RESTful Services

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RESTFul Services

- Principe
- Richardson Maturity Model
- Design Patterns
- Data Formats
- Documentation, Validation
- Frameworks
  - Swagger, JAX-RS (JavaEE), Springfox ...
- Sécurité
  - OAuth2.0

REST = REpresentational State Transfert

- Style d'architecture de type client-serveur
  - 3 Levels of Richarson Maturity Model
    - Best practices http://www.restapitutorial.com/media/RESTful_Best_Practices-v1_1.pdf
- Considère des collections de ressources (maintenant un état intene)
  - Adressables pour une URI
    - `http://www.boeing.com/aircraft http://www.boeing.com/aircraft/747`
  - Accessible via les méthodes (verb) HTTP (CRUD)
    - PUT, GET, POST, DELETE, HEAD, OPTION, PATCH
    - Status code (200, 201, 409, ...), Header (Accept, Location, ...)
  - Représentation formateé en fonction du client
    - Formats : XML, HTML (fragment), JSON, JPEG,…
- Outils
  - Caches, Proxies, Load Balancers ...

Exemple de routage Web

Classiquement (Level 1) → Réponse : text/html

GET http://example.com/book?action=showall

GET http://example.com/book?action=show&isbn=0596529260

GET http://example.com/book?action=modify&isbn=0596529260&price=49.99

POST http://example.com/book?action=modify

GET http://example.com/book?action=delete&isbn=0596529260

Avec REST (Level 2) → Réponse : application/json

GET http://example.com/book

GET http://example.com/book/0596529260

POST http://example.com/book/0596529260

PUT http://example.com/book/0596519260

DELETE http://example.com/book/0596519260

Exercice : comment modéliser un panier d'un client ?

Solution : POST http://example.com/cart

Modèle de Maturité de Richardson

- Level 0
  - Communication client / serveur via le protocole HTTP
  - 1 URL / 1 type de verbe HTTP (en général POST)
- Level 1: Resources
  - Plusieurs URLs hiérarchisées
    - Représente des collections
  - toujours 1 seul verbe HTTP (en général POST)
- Level 2: HTTP Verbs
  - Verbes HTTP (GET, POST, PUT, DELETE, OPTION, HEAD, PATCH)
  - Status code HTTP
- Level 3: Hypermedia Controls
  - HATEOAS (Hypertext As The Engine Of Application State)
  - URL de navigation dans les ressources

- A lire http://martinfowler.com/articles/richardsonMaturityModel.html

CRUD et Verbes REST (RMM Level 2)

- Create
  - PUT if and only if you are sending the full content of the specified resource (URL).
  - POST if you are sending a command to the server to create a subordinate of the specified resource, using some server-side algorithm.
- Retrieve = GET, HEAD.
- Update
  - PUT if and only if you are updating the full content of the specified resource.
  - POST if you are requesting the server to update one or more subordinates of the specified resource.
  - PATCH for semantic changes
- Delete = DELETE.
- Info = OPTION
  - Used to request information about the communication options of the resource you are interested in. It allows the client to determine the capabilities of a server and a resource without triggering any resource action or retrieval.

http://jcalcote.wordpress.com/2008/10/16/put-or-post-the-rest-of-the-story/

Status Code des réponses REST

200 OK - Response to a successful GET, PUT, PATCH or DELETE. Can also be used for a POST that doesn't result in a creation.

201 Created - Response to a POST that results in a creation. Should be combined with a Location header pointing to the location of the new resource

204 No Content - Response to a successful request that won't be returning a body (like a DELETE request)

304 Not Modified - Used when HTTP caching headers are in play

400 Bad Request - The request is malformed, such as if the body does not parse

401 Unauthorized - When no or invalid authentication details are provided. Also useful to trigger an auth popup if the API is used from a browser

403 Forbidden - When authentication succeeded but authenticated user doesn't have access to the resource

404 Not Found - When a non-existent resource is requested

405 Method Not Allowed - When an HTTP method is being requested that isn't allowed for the authenticated user

410 Gone - Indicates that the resource at this end point is no longer available. Useful as a blanket response for old API versions

415 Unsupported Media Type - If incorrect content type was provided as part of the request

422 Unprocessable Entity - Used for validation errors

429 Too Many Requests - When a request is rejected due to rate limiting

- From http://www.vinaysahni.com/best-practices-for-a-pragmatic-restful-api

HATEOAS

Hypertext As The Engine Of Application State

API de navigation dans les collections et les ressources

- *Martin Fowley, RMM Level 3 introduces discoverability, providing a way of making a protocol more self-documenting.*

•

GET /account/12345 HTTP/1.1

HTTP/1.1 200 OK

```
<?xml version="1.0"?>
<account>
 <account_number>12345</account_number>
 <balance currency="usd">100.00</balance>
 <link rel="self" href="/account/12345" />
 <link rel="deposit" href="/account/12345/deposit" />
 <link rel="withdraw" href="/account/12345/withdraw" />
 <link rel="transfer" href="/account/12345/transfer" />
 <link rel="close" href="/account/12345/close" />
 <link rel="comment" type="application/x.atom+xml" title="Blog comments" href="/account/12345/comment"/>
 </account>
```

