

SYNCHRONICITY

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Executive Summary

One fundamental methodology of SynchroniCity is to verify, proof, and validate the developed concepts through a number of pilots. Each reference zone has defined one or more domains for their pilots. Pilots will be designed, implemented, and adjusted to the various needs of different reference zones. The main purpose of the pilots is to validate and refine the effectiveness of the marketplace mechanism and serve as inspiring tools for others in Europe to join the created digital single market by showing real value of IoT for citizens, entrepreneurs, and investors.

To optimally demonstrate both impact and scalability of SynchroniCity Framework three different application themes have been selected: Human Centric Traffic Management (HCTM), Multimodal Transportation (MMT) and Community Policy Suite (CPS). Each of these themes addresses important urban challenges with a high societal and economic impact, high priority, and interest from the SynchroniCity Reference Zones (RZs). The Reference Zones and other consortium partners had strong collaboration in order to identify a specific initial application, for each application theme.

The pilot of **Antwerp** is aiming to feed the existing Multi Modal Navigator 'Slim Naar Antwerpen' with measured bicycle speed data in order to give road user more accurate guidance for planning the route.

The City Council of **Eindhoven** is focussing to achieve a 10% increase in use of bicycles. According to the current plans it will be achieved with Human Centric Traffic Management by allowing traffic lights for cyclists to be controlled by sensing the bicycles.

The city of **Carouge** performs pilots in two themes: Human Centric Traffic Management and Community Policy Suite. The Human Centric Traffic Management pilot delivers a smart parking service for Carouge that provides real-time parking availability data from installed parking sensors and integrated information about nearest public transportation stops. The community policy suite pilot measures noise on the streets where restaurant and bars are gathered.

The main goal for **Helsinki** pilot is to extend the City journey planning application by adding environmental parameters - air quality and noise. The users can select a route to avoid the most polluted and noisy areas. This activity is under the theme of Human Centric Traffic Management.

The pilot from **Manchester** is specifically focus on understanding how IoT deployment can be used to enable data driven policy making as part of the Community Policy Suite theme.

The Municipality of **Milan** is involved in two pilot themes: Human Centric Traffic Management and Multimodal Transportation. The first one deploys the application so-called "Decision support system for bike planning" and aims to use traffic data, bike sharing stations, parks, restricted traffic areas, public transport network, obstacles along the sidewalks to improve cycling mobility schemes and reduce amount of accidents. The second one is named as "Mobile navigator for disabled people" and it provides a mobile navigator specifically designed to help people with disabilities to drive in the city.

The city of **Porto** is involved in two pilot areas: Community Policy Suite and Multimodal Transportation. The CPS pilot application (Porto. Open Interactive Map) gathers, processes and analyses all kind of city data and provides valuable information to the City Council, local business owners and citizens (both inhabitants and visitors). The other pilot (The Porto. Multimodal Assistant) is a mobility solution which gathers city data and user data, and provides a personalised and customised multimodal assistant, based on the user's preferences, requirements and choices.

The city of **Santander** is involved in a pilot area of Multimodal Transportation (MMT) named "Park & Move". The application is composed of two use cases related to urban mobility. The first one, "Smart Parking", helps to find a parking place in an optimum way. The second one, "Multimodal Navigator",

provides a help in internal urban movements combining the information of all facilities (location, timetables, etc).

All pilots will be deployed and operated with regards of common milestones, defined on the project level. It will allow to share, exchange, and utilize the experience and results of pilots not only after the pilot phase but also during the pilot activities across the RZs and for the purpose of other work packages and tasks.

Abbreviations and definitions

AAA	Authentication, Authorization and Accounting
CPS	Community Policy Suite
D	Deliverable
EC	European Commission
HCTM	Human Centric Traffic Management
ICT	Information and Communication Technologies
IPMA	Portuguese Institute for Sea and Atmosphere (Portuguese acronym)
MaaS	Mobility as a Service
MMGV	Milano Municipality Geoportal Viewer
MMT	Multi-Modal Transportation
POI	Point Of Interest
PPP	Point-to-Point Protocol
RZ	Reference Zone
WP	Work Package
WT	Work Task

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1 Introduction

1.1 Purpose of the document

The document contains the plans for deployment and operational support of the IoT service pilots in each reference zones, describes relationship between the pilots, and dependencies with other work packages and tasks. The document is written as a joint effort of reference zone representatives. A pilot deployment plan details the timeline for reference zone pilot roll-out accounting for differences in readiness levels, further specifying infrastructure involved, ecosystem partner responsibilities, supportive actions to be executed, acceptance test protocols and procedures for technical support during the operations and the sustainability mode for the pilot upon project completion.

Actual deployment of the local pilots will be closely coordinated by liaison partners together with reference zone (operational) representatives.

1.2 Acceptance test protocols and procedures

Upon the pilot realization, acceptance test protocols are jointly executed and operational support teams will be set up to respond to failures and calamities. Deployment, operational characteristics and procedures will be comprehensively documented for each reference zone pilot.

Test protocols and procedures for technical support procedure defines the process of validation of the scenarios and functionalities and compliance of the solution with platform's API standards.

For each RZ validation tests will be performed and the results will be reported in deliverable D4.2 [1] (as part of task T4.2, WP4), which is submitted at the end of July 2018.

The procedures, test protocols, and technical support process will be defined in WP4 and released in deliverable D4.2.

1.3 Timeline for pilot roll-outs

The timeline for pilots' roll-outs and operational phase is defined for all RZs. See snapshot (taken 24.8.2018) in Appendix Table 5.

Milestones of each pilot (each RZ) should be connected to overall project milestones (listed in templates) and have a list of pilot phases/steps.

1.4 Structure of the deliverable

The document is structured as below. A short explanation of the described topics is provided.

1.4.1 Pilot motivations, use cases, expected results, after pilot life

This subsection provides a brief description of piloted use cases and explanation why this app/case has been selected by a particular city, what is the expected impact of this case, and why is it important. The subsection has a clear description of the expectation from pilot and the ideas about after pilot life for the use case including utilisation of results and dissemination.

It is important to clarify the relations between the pilot case and other pilots/cases, needed and potential integration and synergy.

1.4.2 Description of infrastructure

This section describes the infrastructure for the pilot, including required data sources (sensors and other data providers, web services), urban and other platforms, as well as software components.

The section should also describe Information and Communication Technologies (ICT) infrastructure for the pilot and its availability.

1.4.3 Ecosystem partners responsibilities

The section describes pilot ecosystem partners, their roles, impact and commitments.

1.4.4 Description of supportive actions

Any types of supportive actions can be described in this section, for example, needed research activities, various workshops, methodology and actions for citizens' engagements, authorities' engagement, pilot feasibility checks, agile piloting activities, working with testing groups, user targeting, etc.

1.4.5 Internal and external dependencies

The internal dependencies that affect the pilot operation are relations with other work packages and their deliverables (WP2, WP4, and WP5) and dependencies within the deliverables, schedules, and resourcing of other tasks of the same WP3 package (e.g. task T3.3).

For example, pilot depends on WP2 in terms of architecture compliance, data marketplace availability.

Pilot roll out and execution is strongly dependant on availability of baseline services and schedule for initial application development in each RZ.

Pilot depends on WP4 regarding validation protocols and procedures.

1.4.6 Description of sustainability mode upon project completion

The section describes short and long-term perspectives on the applicability and dissemination of the project results. Besides, it also specifies the actions to be performed, possible future agreements, business models, and describes any other activities to be performed to ensure a sustainable future of the developed innovations. Furthermore, it should also cover necessary activities in order to ensure smooth transition from the pilot mode to fully functioning product (if applicable).

1.5 Coordination and collaboration between different RZs

Working on this deliverable has required close collaboration and co-working between all reference zones. The deliverable has been produced as a joint effort from project managers, City representatives, and technical people from each reference zone. The work was coordinated on weekly meetings (2 meetings on Wednesdays - WP3 task leads, WP3 task force) and face-to-face meetings in Porto (May, 2018) and Bilbao/Santander (June, 2018). Dependencies with other work packages (WP2, WP4) have been discussed and resolved on City Forum meetings and joint F2F meetings in Porto and Bilbao/Santander.

2 Antwerp

2.1 Pilot motivations, use cases, expected results, after pilot life

The pilot will consist out of an open web application that provides information regarding bicycle use in the city of Antwerp. It will provide insight in the average speed of cyclist in the city of Antwerp and the availability of bicycles in docking stations of the company Velo. The application will be used by citizens and users of the mobility department. It provides a way for the mobility department to visualise and share their data. The data will be coupled to the analytical tool of the city, IBM Cognos [2], here extensive reporting can be done on the data. The influence of major construction sites on the average speed of bicycles and the amount of cycling accidents in the City are of interest for the mobility department. The data can be used to improve the bicycle network in the city of Antwerp and influence policy decisions.

Historical data in the form of GPS tracking data of the mobile application “Ring Ring” [3] will be used to calculate the average speed on road segment level in the city of Antwerp. This information could be used by route planners to improve suggested routes. In addition, live information will be received in the platform in the form of the capacity of bicycle docking stations. Citizens can use the application to gain information on velo stations and the average speed in streets. The framework of SynchroniCity will be used, and the code will be shared with the SynchroniCity members. The main component of the application will be a map where the user can filter between different data sources, have different views on the data and query on date range. In a later phase the platform can be extended with additional data sources like bicycle counting points in the city and live tracking data from hardware trackers.

Rombit will contribute to the overall development of the IoT-based generic services and take the lead on their deployment in the Antwerp reference zone based on the specifications of WP1 as well as city needs, and building on top of existing platforms and assets in the city (traffic data, parking platform).

2.1.1 Scenarios

The application scenarios are described in detail in the deliverable D3.5 [4].

2.1.2 Data sources

- Bicycle GPS tracking data. File based ‘RING-RING’ data as historical data.
- Real-time information on bicycle docking stations.
- Real-time cycling data: hardware trackers on a limited set (max 20) of city pool bikes (To be confirmed).
- Bicycle counting points (To be confirmed).

2.2 Description of infrastructure

2.2.1 IoT Framework

The application will be built on top of the local deployment of the SynchroniCity framework, containing data sources that are integrated via the Digipolis as well as the IMec IoT gateways. IMec will then connect to the Digipolis Orion Context Broker to make the data available. This is shown in Figure 1.

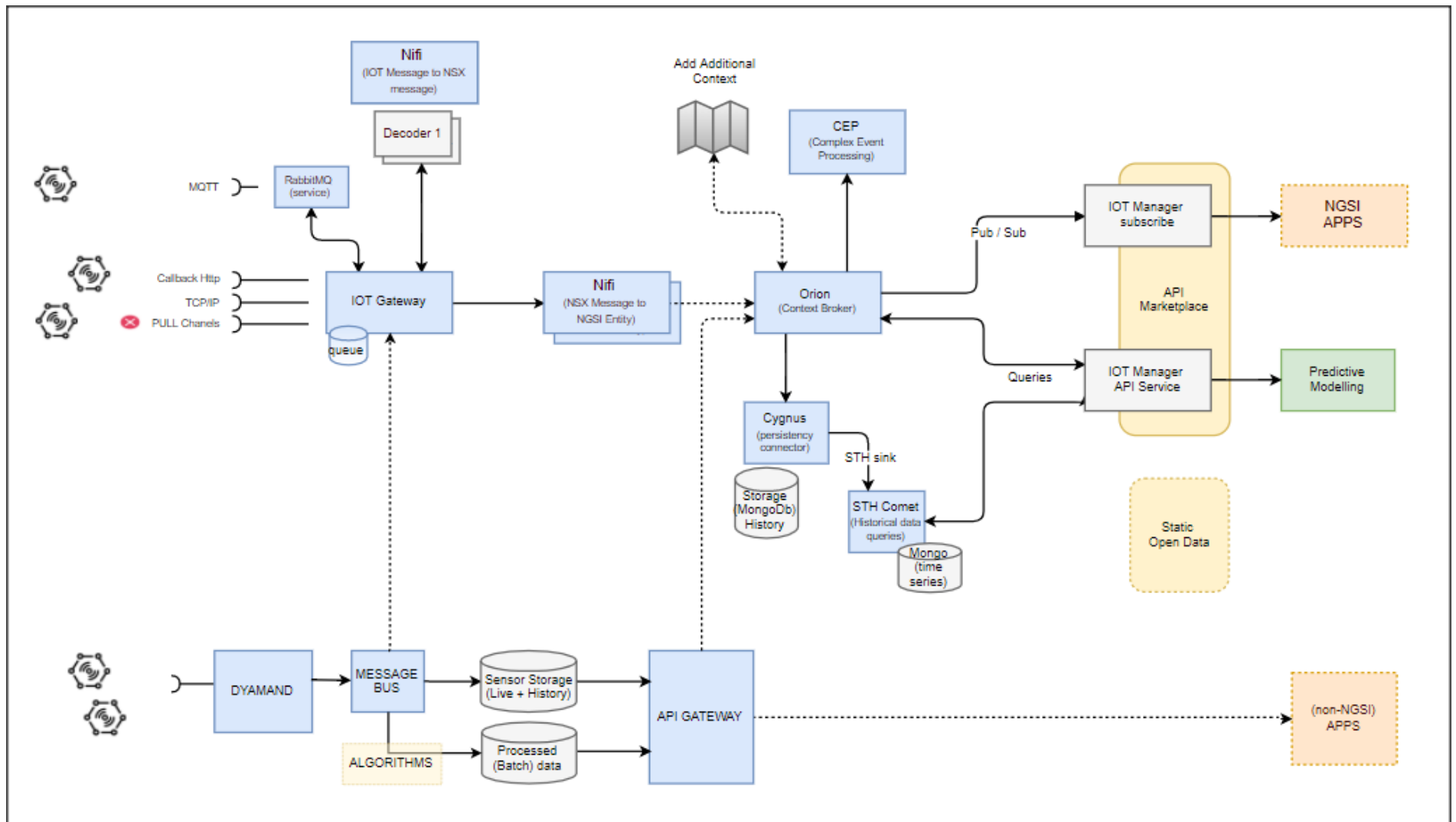


Figure 1. Antwerp IoT Framework

This same architecture can be presented in a format where the SynchroniCity framework components can be recognised with its north- and southbound interfaces (see Figure 2). This also shows the collaboration of both Digipolis and Imec datacenter infrastructure to comply to SynchroniCity framework standards.

2.2.2 Data Models

From a data model perspective, we will use the harmonised data models: Bike Hire Docking Station, Vehicle and Traffic flow observed (see Table 1).

Table 1. Antwerp Data Models.

Title	Description	Open Data/API	Fiware model
City bicycle stations.	Data regarding shared bicycle stations.	Orion	Bike Hire Docking Station
Data of the Ring Ring application.	GPS tracking data of a mobile application.	Orion and STH or CVS	Vehicle, Traffic flow observed

Row data will be translated to data model “Vehicle” extended with “timestamp” as metadata.

This row data will be published on the Orion Context data broker API and exposed on the local API marketplace.

The Rombit IoT application will pick up this data to enrich it with ‘roadsegment’ (as defined in the FIWARE data model, based on OpenStreetMap) and speed data. This data will be delivered to the SynchroniCity southbound interfaces to expose it in the data model “Traffic flow observed”.

This enriched data will be published on the STH-Commet API and exposed on the local API marketplace. Here the data will be available for both Rombit applications and 3th party application providers.

2.2.3 Hardware infrastructure

Hardware infrastructure is depicted on Figure 3.

