

OGC API – MF, an introduction with MF-API Server based on pygeoapi and MobilityDB

[65 mins] How to implement OGC API - MF with pygeoapi and MobilityDB?

[5 mins] A brief explanation of pygeoapi(overall architecture, etc.) and install MF-API Server(using Docker)

[10 mins] A brief explanation of MobilityDB and the functions(and structure) used to handle temporal geometry and properties

[15 mins] Describe how you extended pygeoapi to support OGC API - MF(libraries to use OpenAPI and Mobility DB(pyMEOS, python-mobilitydb, etc.) and extension structure, etc.)

[35 mins] Verify that each API works properly using Swagger.

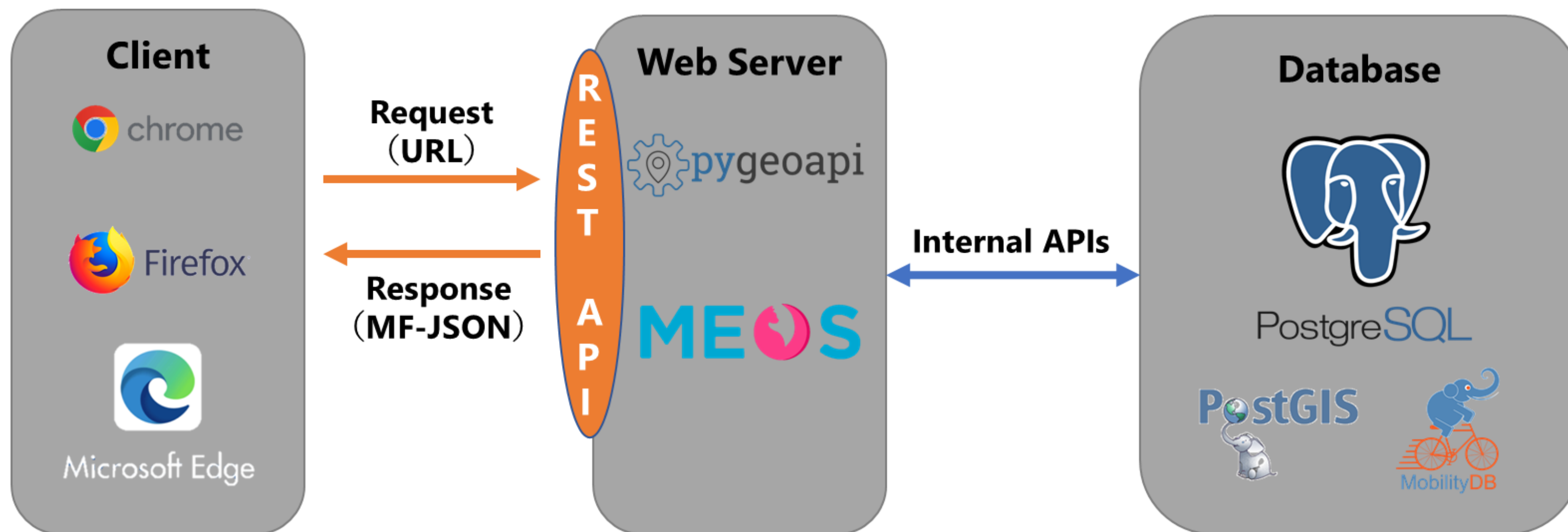


A brief explanation of pygeoapi(overall architecture, etc.) and install MF-API Server(using Docker)

01



Overall architecture





pygeoapi

Python server implementation of the OGC API standard, providing the ability to deploy RESTful OGC API endpoints using OpenAPI, GeoJSON, and HTML

<Features>

Easy-to-install, ready-to-use, state-of-the-art OGC API server

Easy-to-use OpenAPI/Swagger for developers

Built on a robust plugin framework Custom data connections, formats, and processes can be built



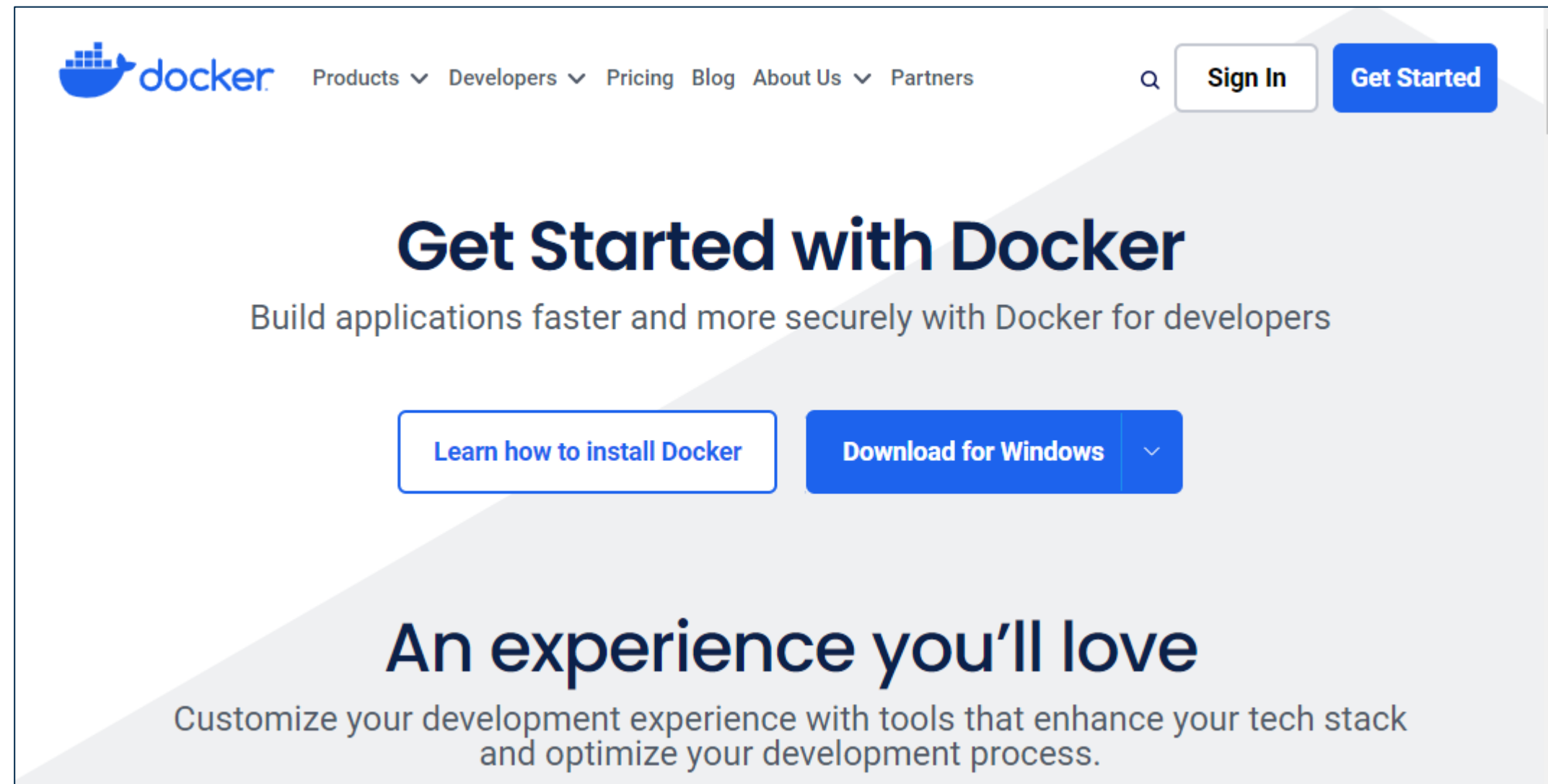


How to install (using Docker)

Workshop GitHub Page (some command and sample data)

https://github.com/ogi-ts-shimizu/FOSS4G2023Workshop_How-to-implement-OGC-API

1st : docker install (<https://www.docker.com/get-started/>)



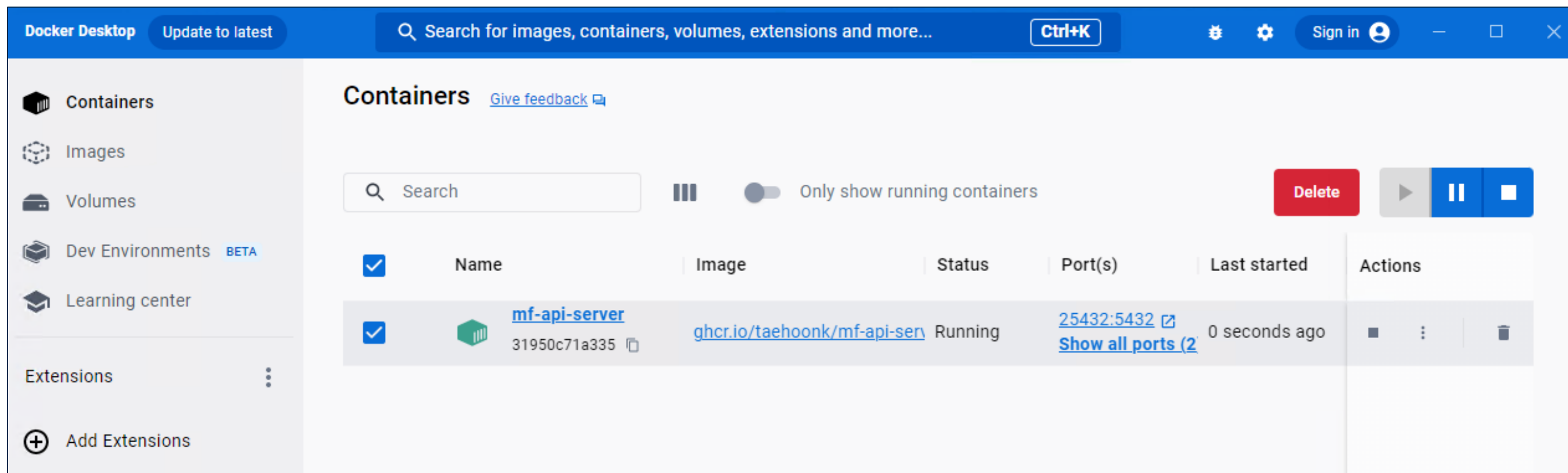


How to install (using Docker)

