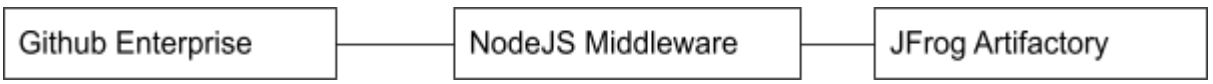
Alternative B

High Level Solution

According the description of the exercise “Alternative B”, at high level, three main services can be identified:



- Github Enterprise: where users/ groups and repositories are created. Also the event on a new issue is generated here.
- NodeJS Middleware: handle the event on a new issue and perform actions over the Artifactory instance adjusting the repositories, users , groups and permissions.

- JFrog Cloud Artifactory: package repository where the NodeJS Middleware will perform actions based on the event info received from Github Enterprise instance.

So, the idea of this implementation is create a middleware which handle the Artifactory's entities when Github event is detected (taking advantage of Github's Webhooks)

Notice: in my opinion the idea of performing actions over an Artifactory based on new issue events (over a Github's repository) is not a common scenario but for testing purposes is useful because to demonstrate the integration capabilities between Github and JFrog Artifactory. Probably a more realistic scenario (and maybe out of scope of this test) could be to create a custom action event which is part of a CICD pipeline.

Tools Selection

Assumptions

- Github Enterprise Tool used is trial version
- JFrog Artifactory is trial version
- NodeJS Middleware deployed locally in my computer and exposed using ngrok tool

In order to speed up the integration of the three main parts described in the previous section, the tools selected are going to be deployed in a cloud service (instead on premise) getting rid of potential issues related with certificates, custom installation steps and so on.

- Github Enterprise Tool: Github is de facto versioning/hosting tool, cloud based and is ready to be used instead of on premise alternatives like "Git Server ".

- NodeJS Middleware: Node.js is an open-source and cross-platform JavaScript runtime environment. The reason why I choose it instead of other alternatives are:
    - Fast-processing (V8 Javascript Engine) and event-based model (asynchronous, non-blocking, single-threaded nature,)
    - Scalability technology for microservices (lightweight technology)
    - Multiple open source libraries npm (Marketplace)
    - Native support for JSON Format in comparison with other technologies (like Ruby or PHP) NodeJS uses JSON instead of converting binary models.

      So, the idea is to create a NodeJS REST API using Express framework. Besides that in order to make it accessible through a public URL , ngrok tool will be used just for a PoC purpose.
        - A real option could be to create a Github Bot using probot but for this test's objective is out of scope due to learning curve and time consumption. But definitely is the best solution for a real github organization

- JFrog Artifactory Cloud: given the cloud free version meets the minimum requirements needed for this exercise (handle repositories, users, permission and groups through REST API) and also many others feature out of the box like reachable through a public, secure URL.

Tools Initial Setup

Github Enterprise

- A Github Organization was created https://github.com/norbertorodas-cariad-techtask-org
- Github Organization teams created: **writers, readers, maintainers**
- Github Organization repositories created: **techtask-audi-repo, techtask-vw-repo, techtask-seat-repo** (*)
- 4 Users invited manually (**) . **The role by default will be member**
- For Rest API usage a personal token will be created. Then this be used by NodeJS Middleware

(*) could be a repetitive task. There are native options like template-repository or do not repeat repository settings https://probot.github.io/apps/settings/

(**) In Alternative A this users should be synchronized for a custom tool from Keycloak instance

NodeJS Middleware

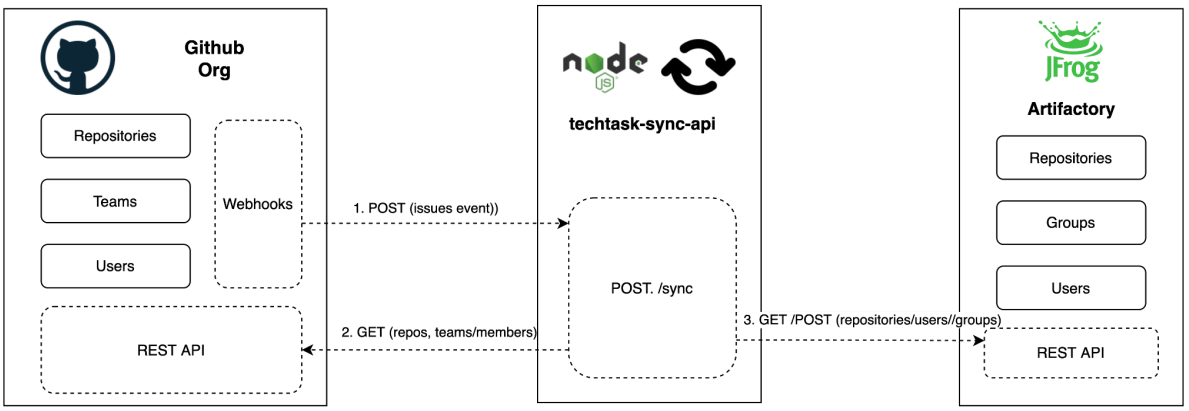
- Repository created https://github.com/norbertorodas-cariad-techtask-org/sync-github-jfrog-artifactory
- NodeJS Express REST API deployed and running locally.
    - Exposed through a public URL through ngrok tool.
    - Github and JFrog credentials will be stored as environment variables (testing purpose)

