decode

CityOS connection

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Project no. 732546

DECODE

DEcentralised Citizens Owned Data Ecosystem

D5.2 CityOS connection

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PU	Public	**X**
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Approved by: Francesca Bria (Chief Technology and Digital Innovation Officer, Barcelona City Hall)
Date: 02/07/2018

This report is currently awaiting approval from the EC and cannot be not considered to be a final version.

Table of Contents

Abbreviations

BCN	Barcelona
CityOS	Operating System of the City
IMI	Municipal Institute of Information Technology / Institut Municipal d'Informatica
WP	Work Package
BCNNow	Barcelona Now (the dashboard system described in detail in deliverable D5.3)
ASIA	Application of Integrated Attention Systems / Aplicatiu de Sistemes Integrats d'Atenció
IRIS	Incidents, Claims and Suggestions / Incidencies, Reclamacions i Suggeriments
SME	Small and medium-sized enterprise
API	Application Programming Interface
WFS	Web Feature Service
IMI	Municipal Institute of Information Technology / Institut Municipal d'Informàtica
KVP	Keyword Value Pair
OAUTH2	Open Authorization
JSON	JavaScript Object Notation
OGC	Open Geospatial Consortium
CRC	Coordinate Reference System
WGS	World Geodetic System

1 Introduction

DECODE aims to fulfill multiple goals related to data sovereignty, which means giving back control and onwership over their data to citizens. To achieve such a goal, many disciplines and actors must come together, including citizens, SME's, private larger companies as well as public institutions. Public institutions are particularly important as its engagement with DECODE can lead to establish a sustainable environment where to grow a consistent privacy-preserving and rights respectin públic data infrastructure and a community beyond the duration of the project. The participation of two city councils in the project ensures that the assets generated in form of cryptography, privacy-aware tecnologies, data commons licencing and societal models of data management can be field tested in real scenarios, but for this efficient, hybrid, forms of integration between citizen-owned infrastructures and public administrations must be developed.

Such an infrastructure is BCNNow, which aims at being the meeting point where data generated through the DECODE pilots meet citizens and public deliberation. BCNNow will be a tool used by DECODE users to generate visualizations, obtain personalized views and information based on both publicly available data, privately owned one and crowd-sourced one. BCNNow adds a visualization and interaction layer to the different components of the DECODE ecosystem[1].

In Barcelona this infrastructure is developed starting from a new approach to data management initiated by the Barcelona City Council and led by the CTIO Francesca Bria. Barcelona has issued a new Data Directive that mandates data sovereignty, privacy and security by design and data ethics, as a set of ethical standards for the digital transformation. This means that these standards are integrated as clauses into government's contracts and procurement processes. This positions Barcelona as pioneer of a new data commons approach here described. The City also defines data as a públic infrastructure, a new meta-utility like wàter, electrivity, roads, and the air we breath. Data should be controlled by citizens and accessible with appropriate privacy-protection, data entitlements, and ethical standards to all citizens, local entrepreneurs, and other organisations that are able to build future data-driven services that deliver públic value.

In this Deliverable, we describe how this vision is realised within the DECODE project, by integrating DECODE with the core data architecture of the City of Barcelona. We detail a new enhancement added to the BCNNow dashboard, following the overall infrastructure and design laid out on D5.1 and D5.3. BCNNow is now connected to the *Data Lake* of the city council of Barcelona, named *CityOS*. Since the *Data Lake* is not

[1] See "D1.4 First version of DECODE Architecture | DECODE " 31 Oct, 2017.

yet in production phase, the data currently being shared via the platform is not exhaustive, but the technical foundations are there to allow for a generalization of the types of data being shared once more datasets are added to the city council platform.

The document is organized as follows: The first section section places in context the current deliverable with the whole project. Section two provides a high level description of the architecture of the CityOS and its relation to the BCNNow infrastructure. Section three gives technical details on the connection between both infrastructures and a final section finalises the document with some concluding remarks.

1.1 Scope of BCNNow & relation to previous deliverables

The general scope of BCNNow and its relation to the BCN Pilots, project tasks and deliverables is highly detailed in the earlier deliverable D5.1. In this document, suffice it to say that as the shape of the BCN pilots becomes more defined, thanks to the iterating *agile* procedure used in this project (see deliverable D1.1 for more details), so does the key role of BCNNow as an interface for data consumption of pilot users. This is schematically shown in the diagram below, where we can see that BCNNow must fulfill a role in being the platform where DECODE Pilot case users in Barcelona will be able to visualize their data rights as well as collectively deliberate over them in order to shape and define a *City Data Commons* that will be described in the future deliverable D2.5 "*Digital democratisation: a heuristic framework*", and will be also the main area of study for WP5 and WP2.

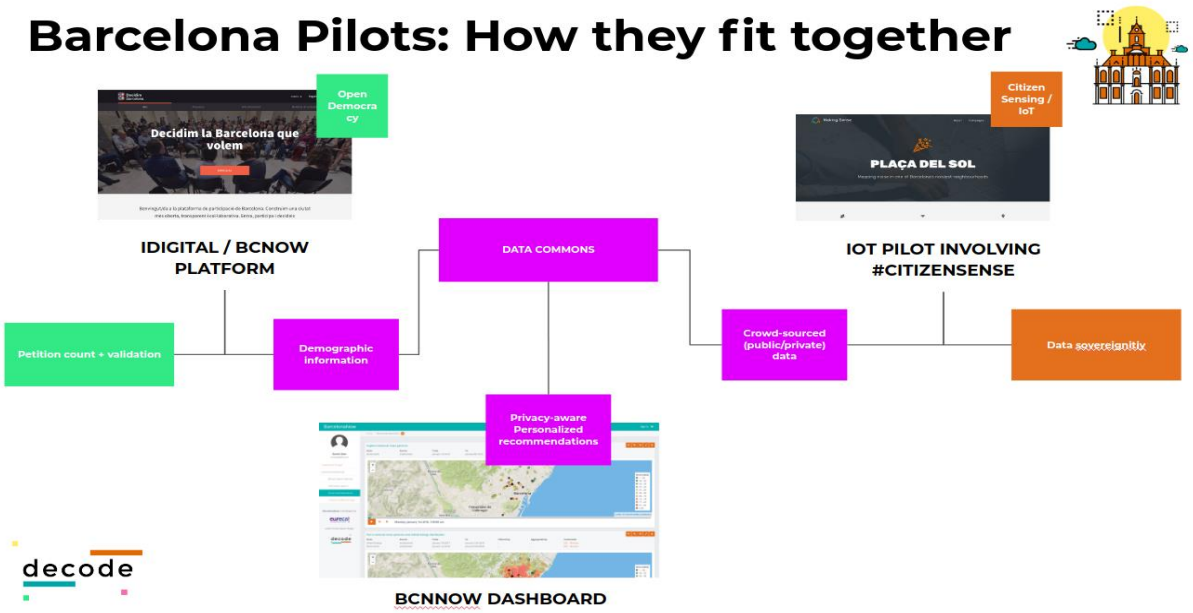


Figure 1: Schema of relations between BCN Pilots and BCN Now.

