Nantes | Hamburg | Helsinki

Deliverable due date: M12 – November 2017

D2.16 Open Specifications framework

WP2/3/4, Task 2/3/4.4

Transition of EU cities towards a new concept of Smart Life and Economy

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Project Acronym	mySMARTLife
Project Title	**Transition of EU cities towards a new concept of Smart Life and Economy**
Project Duration	1st December 2016 – 30th November 2021 (60 Months)
Deliverable	D2.16 Open Specifications framework
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Due date	30/11/2017
Work Package	WP2
Lead beneficiary	CAR
Contributing beneficiary(ies)	NAN, ENG, HAM, TSY, HEL, FVH
Task description	This cross-cutting subtask will set up the basis for the development of solutions that are interoperable and follow an open approach. A common framework to define the functional requirements, software architecture and data structures will be developed. ENG will lead the definition of data integration concepts, TSY will lead the definition of orchestration of software components and open API architecture and finally, FVH will lead the definition of the open data approach, focusing on privacy and security.

Date	Version	Author	Comment
12/07/2017	0.1	CAR	Table of contents and responsibilities
29/08/2017	0.2	ENG	Chapter 5 draft.
30/08/2017	0.3	NAN, ENG	Chapter 5 review.
30/08/2017	0.4	ENG	Chapter 5 complement with data model.
08/09/2017	0.5	FVH	Chapter 7
28/09/2017	0.6	HAM	Chapter 6
06/10/2017	0.7	ENG	Chapter 3 draft. Chapter 5.1 complement.
18/10/2017	0.8	CAR	Section 4 and review of section 5
19/10/2017	0.9	CAR	Sections 6 and 7
06/11/2017	0.10	CAR	Introduction, executive summary and glossary updates
08/11/2017	0.11	HAM	Worked on revisions and added comments to the references and norms sections
09/11/2017	0.12	HAM	Completed requirements and edited the meta data section
17/11/2017	0.13	CAR	Restructure of some sections and rewording
21/11/2017	0.14	CAR	Rewording of section 4

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22/11/2017	0.15a	ENG, NAN	Review on chapters 5.1, 5.2.2, 5.4.1, 5.4.2, 5.4.3, 5.4.4, 5.5
22/11/2017	0.15b	TSY, HAM	Review on chapter 6
22/11/2017	0.15c	FVH, HEL	Review on chapter 7
23/11/2017	1.0	All	Final polish

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Abbreviations and Acronyms

Acronym	Description
AENOR	Asociación Española de Normalización y Certificación (Spanish Association for Normalization and Certification)
API	Application Programming Interface
CIM	Common Interface Model (IEC 61968)
CityGML	City Geography Markup Language
CKAN	Comprehensive Knowledge Archive Network
CSV	Comma Separated Values
CSW	Catalogue Service Web
EIP	European Innovation Partnership
EJB	Enterprise JavaBean
ESPRESSO	systemic Standardisation approach to Empower Smart citieS and cOmmunities
ETL	Extraction, Transform and Loading
FCP	Field Component Platforms
FTP	File Transfer Protocol
FTPS	FTP SSL (Secure Socket Layer)
GDPR	General Data Protection Regulation
GIS	Geographic Information System
HMDK	Hamburger Metadatenkatalog (Hamburg Metadata Catalogue)
HTTP	Hypertext Transfer Protocol
ICT	Information and Communication Technologies
ID	IDentifier
IoT	Internet of Things
IR	Intermodal Routing
ISO	International Organization for Standardization
IT	Information Technologies
ITU-T	International Telegraph Union - Telecommunication Standardization Sector
JSON	JavaScript Object Notation

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JSON-LD	JSON for Linking Data
KPI	Key Performance Indicator
LGV	Landesbetrieb Geoinformation und Vermessung (Agency for Geoinformation and Surveying)
LPWAN	Low Power Low Range Wide Area network
M2M	Machine to Machine
MQTT	Message Queue Telemetric Transport
mySMARTLife	Transition of EU cities towards a new concept of Smart Life and Economy
OGC	Open Geospatial Consortium
OUP	Open Urban Platform
PEP	Policy Enforcement Point
REST	Representational State Transfer
SCC	Smart Cities and Communities
SDK	Software Development Kit
SFTP	Secure FTP
SGFC	Smart Grid Field Component Platform
SOAP	Simple Object Access Protocol
SSFC	Smart Streetlight Field Component Platform
TLS	Transport Layer Security
UNE	Una Normal Española (A Spanish Norm)
XML	eXtensible Markup Language
WFS	Web Feature Service
WMS	Web Map Service
WP	Work Package
WS	Work Stream

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1. Executive Summary

This deliverable is the result of the work between several partners with the aim of establishing a common open and interoperable framework under which the new developments of the urban platforms would fit. In this way, openness and interoperability aspects are ensured across the platforms. One of the expected outcomes is to provide an useful guideline for any other city looking for the replication of the urban platform implementation. Hence, multiple existing initiatives have been taken into consideration, as for instance, the EIP-SCC approach, ITU-T recommendation and ESPRESSO documentation. The three approaches coincide in the main aspects that an urban platform should provide:

- Interoperable open APIs
- Openness for data sharing
- Data acquisition methods from sensing elements
- Data storage and implementation of analytics
- Services focused on the end-users

Having all this information in mind, the common specifications framework is centred into the aforementioned premises and it provides a conceptual approach to the cities. Subsequently, the urban platforms are defined in terms of requirements, architecture, interoperability aspects, data acquisition and privacy/security, among others.

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2. Introduction

2.1 Purpose and target group

This deliverable is the result of the cross-cutting task 2/3/4.4, related to the Open Specifications Framework. It sets up the basis for the development of solutions that are interoperable and follows an open approach. It establishes the conceptual approach under which the new services of the urban platforms will be deployed. Definition of data integration concepts, orchestration of software components, open API architecture and, finally, open data approach, focusing on privacy and security, are requirements that are taken into consideration when drafting the conceptual framework.

More organizational, this task is part of the WP2, WP3 and WP4 dedicated to the lighthouse cities where the urban platforms are being improved. Figure 1 represents the schema how the task is distributed across the work packages. In this way, the implementation of the new services of the urban platform should be according to this task, as well as task 2/3/4.6 related to interoperability of the platforms.

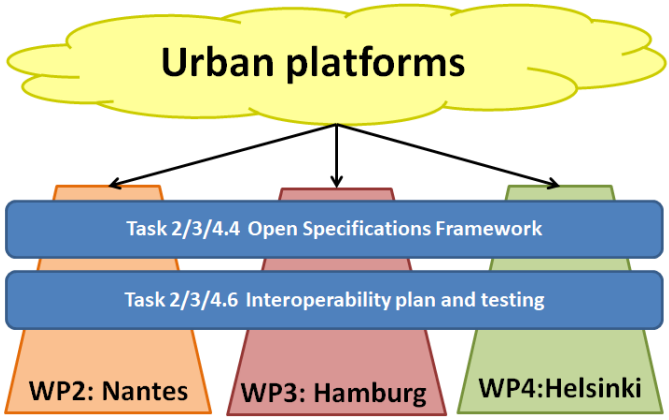

Figure 1: Interoperability task within the work programme

As stated above, the main objective is to establish a common conceptual framework for the implementation of urban platforms, allowing other cities to replicate the same results when starting the implementation of an urban platform. This framework complies with interoperability aspects, openness in terms of open APIs and data, as well as bearing in mind privacy and security aspects. The ultimate goal of the deliverable is to provide a guide to the involved stakeholders at time of designing and developing the urban platform. Then, ICT experts, urban platform developers and IT-related staff may make use of this document with the aim of giving guidance regarding the requirements that should be complied by the urban platforms. In this way, replication activities would take advantage of the definition of the framework as starting point. Moreover, even though each city develops its own urban platform, all of them are according to the common framework, increasing the capabilities of replication. Anyway, this replication activities will be taken into consideration in the WP6, dedicated to these activities.

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On the other hand, the framework is based on the existing initiatives, such as EIP-SCC, ITU-T or ESPRESSO whose approaches are explained in section 4. They have served as references and norms to be followed at time of creating the mySMARTLife framework. Once the framework is set, next chapters are dedicated to the cities in order to establish their own urban platform architectures (all according to the common open framework). Complementary, the services that are already in the platforms and those that are foreseen under the project are documented. Moreover, two key concepts as interoperability and openness are described for each one of the platforms. In the case of interoperability, this is summarised as far as there is a deliverable (D2.17) dedicated to this aspect.

Finally, exploitation of the platforms is not an objective of this deliverable, although a very important aspect to be taken into account. It should be noted the urban platform development teams are composed by public and private entities and the business models need to be refined. This exploitation activity will be one of the focus within WP8 about exploitation of results and one is the urban platform.

2.2 Contributions of partners

The following Table 1 depicts the main contributions from participant partners in the development of this deliverable.

Table 1: Contribution of partners

Participant short name	Contributions
CAR	Task and deliverable leader. Definition of the common open specifications framework according to the existing references and norms.
NAN	Definition of the Nantes architecture and urban platform content.
ENG	Contribution to the Nantes urban platform section and definition of data integration concepts for the urban platforms.
HAM	Definition of the Hamburg architecture and urban platform content and open API architecture.
TSY	Contribution to the Hamburg urban platform architecture and definition of orchestration of software components and open API architecture.
HEL	Definition of the Helsinki architecture and urban platform content.
FVH	Contribution to the Helsinki urban platform section and definition of the open data approach, focusing on privacy and security.

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2.3 Relation to other activities in the project

The following Table 2 depicts the main relationship of this deliverable with other activities (or deliverables) developed within the mySMARTLife project and that should be considered along with this document for further understanding of its contents.

Table 2: Relation to other activities in the project

Deliverable Number	Contributions
D2.17	This deliverable provides the interoperability definition, as well as testing and planning that the urban platforms should comply with. In this way, the architectures of the platforms are accordingly defined to the interoperability.
D2.8	The deliverable is focused on the improved services in Nantes urban platform and these services need to be taken into consideration under the design of the framework.
D3.5	The developments of the new concepts for urban platform in Hamburg include new services and new concepts that are determined within the common open framework.
D3.6	This deliverable determines the open data and open APIs in Hamburg, which are key points within the common framework.
D4.9	This deliverable contains the explanations related to the Carbon Neutral Me, which is a new service in the Helsinki urban platform and, hence, part of this deliverable.
D4.10	Description of the features for new services in the platform, then, again, part of the developments of the urban platform according to the framework.
D4.11	Description of IoT services that are under implementation and must be taken into consideration within the open specifications framework.
D4.13	Similar to previous cases, this deliverable is dedicated to open data and open APIs, being layers of the common approach.
D5.2	It is dedicated to the data-sets, therefore, data management and, thus, related to the privacy and security of data.
D5.3	Related to the actions, this deliverable contains the monitoring programs for these actions and, within them, monitoring should be integrated in the platforms, which is also considered in this deliverable.
D5.4	Data collection should be integrated in the platforms, therefore, procedures for data integration are necessary into the urban platforms definition.

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3. Glossary

Before starting with the definition of the open common specifications framework, it is necessary to establish a common understanding about the main concepts related to urban platforms. Sometimes, it is difficult to understand to each other and that is the reason why having a glossary of terms is helpful to any stakeholder who reads the document. Table 3 includes the definition of several terms, under the point of view of mySMARTLife project, classified in different groups as follows:

- Stakeholders, defined as users that exchange information with the urban platform.
- Processing steps, which refer to the steps into the urban platform for data processing from the data collection to the data sharing passing through the intermediate stages.
- Openness, referring open data and APIs aspects mainly.
- Interoperability, in terms of ability to share data between multiple entities.
- Other definitions, which are more general and do not fit in the previous groups.

Table 3: Glossary of terms

Term	Definition used
	Stakeholders
Platform provider	Stakeholder who: - "*MAINTAINS the eco-system of data, services, and users. DEFINES standards, licenses and regulations and provides terms and conditions for platform usage and the commercial exploitation of data and services. DECIDES WHO is allowed to join the value network of data and services providers.*" [1]
Data publisher	Stakeholder who: - "*PUBLISHES open and proprietary data into the platform.* - *MANAGES AND MAINTAINS RESOURCES in the platform accordingly to terms and conditions.*" [1]
Data consumer	Stakeholder who: - "*CONSUMES open and proprietary data provided in the platform. USES open and commercial data services provided in the platform. PROVIDES FEEDBACK on data and services provision."* [1]
Service provider	Stakeholder who: - "*DEPLOYS open and commercial data services into the platform (e.g. data visualisation, data cleansing, and data integration tools). MANAGES AND MAINTAIN RESOURCES in the platform accordingly to terms and conditions.*" [1]

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Term	Definition used
Final user	Stakeholder who ultimately beneficiates from the Urban Platform. First of all and the most important stakeholder, the citizens. They are the main focus of the urban platform by means of available services. Nevertheless, city managers, city council, etc. make use of the urban platform to make decisions based on data and indicators that the urban platform provides.
	Processing steps
Collect	Processing step #1 (sensing layer / field layer): - At field level, field information (heat, pressure, power, consumption…) are collected and converted into IT data. This step may be under the responsibility of data publisher as defined above or sensor owner as data "vendor".
Publish	Processing step #2 (sensing layer / field layer): - The Incoming Data are made available to the Urban Platform by the Data Publisher in the Data Publisher's format: original or specific or transformed into an open standard format to ensure interoperability. - Access rights (right to publish) are verified at this step. - It is the Data Publisher's responsibility to ensure that the published data meet quality requirements. - Publish – Push: o The Data Publisher sends the data to the Urban Platform; the Urban Platform provides services to receive the data and the according Service Contract. o Example: IoT measurements are sent to the urban platform. - Publish – Pull: o The Urban Platform IT Core fetches the Incoming Data; the Data Publisher provides services to retrieve the data and the according Service Contract. o Example: Weather information is fetched by the urban platform periodically (poll mechanism).
Import	Processing step #3 (data layer / drivers layer): - The Incoming Data Service Contract is verified. - The Incoming Data is stored in a staging data container to be ready for the next step.
Integrate	Processing step #4 (data layer / drivers layer): - The Incoming Data is transformed from the Data Publisher's format into the target data format and stored in the Work Data container. - The data is ready for either being made public ("Expose" step) or being used for a transformation.

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Term	Definition used
Transform	Processing step #5 (business layer / knowledge layer): - Service Providers provide transformation services and the according Service Contracts. - The transformed data must be in target format, i.e. do not require any other Integration step. - Transformation can be of various types: e.g. aggregation, anonymization, calculation, analysis, forecast, cross-referenced with other data… - Not all data require to be transformed prior to exposition.
Expose	Processing step #6 (business layer / interoperability layer): - The Data in target format is tagged as ready to be exposed, either to the public or to a restricted list of Data Consumers. - Only data tagged as "exposed" can be consumed by an actor, which is neither the Platform Provider nor a Service Provider.
Distribute	Processing step #7 (IT enabled services layer / intelligent services layer) - The Data is transferred from the Urban Platform to Data Consumers. Typically, this step can be carried out by an open data portal. - Access rights (data access rights) are verified at this step.
Consume	Processing step #8: - The Data consumers make use of the distributed data.
	Openness
Open data	"*Open data is the idea that some data should be freely available to everyone to use and republish as they wish, without restrictions from copyright, patents or other mechanisms of control.*" [2]
Open specification	The documents fully describing the functional perimeter and the integration details (including the service contract) are free for access.
Open API	"*An open API, also known as a public API, is an application programming interface that allows the owner of a network-accessible service to give universal access to consumers of that service, such as developers. An API is a software intermediary that makes it possible for application programs to interact with each other and share data."* [3] The API is available to any user for free. Authentication may be required, depending on the Platform Provider policy.

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Term	Definition used
Open SDK	Either: a) Technical components, available to third-party users for free, which allow developers to implement components, which would be executed within the Urban Platform without using the Open API. Or: b) Technical components, available to third-party users for free, which allow third parties to use the open APIs. For mySMARTLife, Open SDK will be implemented by open source tools, which apply to the interoperable web services provided at field and API level.
	Interoperability
Interoperability	"*Ability for products/services/systems to exchange data with other products/services/systems in an harmonized and homogeneous way by using open and standard formats and/or protocols.*" [3]
Data format	Structure, cardinality, field formats and field of extent, which together represent in an unambiguous way a piece of information.
Service contract	Document, which defines an interaction between two IT systems. It contains or refers to: - an Interface Contract (cf. definition), and also refers to: - the time windows and/or schedule during which the service is due to be available, - the estimated and/or maximum amount of data involved, - the periodicity at which new data are available or recalculated, - the minimum and maximum latency, i.e. the amount of time before new data are made available through the service or the indication that there is no commitment in this matter, - the rules and regulations applicable to the use of the service.

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Term	Definition used
Interface contract	Technical document, which defines: - Service protocol: file-based (e.g. FTP, SFTP, FTPS…), service-based (e.g. REST, SOAP, EJB…), - Service signature (methods names, arguments names, return values, exceptions), - Data format (e.g. JSON, XML, CSV…), - Data structure: fields and cardinality, - Field information: type (e.g. other data, string, integer, double, date…), format (e.g. length, number of digits…), list of accepted values (e.g. "Y", "N", "ON", "OFF"…). - An explanation of the data and fields, their meaning and any information and/or reference, which helps to understand what the service and data are about and how to use it. - Data related specifications should be as close as possible to existing standards, if not directly refer to it.
	Other definitions
Urban Platform	It is "*the implemented realization of a logical architecture/content/design that brings together (integrates) data flows within and across city systems and exploits modern technologies (sensors, cloud services, mobile devices, analytics, social media etc.)*" [4]. It provides "*the building blocks that enable cities to rapidly shift from fragmented operations to include predictive effective operations, and novel ways of engaging and serving city stakeholders in order to transform, in a way that is tangible and measurable, outcomes at local level (e.g. increase energy efficiency, reduce traffic congestion and emissions, create (digital) innovation ecosystems)*". [4] An urban platform integrates various verticals and enables data exchange between verticals and data analytics regarding the combination of services. It forms a system of systems.
Framework	For software point of view, it refers to a reusable set of libraries or classes for a software system. It represents a common, reusable and open abstraction of the software architectures. It is basically a structure, a logical way to classify, segment and categorize functionalities.
Architecture	It refers to the process of defining a structured solution that meets all of the technical and operational requirements, while optimizing common quality attributes such as performance, security, and manageability. The software architecture of a program or computing system is the structure or structures of the system, which comprise software elements, the externally visible properties of those elements, and the relationships among them.

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Term	Definition used
Sensor	Sensor is a simply measurement device, for instance, a temperature sensor. A device is any equipment sending data, either composed by a single value (single sensor) or multiple values (i.e. multi-sensor, for example, a data collector that sends several values once).
Service	A service is a high-level functionality within any of the defined verticals that allow citizens, city planners, city managers, public administration, etc. to interact with the urban platform via applications (web, mobile...).
Data-set	A data-set is a representation of a collection of data in an established format.
Personal data	It means data relating to a living individual who is or can be identified either from the data or from the data in conjunction with other information that is in, or is likely to come into, the possession of the data controller.
Private data	Private data, as defined by the EC, are defined as those pieces of information that are provided by private companies.

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4. Common open specifications framework

Under this section, the common open framework under which the urban platforms are developed is described. Nevertheless, this specification does not start from scratch, but it takes into consideration existing frameworks like EIP (European Innovation Partnership), ITU-T (International Telecommunication Union) and ESPRESSO. These have been selected because of being a very well-established initiatives and standards in International organizations. As well, the requirements of the cities in terms of the urban platform are considered at time of depicting the common open specifications framework. Finally, the openness criterion has been included.

4.1 State of the art for existing initiatives

As mentioned before, the definition of the common open specifications framework has taken into account the existing initiatives, references and norms that are described below.

4.1.1 EIP-SCC Work Stream 2

The first approach that has been analysed under the mySMARTLife project is the initiative of the EIP-WS2 (Work Stream 2) in which a reference architecture is included. Within this working group, the concept of urban platform is established as depicted in Figure 2 [1][2]. This is based on three main pillars referred to urban mobility, districts environment and integrated infrastructures in order to achieve the view of 'Smart City'. Horizontally, there exist three enablers to achieve the urban platform concept. First of all, decisions which focuses on citizens (societal needs in terms of requirements of new digital services [1]), policies/regulations and planning. Second, insight is referred to open data (i.e. city data under open policies to allow citizens to access the information), standards for communication, knowledge and metrics. Finally, to reach the objectives, funds are required by means of new profitable business models [1].

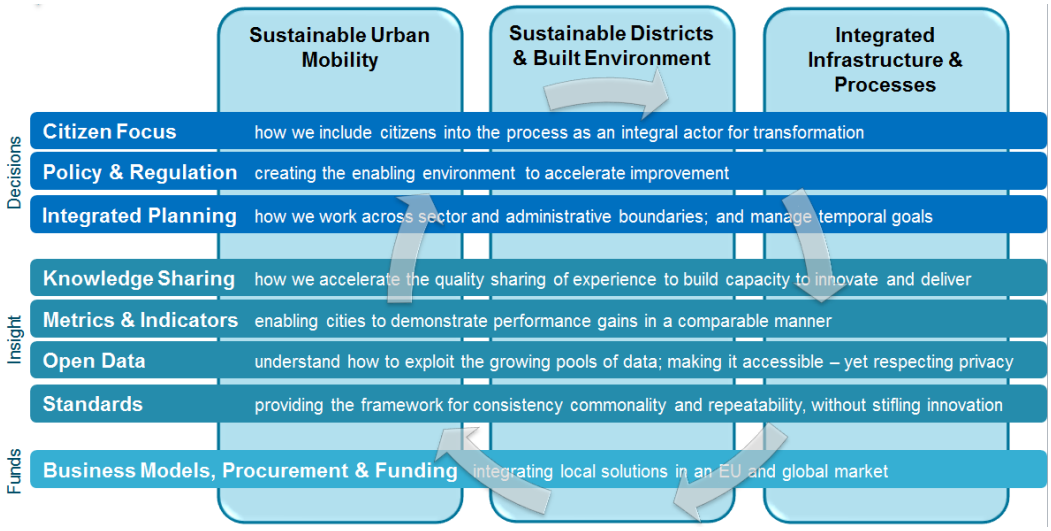

Figure 2: Conceptual definition of urban platform

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According to the aforementioned schema and the European definition [1], the urban platform should:

- Cater for interoperability between urban infrastructures
- Enable replicability of the solutions/platforms city to city
- Scale without technical constraints and excessive cost increase
- Provide open APIs and SDKs
- Enable Real Time capabilities
- Support implementation of functional and technical capabilities

Once the concept is explained, next step is to establish the reference architecture from the EIP-SCC WS2. Figure 3 represents the schema for the EIP open framework [2]. The advantage of this existing reference is the establishment of a starting-point and increase the interoperability. Under this reference architecture, it should be noted that it varies depending on the stakeholder, including city leaders, political advisors, city manager, procurement, IT leaders, developers, vendors and citizens [2]. This approach is multi-layered and, although the details may be looked up into [2], the meaning of each layer is described below.

- Layer 0: Field Equipment / Device capabilities, responsible for the connection of the external environment (field devices, IoT, etc.).
- Layer 1: Communications, Network & Transport, dedicated to the data exchange between applications and devices, including M2M (Machine to Machine) capabilities.
- Layer 2: Device Asset management, which includes the capabilities to enable the delivery and assurance of the assets supporting the device communications and integration.
- Layer 3: Data management & Analytics, in charge of the use of data by applications, analyse these data and share/publish open data.
- Layer 4: Integration and Orchestration, with capabilities of orchestration of process and services to support system and human interaction.
- Layer 5: Generic City & Community capabilities, in terms of deployment of generic capabilities.
- Layer 6: Specific City & Community capabilities, in terms of deployment of specific capabilities for the city under the three main pillars explained in Figure 2.
- Layer 7: Interaction, in order to enable the interaction of users or machines.
- Layer 8: Common Services, which are more generic and not program or mission specific.