JFrog Artifactory

- A cloud instance is deployed with domain https://nrodas.jfrog.io
- A service user will be created with the name **techtest-syncronizator** and proper permissions. Then username and API Key will be used by NodeJS Middleware

Design

The following diagram describes the integration between the services



Implementation

NodeJS Middleware

Given testing purposes we will expose the NodeJS REST API using ngrok tool which enables us to expose a local development server to the Internet with minimal effort (*)

(*) This alternative was chosen for the sake of simplicity (https://dashboard.ngrok.com/get-started/setup). More robust, scalable and secure approaches could be:

- Create a user plugin for JFrog Artifactory. Then the plugin is in charge to handle the whole synchronization logic between Github and Artifactory. More details here
- Expose the NodeJS REST API in a reachable server using SSL.
- Execute or sync logic code as Lambda function provided by a well known cloud provider.

- After ngrok is installed on local, localhost:8082 is exposed . Then we can run our NodeJS REST API in our local environment on port 8082

```
ngrok by @inconshreveable

Session Status                online
Account                       betens85 (Plan: Free)
Version                       2.3.40
Region                        United States (us)
Web Interface                 http://127.0.0.1:4040
Forwarding                    http://01d4-188-192-137-111.ngrok.io -> http://localhost:8082
Forwarding                    https://01d4-188-192-137-111.ngrok.io -> http://localhost:8082

Connections                   ttl     opn     rt1     rt5     p50     p90
                              5       0       0.00    0.00    10.05   10.10
```

The URL is http://<random>.ngrok.io where **<name>** is a random name

(*) More details here

Deep into implementation

As is mentioned in the previous section the language selected is NodeJS, the web framework “Express” and the lib axions (all under MIT License). Besides that for JSON text parsing (github new issue event and REST api calls to Github and Artifactory) `JSON.parse` will be used because is part of the JavaScript standard since ECMAScript 5 and is provided by V8 (Javascript Engine of Node.js).

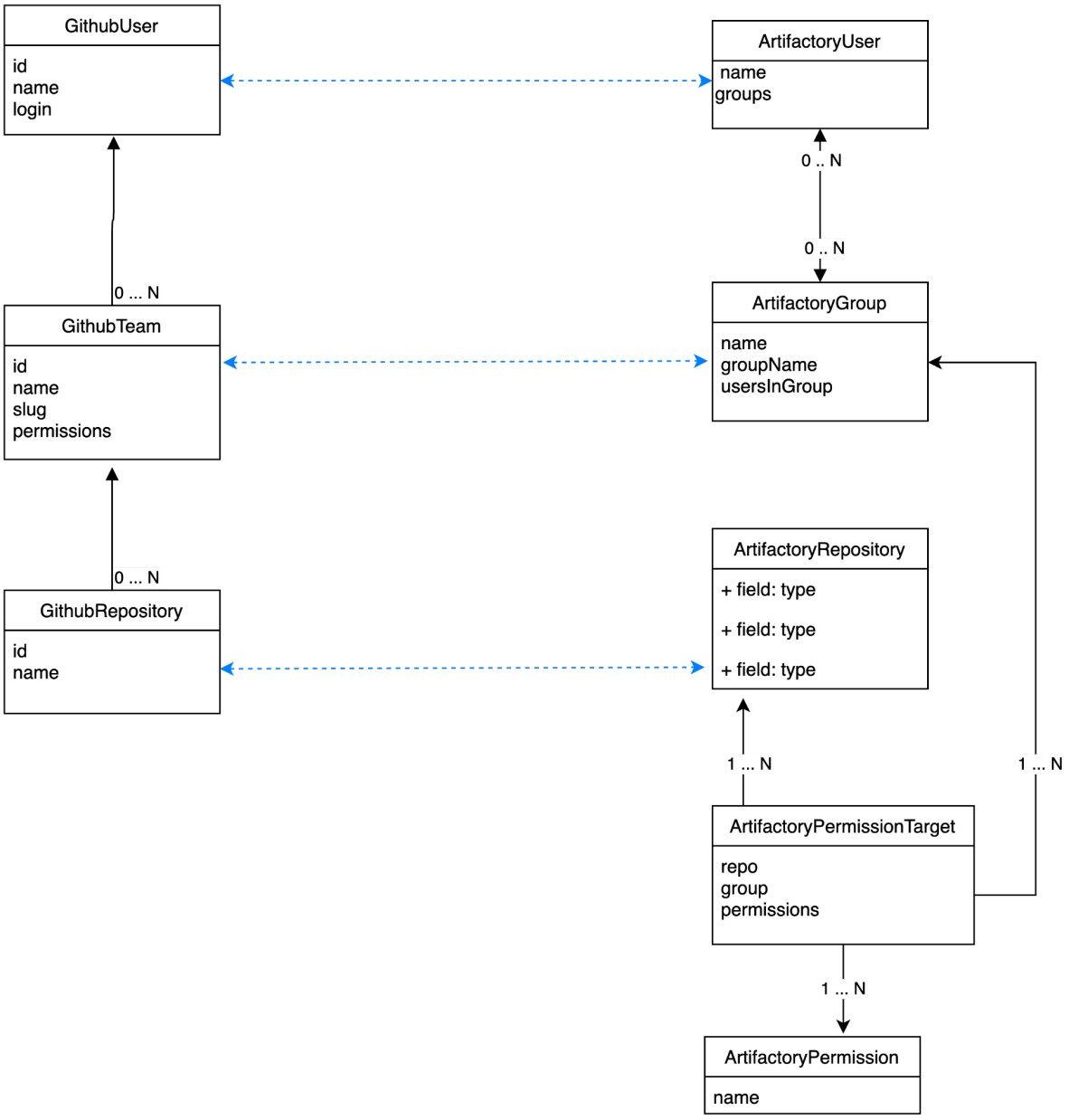
- Npm Axios lib is used because is a promise based http client and simplifies a lot the interaction with Github/Artifactory REST API.

