

# Exercise 12

*Using OAuth introspection with a third-party identity server to replace client-certificates*

## Prior Knowledge

Previous exercises

## Objectives

Replace SSL client authentication with the use of an OAuth2 token

## Software Requirements

(see separate document for installation of these)

- Docker (and thereby WS02 IS 5.1.0)
- Node.js
- Python

## Overview

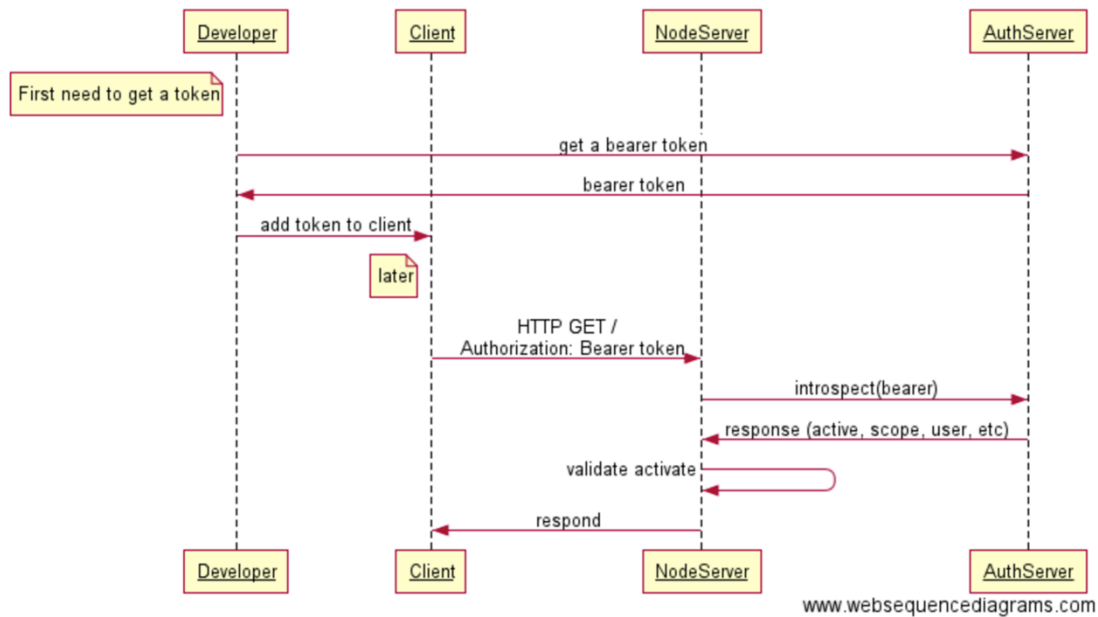
*In this lab, we will use server-side TLS to validate the server to the client, and use an OAuth2 token to validate the client to the server.*

*The lab will follow the following overall approach:*

1. *Run a docker image of the WS02 Identity Server to provide an OAuth2 server.*
2. *Create the OAuth2 client definition inside the Identity Server.*
3. *Issue the token and get approval to access a given scope using client credentials.*
4. *Enhance it to use the authorization grant.*
5. *Enhance the node.js server to validate the token and the scope using the OAuth2 Introspection API*

Here is a picture of what we are looking at:

### OAuth2 authentication flow



### Steps

1. I have created a docker image of the WSO2 Identity Server 5.1.0, and this also includes an add-in that supports OAuth2 Introspection. (Later versions include this natively).

```
docker run -d -p 9443:9443 -p 9763:9763 pizak/wso2is:5.1.0-introspect
```

Please note this is **not** the proper way to run Identity Server in a docker container as none of the state is properly stored. If you kill the container you will have to reconfigure after you start it again. It is just an easy approach for development mode.