2nd : execute command below at commandline

```
docker pull ghcr.io/taehoonk/mf-api-server:1.1
docker run -p 8085:8085 -p 25432:5432 -d --name mf-api-server ghcr.io/taehoonk/mf-api-server:1.1
docker exec mf-api-server ./run.sh
```


3rd : (Optional) check the status of docker application





Check the localhost

http://localhost:8085/

 [Contact](#)

Home [json](#) [json](#) [json](#) [jsonld](#)

Movingfeatures data server

Access to data about moving features

[geospatial](#) [data](#) [api](#)

Terms of service

<https://creativecommons.org/licenses/by/4.0/>

License

[CC-BY 4.0 license](#)

Collections

[View the collections in this service](#)

API Definition

Documentation: [Swagger UI](#) [ReDoc](#)

[OpenAPI Document](#)

Conformance

[View the conformance classes of this service](#)

Provider

AIST, AIRC

<https://www.airc.aist.go.jp/en/>

Contact point

Address

2-4-7, Aomi, Koto-ku, Tokyo

Tokyo, Tokyo

135-0064

Japan

Email

kim.taehoon@aist.go.jp

Telephone

[+XX-XXX-XXX-XXXX](#)

Fax

[+XX-XXX-XXX-XXXX](#)

Contact URL

<https://github.com/aistairc/mf-api>

Hours

Mo-Fr 08:00-17:00

Contact instructions

During hours of service. Off on weekends.



A brief explanation of MobilityDB and the functions(and structure) used to handle temporal geometry and properties

02



MobilityDB

Postgres extensions for geospatial traces of moving objects such as GPS traces

To the PostgreSQL database and its spatial extension PostGIS, Spatiotemporal object support has been added

<Example of MobilityDB specific types>

- **tgeompoint**
- **tfloat**
- **ttext**





functions used to handle

Postgres (POST GIS)

MovingFeature Geometry -> ST_GeomFromGeoJSON

GeoJSON response -> st_asgeojson()

Postgres (mobilitydb)

subTrajectory parameter -> atperiod()

leaf parameter -> attimestampset()

bbox parameter -> stbox(), stbox_z()

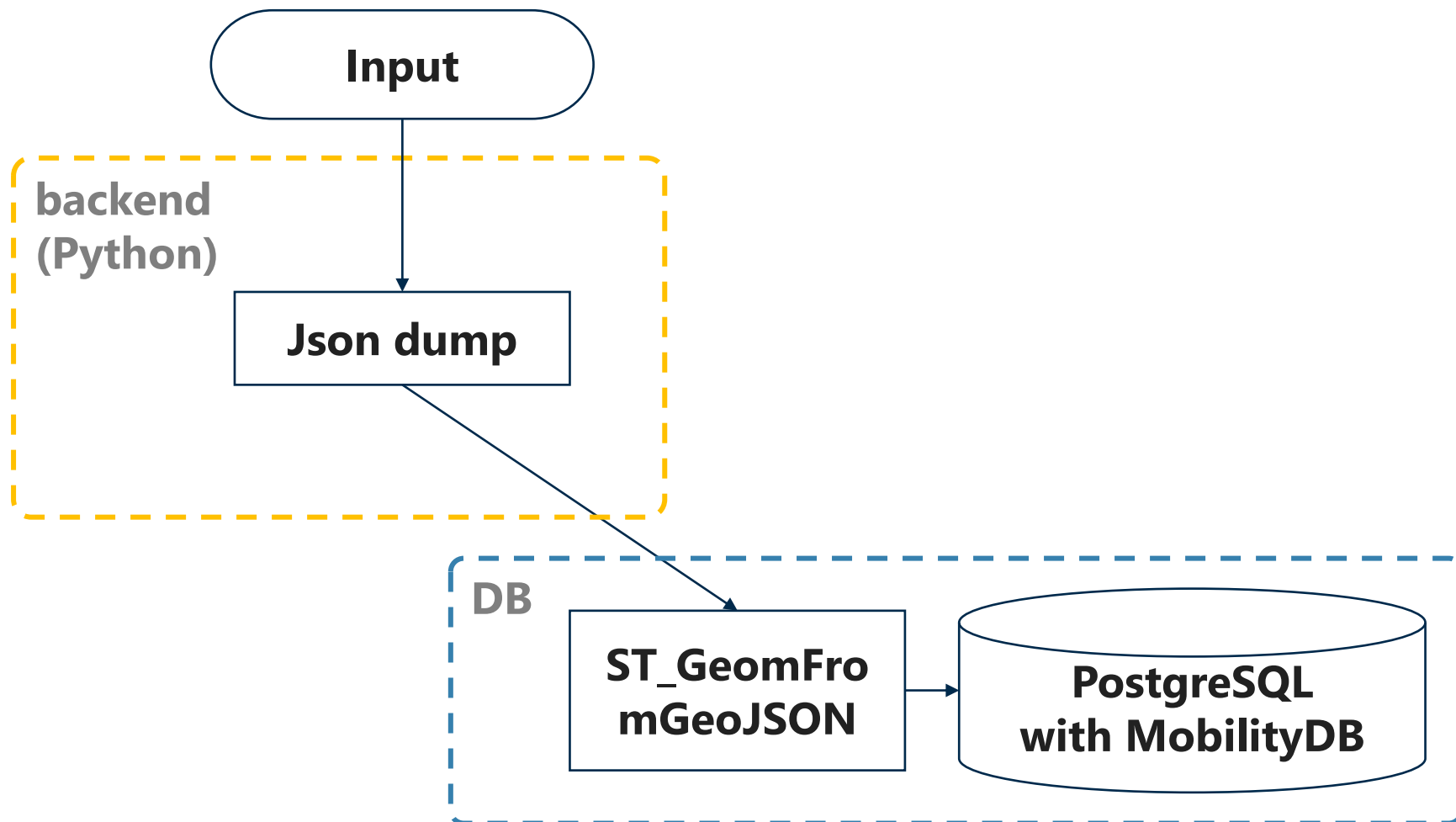
temporalGeometry,temporalProperty GET request -> extent()

PyMEOS

MFJSON interconversion-> from_mfjson(), as_mfjson()



Process flow from MovingFeature to MobilityDB

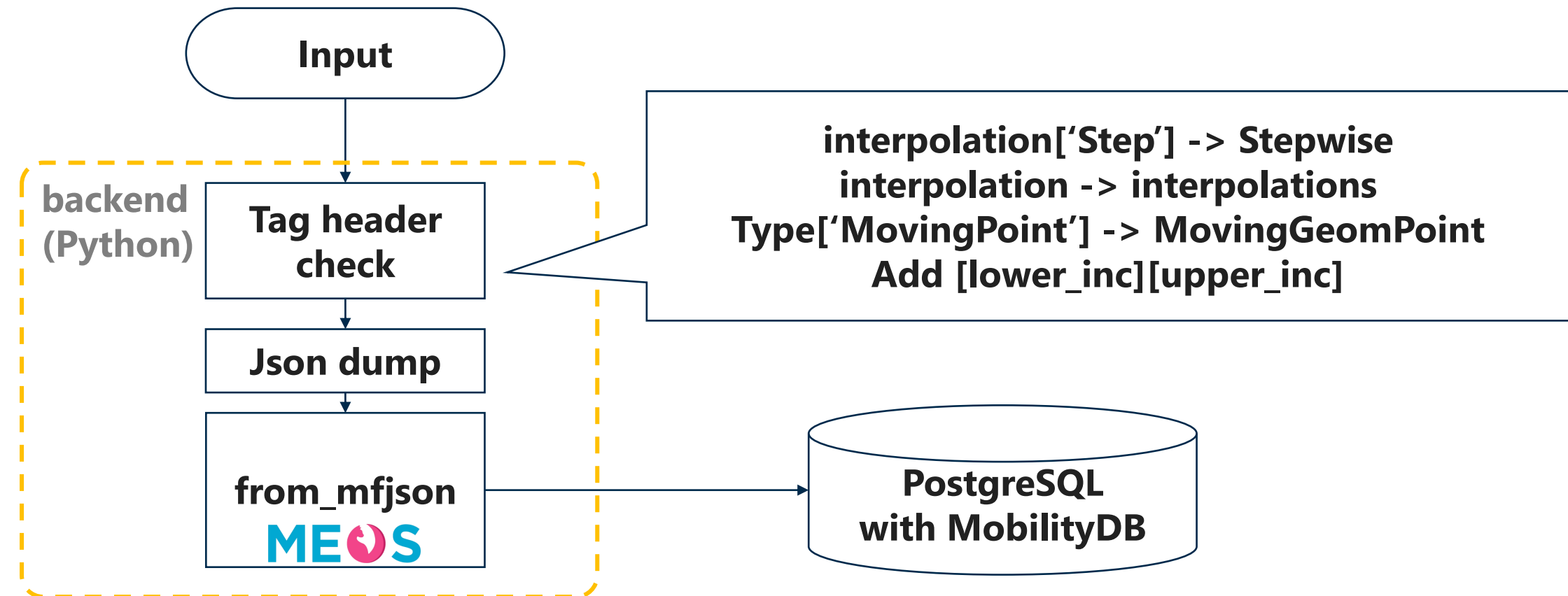


[mfeature]