Endpoint POST sync

This endpoint will be pushed with an issue event from Github (webhook configuration). The main purpose of this endpoint is act as mediator between the entities of Github and Artifactory. Internally it will handle multiple requests, obtaining from Github API and Artifactory and doing the synchronization based on a preconfigured mapping structure: this means our implementation must define in advance the mapping between the entities (Github - Artifactory):

- Repositories - Repositories
- Teams - Groups
- Users - Users
- Permissions - PermissionsTarget (*)

(*) PermissionTarget is an entity which could contain permissions for users/groups given on or more repositories. I decided to map into a permissionTarget repository multiple permissions of github team to 1 artifactory repository and 1 artifactory group (simplicity)

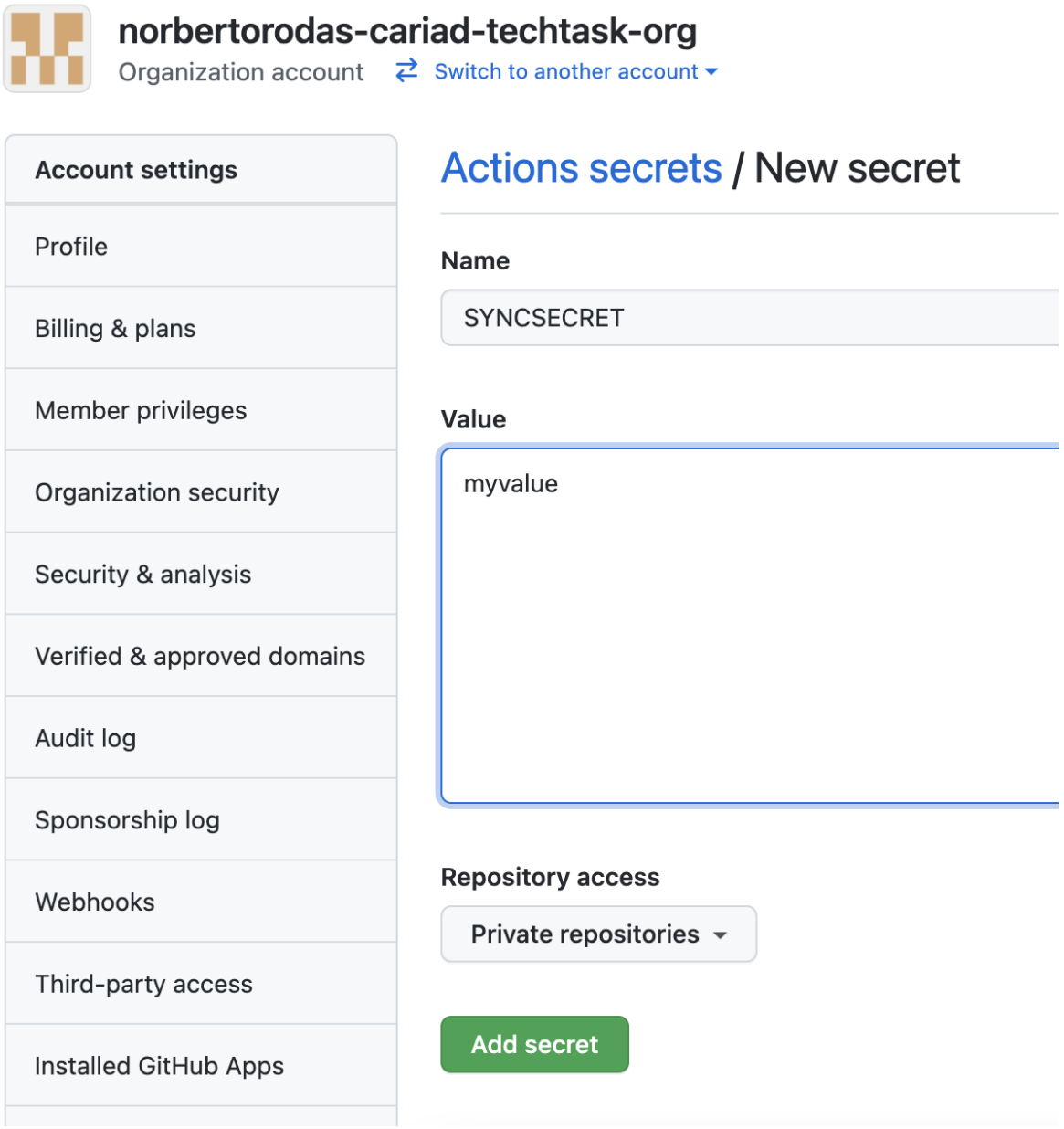

GithubUser
id
name
login
ArtifactoryUser
name
groups
0 .. N
0 .. N
0 ... N
GithubTeam
id
name
slug
permissions
ArtifactoryGroup
name
groupName
usersInGroup
0 ... N
GithubRepository
id
name
ArtifactoryRepository
+ field: type
+ field: type
+ field: type
1 ... N
1 ... N
ArtifactoryPermissionTarget
repo
group
permissions
1 ... N
ArtifactoryPermission
name

Github Permission	Artfactory Permission	Description
pull	read, annotate	Configured per repository and group
push	read,annotate, write, delete	Configured per repository and group

Security aspects