2. I have also enhanced the code of the SSL exercise to support OAuth2 tokens. Copy this code to VM:

```
cd ~  
wget https://freo.me/sec\_oauth -O sec_oauth.zip  
unzip sec_oauth.zip  
cd ~/sec_oauth
```

3. Ensure you have the right Node dependencies for this:  
cd ~/sec\_oauth/server  
npm install querystring express

4. Now look at the file server/server.js  
The main changes are in bold.:

```
var Introspect = require('./introspect.js');

introspect = new Introspect("localhost", 9763, "/introspect");

app.get("/", function(req, res){
  console.log(req.headers);
  auth = req.headers.authorization;

  if (!auth) res.sendStatus(401);

  bearer = introspect.getBearer(auth);
  if (bearer) introspect.introspect(bearer, function (username, scope) {
    if (!username) {
      res.status(401).send();
    }
    else {
      obj = {random : Math.floor(Math.random() * 100) + 1,
        username:username,
        scope:scope};
      res.json(obj);
    }
  });
});
```

This is importing a new module called Introspect. Introspect is configured with a introspection endpoint (localhost:9763/introspect).

We extract the bearer token from the headers and if it exists we call introspect. Notice that since this is node.js, we need to preserve the non-blocking nature of the system, so we pass a callback to Introspect that will actually do our "GET" logic. This is because Introspect is going to call out to another HTTP endpoint and we don't want to block node threads while it is waiting for the response.

If introspect succeeds, it passed a username and scope to the callback, otherwise null, null.

5. What we need introspect to do is to call an introspection API defined in <https://tools.ietf.org/html/rfc7662>

Here is a sample mitmdump:

```
oxsoa@oxsoa: ~  
127.0.0.1 POST http://localhost:9763/introspect  
Content-Type: application/x-www-form-urlencoded  
host: localhost:9700  
Connection: close  
Transfer-Encoding: chunked  
  
token: 2a07bc21c725b0610dd274b354c82d6f  
token_type_hint: Bearer  
  
<< 200 OK 1618  
Date: Tue, 07 Jun 2016 18:50:58 GMT  
Content-Type: application/json  
content-length: 161  
Connection: close  
Server: WS02 Carbon Server  
  
{  
  "active": true,  
  "client_id": "lnfwkuzhClQ1xbfaGpfvKe7HowQa",  
  "exp": 1465329032,  
  "iat": 1465325432,  
  "scope": "user",  
  "token_type": "Bearer",  
  "username": "admin@carbon.super"  
}  
  
127.0.0.1:34754: clientdisconnect
```

6. Now lets look at introspect.js

The main logic (subset of the full file) we care about is here:

```
introspect : function (token, callback) {
  console.log(token);
  data = { token : token,
           token_type_hint : "Bearer"
         }
  encoded = qs.stringify(data);

  var post_options = {
    host: introspect_host,
    port: introspect_port,
    path: introspect_path,
    method: 'POST',
    headers: {
      'Content-Type': 'application/x-www-form-urlencoded'
    }
  };

  var post_req = http.request(post_options, function(r) {
    var body = ""
    r.setEncoding('utf8');
    r.on('data', function (chunk) {
      body += chunk;
    });
    r.on('end', function() {
      try {
        var response = JSON.parse(body);
      } catch (e) {}

      if (response && response.active) {
        callback(response.username, response.scope);
      }
      else
      {
        callback(null,null);
      }
    });
  });

  // post the data
  post_req.write(encoded);
  post_req.end();
}
```

7. The code is actually pretty simple, but the async nature of node.js slightly obfuscates things. Basically we start a post operation, and will get called asynchronously as chunks of response come in. This is slightly overkill as the response to a introspection call will probably always fit in a network buffer, but this is good node.js coding.