mfeature				
Enter a SQL expression to filter results (use Ctrl+Space)				
	collection_id	mfeature_id	mf_geometry	mf_property
1	7513cba0-14d3-4a45-a481-ce1246711ed9	6b8ab3ed-04ba-4a11-a319-6193af8cc378	LINESTRING(139.757083 35.627701 0.5,139.757399 35.627	{"crs": {"type": "Name", "properties": {"n
2	7513cba0-14d3-4a45-a481-ce1246711ed9	646ced18-cc74-4b58-b773-b08c311a4f2a	LINESTRING(139.757083 35.627701 0.5,139.757399 35.627	{"crs": {"type": "Name", "properties": {"n
3	86f99c78-0aa4-413d-8870-bbf502ab5c80	90466a88-383f-45f3-9800-dc5252e179c4	LINESTRING(139.757083 35.627701 0.5,139.757399 35.627	{"crs": {"type": "Name", "properties": {"n
4	86f99c78-0aa4-413d-8870-bbf502ab5c80	c5a703f8-c180-4d91-918b-f0cc5cc5287b	LINESTRING(139.757083 35.627701 0.5,139.757399 35.627	{"crs": {"type": "Name", "properties": {"n
5	86f99c78-0aa4-413d-8870-bbf502ab5c80	a77b19c0-e082-4d3a-b0ab-d2887ba5dde8	LINESTRING(139.757083 35.627701 0.5,139.757399 35.627	{"crs": {"type": "Name", "properties": {"n
6	86f99c78-0aa4-413d-8870-bbf502ab5c80	d317765f-0f2f-4df6-acab-986500d8a279	LINESTRING(139.757083 35.627701 0.5,139.757399 35.627	{"crs": {"type": "Name", "properties": {"n
7	86f99c78-0aa4-413d-8870-bbf502ab5c80	d6ef3703-42b8-409a-8b9e-a05ea14aa6cf	LINESTRING(139.757083 35.627701 0.5,139.757399 35.627	{"crs": {"type": "Name", "properties": {"n
8	86f99c78-0aa4-413d-8870-bbf502ab5c80	dce61f9b-27b2-4e43-934e-561dcc88b818	LINESTRING(139.757083 35.627701 0.5,139.757399 35.627	{"crs": {"type": "Name", "properties": {"n
9	86f99c78-0aa4-413d-8870-bbf502ab5c80	1c8f8490-ef47-41a7-bf9c-dd0c8f27a28d	LINESTRING(139.757083 35.627701 0.5,139.757399 35.627	{"crs": {"type": "Name", "properties": {"n
10	86f99c78-0aa4-413d-8870-bbf502ab5c80	11329643-4265-48cc-bba8-4a595162a4ff	LINESTRING(139.757083 35.627701 0.5,139.757399 35.627	{"crs": {"type": "Name", "properties": {"n
11	86f99c78-0aa4-413d-8870-bbf502ab5c80	18b004ed-bc4e-4d4a-934b-aa5dd20cb370	LINESTRING(139.757083 35.627701 0.5,139.757399 35.627	{"crs": {"type": "Name", "properties": {"n



Process flow from TemporalGeometry to MobilityDB



[tgeometry]

table name here

QL - hanshin_ex

QL - mobility

ity

emas

public

Tables

- collection
- mfeature
- mobilitydb_opcache
- spatial ref sys
- tgeometry

Columns

- collection_id (uuid)
- mfeature_id (uuid)
- tgeometry_id (uuid)
- tgeometry_property (tgeompoint)

Constraints

	collection_id	mfeature_id	tgeometry_id	tgeometry_property
1	a01a5339-673a-415d-8...	45b9cdb9-f369-4f59	935499cf-a9ee-4006-9ee3	[010100008071AB20063A7861405055A18158D0414000000000000E03F@2011-07-14 22:01:01+09, 0101000080BDE
2	86f99c78-0aa4-413d-8...	90466a88-383f-45f3	cfce8354-8be7-4d00-95cf	[010100008071AB20063A7861405055A18158D0414000000000000E03F@2011-07-14 22:01:01+09, 0101000080BDE
3	86f99c78-0aa4-413d-8...	90466a88-383f-45f3	d1199c75-457b-46e0-bf6	[010100008071AB20063A7861405055A18158D0414000000000000E03F@2011-07-14 22:01:01+09, 0101000080BDE
4	86f99c78-0aa4-413d-8...	90466a88-383f-45f3	53b9db8c-e25d-4357-913	[010100008071AB20063A7861405055A18158D0414000000000000E03F@2011-07-14 22:01:01+09, 0101000080BDE
5	86f99c78-0aa4-413d-8...	90466a88-383f-45f3	f17f1c60-c006-4c01-baba	[010100008071AB20063A7861405055A18158D0414000000000000E03F@2011-07-14 22:01:01+09, 0101000080BDE
6	86f99c78-0aa4-413d-8...	90466a88-383f-45f3	99aa36fa-5f37-46a5-b701	[010100008071AB20063A7861405055A18158D0414000000000000E03F@2011-07-14 22:01:01+09, 0101000080BDE
7	86f99c78-0aa4-413d-8...	90466a88-383f-45f3	d31b228-6f2c-4fcf-b780	[010100008071AB20063A7861405055A18158D0414000000000000E03F@2011-07-14 22:01:01+09, 0101000080BDE
8	86f99c78-0aa4-413d-8...	90466a88-383f-45f3	2e1091ba-f531-4c2b-ba9	[010100008071AB20063A7861405055A18158D0414000000000000E03F@2011-07-14 22:01:01+09, 0101000080BDE
9	86f99c78-0aa4-413d-8...	90466a88-383f-45f3	5f4e8bc7-3838-4704-9c9	[010100008071AB20063A7861405055A18158D0414000000000000E03F@2011-07-14 22:01:01+09, 0101000080BDE
10	86f99c78-0aa4-413d-8...	90466a88-383f-45f3	f5081e89-ea56-48ae-8945	[010100008071AB20063A7861405055A18158D0414000000000000E03F@2011-07-14 22:01:01+09, 0101000080BDE
11	86f99c78-0aa4-413d-8...	90466a88-383f-45f3	31994404-f6af-4842-9e45	[010100008071AB20063A7861405055A18158D0414000000000000E03F@2011-07-14 22:01:01+09, 0101000080BDE
12	86f99c78-0aa4-413d-8...	90466a88-383f-45f3	59d7bd34-d96b-46ee-b9	[010100008071AB20063A7861405055A18158D0414000000000000E03F@2011-07-14 22:01:01+09, 0101000080BDE
13	86f99c78-0aa4-413d-8...	90466a88-383f-45f3	f66879a0-9009-4f0f-9fa9	[010100008071AB20063A7861405055A18158D0414000000000000E03F@2011-07-14 22:01:01+09, 0101000080BDE
14	86f99c78-0aa4-413d-8...	90466a88-383f-45f3	15f88bb9-9f0e-40bb-9afe	[010100008071AB20063A7861405055A18158D0414000000000000E03F@2011-07-14 22:01:01+09, 0101000080BDE



[tproperties]

13

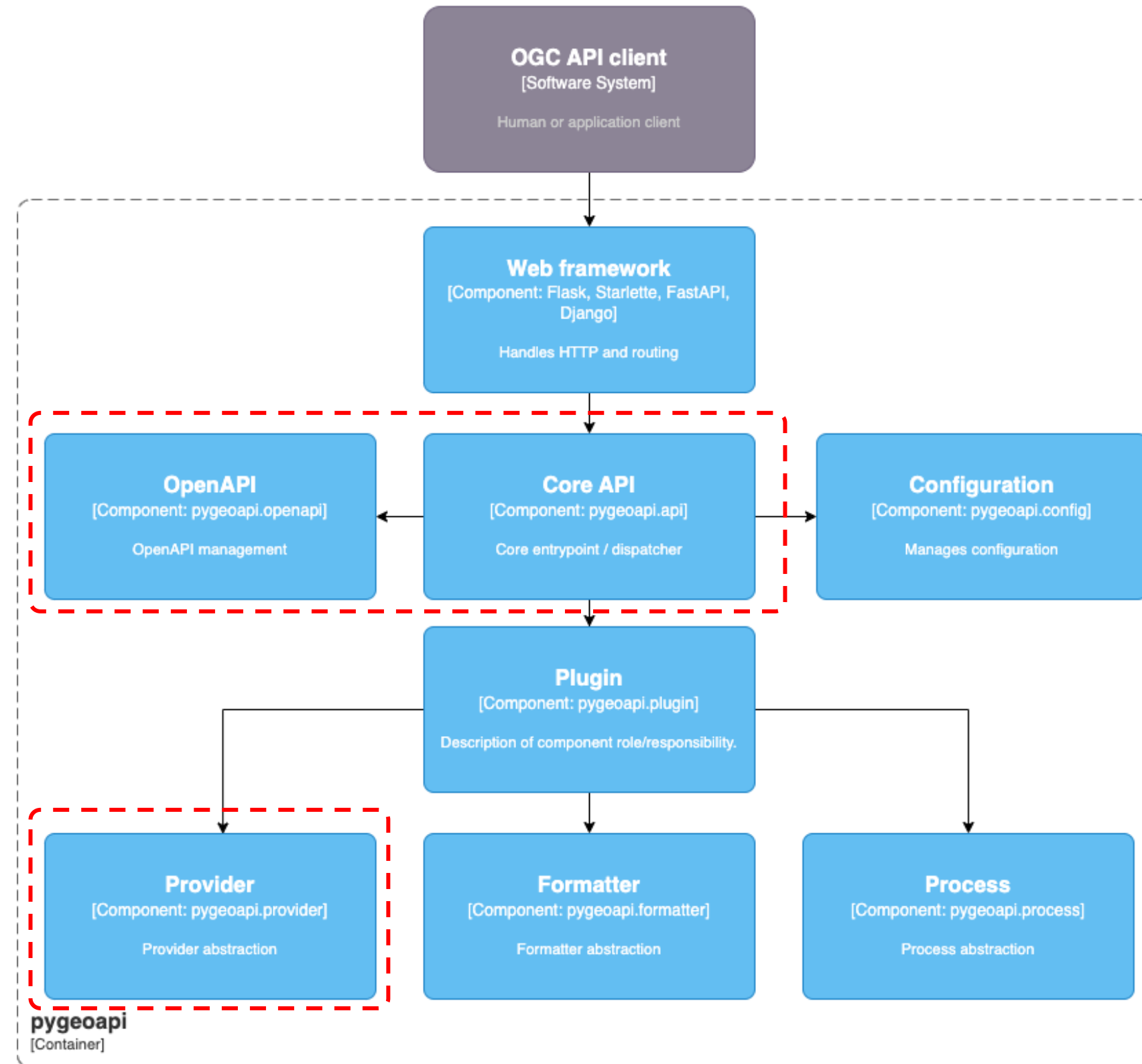
**Describe how you extended
pygeoapi to support OGC API -
MF(libraries to use OpenAPI and
Mobility DB(pyMEOS, python-
mobilitydb, etc.) and extension
structure, etc.)**

