decode

Prototype data visualization tool

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Project no. 732546

DECODE

DEcentralised Citizens Owned Data Ecosystem

D5.4 Prototype data visualization tool

Version Number: V1.0

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Dissemination level:		
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: 30/09/2018

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

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Abbreviations

ASIA	Application of Integrated Attention Systems / Aplicatiu de Sistemes Integrats d'Atenció
BCN	Barcelona
CityOS	Operating System of the City
DTW	Dynamic Time Warping
ICT	Information and Communication Technology
IMI	Municipal Institute of Information Technology / Institut Municipal d'Informatica
IoT	Internet of Things
IRIS	Incidents, Claims and Suggestions / Incidencies Reclamacions i Suggeriments
LBK	LB Keogh
MVP	Minimum Viable Product
ODI	Open Data Infrastructure
PAM	Programa d'Actuació Municipal
TW	ThoughtWorks
WP	Work Package

1 Introduction

BarcelonaNow is the interface through which citizens can explore data from the DECODE pilots in Barcelona, and make sense of them. This includes both public data and personal data, which can be either owned by a user or shared with them by others.

The initial development of BarcelonaNow has focused on public data sources that were already available, or in some cases were made expressly available by the Barcelona City Council during the initial phases of the project, while the integration of private data sources is dependent on the development of the pilots and of the underlying technology stacks.

The prototype was presented in previous deliverables, and in particular in D5.3 "Data analysis methods and first results from pilots" which includes the specification on the architecture and of the different components of the system. Deliverables D5.1 - "Barcelona Open Data and IRIS API available" and D5.2 "CityOS connection" do also include descriptions of the system, and in particular of the components to retrieve data from public sources (data collectors). In the current document we present the advancements in the development of BarcelonaNow, and the design and specification of the planned upgrades.

The document is structured as follows:

- **Section 2** contains a description of the current status of the prototype, highlighting in particular the improvements that were introduced since the previous deliverables (D5.2 and D5.3).
- **Section 3** presents the new data sources added, namely Housing data from the *Observatori Metropolità de l'Habitatge de Barcelona* (Barcelona Housing Observatory (O-HB)), and democratic participation data from Decidim[1], the city council participative democracy platform.
- Then, **Section 4** presents the work done and future plans for integration of BarcelonaNow with the two Barcelona pilots: Distributed Democracy and Data Commons (DDDC) (deliverable 2.5) and CitizenSensing IoT.
- Design and specification of the upgrades planned for the further development of BarcelonaNow are illustrated and discussed in **Section 5**.
- Finally, **Section 6** closes the deliverable drawing some conclusions.

[1] https://www.decidim.barcelona/

2 Improvements of BarcelonaNow

2.1 Current architecture

BarcelonaNow encompasses an integrated set of components for collecting, storing, and processing data and for providing information, knowledge, and co-creation of digital products (Figure 1). Currently, the interactive dashboard is based on a *N*-tier application architecture which provides a model by which the end-users can create flexible, shared and reusable visualizations. By segregating the application into tiers, users acquire the option of adding a specific normalized layer (e.g. JSON files from BCN City Council, external public data and/or from community pilots in Barcelona) included in a scalable data storage and management tier (called "Back-End"), and therefore, in a presentation tier (called "Front-End") users are able to explore different spatial and temporal patterns of those data sources in unique and personalized views.

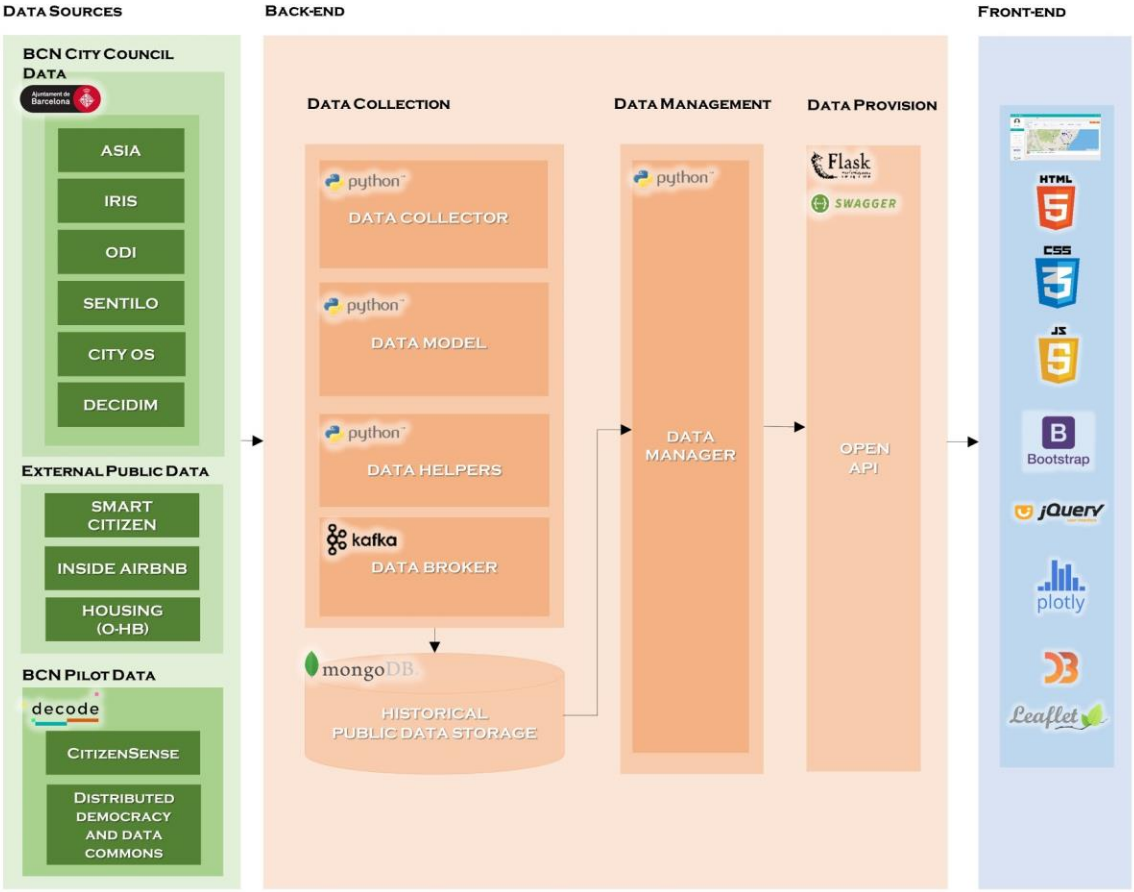


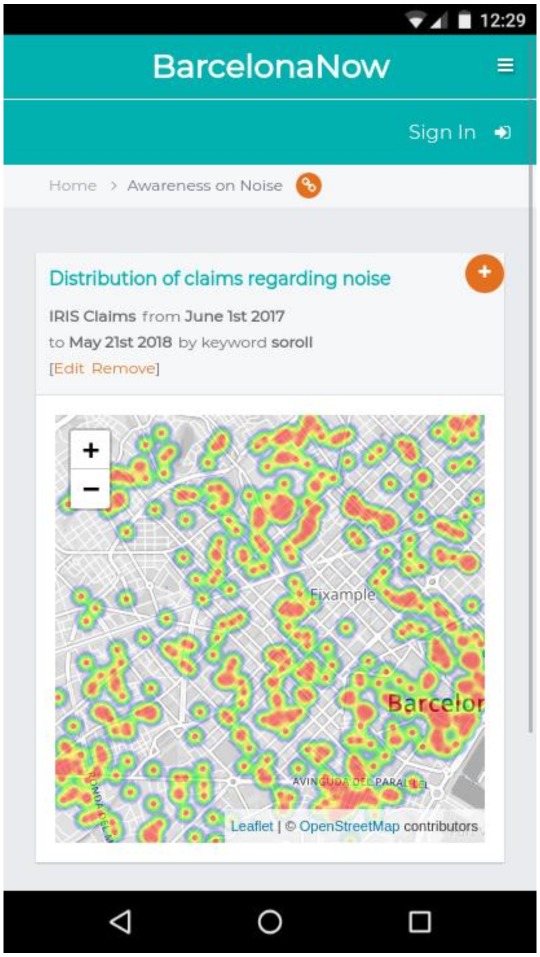
Figure 1: Multitier architecture of Barcelona Now dashboard.

2.2 Improvements

As part of the new release there are two improvements which have been implemented in the front-end.

2.2.1 Resizable User interface

In the previous version of the prototype, presented in deliverable D5.3, the User interface(UI) had a fixed view which made it difficult to use the platform in mobile phone or in a device with smaller screen. Hence, to make it compatible with smaller screen the UI components have been made resizable. Now based on the screen size the UI components will get resized, making the application more user friendly. This not only makes the application usable on mobile and portable devices, but it also improves usability on laptop and large screens, by optimizing the screen usage through flexible resizing (see Figure 2).



Distribution of claims regarding noise

IRIS Claims from June 1st 2017 to May 21st 2018 by keyword soroll

[Edit Remove]

Figure 2: BarcelonaNow dashboard on a mobile emulator.

2.2.2 Usage tracker integration

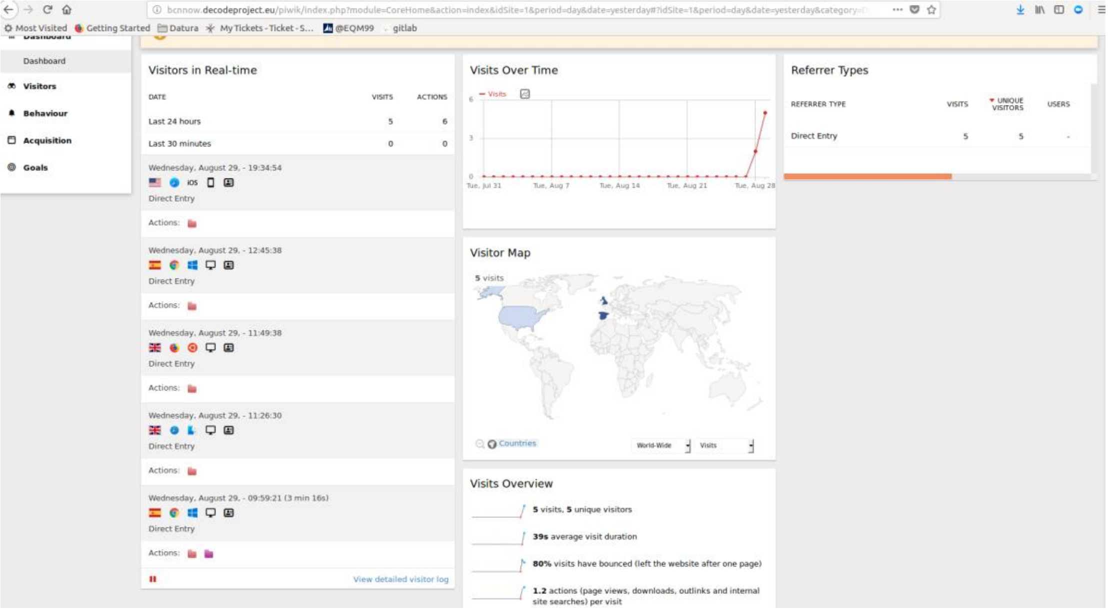
To analyze and keep track of the users visiting and using the website, a web usage tracking software has been configured for BarcelonaNow. The chosen technology to this is end is Matomo[2], an open source analytics platform for tracking website visitors details. Unlike Google Analytics and other cloud-hosted platform, Matomo can be completely hosted internally: in this way, all the data tracked by the platform is private to BarcelonaNow and is stored in a MySQL server inside the BarcelonaNow server. The web tracking has been already deployed and is now tracking the traffic to the dashboard.

The metrics being tracked are:

1) Country of the visitor
2) Device Type
3) Operating system
4) Browser used
5) Time and duration of visit(duration is approximate)
6) Time taken to load the page for the visitor

Based on these metrics different visualization metrics are present such as:

1) Visitors over time
2) Real time visitor count
3) Visitor country Map



Visitors in Real-time

DATE	VISITS	ACTIONS
Last 24 hours	5	6
Last 30 minutes	0	0

Wednesday, August 29, - 19:34:54
Direct Entry
Actions:

Wednesday, August 29, - 12:45:38
Direct Entry
Actions:

Wednesday, August 29, - 11:49:38
Direct Entry
Actions:

Wednesday, August 29, - 11:26:30
Direct Entry
Actions:

Wednesday, August 29, - 09:59:21 (3 min 16s)
Direct Entry
Actions:

View detailed visitor log

Referrer Types

REFERRER TYPE	VISITS	UNIQUE VISITORS	USERS
Direct Entry	5	5	-

Visits Overview

5 visits, **5** unique visitors
39s average visit duration
80% visits have bounced (left the website after one page)
1.2 actions (page views, downloads, outlinks and internal site searches) per visit

Figure 3: Matomo web tracking dashboard for BarcelonaNow.

[2] https://matomo.org/

3 New Data sources

3.1 Decidim Barcelona

The City Council of Barcelona launched in February 2016 Decidim Barcelona[3], a digital platform for the development of the strategic city plan 2016-2019 (Programa d'Actuació Municipal, hereafter PAM). This plan is the mandatory roadmap, to be defined in a participatory manner, of the local government in Barcelona. The resulting plan has to include the objectives and actions which the local government will implement during the legislature.

Thanks to the usage of Decidim Barcelona, the participatory process for the 2016-2019 edition of PAM was large-scale for the first time. It was conceived as as a hybrid method which combined face-to-face meetings and digital spaces in order to allow the citizenry to discuss and support the proposals made by the government; and also make, discuss and support their own proposals. In total, more than 40,000 citizens were involved in this process (Aragón et al, 2016). As a result, 10,860 proposals were submitted (then grouped into 5,375 actions) and 410 face-to-meetings were held.