8. I have also modified random-client.py to look for a bearer token in the command-line:

```
bearer = ""
headers = dict()
url = "https://localhost:8443"
if (len(sys.argv) > 1):
    bearer = sys.argv[1]
    headers = dict(Authorization="Bearer "+bearer)

h = httpplib2.Http(ca_certs="./keys/ca.cert.pem")
resp, content = h.request(url, "GET", headers = headers)
```

9. Start your server!

10. Now if you were to call:

```
python random-client.py fbas78734nerjkka233a1
```

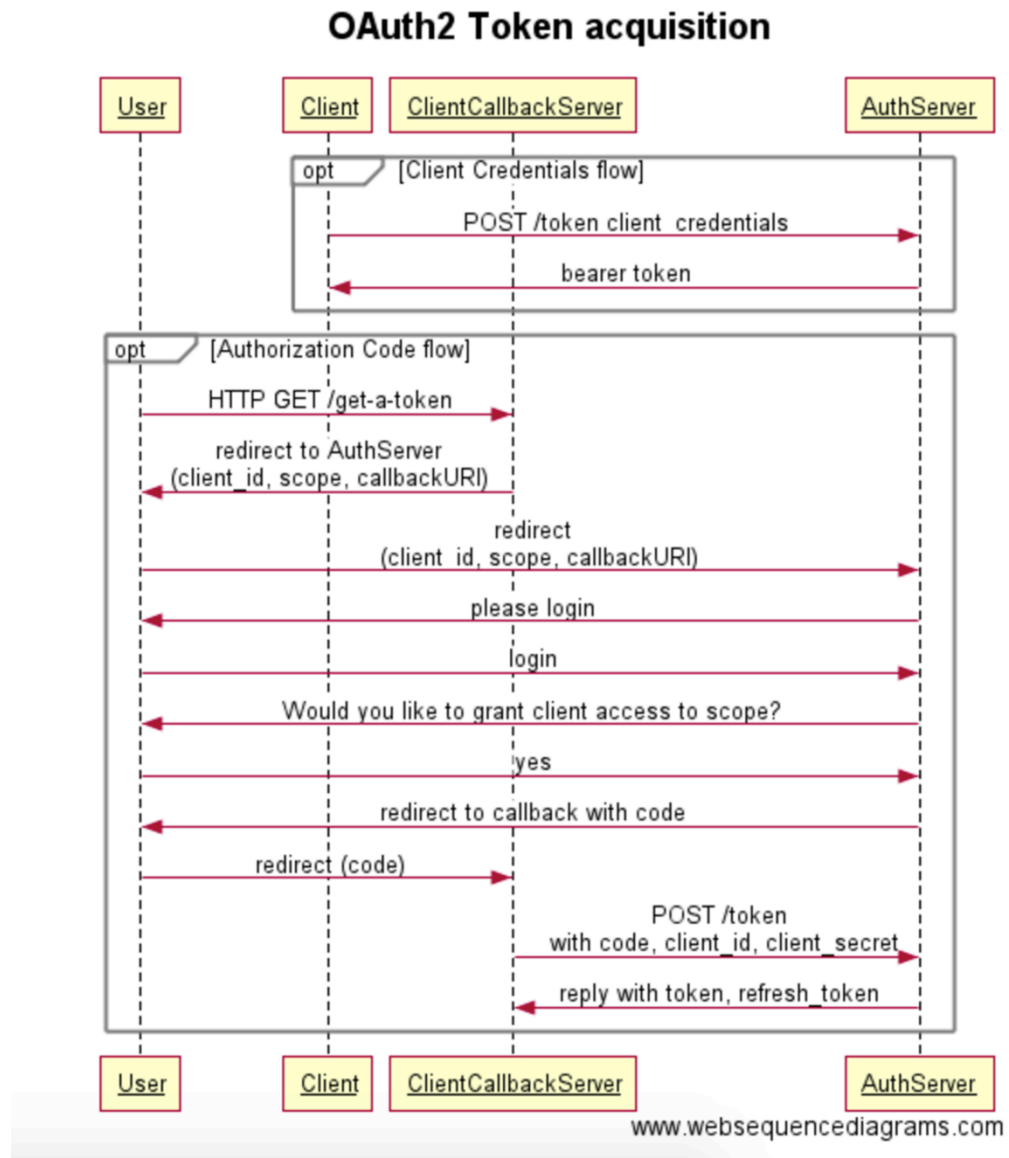
this will add the following HTTP header:

Authorization: Bearer fbas78734nerjkka233a1

(Don't do this - that token is no good!)

