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BUILDING SMART CITIES TOGETHER

# SHARING CITIES

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# D4.5 Report of Urban Sharing Platform Sharing and Reuse

| | |
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# Executive Summary

This document describes the dissemination of the Urban Sharing Platform (USP) and adoption of WP4 results and achievements, as designed in Task 4.5 “Share and Extend the Urban Sharing Platform”. The following dimensions of USP dissemination and reuse are considered:

- USP standards (technical standards, data standards, smart city standards), see Sect. 2.
- Identification of sharing opportunities between project partners, see Sect. 3.
- Communication and dissemination initiatives, see Sect. 4.

Interdependencies between WP4 and other WPs have been considered, discussed and addressed throughout the development of the city USPs through dedicated meetings, both at local and at global level (e.g., all of the latest WP4 global design workshops included a session about analysis of interdependencies and planning of related actions). Requirements stemming from national and European regulations regarding data privacy, security, confidentiality etc. are being addressed through specific data privacy impact assessments both at local and at project level (see, e.g., the GDPR workshops organized by the project). Moreover, the use of open and de-facto standards is being considered to enable other cities with common technical skills to replicate the designs and blueprints provided by the project.

The focus for the first 24 months of the Sharing Cities project has been to prepare for sharing by the identification and application of common approach and standards as we have designed the USP. In the next phase of the project as we build out the USP across the 3 core cities the focus will shift to the practical benefits of sharing, which includes dissemination to the fellow cities.

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# 1 Introduction

The Urban Sharing Platform (USP) is an overarching collection of technical components, capabilities, standards, guidelines and processes, which provides functions and services that enable a Smart City.

This document describes the dissemination of the Urban Sharing Platform (USP) and adoption of WP4 results and achievements, as designed in Task 4.5 “Share and Extend the Urban Sharing Platform”. The following dimensions of USP dissemination and reuse are considered:

- USP standards (technical standards, data standards, smart city standards), see Sect. 2
- Communication and dissemination initiatives, see Sect. 3.

Interdependencies between WP4 and other WPs have been considered, discussed and addressed throughout the development of the city USPs through dedicated meetings, both at local and at global level (e.g., all of the latest WP4 global design workshops included a session about analysis of interdependencies and planning of related actions). Requirements stemming from national and European regulations regarding data privacy, security, confidentiality etc. are being addressed through specific data privacy impact assessments both at local and at project level (see, e.g., the GDPR workshops organized by the project).

## 1.1 Acronyms

**API** Application Programming Interface

**CCOC** Cloud City Operation Centre

**CEP** Complex Event Processing

**EIP** European Innovation Partnership

**EMS** Energy Management System

**ESP** Event Stream Processing

**IaaS** Infrastructure as a Service

**ICT** Information and Communication Technology

**IoT** Internet of Things

**IT** Information Technology

**KPI** Key Performance Indicator

**MQTT** Message Queuing Telemetry Transport

**NGSI** Next Generation Service Interface

| | |
|---|---|
| **PaaS** | Platform as a Service |
| **REST** | REpresentational State Transfer |
| **SaaS** | Software as a Service |
| **SCC** | Smart Cities and Communities |
| **SDB** | Service Delivery Broker |
| **SLA** | Service Level Agreement |
| **USP** | Urban Sharing Platform |
| **WP** | Work Package |
| **XaaS** | "X" (everything/anything) as a Service |

## 1.2 References and Supporting Documentation

The following references and supporting documentation are appropriate for this document.

- Sharing Cities: H2020-SCC-2015 SHAR-LLM Grant Agreement.
- Sharing Cities: D4.1 Urban Sharing Platform Requirements, R01.
- Sharing Cities: D4.2 Urban Sharing Platform Reference Model (M24 update).
- Sharing Cities: D4.3 Urban Sharing Platform Relisation, R01.
- Sharing Cities: D4.4 Report of Urban Sharing Platform Operation.
- EIP SCC: UP Initiatives and Standards Mapping on ICT Urban Platforms for Smart Cities, v3.0.
- EIP SCC: Reference Architecture and Design Principles, v0.62.
- ESPRESSO: D4.2 Definition of Smart City Reference Architecture, rev. 4.
- Triangulum: D6.1 ICT Reference Architecture, Final Version – July 2016.

# 2 USP Standards

The use of open and de-facto standards enables other cities with common technical skills to replicate the designs and blueprints provided by the project.

The goal of this section is to present a selection of technologies and standards that are enabling or will enable the implementation of software components and the sharing of data in the context of the USP of the three lighthouse cities.

## 2.1 Web Services and Data Communication

The Sharing Cities USPs mainly rely on the following technologies as for exposing services and communicating data via APIs:

- SOAP
- REST
- MQTT

## 2.2 Data Formats

The standards used to represent data exchanged in the USP are a fundamental element for enabling interoperability. A data model in fact identifies and defines: the entities and concepts for interacting with an API for exchanging data and delivering functionalities; the representation of such entities and concepts (e.g., the XML serialization to be used in request and response messages). Therefore, it is highly advisable that data models used in the USP are adequately documented, formalized and structured.