Within each level, there exist several capabilities that specify more in detail the functionalities of each layer (yellow boxes in Figure 3) However, as stated before, the objective of this deliverable is not to go into the details of the functionalities, but understand the capabilities of the overall approach to define the mySMARTLife open specifications framework.

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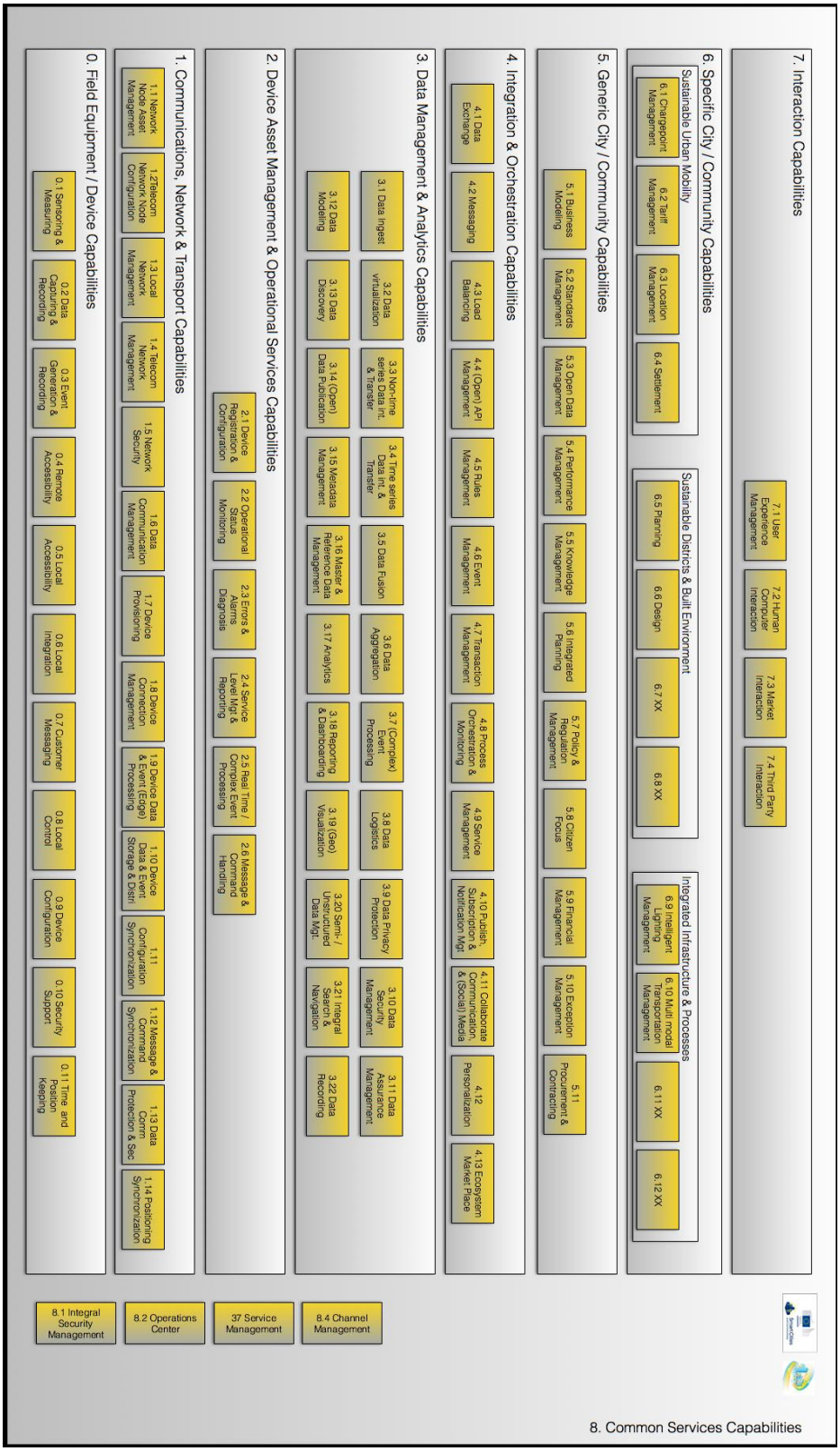

Figure 3: EIP reference architecture

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4.1.2 ITU-T UNE 17804:2015

ITU-T is the Telecommunication Standardization Sector within the International Telecommunication Union and it is in charge of the coordination of the standards for telecommunications. In particular, the standardization group for smart cities is led by the AENOR committee, which is the Spanish entity for Spanish regulations, norms and standards. It has already published multiple documents, but one of them is related to the norm UNE 17804:2015 [5]. Under this norm, reference architecture is determined not only at regional level, but also as ITU-T reference. Figure 4 [5][6] represents the approach that is published under the aforementioned norm.

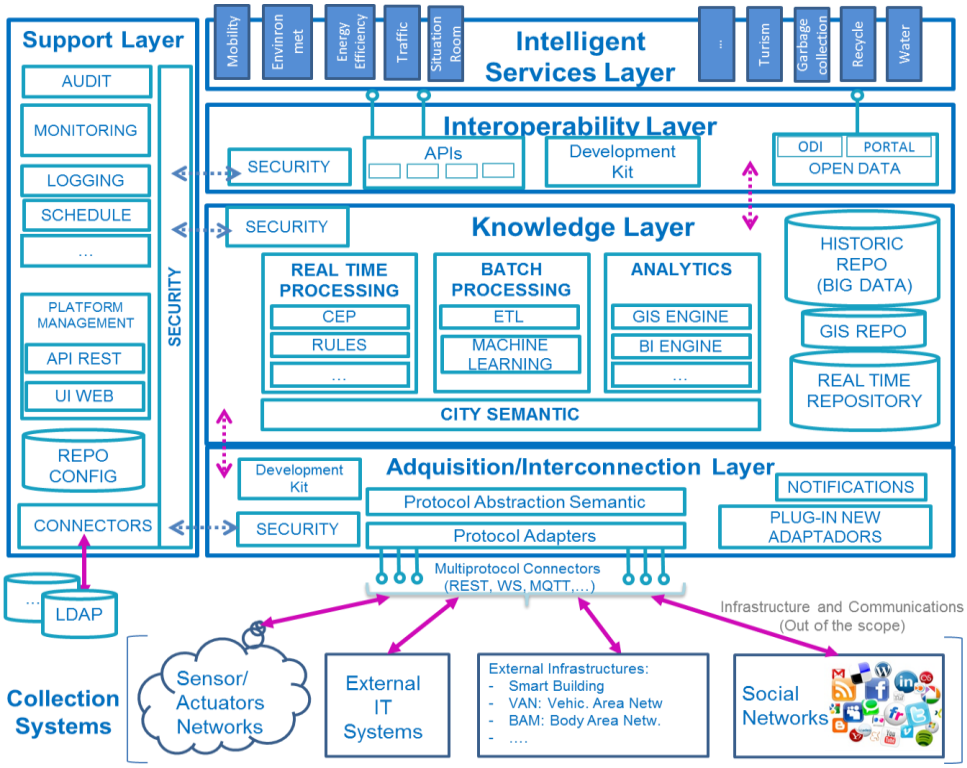

Figure 4: ITU-T reference architecture

In spite of seeming different, conceptually, it is quite similar to the EIP framework. In particular:

- Collection systems function is similar to layer 0 and it represents the field equipment, understood not only as physical sensors, but also any IT system that provides data (e.g. social networks).
- Acquisition/Interconnection layer, similar to layer 1 and 2, Integrates the information from the data sources (Collection Systems), providing the knowledge layer with semantic info.
- Knowledge layer, bound to layer 3 in terms of data management, data repositories, ETL (Extraction, Transform and Loading) procedures, including analytics.
- Interoperability layer, which merges part of layer 3 and 4, provides the sharing data through open APIs and open data. This information allows the implementation of the services and access to the customers.

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- Intelligent services layer, which comprises layers 5, 6 and 7, dedicated to the services of the urban platform. While EIP distinguishes between generic and specific services, as well as urban platform interaction, ITU-T reference merges all these services in a single layer.
- Support layer, which is transversal and is dedicated to those services related to the maintenance of the platform as logging, configuration, etc. This is the highest difference between both frameworks.

4.1.3 ESPRESSO

ESPRESSO develops a “Conceptual Smart City Information Framework” based on open standards [7]. It has been also taken into consideration as reference, which is also taken into account under the EIP-SCC WS2 document. Figure 5 [8] draws its proposal as reference architecture, which is again similar to the two explained before.

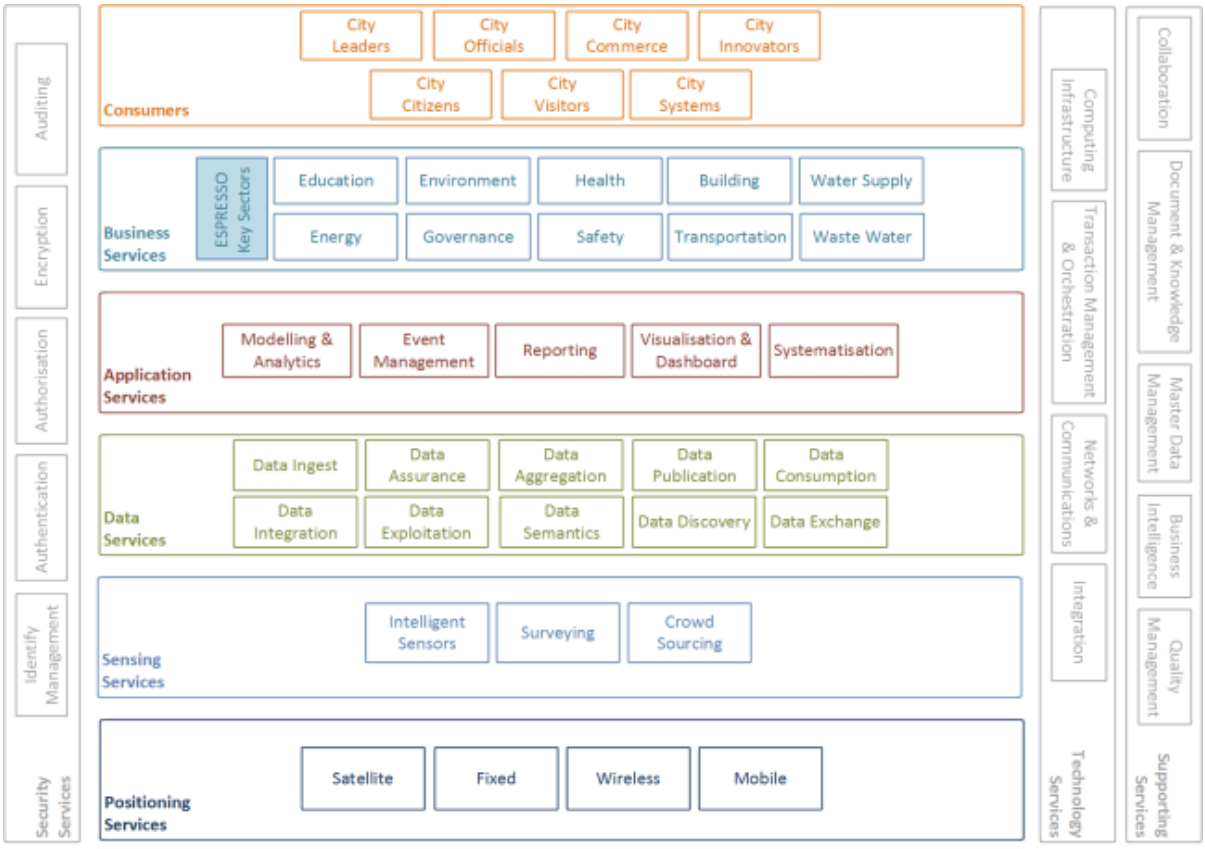

Figure 5: ESPRESSO reference architecture

Apart from the transversal layers, whose functionality is similar to ITU-T architecture, the horizontal layers present similar objectives. In this case, due to the use cases presented in [8], the field level is represented by positioning services and sensing services. Nevertheless, in Figure 6 [9], ESPRESSO defines the concept for Smart Cities where sensing layer is already implemented as sensing layer with all the information. Data layer or data services offer the same functionality than data acquisition and

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management from the previous references. What is slightly different is the way about how to merge the services, while EIP-SCC clearly splits services in different levels, ITU-T simplifies it into a single layer and, finally, ESPRESSO provides services in two terms about visualization/analytics and IT services for the urban services.

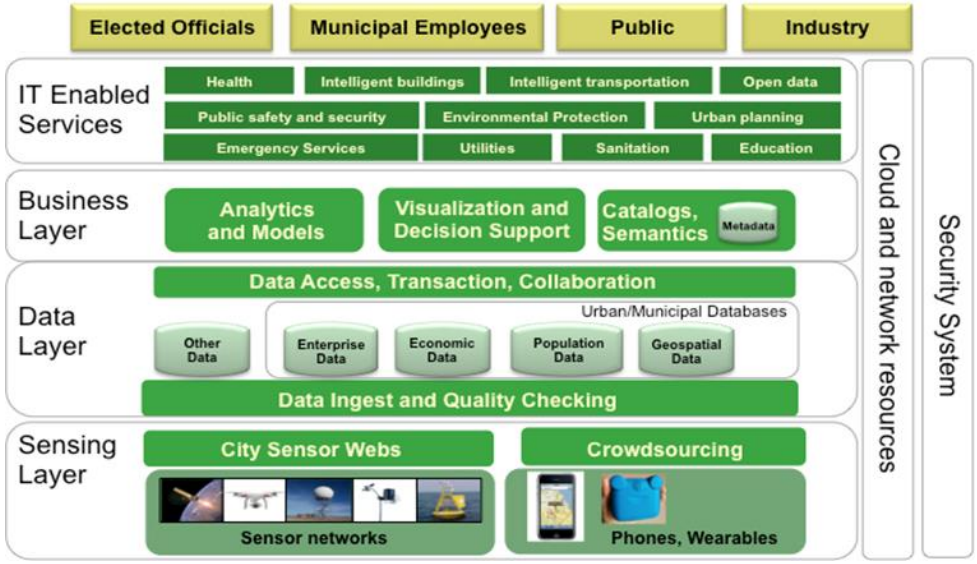

Figure 6: ESPRESSO Smart Cities solution concept

4.1.4 Conclusions from the analysis of the initiatives

In summary, all the references that have been discussed under this section follow the same approach or concept, although explained in different way. Thus, the most important conclusion of this analysis may be described in the next requirements for any urban platform:

- Sensing devices need to be deployed throughout the city in order to monitor multiple parameters, whatever it is the context (i.e. energy, mobility…) and/or the source (IoT devices, phones, 3D city data, social networks…).
- Data acquisition and format processes that collect the information from field through, preferred, open and standard protocols. Thus, communication drivers and data adaptors are required for information gathering.
- Data storage, implementation of analytics and data management are also remarkable topics that need to be considered within the urban platforms in order to keep persistent records. As well, the calculation of indicators gives support at decision-making tools for the city stakeholders or at time of presenting useful information.
- Interoperability aspects need also to be addressed with the objective of providing open APIs, open Data and open SDKs.
- Finally, services by means the end-users may access to the functionalities of the urban platform.

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4.2 Urban platforms requirements

Having collected the main references and norms that have been considered under the mySMARTLife umbrella, next step is to collect the requirements of the cities. With these two inputs, the open framework may be constructed according to both sources. Then, next subsections describe the requirements from the cities in terms of urban platforms.

4.2.1 Nantes requirements

Starting with the case of Nantes Métropole, Table 4 includes all the requirements that have been identified. In this way, all are numbered and described. Moreover, the associated layer is compared against the EIP reference architecture. Besides, the functionality, type of requirement, the partner responsible for fulfilling and the end-user that will take advantage are also identified in the table. In this last case, there are four possibilities as explained in the glossary section.

Table 4: Nantes requirements for the urban platform

Req. #	Description	Associated layer	Action / Functionality	Type	Partner	User
NAN-R101	Data publishers must be authorized by the platform provider prior to publishing data.	1. Communications, Network and Transport Capabilities	Publishing	Functional - access rights	NM, ENEDIS, ENGIE	Data publisher
NAN-R102	Data publishers should be able to publish data in a batch form (e.g. File).	1. Communications, Network and Transport Capabilities	Publishing	Technical	ENEDIS, ENGIE	Data publisher
NAN-R103	Data publishers should be able to publish data in a stream-like way (e.g. synchronous API)	1. Communications, Network and Transport Capabilities	Publishing	Technical	ENEDIS, ENGIE	Data publisher
NAN-R201	Data publishers' activities should be logged.	2. Device asset management	Investigating.	Functional - logging	ENGIE	Data publisher
NAN-R202	Service providers' activities should be logged.	2. Device asset management	Investigating.	Functional - logging	ENGIE	Service provider
NAN-R203	Data consumers activities related to restricted data must be logged.	2. Device asset management	Investigating.	Functional - logging	ENGIE	Data consumer
NAN-R204	Data consumers activities related to public data may	2. Device asset management	Investigating.	Functional - logging	ENGIE	Data consumer

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	be logged.					
NAN-R205	Platform provider activities related to exposing data may be logged.	2. Device asset management	Investigating.	Functional - logging	ENGIE	Data consumer
NAN-R301	Service providers must be authorized by the platform provider prior to deploying data services.	3. Data management and Analytics	Analysing	Functional - access rights	NM, ARMINES, ENGIE	Service provider
NAN-R302	Exposed data must be accompanied by meta-data.	3. Data management and Analytics	Exposing	Functional - meta-data	NM, ENGIE	Platform provider
NAN-R303	Exposed data and meta-data should comply with data structures shared among the lighthouse cities.	3. Data management and Analytics	Exposing	Functional - meta-data	NM, ENGIE	Platform provider
NAN-R304	Exposed data and meta-data should comply with data structures shared by other European initiatives.	3. Data management and Analytics	Exposing	Functional - meta-data	NM, ENGIE	Platform provider
NAN-R305	Exposed data meta-data must be registered in a public dictionary (open specifications).	3. Data management and Analytics	Exposing	Functional - meta-data	NM, ENGIE	Platform provider
NAN-R306	Exposed data types structure must be registered in a public dictionary (open specifications).	3. Data management and Analytics	Exposing	Functional - data	NM, ENGIE	Platform provider
NAN-R307	Exposed data types aggregations must be registered in a public dictionary (open specifications).	3. Data management and Analytics	Exposing	Functional - data	NM, ENGIE	Platform provider
NAN-R308	Exposed data types date of observation (or	3. Data management and	Exposing	Functional - data	NM, ENGIE	Platform provider

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	latency) must be registered in a public dictionary (open specifications).	Analytics				
NAN-R309	Exposed data types medium must be registered in a public dictionary (open specifications).	3. Data management and Analytics	Exposing	Functional - data	NM, ENGIE	Platform provider
NAN-R310	Data publishers are accountable for the quality of the data they publish.	3. Data management and Analytics	Publishing	Data quality	ENEDIS	Data publisher
NAN-R311	Service providers are accountable for the quality of the data they elaborate.	3. Data management and Analytics	Analysing	Data quality	ARMINES	Service provider
NAN-R401	APIs to query exposed data must be registered in a public dictionary (open specifications).	4. Integration and Orchestration capabilities	Exposing	Functional - API	NM, ENGIE	Platform provider
NAN-R402	APIs to query exposed data must be accessible from public network (open API).	4. Integration and Orchestration capabilities	Exposing	Functional - API	NM, ENGIE	Platform provider
NAN-R501	Data consumers should access public exposed data freely.	5. Generic City / Community capabilities	Consuming	Functional - access rights	Citizens, start-ups	Data consumer
NAN-R502	Data consumers must be authorized by the platform provider to access restricted exposed data.	5. Generic City / Community capabilities	Consuming	Functional - access rights	NM, CARTIF (WP5), ENGIE	Data consumer
NAN-R503	Data consumers should be able to get exposed data in a batch form (e.g. File).	5. Generic City / Community capabilities	Consuming	Technical	ENGIE	Data consumer
NAN-	Data consumers should	5. Generic City /	Consuming	Technical	ENGIE	Data

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R504	be able to get unitary exposed data (e.g. Query).	Community capabilities				consumer
NAN-R505	The urban platform provider makes no commitment to synchronous data delivery.	5. Generic City / Community capabilities	Exposing	Technical	ENGIE	Platform provider
NAN-R506	The urban platform provider will provide latency commitment on a per case basis.	5. Generic City / Community capabilities	Exposing	Technical	ENGIE	Platform provider
NAN-R507	Stream-like exchanges with the urban platform will be implemented with REST/JSON web services.	5. Generic City / Community capabilities	Exposing	Technical	ENGIE	Platform provider
NAN-R508	The platform provider should be able to decide if a data-set should be exposed automatically.	5. Generic City / Community capabilities	Exposing	Functional - data quality	NM, ENGIE	Platform provider
NAN-R509	The platform provider should be able to trigger the exposition of a data-set.	5. Generic City / Community capabilities	Exposing	Functional - data quality	NM, ENGIE	Platform provider

4.2.2 Hamburg requirements

Similar to the Nantes case, Hamburg has defined its requirements for the urban platform following the same template than Nantes. Table 5 includes the list of requirements in this case.

