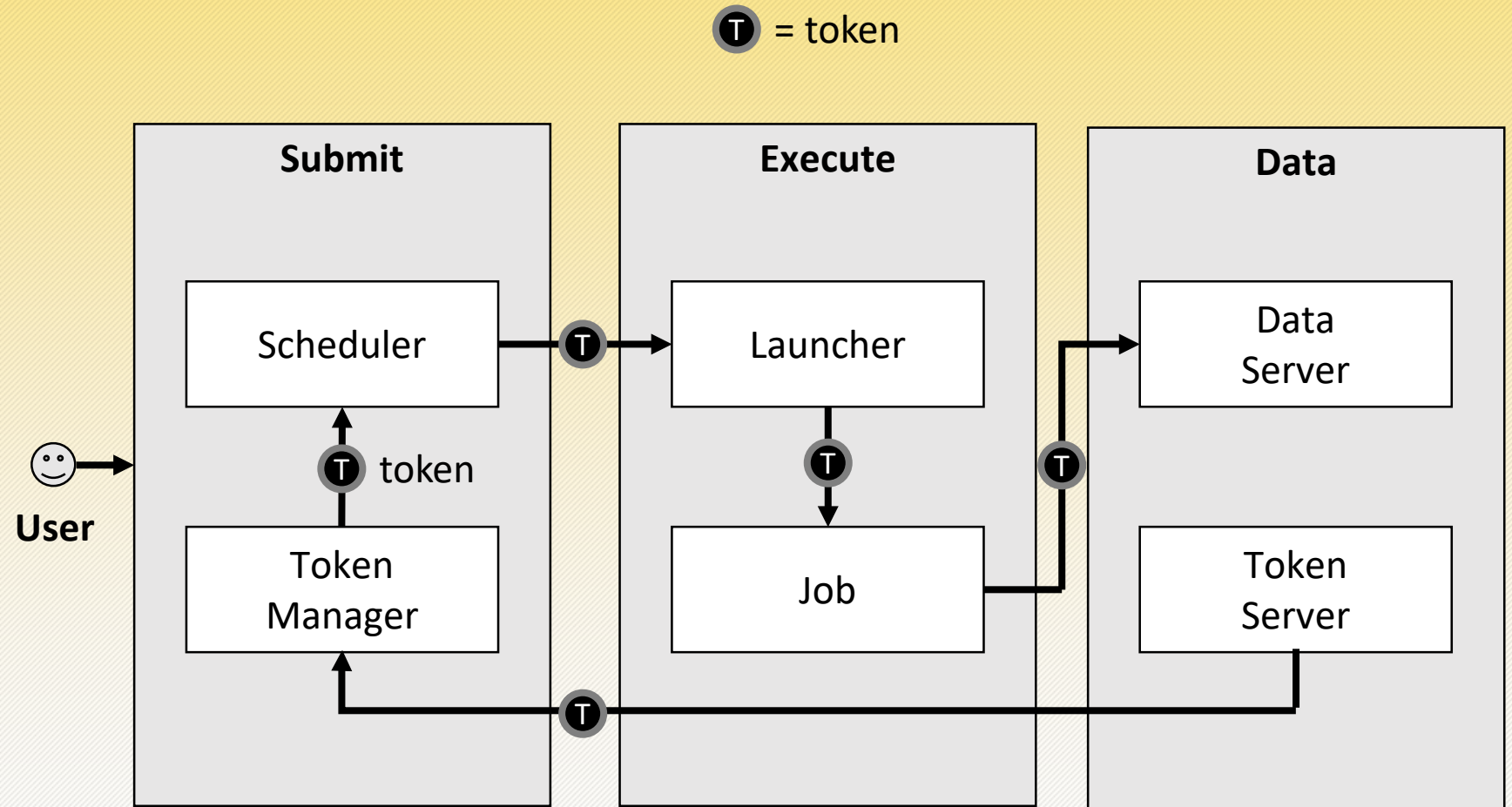
- In OAuth2, there are three abstract entities involved in the authorization workflow:
 - **Authorization server** issues capabilities (tokens).
 - The **resource owner** (end-user) approves authorizations.
 - The **client** receives tokens. Often, this is the third-party website or smartphone app.
- Once the token is issued, it can be used at the **resource server** to access some protected resource.
- In the Google example, Google runs both the authorization and resource servers.