03

Extension parts of pygeoapi

pygeoapi C4 Component diagram

 **Extension**



Extension parts of pygeoapi

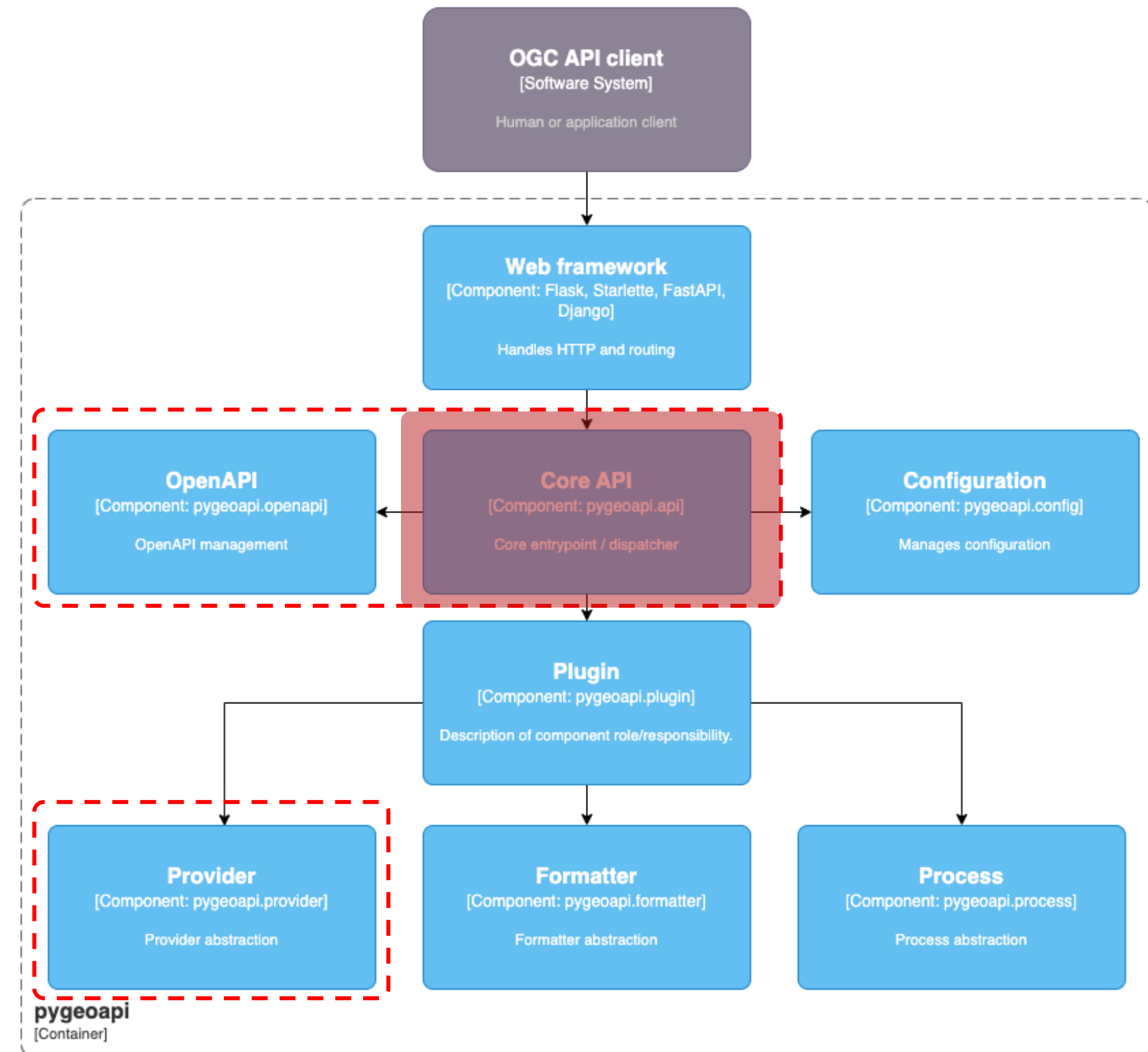
Core API

pygeoapi/api.py

Parameter identification and
response formatting

Extension

pygeoapi C4 Component diagram



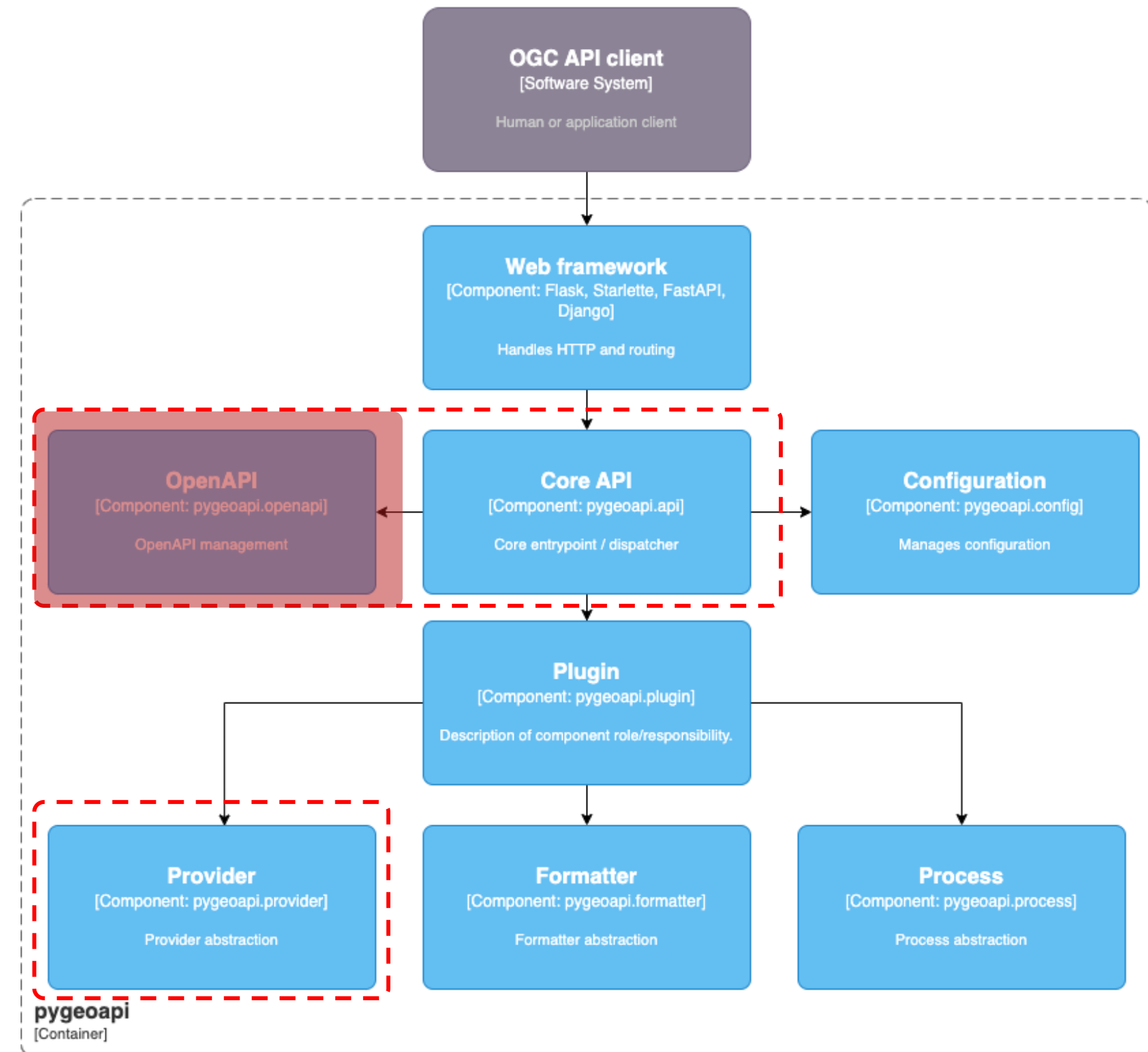
Extension parts of pygeoapi

OpenAPI

`pygeoapi/flask_app.py`

Determine processing from
Swagger requests

pygeoapi C4 Component diagram



Extension

Extension parts of pygeoapi

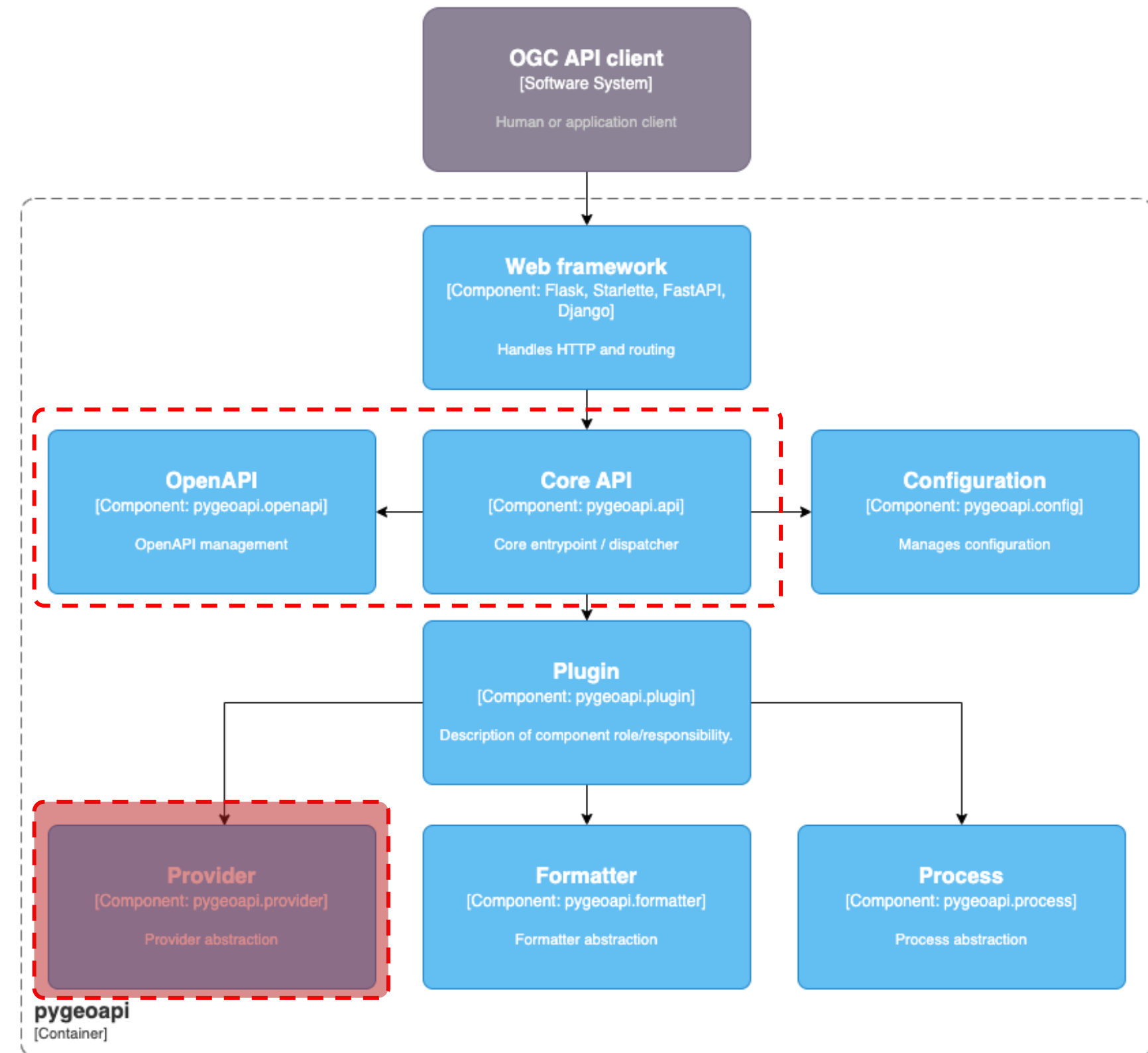
Provider

pygeoapi/models/process_data.py
SQL query generation from
parameters

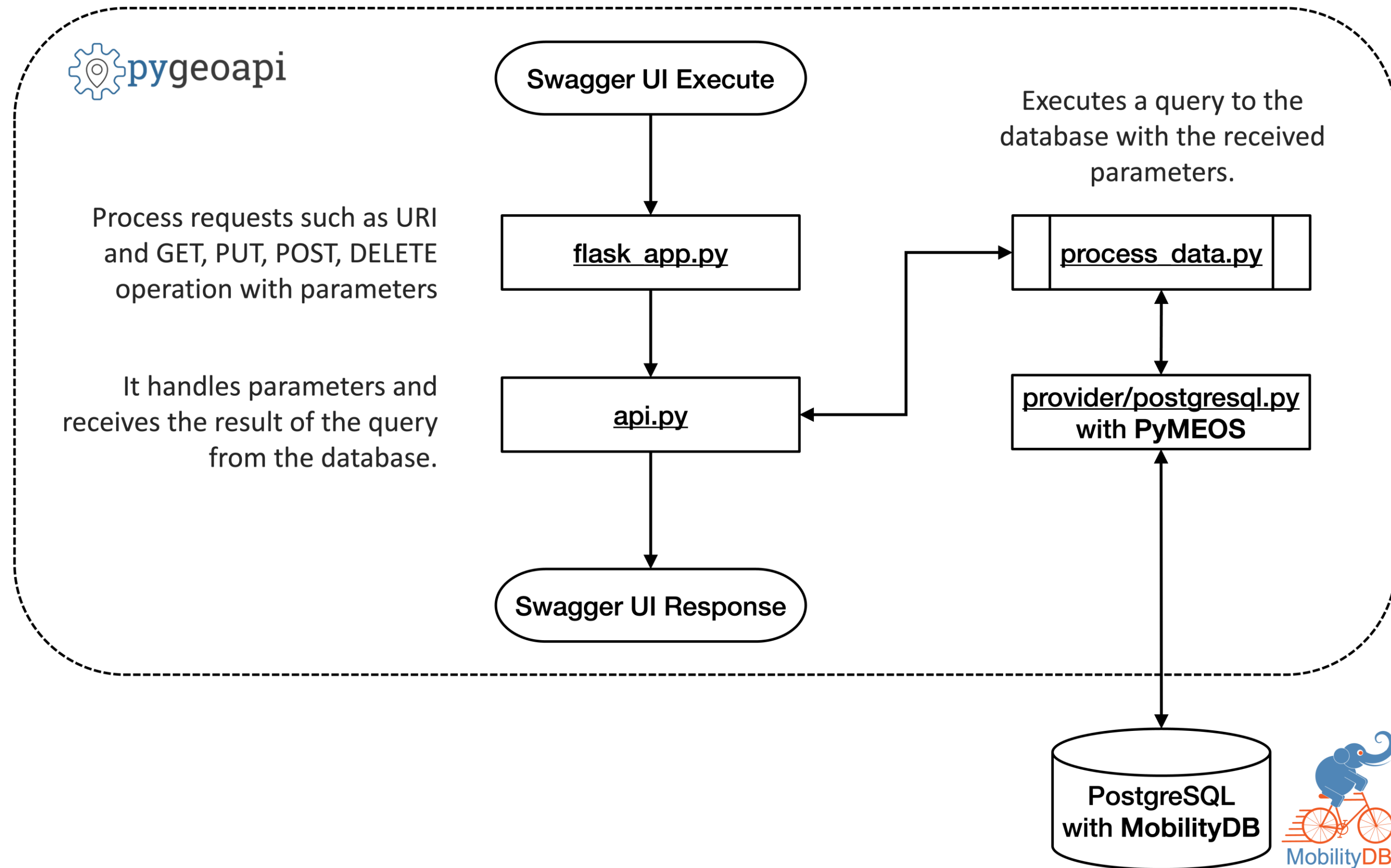
pygeoapi/provider/postgresql.py
Query Execution

 **Extension**

pygeoapi C4 Component diagram



Process flow in pygeoapi





Using libraries for extension structure

Libraries

- **GeoAlchemy2** : query parameters convert
(**ST_MakeEnvelope**, **ST_3DMakeBox**, **ST_MakePoint**)
- **psycopg2** : postgres database adapter for python
- **python-mobilitydb** : mobilityDB database adapter for python

URL

[GeoAlchemy] <https://geoalchemy-2.readthedocs.io/en/latest/>

[psycopg2] <https://pypi.org/project/psycopg2>

[python-mobilitydb] <https://github.com/MobilityDB/MobilityDB-python>



Using libraries for extension structure

Libraries

- **pymeos** : manipulation of temporal and spatio-temporal data based on **MobilityDB's data types and functions**
- **SQLAlchemy** : Python SQL toolkit

Postgres Extension

- **uuid-oss** : generate universally unique identifies (UUID)

