

Muck JSON storage server and API

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work in progress

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1 Introduction

Muck is intended for storing relatively small pieces of data securely, and accessing them quickly. Intended uses cases are:

- storing user, client, application, and related data for an OpenID Connect authentication server
- storing personally identifiable information of data subjects (in the GDPR sense) in a way that they can access and update, assuming integration with a suitable authentication and authorization server
- in general, storage for web applications of data that isn't large and fits easily into RAM

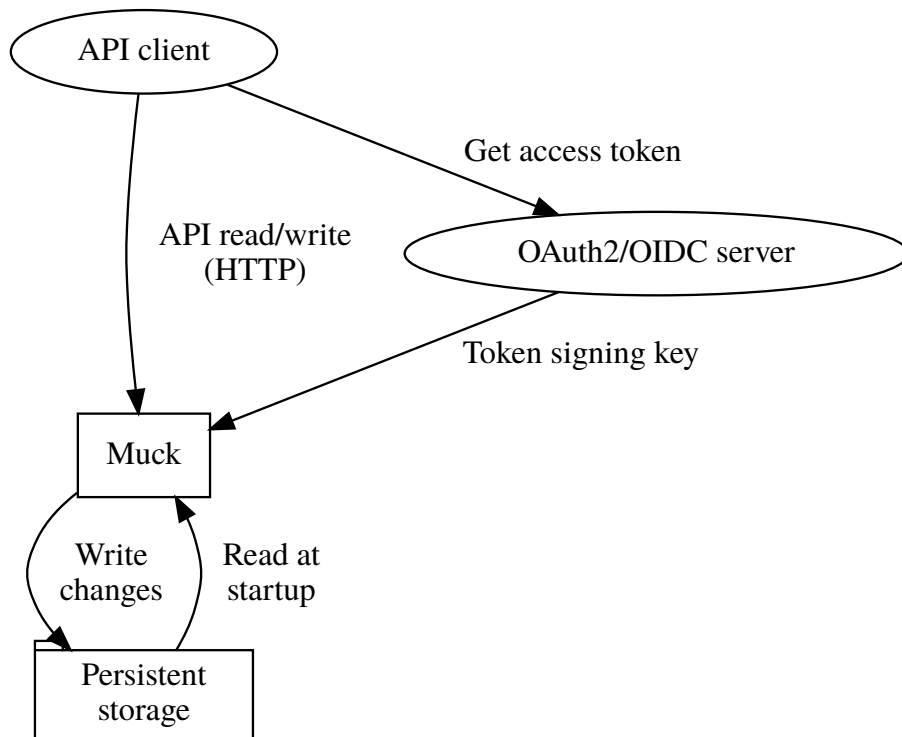
Muck is a JSON store, with an access controlled RESTful HTTP API. Data stored in Muck is persistent, but kept in memory for fast access. Data is represented as JSON objects.

Access is granted based on signed JWT bearer tokens. An OpenID Connect or OAuth2 identity provider is expected to give such tokens to Muck clients. The tokens must be signed with a public key that Muck is configured to accept.

Access control is simplistic. Each resource is assigned an owner upon creation, and each user can access (see, update, delete) only their own resources. A user with "super" powers can access, update, and delete resources they don't own, but can't create resources for other. This will be improved later.

1.1 Architecture

Muck stores data persistently in its local file system. It provides an HTTP API for clients. Muck itself does not communicate otherwise with external entities.



1.2 Authentication

Muck uses OAuth2¹ or OpenID Connect² bearer tokens as access tokens. The tokens are granted by some form of authentication service, are JWT³ tokens, and signed using public-key cryptography. The authentication service is outside the scope of this document; any standard implementation should work.

Muck will be configured with one public key for validating the tokens. For Muck to access a token:

- its signature must be valid according to the public key
- it must be used while it's valid (after the validity starts, but before it expires)
- its audience must be the specific Muck instance
- its scope claim contains the specified scopes needed for the attempted operation
- it specified an end-user (data subject)

Every request to the Muck API must include a token, in the `Authorization` header as a bearer token. The request is denied if the token does not pass all

¹<https://oauth.net/>

²<https://openid.net/connect/>

³https://en.wikipedia.org/wiki/JSON_Web_Token

the above checks.

2 Requirements

This chapter lists high level requirements for Muck.

Each requirement here is given a unique mnemonic id for easier reference in discussions.

SimpleOps Muck must be simple to install and operate. Installation should be installing a .deb package, configuration by setting the public key for token signing of the authentication server.