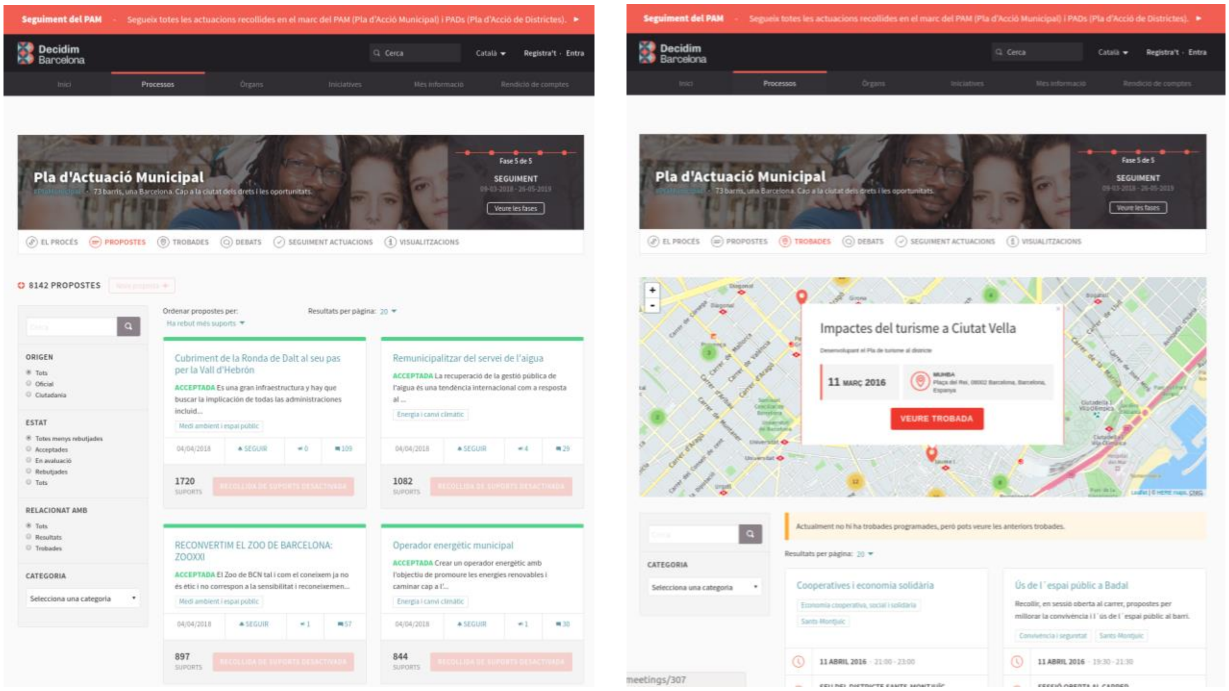

Seguiment del PAM
Segueix totes les actuacions recollides en el marc del PAM (Pla d'Acció Municipal) i PADs (Pla d'Acció de Districtes).
Decidim Barcelona
Cerca
Català
Registra't · Entra
Inici
Processos
Òrgans
Iniciatives
Més informació
Rendició de comptes
Pla d'Actuació Municipal
73 barris, una Barcelona. Cap a la ciutat dels drets i les oportunitats.
Fase 5 de 5
SEGUIMENT
Veure les fases
EL PROCÉS
PROPOSTES
TROBADES
DEBATS
SEGUIMENT ACTUACIONS
VISUALITZACIONS
8142 PROPOSTES
ORIGEN
ESTAT
RELACIONAT AMB
CATEGORIA
Selecciona una categoria
Ordenar propostes per:
Resultats per pàgina: 20
Cubriment de la Ronda de Dalt al seu pas per la Vall d'Hebrón
Remunicipalitzar del servei de l'aigua
RECONVERTIM EL ZOO DE BARCELONA: ZOOXXI
Operador energètic municipal
1720 SUPORTS
1082 SUPORTS
897 SUPORTS
844 SUPORTS
Impactes del turisme a Ciutat Vella
11 MARÇ 2016
VEURE TROBADA
Actualment no hi ha trobades programades, però pots veure les anteriors trobades.
Cooperatives i economia solidària
Ús de l'espai públic a Badal
11 ABRIL 2016

Figure 4: Web interface of Decidim Barcelona for the PAM process in relation to proposals (left) and meeting (right). Source: https://www.decidim.barcelona

[3] https://www.decidim.barcelona/

After the PAM process, Decidim Barcelona has continued to be used as the digital infrastructure in the following participatory processes promoted by the City Council (e.g., the new legislation on citizen participation, the plan for the improvement of Les Rambles, the new model for Sant Antoni market, etc). Given the heterogeneity of these processes and the complexity that characterizes citizen participation, Decidim Barcelona was migrated from the original instance powered by Consul (http://consulproject.org/) to a new instance powered by Decidim (https://decidim.org/), a new technology based on Ruby gems to maximize the modularity of the platform (Pereira et al, 2016; Barandiaran et al, 2017).

The ontology of the latest version of Decidim (Laniado, 2017) is a combination of:

- Spaces
    - Profiles (person-based)
    - Assemblies (collective-based)
    - Processes (temporal-based)
    - Initiatives (bottom-up approach)
    - Consultations (top-down approach)

- Components (features) of spaces
    - Comments
    - Proposals
    - Votes
    - Results
    - Debates
    - Surveys
    - Sortitions
    - Pages
    - Blogs
    - Newsletters
    - Meetings
    - Conferences
    - Participatory Texts

It is presented in Figure 5 as a functional architecture.

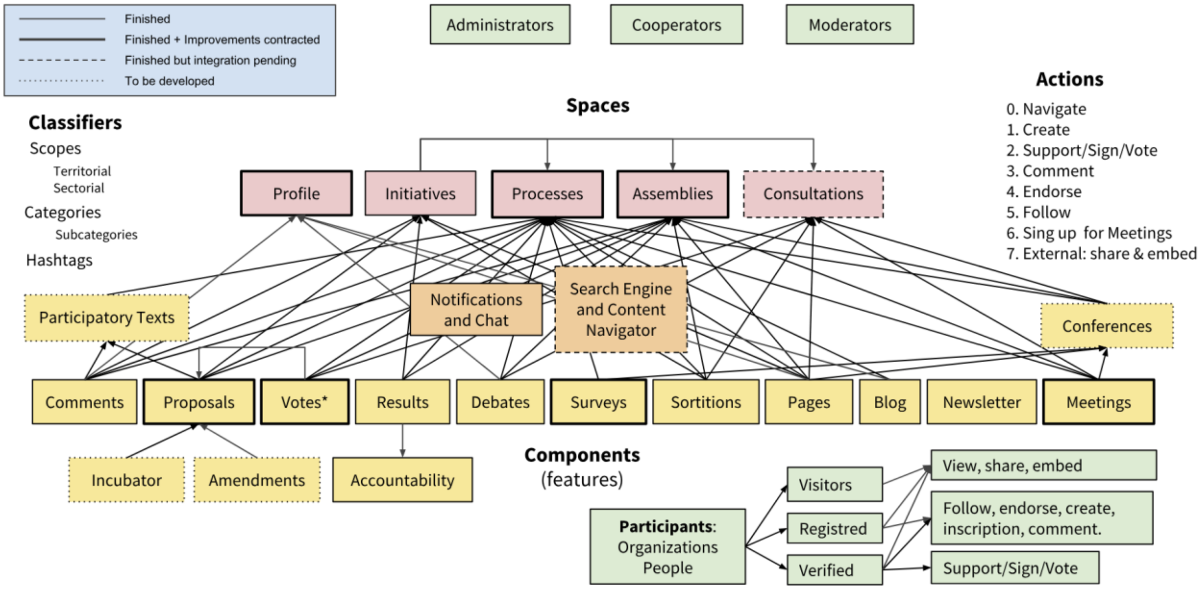
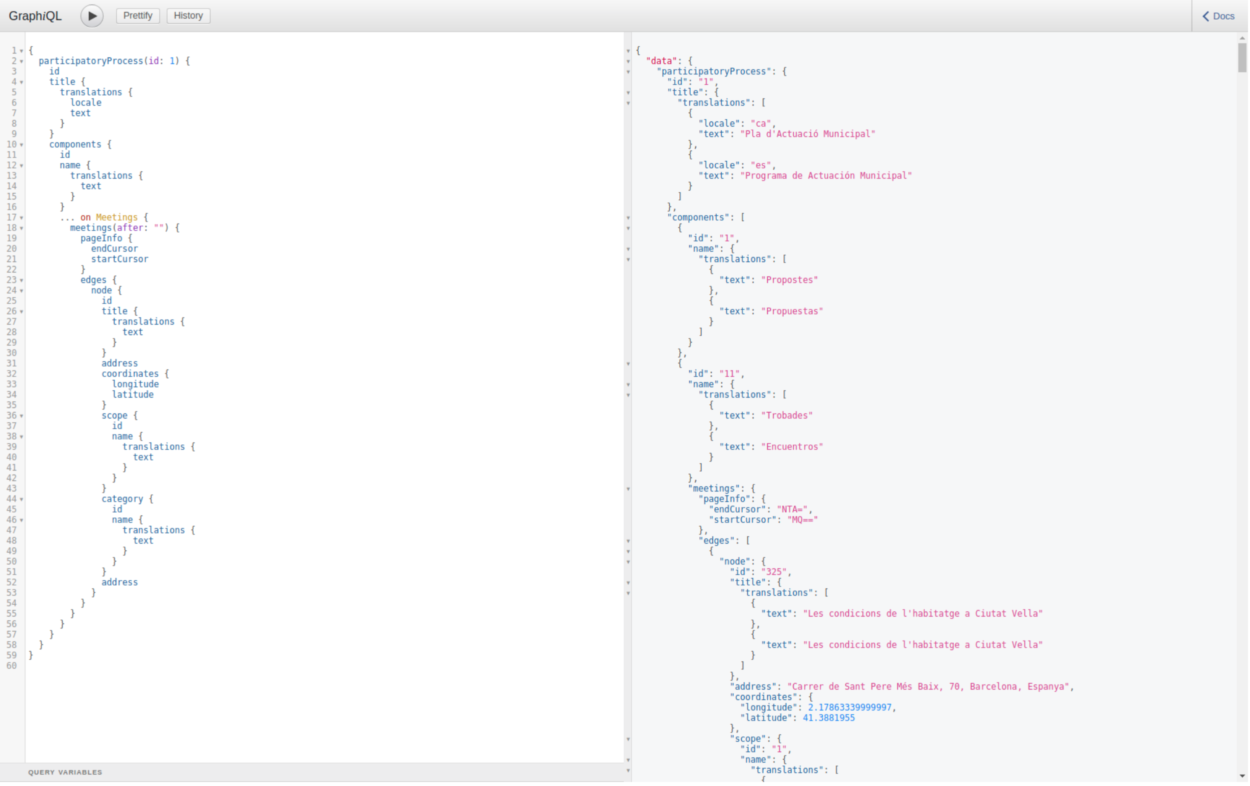


Figure 5: Summary diagram of Decidim's functional architecture showing a combination of components in participatory spaces. Source: https://decidim.org

The Decidim collector developed for BarcelonaNow extracts data from the two components which have received larger attention in the participatory processes powered by Decidim: **proposals** and **meetings**.

The folder of the collector has five files: a configuration file, two payload definition files, and two execution files.

- The **configuration file**, includes a Python class that defines a JSON record with all the configuration parameters needed by the collector. The Decidim collector requires the definition of the following configuration variables:
    a. Source name (e.g., "pam_meeting")
    b. Base URL ("https://www.decidim.barcelona/api").
    c. Queries for the GraphQL of Decidim (see Figure 6).



```
{
  participatoryProcess(id: 1) {
    id
    title {
      translations {
        locale
        text
      }
    }
    components {
      id
      name {
        translations {
          text
        }
      }
      ... on Meetings {
        meetings(after: "") {
          pageInfo {
            endCursor
            startCursor
          }
          edges {
            node {
              id
              title {
                translations {
                  text
                }
              }
              address
              coordinates {
                longitude
                latitude
              }
              scope {
                id
                name {
                  translations {
                    text
                  }
                }
              }
              category {
                id
                name {
                  translations {
                    text
                  }
                }
              }
              address
            }
          }
        }
      }
    }
  }
}
```

```
{
  "data": {
    "participatoryProcess": {
      "id": "1",
      "title": {
        "translations": [
          {
            "locale": "ca",
            "text": "Pla d'Actuació Municipal"
          },
          {
            "locale": "es",
            "text": "Programa de Actuación Municipal"
          }
        ]
      },
      "components": [
        {
          "id": "1",
          "name": {
            "translations": [
              {
                "text": "Propostes"
              },
              {
                "text": "Propuestas"
              }
            ]
          }
        },
        {
          "id": "11",
          "name": {
            "translations": [
              {
                "text": "Trobades"
              },
              {
                "text": "Encuentros"
              }
            ]
          },
          "meetings": {
            "pageInfo": {
              "endCursor": "NTA=",
              "startCursor": "MQ=="
            },
            "edges": [
              {
                "node": {
                  "id": "325",
                  "title": {
                    "translations": [
                      {
                        "text": "Les condicions de l'habitatge a Ciutat Vella"
                      },
                      {
                        "text": "Les condicions de l'habitatge a Ciutat Vella"
                      }
                    ]
                  },
                  "address": "Carrer de Sant Pere Més Baix, 70, Barcelona, Espanya",
                  "coordinates": {
                    "longitude": 2.17863339999997,
                    "latitude": 41.3881955
                  },
                  "scope": {
                    "id": "1",
                    "name": {
                      "translations": [
                        {
```