It is important to note that the learnings of the interaction with public officials to make this connection possible is constituting a valuable output of research. This output combines with the current work being developed to allow the BCN City Council to host different variations of DECODE Nodes developed in the framework of WP4 and more concretely in the deliverable D4.8 *"Hardware prototype and reference platform running the DECODE OS"* and in the next deliverable D4.6 *"Deployment and integration for the DECODE OS and HUB platform"*. The vision behind this work is to make DECODE a critical component of teh BCN City Data infrastructure, that will allow the city to move towards its vision of developing a decentralised, privacy-enhancing and rights preservin Data Commons.

DECODE – with all its components- will allow citizens to be in control of the their own data, and to decide what data they want to share with the city hall as a "common good" that can improve públic services, while at the same time maintaining its ownership and setting the terms of use through the DECODE entitlement and data commons licencing framework. In this way, BCN will be able to implement a mixed públic-commons approach to data management that will allow a better ridistribution of wealth and value generated from the city data. See below the City Hall frameworks that includes this implementation of DECODE:

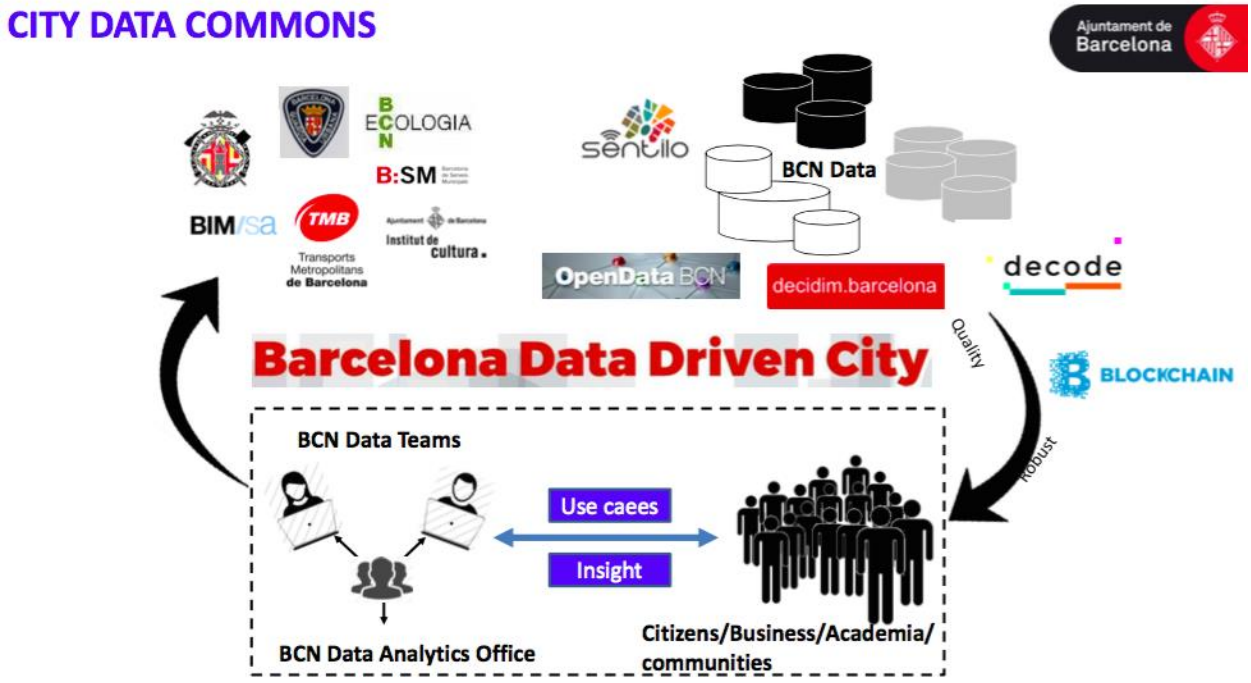


Figure 2: Barcelona Data Commons Framework

2 CityOS

In short, and following the schema of D5.1, we complement the information given there with the details concerning the CityOS infrastructure.

Technology is not neutral, nor the infrastructures that allow for it to be put to service. The city of Barcelona, in line with its technological sovereignty strategy, wants to foster citizen's control of data and the common good. Its strategy in the recent years has been aimed at developing a city model based on new technologies, renewable energies, efficient and sustainable transport and also reliable data management tools. This last point made possible the launch of the CityOS initiative, that is currently is in its last stage of development and will be launched officially in the upcoming weeks with the shocase of new data-driven services.

CityOS can be described as a Big Data technology platform that will give Barcelona real-time knowledge of all data related to city functioning, such as mobility management, energy efficiency, population management, local meteorology, etc, and thus the potential ability to predict and anticipate all kinds of situations, including critical events. "CityOS" is the City Platform actuating like a operative system that gathers city data and manages information access. The platform integrates with legacy City Council applications and with new platforms like DECODE.

The city has conceptualised an urban platform offering decoupled, common and simple connections to all city data and information about City Council services. Then platform also allows open connection for third party data consumers, and provides interoperability with other platforms.

2.1 What it is

The main objectives are:

- Correlate and integrate the maximum data related to the city (municipal and non-municipal databases, sensor systems, social networks, etc.)
- Enable the different services offered by the City to be managed both horizontally (between departments) and vertically (via a global supervision centre)
- Increase the efficiency and efficacy of city services, helping to improve predictability and anticipate emergencies.
- Provide real-time support to decision-making and improve citizens' quality of life and the control over their data.
- Infrastructure based on open source Big Data technology that uses single-window access and internal data management.

Currently CityOS is being developed and it is entering its final phase, where the majority of services are put to production. With the connection of Barcelona Now to the platform, a route is being opened for more integration of DECODE services and citizen-rights enhancing technologies to the public infrastructure.

The details of the CityOS infrastructure are outside of the scope of this deliverable, but a graphical description of its role in connecting users to data sources is provided below.