SciTokens Model




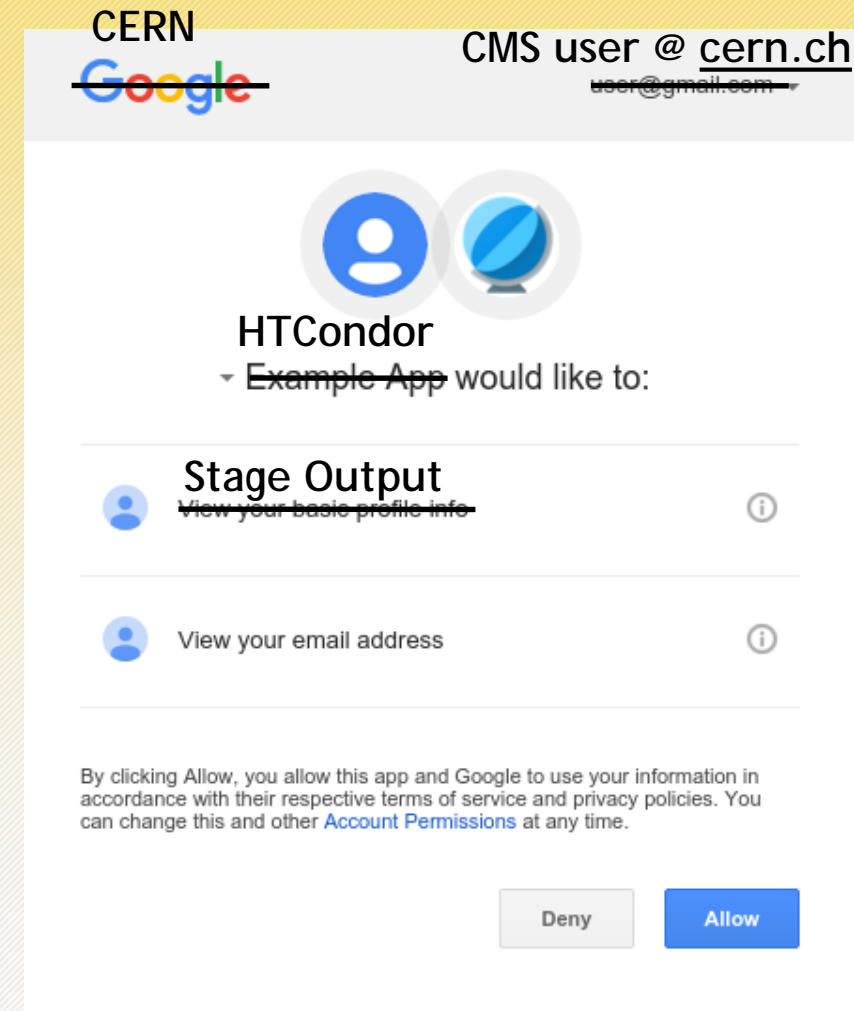
- Integrating an OAuth2 client on the HTCondor submit host
- Enhancing CILogon to support OAuth2 with VO-defined scopes
- Enhancing HTCondor to manage token refresh, attenuation, and delivery to jobs
- Enhancing data services (CVMFS, Xrootd) to allow read/writes using tokens instead of grid proxies



End-Goal



- The end-goal is this 
- The first time you use HTCondor, you navigate to a web interface and setup your desired permissions.
 - On every subsequent `condor_submit`, HTCondor will transparently create the access token for you. *User sees nothing.*
- Replace CERN, usernames, and authorization as desired.
- **Goal:** our first use of OAuth2 will be to stageout from payload jobs to Box.