Figure 6: Screenshot of GraphQL, in-browser IDE for exploring GraphQL, with a query to retrieve the meetings from the PAM process. Source: https://www.decidim.barcelona

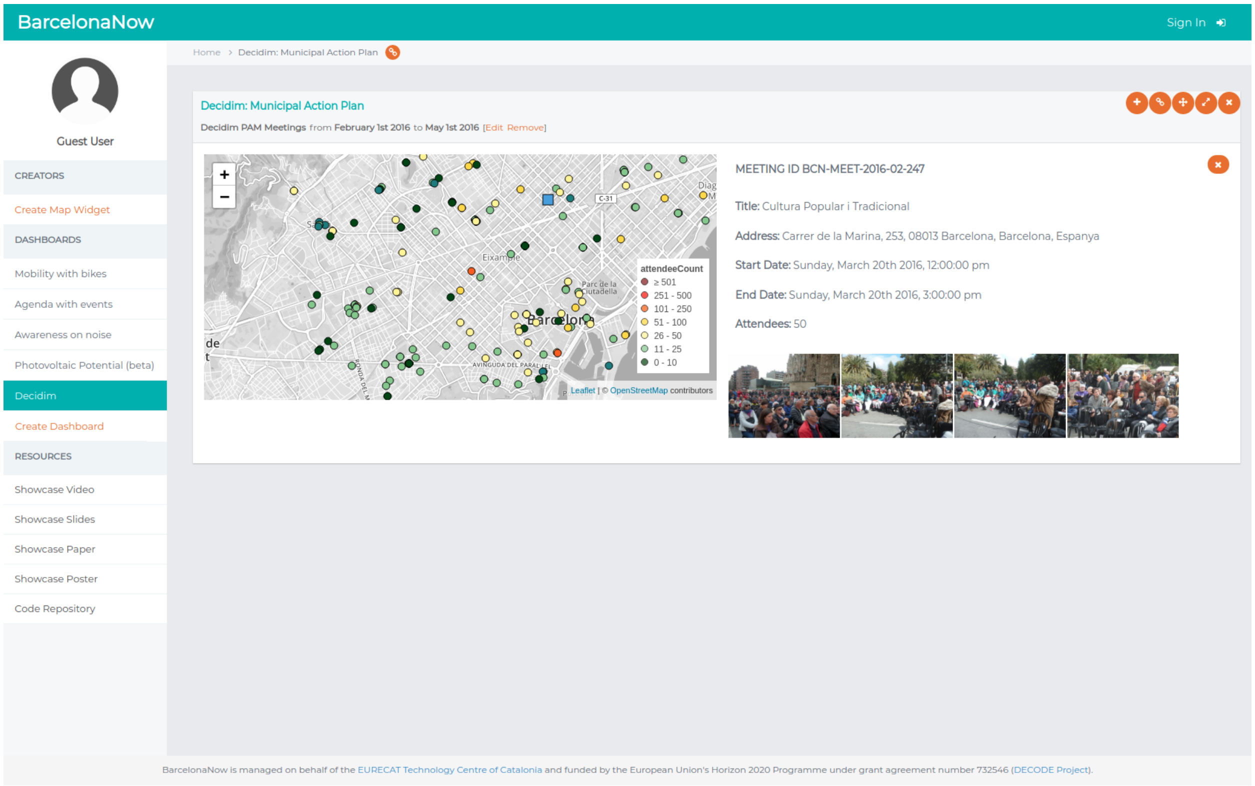
- The **payload definition files** contain a Python class with all the record attributes which are specific of that kind of data source, getter and setter methods, and a method which returns a JSON record containing all the tabular attributes. Table 1 shows the structure of the payload field for a proposal and for a meeting.

Table 1: Tabular attributes integrated in the payload of Decidim data sources.

Decidim payloads	Tabular attributes
Decidim collector 1 - Proposal	● ID ● VOTECOUNT (The total amount of votes the proposal has received) ● TITLE (This proposal's title) ● PUBLISHEDAT (The date and time this proposal was published) ● AUTHOR (The proposal's author) ● SCOPE (The object's scope) ● CATEGORY (The object category)
Decidim collector 2 - Meeting	● ID ● ATTENDEECOUNT (Amount of attendees to this meeting) ● TITLE (The title of this meeting) ● STARTIME (The time this meeting starts) ● ENDTIME (The time this meeting ends)

	● ADDRESS (The physical address of this meeting) ● ATTACHMENTS (This object's attachments, e.g. picture urls)

- The **execution files** contain a Python class with four methods: start() is the main method whose purpose is to loop for all the files to be accessed. 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. Concerning the spatial representation of indicators at district and neighborhoods levels, this is typically provided within the scope field. Otherwise, this is done by tabular linking of the attributes (column "NOM" of each data source) with the attributes of GEOJSON (defines a ID and geometry of district and neighborhoods polygons in the Coordinate Reference System (CRC) WGS84 standard (EPSG:4326)) existing in the modular component of the Front-End.



Decidim: Municipal Action Plan

Decidim PAM Meetings from February 1st 2016 to May 1st 2016 [Edit Remove]

MEETING ID BCN-MEET-2016-02-247

Title: Cultura Popular i Tradicional

Address: Carrer de la Marina, 253, 08013 Barcelona, Barcelona, Espanya

Start Date: Sunday, March 20th 2016, 12:00:00 pm

End Date: Sunday, March 20th 2016, 3:00:00 pm

Attendees: 50

BarcelonaNow is managed on behalf of the EURECAT Technology Centre of Catalonia and funded by the European Union's Horizon 2020 Programme under grant agreement number 732546 (DECODE Project).

Figure 7: Screenshot of BarcelonaNow with a widget of meetings from the PAM process

3.2 Housing (*Barcelona Housing Observatory (O-HB)*)

The Barcelona City Council, the Metropolitan Area of Barcelona (AMB), the Barcelona Provincial Council and the Generalitat/Catalan Government created, in July 2017, a supra-municipal instrument for the analysis and consultation of data related to housing (Figure 2). The institution, named the Barcelona Housing Observatory (O-HB) (*Observatori Metropolità de l'Habitatge de Barcelona (O-HB))*, is presented as the reference body for citizens and administrations in housing matters, a service to review and analyze the available data on this matter.

The Observatory, in whose gestation also participated the Social Housing Managers Association (GHS), centralizes the information, puts it for the first time in a network integrated by the Catalan administrations, homogenizes the data and allows a fluid exchange of information. It also consolidates the methodologies through technical tables that allow the final sharing of the results of the sharing of all the data and information. The O-HB does an x-ray of housing from the available statistical information and develops specific studies based on the design of new indicators. This work allows the users to carefully diagnose the main problems faced by municipalities by generating a system of own indicators and with specific work methodologies.

The objective of the Observatory is to analyze and study in depth the housing situation to provide the administrations with all the information, data, studies and analyses they may need when it comes to promoting public housing policies. In fact, the Observatory aims to become an authentic aggregated database on housing that avoids unnecessary duplication of information and at the same time enhances the statistical and study tasks carried out by the various administrations that integrate it (Trilla et al, 2017). The O-HB provides citizens with a home data viewer (available at http://www.ohb.cat/) with associated cartography and an interactive report where all the indicators can be consulted. The O-HB interactive platform includes 63 indicators, grouped together using the following themes:

- Housing stock.
- Construction and renovation.
- Socio-demographic and socio-economic factors.
- Housing market.
- Housing continuity, access and maintenance issues.
- Housing policies.
- Territory.

The indicators included in these themes allow end-users to consult the following and more:

- Percentage of habitual residences.
- Buildings in poor repair.
- Floor area per person.
- Empty homes belonging to owners of multiple properties.
- Homes built before 1981.
- Energy certification.
- Prices and proportion of tenants.
- Types of owner.
- Differences in rent.
- Evictions.
- Homes without central heating.
- Households with single parents, elderly people living alone and long-term unemployed.

However, we deem it appropriate to integrate and explore some of these indicators (Table 2 and Figure 8) with other external and public sources available in BarcelonaNow, namely the INSIDE AIRBNB data.

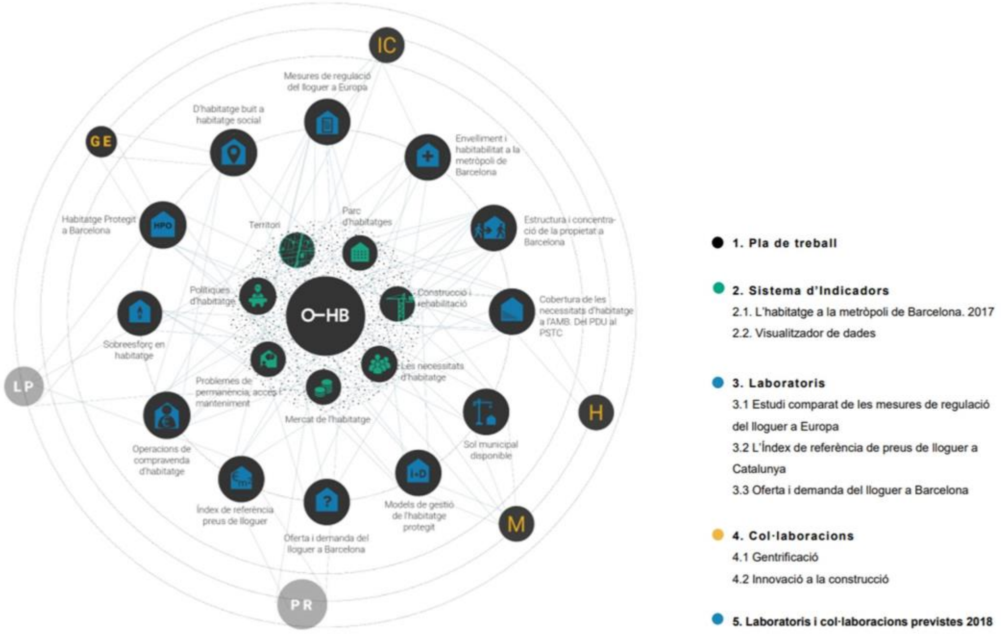
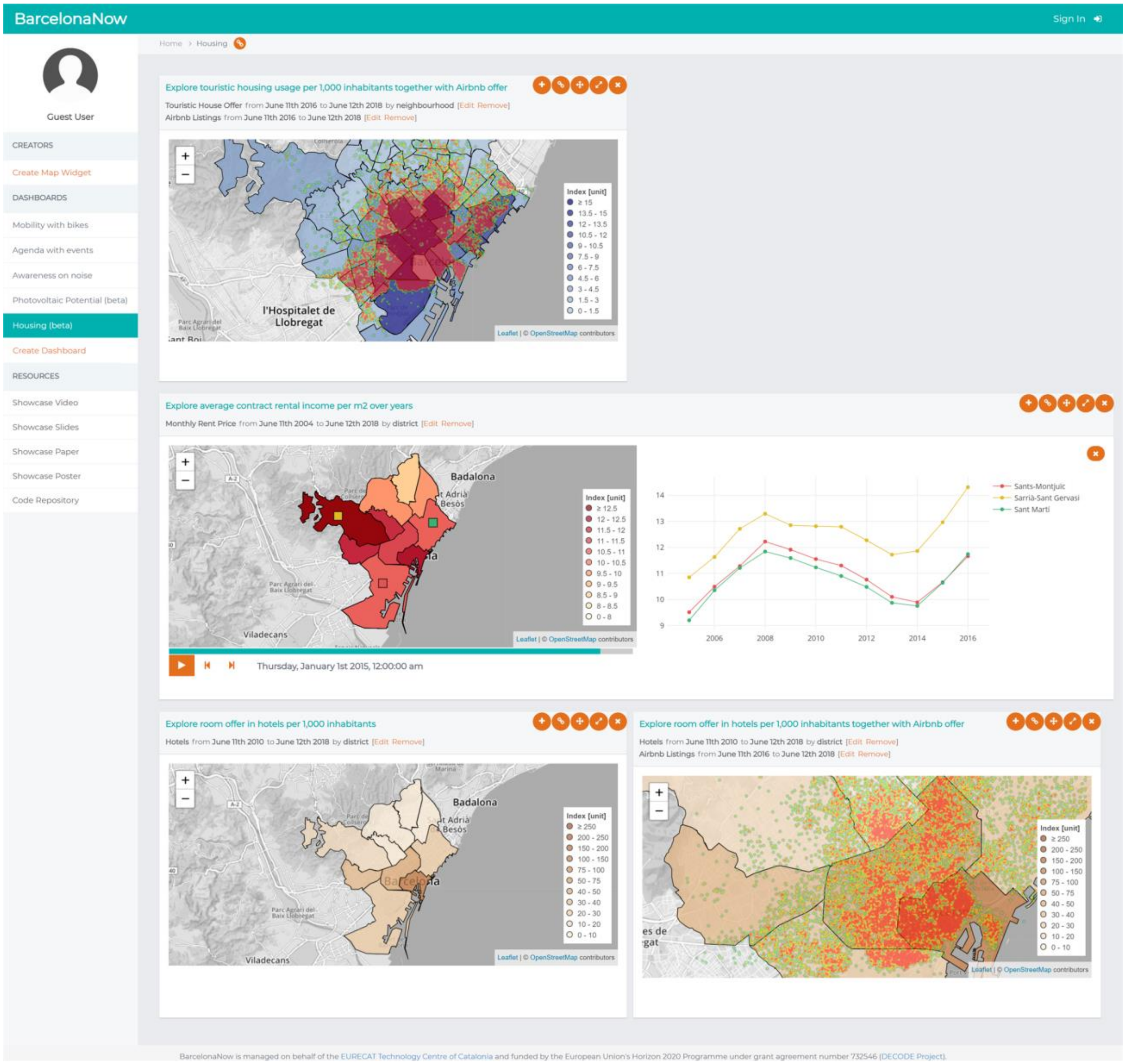

IC
Mesures de regulació del lloguer a Europa
D'habitatge buit a habitatge social
GE
Envelliment i habitabilitat a la metròpoli de Barcelona
Habitatge Protegit a Barcelona
HPO
Territori
Parc d'habitatges
Estructura i concentració de la propietat a Barcelona
Polítiques d'habitatge
O–HB
Construcció i rehabilitació
Cobertura de les necessitats d'habitatge a l'AMB. Del PDU al PSTC
Sobreesforç en habitatge
LP
Problemes de permanència, accés i manteniment
Les necessitats d'habitatge
Mercat de l'habitatge
H
Operacions de compravenda d'habitatge
Sol municipal disponible
I+D
Índex de referència preus de lloguer
Oferta i demanda del lloguer a Barcelona
Models de gestió de l'habitatge protegit
M
PR
● 1. Pla de treball
● 2. Sistema d'Indicadors
2.1. L'habitatge a la metròpoli de Barcelona. 2017
2.2. Visualitzador de dades
● 3. Laboratoris
3.1 Estudi comparat de les mesures de regulació del lloguer a Europa
3.2 L'Índex de referència de preus de lloguer a Catalunya
3.3 Oferta i demanda del lloguer a Barcelona
● 4. Col·laboracions
4.1 Gentrificació
4.2 Innovació a la construcció
● 5. Laboratoris i col·laboracions previstes 2018

Figure 8: Conceptual model and planned operationalization for O-HB.
Source: AMB (2018).

