TUTORIAL

An Introduction to OAuth 2

Security API Conceptual

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English

Introduction

OAuth 2 is an authorization framework that enables applications to obtain limited access to user accounts on an HTTP service, such as Facebook, GitHub, and DigitalOcean. It works by delegating user authentication to the service that hosts the user account, and authorizing third-party applications to access the user account. OAuth 2 provides authorization flows for web and desktop applications, and mobile devices.

This informational guide is geared towards application developers, and provides an overview of OAuth 2 roles, authorization grant types, use cases, and flows.

Let’s get started with OAuth Roles!

OAuth Roles

OAuth defines four roles:

- Resource Owner
- Client
- Resource Server
- Authorization Server

We will detail each role in the following subsections.

Resource Owner: *User*

The resource owner is the *user* who authorizes an *application* to access their account. The application's access to the user's account is limited to the "scope" of the authorization granted (e.g. read or write access).

Resource / Authorization Server: *API*

The resource server hosts the protected user accounts, and the authorization server verifies the identity of the *user* then issues access tokens to the *application*.

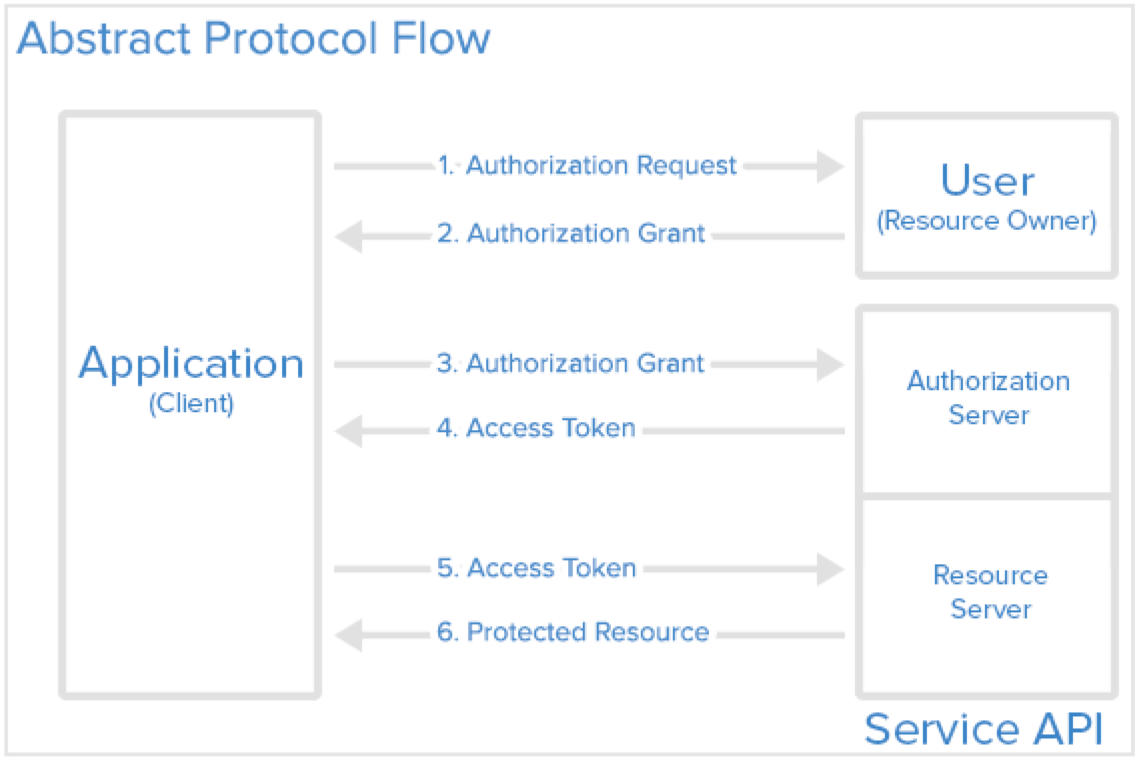
From an application developer's point of view, a service's **API** fulfills both the resource and authorization server roles. We will refer to both of these roles combined, as the *Service* or *API* role.