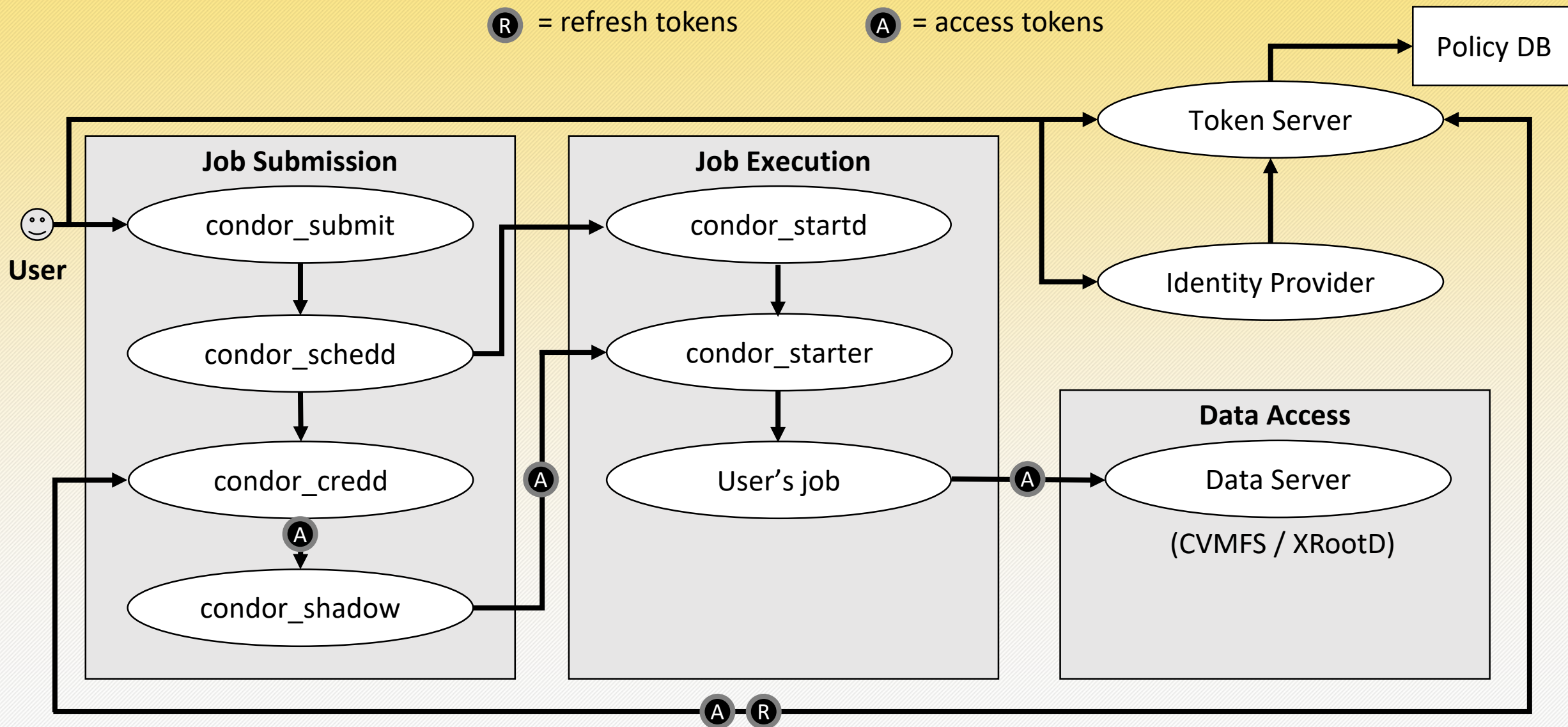
~~USER
MANAGEMENT
OF FILES~~

~~PASSWORD IN
TERMINAL~~

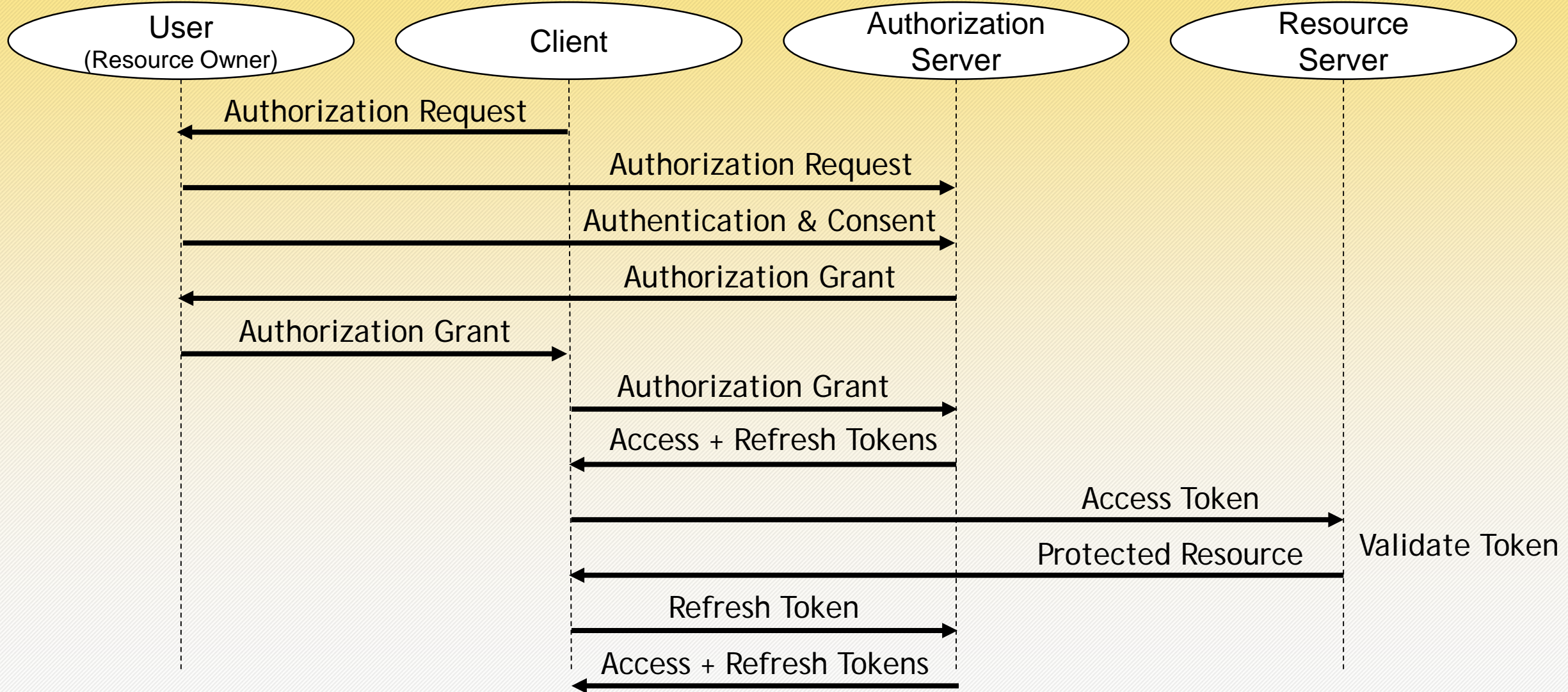
~~SCITOKENS-
PROXY-INIT~~