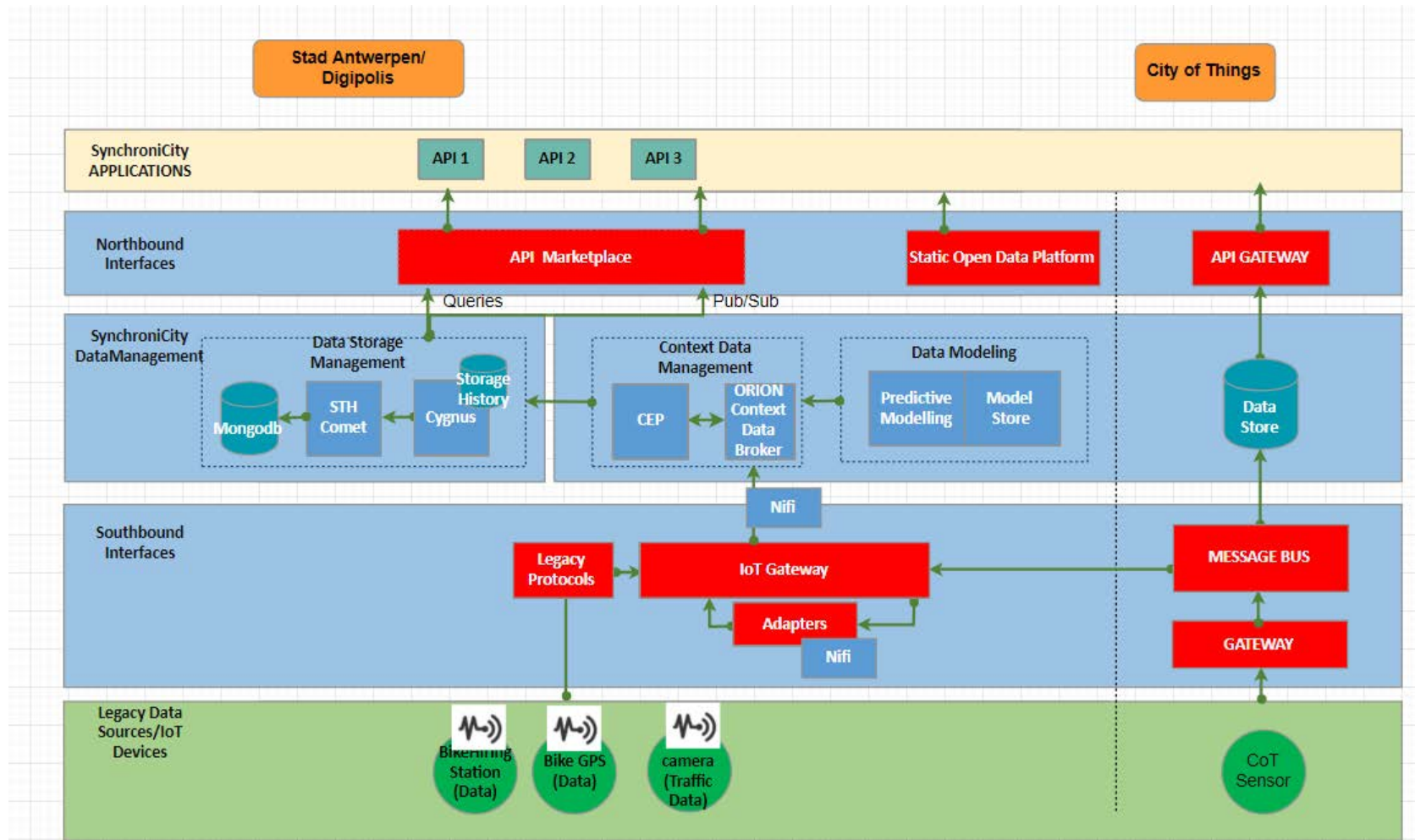


Figure 2. Digipolis and Imec datacenter infrastructure in SynchroniCity architectural framework

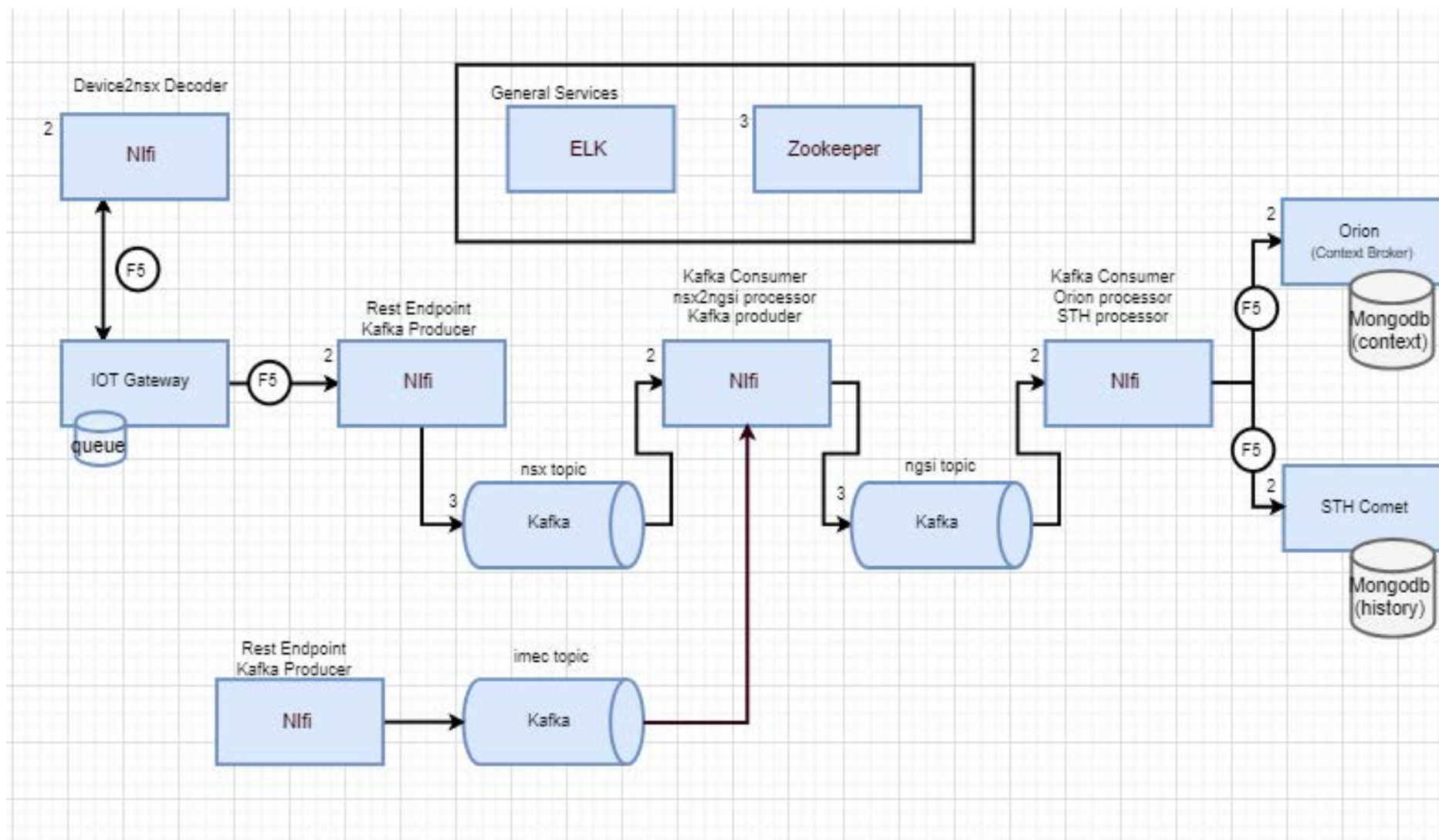


Figure 3. Antwerp Hardware Infrastructure.

2.3 Ecosystem partners responsibilities

User requirements and acceptance: Antwerp mobility department

Functional and technical analysis: Rombit

Application development: Rombit

Framework and hosting: Digipolis

Data ETL to NGSI data model. Digipolis

Architecture design: Rombit

Architecture review: Imec and Digipolis

Development coordination: Rombit

2.4 Description of supportive actions

2.4.1 Design phase

In the first semester of 2018 we had several workgroup meetings with the involved partners: City department mobility, IMEC and Digipolis struggled with the situation of lack of qualitative data for the city challenges (the city priority to improve cycling comfort and safety for bicycles).

We found solutions buying IoT data from bicycle tracking application 'Ring-Ring'. This allows us to create applications with the requested functionality. However, we will continue with our effort to find extra real-time tracking information.

2.4.2 Development phase

For development phase, our workgroup is working following Agile principles. We plan bi-weekly sprint review meetings.

We need to find extra budget for investment in HW trackers for city share bikes, or for development of data-sharing APIs on existing traffic counting devices or beacons.

2.5 Internal and external dependencies

Data source Velo API:

- Consent via data sharing charter to allow usage of the data;
- Testing the real-time Clearchannel API: We are the first user, with related risks.

Data source 'ring-ring' Consent via data sharing charter to allow usage of the data. Data integrity for the 'speed' information is unsure. Rombit will take the risks for validation and improvement of this valuable data source.

We hope to find extra budget for investment in HW trackers for city share bikes, or for development of data-sharing APIs on existing traffic counting devices or beacons. No external dependencies.

2.6 Description of sustainability mode upon project completion

Application source code is shared on GitHub [5]<https://github.com/> for developers. As it was agreed among project partners the code will be shared later via GitLab [6].

The solution can be integrated in the future Mobility as a service platform. Raw and enriched data as provided during the project, will remain available for future consumers on the local SynchroniCity framework.

The solution is open to be extended with new data or functionality. Future projects can provide data to the existing SynchroniCity framework. The city has project for extra counting beacons for non-motorised traffic in the city. After translating the raw data to NGSI formats via our local SynchroniCity framework, we can integrate it to these developed enrichment and application solutions.

3 Carouge

3.1 Pilot motivations, use cases, expected results, after pilot life

The city of Carouge contributes to the Multimodal Transportation theme (MMT) with two applications: Smart parking assistance and Smart noise application. In the scope of Smart parking service running in Carouge, parking sensors are installed in the city parking places and provide real-time parking availability data. At the moment, bus stop information is also integrated in order to give citizens information on the closest public transportation near the parking places. In the scope of noise monitoring service, noise sensors are installed in the streets where restaurant and bars are clustered.

Detailed scenario schema, user profiles, scenarios, functional and non-functional requirements and available data sources have been provided in deliverable D3.5 [4].

3.1.1 Smart parking assistance

Finding an available parking slot in the city of Carouge is time consuming and generates unnecessary traffic in the streets. The “Smart Parking Service” will give benefits to citizens who come to Carouge by car helping them to find a parking place in an improved way. The real-time information is provided in cluster level and a detailed street level in a map. The interactive map (see Figure 4) also allows the users to set a cluster by themselves to give advanced search results fitting to the users’ needs. The integrated bus stop information helps citizens to find connecting public transportation to move around the city without their cars.

Apart from the benefit of the user perspective in terms of economy, time and comfort, the city council will also be benefited in terms of reduction of traffic, traffic accidents, contaminants and a general quality of life improvements. The City Council can retrieve all the data to get a better knowledge of the current parking situation and can design necessary policies and city projects.

3.1.2 Smart noise monitoring

The “Smart Noise Monitoring Service” will contribute to improve the quality of life of Carouge’s citizens. By providing noise levels of the streets, the City Council can have precise information on the noise levels created by the traffic such as cars, trucks or public transports on the streets where restaurant and bars are clustered. As the sensors are located at different height levels, the city will be able to create a 3D map and monitor the evolution of noise in the streets.

3.1.3 Platform integration and Street Map application

Furthermore, the city of Carouge is currently developing a Smart City Platform using SynchroniCity components. All data from the two services described above and further planned services (such as air quality monitoring) are fed to the platform which enables the integration of all the information and generates further services by orchestrating the data. The data is provided in a map tool together with graphs and supplementary popup information. Later it can be enhanced to provide dashboards to different users who have different levels of responsibility.

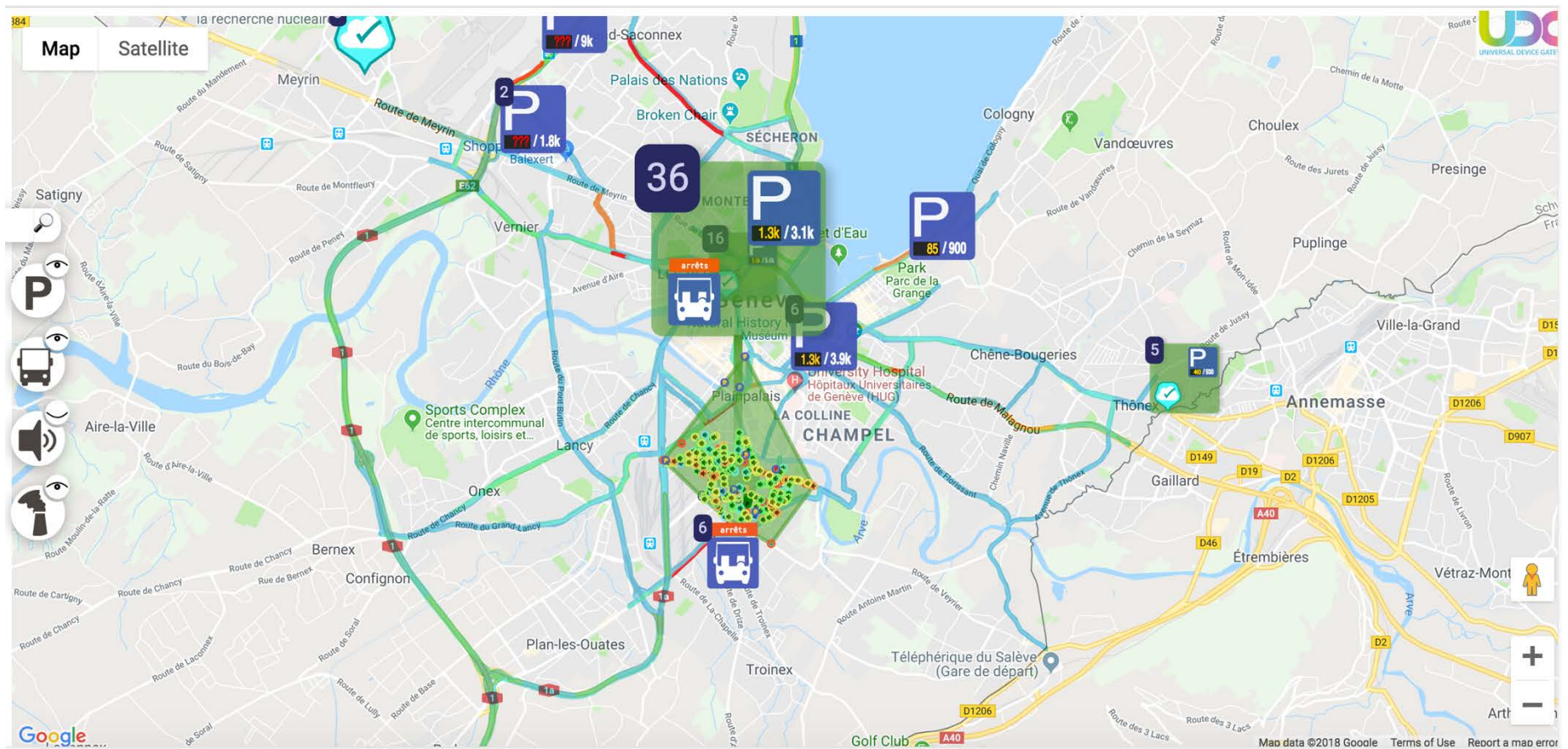


Figure 4. The interactive map of Carouge.