The collection, analysis and harmonisation of data formats is one of the goals of the third project year.

## 2.3 Smart City Standards

This section describes a selection of state-of-the-art initiatives, research efforts and solutions, which are of interest for the design, implementation and sharing of the USP. In particular, WP4 partners are in touch with some of these initiatives and closely follow – and in some cases, inform – their developments.

# 3 USP Sharing at Consortium Level

This section describes the work done to identify sharing opportunities (of software components, know-how, skills etc.) between WP4 partners at various levels.

## 3.1 Milan USP – API Manager

The API Manager component of the Milan USP was one of the first candidates for sharing in WP4. For such reason, it has been described in more details focusing on its characteristics enabling and fostering reuse. The reminder of this section includes the description of this component according to the sharing template defined in WP4.

For more details about the API Manager component of the Milan USP see D4.2 and D4.4.

### 3.1.1 Description of the Component

The WSO2 API Manager is a fully open source, complete solution for creating, publishing and managing all aspects of an API and its lifecycle, and is ready for massively scalable deployments.

It provides a standard, customizable and reusable approach to address the “API Management” feature of an USP.

The solution is production-ready and widely used in different contexts. Current version available for download is 2.0.0. Version in use in the Interoperability Platform of the Municipality of Milan is 1.10.0.

### 3.1.2 Technical Capacity

The WSO2 API Manager is a fully open source Java-based solution (Java version > 1.7.0). It is one of the pillars of the Interoperability Platform of the Municipality of Milan.

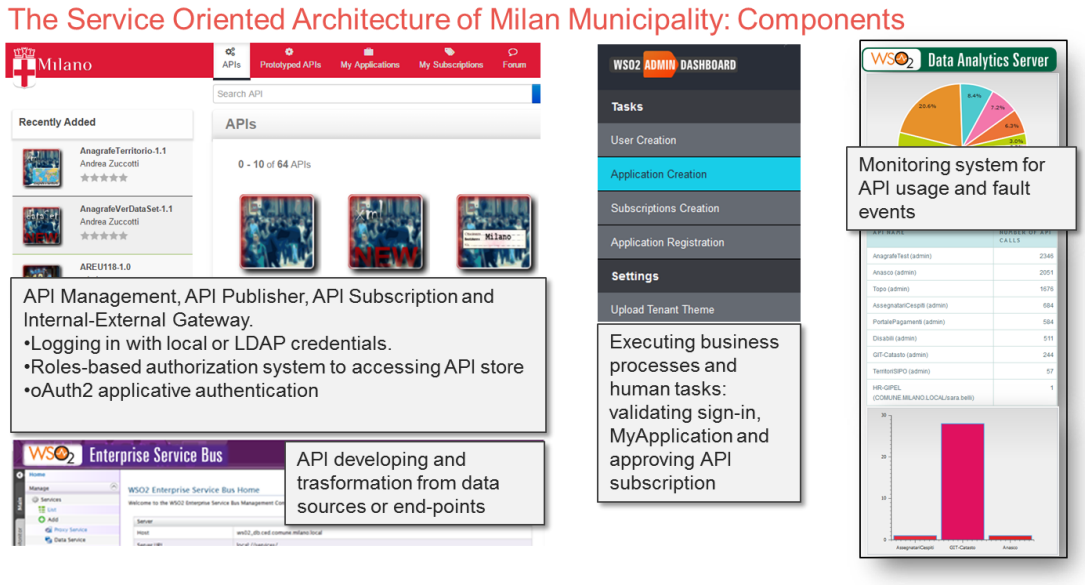



**FIGURE 1. HIGH-LEVEL VIEW OF THE FEATURES OF THE INTEROPERABILITY PLATFORM OF THE MUNICIPALITY OF MILAN**

The version of the WSO2 API Manager currently in use in the Interoperability Platform of the Municipality of Milan is 1.10.0.

Further documentation is available here:

- Product page: http://wso2.com/products/api-manager/
- V1.10.0 technical documentation: https://docs.wso2.com/display/AM1100/WSO2+API+Manager+Documentation
- V2.1.0 technical documentation: https://docs.wso2.com/display/AM210/WSO2+API+Manager+Documentation

The WSO2 API Manager v1.10.0 includes the following modules/sub-components:

- API Publisher v1.10.0, for creating and managing new asset (API) instances.
- API Store v1.10.0, as the self-provisioning Web portal where the published APIs are available.
- API Console Manager (Carbon v4.4.0): the admin/management core of WSO2 solutions.

Moreover, the WSO2 API Manager seamlessly integrates with several solutions of the WSO2 product family: WSO2 ESB, WSO2 Identity Server, WSO2 BPS etc.

### 3.1.3 Operational Info

All WSO2 products of the Interoperability Platform of the Municipality of Milan are currently operated by the Interoperability Team of the Municipality. The Interoperability Platform runs on an on premises IT infrastructure.

Several APIs are already published through the API Publisher module of the API Manager component. The published APIs are available via a self-provisioning portal, i.e., the API Store module of the API Manager component. The following picture lists some of the internal city APIs already available through the API Manager of the Municipality of Milan.