Table 5: Hamburg requirements for the urban platform

Req. #	Description	Associated layer	Action / Functionality	Type	Partner	User
HAM-R1/5-01	Data publishers must be authorized by the platform provider prior to publishing data.	1. Communications, Network and Transport Capabilities and 5. Generic City /	Publishing	Functional	LGV, TSY, City of Hamburg	Data publisher

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		Community Capabilities				
HAM-R1-02	Data publishers should be able to publish data using automation procedures	1. Communications, Network and Transport Capabilities	Publishing	Technical	LGV, TSY	Data publisher
HAM-R1-03	Data publishers should be able to publish data in a stream-like way (e.g. synchronous API)	1. Communications, Network and Transport Capabilities	Publishing	Technical	LGV, TSY	Data publisher
HAM-R1-04	Require TLS for all external communications	1. Communications, Network and Transport Capabilities	Exposing	Technical	LGV, TSY	Everybody
HAM-R2-01	Provide technical statistics of usage of platform	2. Device Asset Management	Monitoring	Functional	LGV	Service / Platform provider
HAM-R2/3/4-01	Interoperability, System of Systems	2. Device Asset Management, 3. Data management and Analytics, 4. Integration and Orchestration capabilities	Publishing, exposing, integrating, consuming	Technical	LGV, TSY	Service / Platform provider
HAM-R3-01	Exposed data must be accompanied by metadata.	3. Data management and Analytics	Exposing	Functional - metadata	LGV, City of Hamburg, TSY	Platform Provider / Data publisher
HAM-R3-02	The accompanied metadata should comply with meta data standards ISO 19115, 19139 as requested by the EU directive 2007/2/EC establishing INSPIRE	3. Data management and Analytics	Exposing	Functional - metadata	LGV, TSY	Platform / Service Provider
HAM-R3-03	Exposed data metadata must be registered in a	3. Data management and Analytics	Exposing	Functional - metadata	LGV, TSY	Platform / Service

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	public catalogue (open specifications).					Provider
HAM-R3-04	Data publishers are accountable for the quality of the data they publish.	3. Data management and Analytics	Publishing	Functional	3rd Party	Data publisher
HAM-R3-05	Service Providers are responsible for the service quality	3. Data management and Analytics	Publishing	Functional	LGV, TSY	Platform / Service Provider
HAM-R3-06	Store sensor data as time-series data available for fast retrieval for trend visualization or analytics	3. Data management and Analytics	Exposing	Functional	LGV, TSY	Service / Platform Provider, Data consumer
HAM-R3-07	Provide dynamic data attributes to 3D city model applications	3. Data management and Analytics	Exposing	Functional	LGV	Service / Platform Provider, Data consumer
HAM-R3-08	Provide support for semantic / linked data approaches in metadata	3. Data management and Analytics	Exposing	Functional	LGV, TSY	Service and Platform Provider
HAM-R3-09	Generate KPIs according to city indicators	3. Data management and Analytics	Exposing	Functional	LGV	Service and Platform Provider
HAM-R3-10	Data hub / Integration layer for systems, FCP, or/and sensors	3. Data management and Analytics	Integrating	Functional and Technical	LGV, TSY	Service and Platform Provider, Data Publisher
HAM-R3-11	Data quality monitoring	3. Data management and Analytics	Integrating	Functional and Technical	LGV, TSY	Service and Platform Provider, Data Publisher
HAM-R3-12	Processing and simulation (predictive	3. Data management and Analytics	Analysing	Functional	LGV, TSY	Service and Platform

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	analysis, maintenance, detecting trends, etc.) of data					Provider, Data Publisher
HAM-R3/4/5/7-01	Metadata catalogue providing data and applications and associated resources	3. Data management and Analytics, 4. Integration and Orchestration capabilities, 5. Generic City / Community capabilities, 7. Interaction	Exposing	Functional	LGV	Service / Platform Provider, Data consumer
HAM-R4-01	APIs to query exposed data must be accessible from public network (open API)	4. Integration and Orchestration capabilities	Exposing	Functional	LGV, TSY	Service / Platform Provider, Data consumer
HAM-R4-02	Coupling of data and services	4. Integration and Orchestration capabilities	Exposing	Functional	LGV	Service/Platform Provider, Data consumer
HAM-R4-03	Development and implementation of scalable infrastructures / computing /applications	4. Integration and Orchestration capabilities	publishing/ Exposing/Consuming	Technical	LGV, TSY	Service / Platform Provider, Data consumer
HAM-R5-01	Data consumers should access public exposed data as Open Data at no cost accordingly to the transparency law.	5. Generic City / Community capabilities	Consuming	Functional	LGV, TSY	Data consumer
HAM-R5-02	Data consumers must be authorized by the platform provider to access restricted exposed data.	5. Generic City / Community capabilities	Consuming	Functional	LGV, TSY	Data consumer
HAM-	Data consumers should	5. Generic City /	Consuming	Technical	LGV, TSY	Data

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R5-03	be able to filter exposed data (e.g. Query).	Community capabilities				consumer
HAM-R7-01	Provide city dashboard to display KPIs and trends for different domains	7. Interaction	Exposing	Functional and Technical	LGV	Service / Platform Provider, Data consumer
HAM-R7-02	Provide event-driven service API to external services, such as analytics or alerts	7. Interaction	Exposing / Consuming	Functional and Technical	LGV, TSY	Service / Platform Provider, Data consumer
HAM-R7-03	Citizen Engagement, Capability to include data (provided by citizens) into the platform	7. Interaction	Publishing / Integrating	Functional	LGV	Service / Platform Provider, Data consumer, Data publisher
HAM-R0/7-01	SensorThings API for sensors and services	0 Field Equipment/Device capabilities and 7. Interaction	Publishing and Consuming	Functional and Technical	LGV, TSY	Service/Platform Provider, Data consumer
HAM-RA-01	BSI (Federal office for Information Security in Germany) compliant, Security according to the requirements the German Federal Office for Information Security	All layers	All actions	Functional and Technical	LGV, TSY	Everybody
HAM-R1/5-01	Data publishers must be authorized by the platform provider prior to publishing data.	1. Communications, Network and Transport Capabilities and 5. Generic City / Community Capabilities	Publishing	Functional	LGV, TSY, City of Hamburg	Data publisher

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4.2.3 Helsinki requirements

Last but not least, Helsinki has completed the same exercise than the other two lighthouse cities. The result is described under Table 6.

Table 6: Helsinki requirements for the urban platform

Req. #	Description	Associated layer	Action / Functionality	Type	Partner	User
HEL - 1	Require authentication using OpenID (YLE ID or hel.fi accounts)	Layer 8. Common Services	8.1 Integral Security Management	Technical	N/A	Platform Administrator
HEL - 2	Option to associate account with government given ID	Layer 8. Common Services	8.1 Integral Security Management	Technical	N/A	Platform Administrator
HEL - 3	Associate account with an organization ID	Layer 8. Common Services	8.1 Integral Security Management	Technical	N/A	Platform Administrator
HEL - 4	Require TLS for all external communications	Layer 1. Communications, Network & Transport	1.5 Network Security	Technical	N/A	Platform Administrator
HEL - 5	Encrypt secure data on the platform	Layer 3. Data management & Analytics	3.10 Data Security Management	Technical	N/A	Platform Administrator
HEL - 6	Aggregate sensor data to CKAN with metadata tags	Layer 3. Data management & Analytics	3.6 Data aggregation	Technical	N/A	Data Steward
HEL - 7	Provide dashboard to display trends including real-time data points	Layer 7. Interaction	7.1 User Experience Management	Functional	3rd Party Developers	Data Steward
HEL - 8	Provide event-driven service API to external services, such as analytics or alerts	Layer 7. Interaction	7.4 Third party integration	Functional	3rd Party Developers	Data Steward / Developer
HEL - 9	Provide way to complete or manipulate data in event-driven fashion	Layer 3. Data management & Analytics	3.5 Data Fusion	Functional	N/A	Data Steward

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HEL - 10	Store sensor data as time-series data available for fast retrieval for trend visualization or analytics	Layer 3. Data management & Analytics	3.4 Time series data int. & Transfer	Functional	3rd Party Developers	Data Steward
HEL - 11	Provide dynamic data attributes to CityGML 3.0 city model	Layer 3. Data management & Analytics	3.9 Geo Visualization	Functional	N/A	Data Steward
HEL - 12	Provide function to user to define and retrieve service-specific consent to use data on attribute-level	Layer 3. Data management & Analytics	3.11 Data Assurance Management	Functional	N/A	Citizen
HEL - 13	Provide technical statistics of usage of platform	Layer 2. Device Asset management	2.3 Errors, Alarms & Diagnosis	Functional	N/A	Platform Administrator
HEL - 14	Provide audit log on data and consent changes according to GDPR requirements	Layer 2. Device Asset management	2.3 Errors, Alarms & Diagnosis	Functional	N/A	Citizen, Legal
HEL - 15	Provide function to integrate data values to required KPIs, e.g. noise levels 7-22	Layer 3. Device Asset management	3.6 Data aggregation	Functional	N/A	Data steward
HEL - 16	Provide a view to display all the available data services to associate with data streams	Layer 7. Interaction	7.4 Third party integration	Functional	3rd Party Developers	Data Steward/Developer/Citizen
HEL - 17	SensorThings API for sensors and services	Layer 0. Field Equipment / Device capabilities	0.1 Sensoring & Measuring	Functional	N/A	Platform Administrator
HEL - 18	Develop key modules in stateless, de-coupled way so that they are easy to duplicate for load balancing	Layer 1. Communications, Network & Transport	1.9 Device data & Event Processing	Technical	N/A	Platform Administrator

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HEL - 19	Provide support for semantic / linked data approaches in metadata	Layer 3. Data management & Analytics	3.15 Metadata management	Functional	N/A	Data Steward / Developer

4.3 mySMARTLife open framework

After having reviewed the state of the art of the existing initiatives, this section describes the selection and definition of the open specifications framework to be followed under mySMARTLife project. It is important to remark before the definition of the framework that the open urban platform memorandum of understanding and reference framework was developed to provide cities with guideline to enable the procurement of an open urban platform. In addition, it should provide a guideline and plea for interoperability based on the systems of systems approach.

Across the project, it has been agreed to make use of ESPRESSO as reference framework. However, it should be noted that ESPRESSO approach is not enough for fulfilling the requirements of mySMARTLife project, therefore, new innovation is necessary to cover the developments of mySMARTLife. In this way, taking the requirements as input, Figure 7 represents the framework that responds to the open specifications and interoperability aspects to be fulfilled. In this sense, one of the most important topics is interoperability. Hence, the interoperability layer is added with functionality related to the citizen consent management in order to better support the upcoming General Data Protection (GDPR) requirements [10]. This approach also increases the value of the platform as an innovation platform, making it easier to create new data-driven services while respecting the privacy requirements. For more information about this approach, see interim deliverable D4.11.

Related to this interoperability aspect, within D2.17 the requirements of interoperability are denoted, as depicted in Figure 8. The details are included in D2.17, but, briefly, it may be set that interoperability for integration of data an open data/APIs is necessary. Moreover, it appears transversal interoperability between urban platforms, which is referred to the capability of reusing a service from one platform to another.

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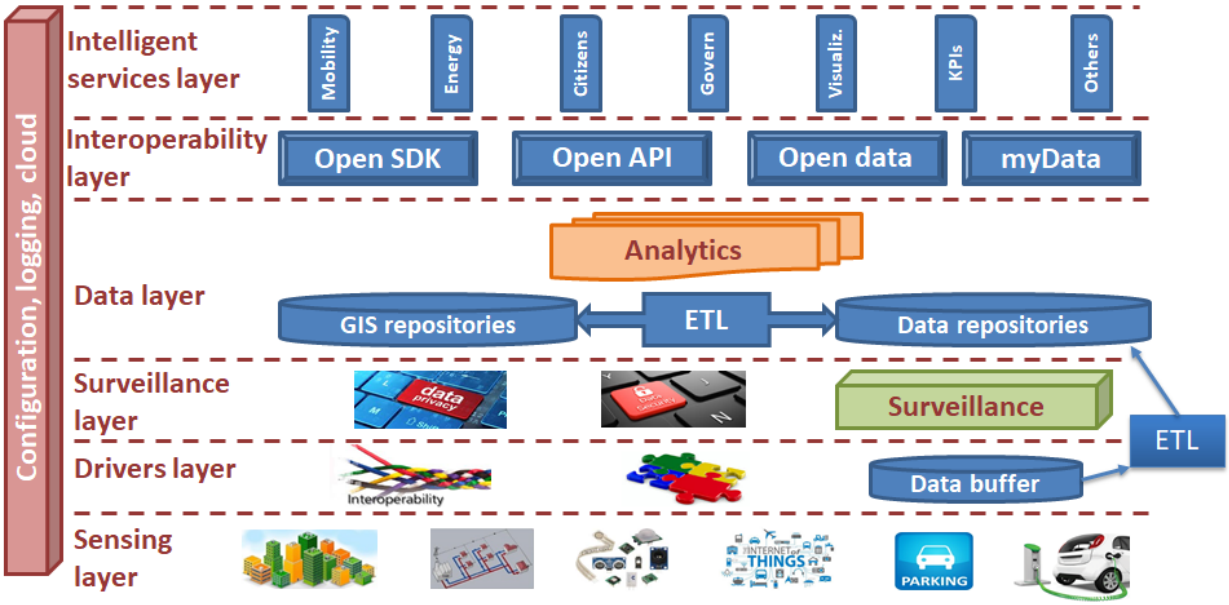

Figure 7: mySMARTLife common open specifications framework

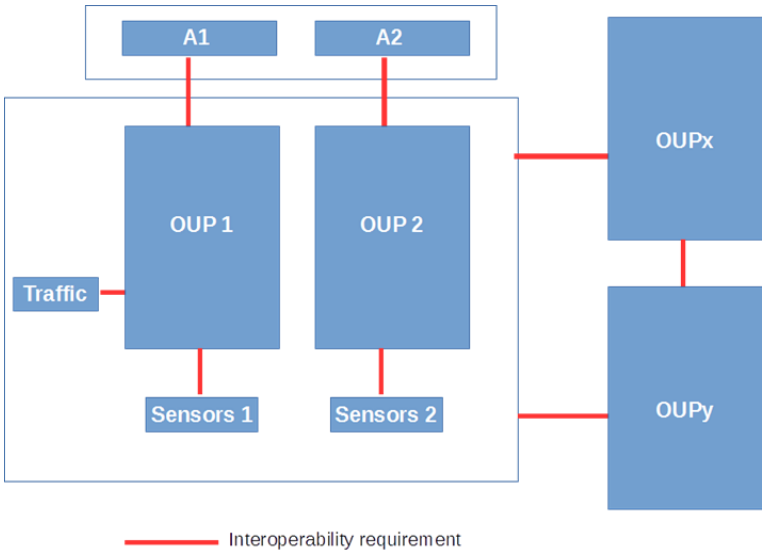

Figure 8: Interoperability definition between urban platforms

Moreover, although the drivers' layer is integrated within sensing layer in ESPRESSO approach, mySMARTLife project has split both concepts. Nevertheless, again, interoperability at this level is also one of the objectives of the urban platform implementation, therefore, this layer specifies the named southbound interoperability. Finally, the idea of surveillance layer is taken from the EIP approach, where the layer 2: Device Asset Management & Operational Services Capabilities includes monitoring of the operational status, management of errors and alarms, among others.

Comparing the proposed framework within mySMARTLife with the initiatives in the state of the art, it is important to firstly highlight that the nomenclature is slightly different in order to provide an easier

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understandable framework where the keywords are according to the functionalities to be covered. Furthermore, as mentioned before, the framework tries to simplify the concepts of the existing initiatives, as well as including new innovations as explained above.

In contrast to the EIP-SCC framework, the mySMARTLife one slightly simplifies it, concentrating the services in a single layer and the functionalities for each layer resumed for applying with the requirements. With respect to the ITU-T and ESPRESSO cases, the way of naming the layers and some concepts about the distribution of the levels have been taken with the aim of represent conceptually the functionality. For instance, there has been integrated a transversal layer dedicated to the configuration of the urban platform, as well as logging aspects.

A second topic to be taken into consideration is that this approach is a framework and not an architecture. It means the urban platform does not need to fully deploy all the layers and all the functionalities. Nevertheless, any individual architecture for any lighthouse/follower/external city must be compliant with this framework. It is not expected the three cities have the same implementation, but, conceptually, they follow the same approach. Going into the details of the framework, next bullets explain the functionalities that are expected under each level.

- Sensing layer, similar to sensing layers in the references, is dedicated to the physical implementation of the sensors and field equipment that injects data to the urban platform. In this sense, any type of data is represented, from energy data from the dwellings/buildings, 3D models of the city (e.g. CityGML files), information from electric vehicles, charging stations, street lighting and any other urban infrastructure that sends data to the platform (for instance, district heating). Of course, IoT concepts are also considered under this layer.
- Drivers layer, which is in charge of the connection with the physical level with the objective of gathering the information. For this purpose, three elements have been considered as follows:
    - Interoperability in charge of the protocols adaptation and, in this sense, ensures the connectivity (i.e. interoperability) of the field equipment with the platform through well-known interfaces (e.g. SensorThingAPI). It is not expected to cover all the existing protocols, but, at least, determine those that are interesting from the city point of view. In this way, any data provider could connect to the platform following the interoperability requirements (i.e. protocol, data format…).
    - Data buffer in case of connection lost. There are situations where connectivity is not possible due to multiple reasons. Then, having a data buffer, it reduces the data missing storing temporary data.
    - Integration (puzzle) with the aim of integrating the diverse information that comes from the field level in the different protocols and, thus, formats.
- Surveillance layer is, as said, an idea coming from the EIP framework and it takes explicitly into consideration the privacy and security of data. Within this layer, the anonymization of data is

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processed and the specifications of the GDPR (General Data Protection Regulation) are implemented. Three main concepts are included:

- Data privacy which is responsible for the implementation of the privacy aspects those need to be taken into account, for instance, the anonymization. The treatment of personal and private data is rendered under this sub-layer. Note that according to the GDPR, data that may identify a natural person could have consequences of fines and that is the reason why this layer is envisaged to deal with privacy aspects.
- Data security aspects, such as the encryption or any mechanism to avoid data hacking.
- Surveillance in charge of data quality aspects. Before the storage of the information, data quality is very important to avoid the insertion of “useless” data. Then, the surveillance concept checks data so that the information is within the established ranges, without errors, gaps, etc. That is to say, validation of data streams.

- Knowledge layer, representing the data repositories. Although in the picture two data repositories are printed, it is only a way to draw the existing several repositories. For instance, GIS repositories, real time data repositories or KPIs, among others. Of course, associated to the repositories, the ETL (Extraction, Transform and Loading) procedures are included. There is also ETL procedures from the data buffering to the repositories with the aim of inserting this temporal information. Finally, the analytics are the most interesting part of this layer whose objective is the aggregation of data, calculation of indicators, implementation of big-data analytics to support the decision-making, etc.
- Interoperability layer is dedicated to the connectivity and openness aspects. In this case, within this level, the open APIs, data and SDKs are published. This layer takes as input the information coming from the repositories and results of analytics in order to make it open for the end-users through portals and APIs. As a new innovation, in the implementation of interoperability layer, the semantic approach will make the platform more dynamic to support data with any kind of metadata requirements. It is expected that the interoperability between urban platforms should also include the elements of semantic approach, otherwise, there is a risk to misinterpret data items in remote services.
- Intelligent services layer which harmonizes all the services from other reference architectures in a single layer that simplifies the deployment. All the high-level services are implemented in this level, such as energy applications, mobility services, visualization dashboards or any other high-level service that are available for the end-users.
- Finally, there is a transversal layer dedicated to the configuration and maintenance of the urban platform. Moreover, logging mechanisms and role accessing are integrated in this transversal layer.

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5. Nantes urban platform

5.1 Current status of the Nantes urban platform

As one of the requirements of the topic, the urban platform in Nantes does not start from scratch, but it starts from TRL7, where some services are already running. Figure 9 illustrates in green the existing functions, mainly sensoring, open data and geo-visualization data acquisition, those capabilities under development in fuchsia, roadmap in light blue and, finally, future interest in violet.

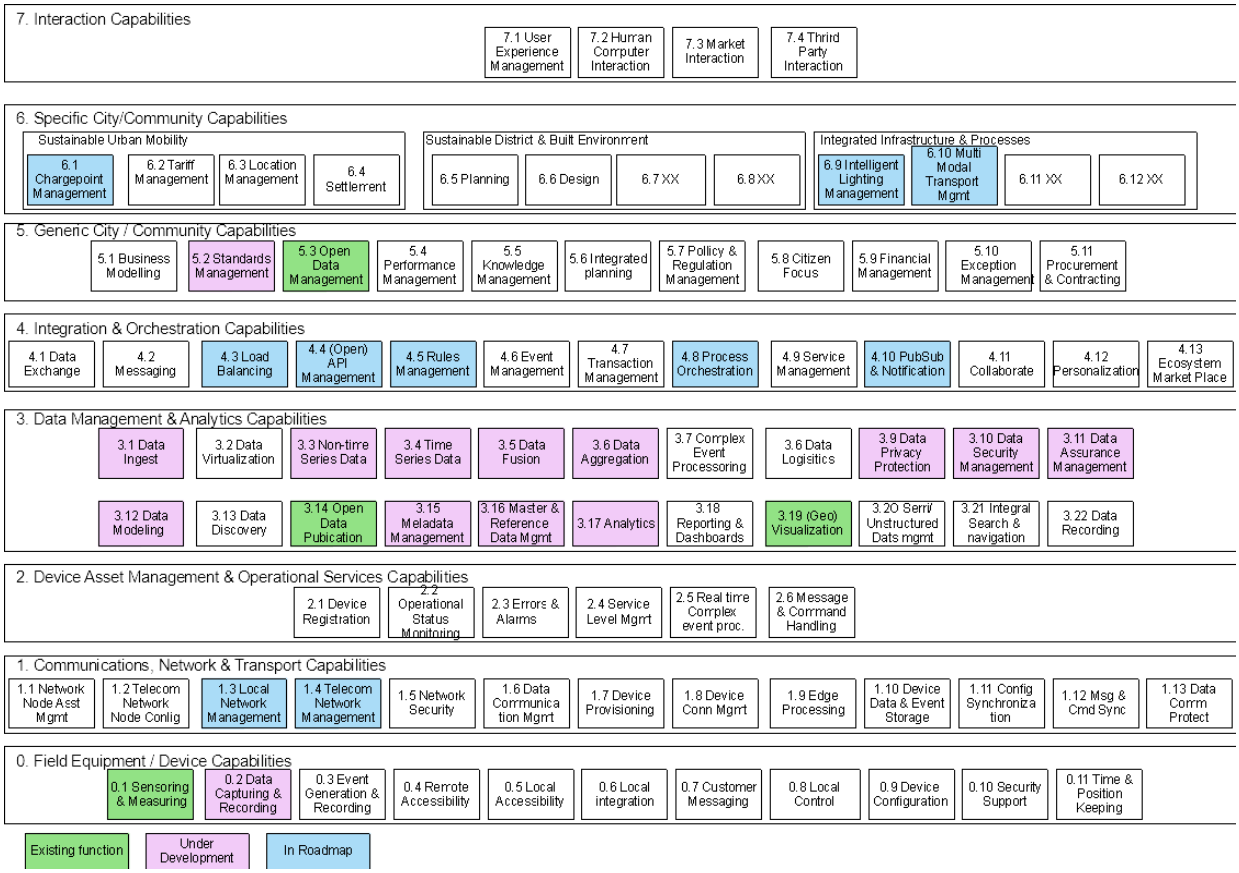

Figure 9: Map between existing Nantes urban platform and EIP framework

5.1.1 Existing services

Nantes Métropole's (greater Nantes) existing Urban Platform was launched in 2011 and now provides more than two hundred data-sets, which are integrated along with those of Département Loire-Atlantique (department) and Région Pays-de-Loire (region) and other administrations through a single open data portal providing over 800 data-sets in total. Nantes Métropole existing data-sets cover the fields of administration data, mobility and transportation referential and live data and geographic referential data, among others.

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Figure 10 identifies the 240 data-sets (details are available on Annex I) that are available on the Nantes urban platform. Besides, the data-set producer is identified. As observed, both Ville de Nantes and Nantes Métropole are the most active stakeholders providing data over the existing urban platform. There are up to 11 data-set producers in the current status.

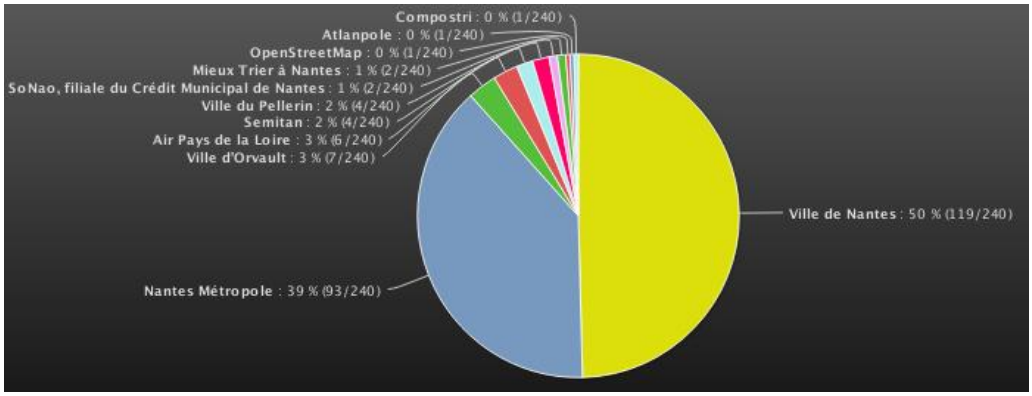

Figure 10: Nantes Métropole data-sets production

On the Data Consumers' end – or at «API Level» – Nantes' Urban Platform provides data, on one hand, in the form of a web open portal[1] from which data can be downloaded as files and, on the other hand, in the form of query-able APIs, the best example the use of which is the mobile application "Nantes dans ma poche" (Nantes in my pocket). This application allows the citizen to choose and organize its own dashboard based on the open data provided by the Urban Platform such as transportation times for a specific bus stop, live traffic information, live parking availabilities, air quality, etc. Figure 11 gives an example of the citizen mobile application that are available over the urban platform.