3.2 Description of infrastructure

3.2.1 Data providers | Sensors

Table 2. Carouge Sensor Data Providers

	Parameter	Data Model	Data Provider	Sensing Infrastructure
Parking	• Parking Slot Status • Available Spot Number • Bus Stop • Occupancy Rate	• ParkingSpot • OffStreetParking • SAN bus data model • TrafficFlowObserved	City of Carouge	Carouge parking sensor infrastructure and system
Noise	Noise	NoiseLevelObserved (FIWARE)	City of Carouge	Carouge noise sensor infrastructure and system

3.2.2 Data providers | Databases and web services

Integrated Street Map tool, based on Google Map API

- Three services are integrated into a street map.
 - Parking availability indicated on the street level (clustered information is also provided.)
 - Average value of noise level in streets (graphical view by clicking)
 - Public transportation data (Bus stop with bus no. and direction of the buses.)
 - Traffic flow on the streets of Carouge
 - Some air quality sensors (PM₁₀, NO₂, O₃)
- Data provider: City of Carouge, (Databases and web services are provided by UDG Alliance)

3.2.3 Components

Parking service:

- Free parking location on street: Context Information (ParkingSpot, OnStreetParking, entities)
- Free parking location underground: Context Information (OffStreetParking entities)

Noise monitoring service:

- Average noise level on street: Context Information (NoiseLevelObserved, entities)

Bus stop:

- Context Information (Bus stop, entities)

3.2.4 Urban Platform

The Carouge Smart City platform is described in deliverable D2.8 [7] and will provide support not only the Carouge RZ pilots, but also to the Open Call. The following Figure 5 shows the components to be used in Carouge for SynchroniCity pilots.

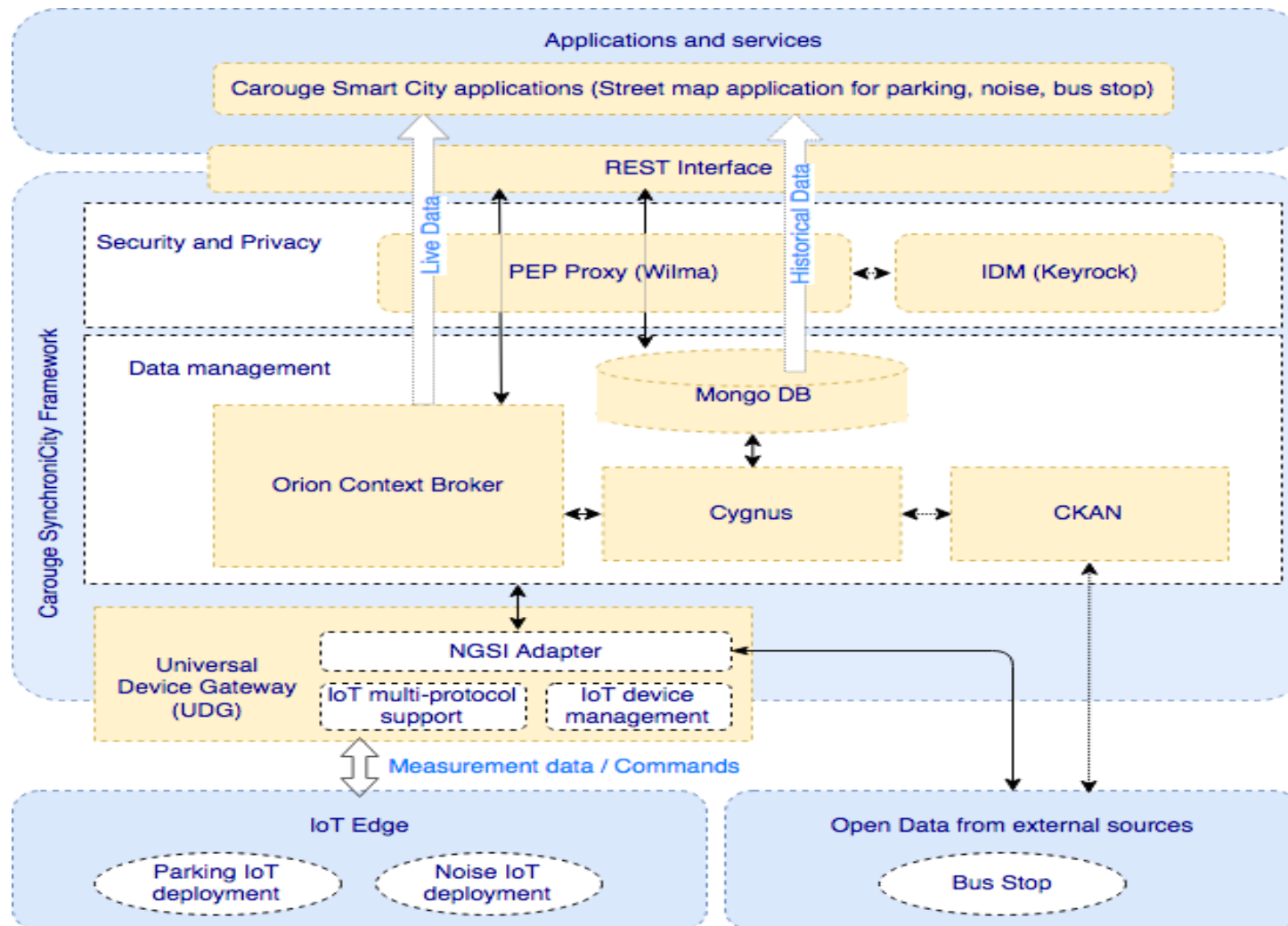


Figure 5. Components of Carouge Smart City platform to be used in pilot.

3.3 Ecosystem partners responsibilities

In the city of Carouge, the City Council takes care of the policy issues on the SynchroniCity pilot services including decision on open data, type of services to be deployed, level of authentication for different users, etc. For the implementation of the platform and services, UDG Alliance and Mandat International take care of all technical issues related to the platform implementation and integration and service development.

The responsibilities of the partners entail the following:

- Carouge City Council: political leadership, city policies, service type, data providers and consumers, end user policies, post-project sustainability assurance, decision on the data sources from the external providers.
- UDG Alliance and Mandat International: technical support, advisors on overall smart city infrastructure, sustainable development of the pilots, training and dissemination.

3.4 Description of supportive actions

The city of Carouge continues its effort on enrichment and enlargement of its Smart City Service. At the time of writing this document, an implementation for an air quality measurement service is in progress. In addition, the city of Carouge is supporting research activities using its Smart City platform and open data.

3.5 Internal and external dependencies

The internal dependencies are related with the other WPs of the project, mainly with WP2 on the SynchroniCity compliant platform components; WP3 on the availability of baseline services and their adaptation, and WP4 on the technical validation as well as stakeholder validation. Regarding the development of the pilots, Carouge, UDG Alliance and Mandat International are the partners with maximum dependence.

The external dependencies are mainly related to the flow of external data coming from external data sources.

3.6 Description of sustainability mode upon project completion

City of Carouge is developing the platform and pilot services keeping in mind their sustainability beyond the project. It is the first Swiss city implementing international standards based on multi-domain, multi-platform interoperable smart city solutions by the support from UDG alliance and Mandat International. Together with its technical partners, City of Carouge actively engages smart city research and innovation activities where the city platform and pilot applications are applicable and will continue to do so upon project completion.

The service platform is developed in a flexible manner to ease integration of other services in the future.

The knowledge acquired during pilot deployment will lead its success of the further development and deployment in a larger scale. All the stakeholders (citizens, municipality officers, decision-makers and local IoT companies) will involve the evaluation of the pilot services and the results will be used as an input for the further service development. This round-robin methodology will bring efficient and sustainable maintenance and growth of the further development.

4 Eindhoven

4.1 Pilot motivations, use cases, expected results, after pilot life

Bicycles are an important transport modality in the city of Eindhoven, which is already known for the many bicycles in the city. The main goal for the pilot applications are to improve the traffic flow for cyclist in balance with motorists traffic.

The use case is described in detail in D3.5 [4]. In the basic scenario, the improvement of traffic flow is primarily based on influencing the cyclist and in the advanced scenario's a step is made to influence the traffic management system. The pilot concentrates on one collected data will be made available to the SynchroniCity platform and the applications will be developed based on data from the SynchroniCity platform.

4.2 Description of infrastructure

Data providers/sensors and the actions needed to have data available in the correct data models.

- **ATOS**
 - Thermal camera data endpoint
 - Waiting bicycle counter data endpoint
 - 'translation' to the standard 'Vehicle' data model
 - SynchroniCity VLOG data endpoint; VLOG is a data set coming from intelligent traffic lights.
 - 'promotion' of Ivera/VLOG to European/FIWARE data model
 - *optional*: TLEX (Traffic Light EXchange) data endpoint
 - 'translation' to the standard 'Traffic Flow Observed' data model,
 - AiREAS data endpoint
 - 'translation' to the standard 'Air Quality Observed' data model
- **Heijmans**
 - FLIR ThermiCam V2X [8] thermal camera (Type of modality, Number of cyclists, Heading, Speed)
 - Waiting Bicycle counter (possibilities to be determined) (Type of modality, Count of waiting cyclists, Headway/origin (parallel on ring road, or from crossing road))
 - Waiting time Bicycle indicator (possibilities to be determined) (Bright LED lights, counting down waiting time)
 - Bicycle speed indicators (possibilities to be determined) (Green 'running LED lights, indicating more or less power to the bicycle pedals)
- **Technolution**
 - Mobimaestro [9] (traffic management system) (Secure VLOG data endpoint to SynchroniCity, 'Import' SynchroniCity advice in MobiMaestro with 'Generic json import' or DWM Exchange module)
- **DTV consultants**
 - 'translate' SynchroniCity advice from MobiMeastro into scenario's and VLOG return message(s)
- **Dynnic**
 - (re)programme' the iTLC street cabinet, based on new/translated scenario's and/or VLOG return message(s)
- **Municipality**
 - Passing cyclists counter display (possibilities to be determined)
 - Waiting cyclists counter display (possibilities to be determined)
 - Flo cyclists speed advice 'poles' (possibilities to be determined)

- My040Routes Local Traffic Tracking Data (to be decided), as described in paragraph 3.4.1.2 of D2.8 [7].

During the pilot operation phase, until the end of the SynchroniCity, project the newly installed IoT infrastructure (Flir thermal cameras, Waiting Bicycle counters, Waiting time Bicycle indicators and Bicycle speed indicators, as described above) are maintained by Heijmans. The thermal camera's and indicators will be installed by Heijmans (not part of the SynchroniCity project) as additional sensors to provide the necessary data. Heijmans will maintain these for the duration of this project. However, Heijmans will not keep paying for maintenance for eternity. If it's successful and the city wants to keep the sensors and indicators we will need a maintenance contract. If not, the hardware will be removed.

ATOS is responsible to keep the data end-point, the data (model) translations, the applications and the system software and data centre up to date and available for the duration of the SynchroniCity project.

All other newly installed IoT infrastructure, data endpoints, interfaces/'translations' and (re)programming are maintained under responsibility of and management by the Municipality.

4.3 Ecosystem partners responsibilities

- Municipality of Eindhoven:
 - Use cases, locations, permits for installation of physical goods, ICT, civil engineering and traffic management expertise, (backup) architecture/integration, funding additional budget and costs
- ATOS Netherlands:
 - Lead architect, implementation and installation of pilot hosting environment
- ATOS Spain:
 - Data endpoints, data (model) 'translation', Software/Application development
- Heijmans Infra:
 - Installation physical goods in the City of Eindhoven, maintenance of physical goods for the duration of SynchroniCity project and sending the sensor data real time to the ATOS pilot server for the duration of SynchroniCity project
- DTV consultants
 - The 'translation' of SynchroniCity advices in MobiMaestro into scenarios and VLOG return message(s)
- Dynnic
 - The '(re)programme' the iTLC street cabinets
- Technolution
 - Provide secure VLOG data endpoint to SynchroniCity and 'Import 'functionality for SynchroniCity advice in MobiMaestro with 'Generic json import' or DWM Exchange module

4.4 Description of supportive actions

Parallel to this project Heijmans and Philips Lighting (former partner in SynchroniCity) work on the project "Jouw licht op 040" [10] in Eindhoven. In this project public lighting is renewed, upgraded and maintained. New sensors will be installed as well, especially regarding public lighting. These sensors could be used for SynchroniCity as well. Within this project there is also an open call to introduce new innovations. If possible a connection between the two projects will be made. The open calls of both projects could strengthen each other.

4.5 Internal and external dependencies

- Internal
 - Approval of/agreement on location and installation of the IoT infrastructure and data sets (as described above), including availability/funding of additional budgets and costs by all RZ eco-system/sub-consortium partners
 - Allocation of needed resources of traffic management department Eindhoven
- External
 - Availability/funding additional budgets and costs for new sensors from “Jouw licht op 040”. For this we need Philips Lighting on our side.

4.6 Description of sustainability mode upon project completion

Eindhoven as a multifaceted city and organization developed several perspectives to shape the vision and traffic approach 'Eindhoven on the Road' that include guiding and innovating of traffic management. The SynchroniCity pilot has provided a framework for this initiative. The results of the pilot will be involved in shaping a further upscaling over the remaining part of the 12 km long urban ring road and other cycle routes and analyzing the data for better insights.

In addition, the municipality is collaborating with its partners Heijmans and Signify (formerly Philips Lighting), using the existing IoT infrastructure, in innovations to improve the quality of life in this area. In addition, the municipality is collaborating with its partners Heijmans and Signify (formerly Philips Lighting) in the project “Jouw licht op 040” (see [10]). The project includes the co-creative development of innovative (light) applications in the public space, as well as the maintenance and management of public lighting in the municipality.

Eindhoven and ATOS Netherlands intend to continue their long-running collaboration in using FIWARE and by extension the SynchroniCity platform as the standard for harmonizing data from anywhere in the city and providing applications as well as analytical / visualisation capabilities on top.

5 Helsinki

5.1 Pilot motivations, use cases, expected results, after pilot life

The main goal for the Helsinki pilot is to extend currently used the journey planning application by adding environmental parameters, such as air quality on it. The users can select a route to avoid the most polluted areas and times. The service is targeted for pedestrians, cyclists and in general for persons who suffer from polluted air.

Air Quality in Helsinki Region is already illustrated on Helsinki Region Environmental Agency website [11] but there is willingness to publish this information in other channels for bigger audiences. The other parameter which can be added on the journey planner is noise. There is already good noise model available in Helsinki. At the moment, the noise will be an option if the air quality data will not be available.

The typical use case could be described as following:

Alice has a 6 months old baby so she usually moves along the city with her pram. She likes to walk with her baby in a big park on the other side of the city. If the weather is fine, she usually walks part of the way to the park. If there is a possibility of rain, she may combine a walk with a bus ride.

The Journey Planner with air quality information app offers her all the possible combinations, including bus lines, metro and urban mobility infrastructures, so Alice can configure her path before leaving home. It also includes current information about noise and air quality, which allows her to avoid crowded, noisy and polluted streets,

The main target groups also include cyclists and people with health problems like asthma.

From the city point of view the main objectives are to increase public awareness about environmental condition in different city parts at different times and seasons, to change people behaviour of how do they select their routes and choice of transportation, to provide better services for risk groups, and in the long term to impact citizens' choices in order to improve air quality and comfort.

For more details see Use Case description in [12] (page 10).

The criteria of pilot success are to understand and test a new model of people behaviour based on increased environmental awareness and develop initial services further by including this feature permanently into Journey Planner application (see Journey Planner) as well as introducing a change in the core platform OpenTripPlanner (OTP) [13] that enables integration of more different types of sensors/parameters.

OpenTripPlanner is a family of open source software projects that provides passenger information and transportation network analysis services. The system combines transit, pedestrian, bicycle, and car traffic using widely available, open standard OpenStreetMap and GTFS data [14]. The service can be accessed directly via its web API or using a range of Javascript client libraries.

5.2 Description of infrastructure

5.2.1 Data providers | Sensors (see data flow on Figure 3)

Table 3. Helsinki Sensor Data Providers

Parameter	Data Model	Data Provider	Sensing Infrastructure
Noise	NoiseLevelObserved (FIWARE)	FVH	3 CESVA sensors

See data flow on Figure 6.