Client: *Application*

The client is the *application* that wants to access the *user*'s account. Before it may do so, it must be authorized by the user, and the authorization must be validated by the API.

Abstract Protocol Flow

Now that you have an idea of what the OAuth roles are, let's look at a diagram of how they generally interact with each other:



Here is a more detailed explanation of the steps in the diagram:

1. The *application* requests authorization to access service resources from the *user*
2. If the *user* authorized the request, the *application* receives an authorization grant

3. The *application* requests an access token from the *authorization server* (API) by presenting authentication of its own identity, and the authorization grant
4. If the application identity is authenticated and the authorization grant is valid, the *authorization server* (API) issues an access token to the application. Authorization is complete.
5. The *application* requests the resource from the *resource server* (API) and presents the access token for authentication
6. If the access token is valid, the *resource server* (API) serves the resource to the *application*

The actual flow of this process will differ depending on the authorization grant type in use, but this is the general idea. We will explore different grant types in a later section.

Application Registration

Before using OAuth with your application, you must register your application with the service. This is done through a registration form in the “developer” or “API” portion of the service’s website, where you will provide the following information (and probably details about your application):

- Application Name
- Application Website
- Redirect URI or Callback URL

The redirect URI is where the service will redirect the user after they authorize (or deny) your application, and therefore the part of your application that will handle authorization codes or access tokens.

Client ID and Client Secret

Once your application is registered, the service will issue “client credentials” in the form of a *client identifier* and a *client secret*. The Client ID is a publicly exposed string that is used by the service API to identify the application, and is also used to build authorization URLs that are presented to users. The Client Secret is used to authenticate the identity of the application to the service API when the application requests to access a user’s account, and must be kept private between the application and the API.

Authorization Grant

In the *Abstract Protocol Flow* above, the first four steps cover obtaining an authorization grant and access token. The authorization grant type depends on the method used by the application to request authorization, and the grant types supported by the API. OAuth 2 defines four grant types, each of which is useful in different cases:

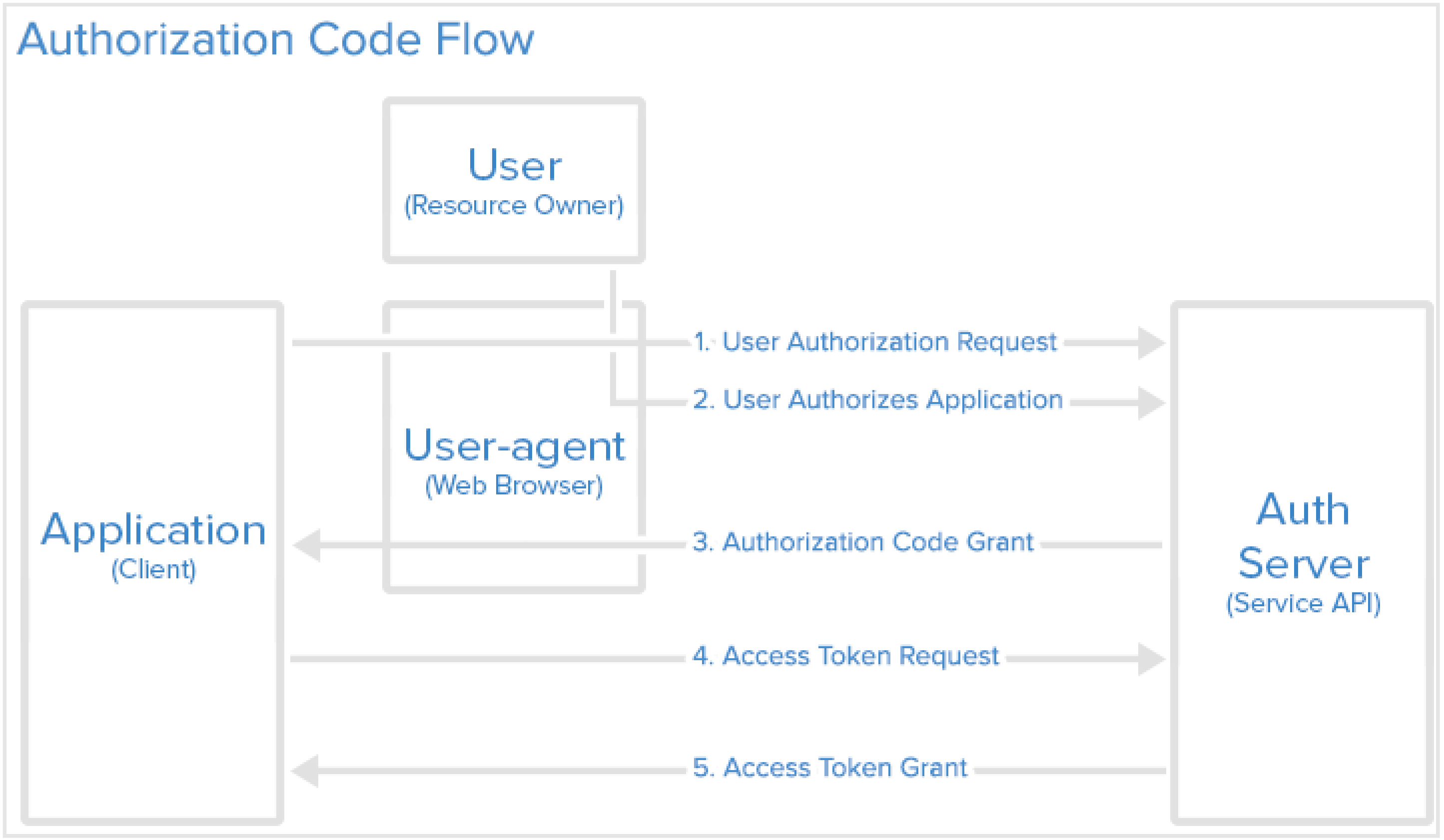
- **Authorization Code**: used with server-side Applications
- **Implicit**: used with Mobile Apps or Web Applications (applications that run on the user’s device)
- **Resource Owner Password Credentials**: used with trusted Applications, such as those owned by the service itself
- **Client Credentials**: used with Applications API access