Table 2: O-HB indicators integrated in BarcelonaNow.

Indicator	Source	Reference year	Granularity level	Data format
Housing for tourist use (apartments, housing used for tourism (HUTs) and rural tourism) for every 1,000 inhabitants. *(Habitatges per a ús turístic (apartaments, habitatges d'ús turístic (HUTs) i turisme rural) per cada 1.000 habitants.)*	*Department of Business and Knowledge networks of the Generalitat/Catalan Government & Statistical Institute of Catalonia (IDESCAT).*	2017	Districts(10) and neighborhoods (73) of Barcelona.	CSV with ANSI Encoding.
Average contract rental income per m2 (€ m2 / month) *(Renda mitjana de lloguer contractual per m2 (€ m2/mes)).*	*Generalitat/Catalan Government Secretariat of Housing and Urban Improvement of the Generalitat/Catalan Government. Based on the deposits of rental housing deposited in the Catalan Land Institute (INCASÒL).*	2005-2017	Districts (10) of Barcelona.	CSV with ANSI Encoding.

Offer of rooms in hotels and pensions for 1,000 inhabitants. *(Oferta d'habitacions en hotels i pensions per 1.000 habitants).*	*Department of Business and Knowledge networks of the Generalitat/Catalan Government & Statistical Institute of Catalonia (IDESCAT).*	2017	Districts(10) and neighborhoods (73) of Barcelona.	CSV with ANSI Encoding.


BarcelonaNow

Explore touristic housing usage per 1,000 inhabitants together with Airbnb offer

Touristic House Offer from June 11th 2016 to June 12th 2018 by neighbourhood [Edit Remove]
Airbnb Listings from June 11th 2016 to June 12th 2018 [Edit Remove]

Explore average contract rental income per m2 over years

Monthly Rent Price from June 11th 2004 to June 12th 2018 by district [Edit Remove]

Thursday, January 1st 2015, 12:00:00 am

Explore room offer in hotels per 1,000 inhabitants

Hotels from June 11th 2010 to June 12th 2018 by district [Edit Remove]

Explore room offer in hotels per 1,000 inhabitants together with Airbnb offer

Hotels from June 11th 2010 to June 12th 2018 by district [Edit Remove]
Airbnb Listings from June 11th 2016 to June 12th 2018 [Edit Remove]

BarcelonaNow is managed on behalf of the EURECAT Technology Centre of Catalonia and funded by the European Union's Horizon 2020 Programme under grant agreement number 732546 (DECODE Project).

Figure 9: BarcelonaNow dashboard with the representation of the selected O-HB indicators together with Airbnb dataset in the city map.

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

- The **configuration file** includes a Python class that defines a JSON record with all the configuration parameters needed by the collector. The O-HB collector requires the definition of the following configuration variables:
  a. Source name.
  b. Base URL.
  c. Paths for CSV file.

- 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 3 shows the structure of the payload field for an instance of a O-HB Base Record (one for each O-HB data sources).

Table 3: Tabular attributes integrated in the payload of O-HB data sources.

O-HB payloads	Tabular attributes
O-HB collector 1 - TouristicOffer	• PERIOD (the year of the data) • CODI (code of the district and neighborhoods) • CODI_OHB (CODI number + 00_000 to control different trimesters and quarters inside a district and neighborhoods) • NOM (name of district and neighborhoods) • Ind_value (value of the indicator "Habitatges per a ús turístic (apartaments, HUTS i turisme rural) per cada 1.000 habitants)
O-HB collector 2 - MonthlyRentRecordedPrice	• PERIOD (the year of the data) • CODI (code of the district and neighborhoods) • CODI_OHB (CODI number + 00_000 to control different trimesters and quarters inside a district and neighborhoods) • NOM (name of district and neighborhoods) • Ind_value (value of the indicator "Renda mitjana de lloguer contractual per m2 (€ m2/mes))
O-HB collector 3 - HotelsRoomOffer	• PERIOD (the year of the data) • CODI (code of the district and neighborhoods) • CODI_OHB (CODI number + 00_000 to control different trimesters and quarters inside a district and neighborhoods) • NOM (name of district and neighborhoods) • Ind_value (value of the indicator "Oferta d'habitacions en hotels i pensions per 1.000 habitants)

- The **execution file** is a Python class analogous to the Decidim collector. The base files (CSV with ANSI Encoding) required a preprocessing step (we excluded the municipality and metropolitan granularity levels) and also the transformation to

UTF-8 Encoding. Concerning the spatial representation of indicators at district and neighborhoods levels was done by tabular linking of the attributes (column "NOM" of each data source) with the attributes of GEOJSON (defines a ID and geometry of district and neighborhoods polygons in the Coordinate Reference System (CRC) WGS84 standard (EPSG:4326)) existing in the modular component of the Front-End.

4 Integration with Barcelona pilots

BarcelonaNow will be the main interface to access and explore data from the Barcelona pilots. This implies that the system needs to be integrated with the different components of the pilots and with work from the other partners involved. In the following we provide an overview of the two pilots, and detail the plan for the integration with BarcelonaNow.

4.1 Distributed Democracy and Data Commons

The Decidim Barcelona platform combines the potential of information and communication technologies and citizen participation to open up a new technopolitical scenario towards a distributed democracy. The most representative example of these new capacities is the articulation of the PAM participatory process in which the citizenry co-produced the municipal government programme in Barcelona. This process which interconnected more than 40,000 citizens might be seen as a complex system that required data analysis and visualization tools in order to understand its emerging properties. In the specific case of PAM, different visualizations of the data were developed to explore (1) the network of comments between users in the discussions (Aragón et al, 2017), (2) the distribution of proposals and meetings by district, category and subcategory, or (3) the relation of proposals by their origin (official, citizenry, associations and meetings) and the category of the resulting action .

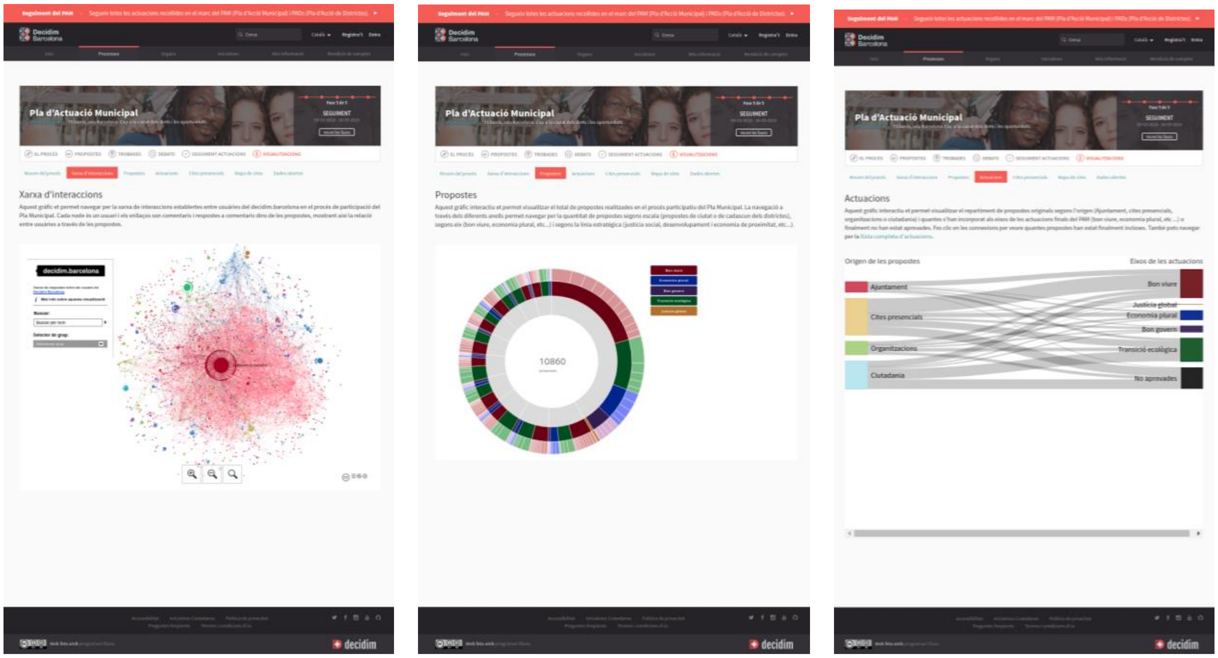
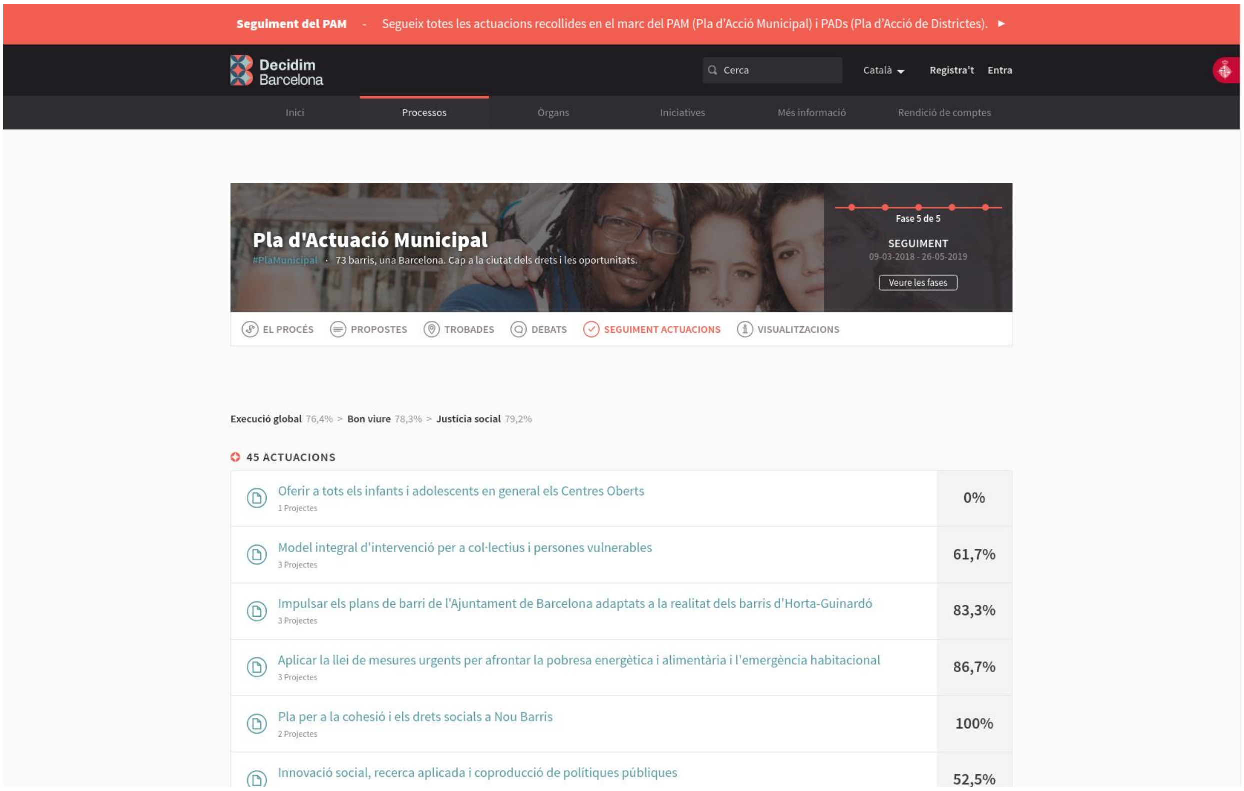


Figure 10. Sections of data visualization for the PAM process in Decidim Barcelona. Source: https://www.decidim.barcelona/processes/pam/f/27/dataviz/

This strategy was proven useful in reporting the results of this massive participatory process. However, the approach lacks socio-demographic information on the participants, which is essential to make an approximation of the representativeness of the sample on the global population of Barcelona. Despite the fact that the latest versions of the Decidim platform have incorporated new modules for evaluating processes and monitoring actions (see Figure 11)[4], Decidim still does not include the usual sociodemographic variables in sociological research surveys (e.g., gender, age group, etc.).



