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!
• 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".
• 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 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.
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
The end-goal is this:

- The first time you use HTCondor, you navigate to a web interface and set up 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.
Architecture

Job Submission
- condor_submit
- condor_schedd
- condor_creedd
- condor_shadow

Job Execution
- condor_startd
- condor_starter
- User's job

Data Access
- Data Server
  (CVMFS / XRootD)

Token Server
Identity Provider
Policy DB

User

R = refresh tokens
A = access tokens
• 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.
• 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.
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
• 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.
Early results on OSG

• We have been able to get a basic end-to-end token-based auth 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.