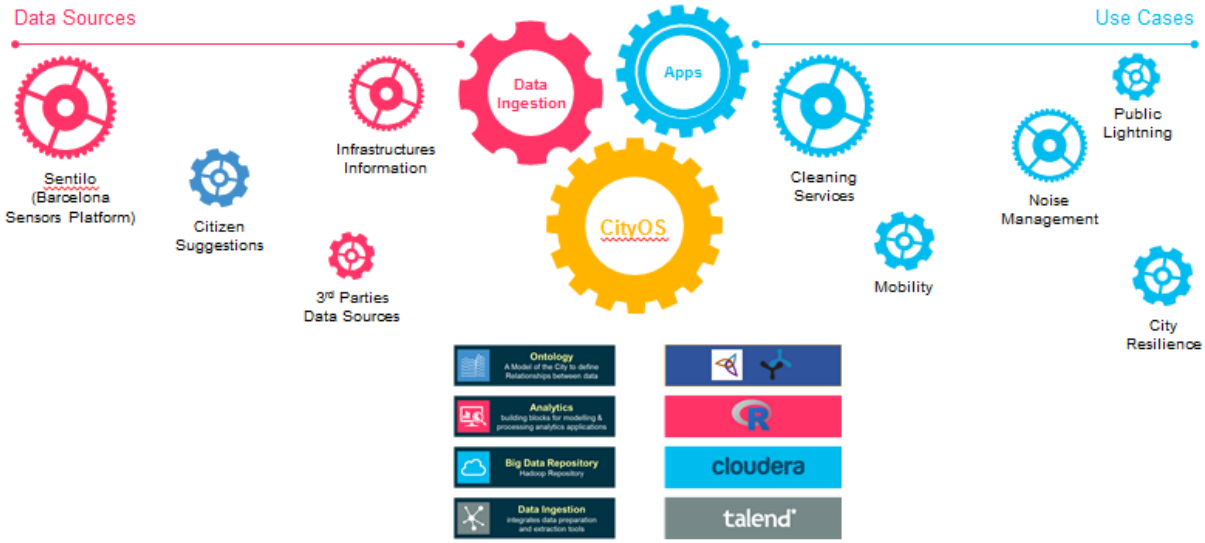


Figure 3: CityOS, a graphical overview of its functions.

2.2 Data provision

BCNNOW will be connected to CityOS via public API. Regarding the CityOS data available, it will work with both internal City Council data and with external agencies' data with information on the city that are under municipal control, albeit not directly managed by City Council institutions.

The available internal City Council data are:

- Adjudication of contracts.
- Subsidies.
- Municipal Action Plan projects.
- Districts.
- Open Data BCN*[2]. Open data infrastructure of the city with several public datasets.
- Sentilo*. The sensor platform of the city.
- IRIS*.The platform that stores citizen demands and requirements.
- ASIA*. The platform that stores the agenda of all public activities and record record all city buildings usage.
- Decidim Barcelona*

External agencies:

- Other public sensor platforms.
- Video platforms.

2.3 Infrastructure

In order to connect to the CityOS platform with BCNNow infrastructure, CityOS has made available a provisional API that allows to reach their Web Feature Service (WFS) publisher[3]. Once a request has been performed from BCNNow infrastructure to CityOS platform, the INET API Connect gets the petition and redirects it to the Corporate API Connect, then following the same flow it is sent to the City OS API Manager, where the procedure to consume the datasets available is started.

The following schema shows the CityOS technical architecture and how it is connected

[2] All the data sources termed with * were already connected (using a different approach) to BCNNow in the context of deliverable D5.1.
[3] For more detailed information see chapter 3. Technical connections details.

with BCNNow.

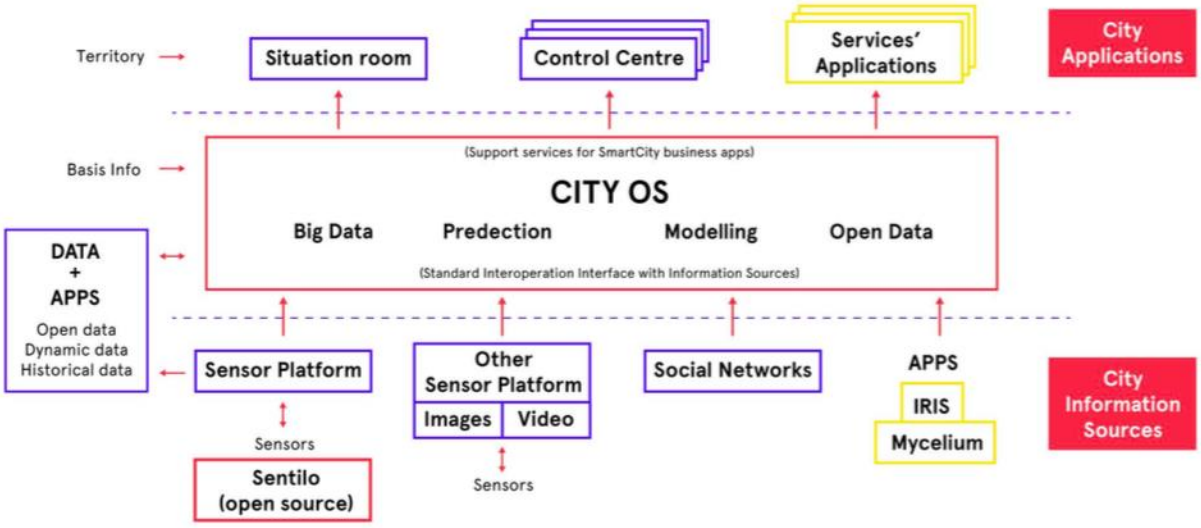


Figure 4: BCN Urban Platform high level integration

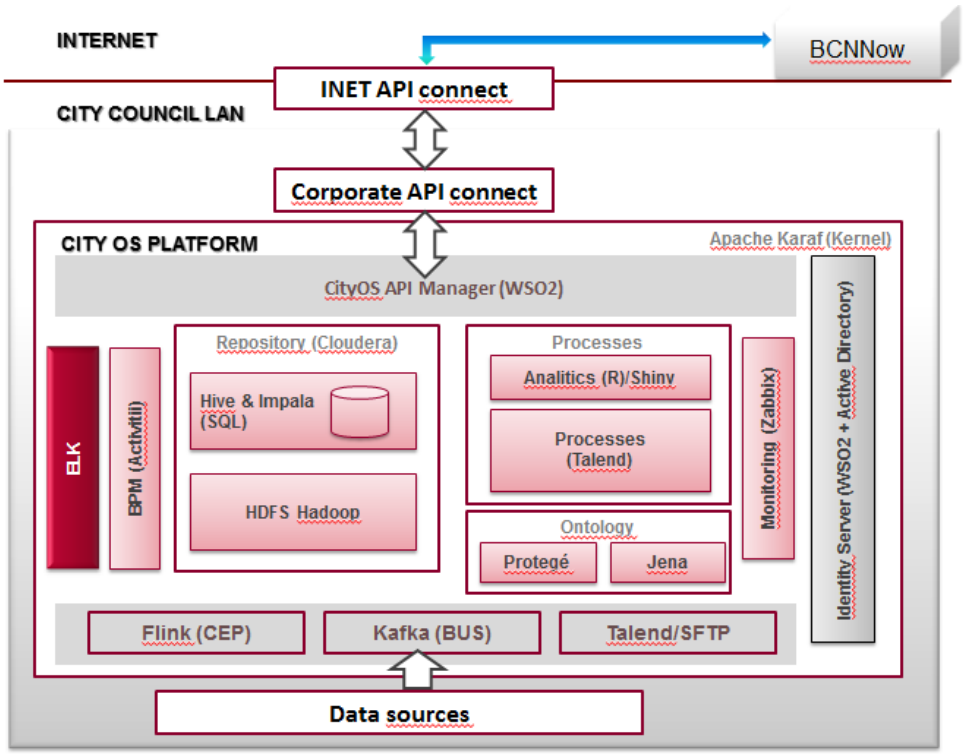


Figure 5: CityOS high level infrastructure and connection to BCNNow.