There is a further slight enhancement which is to also print out the full JSON response (so we can see the extra fields we are adding).

11. Ok, we have almost everything in place! We have an OAuth2 server. We have a client that can send a bearer token, and a server that can read the token, pass it over to the OAuth2 server and validate the response.
12. There are multiple ways defined in the OAuth2 specification to get hold of the OAuth2 token. The two ways we are going to look at are documented in this sequence diagram:



13. In both approaches, before we create the token, we need to register our application to the WS02 Identity Server.

14. Browse to:

<https://localhost:9443>

Sort out any SSL issues and then login as **admin/admin**

You should see:

The screenshot shows the WSO2 Identity Server Management Console. The left-hand navigation bar includes sections for Identity (Users and Roles, User Stores, Claims, Service Providers, Identity Providers), Entitlement (PAP, Policy Administration, Policy Publish, PDP, Policy View, Extension, Search), and Manage (Workflow Engagements, Workflow Definitions, Keystores). The main content area is titled 'WSO2 Identity Server Home' and displays system information in a table format.

Server	
Host	localhost
Server URL	local://services/
Server Start Time	2016-06-07 17:07:13
System Up Time	0 day(s) 15 hr(s) 33 min(s) 53 sec(s)
Version	5.1.0
Repository Location	file:/wso2/wso2is-5.1.0/repository/deployment/server/

Operating System	
OS Name	Linux
OS Version	4.4.0-22-generic

Operating System User	
Country	US
Home	/root
Name	root
Timezone	GMT

Java VM	
Java Home	/usr/lib/jvm/java-1.8-openjdk/jre
Java Runtime Name	OpenJDK Runtime Environment
Java Version	1.8.0_92-internal
Java Vendor	Oracle Corporation
Java VM Version	25.92-b14

Registry	
DBMS	H2
DBMS Version	1.2.140 (2010-07-25)
DBMS Driver	H2 JDBC Driver

15. In the left-hand bar, select **Service Providers -> Add**

Add the Service Provider Name: **oauth2-example**

Click **Register**

Home > Identity > Service Providers > Add

### Add New Service Provider

**Basic Information**

Service Provider Name:   
? A unique name for the service provider

Description:   
? A meaningful description about the service provider



## 16. Expand the Inbound Authentication Configuration

Home > Identity > Service Providers > Add > Service Providers Help

### Service Providers

Basic Information

Service Provider Name\*

oauth2-example

A unique name for the service provider

Description:

A meaningful description about the service provider

SaaS Application

☐

Applications are by default restricted for usage by users of the service provider's tenant. If this application is SaaS enabled it is opened up for all the users of all the tenants.