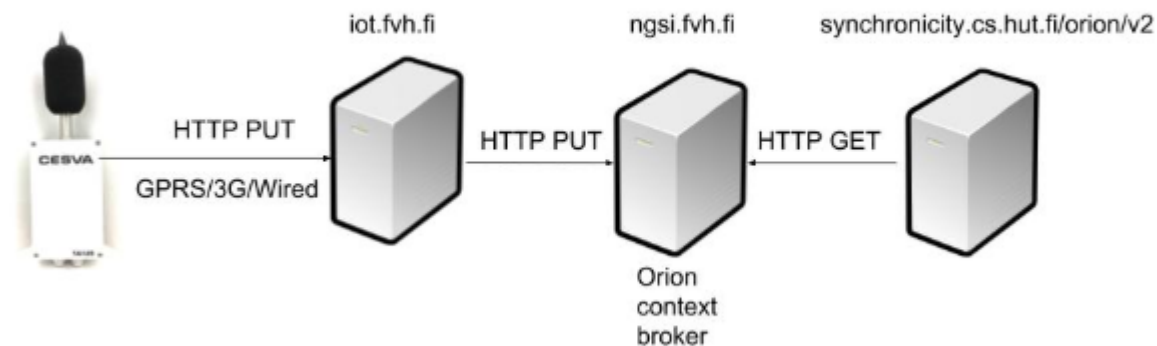


Figure 6. Sensor data flow for Helsinki case

5.2.2 Data providers | Databases and web services

- **Finnish Meteorological Institute**
 - Air pollutants
 - Parameters: SO₂, NO_x, NO₂, PM₁₀, PM₂, PM₅, TRS, CO, O₃
 - Data model: WFS, WSM, GML, INSPIRE
 - Weather
 - Parameters: Wind speed, wind direction, gust speed, air temperature, relative humidity, dew-point temperature, pressure, precipitation amount, horizontal visibility, cloud amount, present weather (weather type)
 - Data model: WFS, GML, INSPIRE
 - Weather Forecast
 - Parameters: GeopHeight, Temperature, Pressure, Humidity, WindDirection, WindSpeedMS, WindUMS, WindVMS, MaximumWind, WindGust, DewPoint, TotalCloudCover, MediumCloudCover, HighCloudCover, Precipitation1h, PrecipitationAmount, RadiationGlobalAccumulation, RadiationLWAccumulation, RadiationNetSurfaceLWAccumulation, RadioationDiffuseAccumulation, LandSeaMask
 - Data model: WFS, GML, INSPIRE
- **HSL (Helsinki Regional Transportation Agency/Digitrasiit)**
 - Public transportation
 - Public transportation data (schedules, routes, lines, stations/stops, etc.)

- Data model: GTFS
- Data provider: HSL (Helsinki Regional Transportation Agency/Digitrasit)
- Real time vehicle tracking via MQTT/JSON
- Bike Hire Docking Station
 - Parameters: location, name, state, totalSlotNumber, freeSlotNumber, availableBikeNumber.

5.2.3 Components

- Multimodal Transportation
 - Multimodal journey planner: DigiTransit [11]
 - Multimodal trip planner and analyst: OpenTripPlanner
 - Route data: OpenStreetMap (OTP)
 - Schedule data: GTFS
 - Map Service
 - Geocoding Service
 - Front end UI Journey Planner
- Environmental information fusion service ENFUSER

5.2.4 ICT infrastructure

Helsinki RZ infrastructure involves:

- An instance of the Digitransit platform for journey planning/navigation app, modified to utilize environmental data for routing. This modified platform is managed by Metadata Oy, a 3rd party.
- Finnish Meteorological Institute [15] (FMI)'s internal infrastructure, which provides the main environmental data sources.
- An instance of SynchroniCity architecture in the premises of Aalto University. This is in practice a virtual machine with Linux Ubuntu LTS. The Orion Context Broker will primarily provide noise data received from FVH's service, possibly FMI's environmental data transformed from the INSPIRE directive, and online or offline Helsinki city repositories such as points of interests and bike rental stations (see Figure 7).

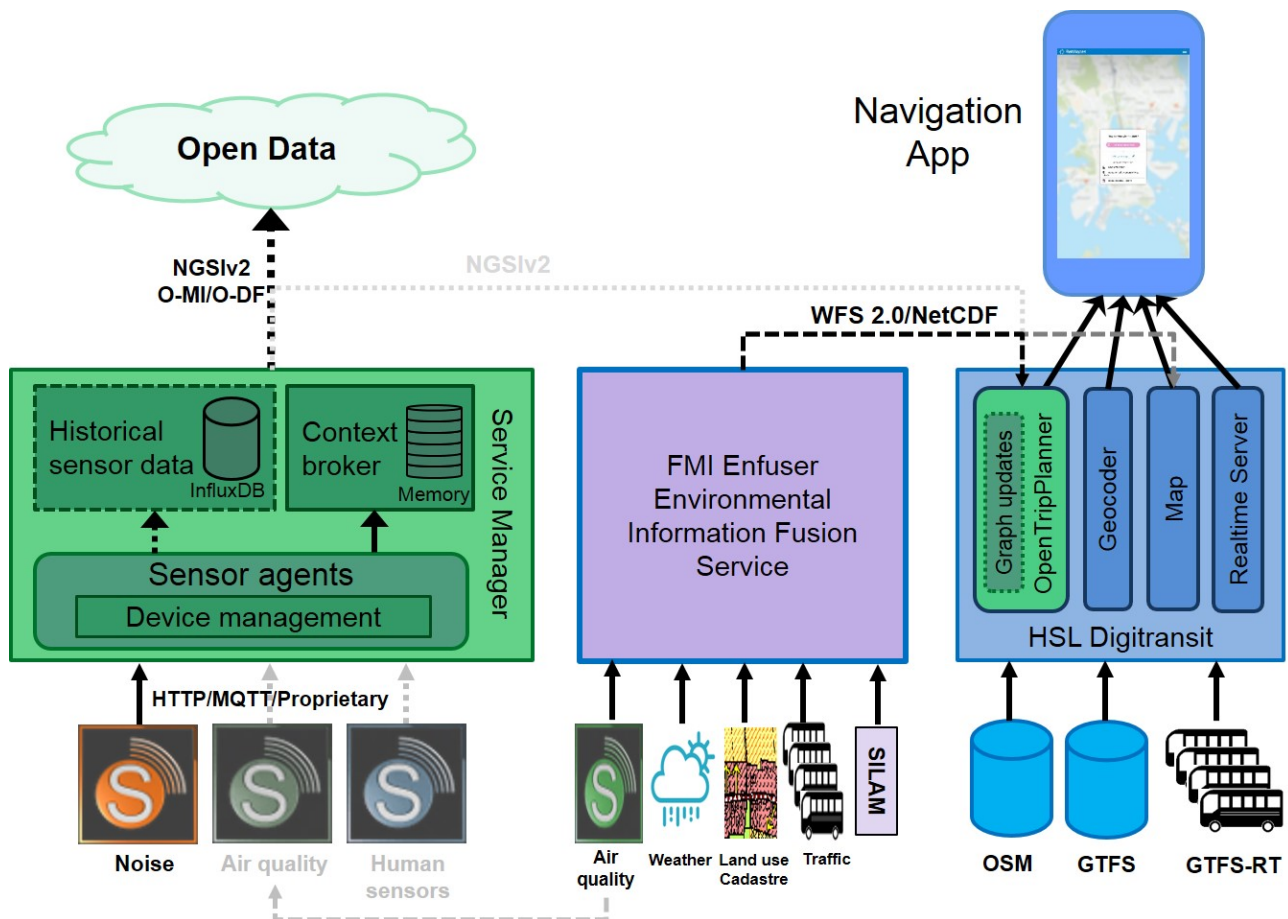


Figure 7. Helsinki ICT infrastructure for pilot.

5.3 Ecosystem partners responsibilities

FVH (Forum Virium Helsinki OY) [16] - project lead participates in several work packages and coordinate contributions from different partners; city representative provides necessary connection to the city authorities, coordinate city/SynchroniCity cooperation, represent the city's decision makers, provide necessary data;

Aalto University - architect, technical partners, gateway hosting for NGSi create technical concepts, implements core elements of the system, provide technical support;

Metatavu OY - implementation of SW components of initial application and pilot servers' hosting;

HSY (Helsinki Region Environmental Services Authority) - advisers for air quality related issues;

HSL (Helsinki Region Transport) - journey planner owners and developers.

The ecosystem partners have regular meetings to follow the progress of the development of initial applications.

5.4 Description of supportive actions

Identifying and planning of different supportive actions is ongoing project task.

In order to get insight into user experience in using the initial applications and provide feedback to the developers the pilot will actively employ HSL users' testing group.

There is a plan to engage into pilot different types of interested groups, such as people with health problems [17], cyclists [18].

5.5 Internal and external dependencies

There are several internal dependencies and methods to manage these dependencies and to resolve the issues with them.

The dependencies related to the SynchroniCity architecture are handled together with WP2 and documented as interoperability points and APIs.

The dependencies with other WP3 tasks (T3.2 and T3.3) are related to the availability and maturity of baseline services and resolved in weekly WP3 meetings.

An important dependency to be followed is related to the possible reusing of software components already developed for other applications. For example, Milan geoportal considers using Helsinki Trip Planner. The reusing of the developed software has a direct impact on the development of initial applications and thus affect pilot deployment schedule. These dependencies are handled in tasks T3.2 and T3.3.

The validation from a technical, user, stakeholder and market perspective will be performed by WP4, and the pilot is dependent on acceptance protocols and procedures that will be defined and performed by WP4 (described in [1]).

The pilot is also dependent on Helsinki City municipality and Aalto University infrastructure that will be exploited for pilot deployment and operation.

The external dependencies emerge mainly from data providers. In Helsinki case noise sensors are installed by the project. The air quality data is coming from the external provider - Finnish Meteorological Institute [15], and the data integration, granularity, availability and formats are still under discussion.

5.6 Description of sustainability mode upon project completion

There are two main influencers on future sustainability - Helsinki Regional Transport Authority (HSL) and Open Trip Planner community and Digitransit (the Finnish adaptation of OTP, Journey Planner).

HSL has an authority to accept/reject implementation of initial applications by the end of pilot. HSL will decide whether and how they would utilize the results of the pilot, e.g. do they incorporate new environmental features into their product, how do they otherwise utilize the project results. HSL will make this decision based on evaluation of technical criteria, test user's feedback, and number of downloads of the beta application. The application will be publicly available for certain period of time. HSL journey planner can only have limited functionalities. The air quality application must bring real additional value for the users.

Application source code is shared on GitHub for developers. As it was agreed among project partners the code will be shared later via GitLab [6].

There is ongoing discussion between involved project partners and other ongoing projects how to reuse the results of the development of Initial Applications in future. One option is that the solution will be integrated in the future Mobility as a Service (MaaS) platforms for cities.

No budget is reserved for operational support or maintenance after the project.

Air Quality application has dependencies on Digitransit and OTP platforms. OTP community and Digitransit will evaluate Air Quality application in order to decide whether it can be integrated to the platforms.

6 Manchester

6.1 Pilot motivations, use cases, expected results, after pilot life

6.1.1 Motivations

Currently the Manchester City Council, like many municipal organisations, often works in silos and would benefit from a more agile and efficient system to coordinate cross-departmental teams. Manchester is unique in that it has been chosen as the U.K.'s Smart City demonstrator, with a £16 million-pound investment in the project, titled CityVerve. This project has allowed Manchester the opportunity to pilot IoT technologies over a two-year period from 2016-2018, and collect various real time and static datasets. For the SynchroniCity project, we are planning to use these datasets to inform the implementation of the Community Policy Suite. We plan to leverage IoT technologies combining sensor data, devices, cloud and mobile services to quickly adapt the deployment of policies to the local needs of a specific area of the city.

The Community Policy Suite will enable us to test, challenge and drive community-led needs, through analysis of data, deploying of policy in a real-world situations and testing efficacy of the solutions, enabling us to dynamically improve the services we provide through the collection and analysing of data, and dynamic service design.

The agility application is intended to:

- Enable faster realization of challenges (or rising challenges)
- Make data visible to the relevant stakeholders
- Enable faster and more intelligent way of forming cross-functional teams in the council
- Facilitating a faster and more efficient way of responding to challenges
- Enable organizational learning and dissipation of such learnings by making expertise visible

6.1.2 Use Cases

Live data on challenges, when shared with all the relevant stakeholders in a speedy manner, can/should lead to:

- Creation of a shared vision and purposes
 - All the relevant stakeholders will be informed and will invest their work in to a common purpose (solving the challenge)
 - Ignites a dialogue and collective co-ordinated actions towards a same end
- Actionable strategic insight
 - Day to day operations of service delivery staff are guided by concrete evidence
 - Enables frequent (sometimes live) feedback on performance to policy makers, leaders and team members
- Flexible resource allocation
 - Frequent evaluation of performance can help decision makers on increasing / decreasing efforts and resources allocated to tasks
 - Key resources (for example key individuals) are deployed and redeployed according to priorities and in between initiatives more effectively.

At the most primitive level, data processing should be done at two levels of Metrics (alerts based on predefined and flexible measures), and Indicators (rising trends). The insights generated from the data are transmitted to at least two group of actors within the council:

- High level decision makers (policy makers);
- Senior relevant operational managers (team leaders).

These people should decide on the level of importance, and whether it requires a new team (see above). Depending on the flexibility, and appropriateness, the data should become available to a wider group of stakeholders. Therefore, it is essential to incorporate a functionality that allows permissions of access to data according to predefined variables (for example seniority of the people involved, the relevance to the projects, etc.).

Such approach and visibility in the decision-making process, creates an *action-oriented architecture* that result in:

- Clear decision-making process, which could enable multiple stakeholders making decisions faster and more efficiently leading to more active partnerships
- People closest to where actions are required became aware of challenges and can make decisions accordingly
- Room for more effective resource allocation by better allocating tasks to existing teams, or creating synergies between various teams

Individuals, teams, and units are evaluated by cross-departmental metrics and targets meaning all the people tasked within a project share same performance metrics and incentives. Continuous feedback is given internally to all the members/stakeholders involved according to progress against targets and outcomes. Additionally, a transparent decision-making process leads to *shared leadership* that enables:

- Leader(s) to better inspire members by allowing them to actively participate and see the organisational and strategic decisions that affect their work
- Creation of an environment where coaching and development, and expertise and experience are more valued than units, organizational structure, and hierarchical authorities
- Creates a potential ecosystem where internal and external stakeholders can contribute the decision-making process

6.2 Description of Pilot Infrastructure

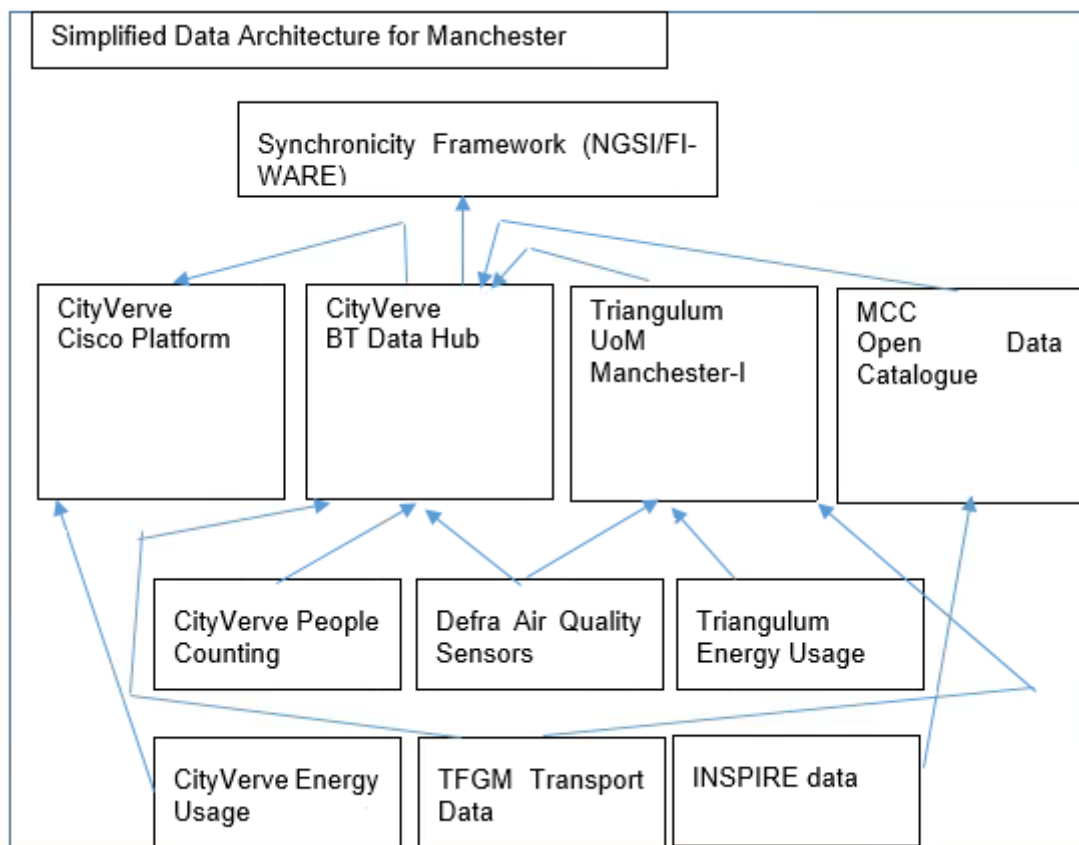


Figure 8. Simplified Data Architecture for Manchester.