2.4 Connection status

The status of the connection is in the testing phase, non production. CityOS staff holds it in the last step of validation, just pending to the internal security test to be put in production stage.

3 Technical connection details

3.1 CityOS Data Description

The CityOS Data Collector was linked to BCNNOW infrastructure considering the characteristics of the Web Feature Service (WFS) "cityos:ptt_carril_bici" and "cityos:potencial_fotovoltaic", through a Provisional API provided by the "Institut Municipal d'Informàtica (IMI) del Ajuntament de Barcelona". CityOS is connected via private access token (TBD). The WFS "cityos:ptt_carril_bici" is related with qualified areas which the regulations establish as exclusively destined for the circulation of bicycles, those that the signaling allows and those for which there is an express authorization (Ajuntament de Barcelona, 2018). On the other hand, the WFS "cityos:potencial_fotovoltaic" is related to the solar and thermal potential of the roofs of Barcelona (Ajuntament de Barcelona, 2013).

The characteristics of each source of information are presented in Tables 1 and 2.

	HEADER	CONTENT
GENERAL INFORMATION	**URLs**	http://ajuntament.barcelona.cat/digital/en/digital-transformation/city-data-commons/cityos (CityOS Blog). http://opendata-ajuntament.barcelona.cat/data/es/dataset/carril-bici ("Carriles Bici de la ciudad de Barcelona" in Open Data BCN).
	Short Description	Bicycle lanes in the city of Barcelona. The data doesn't provide information on the directionality of the Bicycle lanes.
	Provision Constraint	-
	Provision Method	Batch process update to Web Feature Service (WFS) with OAuth2 authentication.
	Update Rate	Weekly.
	Historical Data?	-
	Connection Type	Batch CityOS API.
	Access Permission	Private.
	Data Format	JSON.
	Status	Available.
	Current Size	TBD
	Original Record Structure	Geometry coordinates (latitude-longitude pairs in CRS "EPSG:25831") · Geometry type (LineString). EventCode (Integer) · ID1 (Integer) · ID2 (String) · MD_DATA_PUBLISHED (Year/Month/Day/Hour) · MD_DATA_QUALITY (empty) · MD_DATA_STRUCTURED (String) · MD_DELTA_MODE (String) · MD_ID_PROCES MD_DELTA_MODE (String) · MD_IMPORT_MODE (String) · MD_LOPD (Integer) · MD_NORM_JOB_NAME (String) · MD_NORM_TIME (String) · MD_PRIORITY (Integer) · MD_RAW_TIME (unix timestamp) · MD_ROW_IS_VALID (String) · MD_SECURITY_LEVEL (Integer) · MD_SRC_ENTITY (String) · MD_SRC_SYSTEM (String) · MD_SRC_TIME (String) · MD_VALIDATION_TIME (String) · NOM_FINAL (String) · TYPE_GEOMETRIA (String).
DATA LAYE	**Data Collection Type**	-
	Source Data Preprocessing	*Coordinates conversion Custom ED50 to WGS84*: ED50 / UTM zone 31N (long_cityos:ptt_carril_bici/ 1000 + 400000, lat_cityos:ptt_carril_bici / 1000 + 4500000)
	Source Structure Adaption	"ID": item['properties']['ID'], "SOURCE": "cityos:ptt_carril_bici", "PROVIDER": "cityos", "PUBLISHER": None, "TYPE": "*ptt_carril_bici*",

	HEADER	CONTENT

RINFORMATION		"LOCATION": {
		"LONGITUDE": CENTROID(<*GeoJSON Object*>).*X*,
		"LATITUDE": CENTROID(<*GeoJSON Object*>).*Y*,
		"ALTITUDE": None,
		"DISTRICT": *DISTRICTE*,
		"BARRI": *BARRI*,
		"STREET_TYPE": *TIPUS_VIA*,
		"STREET_NAME": *CARRER*,
		"STREET_NUMBER": *NUMERO*,
		"CITY_NAME": "*Barcelona*"
		"GEOMETRY": <*GeoJSON Object*>
		}
		"TIMESTAMP": C(item['properties']['*MD_DATA_PUBLISHED*']),
		"PAYLOAD": {
		"Id1": *ID1*,
		"Id2": *ID2*,
		"EventCode": *EVENTCODE*,
		}

	Source Duplicates Checking	ID1 and ID2 do not exist in ALL(PAYLOAD.Id1, PAYLOAD.Id2).

Table 1: Characteristics of the information integrated in the Bicycle lanes data collector.

	HEADER	CONTENT
GENERAL INFORMATION	**URLs**	http://ajuntament.barcelona.cat/digital/en/digital-transformation/city-data-commons/cityos (CityOS Blog).
	Short Description	Solar Map of Barcelona - Potential of roofs for photovoltaic and thermal use.
	Provision Constraint	-
	Provision Method	Batch process update to Web Feature Service (WFS) with OAuth2 authentication.
	Update Rate	-
	Historical Data?	-
	Connection Type	Batch CityOS API.
	Access Permission	Private.
	Data Format	JSON.
	Status	Available.
	Current Size	TBD
	Original Record Structure	Geometry coordinates (latitude-longitude pairs in CRS "EPSG:25831") · Geometry type (Polygon). BUILDID (String) · CNT_BUILD_ (Integer) · CO2_TH (Integer) · CODIFICACIO (String) · ELEMENT (String) · EventCode (Integer) · ID1 (Integer) · MD_DATA_PUBLISHED (Year/Month/Day/Hour) · MD_DATA_QUALITY (Integer) · MD_DATA_STRUCTURED (String) · MD_DELTA_MODE (String) · MD_ID_PROCESS (String) · MD_IMPORT_MODE (String) · MD_LOPD (Integer) · MD_NORM_JOB_NAME (String) · MD_NORM_TIME (String) · MD_PRIORITY (Integer) · MD_RAW_TIME (unix timestamp) · MD_ROW_IS_VALID (String) · MD_SECURITY_LEVEL (Integer) · MD_SRC_ENTITY (String) · MD_SRC_SYSTEM (String) · MD_SRC_TIME (String) · MD_VALIDATION_TIME (String) · POW_TH (Integer) · SUITABILITY (String) · SUM_MODARE (Integer).
DATA LAYER	**Data Collection Type**	-
	Source Data Preprocessing	*Coordinates conversion Custom ED50 to WGS84*: ED50 / UTM zone 31N (long_cityos:potencial_fotovoltaic/ 1000 + 400000, lat_cityos:potencial_fotovoltaic / 1000 + 4500000)
	Source Structure Adaption	"ID": item['properties']['ID'], "SOURCE": "cityos:potencial_fotovoltaic", "PROVIDER": "cityos", "PUBLISHER": None, "TYPE": "*potencial_fotovoltaic*", "LOCATION": {

	HEADER	CONTENT

INFORMATION		"LONGITUDE": CENTROID(<*GeoJSON Object*>).*X*,
		"LATITUDE": CENTROID(<*GeoJSON Object*>).*Y*,
		"ALTITUDE": None,
		"DISTRICT": *DISTRICTE*,
		"BARRI": *BARRI*,
		"STREET_TYPE": *TIPUS_VIA*,
		"STREET_NAME": *CARRER*,
		"STREET_NUMBER": *NUMERO*,
		"CITY_NAME": "*Barcelona*"
		"GEOMETRY": <*GeoJSON Object*>
		}
		"TIMESTAMP": C(item['properties']['*MD_DATA_PUBLISHED*']),
		"PAYLOAD": {
		"id": *id*,
		"PowTh": *POW_TH*,
		"EventCode": *EventCode*,
		"Suitability": *SUITABILITY*,
		"SumModare": *SUM_MODARE*,
		}

	Source Duplicates Checking	id does not exist in ALL(PAYLOAD.id).