REST Asynchronous Requests (i)¶

- Opérations différées ou de longue durée (*long-live*) sur des ressources/collections REST

```
POST /blog HTTP/1.1
<blog><title>Bla Bla<title><author>Me</author><text>Bla Bla Bla Bla !
</text></blog>
HTTP/1.1 202 Accepted
Location: /queue/12345

GET /queue/12345 HTTP/1.1
HTTP/1.1 200 OK
<queue>
<status>Pending</status>
<eta>10 minutes</eta>
<link rel="cancel" method="delete" href="/queue/12345"/>
</queue>
...
```

verbe DELETE
pour annuler l'opération

- http://restcookbook.com/Resources/asynchroneous-operations/
- https://www.adayinthelifeof.nl/2011/06/02/asynchronous-operations-in-rest/

REST Asynchronous Requests (ii)¶

…

```
GET /queue/12345 HTTP/1.1
HTTP/1.1 200 OK
 <queue>
 <status>In progress</status>
 <eta>3 minutes, 25 seconds</eta>
 </queue>
```

Plus de verbe DELETE pour annuler l'opération

```
GET /queue/12345 HTTP/1.1
HTTP/1.1 303 See Other
 Location: /blog/20140101-Bla%20Bla
```

- http://restcookbook.com/Resources/asynchroneous-operations/
- https://www.adayinthelifeof.nl/2011/06/02/asynchronous-operations-in-rest/
-

REST PATCH verb

PUT versus PATCH

PUT fournit la nouvelle valeur intégrale de l'entité

PATCH donne des instructions à appliquer

JSON Patch http://tools.ietf.org/html/rfc6902

```
PATCH /users/123
Content-Type: application/json-patch
[
    { "op": "replace", "path": "/email", "value": "new.email@example.org" }
]
```

```
PATCH /agenda/123
Content-Type: application/json-patch+json
 If-Match: "abc123"
[
    { "op": "test", "path": "/a/b/c", "value": "foo" },
    { "op": "remove", "path": "/a/b/c" },
    { "op": "add", "path": "/a/b/c", "value": [ "foo", "bar" ] },
    { "op": "replace", "path": "/a/b/c", "value": 42 },
    { "op": "move", "from": "/a/b/c", "path": "/a/b/d" },
    { "op": "copy", "from": "/a/b/d", "path": "/a/b/e" }
]
```

Si /a/b/c!= foo,
les opérations suivantes
ne sont pas réalisées

207 Multi-Status

http://williamdurand.fr/2014/02/14/please-do-not-patch-like-an-idiot/

REST
Safety and Idempontence

- Idempotency is important in building a fault-tolerant API

Verb	Idempotent	Safe
OPTION	yes	yes
GET	yes	yes
HEAD	yes	yes
PUT	yes	no
POST	no	no
DELETE	yes	no
PATCH	no	no

REST
Paginate collection

- GET /collection HTTP/1.1 HTTP/1.1 200 OK <collection> <article id="1">...</article> <article id="2">...</article> <article id="3">...</article> <article id="4">...</article> <article id="5">...</article> <meta> <link rel="self" href="/collection" title="Current page"/> <link rel="next" href="/collection/2" title="Next page"/> <link rel="first" href="/collection/1" title="First page"/> <link rel="last" href="/collection/5" title="Last page"/> </meta> </collection> - See more at: http://restcookbook.com/Resources/pagination/#sthash.PSefZe0Q.dpuf

REST
Caching

- 2 approaches: ETag and Last-Modified
- Etag
  - When generating a request, include a HTTP header ETag containing a hash or checksum of the representation. This value should change whenever the output representation changes. Now, if an inbound HTTP requests contains a If-None-Match header with a matching ETag value, the API should return a 304 Not Modified status code instead of the output representation of the resource.
- Last-Modified
  - This basically works like to ETag, except that it uses timestamps. The response header Last-Modified contains a timestamp in RFC 1123 format which is validated against If-Modified-Since. Note that the HTTP spec has had 3 different acceptable date formats and the server should be prepared to accept any one of them.

REST Misc

- Range (Pagination)

```
OPTIONS /api/collection HTTP/1.1
HTTP/1.1 200 OK
Accept-Ranges: resources

GET /api/collection
Range: resources=100-199
```

- Notification (long poll)
  - Example : return at least one resource with an ID > 100.

```
GET /api/collection
Range: 100-
Expect: nonempty-response
```

- Notification (long poll)
  - `416 REQUEST RANGE NOT SATISFIABLE`
  - `413 Requested Entity Too Large`
  - `206 PARTIAL CONTENT`

- REST Worst Practices http://jacobian.org/writing/rest-worst-practices/

REST API and Cookies

- Not a best practice for passing parameter
- But existing cookied-based APIs
-
- OpenAPI
  - The location of the paramete can be "query", "header", "path" or "cookie".