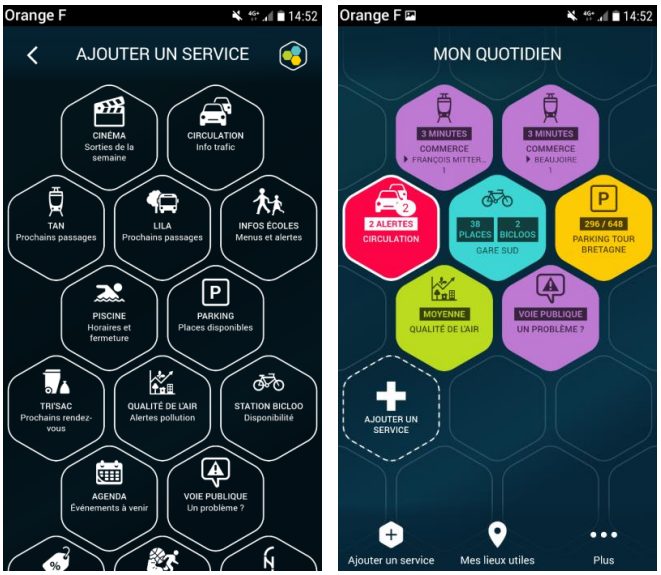

Figure 11: "Nantes dans ma poche" citizen mobile application

[1] This portal is due to be replaced in late 2017 and is out of the scope of mySMARTLife actions.

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Figure 12 provides the image of the open data portal that is deployed in the Nantes case.

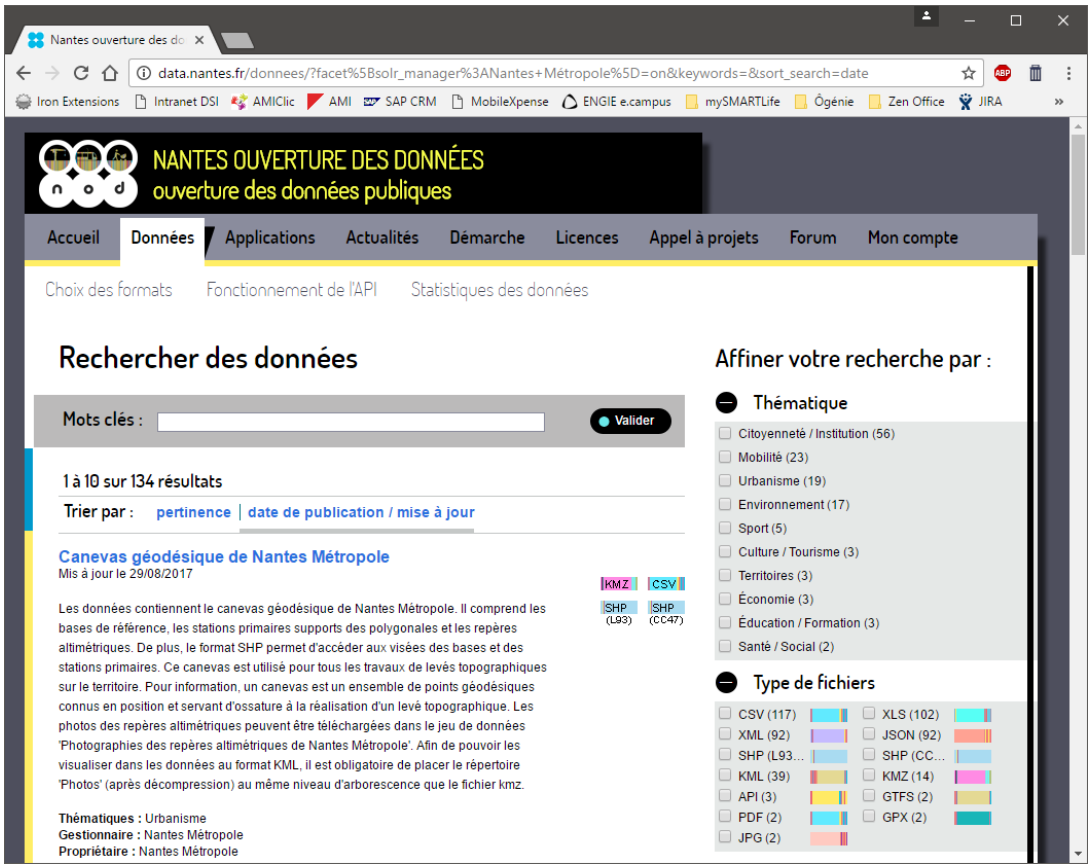

Figure 12: Nantes' existing open data portal (due to be replaced)

5.1.2 Data models and open data

In the existing platform, several models are used to store different data. Data is acquired and most often updated via business software. Consequently, the data models used are proprietary and specific to the business application editor.

Firstly, the geographic data warehouse is the most advanced in terms of structuring and governance. Data from business applications is integrated into a data warehouse and catalogued. Many data held by various services are accessible in Nantes Métropole through the « Geonantes » GIS application. It includes:

- Land description information such as the 2D cadastre (parcels, buildings, addresses) or the road repository,
- Business reference systems, such as the reference system for public facilities, the water and sanitation repository.
- The building repository which manages the community's real estate assets and guarantees their maintenance.

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Secondly, many specific business models are implemented. For example, one will note about the connected objects:

- Mobility: road traffic device supervision, parking meters supervision, availabilities in car parks.
- Water: water and sanitation networks supervision.

Finally, a parking observatory is being developed in our SIAD (Decision Support Information System, initially oriented towards HR and financial management, and internal performance). It meets the needs of parking analysis, such as forecasting, contract monitoring or parking policy evaluations. The data model is also specific and has been built to meet both the following needs:

- Integration of all parking data (parking lots, on-street parking, fines, etc.)
- Query and formatting of reports from a query tool. Pre-defined dashboards can be easily queried.

Apart from data models that store the current data being measured in the city of Nantes, some of this information is opened as open data-sets. The next bullets give an overview about the most interesting ones from mySMARTLife perspective:

Baseline data:

- Directory of routes per communes,
- Public facilities location for all the communes, and per theme.

The above-mentioned baseline data mainly concern Mobility:

Car travel:

- Availability in the public car parks of Nantes Métropole
- Location of the Nantes Métropole road sections and Fluidity of the Nantes Métropole road axes.

Public transportation

- Real-time TAN traffic info (buses and trams).

Green modes of transport:

- Location and availability of self-service bicycle stations in Nantes Métropole.

5.2 Urban platform architecture

Nantes' Urban Platform Extensions architecture contains the definition of the features that the Nantes case will contain according to the framework presented before. It is defined as an iterative process along with the use cases associated to the actions carried out for mySMARTLife. To recall, apart from the integration of data coming from the sensors associated to other interventions, the particular actions for ICTs and urban platform in Nantes are:

- Open APIs

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- Solar cadaster
- Smart data on mobility
- Energy data lab initiative
- Energy data monitoring of public buildings

It is notable that, within the open APIs action, common for the three cities, interoperability concept will be implemented through definition of use cases approaching to “standard” APIs (i.e. common APIs along the project to allow vertical interoperability). However, this is not the scope of this deliverable and the details will be documented in D2.17.

When speaking about the architecture, it refers the implementation level and it should be noted that the three lighthouse cities have different implementations. Nevertheless, all follow the same approach or framework as explained above. This approach offers the advantage of increasing reusability of services, interoperability, scalability and extensibility due to consider the same concept.

Having this idea in mind, Nantes Urban Platform extensions are dedicated to integrate the new data streams associated to the actions that are being monitoring, as well as building value by processing and analysing them to provide them for internal (Nantes Métropole scope) or external Data Consumers.

Figure 13 depicts the architecture for the Nantes Métropole urban platform. The planned extensions will perform the integration of new information based on IoT, with its corresponding data adapters. Moreover, this information, after proper processing, will be shared in form of open data and APIs for the use of the data consumers.

Regarding the details of the architecture, a first layer of Data Integration (driver layer) filters and transforms – if needed – the raw data into standardized form (field interoperability), then the data are stored (knowledge/data layer) for processing: aggregating, anonymizing, analysing (knowledge/business layer). Data initially integrated or data newly built are made available in standardized formats and accordingly to the data access policy decided by Nantes Métropole through specialized APIs (API interoperability) to be used to build value by means of Data Visualisation, KPIs calculations (intelligent services layer) or simply an open data portal.

Data processing is envisaged as asynchronous (batch mode) at first to easily take into account temporization issues necessary to anonymize or aggregate data. The technical architecture based on several data storage units (IMPORT/Staging, WORK/Data Layer & Business Layer, EXPOSITION/Open Data) is compatible with a unitary processing scheme (flow mode).

Open standards (data and APIs) are implemented by reusing open source components such as SensorThings API server (by Fraunhofer Institute). Along the project, as new use cases will be studied, efforts will be directed to keep on using such core components or, if really necessary, introduce new components compliant with new open standards.

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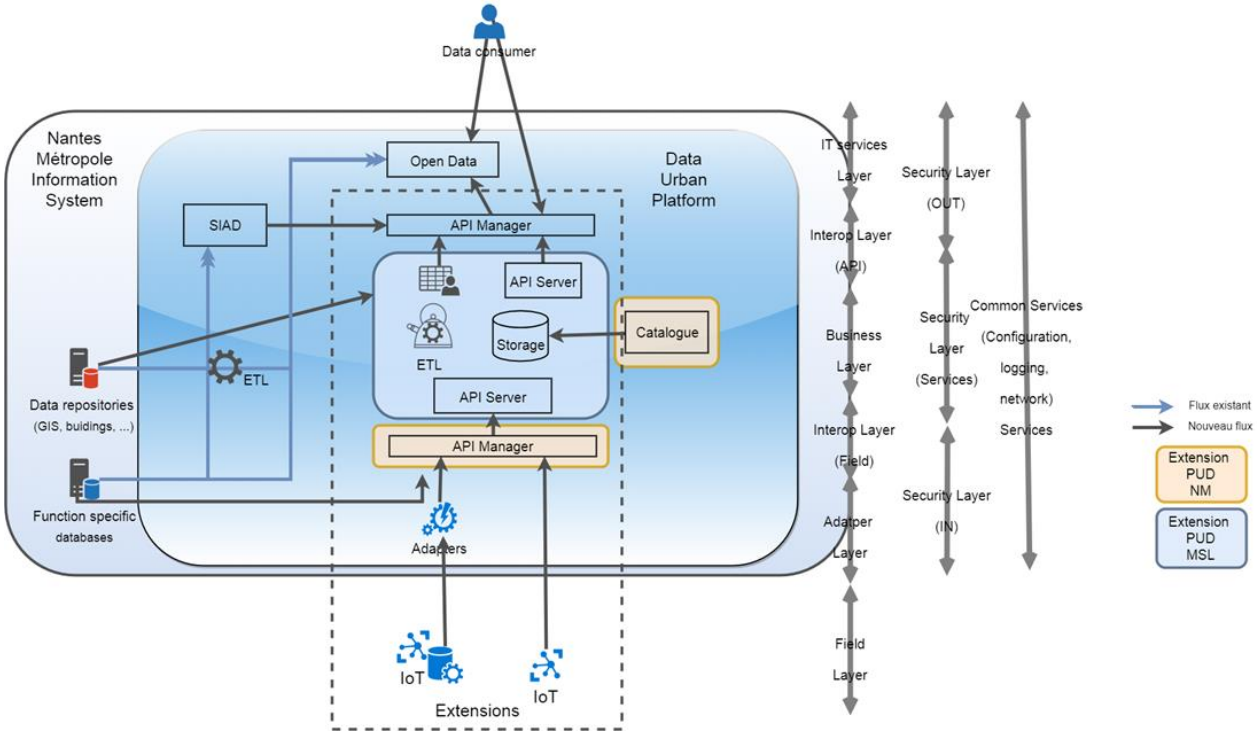

Figure 13: Nantes Urban Platform extensions architecture principle

5.2.1 Nantes Urban Platform compliance with the framework

From what has been stated before, it is clear that the Nantes Métropole urban platform architecture is compliant with the common open specifications framework where the layers and functionalities converge. A mapping between the layers in the architecture and the framework is made in Table 7, where the functionalities that will be implemented in Nantes are in the column 'Functionality'. As it is observed, all the layers from the framework are fully represented in the Nantes urban platform, providing most of the capabilities that were foreseen in the framework.

Table 7: Compliance between Nantes architecture and common framework

Nantes layer	Common framework layer	Functionality
Field layer	Sensing layer	Deployment of the IoT equipment for monitoring
Adapter layer	Driver layer	Data integration, filtering and transformation from the filed interoperability.
Field interoperability and API interoperability layer	Interoperability Layer	Open APIs and Open Data Services.
Business layer	Knowledge layer and interoperability layer	Data aggregation, anonymization, calculation of KPIs and data analysis, as well as open APIs and Data services.
Intelligent services	Intelligent services layer	Visualization and application to be developed under or

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		outside the project (openness).
Security layer	Surveillance layer	Access and security/privacy aspects (open/closed data).
Cloud services	Configuration, logging and cloud	Deployment under cloud specifications

5.2.2 User classes

An important aspect to be defined when dealing with an opened or semi-opened Urban Platform is to clearly define what the role of each stakeholder is with regards to duties and rights. The notion used for Nantes Urban platform is that of user classes, which represent the different types of users who interact with the Urban Platform and are heavily used to refer to and designate the roles and interactions, and especially in describing the processing steps.

The definition used is those defined by the demand-Side engagement team in their work on the requirements specifications for urban platforms [1] that define the following classes (with short definition reminders):

- Data Consumer: citizen, third-party application or system building value on the exposed data.
- Service Provider: provides services to aggregate, transform, analyse the data.
- Data Publisher: produces the original data and transmits them to the Urban Platform.
- Platform Provider: decision maker about the data, services, users and applicable regulations and rights.

5.2.3 Processing steps

More detailed design of the Urban Platform Extensions is then based on the following processing tasks breakdown (Figure 14), which comes in the scope of the previously defined architecture framework.

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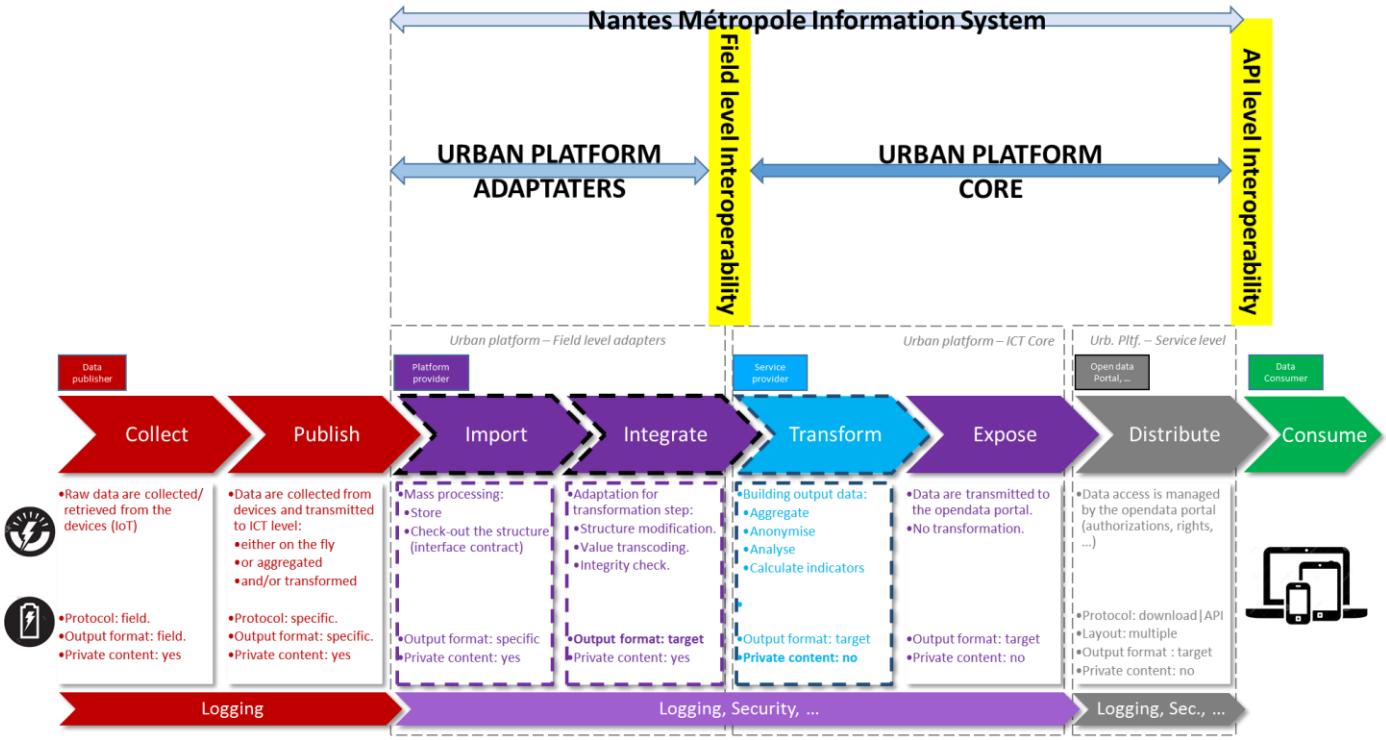

Figure 14: Nantes Urban Platform extensions processing steps

On all steps, the vertical layers apply: “Cloud and network resources” and “Security System/Surveillance Layer”, which are transversal for all the capabilities.

5.3 Definition of verticals / services for the new developments

Under the existing urban platform, within mySMARTLife project, new services will be integrated. Basically, these extensions of the existing urban platform aim at two main objectives:

- Assess the performance of the CO2 reduction actions undertaken for mySMARTLife in the lighthouse of Nantes.
- Demonstrate the value of collecting, aggregating and analysing digital data produced by mySMARTLife CO2 reduction actions and share them with the citizens and economic stakeholders (Data Consumers) to encourage the development of new services.

The digital use cases being or to be defined related to mySMARTLife actions involve:

- Energy consumption in public buildings: Energy consumption of the stock of public buildings, thus providing the means to manage efficiently energy costs and savings measures.
- Public lighting: The planned ICT action regarding street lighting data integration is to provide indicators to help assessing how much energy was saved – compared to a known baseline – using gradation and remote management of lighting points.

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- Energy retrofitting of buildings: The single/window desk for energy retrofitting aims at simplifying support and funding procedures for the owners who want to refurbish their home. The planned ICT action is to collect data from the Single Desk application and be able to improve further retrofitting actions.
- Electromobility (vehicle charging): The planned ICT action regarding electromobility is to collect data and aggregate data related to charging stations of various types (slow, fast, for cars, for bikes) which will be set up for mySMARTLife.
- Mobility observatory: The planned ICT action is to collect data from the cross-modal observatory tool and make them available in a way that is usable to develop new mobile applications which would simplify travel and improve intermodality.
- Heating network optimization: A decision-making tool will be used to help decision makers choose solutions to optimize the heating network. The planned ICT action is to provide the tool with the required data.

The extensions should fully integrate within the existing Urban Platform – especially beneficiate from the existing portal, network capabilities and existing data-sets – but also comply with new requirements:

- Ensure interoperability at both field (Data Provider) and API (Data Consumer) levels.
- Integrate use cases defined gradually as the project actions are set up.

How the new services extend the existing urban platform

Figure 15 presents the extension of the existing urban platform and how it takes into account the interoperability requirements so as to prevent point-to-point integrations and limit specific developments.

(a), (b), (c): different Information Systems connected to the existing Urban Platform.

(1), (2), (3): different Information Systems connected to the Urban Platform Extensions.

- (1) Existing information system, not compliant with the mySMARTLife Field Interoperability Standard.
- (2) Information system or sensing device compliant with mySMARTLife Field Interoperability with help of an adapter.
- (3) Information system or sensing device compliant with mySMARTLife Field Interoperability.

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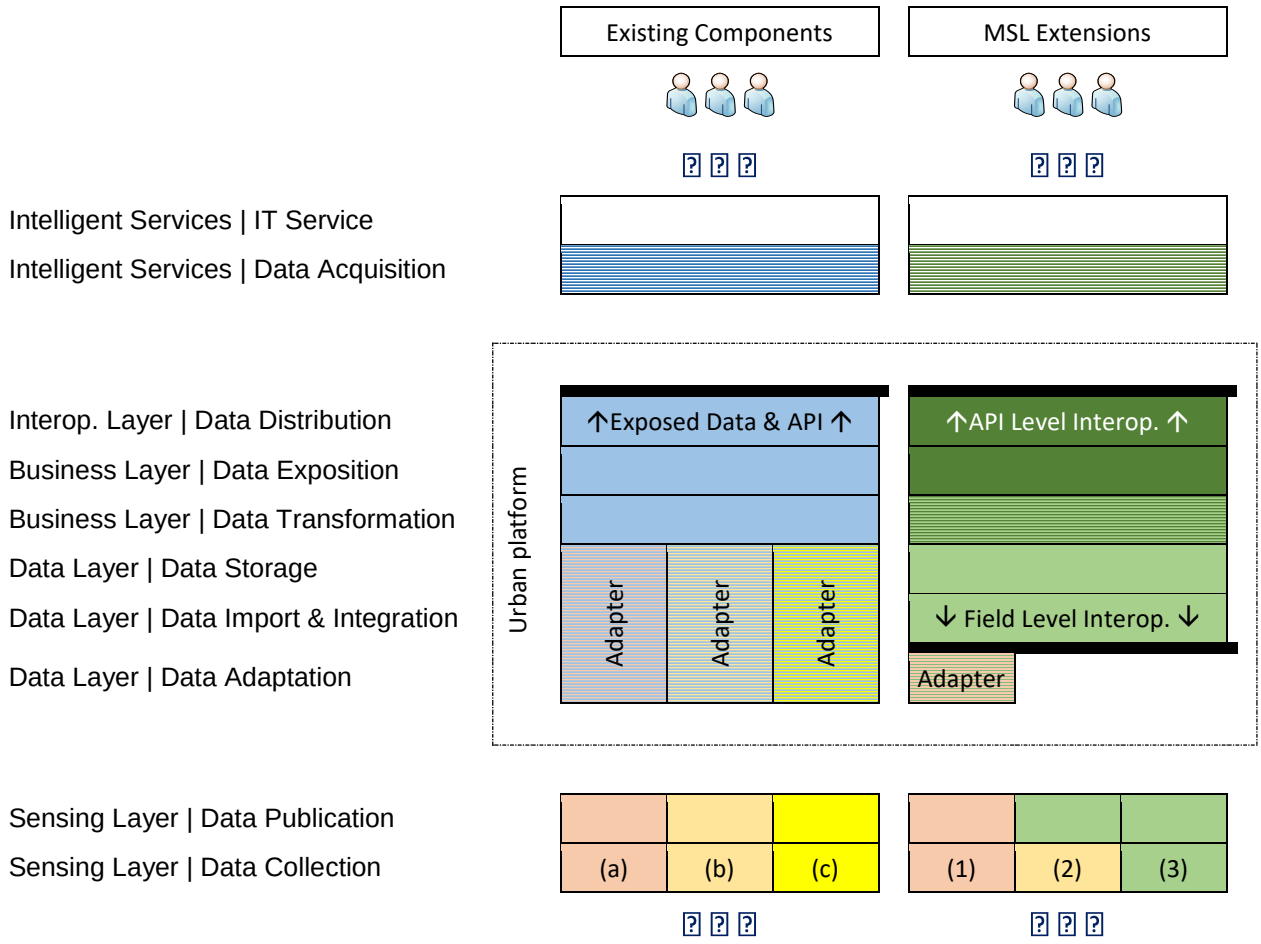

Figure 15: Layers and interoperability in the existing Urban Platform and its MSL extensions Nantes

	Exposed Data and API. Data and Services exposed to the Data Consumers. Standards may or may not be shared with other urban platforms.
	API Level Interoperability. Data structures and API signatures proposed to the Data Consumers follow standards shared at least with the other MSL demo-sites if not already defined by non-profit organization (e.g. OGC).
	Field Level Interoperability. Data structures and API signatures proposed to Data Publishers follow standards shared at least with the other MSL demo-sites if not already defined by non-profit organization (e.g. OGC).
	Field data expressed in a format specific to the Information System or sensing devices, which manage them. This is the case of data provided by existing Information Systems not aligned with the Field Interoperability Level standards.