Table 2: Characteristics of the information integrated in the Photovoltaic (PV) potential data collector.

3.2 Connection with CityOS API

The CityOS platform uses the WFS specification version 1.1.0 and supports both GET and POST HTTP methods (Table 3). The platform implements three operations defined by the WFS standard:

Operation	Description
GetCapabilities	Retrieve service metadata.
DescribeFeatureType	Generate a schema description of features types serviced by the service.
GetFeature	Retrieve features from the service and output them using the JSON representation.

Table 3: Web Feature Service (WFS) specifications provided by the CityOS platform.

When the HTTP GET method is used, the parameters are appended to the URL using a Keyword Value Pair (KVP) encoding. Table 4 presents the list of the common parameters, supported by all WFS operations.

Operation	Description	Possible values
service	The requested service.	WFS
request	The requested	GetCapabilities, DescribeFeatureType, GetFeature

	operation.	
version	The requested version of the service.	1.1.0

Table 4: Parameters supported by the CityOS WFS operations.

An authenticated user with OAuth 2.0 can be granted access to both restricted datasets and benefit from extended quotas for API calls. The API features an authentication mechanism for users to be granted their specific authorizations.

For the CityOS platform to authenticate a user, the CityOS collector shall include the following elements:

- Token OAUTH2 obtained with https://apigateway.bcn.cat/imi/cityosinet/imi-oauth-provider/oauth2/token
- Grant_type: "client_credentials":
  "X-IBM-Client-Id"
  "X-IBM-Client-Secret"
- Authorization: "Bearer + Access Token (e.g. AAIkODE4NzNkMjAtYmFhMy00ZGZiLTkyZjctOWE3OTViYjkwNTI4HJGNpDA9y_LARVmFvOERESFbEySHWiz2pfiFmnoqMsu0-1X82VnmytYCMzTLAZnlp5rFzMjtjfohy3GvNm2moVIk6a4fZBExTPmFcuQ4oYNQ54hDNYmtVqxDVzHzpkMA).
- Scope: none.

Passing the API key of an authorized user will return the JSON response with the list of accessible datasets for this user.

Therefore, the Get requests can be consumed by the API of BCNNOW and visualized through the BCNNOW dashboard, which provides an interface allowing requests for geographical features (Figure 4). The vector data deployed through the collector such as geographic coordinates, points, lines, and polygons describing points, lines and areas are stored as geospatial data in MongoDB, allowing the execution of temporal and spatial queries on a CityOS collections that contains geospatial shapes (lines and polygons and points). These data can be used by the BCNNOW dashboard, and displayed on the screen using scalable shapes, labels, legends and widgets (Figures 5, 6 and 7).

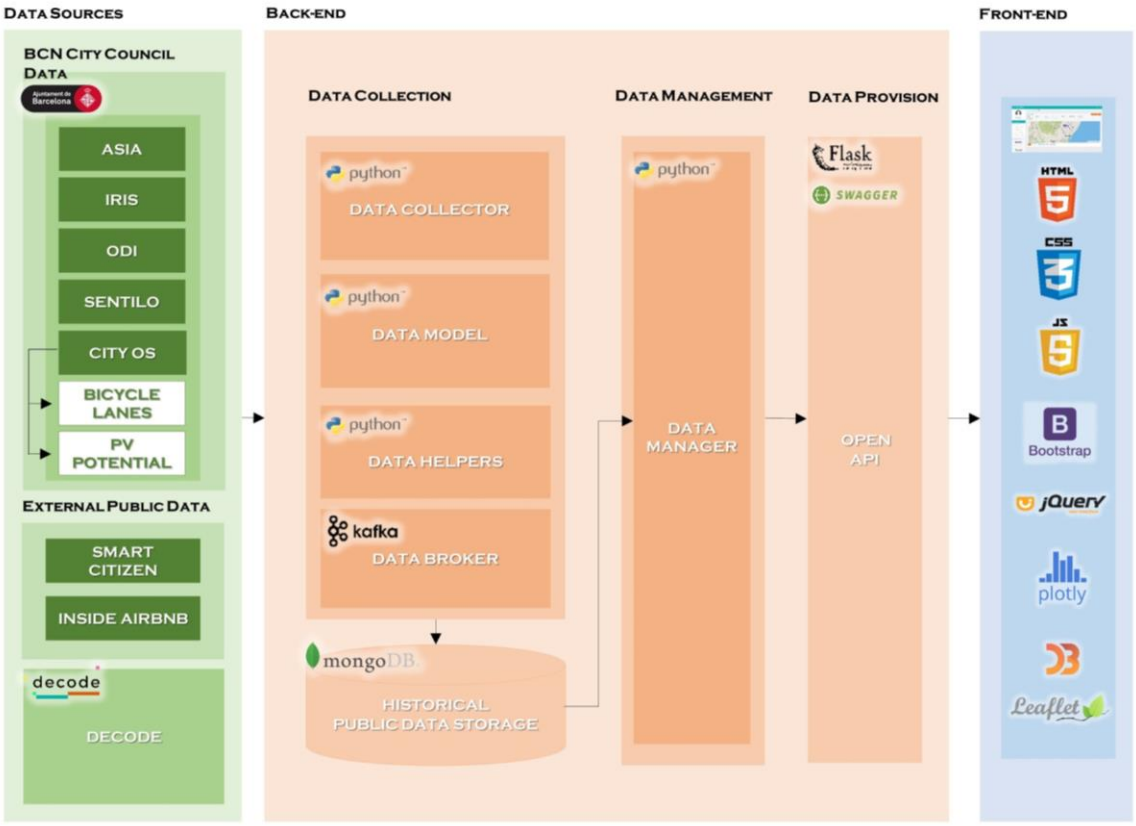


Figure 6: Workflow for the connection of CityOS with BCNNOW infrastructure.