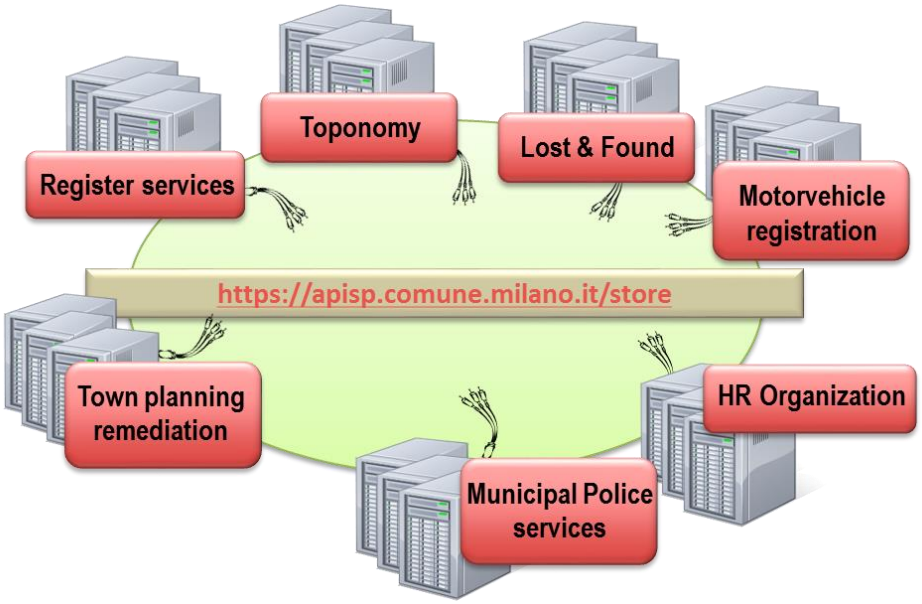



**FIGURE 2. EXAMPLES OF INTERNAL DATA SOURCES (APIS) INTEGRATED WITH THE API MANAGER COMPONENT OF THE INTEROPERABILITY PLATFORM OF THE MUNICIPALITY OF MILAN**

APIs can be used by the subscribers through specific components, i.e., the internal and the external Gateways, under defined security roles and policy. OAuth2 based authentication is supported by the Key Manager module. This way, REST and SOAP services are made available with a unique domain end-point. The end-point services can be developed by internal supplier by ESB tools.

The documentation about available APIs is available vie the portal for authenticated users only.

The API Store is the component where users can access the published API. Users can:

- Create a new account or access with an LDAP username.
- Create new application. “MYApplication” is a logical box to group the API that user have to subscribe to develop a specific application.
- Subscribe an API (view embedded DAS statistics, see below).
- Monitor the user’s own API usage.

The Technical Management Board (TMB) of the Municipality must approve every registration, creation and subscription. This process is supported by the WSO2 Business Process Server component.

Via the API Console Manager module, the Municipality TMB can manage users and their roles (e.g., the TMB can check the list of every registered user and change roles already defined). The default role assigned to every new user is the "Viewer role". It is also possible to define the API visibility for each single user. With the API Console Manager, the Municipality TMB can also change the metadata of APIs already published.

### 3.1.4 Sharing Potential

The WSO2 API Manager instance of the Municipality of Milan can be shared with the other cities of the Sharing Cities project according to the following approaches:

- Replication (preferred): The Interoperability Team of Municipality can share with partners the current instance in terms of software packages and configuration files. The Interoperability Team is also available to share with partners their experience and skills in setting up WSO2 solutions.
- Shared instance / multi-tenant: a multi-tenant feature can be activated, but this has an impact on different fronts (costs related to implementation of this feature, maintenance costs due to higher usage, data policies etc.) and should be discussed.

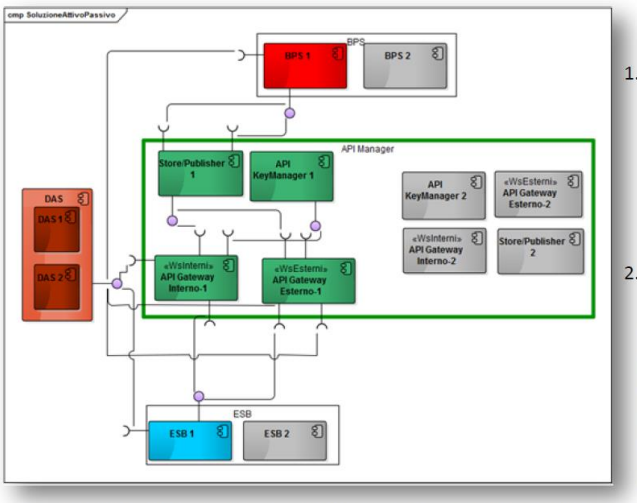
### 3.1.5 Other Technical Information

Platform environment:

- CentOS operating system
- WSO2 Carbon 4.4.0, 4.2.0
- Java version 1.7.0_75
- Java SE runtime environment build 1.7.0_75_b13

The following figures provide a high-level description of the platform deployment infrastructure.

