Capability-Based Authorization for HEP

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See https://scitokens.org for more info!

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Identity-based Authorization

- 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

SCI TOKENS

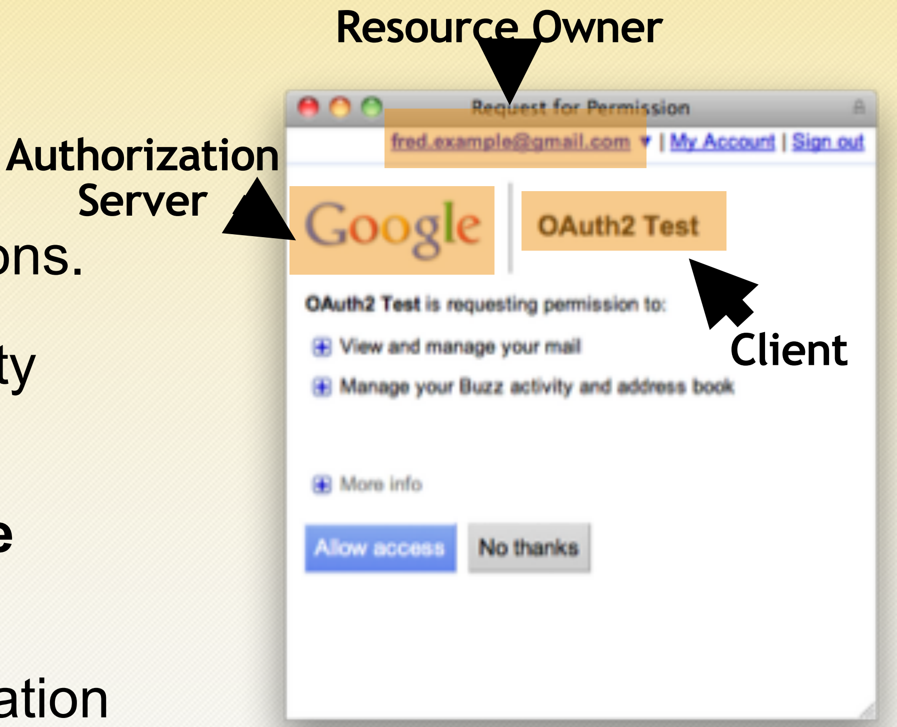
- If GSI took over the world, an attacker could use a stolen grid proxy to make withdrawals from your bank account.
- With capabilities, a stolen token only gets you access to a specific authorization (“stageout to /store/user at Nebraska”).
- SciTokens is following the **principle of least privilege**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

SciTokens Project

- 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.

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.