Now we will describe grant types in more detail, their use cases and flows, in the following sections.

Grant Type: Authorization Code

The **authorization code** grant type is the most commonly used because it is optimized for *server-side applications*, where source code is not publicly exposed, and *Client Secret* confidentiality can be maintained. This is a redirection-based flow, which means that the application must be capable of interacting with the *user-agent* (i.e. the user's web browser) and receiving API authorization codes that are routed through the user-agent.

Now we will describe the authorization code flow:



Step 1: Authorization Code Link

First, the user is given an authorization code link that looks like the following:

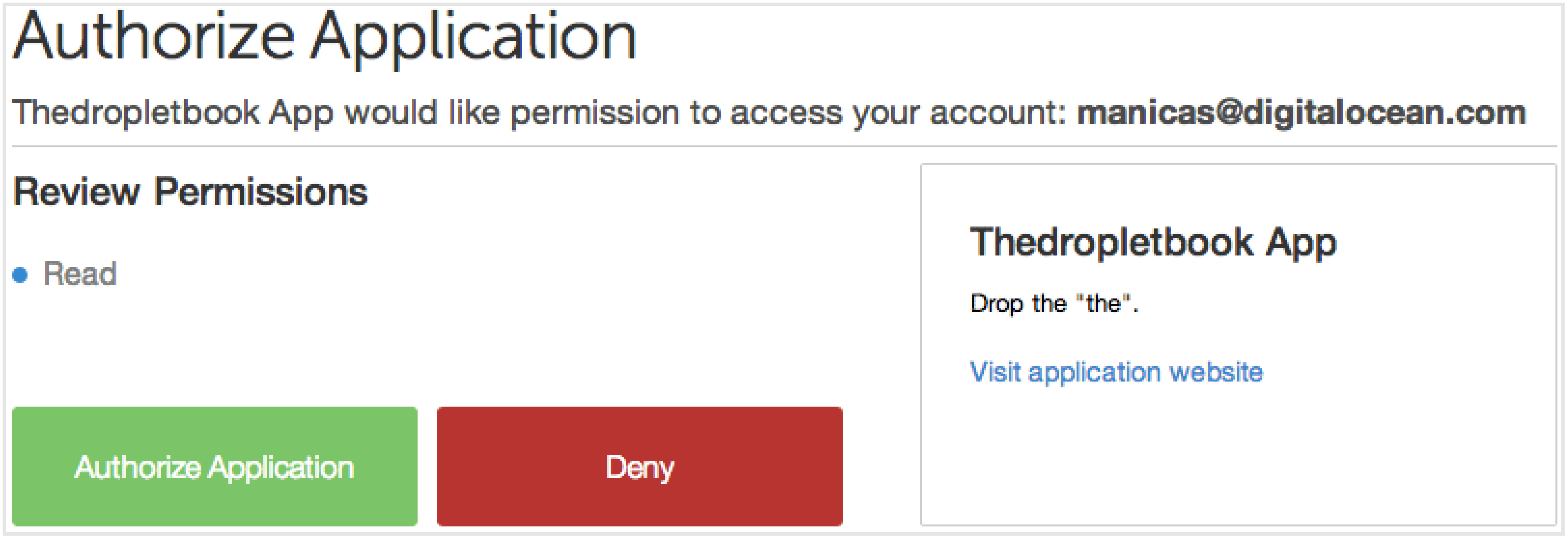
```
tps://cloud.digitalocean.com/v1/oauth/authorize?response_type=code&client_id=CLIENT_ID&redirect_uri=CALLBACK_URL&scope=read
```

Here is an explanation of the link components:

- **https://cloud.digitalocean.com/v1/oauth/authorize**: the API authorization endpoint
- **client_id=client_id**: the application's *client ID* (how the API identifies the application)
- **redirect_uri=CALLBACK_URL**: where the service redirects the user-agent after an authorization code is granted
- **response_type=code**: specifies that your application is requesting an authorization code grant
- **scope=read**: specifies the level of access that the application is requesting

Step 2: User Authorizes Application

When the user clicks the link, they must first log in to the service, to authenticate their identity (unless they are already logged in). Then they will be prompted by the service to *authorize* or *deny* the application access to their account. Here is an example authorize application prompt:


Authorize Application

Thedropletbook App would like permission to access your account: **manicas@digitalocean.com**

Review Permissions

- Read

Thedropletbook App

Drop the "the".

Visit application website

This particular screenshot is of DigitalOcean's authorization screen, and we can see that "Thedropletbook App" is requesting authorization for "read" access to the account of "manicas@digitalocean.com".

Step 3: Application Receives Authorization Code

If the user clicks "Authorize Application", the service redirects the user-agent to the application redirect URI, which was specified during the client registration, along with an *authorization code*. The redirect would look something like this (assuming the application is "dropletbook.com"):

```
https://dropletbook.com/callback?code=AUTHORIZATION_CODE
```

Step 4: Application Requests Access Token

The application requests an access token from the API, by passing the authorization code along with authentication details, including the *client secret*, to the API token endpoint. Here is an example POST request to DigitalOcean's token endpoint:

```
ıt_id=CLIENT_ID&client_secret=CLIENT_SECRET&grant_type=authorization_code&code=AUTHORIZATION_CODE&redirect_uri=CALLBACK_URL
```

Step 5: Application Receives Access Token

If the authorization is valid, the API will send a response containing the access token (and optionally, a refresh token) to the application. The entire response will look something like this:

```
{"access_token":"ACCESS_TOKEN","token_type":"bearer","expires_in":2592000,"refresh_token":"REFRESH_TOKEN","scope":"read","ui
```