API Throwttling and Rate Limiting

- ** Account Level Throttling (429 Too Many Requests)
- *** https://en.wikipedia.org/wiki/Token_bucket (like AWS http://docs.aws.amazon.com/apigateway/latest/developerguide/api-gateway-request-throttling.html)
- *** Add HTTP API Rate Limiting HTTP Response headers
- *** http://ostolc.org/haproxy-rate-limiting.html
- *** https://github.com/dschneller/haproxy-http-based-rate-limiting/blob/master/haproxy.cfg
- *** https://www.loadbalancer.org/blog/simple-denial-of-service-dos-attack-mitigation-using-haproxy-2
- *** https://www.npmjs.com/package/express-rate-limit
- *** http://ratelimit.io/
-
-
-
- description: A simple string response
- content:
- text/plain:
- schema:
- type: string
- example: 'whoa!'
- headers:
- X-Rate-Limit-Limit:
- description: The number of allowed requests in the current period
- schema:
- type: integer
- X-Rate-Limit-Remaining:
- description: The number of remaining requests in the current period
- schema:
- type: integer
- X-Rate-Limit-Reset:
- description: The number of seconds left in the current period
- schema:
- type: integer

API Throwttling and Rate Limiting

- Motivation
  - Limit the number of requests per user profiles
  - Avoid server collasped and spikes
  - DDoS
- HTTP Responses
  - Status Code : 429 Too Many Requests
  - Headers : X-Rate-Limit-Limit, X-Rate-Limit-Remaining, X-Rate-Limit-Reset
- Algorithms
  - Token Bucket …
- Frameworks
  - RateLimitJ, Spring Rate Limit
  - Distributed : ??? based on Redis, Consul, Zookeeper

Netflix Zuul

- Voir VT2017

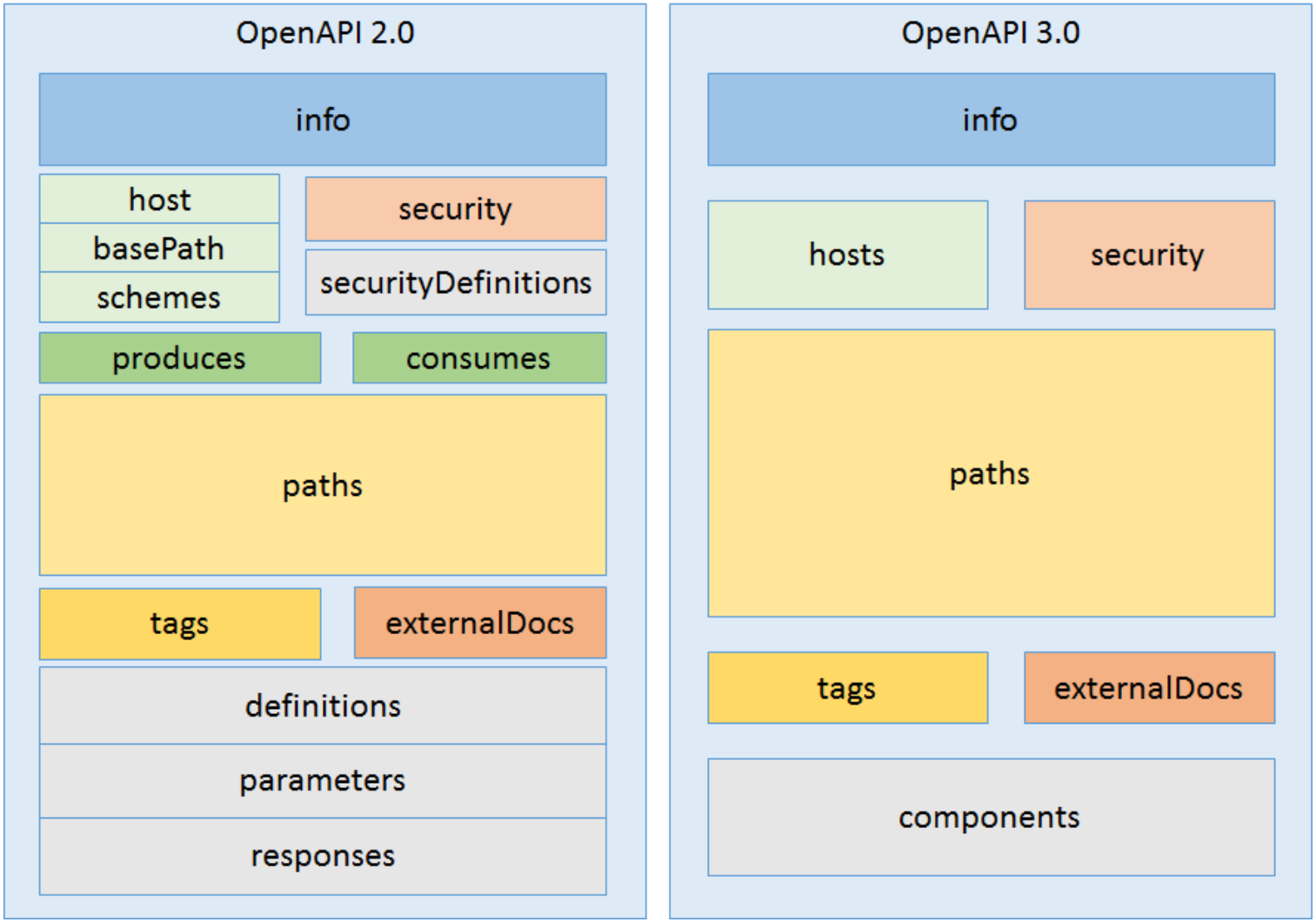
Modélisation / Documentation de services RESTFul

