SETTING UP A MACHINE-TO-MACHINE AUTHENTICATION SYSTEM WITH AMAZON COGNITO

Amazon Cognito

beSharp | 18 September 2020

More and more applications, both mobile and web, rely on managed services such as Amazon Cognito for user authentication and authorization. Cognito allows you to rapidly develop secure applications adhering to recognized security standards for authentication and authorization of end-users.

Leveraging a fully managed service allows developers to stop worrying about the authentication flow and the user pool management, leaving them free to focus on what matters: the business logic of their products.

However quite often we would like to federate with our application third-party service or another microservice.

While Cognito is mainly used for user authentication flows, it can also be used to create a machine to machine authentication system.

In this article we'll describe how Cognito can be used to authenticate a client system that needs access to a set of sensitive APIs exposed by a service.

However before deep diving into the description of the solution, it could be useful to describe the services involved.

What is Amazon Cognito?

When you need to implement an authorization and authentication system on AWS, Amazon Cognito is your best choice.

Amazon Cognito lets you add user sign-up, sign-in, and access control to your web and mobile apps quickly and easily, it scales to millions of users and supports sign-in with social identity providers, such as Facebook, Google, and Amazon, and enterprise identity providers via SAML 2.0.

Furthermore Cognito also supports multi-factor authentication and encryption of data-at-rest and in-transit. Amazon Cognito is HIPAA eligible and PCI DSS, SOC, ISO/IEC 27001, ISO/IEC 27017, ISO/IEC 27018, and ISO 9001 compliant.

Let's move on to describe the main concepts of Cognito.

Users are managed through two types of pools, which are at the heart of Amazon Cognito's operation: User Pools and Identity Pools.

User Pool

A user pool is essentially a user directory that allows you to securely store your users' profile attributes. This is a convenient way to completely off-load user profile management, security, and availability. Among the operations which can be off-loaded, there is certainly the secure storage of user data, the verification of telephone numbers and/or e-mail addresses, the management of the login system APIs, and the flow of registration, login, logout, and password reset.

In addition, to using the Amazon Cognito-specific user APIs to authenticate users, Amazon Cognito user pools also support the OAuth 2.0 authentication protocol to authenticate users or applications.

User pools are a fundamental component of any authentication system based on Amazon Cognito, and we will leverage this component to build our machine to machine authentication system.

Identity Pool

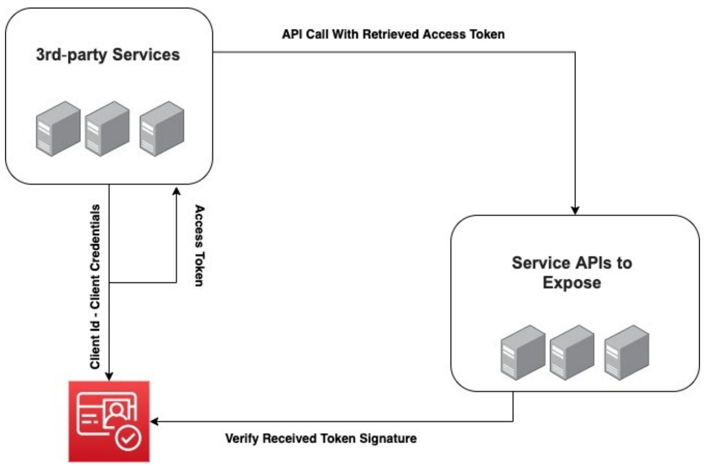
We are not going to use Identity Pools for this specific scenario, but it could be useful to describe them briefly.

Identity pools are used by Cognito Identity to keep the application's federated identities organized. An identity pool associates federated identities from external identity providers with a unique specific user identifier. Identity pools do not store user profiles, but only their unique ids, which are generated and managed by Cognito. Cognito Identity pools assign users a set of temporary IAM credentials with limited privileges. Users or client applications can use those credentials to access AWS resources. Authorizations rules for each user are controlled through customizable AWS IAM roles and policies. It is also possible to define rules to match Users with the desired role.

Now that we've defined all the fundamental concepts we can move on to the central part of our article.

System to system Authentication Flow

Let's start by defining the authentication flow that we will configure in the next steps.


3rd-party Services
API Call With Retrieved Access Token
Service APIs to Expose
Client Id - Client Credentials
Access Token
Verify Received Token Signature

As described in the OAuth 2.0 specifications, we can authenticate a client that presents a valid Client Id and Client Secret to our Identity Provider.