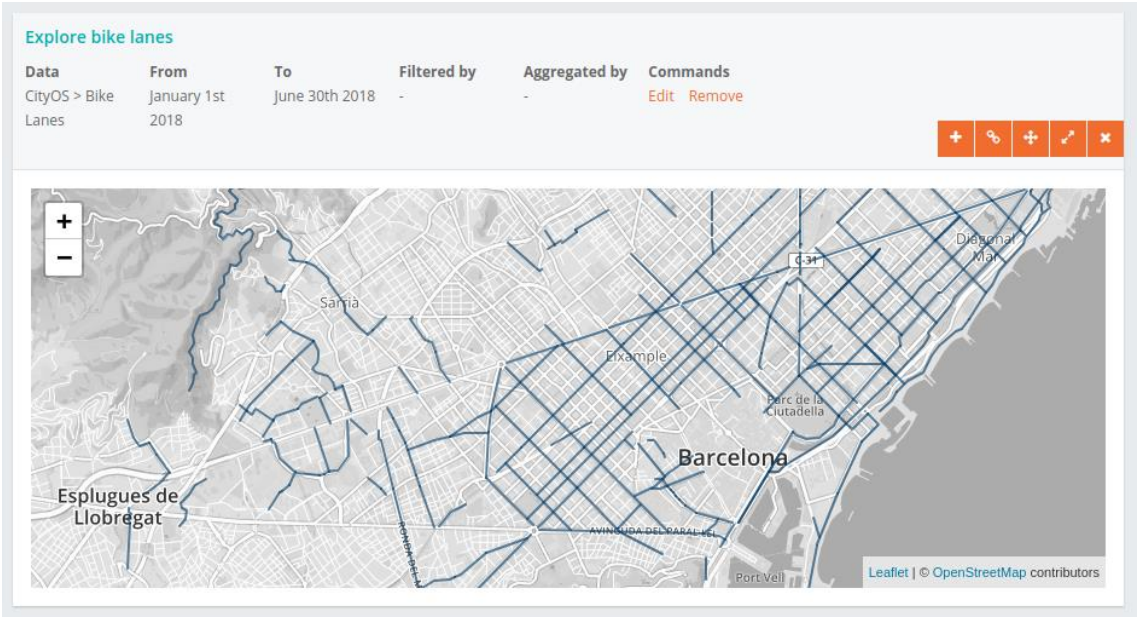


Figure 7: Barcelona Now dashboard with the representation of the WFS "cityos:ptt_carril_bici" as lines in the city map.

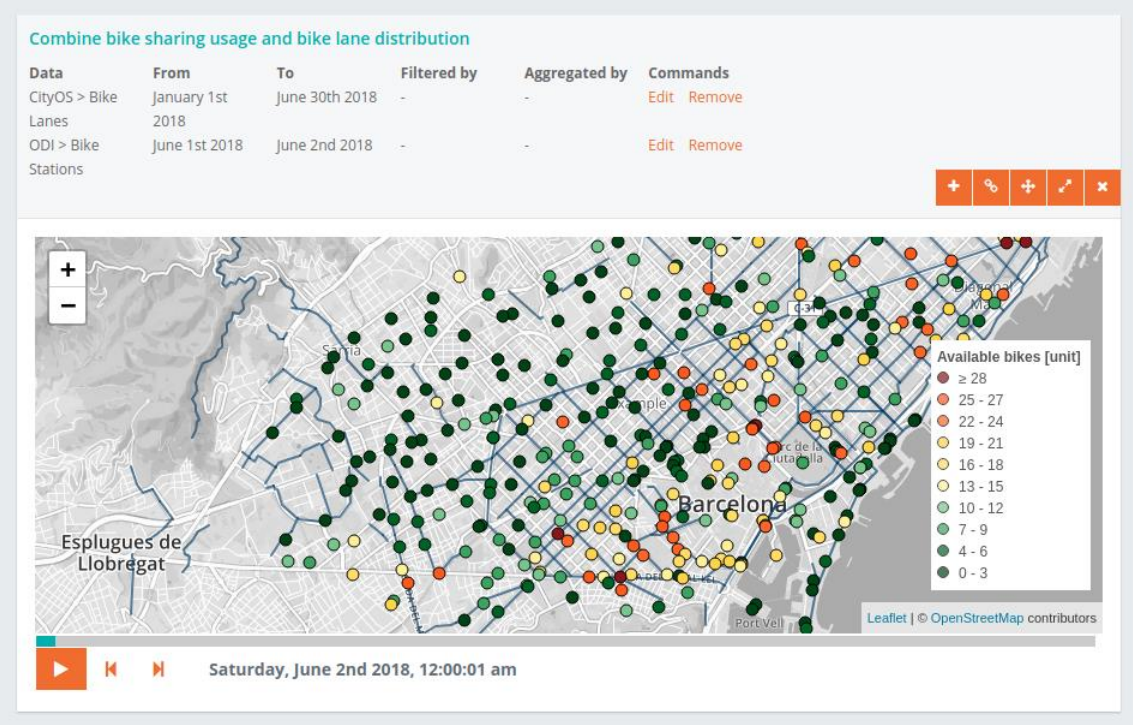
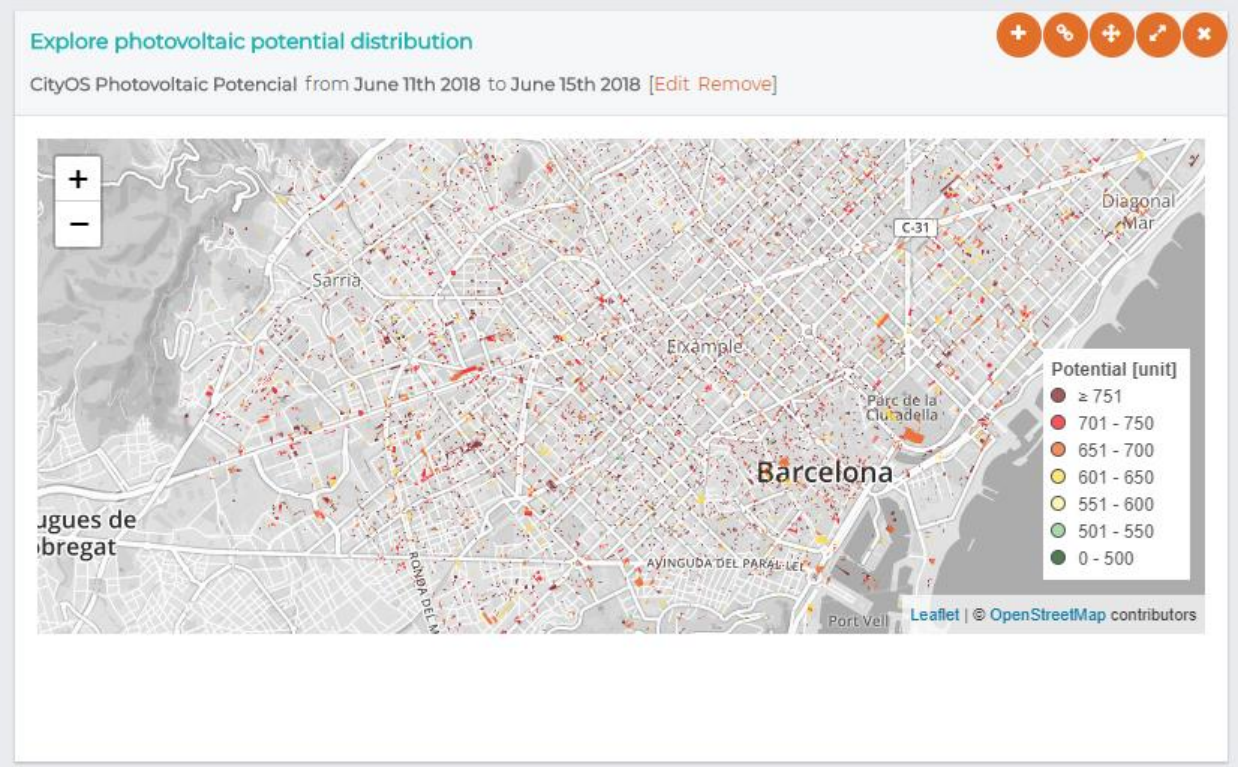