~~COPY/PASTE~~

Architecture



OAuth2 Authorization Framework



CILogon and SciTokens

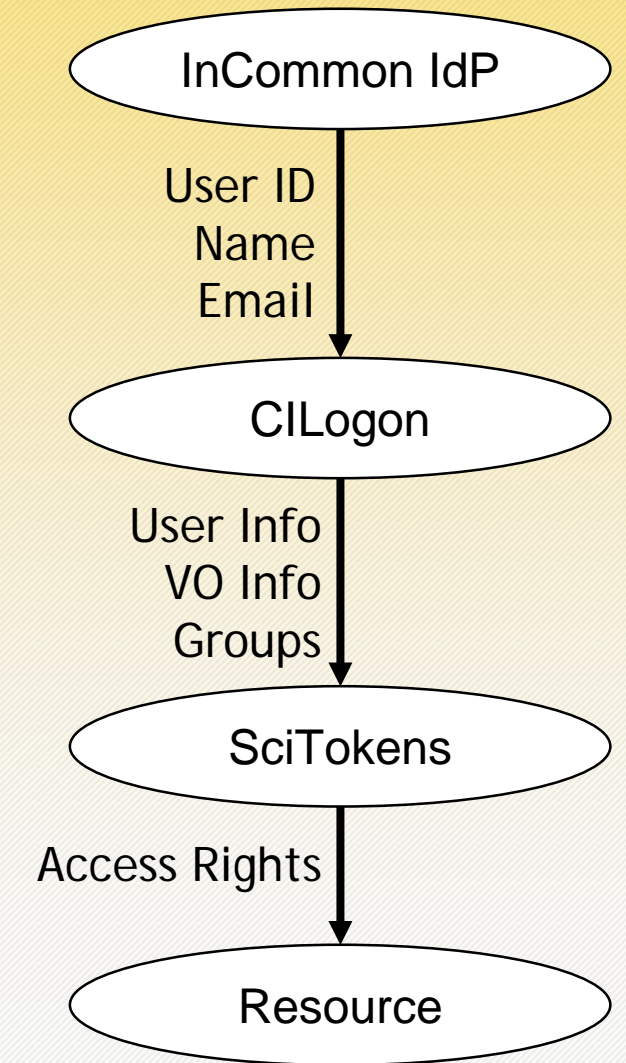
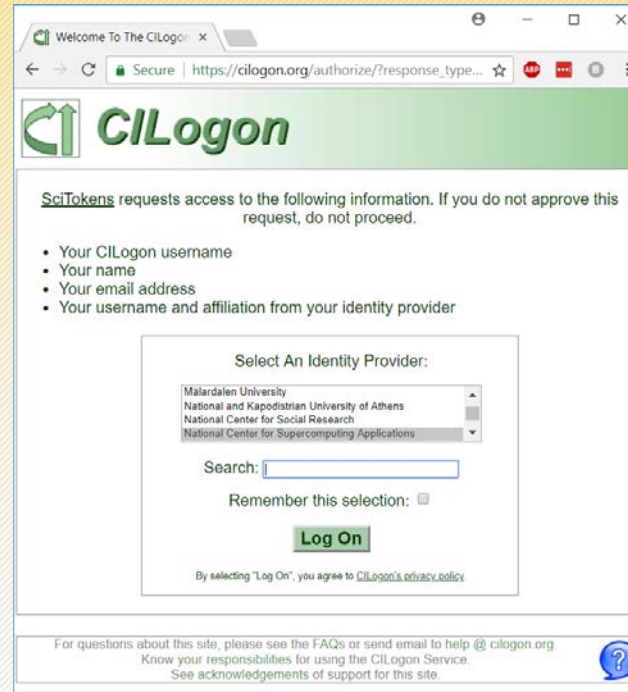