Fast Muck must be fast. The speed requirement is that Muck must be able to handle at least 100 concurrent clients, creating 1000 objects each, and then retrieving each object, and then deleting each object, and all of this must happen in no more than ten minutes (600 seconds). Muck and the clients should run on different virtual machines.

Secure Muck must allow access only by an authenticated client representing a data subject, and must only allow that client to access objects owned by the data subject, unless the client has super privileges. The data subject specifies, via the access token, what operations the client is allowed to do: whether they read, update, or delete objects.

3 HTTP API

The Muck HTTP API has one endpoint – `/res` – that’s used for all objects. The objects are called resources by Muck.

The JSON objects Muck operates on must be valid, but their structure does not matter to Muck.

3.1 Metadata

Each JSON object stored in Muck is associated with metadata, which is represented as the following HTTP headers:

- **Muck-Id** – the resource id
- **Muck-Revision** – the resource revision

The id is assigned by Muck at object creation time. The revision is assigned by Muck when the object is created or modified.

3.2 API requests

The RESTful API requests are POST, PUT, GET, and DELETE.

- **POST** `/res` – create a new object

- **PUT** /res – update an existing object
- **GET** /res – retrieve a existing object
- **DELETE** /res – delete an existing object

Although it is usual for RESTful HTTP APIs to encode resource identifiers in the URL, Muck uses headers (Muck-Id, Muck-Revision) for consistency, and to provide for later expansion. Muck is not intended to be used manually, but by programmatic clients.

Additionally, the “sub” claim in the token is used to assign and check ownership of the object. If the scope contains “super”, the sub claim is ignored, except for creation.

The examples in this chapter use HTTP/1.1, but should provide the necessary information for other versions of HTTP. Also, only the headers relevant to Muck are shown. For example, HTTP/1.1 requires also a Host header, but this is not shown in the examples.

3.2.1 Creating an object: POST /res

Creating requires:

- “create” in the scope claim
- a non-empty “sub” claim, which will be stored by Muck as the owner of the created object

The creation request looks like this:

```

1 POST /res HTTP/1.1
2 Content-Type: application/
3 Authorization: Bearer TOKEN
4
5 {"foo": "bar"}

```

Note that the creation request does not include Muck-Id or Muck-Revision headers.

A successful response looks like this:

```

1 201 Created
2 Content-Type: application/json
3 Muck-Id: ID
4 Muck-Revision: REV1

```

Note that the response does not contain a copy of the resource.

3.2.2 Updating an object: PUT /res

Updating requires:

- “update” in the scope claim
- one of the following:

- “super” in the scope claim
- “sub” claim matches owner of object Muck; super user can update any resource, but otherwise data subjects can only update their own objects
- Muck-Revision matches the current revision in Muck; this functions as a simplistic guard against conflicting updates from different clients.

The update request looks like this:

```

1 PUT /res HTTP/1.1
2 Authorization: Bearer TOKEN
3 Content-Type: application/json
4 Muck-Id: ID
5 Muck-Revision: REV1
6
7 {"foo": "yo"}
```

In the request, ID identifies the object, and REV1 is its revision.

The successful response:

```

1 200 OK
2 Content-Type: application/json
3 Muck-Id: ID
4 Muck-Revision: REV2
```

Note that the update response also doesn’t contain the object. The client should remember the new revision, or retrieve the object get the latest revision before the next update.

3.2.3 Retrieving an object: GET /res

A request requires:

- “show” in the scope claim
- one of the following:
 - “super” in the scope claim
 - “sub” claim matches owner of object Muck; super user can retrieve any resource, but otherwise data subjects can only update their own objects

The request to retrieve a response:

```

1 GET /res HTTP/1.1
2 Authorization: Bearer TOKEN
3 Muck-Id: ID
```

A successful response:

```

1 200 OK
2 Content-Type: application/json
```

```
3 Muck-Id: ID
4 Muck-Revision: REV2
5
6 {"foo": "yo"}
```

Note that the response does NOT indicate the owner of the resource.

4 Acceptance criteria for Muck

This chapter details the acceptance criteria for Muck, and how they're verified.