- Github REST API and Artifactory Credentials will be injected as environment variables into the VM where our NodeJS Middleware (**techtest-sync-api)** is deployed.
- As an extra layer of security we will create a SECRET variable into our Github Organization then we should verify specific headers received and make a validation. More details here

  We can create an organization's secret **SYNCSECRET** which could be used into the NodeJS REST API side in order to validate when a request effectively is coming from Github (**very important).** This will be excluded for the scope of this PoC in order to not increase the complexity of the source code (lib candidate : npm-js)



Design aspects

- Rate limit: in our case is not specified but probably is influenced of rate limits of external services like Github (5000 per hour) and Artifactory
- The endpoint is async given Github does not care about the response of the middleware.
- Logging: logs will be presented in console, but a better option is use a library and create persistent logs files given the nature of our middleware app (server side). Then logs are useful for troubleshooting issues.

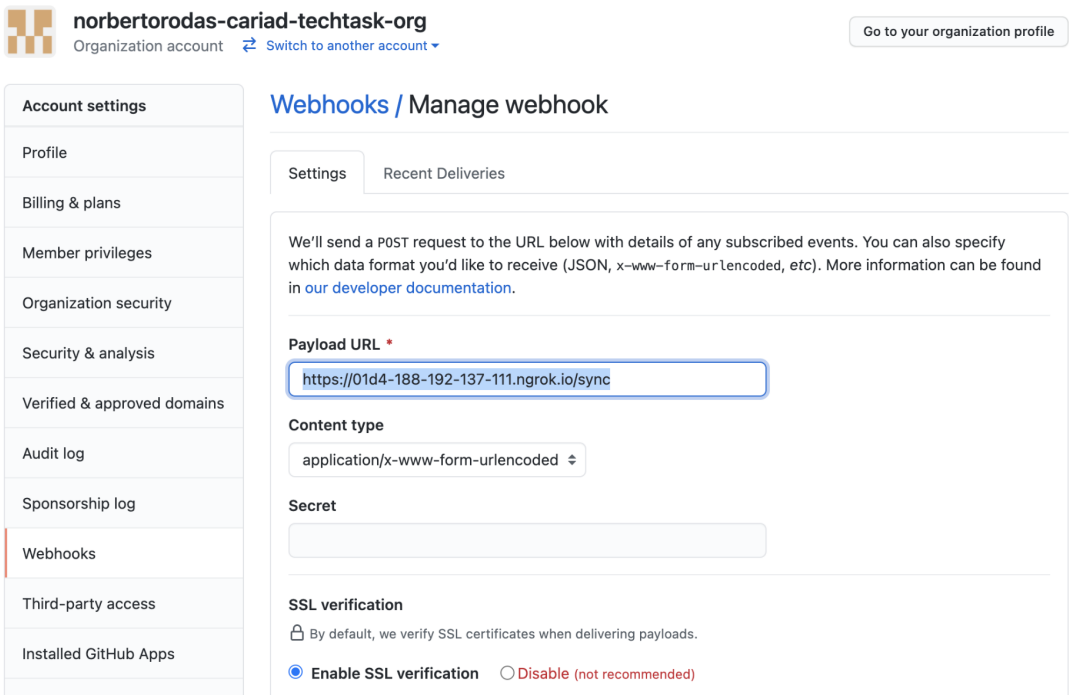
Github Enterprise

Webhooks, on the other hand, are automated calls from server1 to server2. Those calls are triggered when a specific event happens on server1. In our case, server1 is Github Enterprise and server2 is Artifactory. More details about webhooks in github here