Claim Configuration

Role/Permission Configuration

Inbound Authentication Configuration

SAML2 Web SSO Configuration

OAuth/OpenID Connect Configuration

OpenID Configuration

WS-Federation (Passive) Configuration

WS-Trust Security Token Service Configuration

Kerberos KDC

Local & Outbound Authentication Configuration

Inbound Provisioning Configuration

Outbound Provisioning Configuration

Update

Cancel

## 17. Expand **OAuth/OpenID Connect Configuration**, and then click **Configure**

Enter the callback URL: <https://localhost:8444/callback>

Home > Identity > Service Providers > Add > Register New Application

### Register New Application

New Application

OAuth Version\*

☐ 1.0a ☒ 2.0

Callback Url\*

<https://localhost:8444/callback>

Allowed Grant Types

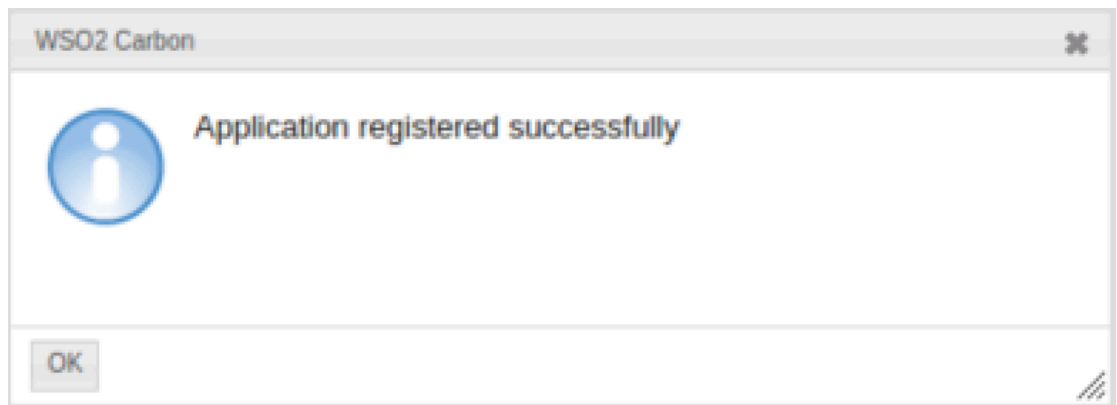
☒ Code ☒ Implicit ☒ Password ☒ Client Credential ☒ Refresh Token ☒ SAML2 ☒ IWA-NTLM

Add

Cancel

Click **Add**

## 18. You should see:



### *Client credentials flow*

19. We now have an OAuth2 Client ID and Client Secret that identifies both the “Client Application” and the user (admin) to the Auth Server.

20. Pull up ARC and create the following request:

URL: <http://localhost:9763/oauth2/token>

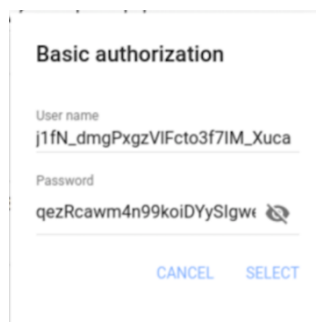
Hint: create the headers with the built in tools (**Headers Form** / then look for the pencil icon)

Headers:

Authorization:

Username: **<your client id copied from the IS web console>**

Password: **<your client secret from the IS web console>**



Basic authorization

User name  
j1fN\_dmgPxyzVIFcto3f7IM\_Xuca

Password  
qezRcawm4n99koiDYySlgw

CANCEL SELECT

Now use the ARC **Data Form** to add the following parameter. Chose the right Content-Type: **application/x-www-form-urlencoded**

grant\_type: client\_credentials

scope: test

Your screen should look like:

The screenshot shows the 'Advanced REST client' interface. At the top, the URL is set to 'http://localhost:9763/oauth2/token'. The HTTP method is 'POST', and the content type is 'application/x-www-form-urlencoded'. The 'Headers form' tab is active, showing two headers: 'authorization' with a Basic token and 'Content-Type' set to 'application/x-www-form-urlencoded'. Below the headers, the 'Data form' tab is active, showing two parameters: 'grant\_type' with the value 'client\_credentials' and 'scope' with the value 'test'. There are buttons for 'ADD' and 'SEND'.

Advanced REST client

Request

Use XHR

> http://localhost:9763/oauth2/token

GET POST PUT DELETE Other methods application/x-www-form-urlencoded

Raw headers Headers form Headers sets

HTTP headers

authorization Basic ajFmTI9kbWdQeGd6VmxGY3RvM2Y3SU1fWHVjYTpxZXpSY2F3bTRuOTlr2lEWXITSWd3

Content-Type application/x-www-form-urlencoded

ADD

Raw payload Data form Files (0)