URL

[pymeos] <https://pypi.org/project/pymeos/>

[SQLAlchemy] <https://www.sqlalchemy.org/>

[uuid-oss] <https://www.postgresql.org/docs/current/uuid-oss.html>



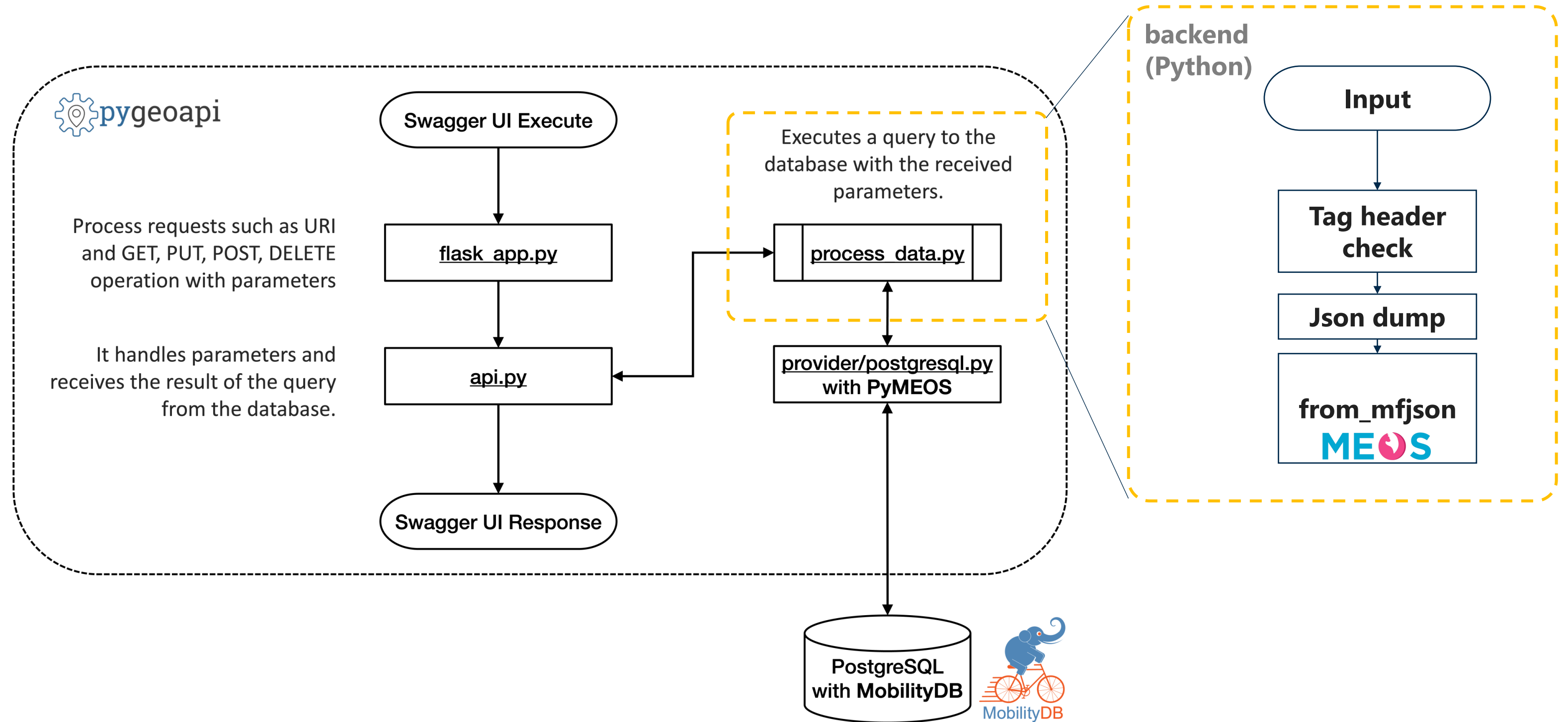
PyMEOS

MEOS (Mobility Engine, Open Source) is a C library which enables the manipulation of temporal and spatio-temporal data based on MobilityDB's data types and functions.

PyMEOS is a library built on top of MEOS that provides all its functionality wrapped in a set of Python classes.



PyMEOS in the process flow






**Verify that each API works properly
using Swagger.**

04



List of APIs (in Swagger UI)

<http://localhost:8085/openapi?f=html>

 **Swagger**
Supported by SMARTBEAR

Building Blocks specified in OGC API - MovingFeatures 0.0.1 OAS 3.0

<http://localhost:8085/openapi?f=json>

This is the OpenAPI definition of Moving Features API specification that conforms to the OGC Moving Features Encoding Extension - JSON.

[Contact APPTec](#)
[OGC License](#)

Capabilities Essential characteristics of the information available from the API.

GET	/	Landing page	▼
GET	/api	API definition	▼
GET	/conformance	Information about specifications that this API conforms to	▼
GET	/collections	Retrieve catalogs of moving features collection	▼

MovingFeatureCollection Collections of moving features to be logically managed by a user.

POST	/collections	Register metadata about a collection of moving features	▼
------	--------------	---	---



MovingFeatureCollection

POST /collections

No1

Try it out



Parameters

Request body (application/json)

Reference GitHub Page

```
{
  "title": "moving_feature_collection_sample1",
  "updateFrequency": 1000,
  "description": "FOSS4G2023 Seoul Workshop"
}
```



Execute



MovingFeatureCollection

POST /collections

No1

Result

Server response

Code	Details
------	---------

201	
-----	--

Response headers

```
access-control-allow-origin: http://localhost:8085
connection: close
content-language: en-US
content-length: 0
content-type: application/json
date: Thu, 16 Nov 2023 07:02:19 GMT
location: http://localhost:8085/collections/9fc1986e-1258-49e3-b130-c2d211326319
server: Werkzeug/2.3.6 Python/3.9.2
vary: Origin
x-powered-by: pygeoapi 0.14.dev0
```

collectionId

collectionId : 9fc1986e-1258-49e3-b130-c2d211326319



MovingFeatureCollection

GET /collections/{collectionId}

No2

Try it out



Parameters

collectionId

9fc1986e-1258-49e3-b130-c2d211326319

The last part of `location` link
when POST response



Execute



MovingFeatureCollection

GET /collections/{collectionId}

Result

No2

Server response

Code

Details

200

Response body

```
{
  "collections": [
    {
      "title": "moving_feature_collection_sample1",
      "description": "FOSS4G2023 Seoul Workshop",
      "updateFrequency": 1000,
      "itemtype": "movingfeature",
      "id": "9fc1986e-1258-49e3-b130-c2d211326319",
      "extent": {
        "spatial": {
          "bbox": [],
          "crs": "http://www.opengis.net/def/crs/OGC/1.3/CRS84"
        }
      },
      "temporal": {
        "interval": [],
        "trs": "http://www.opengis.net/def/uom/ISO-8601/0/Gregorian"
      },
      "links": [
        {
          "href": "http://localhost:8085/collections/9fc1986e-1258-49e3-b130-c2d211326319",
          "rel": "self",
          "type": "application/json"
        }
      ]
    }
  ],
  "links": [
```

Input parameters when POST



MovingFeatureCollection

DELETE /collections/{collectionId}

Skip the DELETE request for the next demonstration

DELETE /collections/{collectionId} Delete the collection

The collection catalog with id `collectionId` and including metadata and moving features SHOULD be deleted.

Parameters

Cancel

Name	Description
collectionId * required string (path)	local identifier of a collection <input type="text" value="9fc1986e-1258-49e3-b130-c2d2113263"/>

Execute

If an id specify, the collection can delete



MovingFeatures

POST /collections/{collectionId}/items

No5

Try it out



Parameters

collectionId

9fc1986e-1258-49e3-b130-c2d211326319

Reference GitHub Page

Request body(application/json)

```
{  
  "type": "Feature",  
  "properties": {  
    "name": "car1", ...  
  }  
}
```



Execute



MovingFeatures

POST /collections/{collectionId}/items

No5

Result

Server response	
Code	Details
201	<div>Response headers<div><div>access-control-allow-origin: http://localhost:8085</div><div>connection: close</div><div>content-language: en-US</div><div>content-length: 0</div><div>content-type: application/json</div><div>date: Fri, 17 Nov 2023 01:17:43 GMT</div><div>location: http://localhost:8085/collections/9fc1986e-1258-49e3-b130-c2d211326319/items/f7a5b599-389e-4fdf-8849-bae0221dbe0c</div><div>server: Werkzeug/2.3.6 Python/3.9.2</div><div>vary: Origin</div><div>x-powered-by: pygeoapi 0.14.dev0</div></div></div>
Responses	
Code	Description
201	Successful create a set of moving features or a moving feature into a specific collection.

mFeatureId : f7a5b599-389e-4fdf-8849-bae0221dbe0c



MovingFeatures

POST /collections/{collectionId}/items

No5-2

Try it out



Parameters

collectionId

9fc1986e-1258-49e3-b130-c2d211326319

Reference GitHub Page

Request body(application/json)

```
{  
  "type": "Feature",  
  "properties": {  
    "name": "car1", ...  
  }  
}
```