The above Figure 8 shows simplified data architecture for Manchester using a sample of 6 services/datasets (People Counting, Air Quality, Triangulum Energy Usage, CityVerve Energy Usage, Transport Data, INSPIRE Data). We have a federated model with a wide range of data owners and providers, and a number of different data hubs/catalogues/platforms.

Each of these is maintained by different organisations and hosted locally by the service. Where this data is open it can be shared amongst several platforms, which will either make a call to an API or upload a static dataset on a regular basis. - The city's own data catalogue provides a single-entry point to find out what data is available but doesn't provide the functionality required by the smart city platforms.

The two CityVerve platforms work together – BT data hub began as primarily a transport hub, but has expanded to include other data and this also is part of the "platform of platforms" available through Cisco's programmable city API. Triangulum's data platform, maintained by the University of Manchester, has some unique data which can then also be accessed via BT data hub. - In order to provide some standardization, the Hypercat [19] standard is applied to data on the BT data hub.

The above diagram indicates how the city, as a non-FI-WARE installation will interact with the SynchroniCity architecture. There will be a single point of integration via data that is on the BT hub which will then be converted from Hypercat format into NGSI format.

Access to the city data from SynchroniCity partners, open call applicants and the SynchroniCity data store will therefore be available in a single place. A local install of Orion Context Broker will be required to enable this. Conversion of datasets to NGSI format will be undertaken by the Digital Catapult, and we perceive this will be an ongoing process as we on-board more services to the city's IoT infrastructure.

The strengths of the model above see a “loosely coupled” system that does not proscribe particular technologies for new sensors and services, but provides an incentive to make data from those available via a shared city platform which can then provide easy access to other data. From a SynchroniCity point of view, this provides a single point of entry (BT hub) into Manchester data. Where datasets are required but not currently on the hub, we will be looking to ensure on-boarding in line with demand.

6.2.1 High level theme and service domains

Manchester will be participating in the Community Policy Suite theme. As this theme does not require the installation of new sensors, and the theme is about developing agile governance across different services we are not limited to a single data set or data type. However, during the development of the baseline service, in order to prove the concept (as detailed in [12]), we are working to identify challenges that utilize a range of existing data sets.

Real Time data

- Air quality monitoring
- People tracking
- Cycle & car counting
- Cycle journeys
- Building energy usage
- Parking data

Table 4. Manchester Data Types

Air quality monitoring. Live <i>Air Quality</i> readings from sensors at key sites around the city	Noise
	PM ₁
	PM ₁₀
	PM2p5
	Humidity
	Heat
People tracking	People Counting – Oxford Road and Portland Street (Camera)
	People Counting – Albert Square (Camera)
	People Counting – Railway Stations (Wifi)
Cycle & car counting	Cycle counting – Oxford Road
	Cycle counting – Albert Square
	Vehicle Counting – Oxford Road
	Vehicle Counting – Albert Square

Cycle & car counting	Cycle counting – Oxford Road Cycle counting – Albert Square Vehicle Counting – Oxford Road Vehicle Counting – Albert Square
Cycle journeys	Seesense data Cargo bike data
Building energy usage	Half-hourly electricity consumption (kWh)
Parking data	Car park occupancy data
Other City data	Bus, tram and train routes Points of Interest Events
INSPIRE data	Compulsory Purchase Orders Planning Obligations (section 106) Smoke control orders
Transparency data	Spend by local authority
Population and Demographic Data	ONS
Street side asset data	Ordnance Survey data on wide range of street side assets

Static data

- Bus, tram and train routes
- Points of Interest
- Events
- INSPIRE data
- Transparency data (e.g. spend by local authority)
- Population and Demographic Data (ONS)
- Street side asset data (Ordnance Survey)

The subset of data that we will be utilizing will be via the BT data hub, and these datasets will, where appropriate use Hypercat as a standard.

6.2.2 City infrastructure and technical elements

Manchester has a high level of connectivity.

- 3G & 4G Networks
 - Maintained and managed by the national mobile operators (e.g. Vodafone, 3, EE)
- Public Wifi

- o FreeBeeMcr – public wifi managed by Virgin Mobile on behalf of Arqiva, who have the concession for providing this service
 - o Wifi on trams – public wifi provided for free by TfGM
- 5G
 - o None currently available
- Low Frequency Networks (LP-WAN)
 - o Sigfox – concession managed by Arqiva
 - o LORA – network installed by Cisco for use with CityVerve
 - o Things Network (LORA) – open LORA network
- FTTP
 - o Superfast fibre is readily available in Manchester via BT and Virgin (Cable) to residents and businesses.
- Localised networks

Bluetooth and Zigbee are easily deployable within Manchester
- Geospatial information

Manchester is working closely with Ordnance Survey, the UK's mapping agency, to develop next generation geospatial tools, including 3D models of our reference zone and point clouds, with a high level of granularity.

6.2.3 Installation of new sensors

We are not currently looking to install new sensors through the SynchroniCity Community Policy Suite theme, however our “loose coupling” approach to city architecture makes it very easy for new sensors to be installed, and for data from them to be shared via the above platforms e.g. via the open call.

A range of public assets are owned by the city or other partners, and our smart city district also includes a major property developer, Bruntwood (major shareholder in Manchester Science Partnerships), the hospital and two universities all of which have considerable estates they are responsible for.

The city and TfGM have access to lamp posts, bus stops and other assets for install of sensors. There is usually a cost associated, but the city can act as a coordinator to enable new sensors via the open call, or as a result of changes highlighted via the community policy suite.

6.3 Ecosystem partners responsibilities

Not applicable.

6.4 Description of supportive actions

6.4.1 Co-creation workshops

In October 2017, Manchester Metropolitan University (MMU) held 2 half-day co-creation workshops with MCC to first validate the problem identified by MMU and MCC's PPR team, second to identify the needs of MCC at an operational level and how the SynchroniCity project could respond to those needs using the Bronze Labs software, and third to further develop and customize the Community Policy Suite's methodology as developed by MMU. The workshops involved service-mapping, brainstorming and reflective/ backstaging case studies. These workshops provided an understanding of historic structure of “problem-based” teams and a validation for the need and desire of the Agile

Governance method. In response to this workshop, MMU created a customisation of the Agile Governance methodology to align the city's needs with the software output.

6.4.2 Working Together Discussion

In May 2018, MCC and MMU met with internal stakeholders within the MCC to follow up the co-creation workshop and discuss potential use cases for the methodology. Members from the Performance, Research and Intelligence team within the MCC and OS joined to discuss the decided methodology, and how to deploy that methodology through the BronzeLabs software with a use case that was relevant, viable and useful.

Several potential use cases were identified and the relevant departments managers and operational staff are being contacted and communicated with to ensure that a feasible use case is chosen and that there is buy in from MCC to adopt the methodology and software for the duration of the project to test the value of the Community Policy Suite tool.



6.5 Internal and external dependencies

6.5.1 Internal

- SynchroniCity Platform - The project is dependent on the deployment of the SynchroniCity Platform.
- Data Transfer - Currently, the majority of Manchester's data is in Hypercat format on the BT Hub. We have been working with BT and Digital Catapult to ensure that the datasets on the BT Hub are converted into NGSI format and stored on an Orion Context Broker. This requires internal management and monitoring to make sure that the appropriate conversion tool is used and that the relevant datasets are prioritised for conversion, as there are currently over 200 datasets to work with.
- Manchester City Council Adoption - It is important that internal stakeholders within the MCC are informed and consulted throughout the process to ensure that a relevant use case is chosen and that operational staff are interested in and enabled to adopt the new methodologies and software that will be developed.

6.5.2 External

- Internal/External Coordination - As the datasets are currently held on the BT Hub, the transfer and conversion of the data needs to be coordinated among internal and external parties from the SynchroniCity project. As BT are not a partner on the SynchroniCity project, we are relying on them to make the datasets available to Digital Catapult. The process and timelines for this need to be coordinated by MCC to ensure readiness for the Open Call
- Conversion Tool: The decision of which conversion tool to use for the transfer from HyperCat to NGSI has not been solidified. Three options have been identified, NodeRed, Engineering, or BT. As Engineering are a partner on the project and the tool they have created is seemingly the best aligned to our needs, they are currently the front-running option. However, their tool was only launched recently and the feasibility of using this tool has not been mapped.
- Sustainability of Data Storage/Access - As the datasets on the BT Hub are stored via the CityVerve project, the sustainability of data access is not guaranteed at this time. The CityVerve project is set to end in May 2018 and the legacy plan has not been decided. As BT are not a partner on SynchroniCity they have no obligation or formal incentive to continue sharing the datasets, or aiding in the process of their conversion.

6.6 Description of sustainability mode upon project completion

The Community Policy Suite application is being developed by SynchroniCity project partner, BronzeLabs as a commercial solution. As is the case with Porto, this is being developed without direct involvement from Manchester aside from customisations created within the scope of the project to ensure compliance with the SynchroniCity platform. However, the Manchester City Council will only have access to the application during the project duration. While MCC plan to find a viable use case to demonstrate the value of the application, the continuation of the pilot after the project duration is contingent on the business case established by the pilot.

7 Milano

7.1 Pilot motivations, use cases, expected results, after pilot life

The Municipality of Milan is involved in two pilot themes: Human Centric Traffic Management and Multimodal Transportation. The Human Centric Traffic Management pilot application is named “Decision support system for bike planning” and the Multimodal Transportation pilot application is named “Mobile navigator for disabled people”.

For both applications, the actors’ definitions, scenarios, functional and non-functional requirements, available data sources and architecture have been provided and detailed in the deliverable D3.5 [4].

7.1.1 Human centric traffic management. Decision support for bike planning

This application aims to support bike planners of the municipality to improve the cycle network by integrating useful information layers. The user interface will exploit the Municipality Geoportal Viewer (MMGV) [20] to show the information layers created integrating data from the SynchroniCity Platform and other data sources when available.

The application intends to use traffic data, bike sharing stations, parks, restricted traffic areas, public transport network (e.g. tramways), obstacles along the pavements to improve cycling mobility schemes and services in the city. By obstacles in premises we mean such installations as kiosks or drinking fountains or flower shops that can be besides the roads and pavements and it is useful to know where they are placed while planning a new bike-lanes. We have more of these information from data-sets from the open data portal of Milan. When localization of road accidents data will be available, also information about accident black spots will be integrated.

An interesting service that will be developed for the application will exploit the bike-sharing origin-destination matrix that will permit to design desired bike-lanes.

7.1.2 Multimodal Transportation. Mobile navigator for disabled people

The application is intended as mobile navigator especially designed to help people with disabilities who drive in the city.

The first application release will consider especially the case of wheel-chaired people.

The navigator will work basically as a classic mobile navigator considering *special permits for disabled people to pass through restricted areas* and also *highlighting special information such as facilities for disabled in using public transportation*.

When parking sensors will be installed (planned by September 2018) and data will be available, the navigator will give the user parking lots occupancy status and probability to find a free parking lot in a selected area. With this goal, the Municipality of Milan contributed, together with other SynchroniCity partners, in developing a free-parking lot estimation baseline service.

7.2 Description of infrastructure

The Municipality of Milan is already using an interoperability platform based on WSO2 (Web Service Oxygenated) [21]. The municipality has also a CKAN based Open Data platform [22] where to expose its data. Moreover, in the Lombardy Region, where the city of Milan is located, the E015 platform is available for data sharing [23], created by a consortium of local public bodies and companies in occasion of the last EXPO 2015 held in Milan.

The SynchroniCity platform instance of Milan is integrating all these data sources and platform as shown in Figure below.

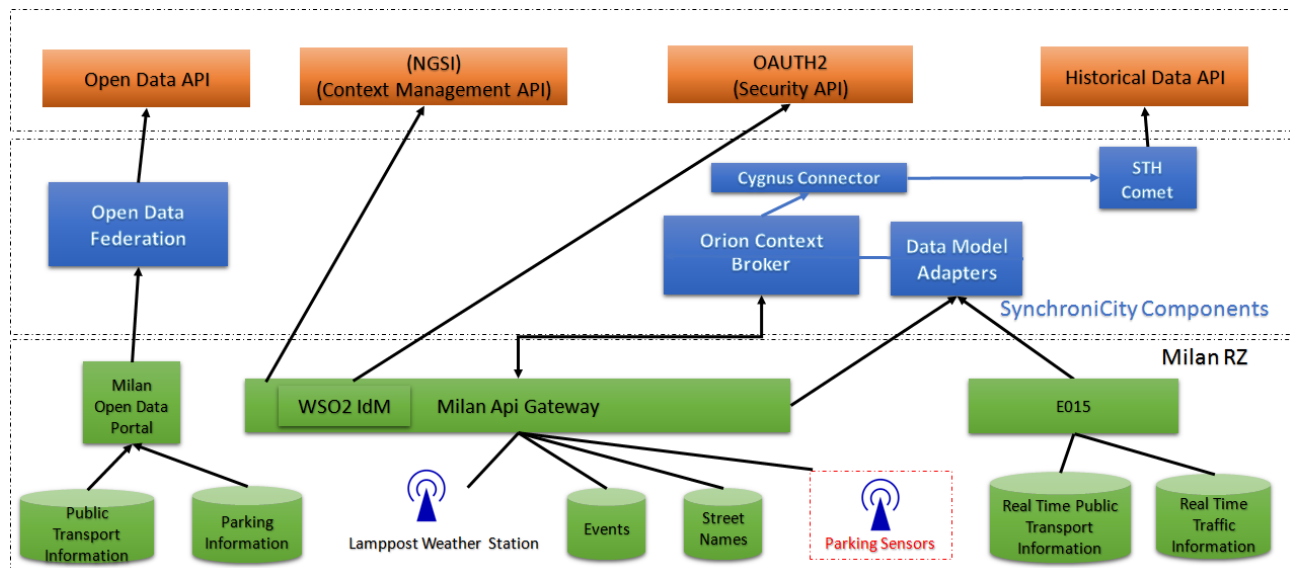


Figure 9. Figure MIL-Integration infrastructure

Data providers | Sensors

- Meteorological sensors
 - Parameter: Pressure, temperature, humidity
 - Data model: WheaterObserved (FIWARE)
 - Data provider: A2A
 - Data infrastructure: WSO2 platform
- Smart parking sensors
 - Parameters: parking lot status
 - Data model: ParkinSpot (FIWARE - TBC after installation)
 - Data provider: Kyunsis
 - Data infrastructure: TBD (waiting for installation)

Meteorological sensors provide data into a native JSON format that is converted by a specific NGSI-adaptor developed by Milan's technical partner (Engineering). Smart parking sensors are planned to be installed within September 2018, so currently there are no definitive information about infrastructure and data model.