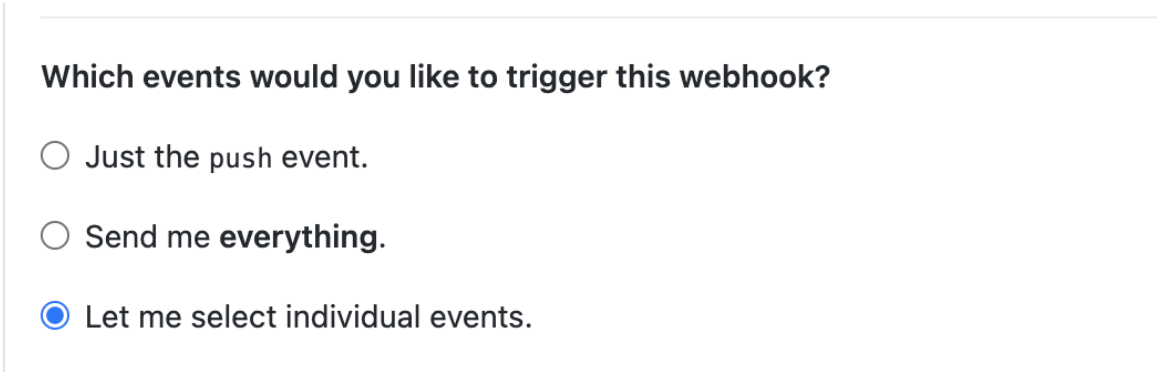
So, for simplicity, I decided to proceed with an organization webhook configuration, so using this approach we can configure a unique webhook which will be shared for all the repositories that are part of my organization. This means we have a single point of configuration which simplifies the whole integration and avoids repetition of configurations (creating multiple webhooks, one per repository).

Creating a organization webhook

1. Go to the organization settings section and choose “Webhooks”. Then the url of our endpoint is added and the content type is selected.