Execute



MovingFeatures

POST /collections/{collectionId}/items

No5-2

Result

Server response

Code	Details
------	---------

201	
-----	--

Response headers

```
access-control-allow-origin: http://localhost:8085
connection: close
content-language: en-US
content-length: 0
content-type: application/json
date: Fri,24 Nov 2023 04:21:25 GMT
location: http://localhost:8085/collections/f71c3c59-becd-4cb7-bd98-a93505e769c8/items/015b3091-2a77-4390-b473-2966b64a8cb8
server: Werkzeug/2.3.7 Python/3.9.2
vary: Origin
x-powered-by: pygeoapi 0.14.dev0
```

mFeatureId

Responses

Code	Description
------	-------------

201	Successful create a set of moving features or a moving feature into a specific collection.
-----	--

mFeatureId :015b3091-2a77-4390-b473-2966b64a8cb8



MovingFeatures

GET /collections/{collectionId}/items

No6

Try it out



Parameters

collectionId

9fc1986e-1258-49e3-b130-c2d211326319

datetime

2011-07-14T22:20:00Z

Reference GitHub Page

limit

10

Default Value

subTrajectory

--

Default Value



Execute



MovingFeatures

GET /collections/{collectionId}/items

No6

Result

Server response

Code

Details

200

Response body

```
{
  "type": "FeatureCollection",
  "features": [
    {
      "id": "f7a5b599-389e-4fdf-8849-bae0221dbe0c",
      "crs": {
        "type": "Name",
        "properties": {
          "name": "urn:ogc:def:crs:OGC:1.3:CRS84"
        }
      },
      "trs": {
        "type": "Link",
        "properties": {
          "href": "http://www.opengis.net/def/uom/ISO-8601/0/Gregorian",
          "type": "ogcdef"
        }
      },
      "type": "Feature",
      "properties": {
        "name": "car1",
        "state": "test1",
        "video": "http://.../example/video.mpeg"
      },
      "geometry": {
        "type": "LineString",
        "coordinates": [
          [

```




MovingFeatures

GET /collections/{collectionId}/items

No6-2

Try it out

Reference
GitHub Page

Parameters

collectionId

9fc1986e-1258-49e3-b130-c2d211326319

datetime

2010-01-01T00:00:00Z/..

limit

10

subTrajectory

--

bbox

138.757083
34.627483
138.757716
34.627701

Reference GitHub Page

Default Value

Default Value

Execute



MovingFeatures

GET /collections/{collectionId}/items

No6-2

Result

Server response

Code

Details

200

Response body

```
{
  "type": "FeatureCollection",
  "features": [
    {
      "id": "f7a5b599-389e-4fdf-8849-bae0221dbe0c",
      "crs": {
        "type": "Name",
        "properties": {
          "name": "urn:ogc:def:crs:OGC:1.3:CRS84"
        }
      },
      "trs": {
        "type": "Link",
        "properties": {
          "href": "http://www.opengis.net/def/uom/ISO-8601/0/Gregorian",
          "type": "ogcdef"
        }
      },
      "type": "Feature",
      "properties": {
        "name": "car1",
        "state": "test1",
        "video": "http://.../example/video.mpeg"
      },
      "geometry": {
        "type": "LineString",
        "coordinates": [
          [

```



MovingFeatures

GET /collections/{collectionId}/items

No6-3

Try it out



Parameters

collectionId

9fc1986e-1258-49e3-b130-c2d211326319

datetime

2011-08-14T22:15:00Z/2011-08-14T22:55:00Z

limit

10

subTrajectory

true

Reference
GitHub Page

Default Value

Change Value



Execute



MovingFeatures

GET /collections/{collectionId}/items

No6-3

Result

Server response

Code

Details

200

Response body

```
{
  "type": "FeatureCollection",
  "features": [
    {
      "id": "f7a5b599-389e-4fdf-8849-bae0221dbe0c",
      "crs": {
        "type": "Name",
        "properties": {
          "name": "urn:ogc:def:crs:OGC:1.3:CRS84"
        }
      },
      "trs": {
        "type": "Link",
        "properties": {
          "href": "http://www.opengis.net/def/uom/ISO-8601/0/Gregorian",
          "type": "ogcdef"
        }
      },
      "type": "Feature",
      "properties": {
        "name": "car1",
        "state": "test1",
        "video": "http://.../example/video.mpeg"
      },
      "geometry": {
        "type": "LineString",
        "coordinates": [
          [

```




MovingFeatures

GET /collections/{collectionId}/items/{mFeatureId}

No7

Try it out



Parameters

collectionId

9fc1986e-1258-49e3-b130-c2d211326319

mFeatureId

f7a5b599-389e-4fdf-8849-bae0221dbe0c



Execute



MovingFeatures

GET /collections/{collectionId}/items/{mFeatureId}

No7

Result

Server response

Code

Details

200

Response body

```
{
  "id": "f7a5b599-389e-4fdf-8849-bae0221dbe0c",
  "crs": {
    "type": "Name",
    "properties": {
      "name": "urn:ogc:def:crs:OGC:1.3:CRS84"
    }
  },
  "trs": {
    "type": "Link",
    "properties": {
      "href": "http://www.opengis.net/def/uom/ISO-8601/0/Gregorian",
      "type": "ogcdef"
    }
  },
  "type": "Feature",
  "properties": {
    "name": "car1",
    "state": "test1",
    "video": "http://.../example/video.mpeg"
  },
  "geometry": {
    "type": "LineString",
    "coordinates": [
      [
        139.757083,
        35.627701,
        0.5
      ]
    ]
  }
}
```



MovingFeatures

DELETE /collections/{collectionId}/items/{mFeatureId}

Skip the DELETE request for the next demonstration

DELETE /collections/{collectionId}/items/{mFeatureId} Delete a single moving feature

The moving feature with id `mFeatureId` and including temporal geometries and properties SHOULD be deleted.

Parameters

Cancel

Name	Description
collectionId * required string (path)	local identifier of a collection <input type="text" value="9fc1986e-1258-49e3-b130-c2d2113263"/>
mFeatureId * required string (path)	local identifier of a moving feature <input type="text" value="f7a5b599-389e-4fdf-8849-bae0221dbe0"/>

Execute

If an id specify,
the Moving Feature can delete



TemporalGeometrySequence

POST /collections/{collectionId}/items/{mFeatureId}/tgsequence

No9

Try it out



Parameters

collectionId

9fc1986e-1258-49e3-b130-c2d211326319

mFeatureId

f7a5b599-389e-4fdf-8849-bae0221dbe0c

Request body(application/json)

```
{  
  "id": "tg-1",  
  "type": "MovingPoint",...
```

Default Value



Execute



TemporalGeometrySequence

POST /collections/{collectionId}/items/{mFeatureId}/tgsequence

No9

Result

Server response		
Code	Details	
201	<div>Response headers</div> <div><div>access-control-allow-origin: http://localhost:8085</div><div>connection: close</div><div>content-language: en-US</div><div>content-length: 0</div><div>content-type: application/json</div><div>date: Fri, 17 Nov 2023 01:47:16 GMT</div><div>location: http://localhost:8085/collections/9fc1986e-1258-49e3-b130-c2d211326319/items/f7a5b599-389e-4fdf-8849-bae0221dbe0c/tGeometries/8602827f-6927-4c3c-9057-12c386889774</div><div>server: Werkzeug/2.3.6 Python/3.9.2</div><div>vary: Origin</div><div>x-powered-by: pygeoapi 0.14.dev0</div></div> <div>tGeometryId</div>	
Responses		
Code	Description	Links
201	Successful add more movement data into a specified moving feature.	No links

tGeometryId : 8602827f-6927-4c3c-9057-12c386889774



TemporalGeometrySequence

GET /collections/{collectionId}/items/{mFeatureId}/tgsequence

No10

Try it out



Parameters

collectionId

9fc1986e-1258-49e3-b130-c2d211326319

mFeatureId

f7a5b599-389e-4fdf-8849-bae0221dbe0c

leaf

2011-08-14T22:30:00Z

subTrajectory

--

limit

10

datetime

2010-01-01T00:00:00Z/..



Execute



TemporalGeometrySequence

GET /collections/{collectionId}/items/{mFeatureId}/tgsequence

No10

Result

Server response	
Code	Details
200	<div>Response body<pre> 159.757716, 35.627483, 4], "datetimes": ["2011-07-14T22:01:06-09Z", "2011-07-14T22:01:07-09Z", "2011-07-14T22:01:08-09Z", "2011-07-14T22:01:09-09Z", "2011-07-14T22:01:10-09Z"], "interpolation": "Linear", "id": "8602827f-6927-4c3c-9057-12c386889774" } }, "crs": { "type": "Name", "properties": "urn:ogc:def:crs:OGC:1.3:CRS84" }, "trs": { "type": "Name", "properties": "urn:ogc:data:time:iso8601" }, "links": [{ "href": "http://localhost:8085/collections/9fc1986e-1258-49e3-b130-c2d211326319/ite "rel": "self", "type": "application/json"</pre></div>



TemporalGeometrySequence

GET /collections/{collectionId}/items/{mFeatureId}/tgsequence

No10-2

Try it out



Parameters

collectionId

9fc1986e-1258-49e3-b130-c2d211326319

mFeatureId

f7a5b599-389e-4fdf-8849-bae0221dbe0c

datetime

2011-08-14T22:15:00Z/2011-08-14T23:15:00Z

subTrajectory

true

limit

10

leaf,datetime

empty



Execute



TemporalGeometrySequence

GET /collections/{collectionId}/items/{mFeatureId}/tgsequence

No10-2

Result

Server response	
Code	Details
200	<div>Response body<pre> 159.757716, 35.627483, 4], "datetimes": ["2011-07-14T22:01:06-09Z", "2011-07-14T22:01:07-09Z", "2011-07-14T22:01:08-09Z", "2011-07-14T22:01:09-09Z", "2011-07-14T22:01:10-09Z"], "interpolation": "Linear", "id": "8602827f-6927-4c3c-9057-12c386889774" }], "crs": { "type": "Name", "properties": "urn:ogc:def:crs:OGC:1.3:CRS84" }, "trs": { "type": "Name", "properties": "urn:ogc:data:time:iso8601" }, "links": [{ "href": "http://localhost:8085/collections/9fc1986e-1258-49e3-b130-c2d211326319/ite "rel": "self", "type": "application/json"</pre></div>