CILogon

- Federated Identity Management
- OpenID Connect
- ID Tokens

SciTokens

- Federated Authorization
- OAuth 2.0
- Access Tokens



Tokens for Distributed Science Infrastructures



- Distributed science infrastructures are distinct from a “resource server” like Google because they are not run by a single central entity.
- Hence, unlike Google, we can’t use opaque random strings for the token. We need something that allows for **distributed verification**.
 - Given a token, a storage service can determine it is valid.
 - Analogously, given a proxy chain and a set of trust roots, you can determine the GSI proxy is valid.
- Goal: Sites set aside some area for each VO; VOs manage the authorizations within these “VO home” areas.

- Free tokens! Navigate to <https://demo.scitokens.org> to get your free tokens!
- This demo illustrates the access token format we're working on.
 - Utilizes JSON Web Tokens (JWT) as the access token format.
 - Various RFCs provide clear guidance on how to verify token integrity.
 - Adds a few domain-specific claims for receiving access to storage.
- The tokens are base64-encoded and can be used as part of a curl command to use protected resources.

Example Token, Decoded



- The decoded token contains multiple scopes - basically filesystem authorizations.
- The audience narrows who the token is intended for.
- The issuer identifies who created the token; value used to locate the public keys needed to validate signature.
- The subject is an opaque identifier for the resource owner. In this case, it also happens to be the identity.
- The expiration is a Unix timestamp when the token expires. A typical lifetime is 10 minutes.