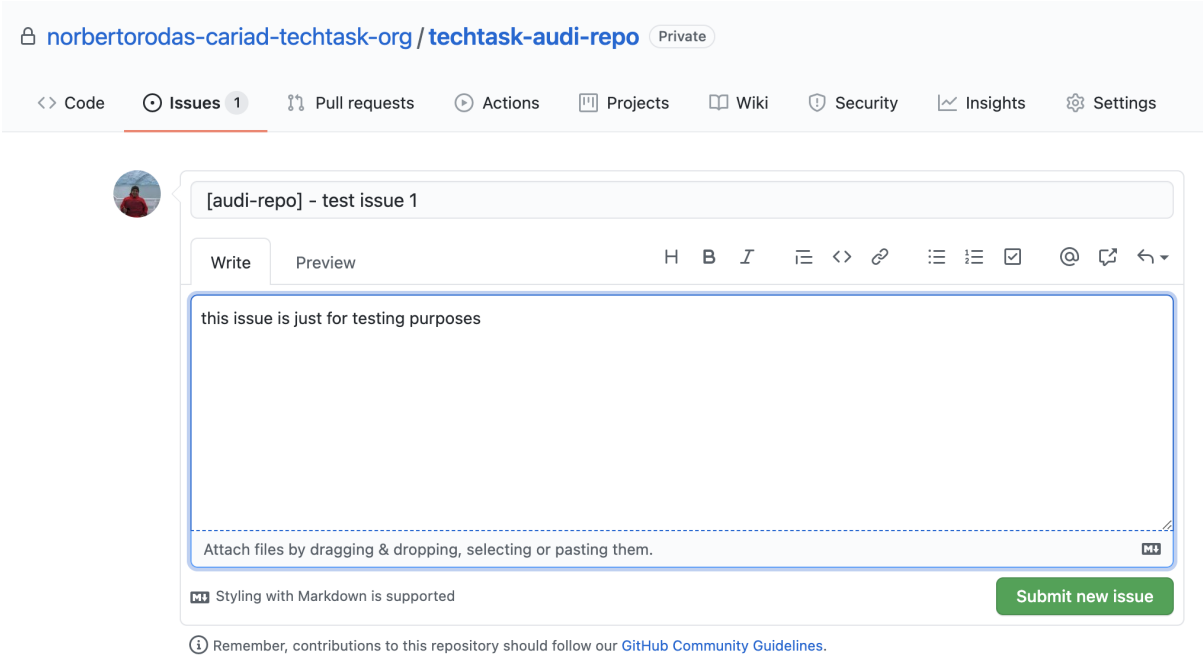


2. Finally in events sections we choose “**Issues**” and the option “**Active**”



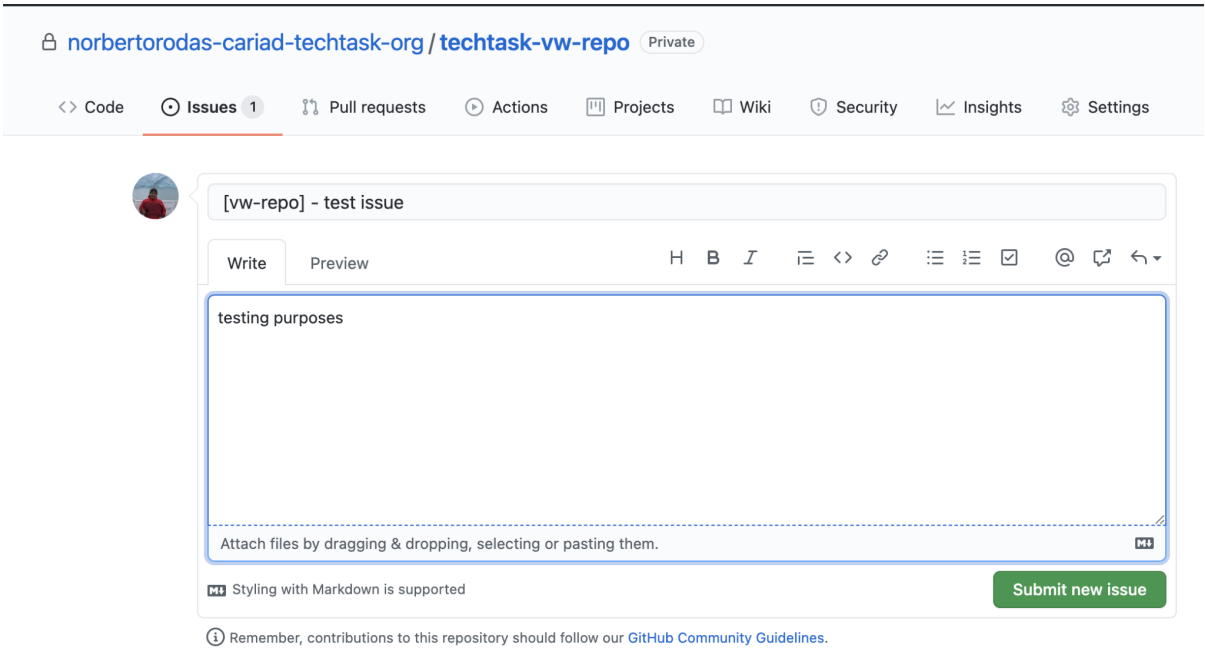
3. Once we configured this our organization webhook is ready to push the payload of our events directly to our NodeJS Middleware which is the main core of our test solution.

4. Fast integration test (from github to NodeJS API without JFrog integration):
    a. Create an issue on repository **techtask-audi-repo** https://github.com/norbertorodas-cariad-techtask-org/techtask-audi-repo/issues/4

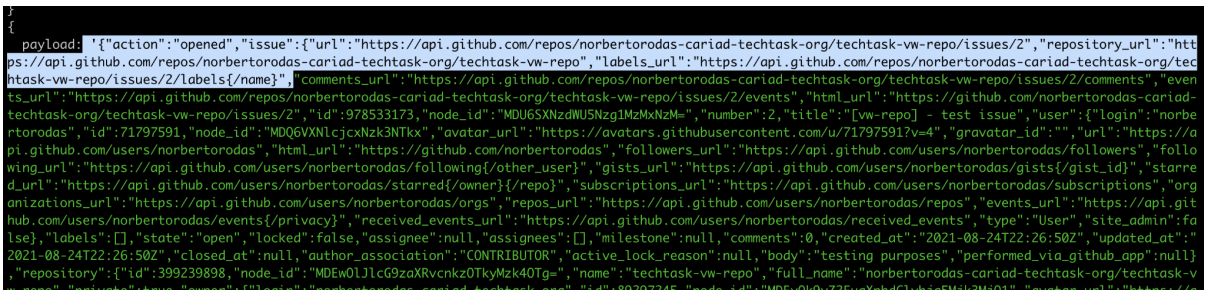


    b. Then we can see the payload received by our NodeJS REST API **techtest-sync-api** through the POST endpoint /sync

c. Create an issue on another repository of organization **techtask-vw-repo**



d. Finally we can see the payload received by our NodeJS REST API **techtest-sync-api** through the POST endpoint /sync



JFrog Artifactory

Authentication of REST API Calls

There are 4 alternatives to authenticate all the requests performed against the REST API:

1. Basic authentication using your username and password
2. Basic authentication using your username and API Key.
3. Using a dedicated header (X-JFrog-Art-Api) with your API Key.
4. Using an access token instead of a password for basic authentication.
5. Using an access token as a bearer token in an authorization header (Authorization: Bearer) with your access token.