7.2.1 Data providers | Databases and web services

- POIs
 - Points of interest (POIs) data
 - Data model: PointOfInterest (FIWARE)
 - Data provider: Municipality
 - Data infrastructure: WSO2 platform
- Events
 - Events data (cultural, festivities, sports, etc.)
 - Data model: Event (W3C / Schema)
 - Data provider: Municipality
 - Data infrastructure: WSO2 platform

- Street Naming
 - Official street naming services from the Municipality
 - Data model: proprietary (no current corresponding FIWARE NGSI model existing)
 - Data provider: Municipality
 - Data infrastructure: WSO2 platform
- Public transportation
 - Public transportation data (schedules, routes, lines, stations/stops, etc.)
 - Data model: GTFS and Santander Bus model
 - Data provider: ATM (Transport operator)
 - Data infrastructure: E015 platform
- Bike sharing data
 - Origin-Destination matrix
 - Data model: ENG developed a datamodel for bikesharing stations
 - Data provider: ATM (Transport operator)
 - Data infrastructure: E015 platform
- Milan road information
 - restricted areas, parks, railway urban track, obstacles upon roads etc
 - Data model: ROAD ngsi-datamodel
 - Data provider: Municipality
 - Data infrastructure: Open Data platform

For “*Public transportation*”, “*Bike sharing data*”, “*Milan road information*” data, the corresponding FIWARE NGSI data model is still to be determined since the data providers (external and even internal) still have to communicate the actual data structure, so at the moment it’s not possible to guarantee a coherent matching with an existing FIWARE NGSI Model by means an NGSI adaptors using the same approach performed by Milan’s technical partner (Engineering) as for the meteorological sensors.

7.2.2 Components

- Multimodal Transportation
 - Multimodal trip planner and analyst
 - Multimodal journey planner
 - Smart parking service
- Human Traffic Management
 - Milan Geoportal viewer

7.3 Ecosystem partners responsibilities

In order to develop the pilot applications for Milan several stakeholders need to be taken into account:

- Comune di Milano (Municipality): is the SynchroniCity partner representing Milano RZ.
 - Interoperability Department: it’s the Department of the Municipality in charge of performing SynchroniCity activities for Milano RZ.
 - Digital Lead Department: is the Department of the Municipality in charge of developing web and mobile services and that it has been involved in the Multimodal Transportation Theme since the Navigator for Disabled people could be integrated in their systems and solutions;
 - Mobility Department: is the Department of the Municipality responsible for meeting air quality and sustainability goals, for creating policy and regulations around mobility, for infrastructure planning;
 - SIT: is the Department of the Municipality responsible for every activity involved with the geoportal;

- Engineering: is the SynchroniCity partner representing the technical partner of the Municipality of Milan in charge of supporting and developing the pilot applications;
- E015 Technical board: is the board representing the E015 platform that must allow the Municipality to integrate its data in order to develop the pilot applications;
- ATM: is the public transport operator in Milano RZ that will provide data about transport and station-based bike sharing data (origin-destination matrix);
- OFO and Mobike: are free-floating bike sharing operators that may (it's very hard to involve them) provide data about bike usage and paths; their involvement in SynchroniCity is not yet confirmed;
- AMAT: is the Mobility agency of the Municipality in charge of support planning activities in the field of mobility and environment;
- Kyunsis: is the operator in charge of installing smart parking sensors;
- A2A Smart City: is the operator in charge of installing traffic sensors.

7.4 Description of supportive actions

The Interoperability Direction, that is in charge of follow the SynchroniCity project on behalf of the Municipality of Milan, have organized workshops and meetings with the Directions of the Municipality and the Mobility Agency AMAT responsible for cycling planning for the co-designing the Human centric application. The Interoperability Direction is also participating in meetings related to the mobility premises for disabled drivers in order to be aware of all the needs of the target of our multi-modal application and to co-design with the technicians the application.

7.5 Internal and external dependencies

The internal dependencies are related with the fully integration of the SynchroniCity architecture (WP2) with the WSO2 interoperability platform of the Municipality of Milan; the availability of baseline services, the reuse of software components already developed for other applications (Milan geoportal); the validation from a technical, user, stakeholder and market point of view (WP4). Generally, the pilot development and implementation are also dependent on the Municipality's SynchroniCity technical partner, Engineering, that will develop both pilots.

The external dependencies are mostly related with data dependency from third party institutions, which are only partially managed by the Municipality of Milan, in particular mobility data from the public transportation operators, the E015 platform and the installation of parking sensors as planned. The bike sharing data is fully dependent on third party operators, in particular, by ATM for station-based bike sharing data, and OFO and Mobike for free-floating bike sharing data.

7.6 Description of sustainability mode upon project completion

The Municipality of Milan is investing a lot of resources on innovation activities. In the last few years it has created the Interoperability Department, that introduced the WSO2 platform, and it is involved in several European H2020 projects such as Sharing Cities and others beyond of SynchroniCity. With this background, the Municipality is deeply interested into a real sustainability model of the pilot application after the project completion.

Concerning the Human Traffic Management theme, the application will be extensively used for a long time by the Mobility Department of the Municipality as it will be based on the already existing internal geoportal. Milan RZ's technical partner, Engineering, already proposed a plan after project completion in order to guarantee the continuity of the SynchroniCity services that creates the information data layers needed to run the application. Details in this sense will be discussed after project completion.

Concerning the Multimodal Transportation theme, the application - a multimodal navigator for disabled people - there's a plan to include the services developed together with SynchroniCity, especially those related to the smart-parking estimation, into the Municipality applications framework.

8 Porto

8.1 Pilot motivations, use cases, expected results, after pilot life

The city of Porto is involved in two pilot areas: Community Policy Suite (CPS) and Multimodal Transportation (MMT). The CPS pilot application is named “Porto. Open Interactive Map” and the MMT pilot application is named “Porto. Multimodal Assistant”.

For both applications, the definition of actors, scenarios, functional and non-functional requirements, available data sources and architecture have been provided and detailed in the deliverable D3.5 [4].

8.1.1 Porto. Open Interactive Map

The Porto. Open Interactive Map application will gather, process and analyse city data, providing valuable information to the City Council, local business owners and citizens (both inhabitants and visitors).

The main city data sources, that are expected to be handled by this application, are: public transportation network (schedules, stops and stations, routes and lines, ticketing and pricing, etc.) and vehicle-sharing systems (docking and parking locations and status, vehicle availability); POIs; events; environment (noise, air quality and meteorological parameters); weather forecasts and alerts; traffic flow and constraints; and geographical data (highway, city roads and streets, bicycle path, sidewalk, public transport lines, etc.). Some of this data will be static (from a database), other data will be provided in real-time (from sensors), and will be showcased on a contextualized dashboard and map.

This application will be a useful analysis tool of updated, real-time and trusted city data to: i) the City Council (in particular, managers, administration and policy makers) and Municipal companies, in order to better inform and implement decision and policy making; ii) local business owners, in order to take informed operational and strategic business decisions and identify future opportunities, challenges and threats or constraints; iii) citizens, in order to have access to contextualized city data, report city problems, occurrences and other civic issues, to suggest new ideas and problem solutions, and to get feedback from the Municipality of Porto about them. This solution will enable a proactive approach to problem solving contributing to a more agile management and policy processes.

This tool will simplify and increase the transparency, ease the interaction and communication between the Municipality of Porto and the local communities, citizens, companies and institutions, in both directions (from and to the Municipality). The flow of information available will not only support the digitalization process but also improve the “de-siloing” trend of the traditional structures, thus promoting an integrated and more effective management system.

The innovative character of this application is based on the fact that it brings a new “intelligent” layer to city governance augmenting the impact of the IoT network deployed in the city. This solution enables a reliable and more consistent usage of interconnected data which enables all the actors (City Council, Municipal Companies, Citizens, Businesses and other relevant stakeholders) to interact with each other by identifying and reporting city’s events and transformations. Trends and patterns can be integrated in the decision-making process and result in an improvement of the quality of life (or quality of the journey, in the case of visitors) of the citizens.

Rewarding and gamification processes are foreseen for a second stage in collaboration with the municipal services and local businesses to maintain the interest of the users in a long-term perspective. The interfaces will be developed with a user-friendly approach enabling not only easy access but also a clear value perception from the User’s point of view aiming at supporting a sustainable use.

8.1.2 Porto. Multimodal Assistant

The *Porto. Multimodal Assistant* application will be more than an ordinary route journey planner. It will be a mobility solution which will better inform citizen's mobility choices and ease the citizen's mobility experience from, within and to the city of Porto.

The application will gather city data and user data, and thus provide a personalised and customised multimodal assistant, based on the user's preferences, requirements and choices. Examples of gathered user data are: home address, work address, other destination addresses, favourite public transportation routes, favourite public transportation stops, disabled person (yes/no), preferences in terms walking (low noise and air pollution, close to nature, etc.), preferences in terms of needing to park a bike along the route (requires a docking place or a vehicle that allows the user to take the bike with him, such as the tram or train), etc.

This data will only be gathered if the user agrees and provides data - user needs to opt in, instead of opting out. The idea is to enable the user to customize the route planning according to the user's preferences, requirements and choices. Instead of applying filters or retyping several data every time he searches for a route, the user can use record these personal settings.

For example, the user wants to use public transportation on the way home. If his/her address is registered in application, she/he just searches for the best route home; there is no need to retype home address.

The main city data sources that are expected to be handled by this application are:

- public transportation network - schedules, stops and stations, routes and lines, ticketing and pricing;
- vehicle-sharing systems - docking and parking locations and status, vehicle availability;
- POIs;
- events;
- environment - noise, air quality and meteorological parameters;
- weather forecasts and alerts; traffic flow and constraints and;
- geographical data - highways, city roads and streets, bicycle path, sidewalk, public transport lines.

Some of this data will be a static data a database, other data will be provided from sensors in real-time (see sections Description if Infrastructure for details).

The route planner will enable search by different and complementary parameters, namely, single or multi-point destinations; POIs names; street names; different transportation modes; personal choice criteria, such as minimum price, minimum time, minimum distance, scenic; complementary use of private or shared vehicles with public transportation. Other search features may be implemented at a later stage, such as:

- Search by the name of event and date, for concerts, festivals, exhibitions;
- Search by taking into consideration user's temporary or permanent preferences and requirements, for example, low mobility, covered connections between intermediate points, air quality and noise levels;
- Search by taking into consideration the real-time environment conditions and weather forecast.

The routes, user's real-time location and complementary information, for example, POIs, will be displayed on a map.

Apart from the route planner features, the application will also provide other transportation information, such as, timetables at stops and stations, nearby stops and stations, parking information, and price and ticketing information. The user will also have access to complementary information not related to the transportation needs, such as, POIs, events and geographic

information. Other features may be implemented at a later stage, for example, the display of the weather forecast at the destinations(s), real-time alerts and notifications, interaction with NFC and BLE beacons and integration with the user's own calendar.

Another innovative functionality that is planned to be implemented at a later stage is to embed an electronic wallet and a MaaS feature in the mobile app version. This will enable the user to check-in and out of several mobility services with the smartphone and only one app (the Porto. Multimodal Assistant) within the city of Porto. With a single app, the user will be able to check-in and out of:

- i) the public multimodal transportation network (instead of using a pre-charged wireless card),
- ii) several vehicle-sharing systems (instead of using several apps or cards),
- iii) car parks (instead of using a ticket), and
- iv) on-street parking machines (instead of using another app or a ticket). In the end, the user will receive a monthly mobility bill which will gather all the used mobility services (public, shared or private).

Right now, this system is managed by a third-party company, which manages the public transportation network ticketing and billing system within the Metropolitan Area of Porto. This company is state owned (Tip - Transportes Intermodais do Porto, A.C.E., see Linhandante [24]).

The idea is to merge the Multimodal Assistant, which is being developed within the SynchroniCity project, with the MaaS app that already exists (see Anda [25]) and is fully operational within the Metropolitan Area of Porto. This feature is planned to be implemented at a much later stage, and will not be part of the SynchroniCity Open Call. In this pilot phase, the Multimodal Assistant will have a link for the MaaS application Anda".

Any city that has a multimodal transportation system, in principle, can reproduce this MaaS app and service, as long as they have the required equipment and hardware to read the mobile phones as a wireless card, and beacons to detect the check-out, etc.

As a start, the Porto. Multimodal Assistant will provide direct links to other mobility services and apps (transportation ticketing, parking ticketing, etc.), in order to ease the user's mobility experience and to inform the user of all the digital payment and ticketing options available.

This application will also enable the user to provide valuable information to the city and transportation operators, in particular, by reporting traffic events, road conditions, occurrences and malfunctions (crowdsourcing), and also to rate and comment the journey experience.

The application may also generate and provide valuable user data to the user himself, in particular, the mobility historical, behavioural indicators and comparison with other users, trip summary and cost, 'green' behaviour grade, etc.

Another innovative functionality that is planned to be implemented at a later stage is to award the users with 'green credits' and incentives by using the public transportation network and vehicle-sharing systems, by parking the owned car outside the city and using the public network to enter the city, by reporting relevant and important malfunctions that occurred in the systems, etc. The credits and awards will be later exchanged by city products and services, such as, a concert ticket, a bike-sharing extended use period, e municipality service, etc.

The use of this app will also provide valuable mobility data to the city authorities and public transportation operators (anonymized data), which will enable all the mobility stakeholders, in particular the City Council, to have better informed decision and policy making in the areas of mobility, environment, urbanism and tourism. The examples of anonymised mobility data gathered from the users are: check-in/check-out locations, stops location at periods of time, number of users inside a vehicle, etc. This gives an idea for public transportation demand and required offer by the Municipality and the public transportation operators. The public transportation authorities may identify the need to create new routes or change the existing ones, by taking into consideration that

many users are taking too much time to go from point A to point B, based on route search or the real routes taken.

8.2 Description of infrastructure

8.2.1 Data providers | Sensors

- Noise
 - Parameter: Noise
 - Data model: NoiseLevelObserved (FIWARE)
 - Data provider: CMP (Municipality of Porto)
 - Sensing infrastructure: Environmental sensor network (ESN)
- Air pollutants
 - Parameters: PM1 particles ($\varnothing < 1 \mu\text{m}$), PM2.5 particles ($\varnothing < 2.5 \mu\text{m}$), PM10 particles ($\varnothing < 10 \mu\text{m}$), Ozone (O_3), Nitrogen dioxide (NO_2), Carbon monoxide (CO)
 - Data model: AirQualityObserved (FIWARE)
 - Data provider: CMP (Municipality of Porto)
 - Sensing infrastructure: Environmental sensor network (ESN)
- Meteorological parameters
 - Parameters: Solar radiation, ultraviolet radiation, wind direction and speed, rainfall, atmospheric pressure, air temperature and humidity
 - Data model: WeatherObserved (FIWARE)
 - Data provider: CMP (Municipality of Porto)
 - Sensing infrastructure: Environmental sensor network (ESN)
- Vehicle location and speed
 - Parameters: Vehicle location and speed
 - Data model: Vehicle (FIWARE)
 - Data provider: CMP (Municipality of Porto)
 - Sensing infrastructure: on-board GPS sensors
- Vehicle counters
 - Parameter: Vehicle count
 - Data model: TrafficFlowObserved (FIWARE)
 - Data provider: CMP (Municipality of Porto)
 - Sensing infrastructure: SGT/road embedded induction loops

8.2.2 Data providers | Databases and web services

- POIs
 - Points of interest (POIs) data
 - Data model: PointOfInterest (FIWARE)
 - Data provider: ATP (Porto Tourism Association)
 - Data infrastructure: BDRT
- Events
 - Events data (cultural, festivities, sports, etc.)
 - Data model: Event (W3C / Schema)
 - Data provider: ATP (Porto Tourism Association)
 - Data infrastructure: nEventos
- Public transportation
 - Public transportation data (schedules, routes, lines, stations/stops, etc.)
 - Data model: TBD
 - Data provider: AMP/AMTP (Metropolitan Area of Porto/Transports Authority)
- Traffic constraints

- Temporary traffic constraints (scheduled events, accidents, etc.)
- Data model: Open511 (TBC)
- Data provider: CMP (Municipality of Porto)
- Weather forecast
 - Weather forecast service
 - Parameters: Precipitation probability, relative humidity, temperature, weather type, wind direction, wind speed
 - Data model: WeatherForecast (FIWARE)
 - Data provider: IPMA (Portuguese Institute for Sea and Atmosphere)

8.2.3 Components

- Multimodal Transportation
 - Multimodal trip planner and analyst: Open trip planner
 - Multimodal journey planner: DigiTransit
 - Maps: OpenStreetMap
- Community Policy Suite
 - Commercial product from Bronze Labs: framework.⁴²

8.2.4 Urban Platform

As any smart city, Porto envisions to improve the Urban User Experience by providing, among others, a technological approach to everyday problems. This technological approach integrates data flows within and across city systems, by using emerging technologies such as IoT/sensors, mobile devices, big data analytics, etc., delivered through a set of tools.