As you can see from the image above, a generic client can call AWS Cognito APIs with the previously shared Client Id and Client Secret. If the two parameters are valid, AWS Cognito returns an Access Token. Now the application can call your services passing the retrieved Token.

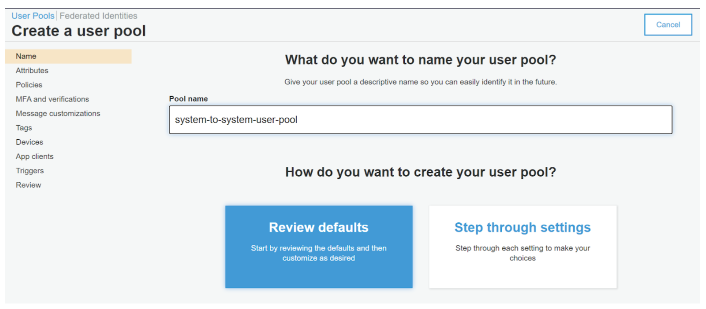
What your services have to do now, is to validate it as described by the OAuth 2.0 specification. In this step you need to:

1. Validate that the received JWT has a valid format.
2. Validate the JWT Signature.
3. Verify all the Claims.

With the authentication flow in mind, let's go on to configure it inside your AWS Account.

Hands-on!

Now that you are aware of the different Amazon Cognito components, we can start with the project. First of all, a basic user group needs to be created from the AWS console. To do so it's possible to choose an explicative name and keep all the default settings by clicking the "Review defaults" button.


User Pools | Federated Identities

Create a user pool

Cancel

Name
Attributes
Policies
MFA and verifications
Message customizations
Tags
Devices
App clients
Triggers
Review

What do you want to name your user pool?

Give your user pool a descriptive name so you can easily identify it in the future.

Pool name: system-to-system-user-pool

How do you want to create your user pool?

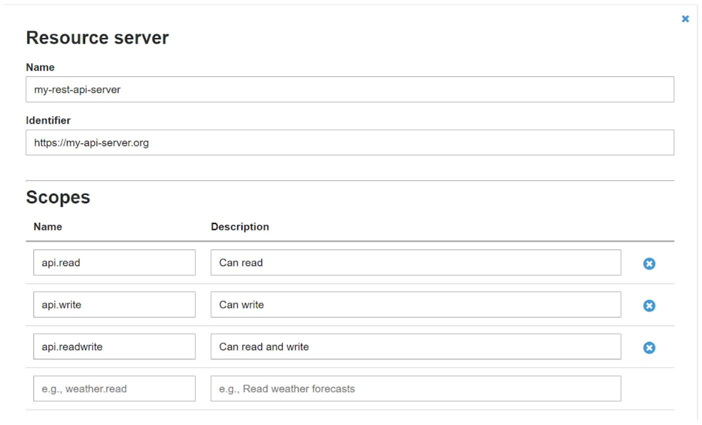
Review defaults
Start by reviewing the defaults and then customize as desired

Step through settings
Step through each setting to make your choices

At this point we can start exploring the numerous options provided by our new user pool, tweaking the ones needed for our project.

The server that will handle the authorized requests can be specified in the resource server page of the Cognito console

Here you'll be able to determine the unique URL of the server exposing the APIs you need to protect. Moreover, a set of scopes can be listed in this page to discriminate, for example, various levels of access to your service.



Resource server

Name: my-rest-api-server

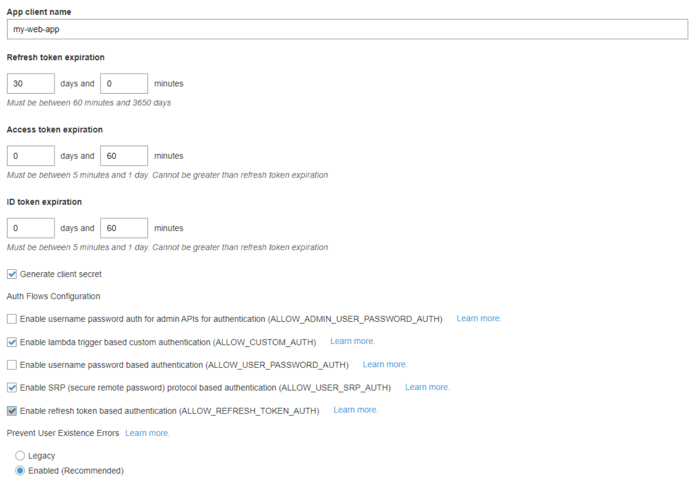
Identifier: https://my-api-server.org

Scopes

Name	Description
api.read	Can read
api.write	Can write
api.readwrite	Can read and write
e.g., weather.read	e.g., Read weather forecasts

Now that the resource server has been configured, we can follow up with the settings of the app clients.