I decided to proceed with option 2 because it is simplest and is enough for the scope of this test. A more secure and reliable option is 5.

The API KEY will be generated manually as is described in this guide but the process can be automated using REST API calls.

REST API Endpoints Usage

A brief overview of the endpoints used by NodeJS Middleware to handle Artifactory resources:

- List repositories
- Create repository
- List groups
- Create group
- Get Users
- Create or Replace User
- Get User Details
- Get Repository
- Create/Replace PermissionTarget

Integration Tests

Case 1

Precondition: techtest-audi-repo is configured with 2 teams (readers, writers) and one user on each team.

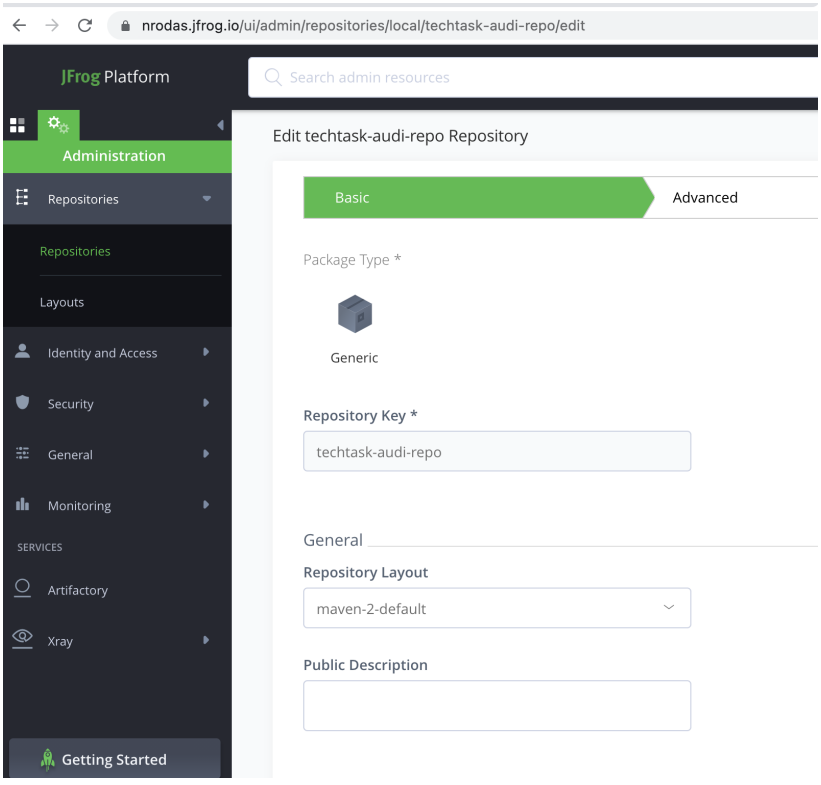
Scenario: Repository ,users and groups does not exists in JFrog

Expected: a new repository is created in JFrog with the same name as the issue's github repository name. Also the users and groups (teams in github) are created into Artifactory.