4.1 Basic object handling

First, we need a new Muck server. It will initially have no objects. We also need a test user, whom we'll call Tomjon.

given a fresh Muck server
given I am **Tomjon**

Tomjon can create an object.

when I do POST /res with {"foo": "bar"}
then response code is **201**
then header **Muck-Id** is **ID**
then header **Muck-Revision** is **REV1**

Tomjon can then retrieve the object. It has the same revision and body.

when I do GET /res with Muck-Id: {**ID**}
then response code is **200**
then header **Muck-Revision** matches {**REV1**}
then body matches {"foo": "bar"}

Tomjon can update the object, and the update has the same id, but a new revision and body.

when I do PUT /res with Muck-Id: {**ID**}, Muck-Revision: {**REV1**}, and body {"foo": "yo"}
then response code is **200**
then header **Muck-Revision** is {**REV2**}
then revisions {**REV1**} and {**REV2**} are different

If Tomjon tries to update with the old revision, it fails.

when I do PUT /res with Muck-Id: {**ID**}, Muck-Revision: {**REV1**}, and body {"foo": "yo"}
then response code is **409**

After the failed update, the object or its revision haven't changed.

when I do GET /res with Muck-Id: {ID}
then response code is **200**
then header **Muck-Revision** matches {REV2}
then body matches {"foo": "yo"}

We can delete the resource, and then it's gone.

when I do DELETE /res with Muck-Id: {ID}
then response code is **200**
when I do GET /res with Muck-Id: {ID}
then response code is **404**

4.2 Restarting Muck

Muck should store data persistently. For this we need our test user to have the “super” capability.

given a fresh Muck server
given I am **Tomjon**, with super capability
when I do POST /res with {"foo": "bar"}
then header **Muck-Id** is ID
then header **Muck-Revision** is REV1

So far, so good. Nothing new here. Now we restart Muck. The resource just created must still be there.

when I restart Muck
when I do GET /res with Muck-Id: {ID}
then response code is **200**
then header **Muck-Revision** matches {REV1}
then body matches {"foo": "bar"}

4.3 Super user access

Check here that if we have super scope, we can retrieve, update, and delete someone else's resources, but if we create a resource, it's ours.

4.4 Invalid requests

There are a number of ways in which a request might be rejected. This section verifies all of them.

4.4.1 Accessing someone else's data

given a fresh Muck server
given I am **Tomjon**
when I do POST /res with {"foo": "bar"}
then header **Muck-Id** is ID
then header **Muck-Revision** is REV1

when I do GET /res with Muck-Id: {**ID**}
then response code is **200**
then header **Muck-Revision** matches {**REV1**}
then body matches {"foo": "bar"}

After this, we morph into another test user.

given I am **Verence**
when I do GET /res with Muck-Id: {**ID**}
then response code is **404**

Note that we get a “not found” error and not a “access denied” error so that Verence doesn’t know if the resource exists or not.

4.4.2 Updating someone else’s data

This is similar to retrieving it, but we try to update instead.

given a fresh Muck server
given I am **Tomjon**
when I do POST /res with {"foo": "bar"}
then header **Muck-Id** is **ID**
then header **Muck-Revision** is **REV1**
given I am **Verence**
when I do PUT /res with Muck-Id: {**ID**}, Muck-Revision: {**REV1**}, and body {"foo": "yo"}
then response code is **404**

4.4.3 Deleting someone else’s data

This is similar to retrieving it, but we try to delete it instead.

given a fresh Muck server
given I am **Tomjon**
when I do POST /res with {"foo": "bar"}
then header **Muck-Id** is **ID**
then header **Muck-Revision** is **REV1**
given I am **Verence**
when I do DELETE /res with Muck-Id: {**ID**}
then response code is **404**

- 4.4.4 Bad signature
- 4.4.5 Not valid yet
- 4.4.6 Not valid anymore
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- 4.4.10 Lack scope for updating
- 4.4.11 Lack scope for deletion
- 4.4.12 No subject when creating
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- 4.4.14 No subject when updating
- 4.4.15 No subject when deleting
- 4.4.16 Invalid JSON when creating
- 4.4.17 Invalid JSON when updating

5 Possible future changes

- There is no way to list all the resources a user has, or search for resource. This should be doable in some way. With a search, a listing operation is not strictly necessary.
- It's going to be inconvenient to only be able to access one's own resources. It would be good to support groups. A resource could be owned by a group, and end-users / subjects could belong to any number of groups. Also, groups should be able to belong to groups. Each resource should be able to specify for each group what access members of that group should have (retrieve, update, delete). There should be no limits to how many group access control rules there are per resource.

This would allow setups such as each resource representing a stored file, and some groups would be granted read access, or read-write access, or read-delete access to the files.

- Also, it might be good to be able to grant other groups access to control a resource's access control rules.
- It might be good support schemas for resources?
- It might be good to have a configurable maximum size of a resource. Possibly per-user quotas.
- It would be good to support replication, sharding, and fault tolerance.

- Monitoring, logging, other ops requirements?
- Encryption of resources, so that Muck doesn't see the contents?
- Should Muck sign the resources it returns, with it's own key?