- OpenAPI (Swagger)
  - YAML, JSON
  - Documentation, Test, Editeur live, Génération muli-langages
  - Utilisé par des nombreuses entreprises
- RESTful API Modeling Language (RAML)
  - YAML
    - https://github.com/raml-org/raml-spec/blob/master/versions/raml-10/raml-10.md/
- Enuciate

OAI OpenAPI

- Describes RESTFul API
- Linux Foundation

OAI OpenAPI v3



OAI OpenAPI v3

-
- Part 1: Background and how to get involved.
- Part 2: Structural Changes
- Part 3: Request Parameters
- Part 4: Protocol and Payload
- Part 5: Documentation
-

API and WebHooks

Swagger UI

- Documentation et Invocation

petstore.swagger.io 50 % Rechercher

swagger http://petstore.swagger.io/v2/swagger.json Explore

Swagger Petstore 1.0.0

[Base url: petstore.swagger.io/v2]
http://petstore.swagger.io/v2/swagger.json

This is a sample server Petstore server. You can find out more about Swagger at http://swagger.io or on irc.freenode.net, #swagger. For this sample, you can use the api key `special-key` to test the authorization filters.

Terms of service
Contact the developer
Apache 2.0
Find out more about Swagger

Schemes
HTTP

Authorize

pet Everything about your Pets

- POST /pet Add a new pet to the store
- PUT /pet Update an existing pet
- GET /pet/findByStatus Finds Pets by status
- ~~GET /pet/findByTags Finds Pets by tags~~
- GET /pet/{petId} Find pet by ID
- POST /pet/{petId} Updates a pet in the store with form data
- DELETE /pet/{petId} Deletes a pet
- POST /pet/{petId}/uploadImage uploads an image

store Access to Petstore orders

- GET /store/inventory Returns pet inventories by status
- POST /store/order Place an order for a pet

Swagger Editor

editor.swagger.io/#/ 67 % Rechercher

Swagger Editor File Edit Generate Server Generate Client Switch back to previous editor

```yaml
swagger: '2.0'
info:
  version: 1.0.0
  title: PetStore on Heroku
  description: |
    **This example has a working backend hosted in Heroku**

    You can try all HTTP operation described in this Swagger spec.

    Find source code of this API [here](https://github.com/mohsen1/petstore-api)
host: petstore-api.herokuapp.com
basePath: /pet
schemes:
  - http
  - https
consumes:
  - application/json
  - text/xml
produces:
  - application/json
  - text/html
  - pipo/rire
paths:
  /:
    get:
      parameters:
        - name: limit
          in: query
          description: number of pets to return
          type: integer
          default: 11
          minimum: 11
          maximum: 10000
      responses:
        200:
          description:  List all pets
          schema:
            title: Pets
            type: array
            items:
              $ref: '#/definitions/Pet'
    post:
      parameters:
        - name: pet
          in: body
          description: The pet JSON you want to post
          schema:
```

PetStore on Heroku 1.0.0

[Base url: petstore-api.herokuapp.com/pet]

This example has a working backend hosted in Heroku

You can try all HTTP operation described in this Swagger spec.

Find source code of this API here

Schemes

HTTP

default

GET /

POST /

PUT /

GET /{petId}

Models

Pet > {...}

Swagger Codegen

- https://github.com/swagger-api/swagger-codegen
- Generate docs, clients and servers project seeds for multiple languages and frameworks.
- Offline
  - Java/Maven
- Online (REST API)
  - Swagger UI https://generator.swagger.io/
    - (Fast) Demo via Swagger Editor http://editor.swagger.io/

Swagger Utils

- https://github.com/Swagger2Markup
- https://www.npmjs.com/package/yamljs
- https://www.npmjs.com/package/bootprint-swagger

DTO
Data Transfert Object

- Formats
  - JSON, XML, YAML ...
- Frameworks
  - MapStruct.org (Java)

RESTFul Utils

- Mock
  -
- Test
  - REST Assured
  - SOAP UI
  - Postman
- Docs
  -
- Clients
  - Postman
- Recording and Replay
  - ???
- Load injection
  - JMeter, Gatling
- CLI
  -