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5.4 Interoperability

Interoperability is one of the main aspects that are being addressed under the definition of the open specifications framework. It is considered at two levels: at field-level and at API-level. Although more details will come in D2.17 dedicated to the interoperability testing, some clues are provided in the next subsections.

5.4.1 Field-level Interoperability

This requirement aims at decoupling the Urban Platform from the Data Publishers. For example, there should be minimal impact on the Urban Platform if an energy provider is changed. The concept set in place for mySMARTLife is to consider that “Adapters” would be realized between the existing Data Publishers Information Systems and the open standard chosen to be Field-Level Interoperability Standard. In this view, when a Data Publisher is replaced or chooses to upgrade its system to one compliant with the Field Level Interoperability Standard then the adapter should just be discarded but the rest of the urban platform remains as is. See Data Publisher (1), (2) and (3) in the “Sensing Layer”.

Moreover, a second intention of the interoperability at field level is that third parties could integrate information in the future to the urban platform. Having a well-established definition of the interface for communication, anyone wanting to upload data could deal with it by means of implementing this interface, i.e. applying with the requirements, data formats, protocol, etc. That is to say, the urban platform provides a well-defined access point.

5.4.2 API-Level Interoperability

This requirement aims at enhancing the value of the IT services provided by the Data Consumers. For example, an application built on top of Hamburg’s Urban Platform should work also – at technical level – with Nantes’ Urban Platform. Of course, it needs to be taken into consideration that the service is developed with certain requirements of data availability and, if they are not complied, the application will not work properly, but, at least, it will be deployable.

Apart from this, as happening before, this interoperability at API level provides the opportunity to third parties to work on high-level services that are interoperable under multiple platforms. In this way, new services and more knowledge may be generated.

As much as possible, the standard chosen at API level should be the same as those at Field-level, if only to minimize the development and maintenance costs.

5.5 Openness

5.5.1 Open data

From the Data Consumer’s point of view, data are accessible through the open data portal, which is already in place, or an API service. As a reminder, the open data portal is shared with various public authorities of the Pays-de-Loire region.

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The Urban Platform Extensions will not involve any modification of this portal[2] as they will be fully integrated with it. This portal provides the list of data-sets, the descriptions of the data structures and API, and the means to query and retrieve data (download). The API service would provide the means to query and retrieve data (API). Also, according to the Platform Provider's policy, the portal and the API service can manage access account or leave it without any restriction. This matter is rather to prevent the platform from being technically misused (number of calls, bandwidth used…) and maintain the quality of service to the Data Consumers.

Data planned to be provided as open data are so far: public buildings energy consumption, number of energy retrofitting actions, smart charging stations data, mobility and intermodality data.

5.5.2 Open APIs

In Nantes Urban Platform, Open API is understood as the following: the APIs exposed to the Data Publishers to provide data (Field-Level Interoperability) and to the Data Consumers to query and retrieve data (API-Level Interoperability) should be fully documented and the documentation is freely accessible as opposed to a proprietary API the access to which is bound to commercial and non-disclosure agreements.

The use of standards helps achieving this goal in the sense that a standard, by definition, should be documented and shared. But, an ad hoc API – because no existing standard was found – could also be set up as Open API if the level of documentation and access to this documentation is met.

Use case, which involves measurement data (electricity consumption, number of actions, traffic flows, charging powers, etc.), will rely on the SensorThings API specification that provides a generic model applicable to any type of measurement or observation (see section 5.5.3). This will help in maintaining as few standards as possible and simplify integration with the Urban Platform. This API should be considered as an Open API since the full documentation is available on the OGC web site [12].

The SensorThings API offers a JSON-based data model (see section 5.5.4) on either REST/HTTP or MQTT transport protocol. For Nantes Urban Platform, at least REST/HTTP will be set up on both field and API levels.

At this time, Nantes Urban Platform is planned to rely on SensorThings API Server, the implementation developed by Fraunhofer Institute. This implementation was certified by the OGC on 16-nov-2016 [13].

5.5.3 Data models

One important issue is data representation and how this information will flow in the urban platform. In order to solve it, the data models are the solution so that data are represented in a specific format. The data model lying under SensorThings API is a generic model which can be used to represent any type of measurement or observation. This data model is represented in Figure 16 [12].

[2] The portal renewal due to end of 2017 is not related to mySMARTLife actions.

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This model is observation-focused. An Observation (for example: 22°C) concerns a Feature Of Interest (a room); a Datastream (daily temperature curve) groups several Observations, provided they measure the same ObservedProperty (temperature) and are detected by the same Sensor (thermometer in the room); the Datastream relates to a Thing (temperature controller system), which can be linked to a Location (room location) and, in the future of SensorThings, to Tasks (control commands).

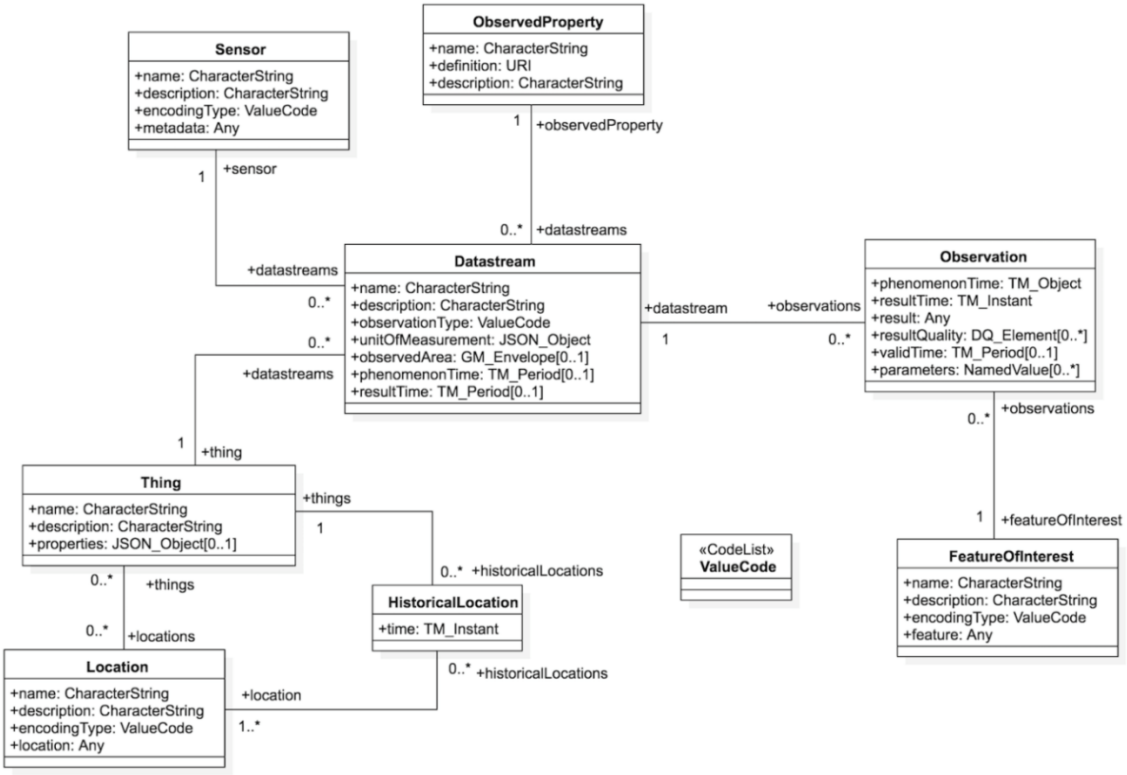

Figure 16: SensorThings API data model

5.5.4 Metadata

Metadata are interesting at time of sharing data because they provide additional information to understand data. It is very much related to interoperability, which analysed within D2.17, hence, the details about it will be described there. The urban platform is expected to support any types of sensors. The data model of urban platform should include any type of sensor, thus making it impossible to have a fixed data model. Instead, the incoming data streams will all have their own data models where properties are defined as linked data, referring to context and definition from external services. Suitable ontology services are evaluated as part of the project, as well as taxonomies close to the domains of the project actions. It is expected that sources such as the Project Haystack and the Unified Code for Units of Measure would be a basis for such service. The actual metadata references will be based on JSON-LD (JSON Linked Data).

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5.6 Privacy and security

As explained previously, there is a difference between the “raw” or “original” data coming from the Data Publishers and data “exposed” to the Data Consumers, not only to manage privacy issues. Exposed data are those available to the open data portal which is the front-end accessible to the Data Consumers. This is how open data are managed: when a data type (original or calculated afterwards, i.e. “Transform”) is defined to be exposed, it means that these data are available to the third-party Data Consumers. It will then be the Platform Manager who will decide which data are meant to be exposed as open data or not and thus define the rules and regulations applicable to the Urban Platform.

From a technical point of view, two separate data storage units are set up: WORK and EXPOSED. The WORK storage unit contains all data integrated from the field side and resulting from transformations (e.g. aggregations, anonymization, cross-analysis with external data such as weather data). The WORK storage UNIT contains personal, private and non-private data and is only available to the Platform Provider and the Service Providers, who may provide transformation services to turn sensitive data into non sensitive data (for example: aggregation or anonymization). Neither to the Data Publishers nor the Data Consumers can get data from the WORK storage unit.

The second storage unit, EXPOSED, contains only data which were authorized by the Platform Provider to be exposed to the Data Consumers. Data are copied from the WORK unit to the EXPOSED unit either by human decision, or each data-sets, or automatically if the data type is configured – by human decision at Platform Provider level – to be exposed automatically.

Furthermore, the access to the EXPOSED unit is provided by means of a portal and/or an API Manager, which allows the Platform Provider to configure which data-set or types can be accessed and according to which rules (bandwidth…). Similarly, the access by the Data Provider to the incoming API at field level is managed by the same kind of policy.

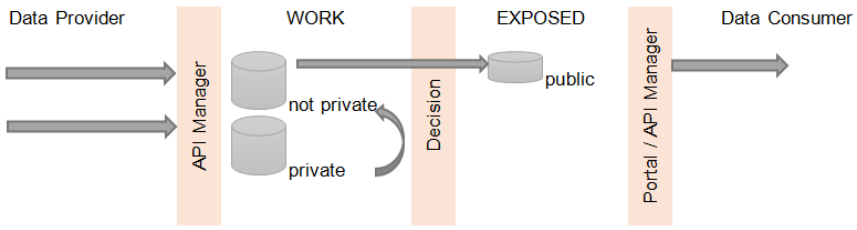

Figure 17: Work and Exposed data storage systems for Nantes

5.6.1 Data ownership

Ownership and usage rights fall into the scope of privacy and security. Data ownership will be negotiated between the stakeholders (Data Publishers and Platform Provider) on a per use case basis. Upcoming WP2 deliverables will be updated accordingly along the project, as well as D5.2 related to the data-sets requirements definition. Once the data-sets are established, the ownership of data could be fully determined.

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6. Hamburg urban platform

6.1 Current status of the Hamburg urban platform

Similar to Nantes case, Hamburg starts from TRL7 developments where an existing platform is deployed and running. Figure 18 shows in green what is currently working, based on geodata visualization, open data publication, metadata management, privacy aspects (Hamburg data protection regulation) and non-time series data, as well as merging information. In fuchsia, the modules that are under development and will come in the further versions of the platforms are highlighted. Finally light blue indicates the roadmap for the urban platform and, finally, violet future interests.

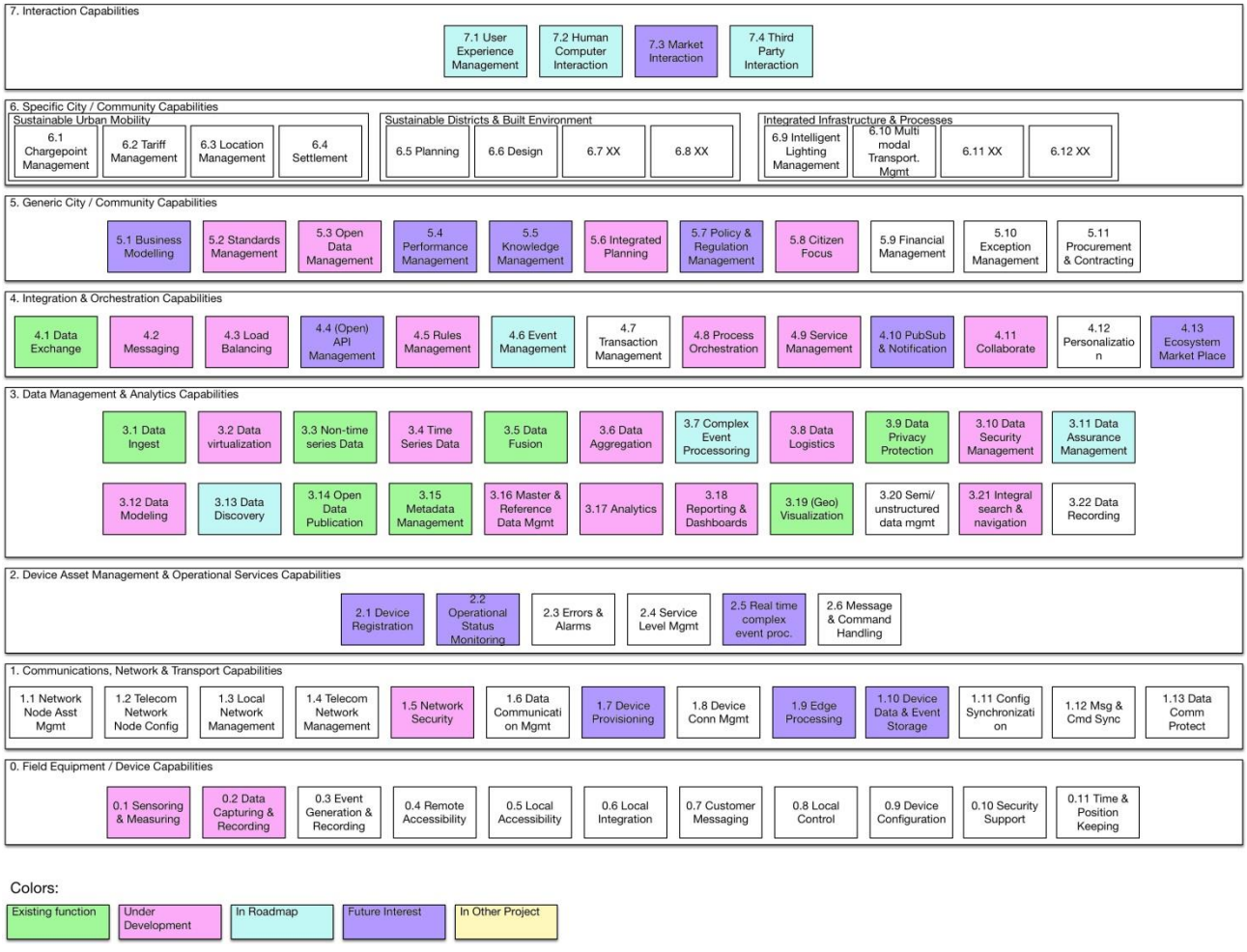

Figure 18: Map between Hamburg urban platform and EIP framework

6.1.1 Existing services

The current Urban Platform of Hamburg exists for a couple of years now. As of May 2017, the Urban Platform provides more than 3300 data-sets, 93 applications, and more than 400 distinct services which receive more than 310 million requests per year (>849,000 request per day). The data-sets cover a wide

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range of urban data. These services are provided using standard APIs and data models usually based on specifications of the OGC i.e. WFS (Web Feature Service), WMS (Web Map Service), GML (Geographic Markup Language), etc. The urban platform also started to provide near real time data e.g. occupation of charging stations for electro mobility, availability of city bikes at the specific bike stations, and availability of parking slots on parking decks. All these data can be searched using the Hamburg Metadata Catalogue (Hamburger Metadatenkatalog – HMDK, see section 6.5.4). Some examples are depicted in Figure 19 and Figure 20.

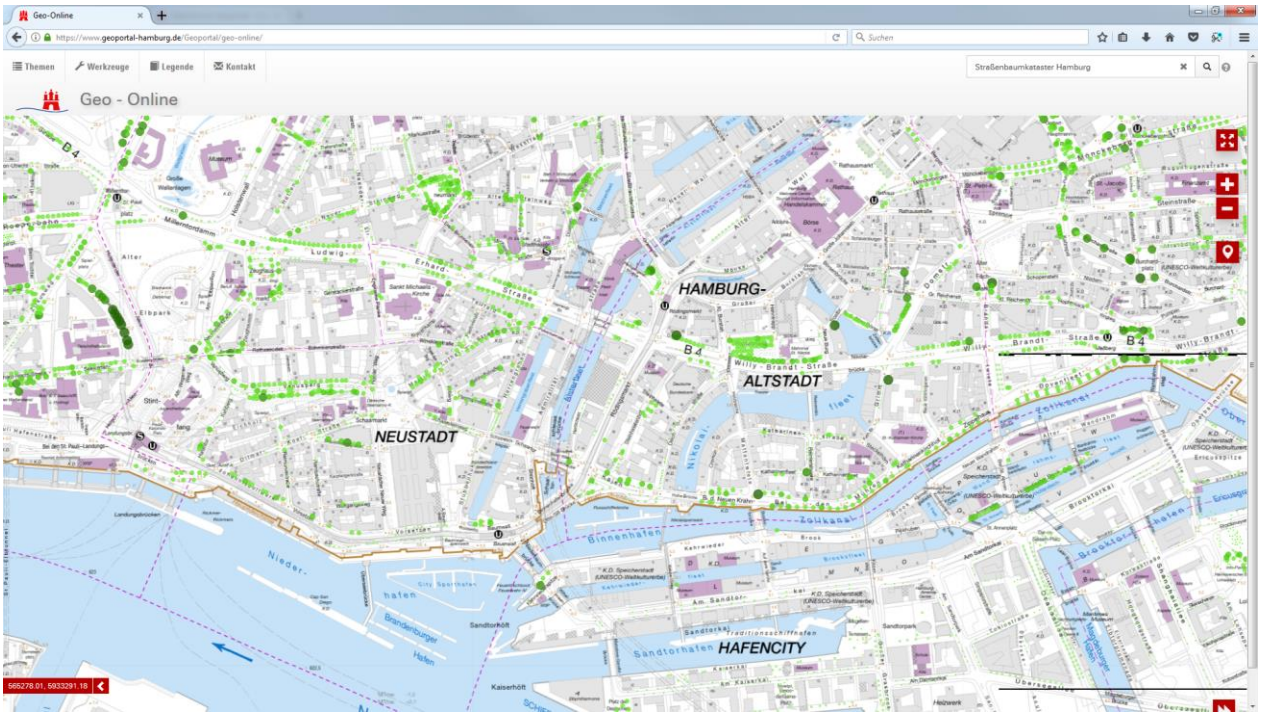

Figure 19: One example of the many services: Cadastre of the trees along roads

In addition, some of the outcomes of the Urban Platform development are geo solutions, which are provided as Open Source Software to the public (https://www.hamburg.de/geowerkstatt/). One solution is the “Masterportal” which is like a toolbox to build geoportals on the Web, as illustrated in Figure 21. Another one is a service manager which allows the management, documentation, and configuration of web services in a geo data infrastructure for a subsequent visualization in the Masterportal

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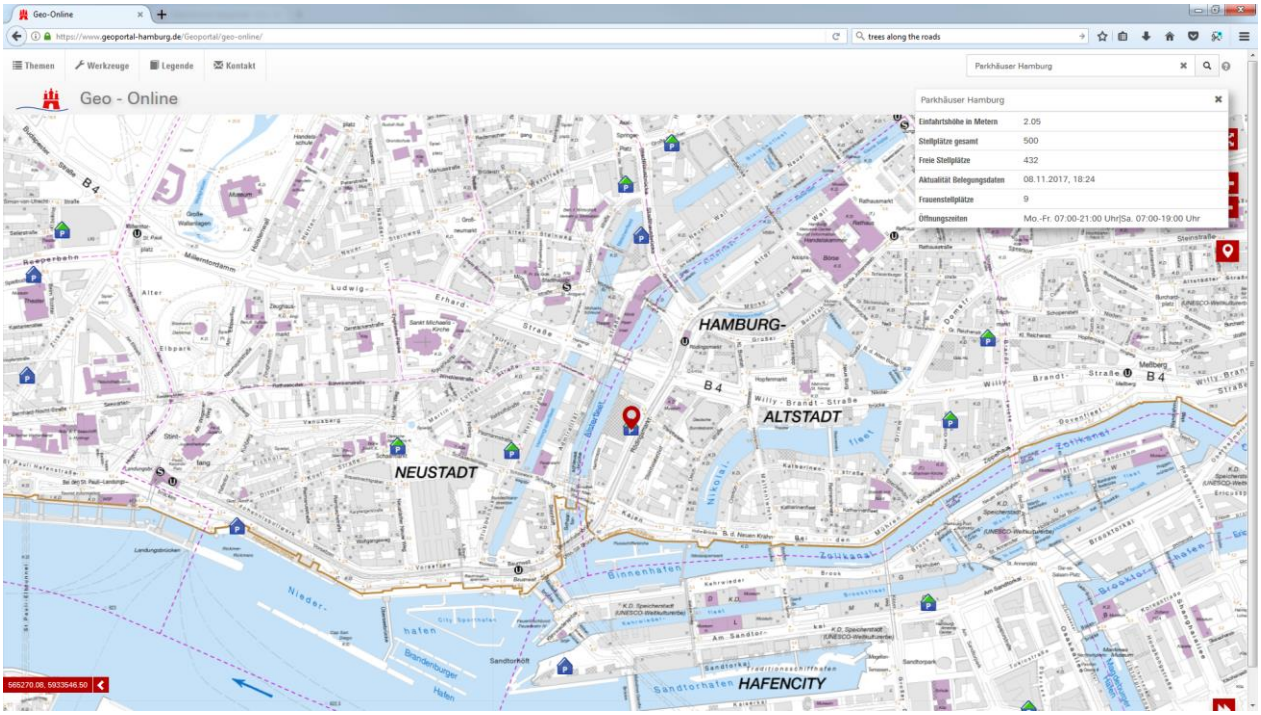

Figure 20: Occupation of storey car parks in Hamburg

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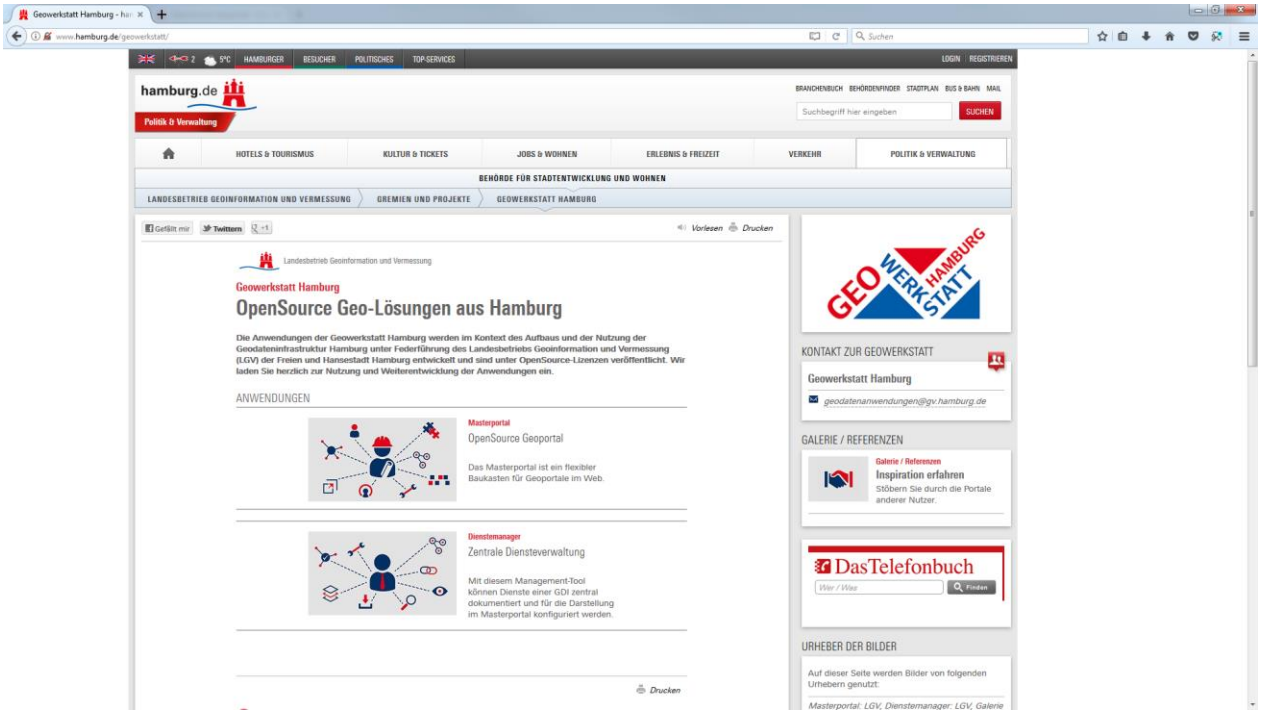

Figure 21: Masterportal and Service Manager as Open Source Solutions

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6.1.2 Data models and open data

In the existing Hamburg urban platform there exist several data models depending on each specific use case. Providing 3D data of the city in LoD1 and LoD2 the data model of CityGML is used.