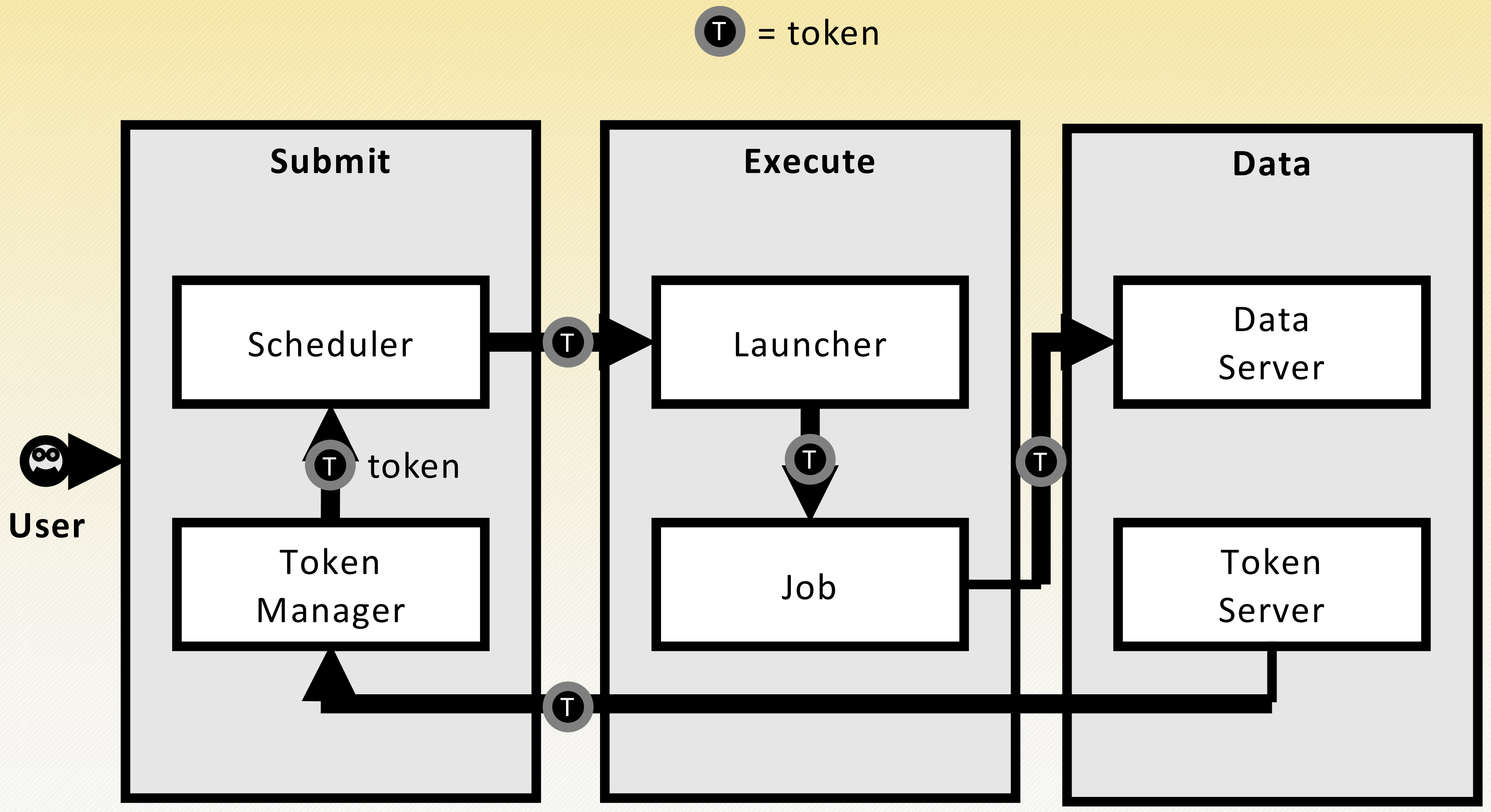


OAuth2 Test is requesting permission to:

- View and manage your mail
- Manage your Buzz activity and address book

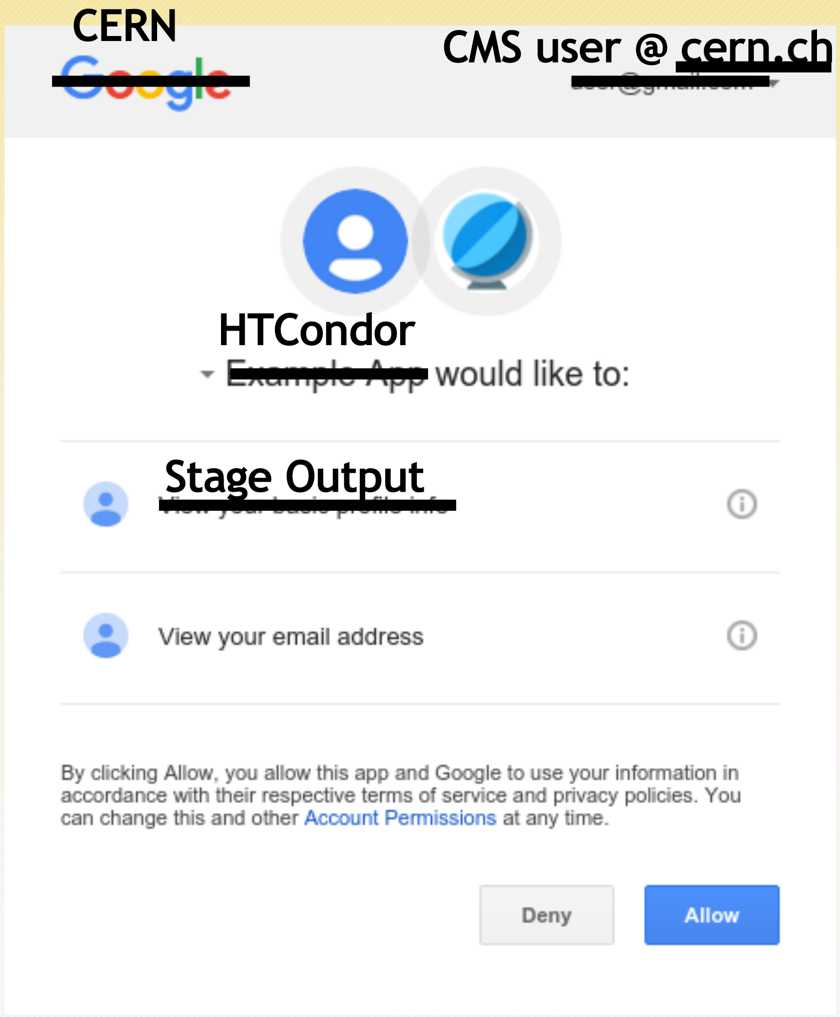
SciTokens Model

- 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.
- **Goals**:
  - Build an OAuth2 client into HTCondor.
  - Allow HTCondor to manage capability tokens and their lifetimes for the running job.
  - Enable the use of capability tokens for data access and other use cases.