In this page it's possible to define a new client, for example, a new web-app that needs to consume the set of APIs you want to protect.



App client name: my-web-app

Refresh token expiration: 30 days and 0 minutes
Must be between 60 minutes and 3650 days

Access token expiration: 0 days and 60 minutes
Must be between 5 minutes and 1 day. Cannot be greater than refresh token expiration

ID token expiration: 0 days and 60 minutes
Must be between 5 minutes and 1 day. Cannot be greater than refresh token expiration

[✓] Generate client secret

Auth Flows Configuration

- [ ] Enable username password auth for admin APIs for authentication (ALLOW_ADMIN_USER_PASSWORD_AUTH) Learn more.
- [✓] Enable lambda trigger based custom authentication (ALLOW_CUSTOM_AUTH) Learn more.
- [ ] Enable username password based authentication (ALLOW_USER_PASSWORD_AUTH) Learn more.
- [✓] Enable SRP (secure remote password) protocol based authentication (ALLOW_USER_SRP_AUTH) Learn more.
- [✓] Enable refresh token based authentication (ALLOW_REFRESH_TOKEN_AUTH) Learn more.

Prevent User Existence Errors Learn more.

Legacy [✓ Enabled (Recommended)]

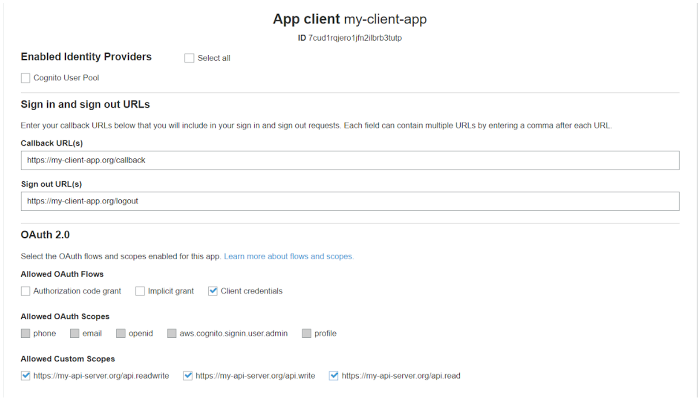
Here you can specify the name of the new client and the expiration of the security tokens used in the authorization process. Due to the client credentials grant type specifications, ID tokens and refresh tokens are not used, hence only the access token's expiration is important.

When these details are submitted, Cognito will prompt us with an app client id and an app client secret. Although the client id is intended as a public identifier of apps, it's important that you never share either the id or the secret for security reasons.

These two tokens need to be encrypted and stored by each of the registered applications to request access tokens to the Cognito user pool. They are essentially the username and password of the system-to-system authorization.

Your app is now successfully registered and it's possible to edit the authorization options you want to enable for its users from the **app client settings** page.

In this form, in fact, you'll be able to choose the client credentials OAuth flow as the single method allowed to request access tokens. From this page, you're also able to define which scopes can be used by each app client, to get rid of the possibility to request APIs that are not meant to be called from a specific client.


App client my-client-app

ID 7cud1rqjero1jfn2ilbrb3tutp

Enabled Identity Providers ☐ Select all

☐ Cognito User Pool

Sign in and sign out URLs

Enter your callback URLs below that you will include in your sign in and sign out requests. Each field can contain multiple URLs by entering a comma after each URL.

Callback URL(s)

https://my-client-app.org/callback

Sign out URL(s)

https://my-client-app.org/logout

OAuth 2.0

Select the OAuth flows and scopes enabled for this app. Learn more about flows and scopes.