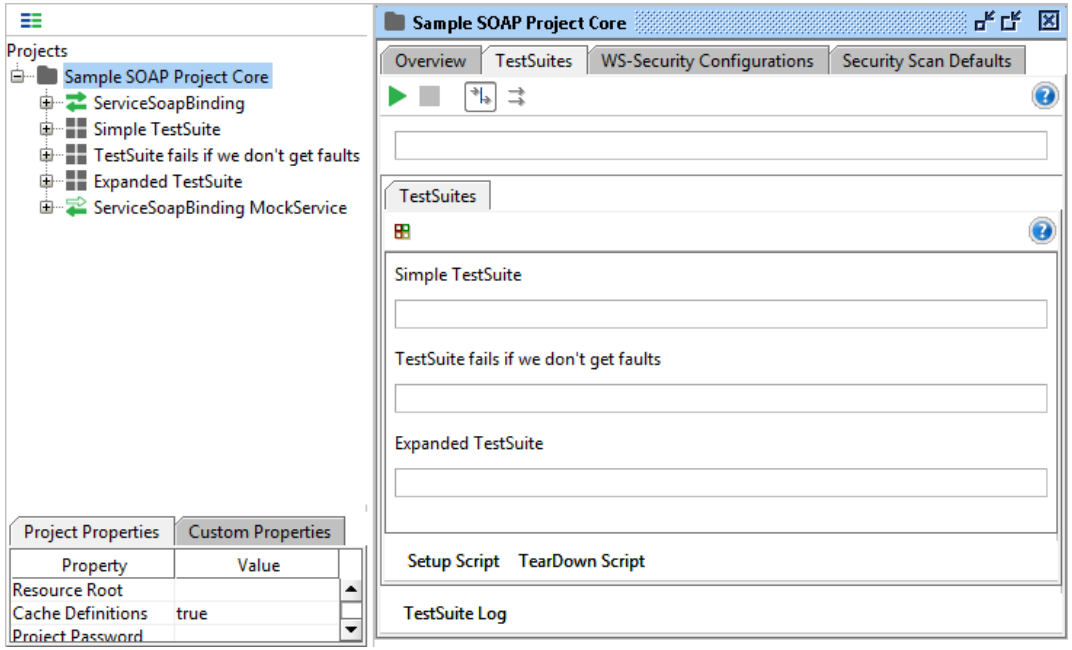
Testing RESTFul Services

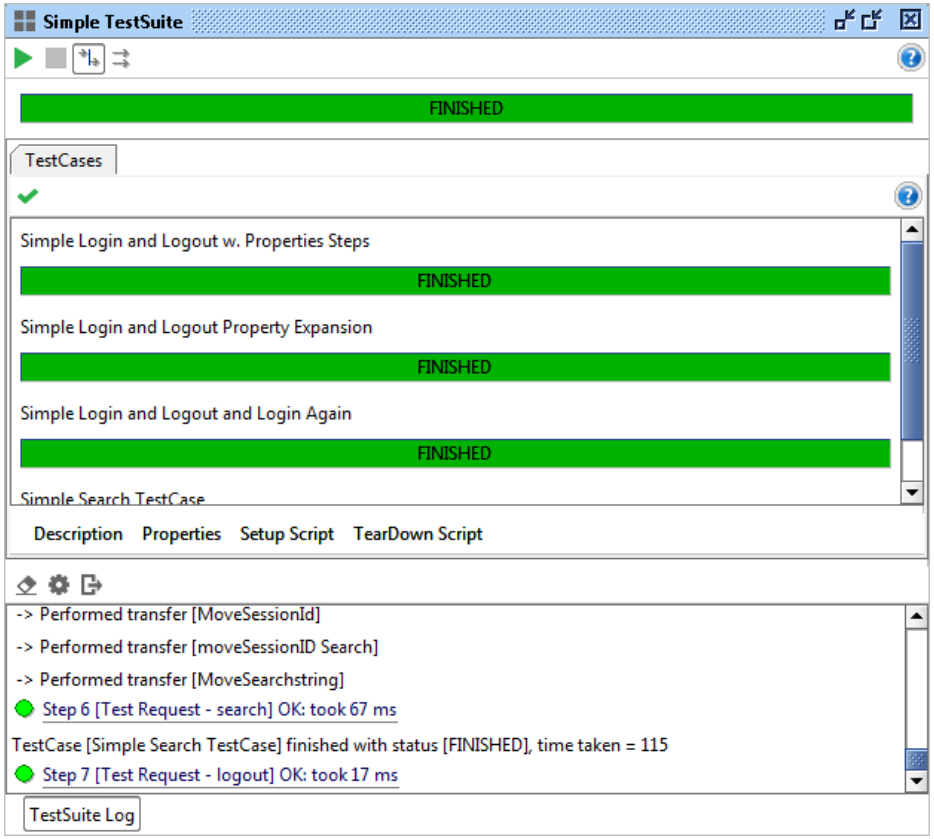
- REST Assured
  - http://rest-assured.io/
  - https://github.com/rest-assured/rest-assured/wiki/Usage

Example

```
@Test public void
lotto_resource_returns_200_with_expected_id_and_winners() {
    when().
        get("/lotto/{id}", 5).
    then().
        statusCode(200).
        body("lotto.lottoId", equalTo(5),
            "lotto.winners.winnerId", containsOnly(23, 54));
}
```

SOAP UI
https://www.soapui.org





Frontends & Backends

- Tendance architecture
  - Frontend SPA (Single Page Application)
    - AngularJS, React, Vue.js …
  - Backend RESTFul
    - Remark : services Pub-Sub (websocket, PubNub, …)
- Frameworks RESTFul
  - JAX-RS implementations
  - Springfox (Spring MVC)
  - Dropwizard
  - Node.JS (Mongoose, ...)
- API Gateway
- OSS
  - Netflix OSS, Consul, ...