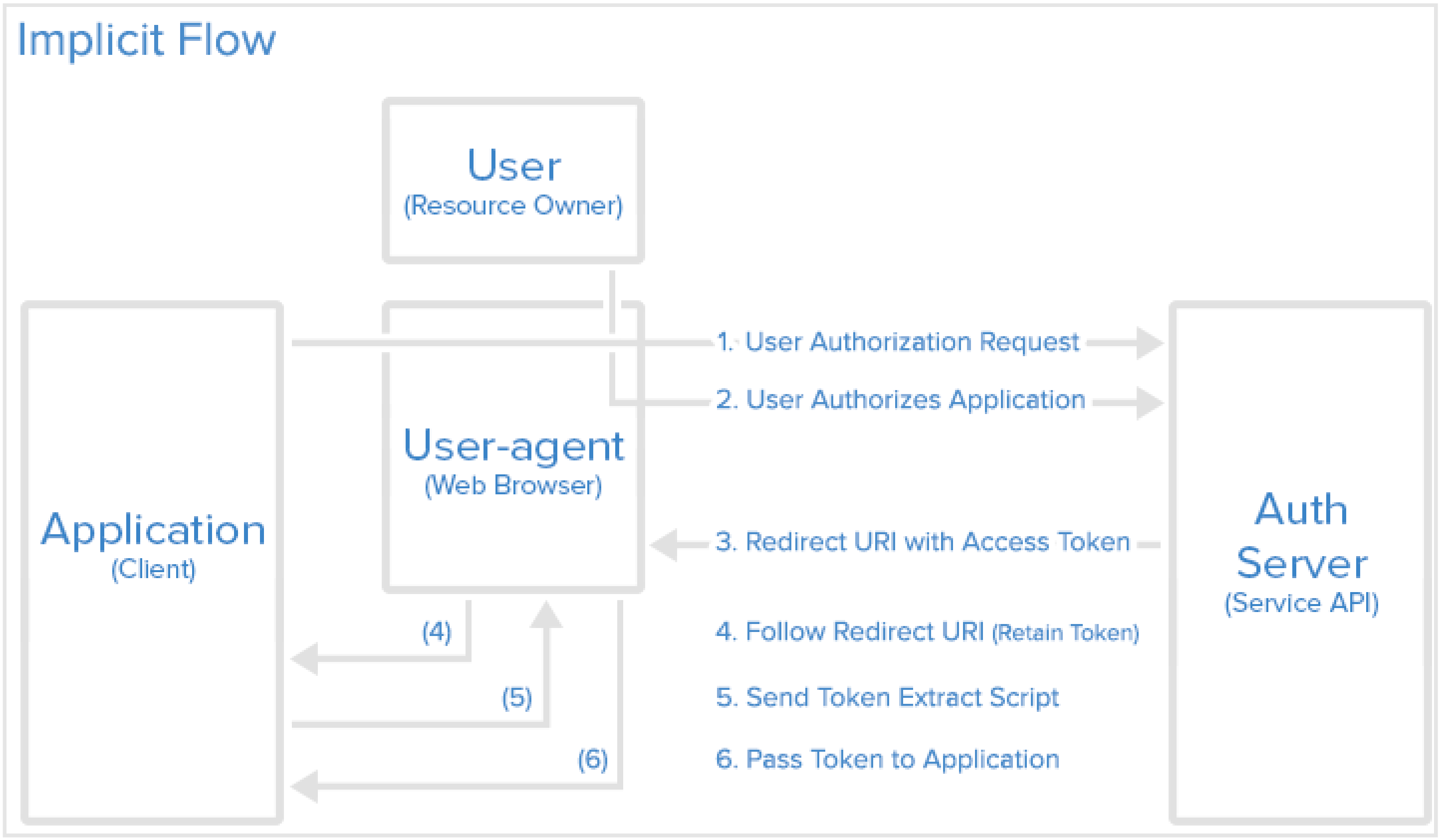
Now the application is authorized! It may use the token to access the user’s account via the service API, limited to the scope of access, until the token expires or is revoked. If a refresh token was issued, it may be used to request new access tokens if the original token has expired.

Grant Type: Implicit

The **implicit** grant type is used for mobile apps and web applications (i.e. applications that run in a web browser), where the *client secret* confidentiality is not guaranteed. The implicit grant type is also a redirection-based flow but the access token is given to the user-agent to forward to the application, so it may be exposed to the user and other applications on the user’s device. Also, this flow does not authenticate the identity of the application, and relies on the redirect URI (that was registered with the service) to serve this purpose.

The implicit grant type does not support refresh tokens.