Allowed OAuth Flows

☐ Authorization code grant ☐ Implicit grant ✓ Client credentials

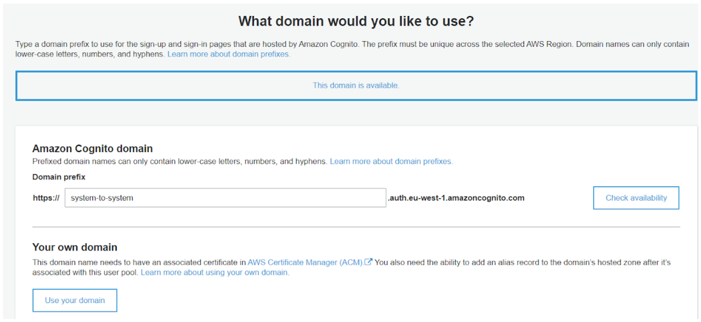
Allowed OAuth Scopes

☐ phone ☐ email ☐ openid ☐ aws.cognito.signin.user.admin ☐ profile

Allowed Custom Scopes

✓ https://my-api-server.org/api.readwrite ✓ https://my-api-server.org/api.write ✓ https://my-api-server.org/api.read

As a final step on the cognito console, a domain name needs to be chosen. In fact, on this page, we'll choose (if available) where the applications will send the access token requests.


What domain would you like to use?

Type a domain prefix to use for the sign-up and sign-in pages that are hosted by Amazon Cognito. The prefix must be unique across the selected AWS Region. Domain names can only contain lower-case letters, numbers, and hyphens. Learn more about domain prefixes.

This domain is available.

Amazon Cognito domain

Prefixed domain names can only contain lower-case letters, numbers, and hyphens. Learn more about domain prefixes.

Domain prefix

https:// system-to-system **.auth.eu-west-1.amazoncognito.com**

Your own domain

This domain name needs to have an associated certificate in AWS Certificate Manager (ACM). You also need the ability to add an alias record to the domain's hosted zone after it's associated with this user pool. Learn more about using your own domain.

Cognito is now ready to prompt to you tons of access tokens!

```python
import requests

TOKEN_ENDPOINT = 'https://system-to-system.auth.eu-west-1.amazoncognito.com/token'

body = {
    'grant_type': 'client_credentials',
    'client_id': CLIENT_ID,
    'client_secret': CLIENT_SECRET,
    'scope': 'https://my-api-server.org/api.readwrite'
}

response = requests.post(TOKEN_ENDPOINT, data=body)
print(response.text)
```

As you can see from the snippet above, the retrieval of the access token is a fairly simple HTTP POST request that needs in its body few simple parameters seen before. The token endpoint is built from the newly created domain name.

The access token we just received is now ready to be shipped within an API call to the resource server. The latter, then, must be able to decode it and validate it against a set of public signature keys exposed by cognito.

```
import functools
import json
import jwt
import urllib.request
def is_valid_token(scope) -> bool:
    def wrapped(func):
        @functools.wraps(func)
        def wrapper(access_token):
            public_keys = get_well_known_jwk(REGION, USER_POOL_ID)
            kid = jwt.get_unverified_header(access_token)['kid']
            key = public_keys[kid]
            payload = jwt.decode(access_token, key=key, algorithms=['RS256'])
            if payload['client_id'] != CLIENT_ID:
                print('Wrong client_id')
                raise Exception('Wrong client id')
            if payload['scope'] != scope:
                print('Wrong scope')
                raise Exception('Wrong scope')
            return func(access_token)
        return wrapper
    return wrapped
def get_well_known_jwk(region: str, user_pool_id: str) -> dict:
    jwk_url = f"https://cognito-idp.{region}.amazonaws.com/{user_pool_id}/.well-known
/jwks.json"
    with urllib.request.urlopen(jwk_url) as url:
        jwks = json.loads(url.read().decode())
    public_keys = {}
    for jwk in jwks['keys']:
        kid = jwk['kid']
        public_keys[kid] = jwt.algorithms.RSAAlgorithm.from_jwk(json.dumps(jwk))
    return public_keys
@is_valid_token(scope = 'https://my-api-server.org/api.write')
def api(access_token):
    resp = {
        "status_code": 200,
        "body": "This is your body."
    }
    print(json.dumps(resp))
```

You can now test the solution and authenticate other services in your application.

That’s all for today! In this article, we explained how to build a secure, reliable, and fully managed machine to machine authentication system leveraging Amazon Cognito and Cognito User Pools.

Feel free to contact us and comment below to ask questions or just to add your thoughts on the subject.

Stay tuned for the next article and see you **in 14 days** on **#Proud2beCloud**!

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