**Failover solution (active-stanby configuration with 8 istances x 500 transactions per second)**




1. fault tolerant redundant environment F5 balancer based.

   Send String Example
   *HEAD /services/Version HTTP/1.1\r\nHost: www.wso2cdm.local \r\n\r\n*

2. WSO2 Technical Support 24x7x365 for every active istance

| Component | N. Active | N. Standby |
|---|---|---|
| API Manager | 4 | 3 |
| DAS | 2 | 0 |
| ESB+DSS | 1 | 1 |
| BPS | 1 | 1 |
| | 8 | 5 |

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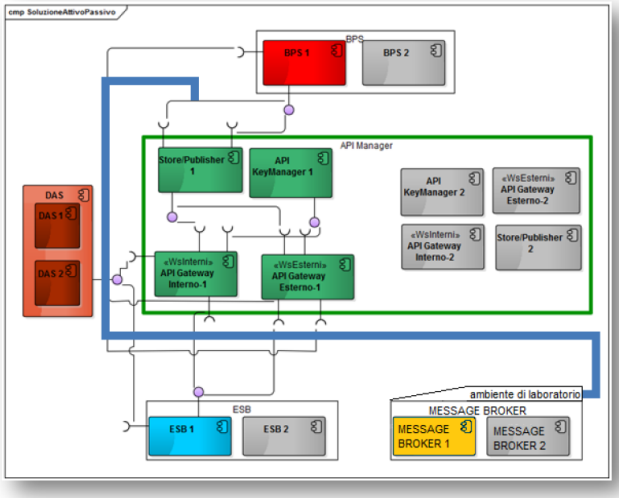
**FIGURE 3. DEPLOYMENT INFRASTRUCTURE OF THE INTEROPERABILITY PLATFORM OF THE MUNICIPALITY OF MILAN (AS-IS)**

**Failover solution (active-stanby configuration with 8 istances x 500 transactions per second)**




Municipality is implementing production environment with Message Broker to support a Publish/Subscribe role for Sharing City USP and also for other applications.

2017
only DEVELOP enviroment

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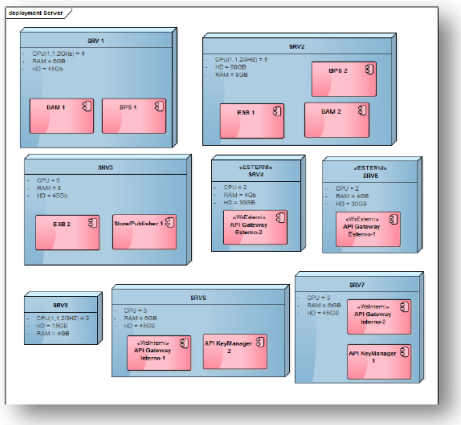
**FIGURE 4. DEPLOYMENT INFRASTRUCTURE OF THE INTEROPERABILITY PLATFORM OF THE MUNICIPALITY OF MILAN (POSSIBLE EVOLUTION)**



The configuration of the hardware architecture can by applied, only with few changes, to other different scenarios of logical-functional architectures.

The architecture is currently build of 8 virtual machine on the Municipality VMware Virtual Center.

Two additional machines are planned to separate the DAS component.

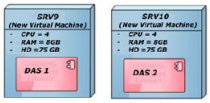


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**FIGURE 5. DEPLOYMENT INFRASTRUCTURE OF THE INTEROPERABILITY PLATFORM OF THE MUNICIPALITY OF MILAN: SERVERS AND CHARACTERISTICS**

The following diagrams depict the three-step OAuth2-based authorization process supported by the API Manager component.

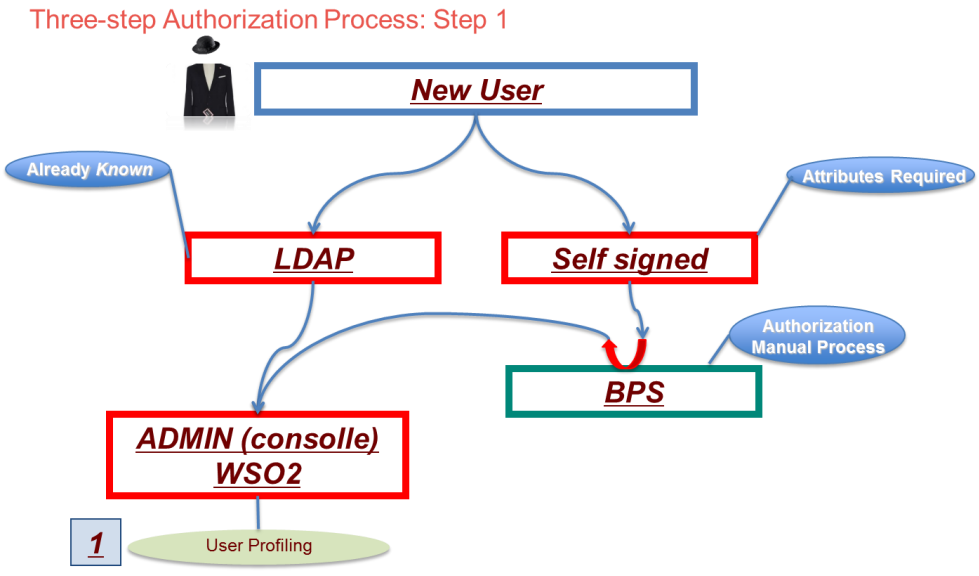



**FIGURE 6. OAUTH2-BASED AUTHORIZATION PROCESS SUPPORTED BY THE API MANAGER COMPONENT OF THE INTEROPERABILITY PLATFORM OF THE MUNICIPALITY OF MILAN**