Seguiment del PAM - Segueix totes les actuacions recollides en el marc del PAM (Pla d'Acció Municipal) i PADs (Pla d'Acció de Districtes). ►

Pla d'Actuació Municipal

#PlaMunicipal · 73 barris, una Barcelona. Cap a la ciutat dels drets i les oportunitats.

Fase 5 de 5

SEGUIMENT

09-03-2018 - 26-05-2019

Execució global 76,4% > **Bon viure** 78,3% > **Justícia social** 79,2%

45 ACTUACIONS

Oferir a tots els infants i adolescents en general els Centres Oberts 1 Projectes	0%
Model integral d'intervenció per a col·lectius i persones vulnerables 3 Projectes	61,7%
Impulsar els plans de barri de l'Ajuntament de Barcelona adaptats a la realitat dels barris d'Horta-Guinardó 3 Projectes	83,3%
Aplicar la llei de mesures urgents per afrontar la pobresa energètica i alimentària i l'emergència habitacional 3 Projectes	86,7%
Pla per a la cohesió i els drets socials a Nou Barris 2 Projectes	100%
Innovació social, recerca aplicada i coproducció de polítiques públiques	52,5%

Figure 11. Module for monitoring actions from the PAM process in Decidim Barcelona. Source: https://www.decidim.barcelona/processes/pam/f/8/results

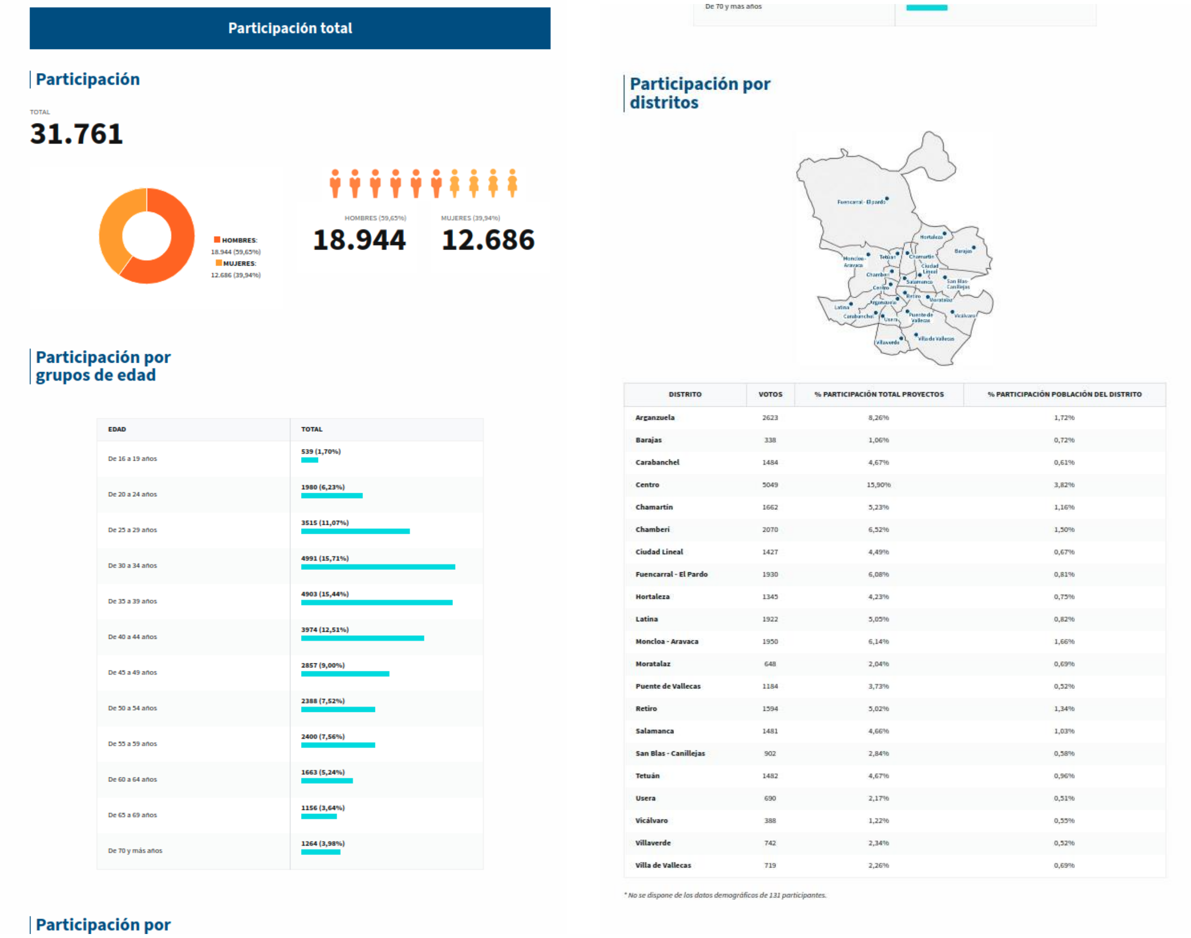
Civic technologies with similar functionalities do provide this type of statistics in citizen participation processes. For example, massive relevant processes in Decide Madrid platform such as "Remodelación de Plaza España"[5] (January and February 2016) or "Once Plazas[6] (October 2017) report the total number of participants as well as the

[4] This module was proposed by Metadecidim, the community co-designs Decidim https://www.decidim.barcelona/processes/metadecidim/f/5/proposals/11274

[5] https://decide.madrid.es/proceso/plaza-espana-estadisticas

[6] https://decide.madrid.es/estadisticas-once-plazas

number of participants by gender, age group and district (see Figure 12). This feature relies on the fact that the platform stores the link between user and citizen and, therefore, aggregated statistics can be computed. This is not the case of Decidim Barcelona. Users are verified with the official population census of the city to guarantee their veracity. However, once the verification has been carried out, no record of this link is kept for the purpose of preserving the users' privacy in case of a security breach in the system.



Participación total

Participación

TOTAL
31.761

HOMBRES (59,65%)
18.944

MUJERES (39,94%)
12.686

Participación por grupos de edad

EDAD	TOTAL
De 16 a 19 años	539 (1,70%)
De 20 a 24 años	1980 (6,23%)
De 25 a 29 años	3515 (11,07%)
De 30 a 34 años	4991 (15,71%)
De 35 a 39 años	4903 (15,44%)
De 40 a 44 años	3974 (12,51%)
De 45 a 49 años	2857 (9,00%)
De 50 a 54 años	2388 (7,52%)
De 55 a 59 años	2400 (7,56%)
De 60 a 64 años	1663 (5,24%)
De 65 a 69 años	1156 (3,64%)
De 70 y más años	1264 (3,98%)

Participación por

De 70 y más años

Participación por distritos

DISTRITO	VOTOS	% PARTICIPACIÓN TOTAL PROYECTOS	% PARTICIPACIÓN POBLACIÓN DEL DISTRITO
Arganzuela	2623	8,26%	1,72%
Barajas	338	1,06%	0,72%
Carabanchel	1484	4,67%	0,61%
Centro	5049	15,90%	3,82%
Chamartin	1662	5,23%	1,16%
Chamberi	2070	6,52%	1,50%
Ciudad Lineal	1427	4,49%	0,67%
Fuencarral - El Pardo	1930	6,08%	0,81%
Hortaleza	1345	4,23%	0,75%
Latina	1922	5,05%	0,82%
Moncloa - Aravaca	1950	6,14%	1,66%
Moratalaz	648	2,04%	0,69%
Puente de Vallecas	1184	3,73%	0,52%
Retiro	1594	5,02%	1,34%
Salamanca	1481	4,66%	1,03%
San Blas - Canillejas	902	2,84%	0,58%
Tetuán	1482	4,67%	0,96%
Usera	690	2,17%	0,51%
Vicálvaro	388	1,22%	0,55%
Villaverde	742	2,34%	0,52%
Villa de Vallecas	719	2,26%	0,69%

* No se dispone de los datos demográficos de 131 participantes.

Figure 12. Statistics of the "Remodeling of Plaza España" process in Decide Madrid. Source: https://decide.madrid.es/

The "Distributed Democracy and Data Commons (DDDC) pilot" must enhance the DECIDIM platform allowing participants/users, while preserving their privacy, to decide whether or not, they would like to share some attributes (as gender, age, ...) with the objective to display statistics of participation. This will be done using the existing data visualization capabilities of BarcelonaNow together with the DECODE platform. As shown in Figure 13, once a participatory process is finished, the sociodemographic variables voluntarily provided by participants will be retrieved in an aggregated and privacy preserving manner from the Chainspace, the distributed ledger built to support cryptographically secure smart contracts. This will guaranty verifiability and traceability of the process while not exposing any personally identifiable data. BarcelonaNow will connect to the Chainspace through the QueryAPI and offer these statistics together with the open data from Decidim as detailed in Section 3.1.

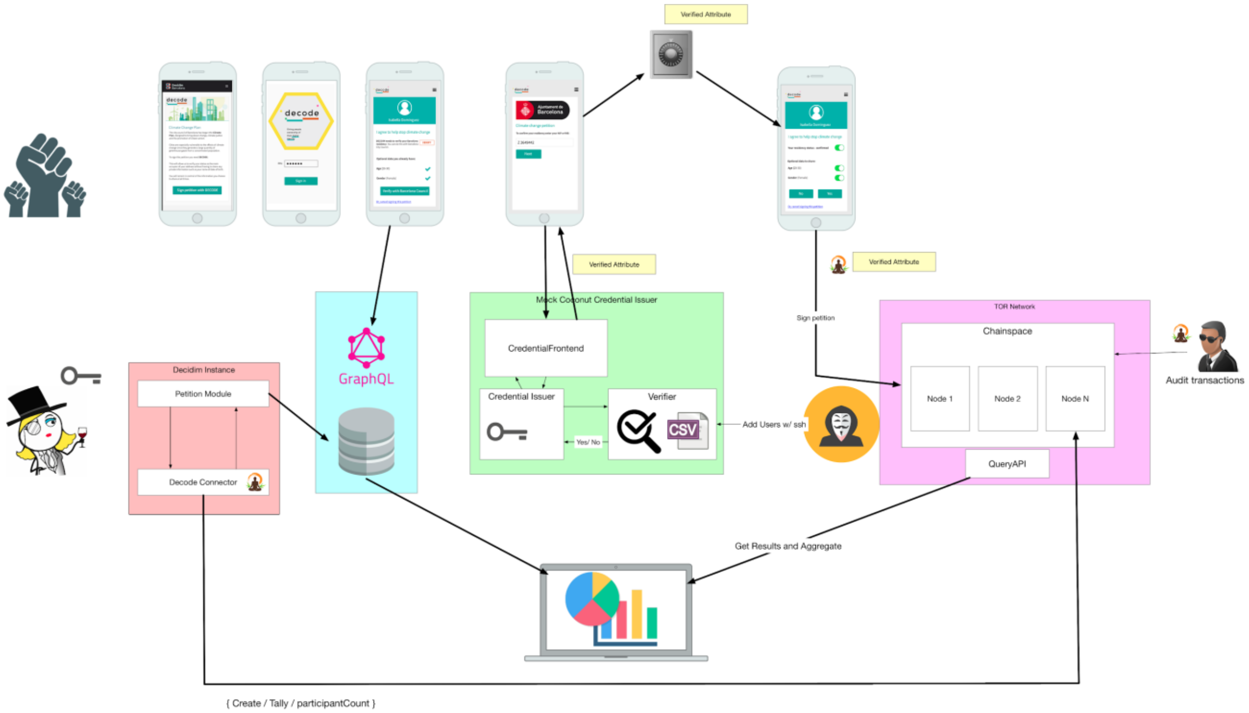


Figure 13. Functional architecture of the "Distributed Democracy and Data Commons" pilot. BarcelonaNow will obtain, through the "Get Results and Aggregate" method, the demographic statistics of participants who agreed on providing these data to be displayed in an aggregated manner. Author: Thoughtworks team.

4.2 CitizenSensing (IOT)

Through the CitizenSensing (IoT) pilot, DECODE will explore a data-centric digital economy where data that is generated and gathered by citizens, the Internet of Things (IoT), and sensor networks is available for broader communal use, with appropriate privacy protections. In this sense, the main objectives of the IoT pilot are:

- Support engagement with existing Smart Citizen communities in Barcelona
- Demonstrate a data sovereignty approach within an IoT context
- Demonstrate differential data entitlements
- Make use of existing DECODE technologies
- Develop components that can be introduced within existing environments with minimal disruption for easy adoption.

The IoT pilot will be assessed by the following success metrics:

- Successful deployment of IoT pilot components on Smart Citizen infrastructure
- MakingSense/IoT pilot being supported by DECODE components
- Showcase real world usage of DECODE technologies.

BarcelonaNow has an important role in the CitizenSensing Iot pilot, as the interface through which data shared by citizens and communities will be accessible and explorable.

In Figure 14, we present the system architecture depicting the various integration points of BarcelonaNow with other systems and with the work from other partners for the pilot. We will not go into the details of all the interactions which will be described in deliverable D5.6 "Deployment of pilots in Barcelona", and will here only focus on the interaction with BarcelonaNow.