HEADER: ALGORITHM & TOKEN TYPE

```
{  
  "typ": "JWT",  
  "alg": "RS256"  
}
```

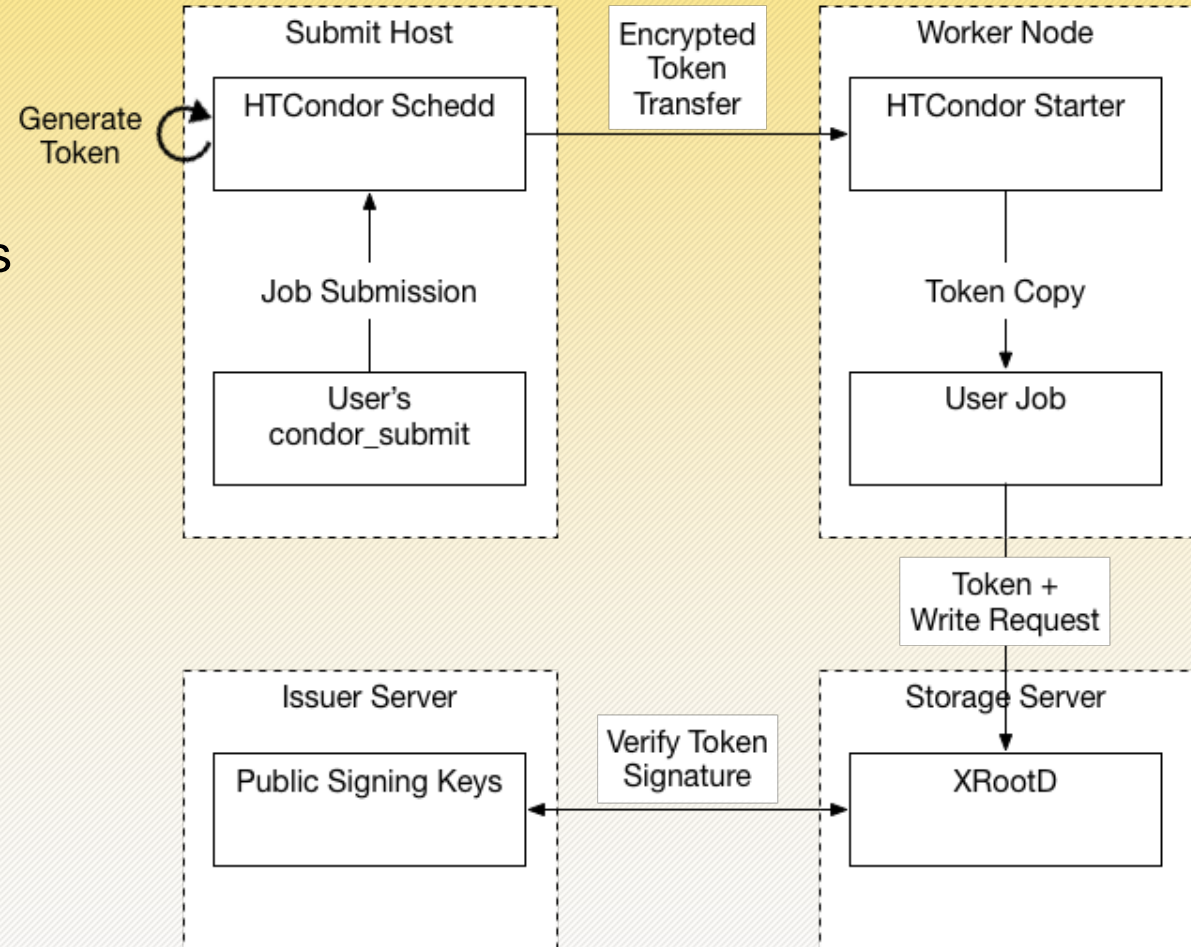
PAYLOAD: DATA

```
{  
  "scope": "read:/protected write:/store/u25321",  
  "aud": "https://demo.scitokens.org",  
  "iss": "https://demo.scitokens.org",  
  "sub": "bbockelm@cern.ch",  
  "exp": 1526954997,  
  "iat": 1526954397,  
  "nbf": 1526954397,  
  "jti": "78c44ce9-62bb-43e8-a7a6-f035f7ebd42b"  
}
```

Early results on OSG



- We have been able to get a basic end-to-end token-based auth{z,n} workflow working for the OSG VO submit service.
- *This includes* patches to Xrootd to validate tokens presented via HTTP and to write files out with the correct Unix user permissions.
- **Cheats:**
 - instead of using OAuth2 to generate the token, we keep a signing key on the submit host.
 - only one token needed.
 - submit host and storage server owned by OSG.



Wait, I've seen this before!



- If you're from ALICE and getting a sense of déjà vu — you're right!
 - The capability-based infrastructure is precisely the authorization infrastructure used by ALICE for the **past decade**.
 - SciTokens takes this **successful model**, recasts it using modern web protocols, and utilizes OAuth2 workflows to issue the tokens.
- The use of common protocols and workflows means that we have a large number of battle-tested libraries we can leverage (spend our time doing other stuff besides writing the basics!).
- Using JWT-formatted access tokens is somewhat-commonplace among web companies.
 - We *think* SciTokens is unique in using JWT access tokens for distributed verification in a federated infrastructure.

Status & Next Steps



- So far we have:
 - Version 1.0 of Python and Java libraries
 - Simple HTCondor OAuth client implementation
 - XRootD token validation plugins
 - Token-based CVMFS access
 - X509-to-SciToken translation service
 - 3rd-party HTTPS FTS transfers authorized with SciTokens
- Next steps:
 - Use Java library for a dCache authorization plugin
 - Release plugin for CVMFS support
 - More fine-grained token management in HTCondor
 - Integration with LIGO LDAP
 - Enhancing HTCondor token support with OAuth flows

Thanks!

Visit

<https://scitokens.org/>
for more info.

Any questions?