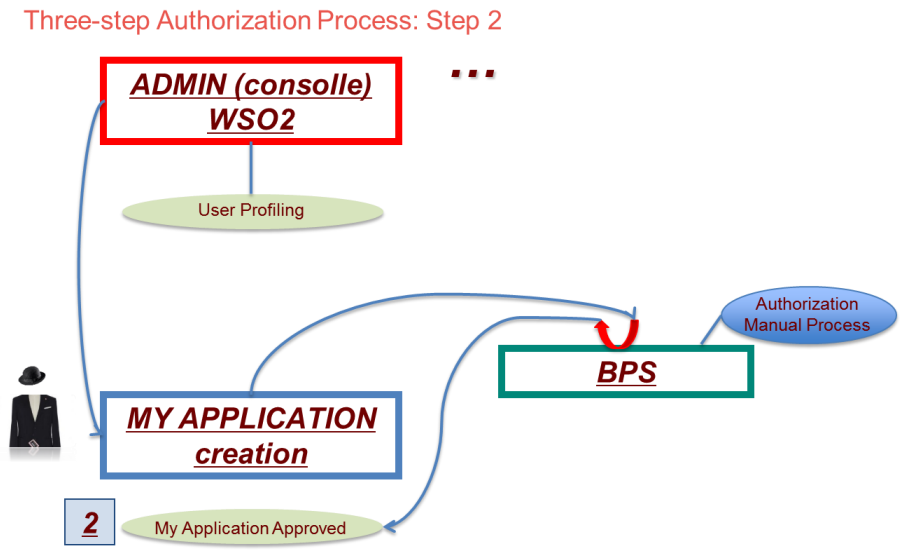



**FIGURE 7. OAUTH2-BASED AUTHORIZATION PROCESS SUPPORTED BY THE API MANAGER COMPONENT OF THE INTEROPERABILITY PLATFORM OF THE MUNICIPALITY OF MILAN (CONT.)**

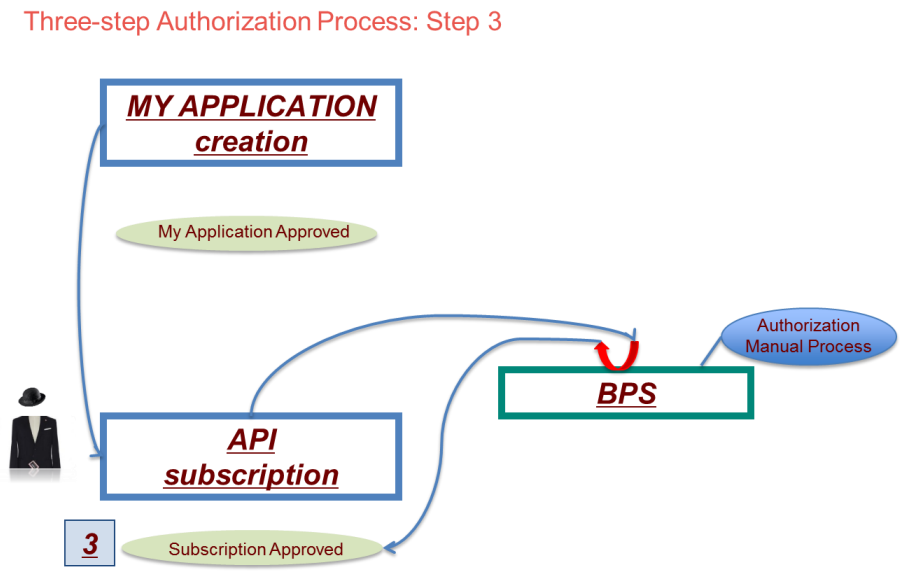



**FIGURE 8. OAUTH2-BASED AUTHORIZATION PROCESS SUPPORTED BY THE API MANAGER COMPONENT OF THE INTEROPERABILITY PLATFORM OF THE MUNICIPALITY OF MILAN (CONT.)**

As mentioned before, every activity requiring human interaction (e.g., validation and approval of user registration, API subscription) can be manage thanks to the integration of the WSO2 API Manager component with the WSO2 Business Process Service (v3.5.1). The BPS component also manages the definition of the Throttling Tiers for published API usage.

Thanks to the integration with another WSO2 component, i.e., the Data Analytics Server, it is possible to collect statistics about API usage, response time etc. The DAS component analyses data in real time or in batch mode and it is needed to control the status of the request load related to the machine request time. The DAS component is also necessary to locate service failures and enable solutions.