Supporting these data flows (and data itself), the tools and all its backend services, is what we call the Porto Urban Platform. This platform is composed of systems and services, based on the FIWARE stack (context broker, historical data, etc.), integration services (with existing systems), security and data protection systems, managements tools.

Particularly, for pilot applications purposes, the Porto Urban Platform will hold, besides data and FIWARE stack, all the backend services that will enable apps to get real-time data and notifications, but also geospatial related operations such as route calculations, compute estimations to predict future conditions (such as traffic behaviour), AAA (Authentication, Authorisation and Accounting), etc.

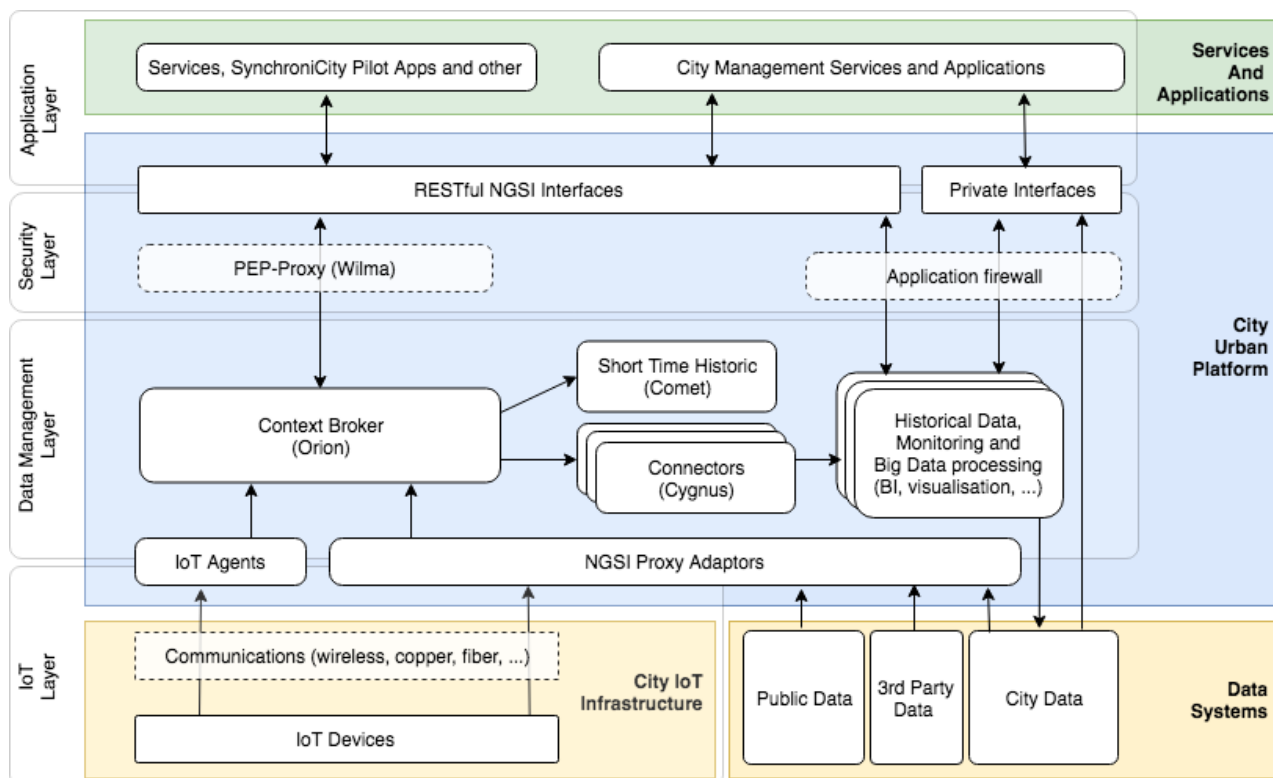


Figure 10. Porto Urban Platform.

8.2.5 ICT Infrastructure (Datacenter)

To support the Porto Urban Platform, the city upgraded its ICT Infrastructure (datacentre), owned and managed by both the Municipality of Porto and Porto Digital, with a set of hardware and services, including power (via uninterrupted power supply), network (copper and fibre high speed connections), server and storage, and virtualization solutions.

Arrangements and decisions have been made to assure resilience and performance, within the datacentre premises. Finally, it's under consideration duplicating its hardware capabilities, on a second location/datacentre (for redundancy and security purposes).

8.3 Ecosystem partners responsibilities

Some partners have transverse responsibilities, others only have responsibilities in one of the pilot areas [CPS or MMT]. The main partners involved in the SynchroniCity project are the following:

- Porto Digital (APD): project leadership and coordination, representative of the city of Porto, digital infrastructure management (Urban Platform, FIWARE node, SynchroniCity platform, communications, datacentre).
- Municipality of Porto (CMP): political leadership, city policies, data provider and consumer, end user [CPS], post-project sustainability assurance.
- Porto Tourism Association (ATP): data provider and consumer, tourism policies.
- Metropolitan Area of Porto (AMP) / Transports Authority (AdT): data provider and consumer, metropolitan mobility policies.
- Ubiwhere: technical partner of the city of Porto within the context of the SynchroniCity project, system architecture [MMT], solution development [MMT].
- Bronze Labs: system architecture [CPS], solution development [CPS].
- University of Porto (UP): advisors on environmental, mobility, data protection and cyber security issues.

8.4 Description of supportive actions

Regarding the multimodal transportation pilot area, several quantitative and qualitative research activities based on service design and design thinking methodologies and tools, have already taken place, in particular, design of the customer journey and service blueprint to help visualize the citizens experiences As-is and To-be; stakeholder mapping to understand who are the key stakeholders, what are their value exchange and how is their relationship towards the service; in-depth and guerrilla interviews with key stakeholders and citizens, to capture detailed insights and get a deep understanding of users experiences and expectations; online questionnaires; cultural probes to gather inspirational data about citizen's lives, values and thoughts; observations to understand the usability of the current service and to have overall view of the user experience; and analysis of market and mobility trends, paradigms and tendencies. These research activities have been providing valuable insights and a better understanding of the mobility habits, desires, needs and requirements of the citizens of Porto, and have been identifying opportunities for improving and increasing the mobility services and experience in the city of Porto.

Two workshops have already been organized within the scope of the two pilot areas:

- Community policy and agile governance areas (17/04/2018): Porto Digital organized a workshop with several stakeholders directly involved in public policy making and execution, and in city operations management, in particular, from the departments of environment, urbanism, procurement, mobility, health and IT of the Municipality of Porto. The objective of this workshop was to gather insights from the different stakeholders regarding their roles, goals, fears, challenges, connections, channels, pain-points and opportunities (among others).



- Mobility and multimodal transportation areas (21/04/2018): Porto Digital organized a workshop with several users of public transportation services and other mobility solutions (for example, bike and bike-sharing). The main objectives were to explore topics around general mobility and new mobility concepts in the city of Porto, and to pre-validate the concepts and functionalities of the Multimodal Assistant with potential end-users.



Other supportive actions include discussions with local stakeholders with the following goals:

- Assess the feasibility, interest and required effort to embed the already existing multimodal ticketing system into the Multimodal Assistant app.
- Assess the feasibility, interest and required effort to deploy pilots of vehicle-sharing systems (such as, bike-sharing, scooter-sharing and car-sharing) and to embed those services into the Multimodal Assistant app.
- Gather more data from other sources (from the Municipality group and from third-party public and/or private institutions), which will add extra value to the two pilot applications and will enable new features and functionalities in the future.

8.5 Internal and external dependencies

The internal dependencies are related with the availability of a data marketplace and compliance with the SynchroniCity architecture (WP2); the availability of baseline services, the reuse of software components already developed for other applications [MMT], and the total dependence on a closed software platform [CPS] (WP3); and the validation from a technical, user, stakeholder and market point of view (WP4). Generally, the pilots' development and implementation are also dependent on two SynchroniCity partners: Ubiwhere (for both pilots, but in particular for the MMT application) and Bronze Labs (for the CPS application).

Some internal dependencies are minimized, because: i) our Urban Platform is FIWARE and SynchroniCity compliant (WP2), ii) we are cooperating with other SynchroniCity partners in the development of common baseline services, in particular, the "Traffic flow estimator", which are needed for both pilots (WP3) and iii) we are using service design and co-creation methodologies,

and taking into consideration the end users and stakeholders requirements and needs, in the design of both pilot applications and services (WP4).

The external dependencies are mostly related with data dependency from third party institutions, which are only partially managed by the Municipality of Porto, in particular, POIs and events data from the Porto Tourism Association (ATP) and mobility data from the Metropolitan Area of Porto (AMP) and the public transportation operators. The weather forecast data is fully dependent on third party institutions, in particular, on the Portuguese Institute for Sea and Atmosphere (IPMA).

8.6 Description of sustainability mode upon project completion

The sustainability plan of both pilot applications after the SynchroniCity project ends is well defined but has significant differences between the two applications.

The “Porto. Multimodal Assistant” is presently being specified and designed by Porto Digital (APD) and the Municipality of Porto (CMP), and is being built and developed from scratch by the SynchroniCity partner Ubiwhere, under the coordination of APD.

Significant time and financial effort is being made by APD and CMP out of the scope of the SynchroniCity project; this application will use significant digital and physical resources from the city’s IoT infrastructure.

Some features of the application will be released within the scope of the SynchroniCity project, other will be implemented after the project ends, or at least, after the pilot is fully deployed.

The Municipality of Porto strongly believes that the “Porto. Multimodal Assistant” can be a key tool to ease and encourage the use of public transportation and other new transportation means (such as, bike and scooter-sharing) in the city of Porto. Accordingly, APD and CMP will keep investing in new developments, features and releases of this application after the pilot phase and after the SynchroniCity project ends, including communication and dissemination activities.

It is expected that, in the near future, the “Porto. Multimodal Assistant” will be the official mobility app of the city of Porto.

The “Porto. Open Interactive Map” is quite different from the MMT application, in the sense that this CPS application is being developed by the company Bronze Labs (partner of the SynchroniCity project) as a commercial solution (see Framework.⁴²), without direct involvement of the city of Porto. Some feature customizations and connections to our city platform are expected to be made by the company within the scope of the SynchroniCity project, in particular, in order to make this application compliant with the SynchroniCity platform, and the city of Porto will only have access to this application during the project duration.

Accordingly, although the city strongly believes that an application with these features brings value to the city and the Municipality of Porto, the future of the Pilot will be dependent on a deeper analysis of a commercial proposal from the supplier (Bronze Labs) and other potential suppliers.

The Municipality of Porto intends to integrate the functionalities of this application in Porto Urban Platform, either as a vertical or horizontal solution, and to make them available to the citizens, to the Municipality’s departments and to the teams of the Integrated Management Centre (CGI).

It is expected that, in the near future, the “Porto. Open Interactive Map” will not be a single and stand-alone application (as it will be within of the context of the SynchroniCity project’s pilot), but a set of features and functionalities of the Porto Urban Platform, and as such, APD and CMP will keep investing on its development, integration and deployment, either directly, or by subcontracting to a software company.

9 Santander

9.1 Pilot motivations, use cases, expected results, after pilot life

The city of Santander is involved in a pilot area of Multimodal Transportation (MMT) named “Park & Move”. Detailed scenario schema, user profiles, scenarios, non-functional requirements, available data sources and architecture has been provided in deliverable D3.5 [4].

9.1.1 Park & Move

Park & Move application is composed by 2 separate applications that represents 2 scenarios/use cases within the MMT area. Each scenario is focused in solving a different issue regarding urban mobility. The beneficiaries will be the citizens, commuters, casual visitors and tourists. The information gathered and processed will also benefit the municipality's responsible staff for urban services planning and maintenance (bus, urban infrastructures, etc) and will ease City Council in governance.

The first App, “Smart Parking”, will benefit users arriving to Santander city by car and will allow to find a parking place in an optimum way. Apart from the benefit from the user perspective in terms of economy, time and comfort, the rest of car users, citizens and also the City Council will benefit in terms of reduction of traffic, traffic accidents, contaminants and an increasing of general life quality.

The second App, “Multimodal Navigator”, will benefit people moving in the city without private cars. it will provide a help in internal urban movements combining the information of all facilities (location, timetables, etc). Apart from the direct benefit to users (both inhabitants and visitors), it will provide benefits to local business. Also, valuable information for City Council in terms of insight knowledge of urban movements will be collected. Frequently and updated mobility information will be of great help for urban facilities maintenance optimization and planning and development of current facilities and infrastructures.

Planned functionalities and atomic services initially designed to implement SAN pilots do not involve personal information but based on “public” data related to infrastructures, traffic and parking status and public transportation never related to any concrete user. Any personal data required to calculate routes or provide elaborated info (user location or profile) will be kept internally and not used in/nor shared with any other service/app. It is not envisioned (initially) any personal data collection that may derive from the use of the defined apps. In the case this could be finally interesting from the city council perspective, end users will be properly notified and all their potentially captured data will be managed according the relevant legislation (data protection). Of course, end users will be able to deny, limit or revoke their consent for this data collection (if any) without losing the access to these pilots' functionalities.

The potential sources to be handled by this application are: weather forecast, traffic intensity in main streets, on street parking availability on free or regulated parking service, private underground or surface parking, public transportation network, urban mobility premises, such as escalators, sections, and user location and destination. Some of this data will be updated in a yearly schedule quasi-static data, other will be quasi real-time in a periodic and seamlessly way (sensors) and other will be real-time, mainly from users' requests. The processed information will be showcased in a map or any other suitable and useful display system for the user and also in an aggregated form to feed municipality Smart City urban platform.

The application will process data and requests providing useful insight information to: i) users of the Apps, having access to contextualized and processed information, e.g. private car drivers and non-private car users inside the city; ii) the City Council, urban planners, municipality service responsibilities and decision makers; iii) private companies in charge of municipality services; iv)

entrepreneurs and private companies including local business owners in order to have information for new business models, operational decisions and other optimization tasks.

Furthermore, as Santander City Council is currently developing a Smart City Platform, all this information will be fed to the system. This platform is focusing on integrating all the information provision from all the sources of information of the city (internal and external ones, digitized and non-digitized ones) in order to provide processed information in form of dashboards to different levels of responsibility in the municipality. With this platform, breaking the traditional silo approach, any service worker or decision maker will have the most updated, complete and focused on his/her needs, not only from its service, but also from other services and external non-municipality sources of information.

The application is conceived to bring an innovative approach to the mobility issue in the city. The requests from the users mixed with the information of the context will bring a combination of demand-supply loop not addressed before in such a seamless and frequently updated way. Also, it will provide, a way of checking the performance of changes or setup of new facilities in the city. Seasonal, daily distribution and event information will improve the degree of knowledge of municipality mobility behaviour in order to optimize the decision-making process of every responsible and more important, based on objective data.