The urban platform provides already open data. Due to the transparency law in the federal state of Hamburg it receives special attention. Further details can be found in section 6.5.1.

6.2 Urban platform architecture

The current Urban Platform of the City of Hamburg is a data storing unit containing open and non-open data of different authorities, third parties and few sensor data. It holds geospatial information to several categories, e.g.: education, culture, urban development and planning, environment, traffic which are distributed via standardized web services (OGC) for viewing, downloading and processing of data. Each data-set is connected to a metadata catalogue web service interface, which is based on a city metadata catalogue (HMDK) for government information. The city data are further connected across each other to extract additional insights. E-Government applications and services use the standardized web interfaces for domain specific solutions via intranet and internet. Many additional services/data are already planned to be deployed i.e. supervision of streetlights, charging station management, traffic light and many more.

The open urban platform of Hamburg follows the common architectural framework defined in mySMARTLife Project (see section 4.3) and a System of Systems approach/architecture as illustrated in Figure 22. Heterogeneous systems or platforms can easily be connected and at times incorporated i.e. the DT Open IoT Platform of the Deutsche Telekom. Thus, the system of systems architecture during this project consists of the Hamburg Urban Platform, the Deutsche Telekom Open IoT Platform and other Systems and Field Components respectively. Depending on the technical solution, the Urban Platform is either directly connected to sensors or to the different systems managing sensors (e.g. traffic management).

The Core of the data management of the Hamburg Urban Platform is divided in five modules: Data Web Services, Metadata Web Services, Processing Web Services, Data Analytics and Sensor Web Services. While the former four are fully deployed (and extended regularly), the latter is under development. The five modules are substantiated by the Data Warehouse where all data is stored and extracted for the different services. The data from neighbouring systems are integrated using ETL techniques with different adaptors. The Urban platform is under continuously development. Similar to the development in Nantes, this follows an iterative approach. New capabilities will be incorporated according to the actions to be implemented within mySMARTLife project.

The DT Open IoT Platform is a system which gather information from different data sources and systems. Systems like the Hamburg Urban Platform, Field Component Platforms and IoT Devices have interfaces to the DT IoT Platform. The information from these neighbouring systems is migrated in the Data Storage of the DT IoT Platform. Intermodal Routing and Smart Grid are Vertical Systems which are not part of the

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core system. These parts are also considered as systems and field components from the point of view of the DT Open IoT Platform. Interfaces to all of these neighbour and vertical systems will be implemented in the intelligent integration layer (data Orchestration) or with the use of dedicated components which will be provided by a manufacturer.

The collected data in the data storage can be used by the Data Analytics component and the Complex Services to provide analysed and combined data. Furthermore, the content of the data storage can be retrieved via an API from external users and third party App developers. Interoperability with other systems and platforms is ensured through the Integration Layer.

If it is necessary to connect sensors to the DT Open IoT Platform, this can be made possible via the IoT Hub component. The connection can take place via different ways besides a Field Gateway or directly from the device. The preferred way is to be clarified in the individual case.

6.2.1 Hamburg Urban Platform compliance with the framework

Similar exercise as in the case of Nantes is rendered in Hamburg so as to check the compliance of the architecture with the proposed framework. Table 8 illustrates that the compliance is also ensured and, although it is represented in a different way, the concept remains intact, which is the objective of the framework (i.e. define a conceptual view).

Table 8: Compliance between Hamburg architecture and common framework

Hamburg layer	Common framework layer	Functionality
System and Field component	Sensing and driver layer	IoT equipment and data that are being integrated in the platform to be used by the services.
Integration layer	Knowledge and interoperability layer	Data storage, analytics and big-data. Moreover, APIs and connectivity capabilities.
IT services	Intelligent services layer	Dashboards, eGovernment services, apps, 3rd party applications…
Security layer	Surveillance layer	Anonymization and security/privacy aspects

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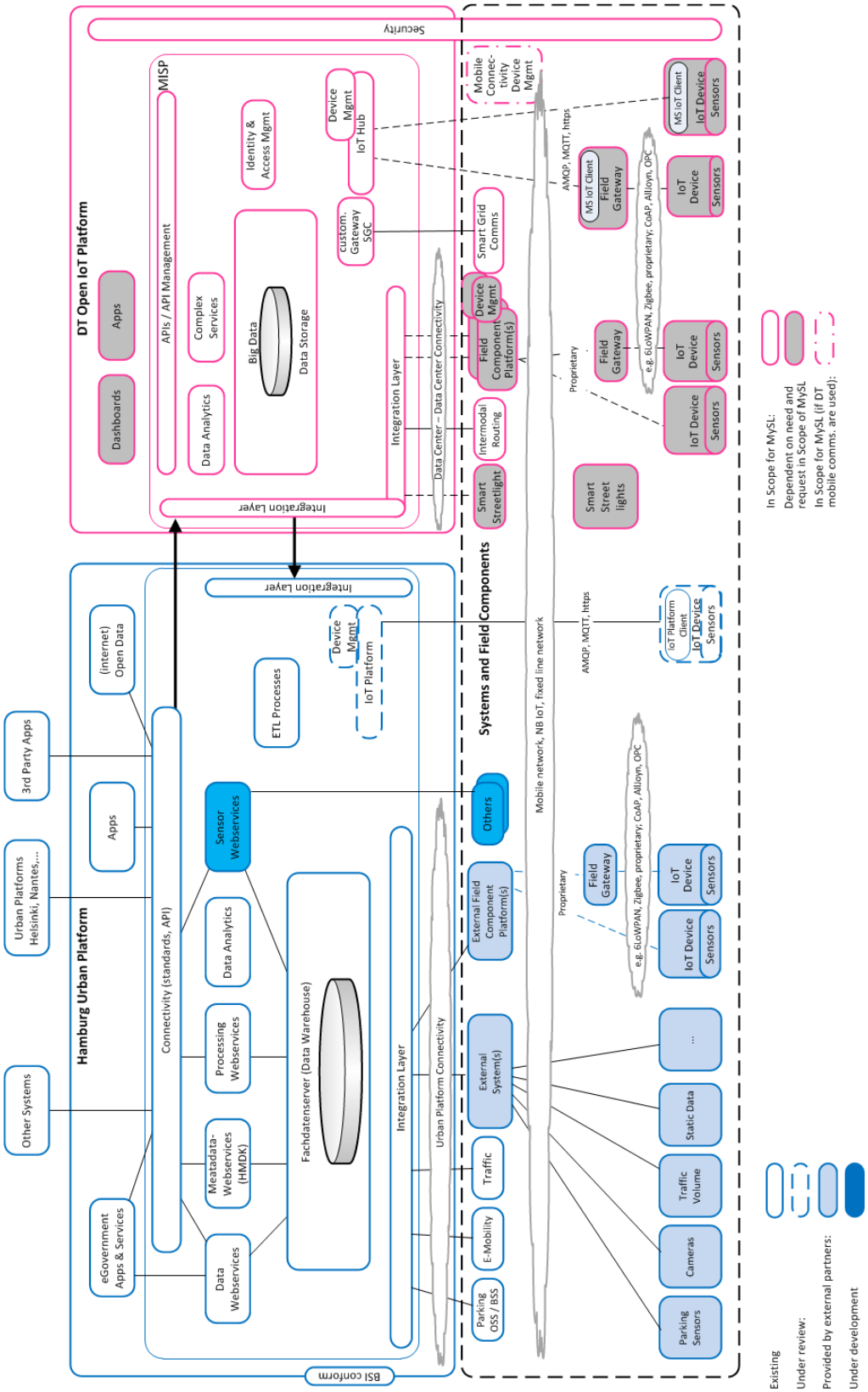

Figure 22: Hamburg urban platform architecture

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6.3 Definition of verticals / services for the new developments

Since most “vertical” domains use dedicated so called field component systems the composition of an Open Urban Platform (OUP) follows vastly a Systems of Systems approach, where the OUP may act as aggregation and analytics engine for the specific urban region.

Intermodal Routing (Action 34)

The service Intermodal Routing (IR) is based on a funded project in Austria called SEAMLESS. IR will be a service to provide towards citizens dynamic intermodal mobility to select the most appropriate route and transport methodology in real time. This includes the integration of existing timetables available and if possible acceptance / usage reports. The task for the city of Hamburg thus requires replicating the service created for Vienna in the SEAMLESS project towards Hamburg and in addition to develop the corresponding User Interface / Application.

Technical implications:

The service uses a backend IT infrastructure, composed of a server where the required logics and algorithms to deduce IR run. It provides open Interfaces, e.g. based on an adapted JSON Interface for data exchange. Therefore the solution acts as a field component which needs to be connected with the OUP of Hamburg.

To use the service, this requires data exchange between the OUP of Hamburg, e.g. for landmark infrastructure or timetables of public transport and the dynamic interchange of routing information towards the application.

Smart Grid (i.e. Action 20)

The service Smart Grid shall provide the possibility to combine renewable energy and heating services within a project area towards an autarchy energy / heating neighbourhood. This includes for example usage of photovoltaics and combined heat and power stations. In the first place solely a simulation based on existing data is planned. On a service level this means the provisioning of context depending reports.

Technical implication:

It is planned to use an existing Smart Grid Field Component Platform (SGFC) to run the required algorithms. Similar to IR this requires the exchange of energy / heat related data between the OUP of Hamburg and the (SGFC). Similar to IR this implies the usage of near real time data and the provisioning of a reporting function towards the application layer.

Smart Streetlight (Actions 15, 16, 32)

Within the project area also smart streetlights will be integrated. In addition to adapted lighting, additional services like WIFI or movement detection shall be integrated.

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Technical implication:

It is planned to use an existing Smart Streetlight Field Component Platform (SSFC) to run & manage the services. Still this requires the exchange of landmark data towards the OUP of Hamburg and in addition technical service and other data to be used for other vertical services or as open data.

Preparation of providing real time (spatial) data as open data (needed for several actions)

It is planned to provide real time (spatial) data to the public as open data using standardized APIs such as the SensorThingsAPI of the OGC. This allows to provide sensor data using a publish/subscribe architecture (MQTT) instead of a request/response architecture (HTTP) yielding in lower latency and the possibility of a 1-many distribution of the sensor data.

Make OUP Big Spatiotemporal Data Analytics ready (could be used i.e. for Action 10 and 20)

A smart city is based on data, which become smart if one combines different types of data sources e.g. of different domains like energy and mobility give e-mobility in a way that new insights are gained. Facing a large volume of data along with an increasing variety required in real time is the challenge and the demand. Therefore, we will experience an increased velocity of the incoming data streams along with the challenges to cope with the problem of veracity of the data. This holds true for non-spatial data and becomes even more challenging if the spatial component is integrated. Although it is not in the scope of mySMARTLife this needs to be considered during the integration of new services, subsequently making the OUP ready for future tasks within i.e. Big Spatiotemporal Data Analytics.

6.4 Interoperability

Interoperability is crucial for the success of the Urban Platform and one part of the city interests. The Urban Platform provides an easy access to the existing data using standardized data formats and APIs (see sections above). For the integration of sensor and real time data, an implementation of the OGC SensorThingsAPI will be put in place. This API allows interoperability at the north and southbound of the OUP, as explained in Nantes chapter. Furthermore, it will also allow horizontal interoperability with others systems. At the same time the OUP is able to integrate multiple different (proprietary) data formats by extracting, transforming and loading data (ETL-Process) from a source into a standardized format, hence making it available to the public. For interoperability measures the usage of an interoperability standard like oneM2M is planned to be evaluated. All the details about interoperability will be documented in D2.17.

6.5 Openness

6.5.1 Open data

The unambiguous trend towards the establishment of new forms of open administrative transactions and the provision of free administrative data as "open data" was manifested on June 13, 2012 with the unanimous decision of all parties represented in the “Hamburger Bürgerschaft” (Hamburg Parliament) on the application for the adoption of a Hamburg Transparency Act (HmbTG). The LGV (Landesbetrieb

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Geoinformation und Vermessung - Geoinformation and Surveying) has taken up this trend in autumn 2011 and developed its own Open (Geo) data strategy.

In order to promote administrative transparency and economy, data-sets are being made available online ranging from education, culture, urban development and planning, environment to traffic and many more. Geodata are provided in a reusable, manufacturer-independent format, which is suitable for automated processing. However, data-sets are protected if they interfere with other laws or interests e.g. privacy law. This means all data that is not protected as described before will be accessible as open data. The further development of the Urban Platform will follow these guidelines. Within the project of mySMARTLife we will evaluate how to provide sensor data as open data to the public.

6.5.2 Open APIs

The current implemented APIs follow an open design, in most cases provided by the OGC (i.e. WFS-T, WFS, WMS, etc.), ensuring a reusable, manufacturer-independent format (see also D2.17). This allows data consumers for an easy integration of the open data into their systems and applications. The Urban Platform uses standard WebGIS Server Software to fulfil these requirements. The Urban Platform will also focus on open APIs in the future, which requires a full and open documentation of them. In example for the SensorThingsAPI the Urban platform evaluates the open source applications “SensorThingsServer” by the Fraunhofer Institute (https://github.com/FraunhoferIOSB/SensorThingsServer) and the GOST IoT Platform by Geodan (https://www.gostserver.xyz/). These standard APIs are based on REST, SOAP, XML, and JSON using HTTP and MQTT.

6.5.3 Data models

The combination of different services and data is seen as the most promising aspect of an OUP and shall provide new insights into the functioning of an urban area. Technically this “process” of horizontalization implies a lot of additional work towards the data. The reason is, that most vertical specific Field Component Platforms (FCP) are based on their own system management logic or data model. Therefore a critical path needs to be investigated to use a) open standard driven data models to achieve b) interoperability between different city wide and other urban area systems.

Therefore for the OUP of Hamburg the data model of OGC Sensor Things in conjunction with the complementing API will be used, as illustrated in Figure 16 in section 5.5.3. For interoperability measures the usage of an interoperability standard like oneM2M is planned to be evaluated. This might include the usage of automatic data mapper.

6.5.4 Metadata

According to the decision made in the Privy Council (Staatsräte) in May 2000, metadata for geospatial data is collected in the Hamburg Metadata Catalogue (Hamburger Metadatenkatalog - HMDK). It was at first based on voluntariness but from July 2005 on, it is obligatory for the data owning administrations to enter metadata into the HMDK. The Agency for Geoinformation and Surveying (LGV) was given the

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responsibility to run the HMDK, while the data owning administrations remain responsible for the content and to keep them up to date. End of 2014 the HMDK was integrated into the new metadata catalogue (MetadatenVerbund - MetaVer www.metaver.de) of several federal states.

The definition for the mandatory and possible elements of metadata for a data-set is based on the standard ISO 19115 “Geographic Information – Metadata”, while the structure of the metadata is defined by the standard ISO19139 “Geographic information – Metadata – XML schema implementation”. With having these two standards and providing a Catalogue Service Web (CSW) interface the HMDK can easily exchange metadata with other systems and can be harvested by other catalogues. The used technology for HMDK is the modular software InGrid®. In the text of ISO 19115 and in the text of ISO 19115-2 (for imagery and gridded data) the importance of metadata describing digital geographic data is explained in detail. ISO 19115 and ISO 19115-2 are abstract in that they provide a worldwide view of metadata relative to geographic information, but no encoding. Since ISO 19115 does not provide any encoding, implementation of geographic information metadata could vary based on the interpretation of metadata producers. In an attempt to facilitate the standardization of implementations, ISO/TS 19139 provides a definitive, rule-based encoding for carrying out ISO 19115. ISO/TS 19139 provides Extensible Markup Language (XML) schemas that are meant to enhance interoperability by providing a common specification for describing, validating and exchanging metadata about geographic data-sets, data-set series, individual geographic features, feature attributes, feature types, feature properties, etc. This Technical Specification utilizes ISO/TS 19139 specification and extends it to define XML Schema implementation for ISO 19115-2. It provides a definitive, rule-based encoding for carrying out ISO 19115-2 (https://www.iso.org).

With having these two standards and providing a Catalogue Service Web (CSW) interface the HMDK can easily exchange metadata with other systems and can be harvested by other catalogues. The used technology for HMDK is the modular software InGrid®.

6.6 Privacy and security

Besides the technical issues about the architecture, interoperability and openness of the Urban Platform, dealing with the questions about privacy is also an indispensable task. And dealing with privacy issues will remain an ongoing work as long as new data-sets are generated and new type of data e.g. sensor data are included into the platform. New data-sets and new type of data are inevitable in a world where technology is continually evolving. This is why the Hamburg Urban Platform has already started to work on the topic of privacy and will continue to work on it and especially paying attention to the new EU General Data Protection Regulation (GDPR).

The origin of the Hamburg Urban Platform lies in the development of an infrastructure for spatial information (GDI) driven by the INSPIRE Directive. With the geodata infrastructure law of Hamburg (HmbGDIG) the GDI and likewise the Urban Platform have the mission to provide an infrastructure for

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spatial information in the city of Hamburg. For this infrastructure it is required to use the data from the cadastral register, topographical data and data on the geodetic reference frame to form its core components. In alignment to the core components all kind of data from various authorities and data controllers of the city are gathered in the Urban Platform.

With data, there is the potential for privacy issues and for sure when personal or sensitive data are collected, when personal or sensitive data are given to third parties or when data-sets are combined and persons can be identified. That is why the core components of the Urban Platform have been checked with the Hamburg Commissioner for Data Protection regarding privacy issues. Some of the data from the core component contain personal data but most of the data are free from privacy issues. Since the data for the core component are required by the law, it was just necessary to define the disclosure of the data affected by privacy issues.

For the other data in the Urban Platform, the data controller will remain responsible for the content. With a declaration ("Freigabe-Erklärung"), the data controller has to confirm that the data has no privacy issues or that the collection of personal data is done on a legal basis and how to disclose the data. With this declaration the provider of the data is responsible to deal with all of the privacy issues before they become part of the Urban Platform. Lastly, the Urban Platform makes data-sets available via spatial data services, Web-Map-Services and/or Web-Feature-Services which alone are free from privacy issues. But everyone with access to these services can include and present the data in their own application. It is likely that other data-sets and services are included into that third party application and are combined, overlaid and analysed together with the data from the Urban Platform. Checking privacy issues for these third party applications is beyond the scope of the Urban Platform and are in the hands of the third parties who use data-sets from the Urban Platform. In terms of privacy the OUP of Hamburg will follow the newly set (DSGVO) of the EU. But already today, this implies that for all data, provided as open data, the German privacy laws are in place. All service providers towards the OUP need to fulfil prior to data provisioning these requirements.

Regarding security, the interaction of the Sensor Things API and other components will use the https protocol. For encryption, TLS (Transport Layer Security) will be used. In addition, for authentication and authorization, standard authentication protocols like OAuth shall be used. For data access and exchange specific policies need to be defined.

6.6.1 Data ownership

Similar to Nantes, the data ownership and property rights are still under discussion between the urban platform stakeholders. Hence, more details will be included in the WP3 deliverables related to the implementation of the IoT data integration, as well as D5.2 where data-sets will be established according to the indicators and urban platform data requirements.

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7. Helsinki urban platform

7.1 Current status of the Helsinki urban platform

Similar to Nantes and Hamburg, the urban platform in Helsinki starts from TRL7, where some services are already running. Figure 23 illustrates in green the existing functions, mainly data acquisition, processing and open data publication, those capabilities under development in fuchsia, roadmap in light blue and, finally, future interest in violet.