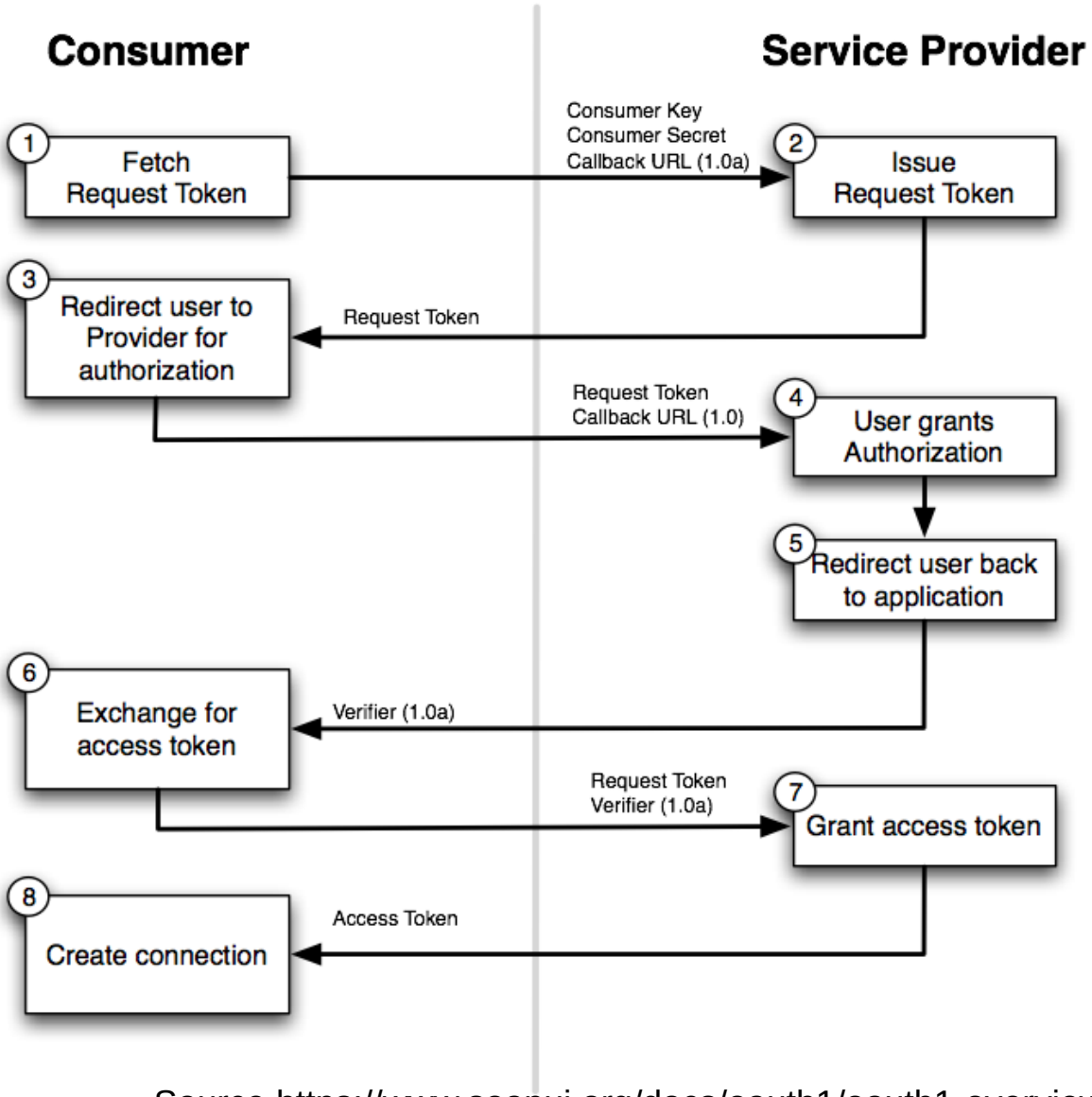
JAX-RS

Springfox

Securité

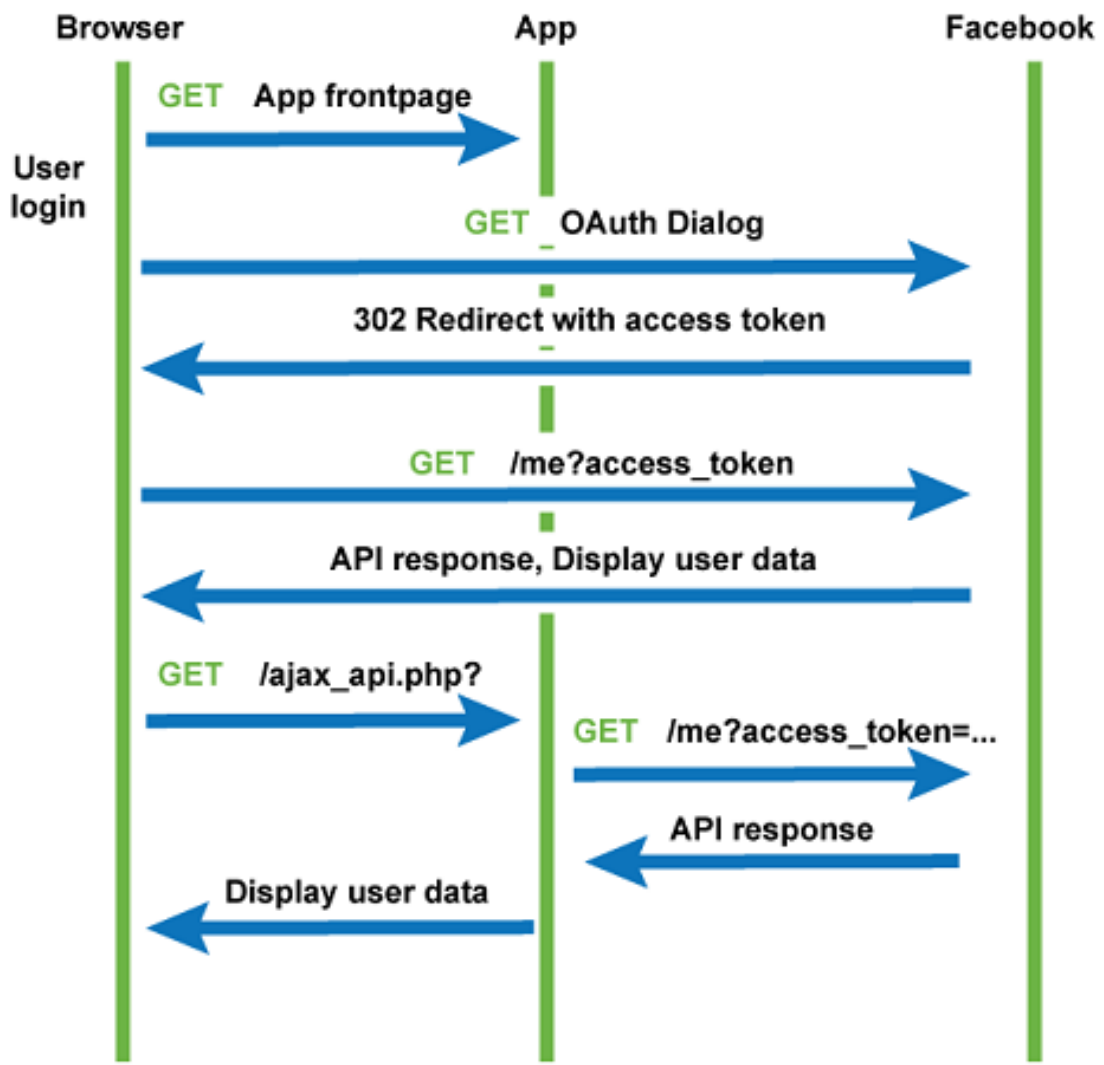
- Confidentialité
  - HTTP over TLS/SSL
- Authentication
  - Basic
  - OAuth 2.0
  - JWT (JSON Web Token)

OAuth 1.0



Source https://www.soapui.org/docs/oauth1/oauth1-overview.html

OAuth 2.0
Voir VT2017



Source https://www.soapui.org/oauth2/oauth2-overview.html

Demo Angular + JAX-RS + Swagger

localhost:8080/javaee7-angular/

Rechercher

Java EE - Angular Application

List Persons

Id	Name	Description	
1	Uzumaki Naruto	Konoha	✖
2	Hatake Kakashi	Konoha	✖
3	Haruno Sakura	Konoha	✖
4	Uchiha Sasuke	Missing-nin	✖
5	Gaara	Sunagakure	✖
6	Killer Bee	Kumogakure	✖
7	Jiraya	Konoha	✖
8	Namikaze Min…	Konoha	✖
9	Uchiha Madara	Missing-nin	✖
10	Senju Hashirama	Konoha	✖

First | Previous | 1 | 2 | 3 | Next | Last

Edit Person

Name:

Gaara

Description:

Sunagakure

Image URL:

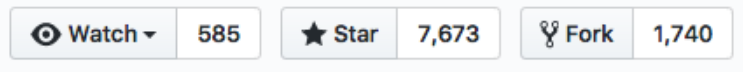
http://img3.wikia.nocookie.net/__cb201309