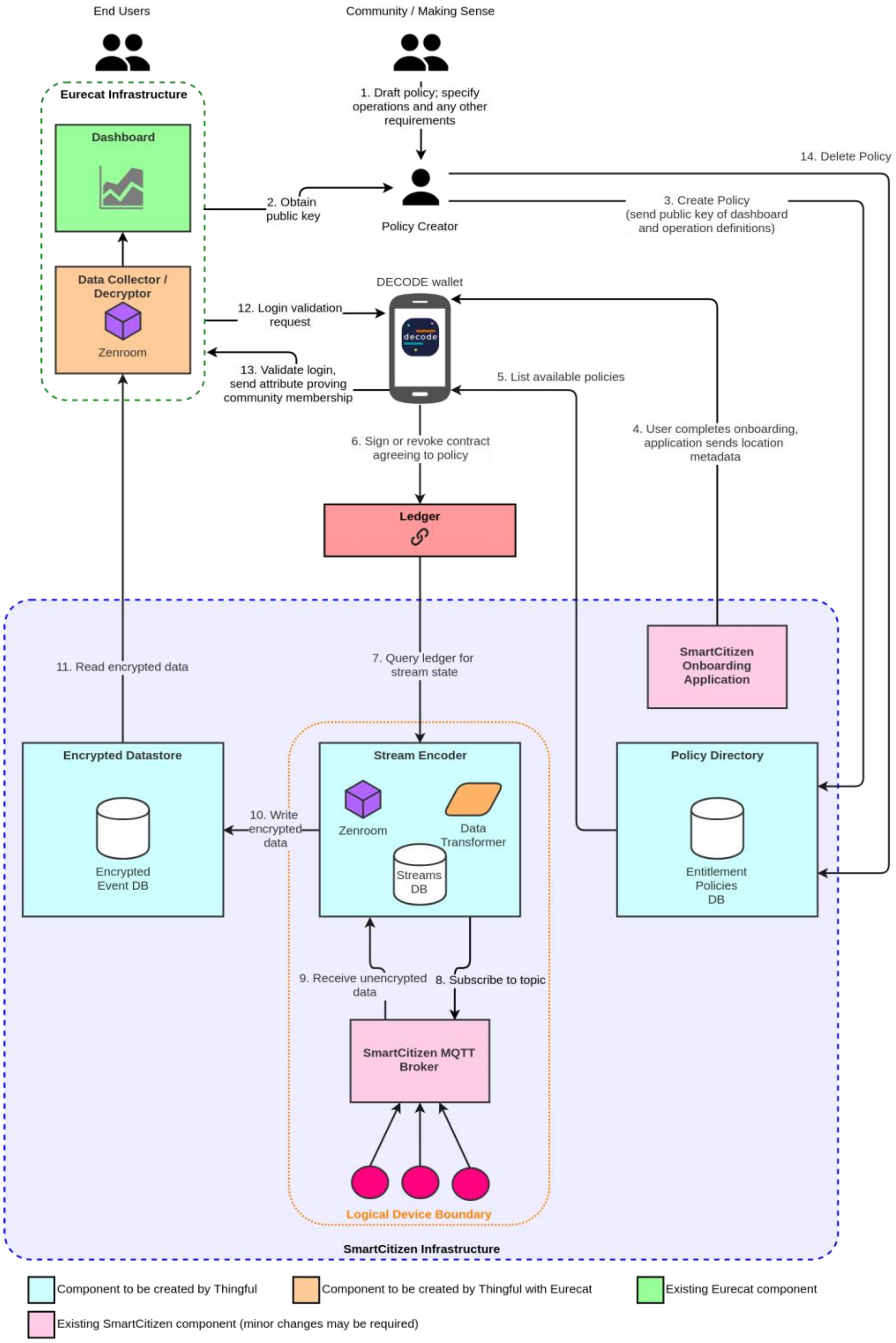

End Users
Community / Making Sense
Eurecat Infrastructure
Dashboard
1. Draft policy; specify operations and any other requirements
14. Delete Policy
2. Obtain public key
Policy Creator
3. Create Policy (send public key of dashboard and operation definitions)
DECODE wallet
Data Collector / Decryptor
Zenroom
12. Login validation request
decode
13. Validate login, send attribute proving community membership
5. List available policies
4. User completes onboarding, application sends location metadata
6. Sign or revoke contract agreeing to policy
Ledger
11. Read encrypted data
7. Query ledger for stream state
SmartCitizen Onboarding Application
Encrypted Datastore
Stream Encoder
Policy Directory
10. Write encrypted data
Zenroom
Data Transformer
Streams DB
Encrypted Event DB
Entitlement Policies DB
9. Receive unencrypted data
8. Subscribe to topic
SmartCitizen MQTT Broker
Logical Device Boundary
SmartCitizen Infrastructure
Component to be created by Thingful
Component to be created by Thingful with Eurecat
Existing Eurecat component
Existing SmartCitizen component (minor changes may be required)

Figure 14: System architecture for IoT Pilot.

There will be in total 3 integration points between BarcelonaNow and other components in the system:

A. **Create Data source**: This will be a manual process during which a private/public key pair is generated and a new data source is registered in BarcelonaNow with its own code for the collector. The public key is published so that the data generated from the devices are encrypted using the public key. The private key will be used by the data source collector code to decrypt the data. This is shown as step 2 in the diagram.

B. **Collect data**: This is the secure data reading from encrypted data store and storing it in BarcelonaNow server. The technical details of this integration, and of how the data will be consumed from this new secure data source is given in section 5.1.3. This is shown as step 11 in the above diagram.

C. **User Login**: As user management for this pilot is done outside BarcelonaNow, the user credentials and their affiliation to the community and right to access its data will be validated by the Decode Wallet. More specifically, users will be able to access data shared with their communities by using specially generated credentials stored in the Wallet app. These credentials are used to authenticate the user and allow access to community data without requiring the exchange of any personally identifiable information. The interface between the login to the dashboard and these credentials will be semi-automated through the Wallet app. The technical details of this integration are given in section 5.1.2. This is shown as integration points 12 and 13 in the above diagram.

5 Upgrades Planned for BarcelonaNow

Many upgrades and new features have been planned for BarcelonaNow based on requirements gathered from different pilots and user feedback. In the next subsections, we will discuss them in detail along with the design and implementation details. We have divided the upgrades in two main categories: Backend and Frontend, to capture changes on the two modules separately.

5.1 Backend

5.1.1 User Access Control

Until now, BarcelonaNow had an open access, any user could use it without a need to login. As all the data sources were public and all the analytics done on those data sources were also public, this was a natural choice of design. But based on the requirement of private and community based data sources, which implies an authorized access control on the platform, we have decided to integrate a User Management and Authorization Control module. The User Management module will be used to create and manage user accounts and their details. The Authorization control module will be used to control and enforce user access to different data sources and dashboards in BarcelonaNow. We will have a default guest user with user id "guest" and password "guest" who will have access to all public data sources. The new architecture with the new modules is shown in the figure below. The new module will be built using Flask-login plugin and user data and access details will be stored in a mysql server.

Apart from our own login management module, we will also support external login validators. In this case, instead of storing the user login details in the BarcelonaNow database, the users will be validated externally by a API call. We will present this external case with the IoT pilot example in the next section.

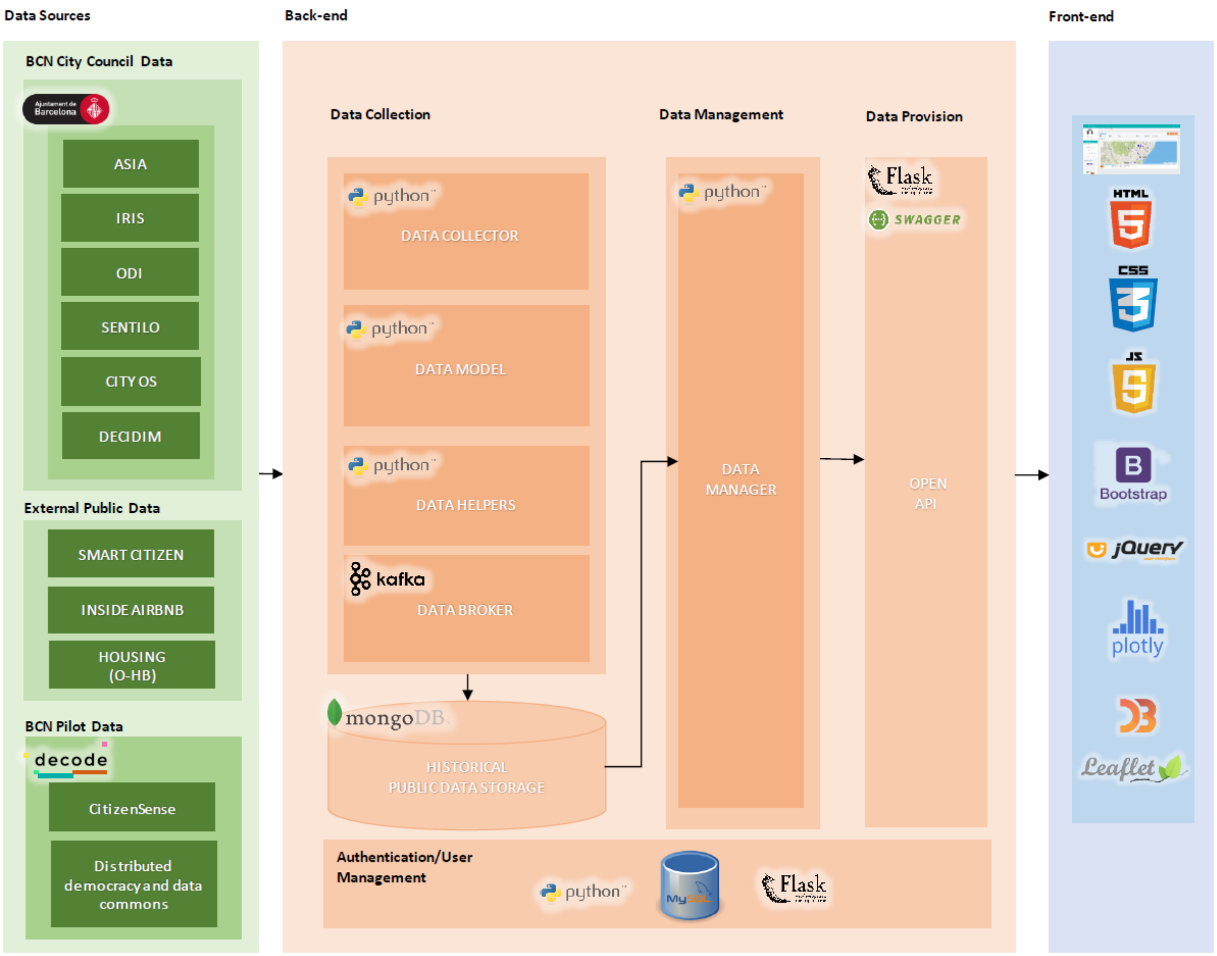


Figure 15: New Architecture of BarcelonaNow

5.1.2 Login integration with IoT wallet

Extending the User management module in the new architecture we also designed an external User authorization source for the IoT wallet integration. In this approach, instead of directly maintaining user details in our database, these data will be stored and validated by IoT wallet. A generic user named "IoT user" will be created in our database without any password details. This IoT user will be mapped to all the community data sources the pilot has access to. There will be a separate login page created for the IoT pilot which will have a QR code (or an embedded button with a link in case the login is initiated from the IoT wallet app). On scanning the QR code, a session id will be generated for BarcelonaNow and then a request will be made to the IoT wallet with the sessionId, a callback function and header information. The IoT wallet will then ask the user to select the credentials she want to share and on validating her credentials the IoT wallet will send back the sessionId and the community id for which the user has access. On BarcelonaNow, on verifying that the session id and community id are valid the session will be validated and the user will have access to the dashboards. A sequence flow diagram for this interaction is shown in the figure below.

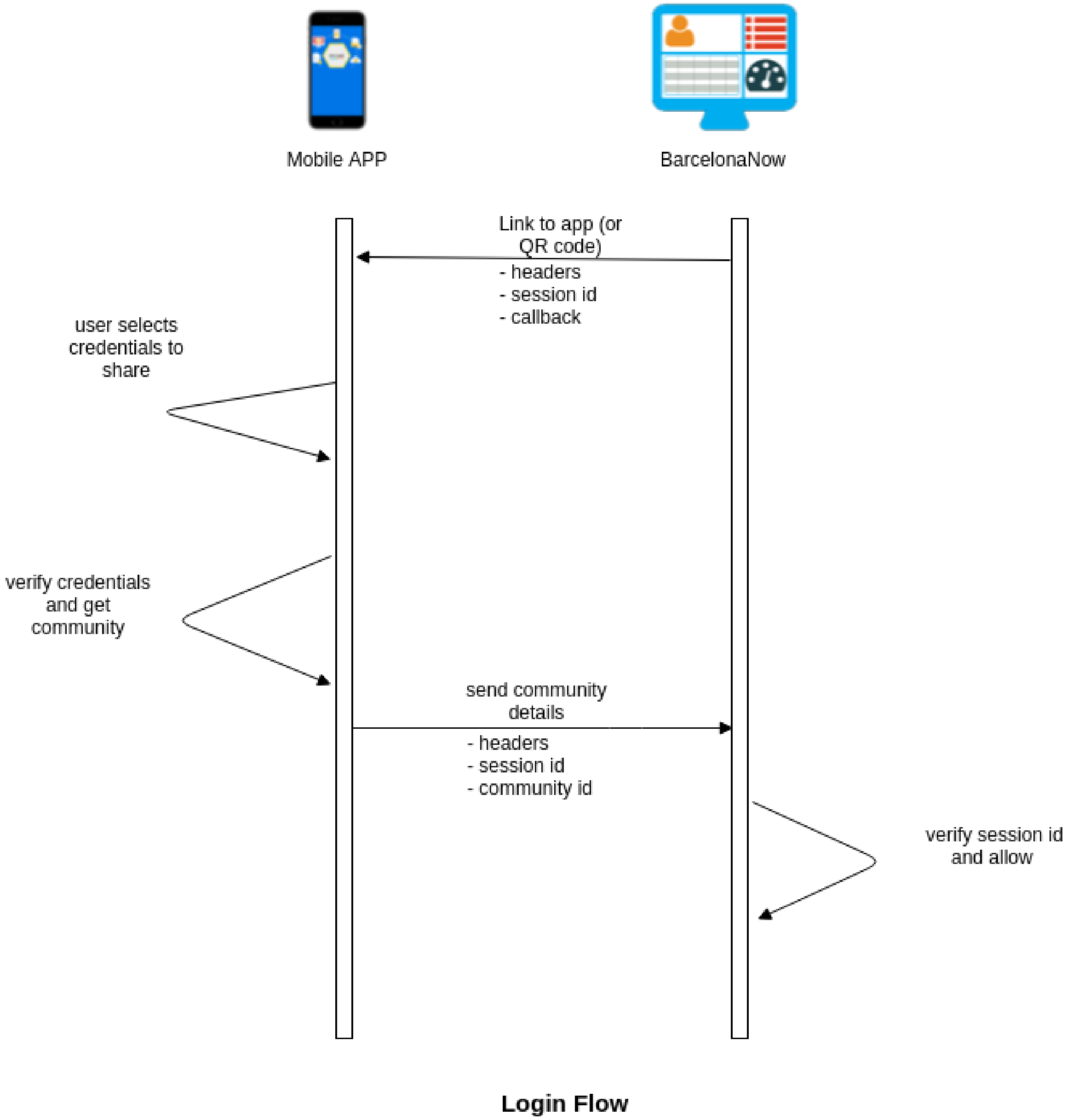


Figure 16: Sequence flow diagram of the IoT Wallet login with BarcelonaNow.