The implicit grant flow basically works as follows: the user is asked to authorize the application, then the authorization server passes the access token back to the user-agent, which passes it to the application. If you are curious about the details, read on.


Implicit Flow
User
(Resource Owner)
Application
(Client)
User-agent
(Web Browser)
Auth
Server
(Service API)
1. User Authorization Request
2. User Authorizes Application
3. Redirect URI with Access Token
4. Follow Redirect URI (Retain Token)
5. Send Token Extract Script
6. Pass Token to Application
(4)
(5)
(6)

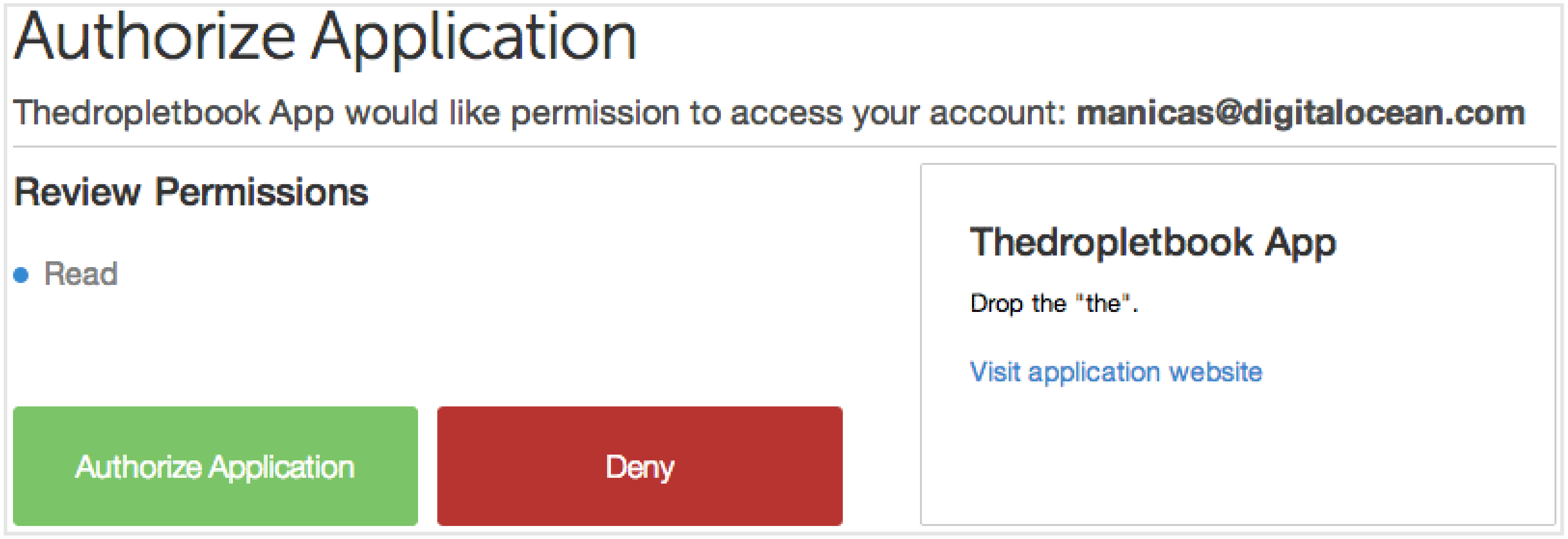
Step 1: Implicit Authorization Link

With the implicit grant type, the user is presented with an authorization link, that requests a token from the API. This link looks just like the authorization code link, except it is requesting a *token* instead of a code (note the *response type* "token"):

```
ps://cloud.digitalocean.com/v1/oauth/authorize?response_type=token&client_id=CLIENT_ID&redirect_uri=CALLBACK_URL&scope=read
```

Step 2: User Authorizes Application

When the user clicks the link, they must first log in to the service, to authenticate their identity (unless they are already logged in). Then they will be prompted by the service to *authorize* or *deny* the application access to their account. Here is an example authorize application prompt:



Authorize Application

Thedropletbook App would like permission to access your account: **manicas@digitalocean.com**

Review Permissions

- Read

Thedropletbook App

Drop the "the".