Clear | Save

Demo JHipster
Spring + Angular 2

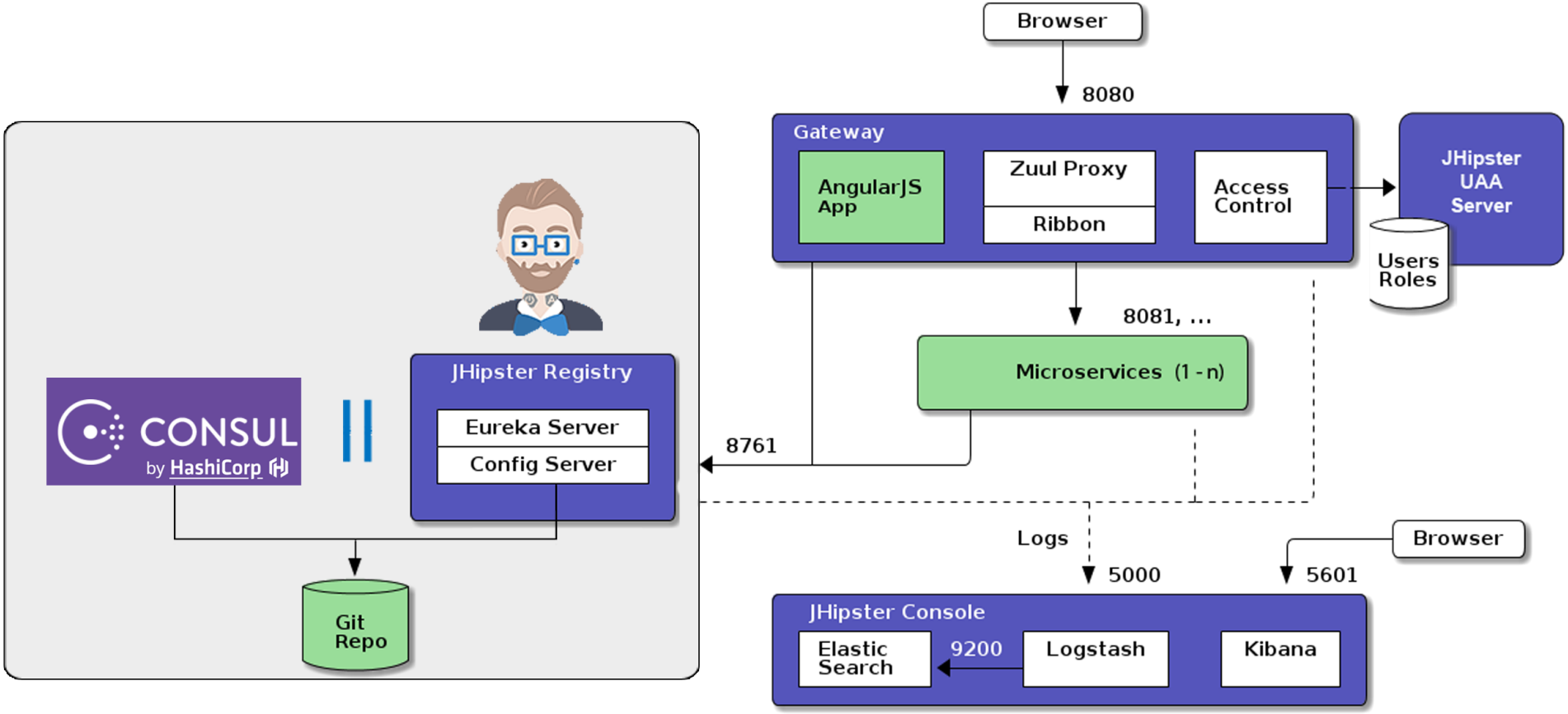
- Gestion de courses sportives
- Gestion de bogues (Bug tracker)
- Site de eCommerce

JHipster



- https://jhipster.github.io/tech-stack/
- Single Web page application:
  - AngularJS v1.x or 4
  - Responsive Web Design with Twitter Bootstrap
  - HTML5 Boilerplate
    - Responsive Web Design with Twitter Bootstrap
  - Spring
    - Optional WebSocket support with Spring Websocket
  - Authentication, API Gateway,Rate Limit, Metrics, Kafka, Consul
- Demo
    - https://jhipster.github.io/showcase/
    - https://github.com/mraible/21-points
    - http://www.21-points.com

Example :
The JHipster Mini-Book 2.0



Netflix OSS

- TODO

Consul

- TODO

REST and IoT

- CoAP (IETF CoRE)
- OneM2M/SmartM2M

Constrained Application Protocol (CoAP)

- Motivation : HTTP/REST-like protocol for constrained sensors
  - Typical configuration : 128KB FlashRAM and 4KB RAM
  - Battery consumption (sleep and periodical wakeup)
- Interaction
  - Request-response
  - Subscribe-Notify
- REST (CRUD)
  - Map on HTTP methods : PUT, GET, POST, DELETE
- Resource discovery
  - /profile URI multicast + DISCOVER method
- Protocol binding
  - UDP and UDP Multicast (16-bit sequence number for reliability)
  - Optionally TCP without “stop and wait”
- Caching
  - Important since sleeping mode
  - CoAP proxy (for subscription …)
- Standardization
  - IETF Constrained RESTful Environments (CoRE) Working Group

Demo CoAP

- Eclipse Californium
- Plugin Firefox : Cupper (Cu)
- Demo
  - https://github.com/donsez/californium