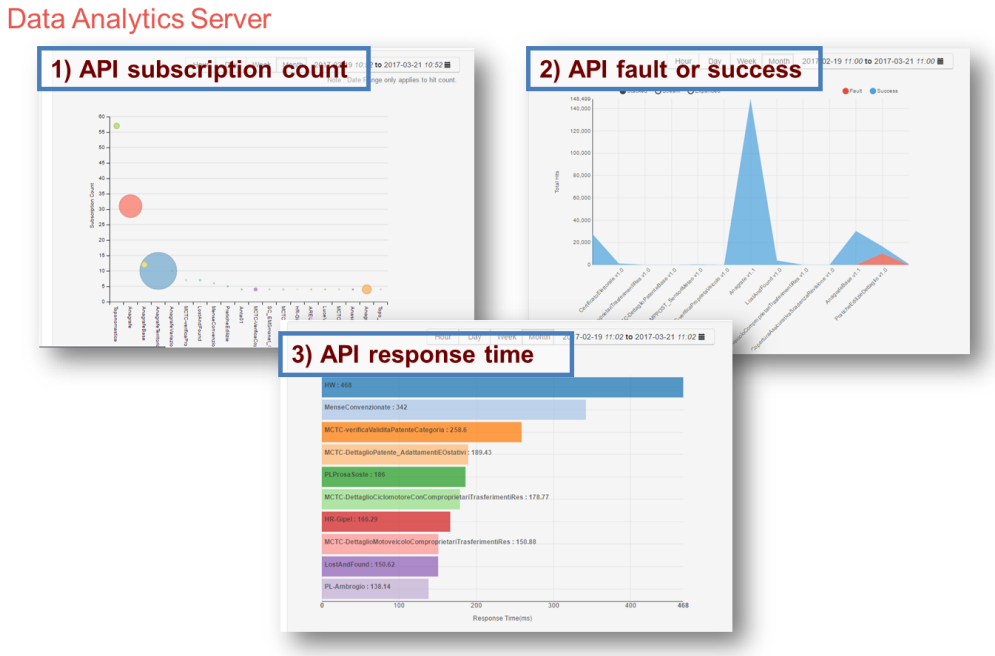


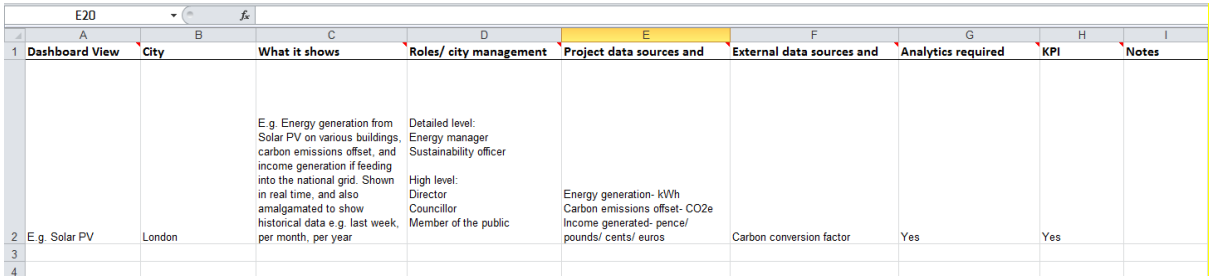

**FIGURE 9. EXAMPLE OF DIAGRAMS ABOUT API USAGE BASED ON THE INTEGRATION BETWEEN THE API MANAGER COMPONENT AND THE DATA ANALYTICS SERVER COMPONENT OF THE INTEROPERABILITY PLATFORM OF THE MUNICIPALITY OF MILAN**

## 3.2 City Dashboard Template

A template was created by Greenwich to define city manager end user visualization needs or 'dashboards', to consider how data would need to flow and be manipulated within the USP, the end use of the USP needed to be considered, for example how a city manager would like to visualize and interact with data on a certain topic or measure, at what level of detail would then inform both how the USP would visualize this data and what would need to be performed on one or more data sets (i.e., analyses, KPI's, Business Intelligence) in order to meet that user need.

Such template was then shared with project partners (first at the London Consortium Meeting in 2017, and then finalised during the Bordeaux WP3 meeting in 2017) so that each city could contribute to its structure and then start the process of describing city dashboards.

For more details, see D4.4., Sect. 2.1.2.



| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Dashboard View | City | What it shows | Roles/ city management | Project data sources and | External data sources and | Analytics required | KPI | Notes |
| 2 | E.g. Solar PV | London | E.g. Energy generation from Solar PV on various buildings, carbon emissions offset, and income generation if feeding into the national grid. Shown in real time, and also amalgamated to show historical data e.g. last week, per month, per year | Detailed level:<br>Energy manager<br>Sustainability officer<br><br>High level:<br>Director<br>Councillor<br>Member of the public | Energy generation- kWh<br>Carbon emissions offset- CO2e<br>Income generated- pence/ pounds/ cents/ euros | Carbon conversion factor | Yes | Yes | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |

**FIGURE 10. EXAMPLE OF THE STRUCTURE OF THE CITY DASHBOARD TEMPLATE**

## 3.3 Use Case Matrix and Data Capture Table

As a joint effort of WP4 and WP3 project teams, a "Use Case Super Matrix and Data Capture Table" tool was created in order to collect in a single place all information about project UCs and related data. Such tool is in fact a common spreadsheet including information about:

- UC: general description , sub-use cases, responsibilities for each city etc.
- Data: characteristics of data, devices generating such data, API exposing such data etc. with related technical information.