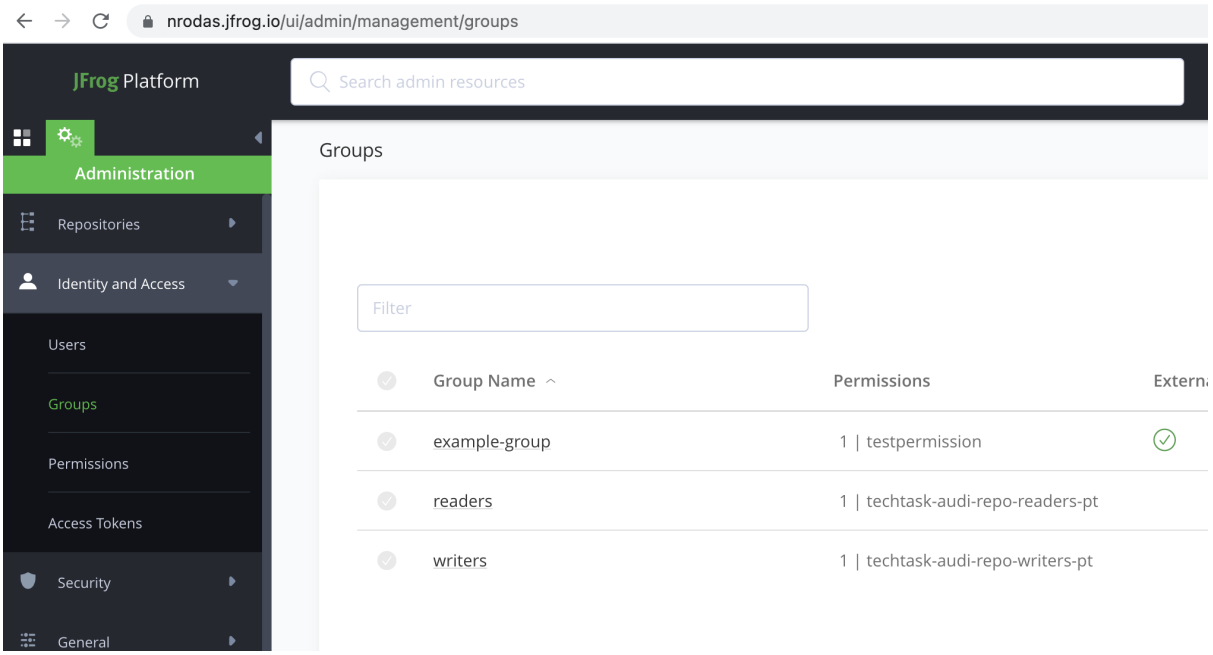
Middleware logs

```
[INFO] The issue event is opened
[INFO] - getArtifactoryRepository
[INFO] - getArtifactoryRepository - repository.name= techtask-audi-repo
[INFO] - internalArtifactoryRepositoryHandling
[INFO] - internalArtifactoryGroupsHandling
[INFO] - getGithubTeamsPerRepository
[INFO] - getGithubTeamsPerRepository - repository.name= techtask-audi-repo
[INFO] - getArtifactoryGroupByName
[INFO] - createUpdateArtifactoryUsers
[INFO] - getGithubTeamMembers
[INFO] - getGithubTeamMembers - team= readers
[INFO] - getArtifactoryUserByName
[INFO] - getArtifactoryUserByName
[INFO] - createArtifactoryGroup
[INFO] - handlePermissionTargetInArtifactoryPerRepoAndGroup
permissionsInArtifactory read,annotate
[INFO] - getArtifactoryGroupByName
[INFO] - createUpdateArtifactoryUsers
[INFO] - getGithubTeamMembers
[INFO] - getGithubTeamMembers - team= writers
[INFO] - getArtifactoryUserByName
[INFO] - getArtifactoryUserByName
[INFO] - createArtifactoryGroup
[INFO] - handlePermissionTargetInArtifactoryPerRepoAndGroup
permissionsInArtifactory read,annotate,write,delete
```

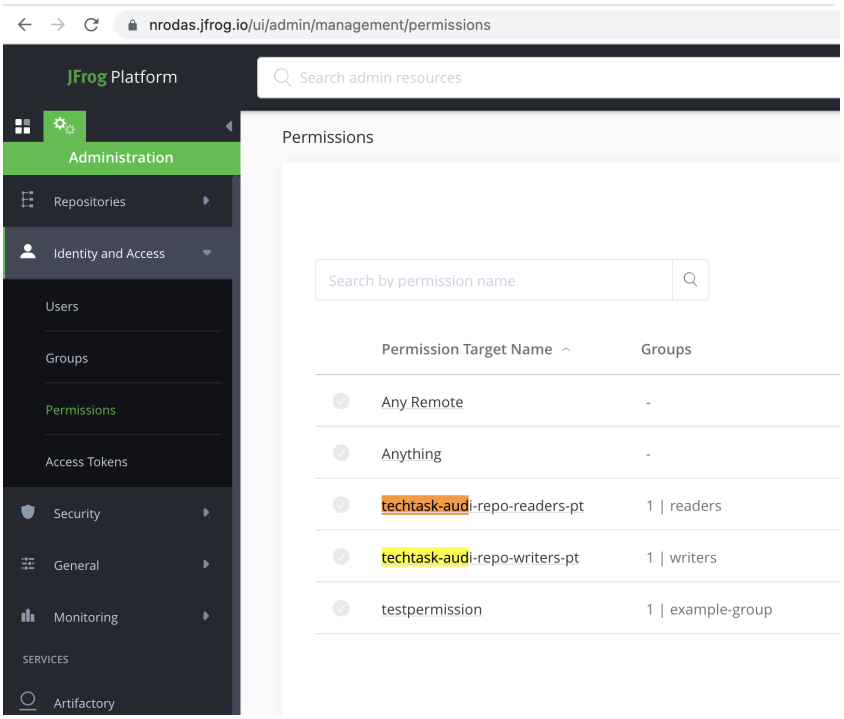
Artifactory repository



Artifactory groups



Artifactory permissionTargets



Case 2

Precondition: techtest-audi-repo is configured with 2 teams (readers, writers) and one user on each team.

Scenario: Repository,users and groups already exists in JFrog

Expected: JFrog entities (repositories, users. groups) must not change

Case 3

Precondition: techtest-audi-repo is configured with 1 teams (readers) with 2 users

Scenario: Repository, users and groups already exists in JFrog

Expected: the JFrog repository ‘techtest-audi-repo` is not recreated. Group ‘readers’ is updated (2 users instead 1) and group ‘writers’ is removed.