5.1.3 Secure Data source integration with IoT data source

To enable support for the IoT pilot, a new kind of secure data collector will be used. This data collector will use the Zenroom APIs to decrypt the data. A public/private key pair will be generated (this step will be done offline for now) and the public key will be manually shared with other partners. The IoT data will be encrypted using this public key and shared with BarcelonaNow in an encrypted stream. A detailed description of the read API and the technology used behind is provided below.

Technology detail

RPC vs REST

Prevailing currents in web development have for many years been towards designing RESTful APIs where REST stands for “Representational State Transfer”. REST style APIs are designed around using the different "verbs" offered by HTTP (GET, POST, PUT, DELETE, PATCH) to put, get or delete resources.

In contrast RPC style APIs are designed around a conceptual model based on function calls with parameters (like the functional calls you would expose within your program). Both API styles can implement exactly the same type of functionality; for example a RESTful todo list might model the creation of a new todo item as POSTing a representation of the item to a URL representing the collection of all todo items, whereas the same operation modelled via RPC might expose a CreateTodoItem function endpoint that takes the new item as a parameter. Both approaches would get us to exactly the same logical end state, it's just a different way of getting there.

When thinking about how we would approach this in the context of the system architecture shown in Figure 14, we felt that the types of operations defined for the system would be a more natural fit for RPC style APIs, and modelling the problem that way would avoid the awkwardness that can result if you have to try and force a set of operations to be defined in a RESTful compatible way.

Protocol Buffers

Protocol Buffers[7] are a method of serializing structured data, originally developed by Google for internal use, but released under an open source licence in 2008 as an alternative to other serialization formats like XML or JSON. In contrast to XML or JSON, protocol buffers serialize to a binary wire format, which is designed to be much more compact than a comparable XML or JSON document. In addition, protocol buffers support strongly typed messages unlike XML or JSON, so in many languages it can be significantly easier to work with.

Protocol Buffers are used by means of an interface definition language that can be used to describe the structure of some data to be passed between components, and also optionally the interface to the components that consume or produce this data. A code generation tool can then consume the interface definition in order to produce

[7] "Protocol Buffers | Google Developers." https://developers.google.com/protocol-buffers/. Accessed 28 Aug. 2018.

code that takes care of all data parsing, client code and often stubs that greatly simplify the implementation of the associated server.

Twirp

The current state of the art when it comes to protocol buffer based services is a framework called GRPC[8]. GRPC is an open source remote procedure call (RPC) framework originally developed at Google, designed to efficiently connect services in and across data centers. It uses protocol buffers to define service interfaces, and there is a sophisticated code generation tool that allows building clients and service stubs directly from the GRPC service definitions. It is a very powerful and flexible framework but it has a couple of issues that currently make it slightly hard to use it in heterogeneous environments. Most significantly GRPC services have a hard requirement on HTTP/2 in order to support some of GRPC's advanced features. HTTP/2 is a major revision to how HTTP works and is not yet widely supported by all components we might encounter in the deployment network stack. In addition, GRPC is a very large and complex framework, meaning there is a significant effort involved in developing GRPC based components.

In contrast Twirp[9] is a simple RPC framework originally created by Twitch Interactive, which borrows heavily from the learnings of GRPC but designed to be a simpler framework within which to develop. Twirp offers the same benefits as GRPC:

1. It allows for the generation of service stubs and clients in exactly the same way as GRPC (which for me is the real advantage of a protocol buffer based system over having to manually create a JSON RESTful API client and implement tedious code for serializing/deserializing messages).

2. It uses protocol buffers as a compact and high performance serialization standard.

However Twirp makes the following key changes from GRPC:

1. Twirp operates over HTTP/1.1 which makes it much easier to deploy, operate and manage in messier, less bleeding edge network configurations.

2. Twirp automatically creates a JSON API from the same single protocol buffer interface definition. This JSON API is an RPC style interface rather than a RESTful

[8] "grpc / grpc.io." https://grpc.io/. Accessed 28 Aug. 2018.
[9] "GitHub - twitchtv/twirp: A simple RPC framework with protobuf service ...." https://github.com/twitchtv/twirp. Accessed 28 Aug. 2018.

one, however it makes it very easier to test out a service using curl from the command line. In contrast GRPC requires the addition and configuration of a 3rd party component in order to do something similar.

3. Twirp has intentionally removed some of the more advanced features from GRPC (e.g. streaming and stream multiplexing). These features rely on HTTP/2, and just complicate server and client implementations so Twirp just does not provide this functionality.

Some other facts it is important to know about Twirp based services:

- All requests sent to Twirp services must by POST requests whether or not the RPC endpoint is intended for reading or writing data
- All Twirp endpoints are mapped to routes that look like:

  POST /twirp/<package>.<Service>/<Method>

  If you are using generated client bindings this will be invisible to the caller, but is important to know it if we wish to interact with the API manually from the command line for example.
- Requests made to the protocol buffer API must include a Content-Type header with the value: application/protobuf.
- Requests made to the JSON API must include a Content-Type header with the value: application/json.
- Wherever possible the protocol buffer API should be preferred to the JSON API. JSON is easier for debugging, but protocol buffers are better in almost any other way.

Read API

Below we give details of the Read API to get data from encrypted data store using the JSON/HTTP API, and then decrypting it in dashboard.

Example Request

```
POST /twirp/decode.iot.datastore/Datastore/ReadData HTTP/1.1
Host: <datastore.address>
Content-TYpe: application/json
```

```
{"public_key":"BHRLc+Cae6vvfmpbv\/fEH\/EXmY7nnIDrFbosICd\/PpCFb6nZUdUBJNa7zGSx2KKO+MSRLwp
sUZTWClLT6fUuWFQ=","start_time":"2018-08-29T16:08:26Z","page_size":500}
```

The following fields are required to be present within the request:

- public_key - identifies the recipient (i.e. dashboard for which data is being requested)
- start_time - the beginning of a time interval for which the client desires data expressed in UTC.

The following fields are optional when making a request:

- end_time - the end of the time interval for which the client desires data. If this field is omitted it defaults to "now". This field should be expressed in UTC.
- page_cursor - an optional opaque string containing a cursor which the server is able to parse in order to provide the "next" page of results. This cursor value cannot be calculated by the client, rather the server will return this value if more data is available than can be obtained in a single request.
- page_size - the number of events to return in a single request. If not present, the default page size of 500 events will be returned. The current maximum page size is 1000, and requesting more than this will result in an error being returned.

Example Response

```
HTTP/1.1                                200                                OK
Content-Type: application/json
Content-Length: 12582

{"public_key":"BHRLc+Cae6vvfmpbv\/fEH\/EXmY7nnIDrFbosICd\/PpCFb6nZUdUBJNa7zGSx2KKO+MSRLwpsUZTWClLT6fUuWFQ=","
events":[{"event_time":"2018-08-29T16:01:32Z","data":"0CKygC0vJjphUPRFoVk\/Zw=="},{"event_time":"2018-08-
29T16:01:33Z","data":"0CKygC0vJjphUPRFoVk\/Zw=="}...],"next_page_cursor":"eyJldmVudF9pZCI6MTM0LCJ0a","page_size":500}
```

The above example shows an example of the response that will be returned by the server as the result of a read request. The response object contains the following fields:

- public_key - the key that identifies the recipient (i.e. the specific dashboard)
- events - an array of event objects, each of which has the following structure:
    - event_time - the timestamp at which the event was received expressed in UTC

    - data - a single encrypted message from a device. This data will be passed to Zenroom to be decrypted and stored.
- next_page_cursor - this field may be an empty string, but if not empty will contain a cursor value that the client may use in order to request the next page of data by passing it back via the page_cursor attribute defined above. If this value is empty the client may be sure that there are no more events for the currently requested time interval.
- page_size - the server also returns the requested page size to the client.

Python Library for BarcelonaNow

The above examples show how the raw API endpoints works and could be called manually from the command line using a tool like curl, however for BarcelonaNow a Python package will be generated using the Twirp inbuilt Python binding generator.

The above request/response interaction could then be implemented as follows:

Example Python Client Code

```
from decode.datastore_pb2_twirp import DatastoreClient
from decode.datastore_pb2 import ReadRequest
from decode.datastore_pb2 import response

public_key = ‘BHRLc+Cae6vvfmpbv\/fEH\/EXmY7nnIDrFbosICd\/PpCFb6nZUdUBJNa7zGSx2KKO+MSRLwpsUZTWClLT6fUuWFQ=’

client = DatastoreClient('<server.address>')

read_request = ReadRequest()
read_request.public_key = public_key
read_request.start_time = make_timestamp(‘2018-08-29T16:08:26Z’)
Read_request.page_size = 500

response = client.read_data(read_request)
for event in response.events:
  decrypt(response.data)
```

Note:

- The code shown in the examples above is just an example and the exact name of the method might change in the final implementation.
- The decrypt method from Zenroom is still under discussion and will be finalized based on what kind of encryption scheme is finally adopted.

5.1.4 Datasource manager

Currently, all the data sources are publicly available and the metadata related to these data sources were stored in a static file (javascript file) from where everything was being loaded for all users. As in the future version, we are moving towards a access controlled dashboard we have also designed a datasource manager to store the meta data inside mongoDB with mapping of data source to public or private/community. As before public data source will be available to all users and guest user(default login) but the private/community data sources will be available to authorized users. The json structure of the data sources is similar to previous one but with one new element "access" (marked in bold) to capture the access level of the datasource. Datasources marked as "private" will be visible to only those used who have the required authorization. The authorization will be checked by the Authorization management module which returns a list of authorized datasources.

Example of json doc type for the data sources:

```
 datasets = {
  2: {
  id: 2,
  type: "record",
  access: “public”,
  name: "asia",
  description: "ASIA Events Rohit",
  provider: "asia",
  start: "2017-11-01T00:00:00Z",
  end: "2018-02-01T00:00:00Z",
  language: "Spanish",
  labels: null,
  targetvalue: 1,
  aggregator: "count",
  radius: 20,
  colors: ['#01579B'],
  "cuts: [-1],
  parameters:
"name@payload.name,enddate@payload.enddate,startdate@payload.startdate,categories@payload.categories,",
  details:
'name@payload.name,enddate@payload.enddate,startdate@payload.startdate,categories@payload.categories,',
  filter_field: "payload.name",
  allowed_visual_models: ["points-map", "heat-map"]
  },
  3: {
  id: "3",
  type: "record",
  access: “private”,
  name: "iris",
  description: "IRIS Claims",
  provider: "iris",
  start: "2014-01-01T00:00:00Z",
  end: "2018-01-01T00:00:00Z",
  language: "Catalan",
  labels: null,
  aggregator: "count",
  targetvalue: 1,
  radius: 10,
  colors: ['#E91E63'],
  cuts: [-1],
 parameters: "element@payload.element,detail@payload.detail,area@payload.area,",
  details: 'element@payload.element,detail@payload.detail,',
  filter_field: "payload.element",
  allowed_visual_models: ["points-map", "heat-map"]
  }};
```

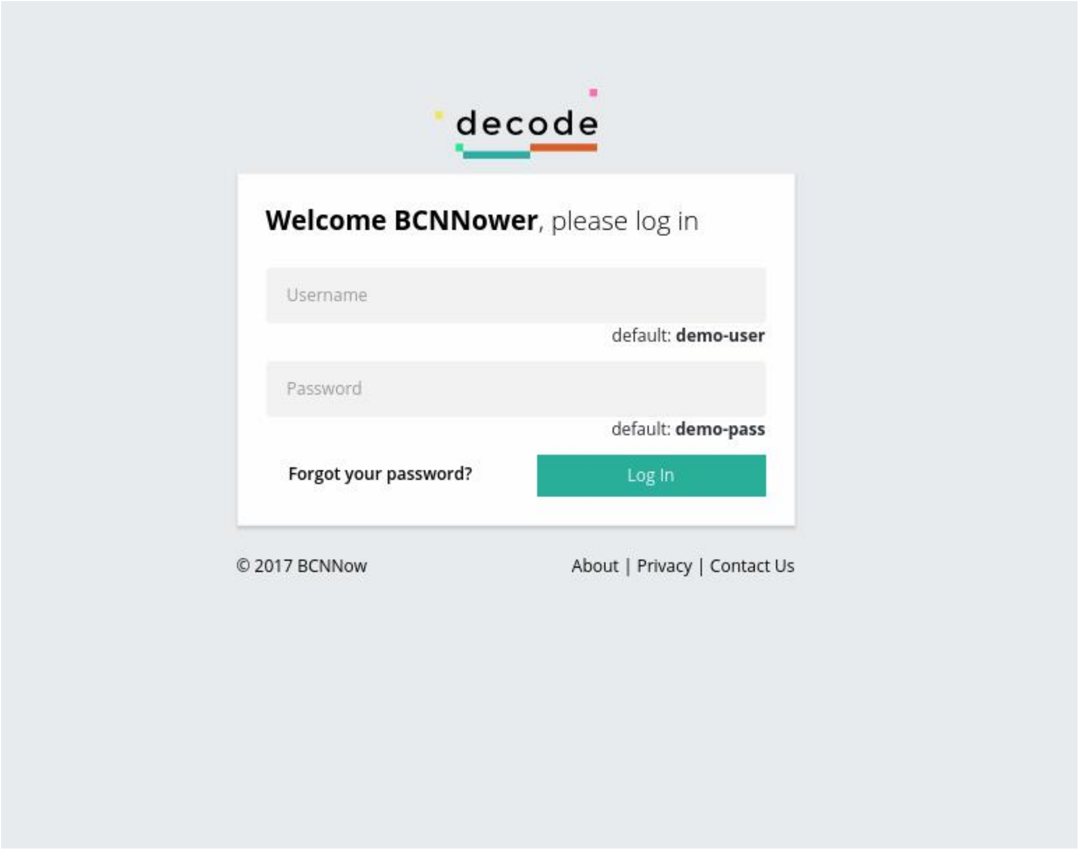
A separate table would be maintained in the mysql server to store the datasource id and the access mapping for non-public data sources.