This tool proved to be very effective in: ensuring consistency in describing project data and linking it to UCs, track changes, build incrementally a common knowledge base.

The tool relies on a conceptual model that identifies the main entities, together with their attribuets and relationships, as shown in the following Figure:

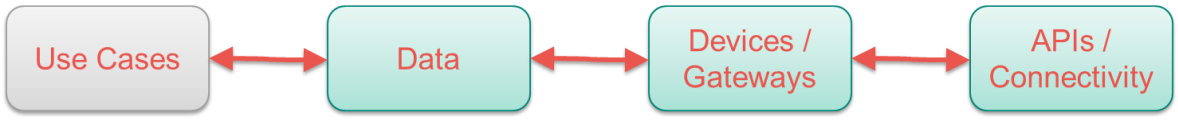



**FIGURE 11. USE CASE MATRIX AND DATA CAPTURE TABLE: HIGH-LEVEL VIEW OF THE CONCEPTUAL MODEL**

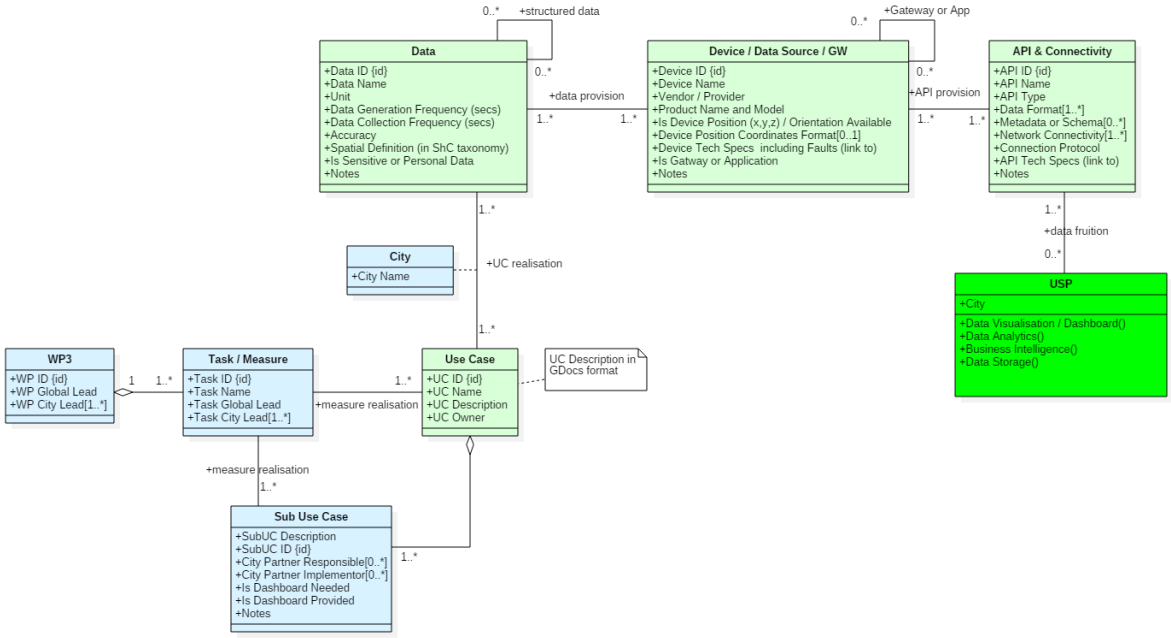



**FIGURE 12. USE CASE MATRIX AND DATA CAPTURE TABLE: DETAILED FORMALISATION OF THE CONCEPTUAL MODEL**

A specific process, with roles and responsibilities, was also defined in order to manage how partners contribute information to this tool.

The result is a constantly updated common knowledge base of project information that provides a powerful communication tool between WP3, WP2 and WP4 in particular.