We can see that “Thedropletbook App” is requesting authorization for “read” access to the account of “manicas@digitalocean.com”.

Step 3: User-agent Receives Access Token with Redirect URI

If the user clicks “Authorize Application”, the service redirects the user-agent to the application redirect URI, and includes a URI fragment containing the access token. It would look something like this:

```
https://dropletbook.com/callback#token=ACCESS_TOKEN
```

Step 4: User-agent Follows the Redirect URI

The user-agent follows the redirect URI but retains the access token.

Step 5: Application Sends Access Token Extraction Script

The application returns a webpage that contains a script that can extract the access token from the full redirect URI that the user-agent has retained.

Step 6: Access Token Passed to Application

The user-agent executes the provided script and passes the extracted access token to the application.

Now the application is authorized! It may use the token to access the user's account via the service API, limited to the scope of access, until the token expires or is revoked.

Grant Type: Resource Owner Password Credentials

With the **resource owner password credentials** grant type, the user provides their service credentials (username and password) directly to the application, which uses the credentials to obtain an access token from the service. This grant type should only be enabled on the authorization server if other flows are not viable. Also, it should only be used if the application is trusted by the user (e.g. it is owned by the service, or the user's desktop OS).

Password Credentials Flow

After the user gives their credentials to the application, the application will then request an access token from the authorization server. The POST request might look something like this:

```
https://oauth.example.com/token?grant_type=password&username=USERNAME&password=PASSWORD&client_id=CLIENT_ID
```

If the user credentials check out, the authorization server returns an access token to the application. Now the application is authorized!

Note: DigitalOcean does not currently support the password credentials grant type, so the link points to an imaginary authorization server at “oauth.example.com”.

Grant Type: Client Credentials

The **client credentials** grant type provides an application a way to access its own service account. Examples of when this might be useful include if an application wants to update its registered description or redirect URI, or access other data stored in its service account via the API.

Client Credentials Flow

The application requests an access token by sending its credentials, its client ID and client secret, to the authorization server. An example POST request might look like the following:

```
https://oauth.example.com/token?grant_type=client_credentials&client_id=CLIENT_ID&client_secret=CLIENT_SECRET
```

If the application credentials check out, the authorization server returns an access token to the application. Now the application is authorized to use its own account!

Note: DigitalOcean does not currently support the client credentials grant type, so the link points to an imaginary authorization server at “oauth.example.com”.

Example Access Token Usage

Once the application has an access token, it may use the token to access the user’s account via the API, limited to the scope of access, until the token expires or is revoked.

Here is an example of an API request, using `curl`. Note that it includes the access token:

```
curl -X POST -H "Authorization: Bearer ACCESS_TOKEN""https://api.digitalocean.com/v2/$OBJECT"
```

Assuming the access token is valid, the API will process the request according to its API specifications. If the access token is expired or otherwise invalid, the API will return an “invalid_request” error.

Refresh Token Flow

After an access token expires, using it to make a request from the API will result in an “Invalid Token Error”. At this point, if a refresh token was included when the original access token was issued, it can be used to request a fresh access token from the authorization server.

Here is an example POST request, using a refresh token to obtain a new access token:

```
ean.com/v1/oauth/token?grant_type=refresh_token&client_id=CLIENT_ID&client_secret=CLIENT_SECRET&refresh_token=REFRESH_TOKEN
```

Conclusion

That concludes this OAuth 2 guide. You should now have a good idea of how OAuth 2 works, and when a particular authorization flow should be used.

If you want to learn more about OAuth 2, check out these valuable resources:

- How To Use OAuth Authentication with DigitalOcean as a User or Developer
- How To Use the DigitalOcean API v2
- The OAuth 2.0 Authorization Framework

About the authors

Mitchell Anicas

Software Engineer @ DigitalOcean. Former Señor Technical Writer (I no longer update articles or respond to comments).

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5 maximoishi July 24, 2014

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1 adolphenom July 30, 2014

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1 joamag October 10, 2014

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1 meidydoang October 13, 2014

wow fabulos..thank for share buddy

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1 **Soham** October 27, 2014

Which flow is most suitable for system to system communication using REST APIs?