CERN ~~Google~~

CMS user @ cern.ch ~~user@gmail.com~~

HTCondor ~~Example App~~ would like to:

Stage Output ~~View your basic profile info~~

View your email address

By clicking Allow, you allow this app and Google to use your information in accordance with their respective terms of service and privacy policies. You can change this and other Account Permissions at any time.

Deny Allow

~~USER MANAGEMENT OF FILES~~

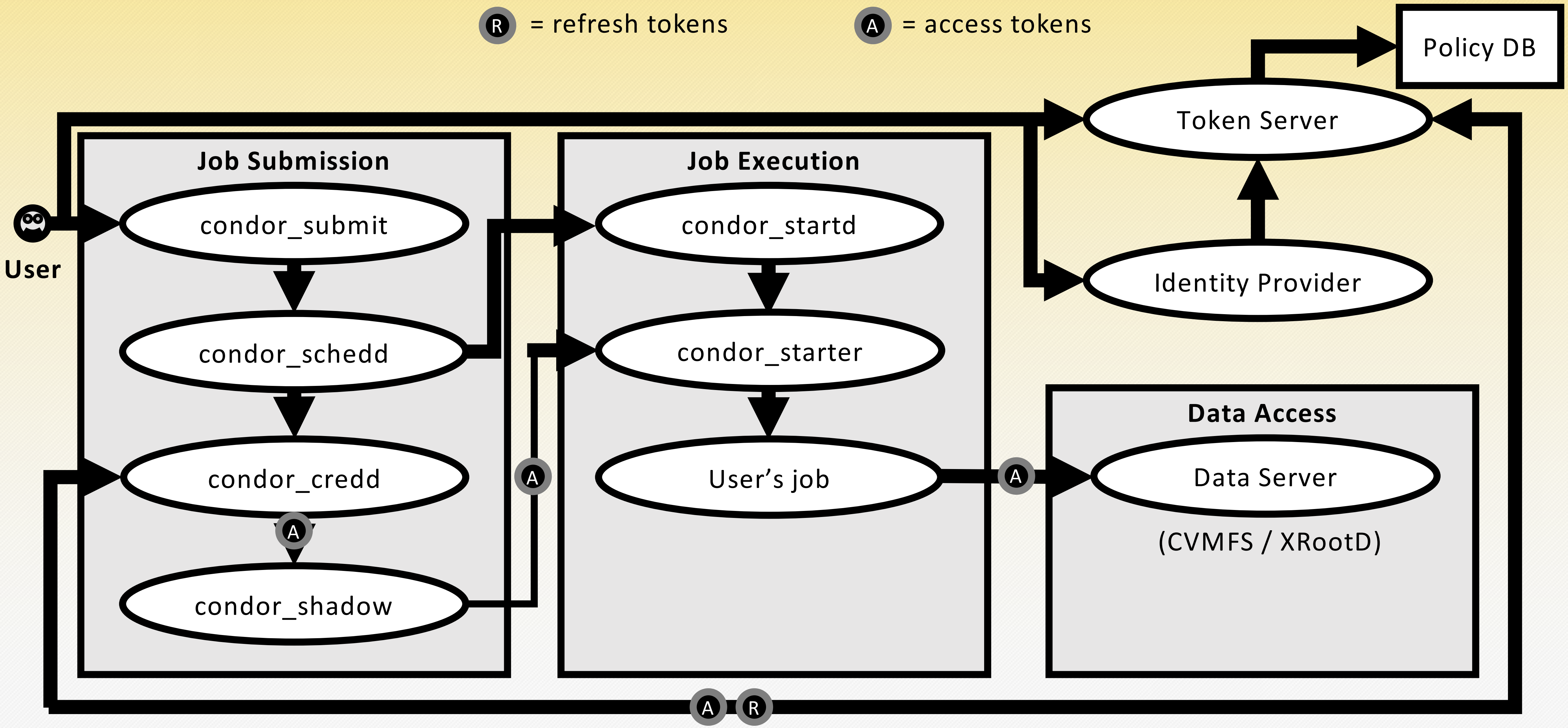
~~PASSWORD IN TERMINAL~~

~~SCITOKENS-PROXY-INIT~~

~~COPY / PASTE~~

Architecture

SCITOKENS



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.
- The operational model is a site sets aside storage for each VO but the VOs manage the authorizations within these areas.