5.2 Frontend

5.2.1 Authentication and User Management

To support authorization access and user management new pages will be designed. The existing pages where static html pages which will be converted into dynamic jsp pages. List of new pages

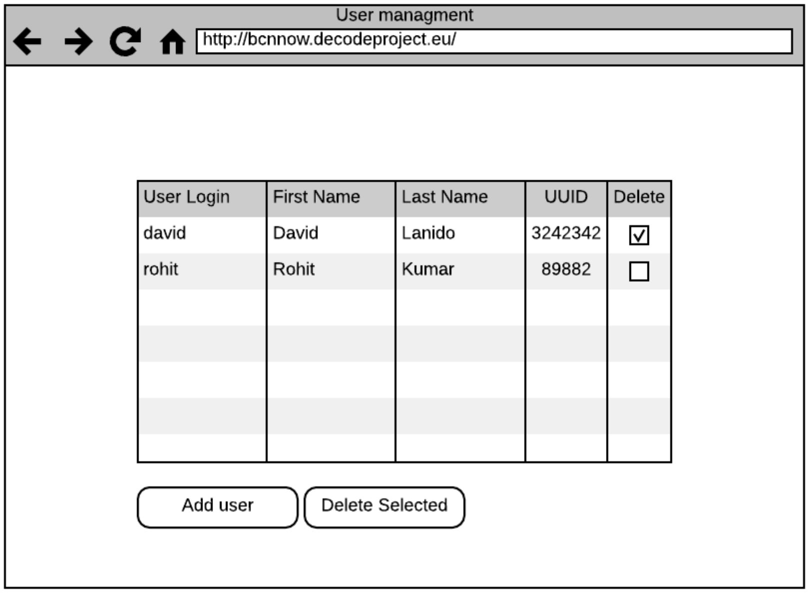
1)



Welcome BCNNower, please log in

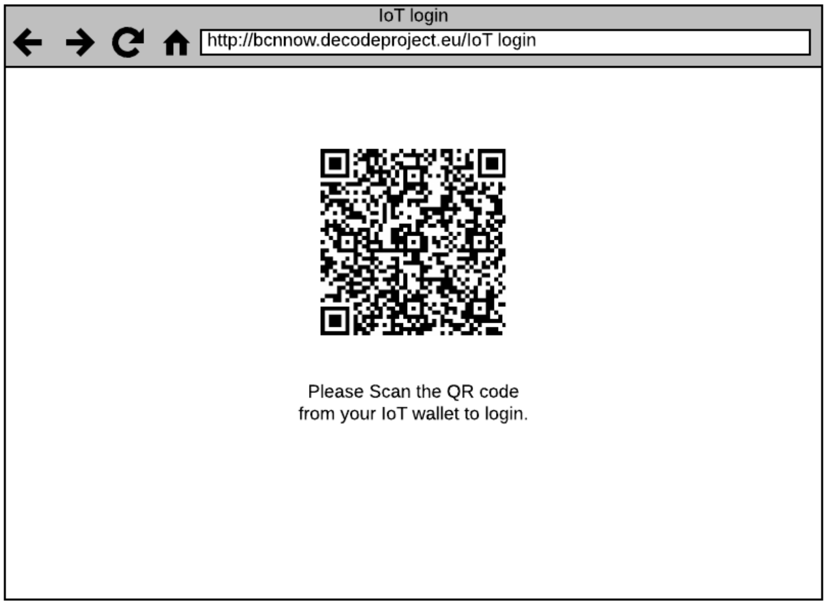
Figure 17: Login page

2)



User Login	First Name	Last Name	UUID	Delete
david	David	Lanido	3242342	☑
rohit	Rohit	Kumar	89882	□

Figure 18: Add/Edit user page



Please Scan the QR code
from your IoT wallet to login.

Figure 19: IoT login page (with QR code)

Existing pages will be converted from static html pages to dynamic jsp pages with session check inside to make sure only authorized users could access the dashboard. The datasource.js and dashboard.js which currently store the required data to display on the dashboard will be saved in mongoDB and will be loaded dynamically on user page.

5.2.2 New data visualizations

As we work with urban data, most data come with a geolocation and can be visualized on a map; indeed, the visualizations currently provided by the prototype system are all based on maps of the city, at least as a starting point (then for some datasets it is possible to click on individual points on the map and open other visualizations, such temporal evolution charts for noise sensor data).

However, in the future developments of BarcelonaNow we envision to include data which are not associated to a location; this is for example the case of the demographic composition of petition supporters in the Distributed Democracy and Data Commons (DDDC) pilot: a petition may be relevant to the whole city, without being associated to any specific point, neighborhood or district, and data visualization in this case should serve to break down the composition of this group of citizens along different demographic indicators such as age, gender and occupation type. For this and analogous scenarios, we envision BarcelonaNow's front-end to provide other kinds of visualizations. Namely, we plan to introduce first two general and consolidated kinds of non-maps visual models, which can suit a variety of use cases:

Bar charts

A bar chart is a classic element of data visualization to compare numerical values (Y-axis) between discrete categories (X-axis). Additionally, the color of the bars can be used to include a new dimension.

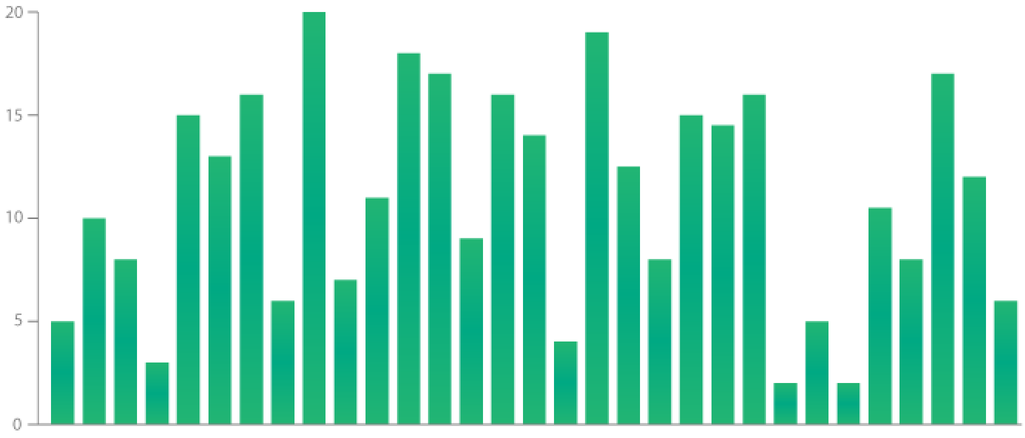


Figure 20: Example of a barchart. Source: https://datavizcatalogue.com

Bubble charts

Bubble charts are a hybrid version of bi-variable charts (scatter plots) and proportional area charts. Graphs of this type represent each record through two dimensions (X axis and Y axis) making the possible correlation between them explicit. In addition, the use of bubbles, instead of dots, allows to use the colour and size of each bubble in order to code the values of a discrete dimension and a continuous dimension, respectively. Both codings require the use of legends for their interpretability. In general, the simplicity and versatility of bubble charts make them one of the most widely techniques in data exploration.

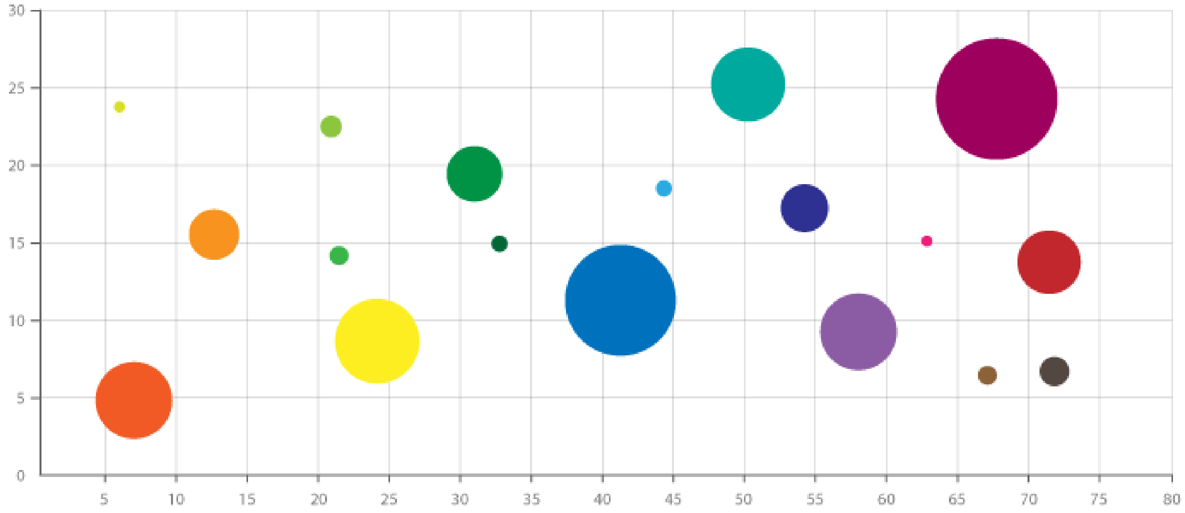


Figure 21: Example of a bubble chart. Source: https://datavizcatalogue.com

6 Conclusions

The development of BarcelonaNow started during the initial phase of the project, driven by the specifications of the use cases (included in deliverable D1.1 "DECODE scenarios and requirements definition report") and privacy design strategies (included in deliverable D1.2" Privacy Design Strategies for the DECODE architecture & Data Management Plan"), and in parallel with activity in the other technical work packages and with the development of the pilots. This is why the development of the first prototype was focused on creating a tool for processing and visualizing public datasets, addressing especially scalability and usability issues.

Now with the advancements in WP3 and in the development of the pilots (WP5), we have been able to start the integration of BarcelonaNow with the pilots and with the lower layers of the technology stack, which means also dealing with private data accessible only to specific individuals or communities. This in turn implies implementing functionalities of login and user-management, and re-designing some aspects of the architecture and technology stack of the system for making it more robust and secure, and fully suitable for implementing the encryption schemes defined in WP3. Therefore, the biggest novelty in this deliverable resides in the design and specification of the upgrades foreseen for such integration, in the context of the Barcelona pilots, grounded also in the discussion with the interested partners. We have described and discussed the main improvements and choices planned, both from an architecture and technology point of view. Of course, some changes might occur along the development, due to the appearance of new issues or opportunities we have not foreseen, however the progress reported in this deliverable serves to validate the reliability of the roadmap.

Aside from these planned upgrades, the development of the prototype has advanced in other directions which are presented in this deliverable, including the improvements in the front-end (such as the resizable user interface which makes the system usable also from mobile phone) and the addition of new data sources. The integration of public data from Decidim, besides being of great interest given the importance and magnitude of the participative democracy processes they document, is especially relevant for integration with the *Distributed Democracy and Data Commons (DDDC) pilot*, which pivotes around the Decidim platform. We firmly believe the other new data source added, i.e. data from the Housing Observatory of Barcelona (OHB) is also very relevant given the current rise of public attention on the issues of housing, gentrification and short-term rent platforms in Barcelona (Gutiérrez et al, 2017; Segú, 2018) as well as in many other cities (Lee, 2016; Fortuny Borysiewicz et al 2018).

All in all, this deliverable captures the current status of BarcelonaNow and the design and specification of the upgrades planned for the next steps in the development. In particular, the integration with the two pilots is aimed at becoming a leading example of how data valorisation can be applied for the common good. The main challenges to be faced in the next phase are related to the need of combining a security and privacy by design paradigm with usability, personalization and with the need of providing useful information to the end-users in an easily accessible way. If the price for achieving security and privacy is too high, and for using DECODE technologies one had to renounce to fundamental desired features such usability or personalization, then the project would not achieve its goal of paving the way for an alternative and sustainable model as to how we share our data on the Web.

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