ENCODE PAYLOAD DECODE PAYLOAD

Form data for x-www-form-urlencoded parameters

grant\_type client\_credentials

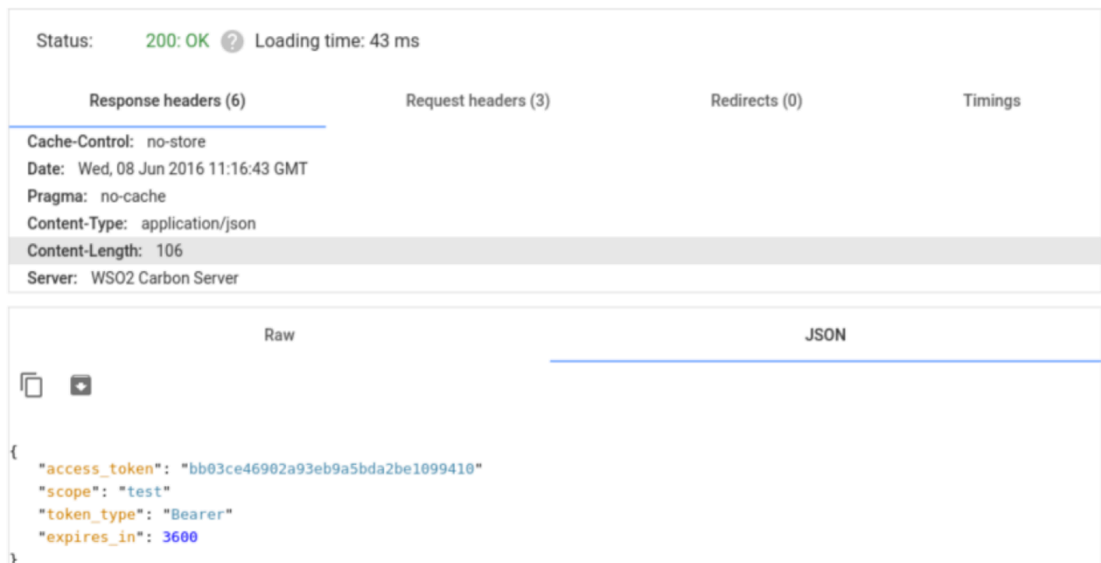
scope test

ADD ANOTHER PARAMETER

SEND

21. Now **Send**

22. You should see a response like:



23. Copy that access token. Now open a new terminal window.  
`cd ~/sec_oauth/client`  
`python random-client.py ce6c89211ac41044e17c7012726d583e`

(but use your token!)

You should see:

```
oxsoa@oxsoa: ~/sec_oauth/client
oxsoa@oxsoa:~/sec_oauth/client$ python random-client.py bb03ce46902a93eb9a5bda2be1099410
return code: 200
{'u'username': u'admin@carbon.super', u'scope': u'test', u'random': 38}
random number: 38
oxsoa@oxsoa:~/sec_oauth/client$
```

24. Congrats, we have made the first type work.

25. This client\_credentials model doesn't really implement what we would properly like, which is that a user *delegates authority* to a client to do something with a scope. The reason is that we expected the User to somehow issue this HTTP request and get the credential.

26. The better model is documented in the second flow in the sequence diagram. Please take another look.

27. To support this, we need logic running in a server<sup>1</sup>. Normally this would be coded into the same system as the client is running as. In other words, our client is a website so it can host this logic. Since we just have a Python

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<sup>1</sup> This isn't strictly true. You can google `urn:ietf:wg:oauth:2.0:oob` to find out more. This would have probably been the right way to code the python client, but the server based approach we have implemented is more likely to be of use to you in real life.

command-line client, I have coded a simple server that does this. You can look at the code for this in the **callbackserver.js** and **oauth2token.js** code in the **~/sec\_oauth/server** directory.

28. Edit the callbackserver.js and replace the existing client\_id and client\_secret with yours copied from the IS Web Console.

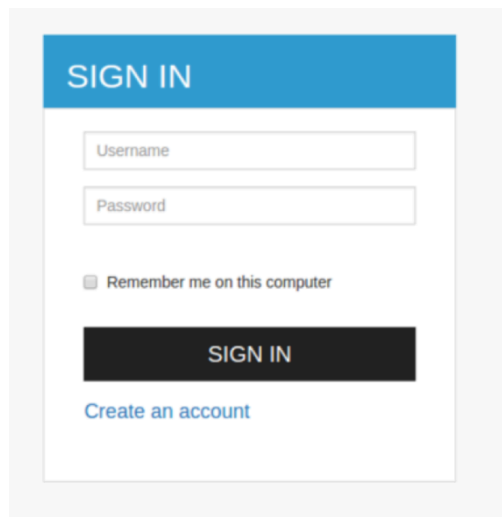
29. Start a new terminal and run the callback server:

```
cd ~/sec_oauth/server  
node callbackserver.js
```