Reply Report

1 **gregj** December 16, 2014

Good explanation of the Grant Types

Re: Your diagrams for Grant Type: Authorization Code Link and Grant Type: Implicit.

Step 1. User Authorization Request … is this truly the "User/Resource Owner" request or is this the Application/Client request. The arrow shows the source as Application/Client however the text on the arrow indicates User/Resource Owner. Also the detailed text indicates "User"

Reply Report

> 1 **aywu** February 24, 2016
>
> I agree. Confused.
>
> Reply Report

2 **gowthamgts12** May 26, 2015

Awesome.. Thanks man..

Reply Report

1 **devendiran** September 8, 2015

Great this helps alot.thanks!

Reply Report

3 **gihanchanuka** October 2, 2015

@author @manicas Why are you sending sensitive data as Query parameters (in URL), even though it isn't recommended by the OAuth2 specification itself ?

See the last point.

<^>
Don’t pass bearer tokens in page URLs: Bearer tokens SHOULD NOT be passed in page URLs (for example as query string parameters). Instead, bearer tokens SHOULD be passed in HTTP message headers or message bodies for which confidentiality measures are taken. Browsers, web servers, and other software may not adequately secure URLs in the browser history, web server logs, and other data structures. If bearer tokens are passed in page URLs, attackers might be able to steal them from the history data, logs, or other unsecured locations.
<^>

Reply Report

1 kayode October 19, 2015

Thank you guys. This tutorial really helped me understand how OAUTH works. I have a little question though I will like to ask what are the steps or how can I generate a signature for my OAUTH requests as I have read that requests without signature may not be so secured.

Thanks.

Reply Report

1 riteshdwivedi January 12, 2016

Very good explanation of the concepts. The way content is ordered helped me getting first about the OAuth 2.0 and then each grant type helped me to understand the required grant typed for my project.
Thanks.

Reply Report

1 amabhinavkumar February 15, 2016

Good job

Reply Report

1
misterlemons February 19, 2016
2016 and still useful! Very neat write up.

Reply Report

1
devahmad92 February 22, 2016
This an awesome new feature. Thanks guys !!!

Reply Report

1
aywu February 24, 2016
In general, this tutorial is pretty good in contents, technical level and formatting. In the beginning, I really liked it and I wanted to finish it. But the more I read, the more I got confused. For example, these terms “application”, “client”, “user” should be explained in more details. In some context, “application” actually meant to be “client”. In step 2 of Authorization Code section, a “user” actually means “client” instead of resource owner. In other context, “user” means resource owner. Thanks a lot for the work!

Reply Report

1
aglioolio March 18, 2016
I really love this explanation, concise, clear, and complete. I’ve printed this out and put into a folder called “oauth bible”. Thanks for the great job!

Reply Report

0
ilyes March 22, 2016
Nice tutorial thanks !

Reply Report

0
maimohamedmoham April 10, 2016
good work

Reply Report

1
riteshdwivedi July 21, 2016

Should **client_secret** not be supplied along with client_id, username and password in case of **resource owner password credential grant** ?

Reply Report

0

neoderby August 8, 2016

Excellent article.

Example URLs does not show state parameters. Might be good to mention this so that readers are aware of it and developers make use of it to protect against CSRF attacks

Reply Report

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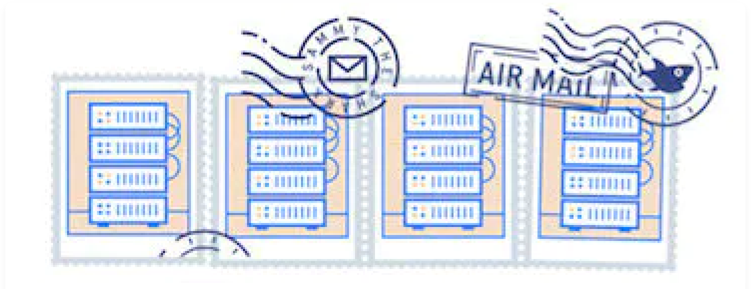

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