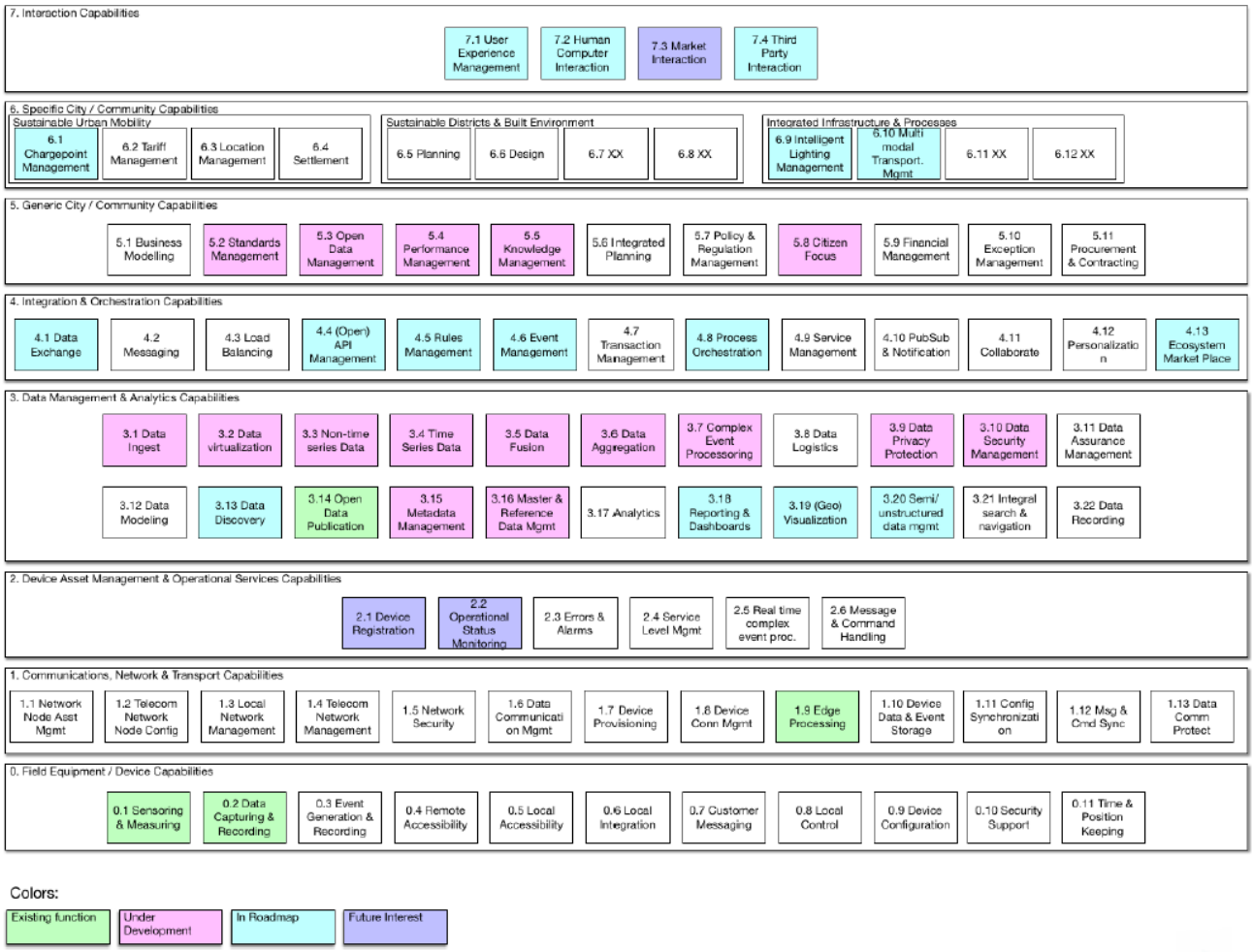

Figure 23: Map between Helsinki urban platform and EIP framework

7.1.1 Existing services

The Urban Platform includes the existing CKAN system (Helsinki Region Infoshare in Figure 24) that acts as a clearinghouse and data catalogue for static data-sets. It is planned to be used for sensor data as well in a way, that aggregated and time series data-sets would be stored into CKAN after certain period of time.

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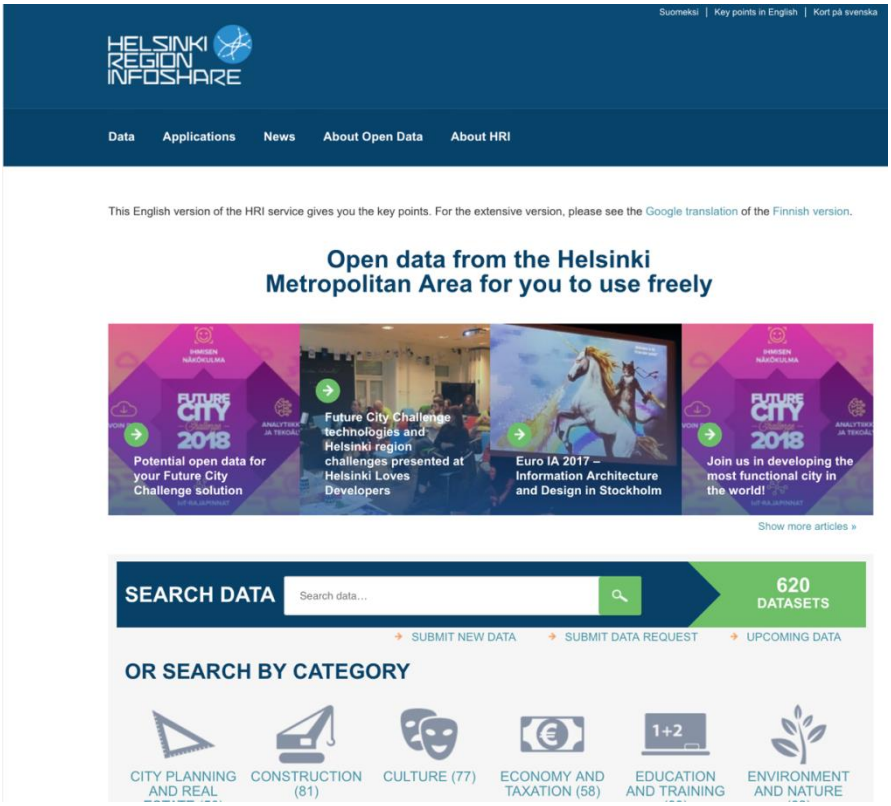

Figure 24: Helsinki Region Infoshare service

The existing authentication services for City of Helsinki shall be used to provide authentication services. It will only include employees of city of Helsinki so it will be complemented by other authentication services such as YLE ID. Currently it is not fully certain whether the upcoming GDPR regulation will effect on the ways of how a user must have been identified when creating the account for authentication service. It is possible that providers such as Google could not therefore be used to provide authentication.

7.1.2 Data models and open data

The baseline status for the Helsinki urban platform regarding data models is that the service relies on the CKAN data model. While it is limited in wider use, it has covered the needs for a data publishing point well. The discovery of data is based on free text search on indexed metadata. The service includes information from several different sources: data material generated by public authorities and associated metadata, posts and comments written by the users. As a general rule, the content made available is subject to broad user license under the terms of the Creative Commons Attribution 4.0 International (CC BY 4.0) license. Ownership of the materials however remains with the publisher of the original content.

7.2 Urban platform architecture

Currently, the city of Helsinki has implemented various data and IoT platforms for diverse application specific usages. The Urban Platform is therefore seen as a somewhat abstract concept that provides capability to complement existing systems and providing them new functionality such as ETL – processes

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for data transformation. While the existing systems have been studied, several key functional areas have been recognized that would require attention when drafting a plan for a scalable, city-wide urban platform. As an example, device management and API management are typically ignored in small-scale pilots. The scalability is not only about technical capability to handle larger volumes of data but also more straightforward and automated workflows when managing the data flows.

As happening with the other two lighthouse cities, Helsinki also follows the mySMARTLife framework approach. In this way, additional functionalities and capabilities will be developed as listed in the next bullets. In this case, whenever the framework requires more detailed description. EIP-SCC will be taken into consideration (as already done for the definition of the conceptual framework).

- Urban platform improvements with building-level open energy data on energy savings potential+
- Implementation of “mySMARTLife features” into public transport navigation app
- Implementation of “Carbon-Neutral Me” app
- Lighthouse IoT repository up-take and integration of sensor sources to the repository
- Up-take of new sensoring infrastructure in the smart districts

Then, having in mind the specific requirements to complement the existing IoT platforms, the architectural diagram shown in Figure 25 was defined to illustrate the development activities.

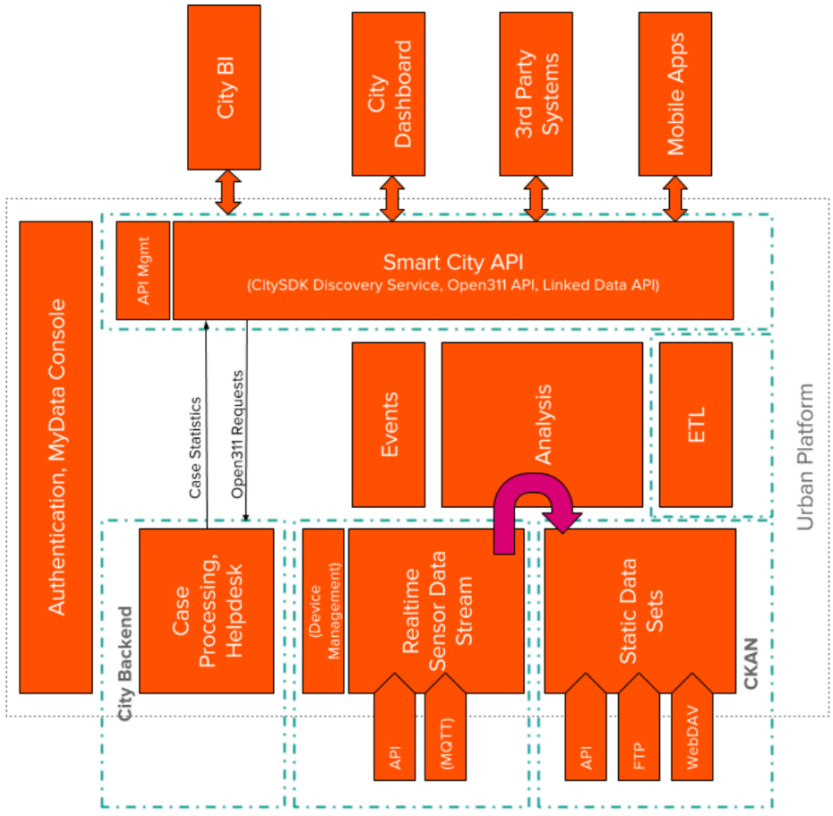

Figure 25: Helsinki urban platform architecture

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7.2.1 Helsinki Urban Platform compliance with the framework

Finally, Helsinki, as expected, is compliant with the common framework of mySMARTLife, as demonstrated with Table 9.

Table 9: Compliance between Helsinki architecture and common framework

Helsinki layer	Common framework layer	Functionality
City backend	Sensing and driver layer	The sensor equipment and the adaptation of the data are rendered.
Events, analysis, ETL	Knowledge layer	Data storage, management and analysis
SmartCity API	Interoperability layer	Open API, open Data portals and open SDKs
Dashboard, city BI, apps	Intelligent services layer	Dashboards, city services, apps, 3rd party applications…
Authentication, MyData console	Configuration, logging and cloud	Access rights and configuration of the urban platform

7.3 Definition of verticals / services for the new developments

While the urban platform in Helsinki has received a high score in technical readiness it is important to notice that this has only meant its use as a data catalogue for files that have lower rating on 5-star assessment. The Helsinki urban platform currently provides limited options for managing document publishing workflows, data cleansing or real-time data sources. In mySMARTLife, the actions 47 and 48 for IoT sensors and middleware allow us to enhance the platform with such required features.

New services to be integrated are the services required to manage the real-time data flows. This includes at least a policy enforcement point (PEP), a context broker and connections to various data sources. The ETL process is provided by using an external service base on commercial Altova Mapforce products. During the project it will be studied whether an open source version of ETL would be adequate for the operations such as generating CityGML dynamic attributes on the fly from sensor data.

7.3.1 User roles and cases

Within Helsinki, the access rights are currently well-established and this section summarises all the user roles and cases to access the information. Table 10 illustrates the mapping between the user roles and their stories related to the urban platform functionality. The users are classified as citizens (i.e. 1XX), scientists (i.e. 2XX), data publisher (i.e. 3XX), platform admin (i.e. 4XX), developer (i.e. 5XX) and hardware (HW) vendor (i.e. 6XX).

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Table 10: User roles and access rights for Helsinki urban platform

#US101	As a citizen, I want to view all the data I have collected in the forms of lists or graphs so that the data points are visualized in an easy way
#US102	As a citizen, I want to view the public data in the form of list, graphs or maps so that the data points are visualized in an easy way
#US103	As a citizen, I want to view, add and remove my own sensors in the system so that I can take part on crowdsourcing or have my private sensors connected
#US104	As a citizen, I want to manage who has access to my data so that my privacy concerns are met (MyData)
#US105	As a citizen, I want to be able to sign on using my current hel.fi or yle.fi accounts so that I do not need to set up yet another account
#US106	As a citizen, I want to be able to define alarm levels that trigger notifications (x<y, x>y) so that I do not have to constantly monitor my sensors
#US107	As a citizen, I want to have an opportunity to donate the data collected of my activities on public use so that I can manage the privacy when appropriate
#US108	As a citizen, I want to have an option to anonymize my data points i.e. by summing them with 10 other citizens from the same neighbourhood so that my daily activities remain private
#US109	As a citizen, I want to choose a convenient notification method (email, app notification, etc.) so that I can receive them on the channel I otherwise follow
#US110	As a citizen, I want to create a personal dashboard of data widgets in order to easily view the information I need (see example http://dashboard.leedsdatamill.org/canvas/leeds-city-council)
#US111	As a citizen, I want the platform to allow me forward my sensor data to 3rd party services so that I can use the same sensors for multiple services
#US112	As a citizen, I want to be able to pull off my sensor data from any service and aggregated data-set any time so that my right to be forgotten is met
#US201	As a scientist, I want to view the public data in the form of list, graphs or maps so that the data points are visualized in an easy way
#US202	As a scientist, I want to have a free text search to locate the data-sets that have the information I need in order to make it easier for my work

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#US203	As a scientist, I want to be able to generate a “Call for Data” – request system – wide and to define privacy options (i.e. anonymized or not) in order to get new, useful data
#US204	As a scientist, I want to be able to easily see how complete the data-set series are in order to make a judgement whether to use them or not
#US301	As a data publisher, I want to be able to monitor who have accesses the protected data-sets in order to fulfil my regulatory requirements
#US302	As a data publisher, I want the system to notify me in case an automated transfer of data-set was not received or there were parsing errors in order to not having to manually follow the transactions
#US303	As a data publisher, I want to have the option to upload the data in file form (CSV, XLS) in order to minimize the technical effort in our side
#US401	As a platform admin, I want to define system-wide data retention policies (i.e. to what time scale the data points are aggregated in archiving phase) in order to automate capacity management tasks
#US402	As a platform admin, I want to have an easy utility to manage the API use, generate keys, access controls and accounts in order to minimize the effort and human errors
#US403	As a platform admin, I want the platform to have a separate real-time storage from where the data is transferred into Big Data storage in order to optimize the capacity of the system
#US404	As a platform admin, I want to manage my sensor network with a simple catalog that contains the type, supplier and location (LatLong) in order to ease service requests
#US405	As a platform admin, I want all the data publishers to register before uploading data and accept open data licensing terms in order to make all the data usable
#US406	As a platform admin, I want the system to be scalable on its API capacity and have load-balancing option so that new servers can be added elastically to share the load
#US407	As a platform admin, I want all the data-sets contain adequate metadata so that I can prepare the required GDPR documents (audit logs, user consent proofs, etc.)
#US408	As a platform admin, I want the system to have as little dependencies as possible, prefer not requiring a separate application server and have plain LAMP stack instead so that I can run the required updates with little hassle and little overhead
#US501	As a developer, I want to study the data ontologies and taxonomies available in certain API using an online documentation such as Swagger in order to make my development effort

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	easier and to prevent wasting time on reverse-engineering or hacking
#US502	As a developer, I want that my app can retrieve and distribute Open Data also without any specific authentication whenever the data is public
#US503	As a developer, I want each API have a version number and work in parallel so that I do not need to update my app immediately when a new API version is released
#US504	As a developer, I want all the data-sets use the same date and time format (ISO 8601) so that retrieving data on certain time range is easy without conversion
#US505	As a developer, I want the southbound to have connectors to the local, commercial LoRa platforms so that I do not need to put effort on the connectivity and device management
#US506	As a developer, I want to create widgets of specific data in order to minimize the effort required on embedding the data on 3rd party website
#US601	As a HW vendor, I want to be able to produce data using the protocols (i.e. Modbus, BACnet) that already exist in the legacy devices so that my clients do not need to replace fine and working devices
#US602	As a HW vendor, I prefer connectivity methods that do not require heavy processing so that the functionality can be built on embedded and microcontroller – driven gateways
#US603	As a HW vendor, I want the option to maintain a parallel IoT platform whenever I need to control the sensors or actuators so that the IoT platform functionality does not limit my business cases

7.3.2 Project timeline

The development effort in mySMARTLife project has been structured in a way that the technical capability to receive real-time data from sensors and to manipulate it is reached in early stages in order to support the baseline KPI definitions. The diagram in Figure 26 illustrates the areas of development.

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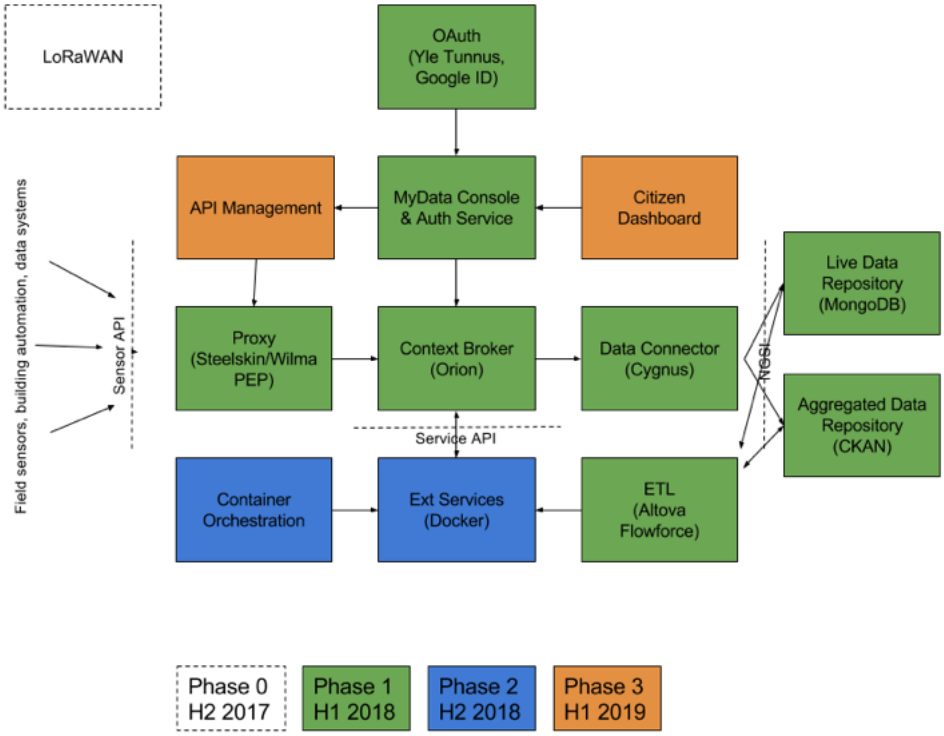

Figure 26: Areas of development and stages for Helsinki urban platform

The names of the modules may change during the project if for technical reasons a more suitable solution is found or needs to be developed. As an example, the planned Orion Context Broker might be replaced with a service that supports SensorThings API in a native way.

7.4 Interoperability

7.4.1 Southbound API's

The real-time sensor and building data are collected using an implementation of OGC SensorThings API in the southbound. A SDK will be provided using the SwaggerHub –service. For project activities related to smart grids and demand management, a simple implementation of the CIM interface (IEC 61968) is to be developed for testing and research data collection purposes

7.4.2 Northbound API's

In the development, specific attention is put on the interoperability with existing 6Aika API's (CitySDK) that will define the requirements between the Urban Platform and the city backend data systems. SensorThings API will be provided also on the northbound to provide data for applications and visualization services.

7.4.3 Authentication

In order to provide interoperability between the Urban Platform and other citizen-oriented services, the authentication is based on OAuth2.0.

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7.5 Openness

7.5.1 Open data

The urban platform shall follow the default principle set for Helsinki Region Infoshare that the data produced by the City of Helsinki shall be open if there is not any specific reason to not to do so. It is naturally possible that certain sensors can provide personal data that involve the GDPR requirements. In such case the Nordic MyData Model[3] shall be followed.

7.5.2 Open APIs

The APIs included in the urban platform shall be based on open design. The implementations of APIs are to be provided as open source when possible using SwaggerHub.

7.5.3 Data models

By nature, the Urban Platform is not restricted to any single data model and should therefore be flexible to adopt new services and data sources. While the CKAN supports data-set classifications in a flexible way, it is expected that more semantic approach shall be required for the future development. In this way, ETL processes are required to perform the extraction, loading and transformation operations. Figure 27 provides an example about data management in the Helsinki data model, where date parsing, concatenation of data and formatting are the main functions.

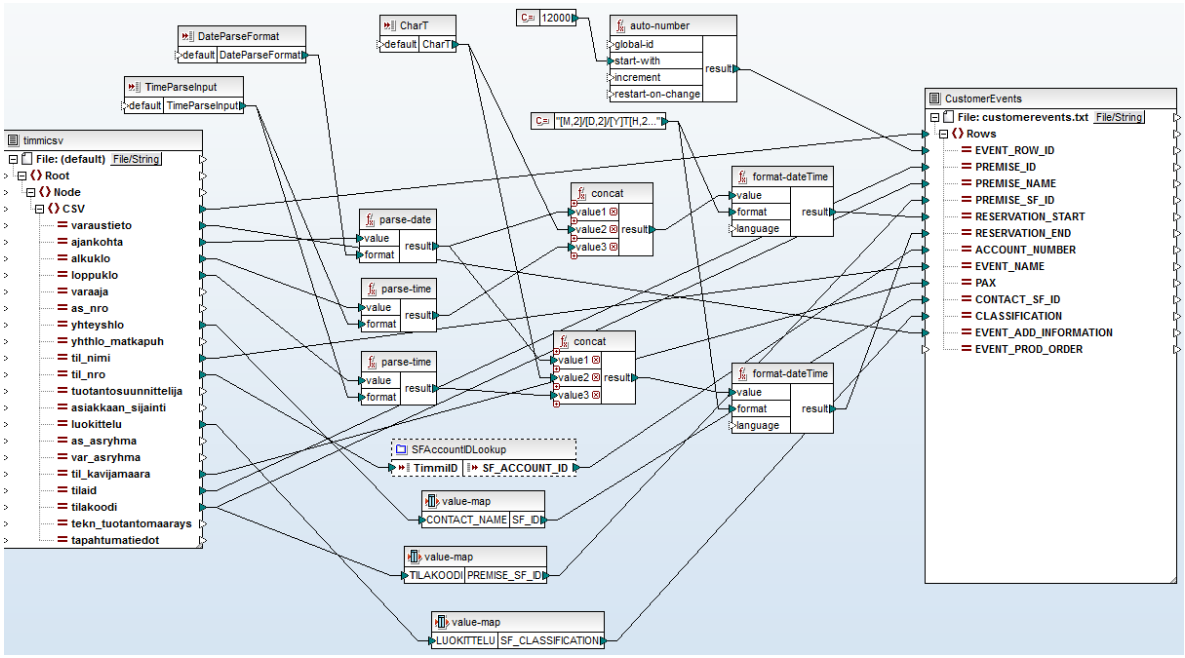

Figure 27: ETL process example for Helsinki data model

7.5.4 Metadata

Although specific metadata studies are not yet completed, it is expected that a semantic approach based on ontologies shall be required as addition to fixed sets of metadata and taxonomies. This approach is

[3] https://www.lvm.fi/documents/20181/859937/MyData-nordic-model/

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supported by the latest developments in the SensorThings API and the CityGML format that is used by the 3D model of the city. Anyway, as it was stated in the Nantes case, metadata are related to the interoperability aspects so as to provide extra info to understand data, hence, additional content will be described in D2.17 about interoperability testing.

7.6 Privacy and security

The upcoming General Data Protection Regulation (GDPR) defines a location as personal data, thus defining various sensor data sources as personal data and requiring adequate privacy and security implementations. It cannot be assumed that the platform as whole could just ignore such cases, therefore it is expected that any data on the platform could have privacy and security implications and should treated accordingly. This makes it vital to be able to manage data streams and associating them with the identity of their owner throughout the data stream. This approach is supported by the technical architecture when the context broker either manages the streams according to the authenticated owner's directions or simply erases the data. All the stored data that may involve presonal data must be encrypted. All the activities related to forwarding data stream into third party services shall be logged appropriately allowing later auditing of the behaviour of the service.