30. Now let's create a "real" userid instead of admin/admin.

31. Log out of the Admin console and go to <https://localhost:9443/dashboard>

32. You should see:

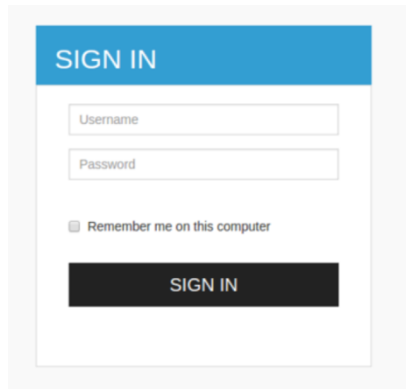


33. Click Create an account and follow the process.

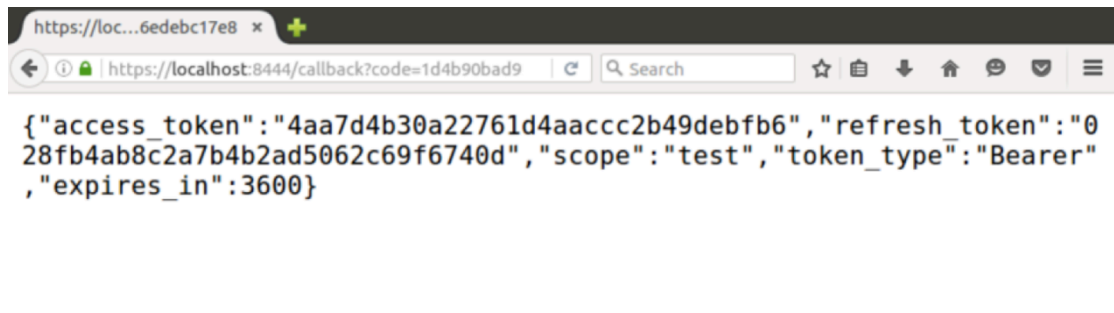
34. Now browse: <https://localhost:8444/gettoken>

35. Accept the risk!

36. You should be redirected to the Auth server to login.



37. Sign in using the ID that you created.
38. You are asked if you want to approve this.
39. Click **Approve Always**
40. You should see something like:



41. Copy the access token and try your random-client again with this token.
42. You should see something like:

```
oxsoa@oxsoa: ~/sec_oauth/client
oxsoa@oxsoa:~$ cd sec_oauth/client/
oxsoa@oxsoa:~/sec_oauth/client$ python random-client.py 4aa7d4b30a22761d4aacc2b49debfb6
return code: 200
{'username': u'paul@carbon.super', u'scope': u'test', u'random': 94}
random number: 94
oxsoa@oxsoa:~/sec_oauth/client$
```

43. Notice that we now have a “real” userid in this response. For example, we could evaluate the scope and the username in our server logic to implement more fine grained logic.
44. Congratulations. The lab is complete!

## 45. Extension 1

Add the refresh client to the python code and code a refresh flow.

Here is the sample refresh flow from the OAuth2 spec:

<https://tools.ietf.org/html/rfc6749#page-47>

```
POST /token HTTP/1.1
Host: server.example.com
Authorization: Basic czZCaGRSa3F0MzpnWDFmQmF0M2JW
Content-Type: application/x-www-form-urlencoded
grant_type=refresh_token&refresh_token=tGzv3JOkF0XG5Qx2TlKWIA
```

## Extension 2 (Advanced)

Create a python client checks if the secret is already there (e.g. in ~/.random/token). If not, it opens up a server on <http://localhost:8444/callback> and invokes the initial token flow, receives the callback, finishes the OAuth2 flow, and stores the secret on disk, then continues.