JWT in action!

- 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.

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.

SciTokens and the WLCG Authorization Working Group

- So far we have:
  - HTCondor “credmon” integration for OAuth2 tokens.
  - Java and Python client libraries.
  - Java-based token server.
  - XRootD plugins for authorizing with SciTokens.
  - Prototype “authenticated CVMFS” integration.
  - Prototype dCache SciTokens authorization.
- We are working within the WLCG Authorization Working Group to standardize the use of SciTokens.
  - I personally hope this is sufficiently close enough to adopt as “SciTokens 2.0”!
  - The working group is looking at harder problems at how these capability tokens can be issued.

Thanks!

Visit

https://scitokens.org/

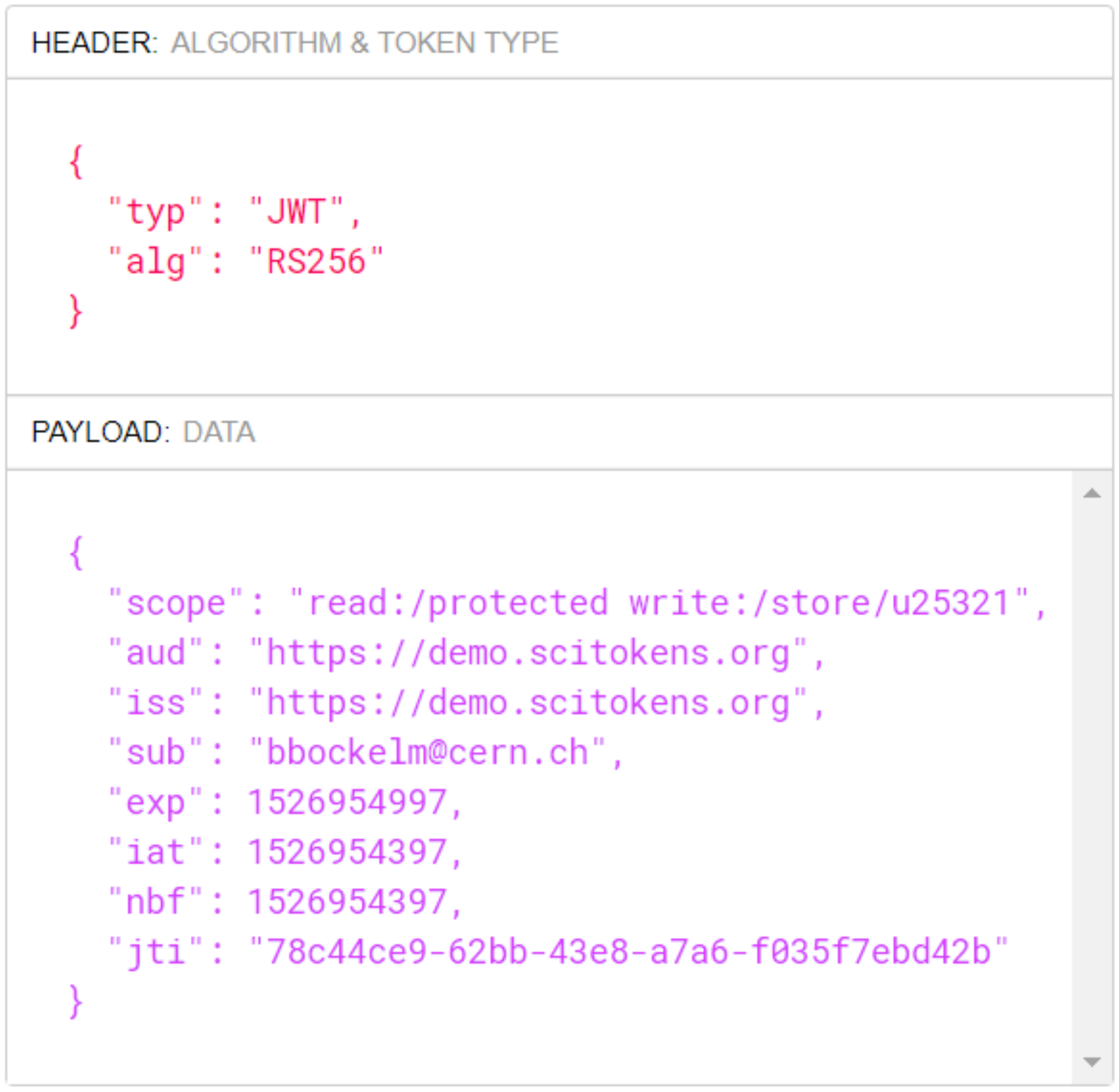
for more info.