In this way, Helsinki will provide a MyData Service that is an application for data management based on consent from the users. The MyData concept fits well with the upcoming GDPR regulation since in both of them, the citizen is put in control in all the data related to him/her. When such control mechanisms are applied, a good coverage of GDPR compliance is reached with the same effort. Then, a strong authentication system is deployed to give the consent to be proven accordingly with the GDPR. This ensures the authentication when provisioning sensor data to the platform. In this sense, Figure 28 depicts an example of the application. On the left side, my Sensors view provides a quick overview on all the sensors and data sources the person has provisioned. The term sensor is used in a broad sense, i.e. it could be any kind of data source or API – as an example a Google Health API. Moreover, the management of the data is easy through the sharing options by simply clicking the "add" button. Once it is added, a common name is given, as well as the device ID, which may be extracted from barcode (see middle image of Figure 28). Finally, on the right side, the sensor may be associated to a service from the list of subscribed services, where the consent to use data is also given.

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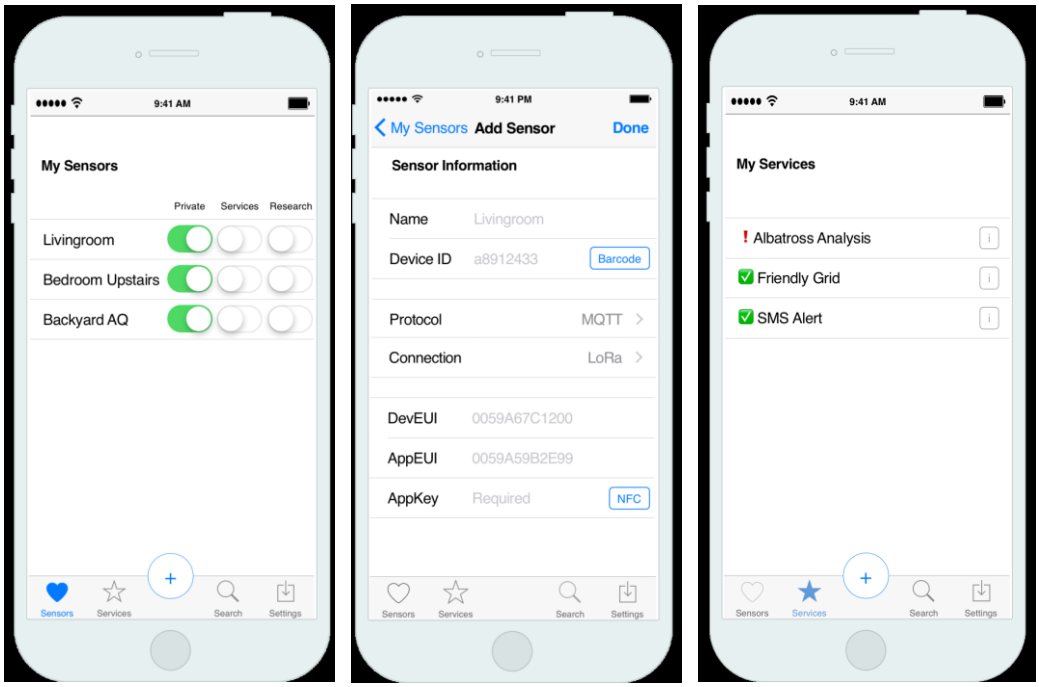

Figure 28: Example of MyData app

This applies in the urban platform at sensing level before inserting data from smart home sensors and electric vehicles. As observed in Figure 29, MyData is integrated between as data provider agent.

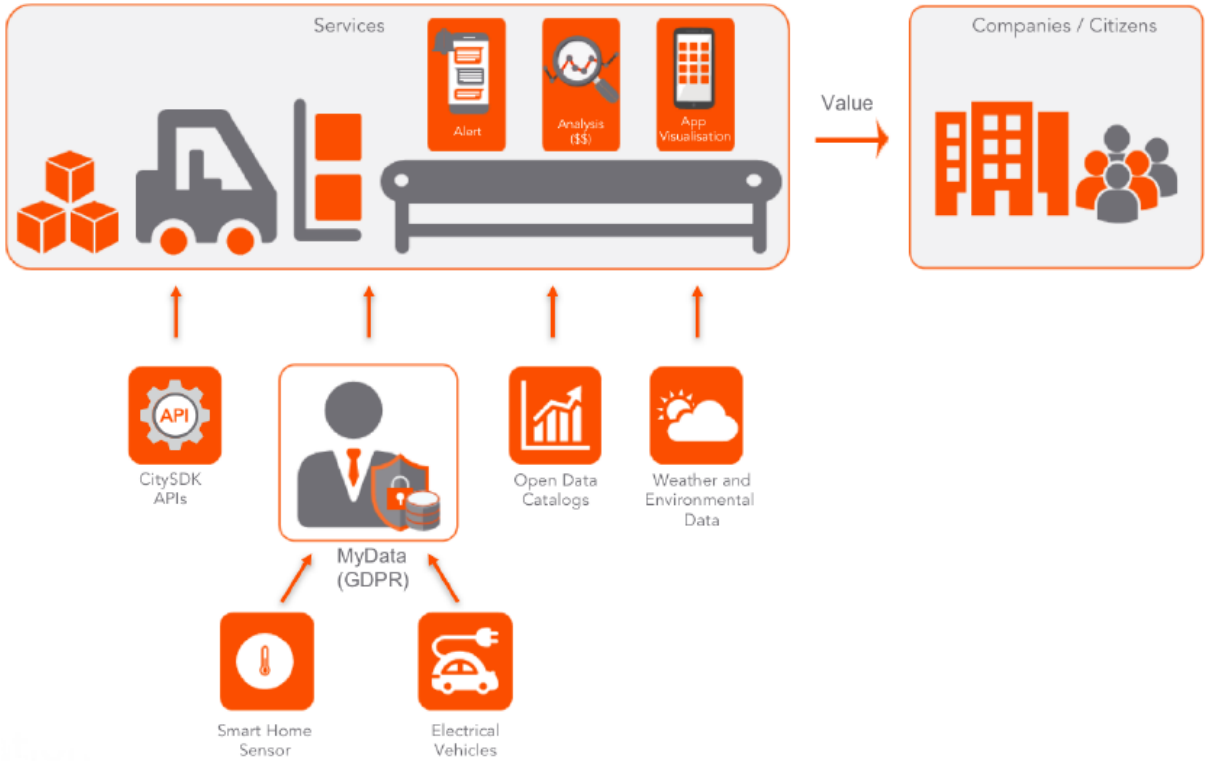

Figure 29: MyData integration into Helsinki urban platform

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7.6.1 Data ownership

As mentioned in the previous lighthouse cities, data ownership is a key question to deal with the privacy and security of data. In this sense, Table 11 provides a very preliminary version of the data ownership at high-level for Helsinki, whose initial discussions have already started in contrast to Nantes and Hamburg. During the developments of the WP4, more details will be provided when actions are being implemented in the city, as well as when defining the data-sets into D5.2.

Table 11: Data ownership for Helsinki

Data-set type	Owner	Usage rights
Mobility	Charger owner, partially personal data	Data may include references that will link it to identity of a person, thus falls into category of GDPR and consent required accordingly
Dwelling-level energy	Personal data	Data may include references that will link it to identity of a person, thus falls into category of GDPR and consent required accordingly
Building-level energy	Building owner	Corporate decision to open
Smart grids	Grid company	Corporate decision to open
District heating	Heating company	Corporate decision to open
Street lighting	City	City decision to open
Integrated infrastructures	City	City decision to open

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8. Conclusions

One of the objectives of mySMARTLife project is to improve the current statues of the urban platforms for the lighthouse cities. These new developments must comply with interoperability and openness aspects. In this way, several initiatives have been already defined some framework approaches, like EIP-SCC, ITU-T and ESPRESSO. Taking them into consideration, as well as the new implementations of the urban platforms, a common open specifications framework establishes, within mySMARTLife, the conceptual approach where all the developments are wrapped. The aforementioned framework is completely compliant with the initiatives stated before and it sets the concepts for ensuring a framework under which the new developments comply with interoperability aspects, as well as open data and APIs for data sharing. Basically, the following ideas are included and defined as necessary:

- Devices to sense data from the field in order to obtain diverse parameters from energy consumption, mobility, etc. and through different technologies, e.g. IoT, 3D data…
- Data collection and data modes with the aim of processing the information in a common way before sharing. This treats the data management.
- Storage of information in persistent entities to keep record of the information and, thus, allow the implementation of data analytics, calculation of indicators or simply data accesses for providing useful information to the stakeholders.
- Interoperability, which is one of the key elements of the framework, whose aim is to offer data interfaces to third parties with the objectives of injecting additional data-sets and/or providing information for visualization or implementation of new services (open APIs and open Data).
- Services or application for end-users of the urban platform.

The new developments of the urban platforms for the cities need to be compliant with the aspects above. Hence, their architectures have followed the approach, being thus compliant with the framework. Nevertheless, the framework does not cover the design of the technological solutions. In this sense, the cities have dealt with standards that ensure interoperability. For instance, the use of SensorThings API provides a powerful tool with the goal of providing interoperability at data collection level and open APIs. Similar happens to the open data aspects. Moreover, the collection of data (or drivers' layer) connects to standard protocols so as to connect devices and platforms under the defined interface.

With all these aspects well-established, the main conclusion is that a common specifications framework helps the developers to define the initial concepts and terms for assuring interoperability and openness. Moreover, standards support the achievement of these objectives. At the end, creating such an infrastructure provides a way to increase the business because third parties may integrate data into the platform, as well as developing new services based on the exposed data.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

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[6] SmartEnCity project partners, “Deliverable 6.2: CIOP architecture generic implementation”, technical report, v1.0, January 2017.

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

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Annex I: Data-sets provided by Nantes

Although D5.2 includes the data-sets of the urban platforms, this annex illustrates the data-sets that are available as open data by the Nantes Urban Platform. Table 12 describes the current data-sets that are available.

Table 12: Nantes available open data-sets

Jeu de données	Thématique	Fréquence de mise à jour
Abris vélos de Nantes Métropole	Mobilité	Annuelle
Adresses postales de Nantes Métropole	Urbanisme	mensuelle
Adresses postales de Nantes Métropole par commune	Urbanisme	mensuelle
Agenda des animations culturelles de la Bibliothèque Municipale de la ville de Nantes	Culture / Tourisme	Hebdomadaire
Aires de covoiturage de Nantes Métropole	Mobilité	Annuelle
Aires de livraison du centre-ville de la ville de Nantes	Mobilité	Mensuelle
Alertes info-trafic de Nantes Métropole	Mobilité	temps réel (5 minutes)
Annuaire des associations et des activités de Nantes	Citoyenneté / Institution	hebdomadaire
API temps réel de la TAN	Mobilité	Temps réel
Appuis-vélos de Nantes Métropole	Mobilité	annuelle
Arrêts, horaires et circuits TAN	Mobilité	Variable
Arrêts, horaires et circuits TAN 2017-2018	Mobilité	Variable
Bilan sur la rénovation énergétique des copropriétés	Environnement	Annuelle
Budget primitif (BP) de la Ville Nantes	Citoyenneté / Institution	annuelle
Budget primitif (BP) de Nantes Métropole	Citoyenneté / Institution	annuelle
Budget primitif (BP) du CCAS de la Ville de Nantes	Citoyenneté / Institution	annuelle
Canevas géodésique de Nantes Métropole	Urbanisme	hebdomadaire
Chiffres de l'économie de l'innovation - Atlanpole	Économie	annuelle
Composteurs de quartier - Nantes Métropole	Environnement	annuelle
Compte administratif (CA) de la Ville Nantes	Citoyenneté / Institution	annuelle
Compte administratif (CA) de Nantes Métropole	Citoyenneté / Institution	annuelle
Compte administratif (CA) du CCAS de la Ville de Nantes	Citoyenneté / Institution	annuelle
Dates et lieux de retrait des sacs TRI'SAC des rendez-vous de quartier de Nantes	Environnement	Annuelle
Déchèteries-écopoints de Nantes Métropole	Environnement	Annuelle
Découpage géographique des bureaux de vote de la ville de Nantes	Citoyenneté / Institution	Publication unique
Découpage géographique des bureaux de vote de la ville de Nantes de 2001 à 2006	Citoyenneté / Institution	Publication unique
Découpage géographique des bureaux de vote de la ville de Nantes de 2007 à 2014	Citoyenneté / Institution	Publication unique
Défibrillateurs de la ville de Nantes	Santé / Social	Annuelle
Délibération du 17 mars 2016 fixant les tarifs applicables sur la commune du Pellerin	Citoyenneté / Institution	annuelle
Dictionnaire des questions de l'évaluation du PCET 2015 de Nantes Métropole	Environnement	Publication unique
Disponibilité dans les parkings publics de Nantes Métropole	Mobilité	Temps réel (5 minutes)
Eléments de la charte graphique TAN	Mobilité	variable / ponctuelle
Evolution du nombre de copropriétés suivies par Nantes Métropole	Environnement	Annuelle
Fluidité des axes routiers de Nantes Métropole	Mobilité	Temps réel (5 minutes)
Fréquentations des déchèteries-écopoints de Nantes Métropole	Environnement	Annuelle
Gonfleurs en libre-service de Nantes Métropole	Mobilité	semestrielle
Horaires des déchèteries-écopoints de Nantes Métropole	Environnement	Annuelle
Horaires des piscines de Nantes Métropole	Sport	annuelle
Horaires des structures de ré-emploi de Loire-Atlantique	Environnement	Annuelle
Horodateurs de la ville de Nantes	Mobilité	semestrielle
Indicateur d'activité des grands équipements de Nantes Métropole	Culture / Tourisme	Annuelle
Indice ATMO journalier à Nantes	Environnement	Annuelle
Indice ATMO prévisionnel dans l'agglomération de Nantes	Environnement	Toutes les heures
Info-trafic TAN prévisionnel	Mobilité	Temps réel (5 minutes)
Info-trafic TAN temps réel	Mobilité	Temps réel (5 minutes)
Inventaire des camélias du Jardin des Plantes de la ville de Nantes	Environnement	annuelle
Inventaire des collections du Musée d'Arts de Nantes	Culture / Tourisme	Annuelle
Inventaire des herbacées du Jardin des Plantes de la ville de Nantes	Environnement	annuelle
Inventaire des ligneux de type arbre du Jardin des Plantes de la ville de Nantes	Environnement	annuelle
Inventaire des ligneux de type arbuste du Jardin des Plantes de la ville de Nantes	Environnement	annuelle
Inventaire des ligneux de type conifère du Jardin des Plantes de la ville de Nantes	Environnement	annuelle

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Jeu de données	Thématique	Fréquence de mise à jour
Jardins familiaux de la ville de Nantes	Environnement	annuelle
Jours de collectes des déchets à Nantes	Environnement	semestrielle (et/ou à l'occasion de modification majeure)
Lieux des permanences de conseils info énergie et aides financières de Nantes Métropole	Environnement	annuelle
Limites des communes de Nantes Métropole	Urbanisme	Variable
Linéaires de voies de la commune du Pellerin	Territoires	annuelle
Liste des adhérents professionnels à SoNantes	Économie	journalière
Liste des bons plans SoNantes	Économie	journalière
Liste des horaires des équipements culturels de Nantes	Culture / Tourisme	Annuelle
Liste des horaires des parkings publics de Nantes	Mobilité	Annuelle
Liste des prénoms des enfants nés à Nantes	Citoyenneté / Institution	Annuelle
Liste des tarifs applicables dans les équipements culturels de Nantes	Culture / Tourisme	Annuelle
Liste des tarifs applicables dans les parkings publics de Nantes	Mobilité	Annuelle
Liste des tarifs applicables dans les stations bicloo et Marguerite de Nantes	Mobilité	Annuelle
Liste des tarifs applicables dans les transports en commun du réseau TAN à Nantes	Mobilité	Annuelle
Localisation des colonnes aériennes de Nantes Métropole	Environnement	semestrielle (et/ou à l'occasion de modification majeure)
Localisation des colonnes enterrées de Nantes Métropole	Environnement	trimestrielle
Localisation des équipements et espaces communaux du Pellerin	Territoires	annuelle
Localisation des équipements publics de Nantes Métropole	Citoyenneté / Institution	trimestrielle
Localisation des équipements publics relevant de la catégorie 'Vie associative' de Nantes	Citoyenneté / Institution	trimestrielle
Localisation des équipements publics relevant du thème 'Action sociale' de Nantes Métropole	Santé / Social	trimestrielle
Localisation des équipements publics relevant du thème 'Culte' de Nantes Métropole	Citoyenneté / Institution	trimestrielle
Localisation des équipements publics relevant du thème 'Culture' de Nantes Métropole	Culture / Tourisme	trimestrielle
Localisation des équipements publics relevant du thème 'Enseignement' de Nantes Métropole	Éducation / Formation	trimestrielle
Localisation des équipements publics relevant du thème 'Justice et sécurité' de Nantes Métropole	Citoyenneté / Institution	trimestrielle
Localisation des équipements publics relevant du thème 'Mobilité' de Nantes Métropole	Mobilité	trimestrielle
Localisation des équipements publics relevant du thème 'Service public' de Nantes Métropole	Citoyenneté / Institution	trimestrielle
Localisation des équipements publics relevant du thème 'Sports, loisirs' de Nantes Métropole	Sport	trimestrielle
Localisation des équipements publics relevant du thème 'Vie pratique' de Nantes Métropole	Citoyenneté / Institution	trimestrielle
Localisation des équipements publics relevant du thème 'Vie sociale' de Nantes Métropole	Santé / Social	trimestrielle
Localisation des Panneaux à Message Variable (PMV) de Nantes Métropole	Mobilité	Trimestrielle
Localisation des tronçons routiers de Nantes Métropole	Mobilité	trimestrielle
Localisation des Zones d'Activité Economique (ZAE) de Nantes Métropole	Économie	Annuelle
Localisation et caractéristiques des parcs et jardins de Nantes	Environnement	Annuelle
Marchés publics conclus par la Ville de Nantes	Citoyenneté / Institution	annuelle
Marchés publics conclus par le CCAS de la Ville de Nantes	Citoyenneté / Institution	annuelle
Marchés publics conclus par Nantes Métropole	Citoyenneté / Institution	annuelle
Menus des cantines scolaires de la ville d'Orvault	Éducation / Formation	Mensuelle
Menus des cantines scolaires de la ville de Nantes	Éducation / Formation	Mensuelle
Niveau de dioxyde d'azote dans l'agglomération nantaise	Environnement	Annuelle
Niveau de dioxyde de soufre dans l'agglomération nantaise	Environnement	Annuelle
Niveau de pollution d'ozone dans l'agglomération nantaise	Environnement	Annuelle
Niveau de pollution en particules fines PM10 dans l'agglomération nantaise	Environnement	Annuelle
Nombre annuel de décès à Nantes	Citoyenneté / Institution	annuelle
Nombre annuel de décès à Orvault	Citoyenneté / Institution	annuelle
Nombre annuel de mariages à Nantes	Citoyenneté / Institution	annuelle
Nombre annuel de mariages à Orvault	Citoyenneté / Institution	annuelle
Nombre annuel de naissances à Nantes	Citoyenneté / Institution	annuelle
Nombre annuel de naissances à Orvault	Citoyenneté / Institution	annuelle
Occupation du Sol 1952 de niveau 3 de Nantes Métropole	Urbanisme	Publication unique

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731297.

Jeu de données	Thématique	Fréquence de mise à jour
Occupation du Sol 1981 de niveau 3 de Nantes Métropole	Urbanisme	Publication unique
Occupation du Sol 1999 de niveau 3 de Nantes Métropole	Urbanisme	Publication unique
Occupation du Sol 2004 de niveau 3 de Nantes Métropole	Urbanisme	Publication unique
Occupation du Sol 2008 de niveau 3 de Nantes Métropole	Urbanisme	publication unique
Occupation du Sol 2012 de niveau 3 de Nantes Métropole	Urbanisme	Publication unique
Occupation du Sol 2014 de niveau 3 de Nantes Métropole	Urbanisme	Publication unique
Offres de services des parkings publics de la Ville de Nantes	Mobilité	annuelle
Orthophotographie 2005 de Nantes Métropole	Urbanisme	Publication unique
Parcs relais de Nantes Métropole	Mobilité	Annuelle
Patrimoine arboré de la Ville de Nantes	Environnement	annuelle
Périmètres scolaires de la ville de Nantes	Éducation / Formation	annuelle
Photographies des repères altimétriques de Nantes Métropole	Urbanisme	tous les 3 ans
Point d'étape des engagements de la municipalité de Nantes à mi-mandat (2017) - Engagements	Citoyenneté / Institution	Publication unique
Point d'étape des engagements de la municipalité de Nantes à mi-mandat (2017) - Récapitulatif chiffré	Citoyenneté / Institution	Publication unique
Pôles de proximité de Nantes Métropole	Urbanisme	annuelle
Projet des forêts urbaines de Nantes Métropole	Environnement	Annuelle
Quartiers de la ville de Nantes	Urbanisme	Publication unique
Répertoire des lieux-dits de Nantes Métropole	Urbanisme	mensuelle
Répertoire des lieux-dits de Nantes Métropole par commune	Urbanisme	mensuelle
Répertoire des voies de Nantes Métropole	Urbanisme	mensuelle
Répertoire des voies de Nantes Métropole par commune	Urbanisme	hebdomadaire
Résultats de l'évaluation du PCET 2015 de Nantes Métropole	Environnement	Publication unique
Résultats des élections européennes	Citoyenneté / Institution	Publication unique
Résultats des élections municipales	Citoyenneté / Institution	Publication unique
Résultats du premier tour de l'élection présidentielle à Nantes	Citoyenneté / Institution	Publication unique
Résultats du second tour de l'élection présidentielle à Nantes	Citoyenneté / Institution	Publication unique
Résultats du premier tour des élections départementales par canton de loire-Atlantique	Citoyenneté / Institution	Publication unique
Résultats du second tour des élections départementales par canton de loire-Atlantique	Citoyenneté / Institution	Publication unique
Résultats du premier tour des élections législatives par circonscription de Loire-Atlantique	Citoyenneté / Institution	Publication unique
Résultats du second tour des élections législatives par circonscription de Loire-Atlantique	Citoyenneté / Institution	Publication unique
Résultats du premier tour des élections municipales à Nantes	Citoyenneté / Institution	Publication unique
Résultats du second tour des élections municipales à Nantes	Citoyenneté / Institution	Publication unique
Résultats du premier tour des élections régionales à Nantes	Citoyenneté / Institution	Publication unique
Résultats du second tour des élections régionales à Nantes	Citoyenneté / Institution	Publication unique
Résultats du premier tour des élections régionales à Orvaut	Citoyenneté / Institution	Publication unique
Résultats du second tour des élections régionales à Orvaut	Citoyenneté / Institution	Publication unique
Salles de la ville de Nantes disponibles à la location	Citoyenneté / Institution	semestrielle
Services des piscines de Nantes Métropole	Sport	annuelle
Stationnements en zone bleue de la ville de Nantes	Mobilité	annuelle
Stations Marguerite de Nantes Métropole	Mobilité	Semestrielle
Stations vélos en libre-service de Nantes Métropole	Mobilité	Semestrielle
Structures de ré-emploi de Loire-Atlantique	Environnement	Annuelle
Tarifs de location des salles de la ville de Nantes	Citoyenneté / Institution	annuelle
Temps de parcours sur les itinéraires de Nantes Métropole	Mobilité	Temps réel (5 minutes)
Toilettes publiques de Nantes Métropole	Territoires	Annuelle
Tonnages des déchèteries-écopoints de Nantes Métropole	Environnement	Annuelle
Veille-presse autour de Jules Verne	Culture / Tourisme	semestrielle
Vélocistes de Nantes Métropole	Mobilité	Annuelle
Zones de stationnement des deux-roues motorisés de la ville de Nantes	Mobilité	annuelle
Zones de stationnement payantes de la ville de Nantes	Mobilité	annuelle
Zones piétonnes de la ville de Nantes	Mobilité	annuelle

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