9.2 Description of infrastructure

9.2.1 Data providers | Sensors

- Traffic
 - Parameter: traffic intensity
 - Data model: TrafficFlowObserved
 - Data provider: Municipality of Santander
 - Sensing infrastructure: SmartSantander
- Parking
 - Parameter: on surface free parking space, parking lots status; underground number of free parking spaces
 - Data model: ParkingSpot; OnStreetParking; OffStreetParking
 - Data provider: Municipality of Santander; Parking service exploitation licensed company
 - Sensing infrastructure: SmartSantander; Parking licensed company info system
- Meteorological parameters:
 - Parameters: wind direction and speed, rainfall, atmospheric pressure, air temperature and humidity
 - Data model: WeatherObserved
 - Data provider: Municipality of Santander
 - Sensing infrastructure: SmartSantander

9.2.2 Data providers | Databases and web services

- Weather forecast
 - Weather forecast service
 - Parameters: Precipitation probability, relative humidity, temperature, weather type, wind direction, sky status, wind speed & direction, UV,
 - Data model: WeatherForecast
 - Data provider: Agencia Estatal de Meteorología - AEMET. Gobierno de España (www.aemet.es)
- Public transportation
 - Public transportation data (schedules, routes, lines, stations/stops, etc.)

- Data models: BusStop; BusArrivalEstimation; busLine
 - Data provider: Municipality of Santander
- POIs
 - Points of interest (POIs) data
 - Data model: PointOfInterest, Museum, Beach
 - Data provider: Municipality of Santander
 - Data infrastructure: SmartSantander

9.2.3 Components

- Multimodal transportation
 - Multimodal trip planner and analyst: Routing Service
 - Maps: Santander City Maps (OpenStreetMaps)
- Parking services
 - Free parking location on surface: Context Information (ParkingSpot, OnStreetParking, entities)
 - Free parking location underground: Context Information (ParkingSpot, OffStreetParking entities)
 - Parking Estimation Service

9.2.4 Urban Platform

The whole Santander Urban platform is fully described in D2.8 and will provide support not only to Santander RZ pilots, but also to the Open Call. SynchroniCity pilots to be deployed in SAN will use the component shown in Figure 11.

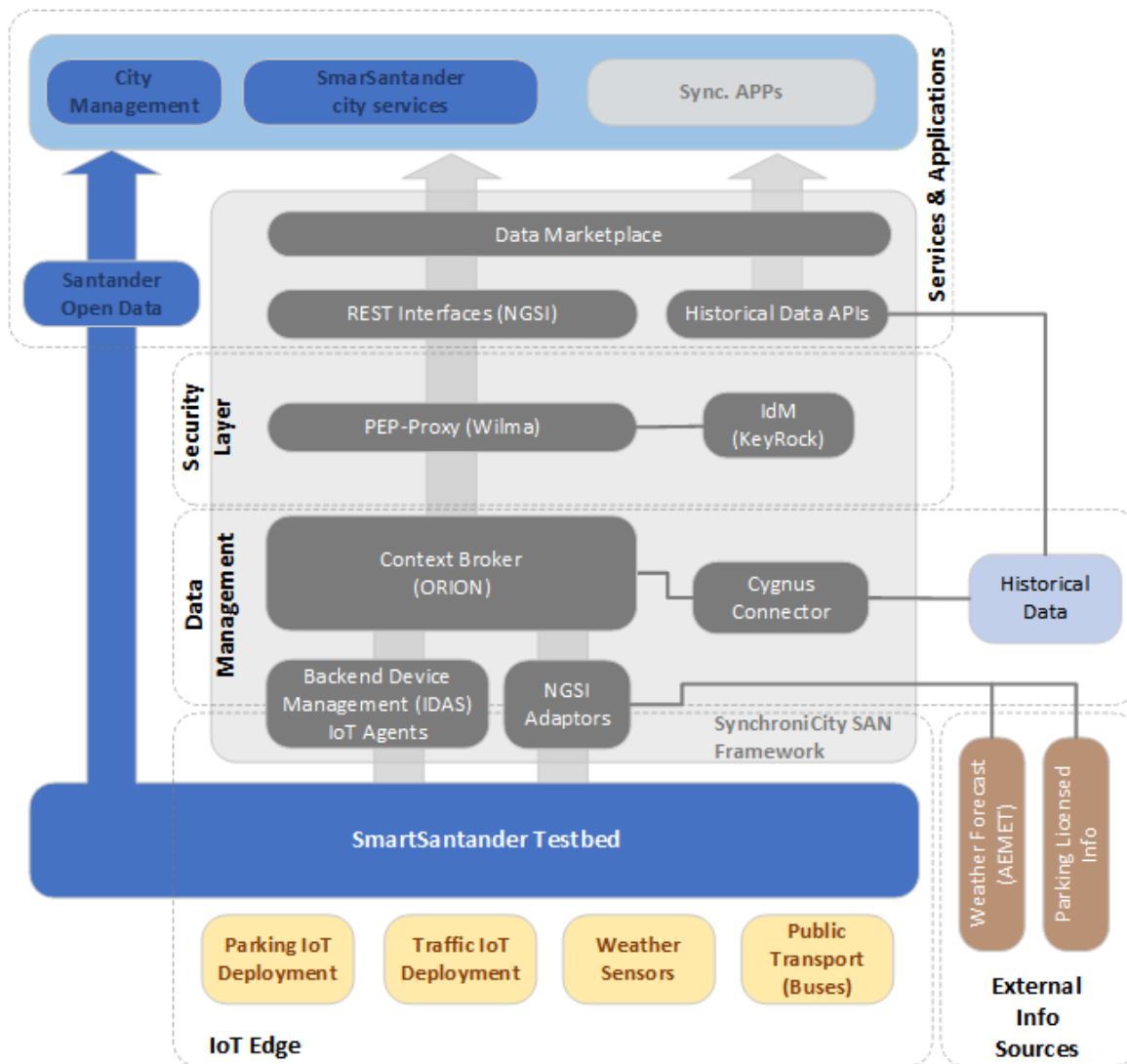


Figure 11. Santander Urban Platform.

9.2.5 ICT Infrastructure (Datacenter)

In the same way, D2.8 [7] includes the ICT complete description for the SAN RZ framework, detailing the technical components, protocols and technologies used to capture, transport, store and present SAN IoT data. Figure 12 presents a summarised vision of this infrastructure, linked to the Urban platform description already presented.

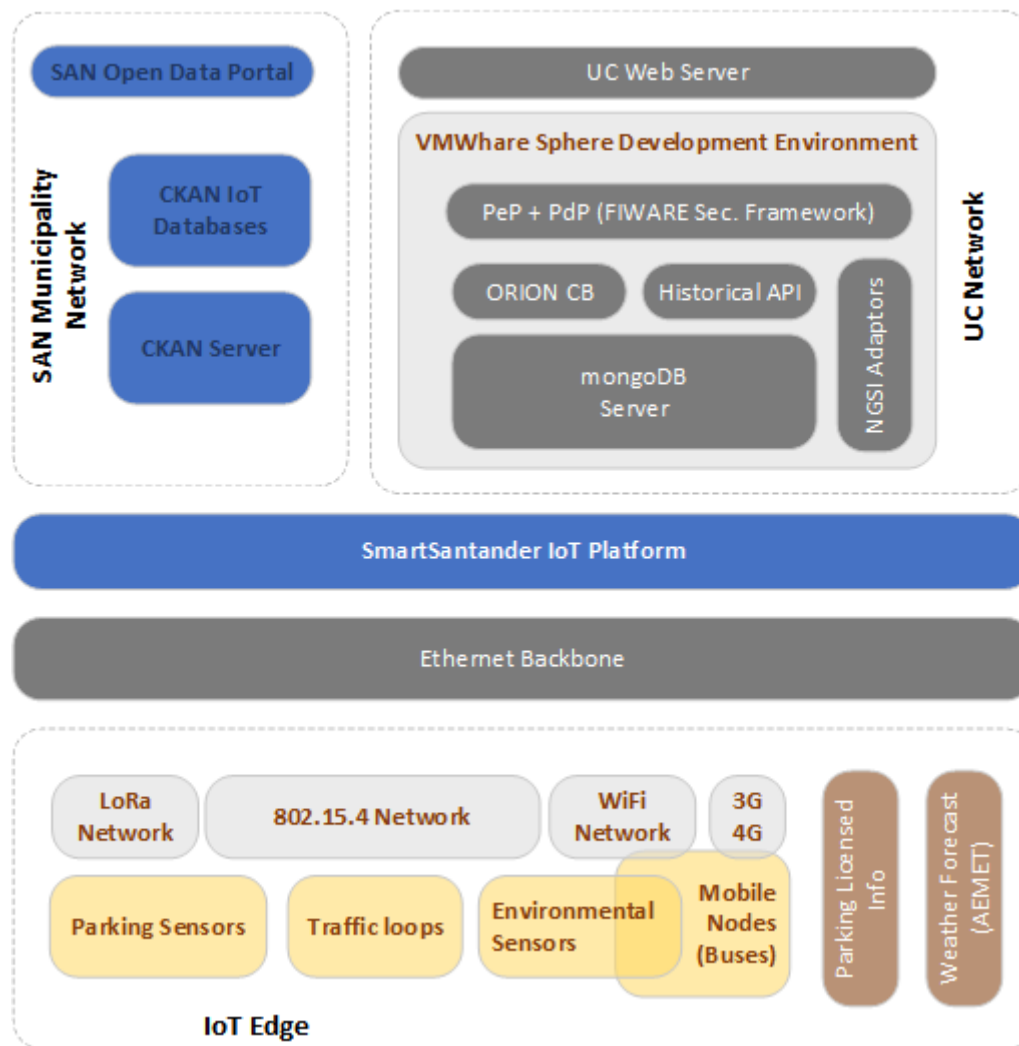


Figure 12. A summarised vision of Santander ICT platform.

From an ICT point of view, it is worth remarking the wireless network technologies deployed in SAN RZ: LoRa 802.15.4, WiFi and Mobile (3G/4G) networks, that supports existing IoT nodes and will be available to support new deployments from the Open Call. Services, code, adaptors and components instances are installed on the UC VMWare development environment, that will support the SynchroniCity framework SAN RZ instance.

9.3 Ecosystem partners responsibilities

In Santander, there is a mixed responsibility shared by Santander City Council and the University of Cantabria. Technical issues fall mainly into the responsibility of University of Cantabria, whereas global feasibility, integration with city services, etc. is a responsibility of Santander City Council. The detailed description is hereafter:

- Santander City Council: political leadership, city policies, data provider and consumer, end user, post-project, sustainability assurance, interfacing with data sources provision from external providers in Point-to-Point Protocol (PPP) contracts.
- University of Cantabria: technical issues and support, advisors on IT, mobility, environmental issues.

9.4 Description of supportive actions

During the recent years Santander municipality has carried out an important amount of activities in all its areas of activities with a research and innovation focus. Regarding multi-modal transportation, we have currently on-going a UE funded European Project (see Setamobility [26]), which aims to an ubiquitous data and service ecosystem for better metropolitan mobility. SETA creates technologies and methodologies set to change the way mobility is organised, monitored and planned in large metropolitan areas. Several activities have been carried out in the scope of the SETA project with it can be found useful insights and synergies.

9.5 Internal and external dependencies

The internal dependencies are related with the other WPs of the project, mainly with WP2, in what corresponds to compliance to SynchroniCity architecture; WP3, in what corresponds to the availability of baseline services and WP4, from the validation from the point of view of stakeholders (mainly users) and from the technical perspective. Regarding the development of the pilots, Santander City Council and University of Cantabria are both the partners with maximum dependence.

The external dependencies are mainly related to the flow of external data coming from external private companies in charge of municipality services. However, the impact can be minimized owing to the relationship between Santander Council and these companies. For instance, TUS (Santander municipality service) is a linked entity and other private companies providing data, like underground parking, has strict requirements in terms of data quality and quality of service that have to fulfil in order to avoid fines.

9.6 Description of sustainability mode upon project completion

Santander municipality has a global sustainability plan suitable for any research and innovation activity that is applicable to the pilot application. Hereafter, the global approach is going to be described and then, some particularities are added.

During the past years, Santander City Council has published several planning documents in which the sustainability model is considered. The first document is the “Santander Strategic Plan 2010-2020” in which mobility and innovation are declared as cornerstones for future city development. The “Master Plan of Innovation” includes the Smart City platform, urban mobility and the open innovation concept as part of its Actions Plan. Then the “Santander Smart City Innovation Plan” establishes the maturity degree in terms technology of every municipality service.

The overall strategy consists of considering the city as an urban lab in which the municipality is an enabler and supporter of innovation and experimentation pilots. The knowledge acquired during pilot deployment, joined to the degree of success of the final results and combined with the stakeholder (citizenship, municipality workers, decision-makers and external private companies) conforms the optimum point for further implementation at larger scale. When an initiative obtains all the green-lights the implementation is carried out by including specific IT requirements in the call for procurements. This has to be made in a timely manner because each external services contract has its own duration and condition.

Regarding the multimodal application, it will follow the same process described earlier. One of the key entities involved in the concept is the TUS (municipality bus service) which is, as mentioned before, a Santander City Council linked party.

10 Conclusions

In order to verify and prove the validity of the concept of marketplace mechanism SynchroniCity actively performs a number of pilots in all reference zones. The aim is to validate the developed concepts as well as provide inspiring examples to other cities and share an important experience for future development. Each of eight reference zones has chosen one or several application themes in order to pilot so-called initial applications that are important and relevant for these themes use cases. The success, disappointments, and other outcomes from the pilots can have significant impact on the process of creation of digital single market, and thus it is paramount of importance to ensure a systematic and uninterrupted pilots' roll-out and execution.

The present document describes how the pilots will be completed in the following phases in each reference zone:

- Initial applications and basic services operational in lead cities;
- Initial applications and basic services operational in all cities;
- Pilot agreements with selected applicants signed;
- Advanced framework deployed and operational in all cities;
- Initial applications and advanced services operational in all cities;
- Open Call pilot completed;
- Assessment of all pilots completed.

The document also covers crucial aspects for pilot deployment and operation, such as availability of data, commitments of partners and other ecosystem players, internal and external dependencies that can affect pilots, and other related and supporting activities.

An important part of this document is the description of sustainability mode of pilot lifecycle that provide current understanding on how the pilots' result will be utilized how what are the perspectives of the development of digital single market.

The actual deployment and operation for the pilots will be managed according to the plan; all changes and deviations will be documented and reported in deliverable D3.8 - Pilot report.

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12 Appendix

Table 5. Timeline for pilots roll-out and operational phase

				IMS1	IMS2	D3.7			D3.7	MS16		MS25	MS18	MS21	MS27	MS28	D3.8
						plan			review			MS17	MS25				
RZ	APP	Planning Phase					Deployment							Operations			
		M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24	M25	M26	...	M30	M35
		Feb18	Mar18	Apr18	May18	Jun18	Jul18	Aug18	Sep18	Oct18	Nov18	Dec18	Jan19	Feb19			
		Content		Schedule and resources	Draft	Plan											
ANT	HCTM		U/C defined	Rombit & DP	scenarios	V 0.1 dev	V 0.1 dev	0.1 Accepted	0.2 Dev								
CAR	HCTM			scenario	reqs&sources	WP2&app				parking+WP2		pilot ready					
	CPS			scenario	reqs&sources	WP2&app				Full WP2		pilot ready					
EIN	HCTM		U/C	U/C	U/C	U/C defined	SW dev	thermal cam	Data	basic operational		SW adv	Thermal adv	Pilot ready			
HEL	MMT		Contract	Archi	Specs	Specs ready		Demo - main scenario		WP2 deployed	integr HSL	pilot ready					
MAN	CPS							1st IT									

MIL	HCT M			App def	Specs	Ext data	Int data		E015 integr	1st ver app		Pilot ready				
	MMT					Deploy										
PO R	MMT			Specs		Plan		Atomic	MMN rel	TFES		Pilot Read y				
	CPS									1st IT						
SAN	MMT	Analysi s		Specs	Archi	Plan		RCS valid	Integ MMT	PES		Pilot ready				