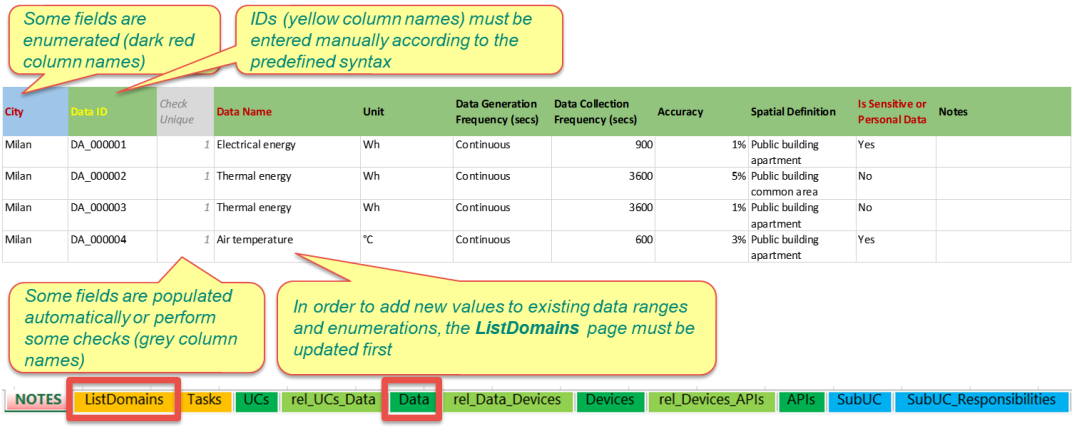



**FIGURE 13. SAMPLE FROM THE DOCUMENTATION OF THE USE CASE MATRIX AND DATA CAPTURE TABLE**

# 4 Communication and Dissemination Initiatives

This section summarises the USP communication and dissemination activities in support of WP6 (workshops, papers, contribution for the project dissemination tools etc.).

## 4.1 Replication Event in Burgas

In August 2017, Cefriel participated in a replication event organised by the Municipality of Burgas, a two-day forum "On our way to becoming smarter cities" that took place in the Flora Expo Center in Burgas, as a part of the activities of the Burgas municipality related to the Sharing cities. In that occasion, Cefriel presented the overall USP model as well as the implementation status in Milan. The presentation raised various questions from the audience.

## 4.2 Hackaton Campus Party

Campus Party, the world's largest talent and innovation event dedicated to young talents from 18 to 28 years ago, took place in Milan from 20 to 23 July 2017: over 1200 "campuseros" participated in the first Italian edition of the international festival dedicated to technology, entrepreneurship, coding, science, creativity and entertainment. Unique in its kind, both for the characteristics of the event itself and for the variety of the protagonists concerned, Campus Party involved not only young talents but also universities, companies, institutions and communities.

Services exposed through the Interoperability Platform of the Municipality of Milan, which is part of the Milan USP (see D4.2 and D4.3) were made available to hackathon participants in order to let them create new solutions for end-users.

## 4.3 Meetings with AnciLab

On 28 September 2017, Cefriel presented the Sharing Cities USP and the E015 digital ecosystem during a meeting with AnciLab with several cities' representatives.

## 4.4 SEB 2016

Siemens IT and Cefriel presented two papers at the 8th International Conference on Sustainability in Energy and Buildings (11-13 September 2016, Turin, Italy):

- M. Bigoloni, S. Filipponi, "Monet: an innovative system to manage energy services".
- M. Zuccalà, E.S. Verga, "Enabling Energy Smart Cities through Urban Sharing Ecosystems".

## 4.5 Design Week 2017

Siemens IT presented a session during the Design Week 2017 (Milan, 3 April 2017) about "Smart Cities Intelligent infrastructure".

## 4.6 Forum Telecontrollo 2017

Siemens IT participated in the Forum Telecontrollo 2017 conference (Verona, 24-25 October 2017) with a paper about “Il dimostrativo Italiano del progetto Europeo SharingCities: Monet, un sistema innovativo di gestione dell’energia e monitoraggio ambientale per il distretto di Porta Romana a Milano” (in Italian).

## 4.7 Bordeaux Design Forum

A USP Design Workshop confirmed in Bordeaux on 23rd November 2017 and presented to representatives of the Bordeaux IT department the work to date. This included the USP Reference Architecture, the Use Case Super-Matrix and the design of the London City DataStore. Bordeaux are now considering the utilisation of this material for their planned city data platform, which is in the early design stages.

# 5 Conclusions and Next Steps

The focus for the first 24 months of the Sharing Cities project has been to prepare for sharing by the identification and application of common approach and standards as we have designed the USP. At the end of this period, the main findings can be summarised as follows:

- Each core city adopts web standards and technologies (e.g., SOAP, REST) that form a common ground for enabling API-based interoperability via the USP.
- Each core city is adopting different formats for representing and conveying data to the USP: convergence on this front is desirable, therefore specific effort will be put in assessing commonalities and fostering harmonisation of data formats and related best practices.
- Each core city has high potential for sharing actual USP components: the process of identifying sharing opportunities (of software components, know-how, skills etc.) between partners at various levels has already started and it is expected to bring results during the next stage of the project.
- Each core city has high potential for dissemination of project results also related to the development of the USP. The possibility to organize joint communication initiatives will be explored in the next phase of the project, so to further strengthen the visibility and impact of project achievements.
- The “Use Case Super Matrix and Data Capture Table”, created as a joint effort of WP4 and WP3 project teams, proved to be a very effective and useful project tool for collecting in a single place all information about project UCs and related data.

In the next phase of the project, as we finish to build out the USP across the 3 core cities, the focus will shift to the practical benefits of sharing, which includes dissemination to the fellow cities. The expectation is that some of the method, designs and even applications will be adopted by both core and fellow cites to extend their respective city platform capabilities with reduced risk and cost by utilising the proven Sharing Cities USP approaches.