Figure 8: Barcelona Now dashboard with the representation of the WFS "cityos:ptt_carril_bici" as lines in the city map, together with coloured circles representing bicing bikes availability.



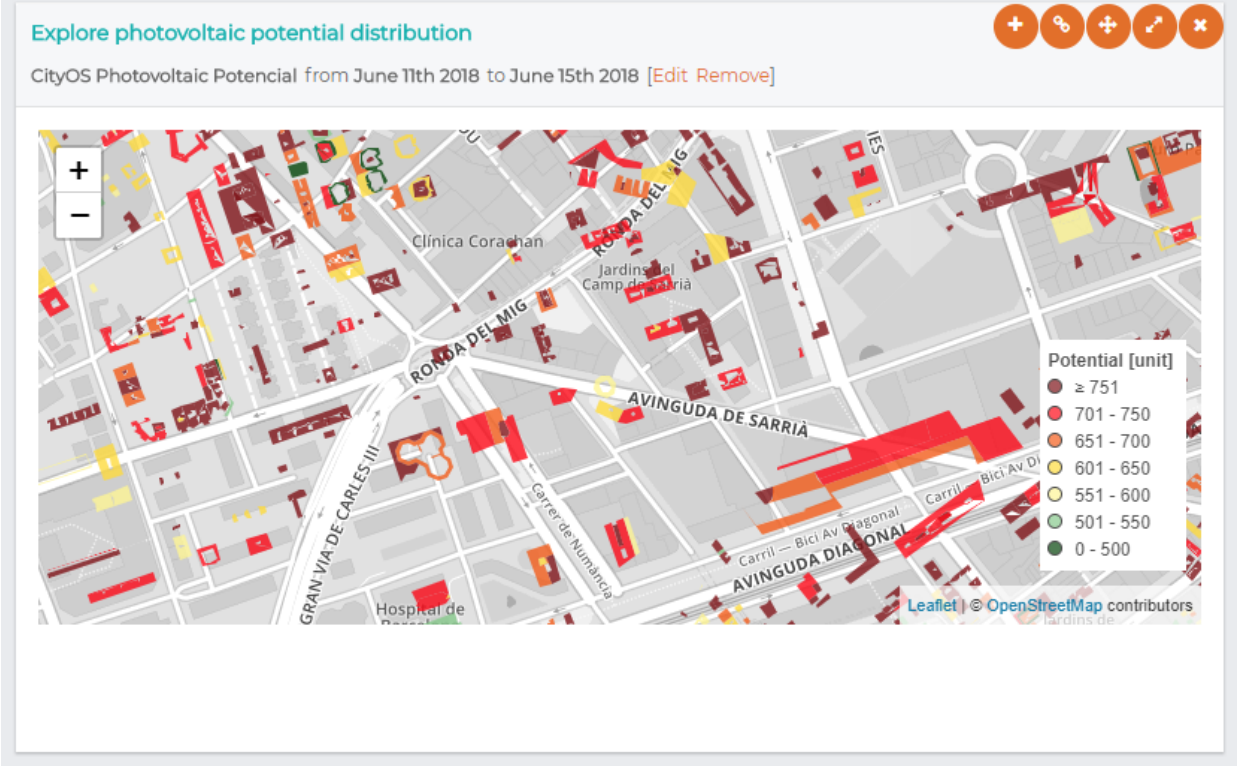


Figure 9: Barcelona Now dashboard with the representation of the WFS "cityos:potencial_fotovoltaic" as polygons in the city map.

3.3 CityOS Connection to BarcelonaNow

The two Web Feature Service (WFS) are presented as geographic data according to Open Geospatial Consortium (OGC), in the coordinate system ETRS89 / UTM zone 31N (EPSG:25831). The WFS "cityos:ptt_carril_bici" is composed of data about geo-located features represented primarily by lines. On other hand, the WFS "cityos:potencial_fotovoltaic" is composed of data about geo-located features represented primarily by polygons (Table 5).

CityOS WFS	Geometry attributes
cityos:ptt_carril_bici	• Geometry coordinates (e.g. latitude-longitude pairs for the Id '187': [[166021.44309607, 0, 0], [166021.44309607, 0, 0]]) • Geometry type - *'LineString'* • Geometry name - *'GEOMETRY'* • CRS: *'EPSG:25831'*
cityos:potencial_fotovoltaic	• Geometry coordinates (e.g. latitude-longitude pairs for the Id '1342': [[[425419.26009317, 4576451.42906721, 0], [425419.26009317, 4576451.42906721, 0], [425424.34109316, 4576440.5500672, 0], [425428.57009315, 4576431.50906719, 0], [425380.73109321, 4576409.30006716, 0], [425378.83109321, 4576404.22006716, 0], [425375.58109322, 4576391.63906714, 0], [425406.57009318, 4576355.3790671, 0], [425405.22109318, 4576351.8140671, 0], [425400.72109318, 4576339.91006708, 0], [425391.1010932, 4576331.73006707, 0], [425373.23409322, 4576352.14406709, 0], [425354.95109324, 4576373.03006712, 0], [425355.92009324, 4576375.62906712, 0], [425357.16109324, 4576377.61006712, 0], [425361.22109323, 4576384.38906713, 0], [425336.26009327, 4576413.13906717, 0], [425333.70109327, 4576411.92906716, 0], [425331.73109327, 4576416.11006717, 0], [425330.85109327, 4576418.30006717, 0], [425416.07009317, 4576458.25906722, 0], [425419.26009317, 4576451.42906721, 0]]]) • Geometry type - *'Polygon'* • Geometry name - *'GEOMETRY'* • CRS: *'EPSG:25831'*

Table 5: Geometry attributes of the CityOS WFS.

The CityOS collector in addition to the authorization credentials and token OAUTH2 URL, also required the implementation of standardization of the source data and specific geographic functions related to the geometries associated with the two services, lines and polygons.

The integration of data from WFS with a new access method requires a pre-processing step in order to provide a unified view of them. The pre-processing phase receives the original data provided by the CityOS WFS, and transforms them to a standardized JSON format. For each data source, attribute names have been translated to English. The implementation of the data model of the CityOS collector was based on the GIS Metadata and on the Data Documentation of both WFS, provided by IMI.