TemporalProperties

POST /collections/{collectionId}/items/{mFeatureId}/tproperties

No12

Try it out



Parameters

collectionId

9fc1986e-1258-49e3-b130-c2d211326319

mFeatureId

f7a5b599-389e-4fdf-8849-bae0221dbe0c

Request body(application/json)

```
{  
  "temporalProperties": [  
    { ...  
  ]  
}
```

Reference
GitHub Page



Execute



TemporalProperties

POST /collections/{collectionId}/items/{mFeatureId}/tproperties

No12

Result

Server response

Code	Details
------	---------

201	Response headers
-----	------------------

```
access-control-allow-origin: http://localhost:8085
connection: close
content-language: en-US
content-length: 0
content-type: application/json
date: Mon, 20 Nov 2023 04:16:19 GMT
location: http://localhost:8085/collections/8f7c2c94-82db-4cad-b3f2-27c13cae5c5/items/1be529cd-fb42-416f-ab2e-3ed1f8e26c6d/tProperties/labels
server: Werkzeug/2.3.7 Python/3.9.2
vary: Origin
x-powered-by: pygeoapi 0.14.dev0
```

Responses

Code	Description
------	-------------



TemporalProperties

GET /collections/{collectionId}/items/{mFeatureId}/tproperties

No13

Try it out



Parameters

collectionId

9fc1986e-1258-49e3-b130-c2d211326319

mFeatureId

f7a5b599-389e-4fdf-8849-bae0221dbe0c

datetime

2011-08-14T22:15:00Z/2011-08-14T22:55:00Z

limit

10

subTemporalValue

true



Execute



TemporalProperties

GET /collections/{collectionId}/items/{mFeatureId}/tproperties

No13

Result

Server response

Code

Details

200

Response body

```
{
  "temporalProperties": [
    {
      "type": "Image",
      "name": "camera"
    },
    {
      "form": "MQS",
      "type": "Measure",
      "name": "discharge"
    },
    {
      "type": "Text",
      "name": "labels"
    },
    {
      "form": "http://www.qudt.org/qudt/owl/1.0.0/quantity/Length",
      "type": "Measure",
      "description": "description1",
      "name": "length"
    }
  ],
  "links": [
    {
      "href": "http://localhost:8085/collections/9fc1986e-1258-49e3-b130-c2c",
      "rel": "self",
      "type": "application/json"
    }
  ]
}
```



TemporalProperty

GET /collections/{collectionId}/items/{mFeatureId}/tproperties/{tPropertyName}

No14

Try it out



Parameters

collectionId

9fc1986e-1258-49e3-b130-c2d211326319

mFeatureId

f7a5b599-389e-4fdf-8849-bae0221dbe0c

tPropertyName

length

limit

10

subTemporalValue

--

datetime

2010-01-01T00:00:00Z/..



Execute



TemporalProperty

GET /collections/{collectionId}/items/{mFeatureId}/tproperties/{tPropertyName}

No14

Result

Server response

Code

Details

200

Response body

```
{
  "temporalProperties": [
    {
      "values": [
        1,
        2.4,
        1
      ],
      "datetimes": [
        "2011-07-14T22:01:01.45-09Z",
        "2011-07-14T23:01:01.45-09Z",
        "2011-07-15T00:01:01.45-09Z"
      ],
      "interpolation": "Linear"
    }
  ],
  "links": [
    {
      "href": "http://localhost:8085/collections/8f7c2c94-82db-4cad-b3f2-27c13ca1e5c5/items/1be529cd-fb42-416f-ab2e-3ed1f8e26c6d/tProperties/length?offset=0&limit=10",
      "rel": "self",
      "type": "application/json"
    }
  ],
  "timeStamp": "2023-11-20T04:17:45.377817Z",
  "numberMatched": 1,
  "numberReturned": 1
}
```




TemporalProperty

POST /collections/{collectionId}/items/{mFeatureId}/tproperties/{tPropertyName}

No15

Try it out



Parameters

collectionId

9fc1986e-1258-49e3-b130-c2d211326319

mFeatureId

f7a5b599-389e-4fdf-8849-bae0221dbe0c

tPropertyName

length

Request body(application/json)

```
{  
  "datetimes": [  

```

Reference
GitHub Page



Execute



TemporalProperty

POST /collections/{collectionId}/items/{mFeatureId}/tproperties/{tPropertyName}

No15

Result

Server response

Code	Details
201	<div>Response headers</div> <pre>access-control-allow-origin: http://localhost:8085 connection: close content-language: en-US content-length: 0 content-type: application/json date: Mon, 20 Nov 2023 04:19:15 GMT location: http://localhost:8085/collections/8f7c2c94-82db-4cad-b3f2-27c13cae5c5/items/1be529cd-fb42-416f-ab2e-3ed1f8e26c6d/tProperties/length/pvalue/0a59f0f1-2281-4133-811b-339b4863ce5c server: Werkzeug/2.3.7 Python/3.9.2 vary: Origin x-powered-by: pygeoapi 0.14.dev0</pre>

Responses

GET /collections/{collectionId}/items/{mFeatureId}/tproperties/{tPropertyName}

Server response

Code	Details
200	<div>Response body</div> <pre>{ "temporalProperties": [{ "values": [0, 20, 50], "datetimes": ["2011-07-15T08:00:00-09Z", "2011-07-15T08:00:01-09Z", "2011-07-15T08:00:02-09Z"], "interpolation": "Linear" }, { "values": [1, 2.4, 1], "datetimes": ["2011-07-14T22:01:01.45-09Z", "2011-07-14T23:01:01.45-09Z", "2011-07-15T00:01:01.45-09Z"], "interpolation": "Linear" }] }</pre>

confirm additions



Reference

MF-API Server based on pygeoapi

<https://github.com/aistairc/mf-api>

OGC API – Moving Features official GitHub repository

<https://github.com/opengeospatial/ogcapi-movingfeatures>

MobilityDB (and its Python driver, PyMEOS, and MEOS)

<https://github.com/MobilityDB>

STINUUM (The installation of each program will use a Docker file.)

<https://github.com/aistairc/mf-cesium>

Lastly, you can check many helpful information about OGC API – MF here

<https://ogcapi.ogc.org/movingfeatures/>

Workshop Github Page

https://github.com/ogi-ts-shimizu/FOSS4G2023Workshop_How-to-implement-OGC-API/

Optional Request



Moving Feature Collection

PUT /collections/{collectionId}

No3

Try it out



Parameters

collectionId

9fc1986e-1258-49e3-b130-c2d211326319

The last part of `location` link
when POST response

Request body(application/json)

```
{
  "title": "moving_feature_collection_sample2",
  "updateFrequency": 1000,
  "description": "FOSS4G2023 Seoul Workshop PUT test"
}
```



Execute



Moving Feature Collection

PUT /collections/{collectionId}

No3

Code 204 is Successfully

Result

Server response

Code	Details
------	---------

204	
-----	--

Response headers

```
access-control-allow-origin: http://localhost:8085
connection: close
content-language: en-US
content-type: application/json
date: Fri, 17 Nov 2023 00:50:32 GMT
server: Werkzeug/2.3.6 Python/3.9.2
vary: Origin
x-powered-by: pygeoapi 0.14.dev0
```

Responses

Code	Description
------	-------------

204	
-----	--

Successfully replaced.

A GET request again will confirm the change



TemporalGeometryCollection

DELETE /collections/{collectionId}/items/{mFeatureId}/tgsequence /{tGeometryId}

No11

Try it out



Parameters

collectionId

9fc1986e-1258-49e3-b130-c2d211326319

mFeatureId

f7a5b599-389e-4fdf-8849-bae0221dbe0c

tGeometryId

8602827f-6927-4c3c-9057-12c386889774



Execute



TemporalGeometryCollection

DELETE /collections/{collectionId}/items/{mFeatureId}/tgsequence /{tGeometryId}

No11

Result

Server response		
Code	Details	
204	<div>Response headers</div> <div><pre>access-control-allow-origin: http://localhost:8085 connection: close content-language: en-US content-type: application/json date: Fri, 17 Nov 2023 01:59:14 GMT server: Werkzeug/2.3.6 Python/3.9.2 vary: Origin x-powered-by: pygeoapi 0.14.dev0</pre></div>	
Responses		
Code	Description	Links
204	Successfully deleted.	No links

A GET request again will confirm the delete



TemporalPropertyCollection

DELETE /collections/{collectionId}/items/{mFeatureId}/tproperties/{tPropertyName}

No16

Try it out



Parameters

collectionId

9fc1986e-1258-49e3-b130-c2d211326319

mFeatureId

f7a5b599-389e-4fdf-8849-bae0221dbe0c

tPropertyName

length



Execute



TemporalPropertyCollection

DELETE /collections/{collectionId}/items/{mFeatureId}/tproperties/{tPropertyName}

No16

Server response	
Code	Details
204	<div>Response headers</div> <div>access-control-allow-origin: http://localhost:8085 connection: close content-language: en-US content-type: application/json date: Mon, 20 Nov 2023 04:22:19 GMT server: Werkzeug/2.3.7 Python/3.9.2 vary: Origin x-powered-by: pygeoapi 0.14.dev0</div>
Responses	
Code	Description
204	Successfully deleted.

GET /collections/{collectionId}/items/{mFeatureId}/tproperties/{tPropertyName}

Server response	
Code	Details
404	<div>Error: NOT FOUND</div> <div><i>Undocumented</i></div> <div>Response body</div> <div>{ "code": "NotFound", "description": "Temporal Property not found" }</div>