Any questions?

Backup

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

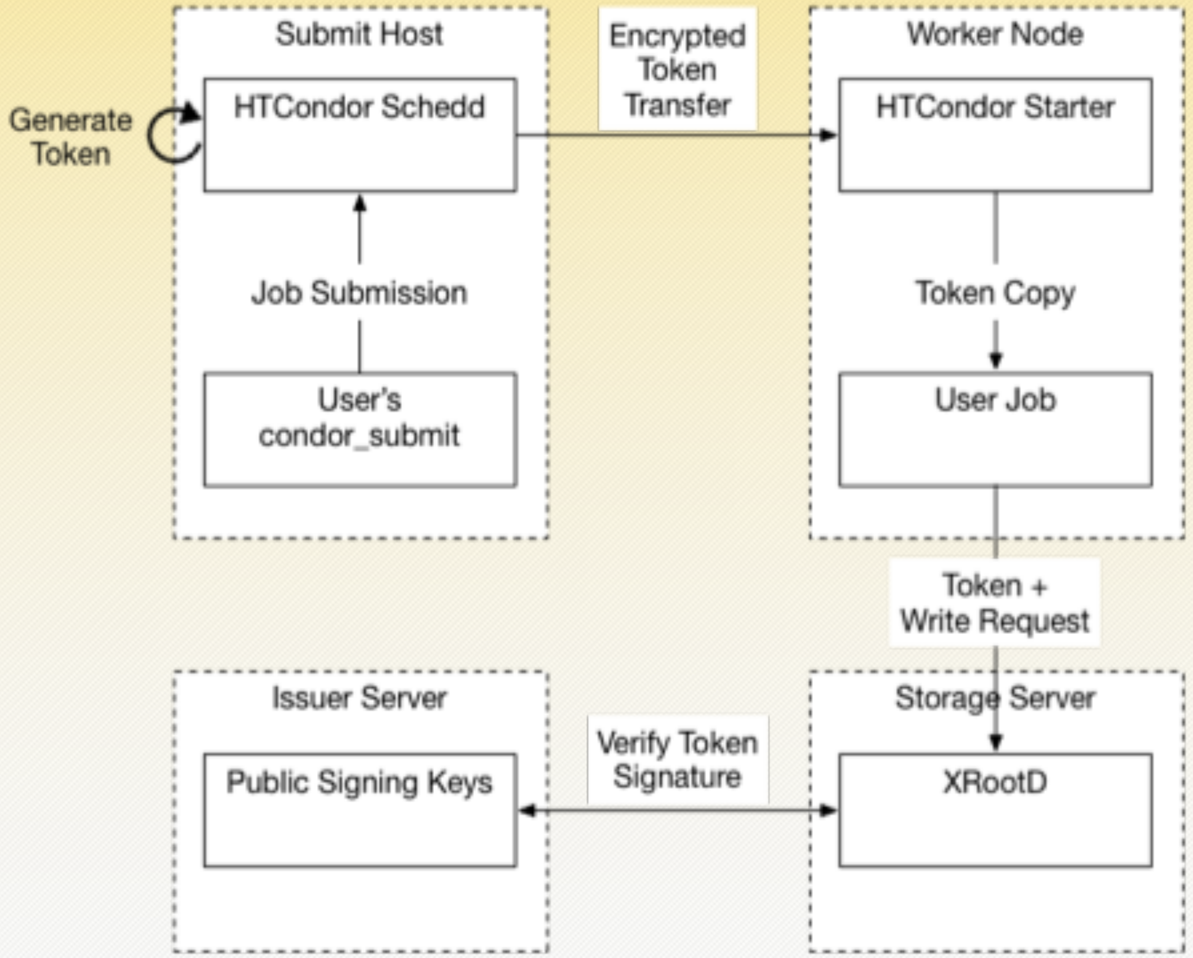
```
{
  "typ": "JWT",
  "alg": "RS256"
}
```

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* plugins 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.


Submit Host
Generate Token
HTCondor Schedd
Job Submission
User's condor_submit
Encrypted Token Transfer
Worker Node
HTCondor Starter
Token Copy
User Job
Token + Write Request
Issuer Server
Public Signing Keys
Verify Token Signature
Storage Server
XRootD