The CityOS collector has its folder with four files: a configuration file, two payload definition files, and an execution file.

- The first one, the **configuration file**, includes a Python class that defines a JSON record with all the configuration parameters needed by the collector. The CityOS collector requires the definition of the following configuration variables:
  - Source name.
  - Token URL.
  - Base URL.
  - WMS for the datasets "cityos:ptt_carril_bici" and "cityos:potencial_fotovoltaic".
  - Token credentials:
    - Client Id.
    - Client secret.
    - Headers "X-IBM-Client-Id" and "X-IBM-Client-Secret".
  - Authorization grant type: "client_credentials".
  - Scope: "none"

- The second and third ones, the **payload definition files**, contain a Python class with all the record attributes which are specific of that kind of data source, getter and setter methods, and a method which returns a JSON record containing all the tabular attributes. Table 6 shows the structure of the payload field for an instance of a CityOS Base Record (one for each CityOS service).

CityOS payloads	Tabular attributes
CityOSBicycleLanesPayload	• Id1(e.g. '187') • Id2 (e.g. 'PTT_CARRIL_BICI.836') • EventCode (e.g. '051')
CityOSPVPotentialPayload	• Id (e.g. '1342') • PowTh (e.g. '794') • EventCode (e.g. '051') • Suitability (e.g. 'very good') • SumModare (e.g. '19')

Table 6: Tabular attributes integrated in the payload of CityOS WFS.

- The fourth one, the **execution file**, contains a Python class with four methods: start() is the main method whose purpose is to loop for all the files to be accessed or all the API calls to be executed. For API access, it calls the sendRequest() which takes a URL as parameter and returns the data retrieved from that URL. According to the access method, sendRequest() is able to get data in JSON format by using the proper Python package. Once the data is retrieved, start() calls saveData(). This method has the purpose of accessing each record represented in the original format, calling buildRecord() to create an instance of the record coded in the internal unified format for that data source and using store() from StorageHelper to save the record into MongoDB (Figure 8). It should be emphasized that for each instance ('CityOS Base Record'), the payload field structure depends on the specific data source that we considered, so we have a different structure for each data source.
  Concerning the transformation of Coordinate Reference System (CRC), the coordinates of the CityOS standard (ETRS89 / UTM zone 31N (EPSG:25831)) had to be converted to WGS84 standard (EPSG:4326).

  Finally, the centroid creation function (lines to points and polygon to points) was also implemented in the execution file.

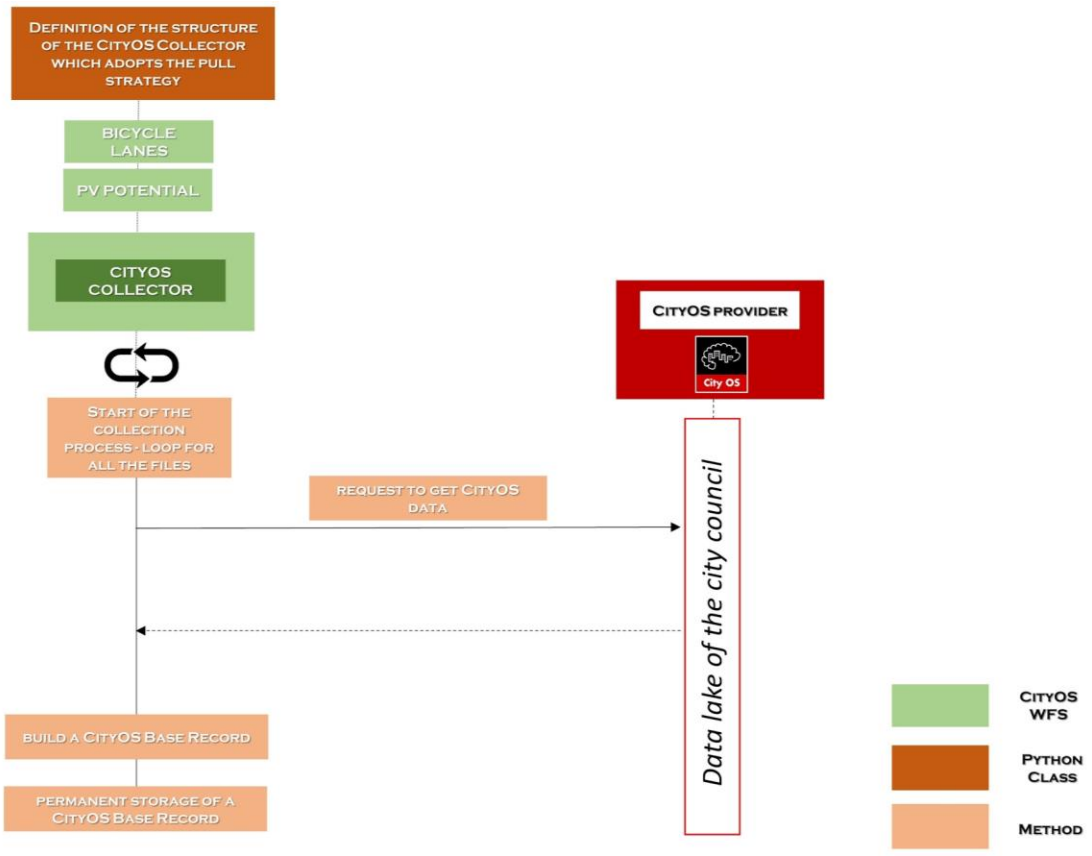


Figure 10: UML Sequence Diagrams: CityOS Collector.

The public data records are stored into Decode MongoDB. At the moment, we have the following CityOS collections:

- "cityos:ptt_carril_bici": (299 records). Information on bike line geometries in Barcelona.
- "cityos:potencial_fotovoltaic": (over 112.000 records). Information on green solar energy production of building roofs (polygon geometry) in Barcelona.

Conclusions

This deliverable further consolidates the BCNNow tool sketched and deployed throughout D5.1 and D5.3 by adding a new connection to the city council data infrastructure. It provides a technical description of the connection as well as a frame where to place both BCNNow and the CityOS (the *data lake* of the city council) within the context of the DECODE project.

This feat marks an important hallmark as it further interconnects the DECODE project to an advanced Big Data tool that can be considered as integral part of the core data infrastructure of the city council. Achieving such a connection has allowed also to develop research on the dynamics and procedures needed for widen DECODE adoption into administrative institutions.

With this new addition, the BCNNow tool closes its initial phase of acting as a public dashboard. While BCNNow already adds a lot of value providing a unique, centralized, and customizable visualization tool for a group of datasets never gathered together before, by starting a second phase of development, we aim to allow, in conjunction with other DECODE technologies being developed in the context of the project, for a more personalized experience and control over data gathered by users in a privacy-respectful way.

This second stage of BCNNow will be permanently informed by the evolution of the pilots and the feedback produced with the iterative and *agile* methodology being used therein.

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