PRE-COMMERCIAL PROCUREMENT

(PCP)

SELECT FOR CITIES

Standardized, opEn, data-driven, service-oriented user-centric pLatform Enabling large-scale Co-creation, Testing validation of IoE services for Cities

TENDER DOCUMENT 2:
FUNCTIONAL SPECIFICATION

Definitions

Acronym	Explanation
AMQP	Advanced Message Queuing Protocol
CoAP	Constrained Application Protocol
IoT	Internet Of Things
JSON	JavaScript Object Notation
MQTT	MQ Telemetry Transport
OMC	Open Market Consultation
PBD	Privacy by design
REST	Representational State Transfer
RTI	Real Time Information
SOAP	Simple Object Access Protocol

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1 Description of Services to be Procured

1.1 Introduction

This document provides the tenderers a detailed look at the Select for Cities PCP. It gives the tenderers an in depth understanding of the PCP challenge, the different project phases, the requirements, the deliverables and the way each phase will be scored. Tenderers are informed of the different milestones, the deliverables that will have to be provided during the different Phases and the way they will be scored.

1.2 Motivation for the PCP

The common challenge of the SELECT for Cities PCP is the design, research and development of "cities as linked and large-scale Internet-of-Everything (IoE labs)". The challenge lies in developing an open, open standards based, data-driven, service-oriented and user-centric platform for European cities that enables large-scale co-creation, testing and validation of urban IoE applications and services. This approach fosters the longer-term goal of evidence-based innovation in Smart Cities.

Smart Cities are a combination of horizontal data and service platforms and vertical market sectors. The service development for smart cities follows the Internet model of harvesting the lateral power of the Web, utilizing wide-scale citizen participation and involvement, distributed value chains, fast prototyping and piloting, and service creation through experimentation.

To succeed in supporting the urban innovations landscape, cities need to introduce more systematic ways to engage and work with external developers and evaluate new solutions. Current development and testing is mostly done in unorganised, random ways, within existing organisational silos. This practice – or the lack of it - has lots of problems:

1. Different city departments pilot solutions in an unorganised manner, mostly based on the interests of individual sub-departments or even individuals;
2. Pilots are deployed in isolation, without checking if other entities in the city might have already existing solutions or similar needs, or non-compatible services already in use;
3. The outcomes of pilots are not captured and followed up:
    - Successful pilots don't lead to wider implementation, and resources are lost;
    - Failed pilots are not analysed and communicated, which creates the danger of repeating same mistakes;

- Pilots and tests are not road mapped or evaluated from the technology or practice maturity point of views, which often leads, on the one hand, to the adaptation of obsolete “sunset technologies”, and on the other hand to disappointments when new technologies are introduced to actual services too early.

The biggest challenge is the existing legacies (in ICT, service offering and processes). Cities have to be retrofitted to become smart. Retrofitting requires both top-down and grassroots-up approaches: cities should collaborate to agree on smart city standards and de-facto-standards, but they should also support open approaches to data, licenses, interfaces and participation to create robust interoperability. Standardization should not slow down the development of the market.

The overarching goal is simple: one-domain, city stand-alone, proprietary platforms and solutions are too small-scale, and therefore too expensive to develop and maintain. Therefore, cities must support the creation of a properly functioning Smart City marketplace by supporting maximum interoperability of service interfaces and portability of services, solutions and apps internally (across city departments, across the boundaries of private and public urban services), regionally, nationally (in national city networks) and internationally (roaming of services across borders to create a critical mass). Portability of solutions is critical to the success of Smart Cities and Smart City service companies.

The development of urban services is exceedingly a collaboration process, in which the cities act as enablers of innovation in various ways:

1. Procuring sub-services and solutions from companies, to be integrated in the entity of urban services which the city offers;
2. Opening the data and service interfaces of cities for private developers to build and run their services;
3. Monitoring the field of urban innovations, and supporting the creation and use of innovative services developed by the urban community, especially developers and SMEs;
4. Reacting in an agile way to new innovations and opportunities by quickly removing the barriers of innovation created by old regulation and practices.

The envisaged SELECT for Cities platform has several requirements, components and features that are currently not available in a single solution (nor as interoperable separate components) that allows profound interaction between cities, nor (automated) testing and validation of -related services. Bidders should take into account the design and development of an open platform and its ability to support (externally developed) IoE service components that can be tested and validated in (semi-) automated ways.

1.3 Preparation for the PCP

In preparation of the Select for Cities PCP project, during a so called "phase 0 - Curiosity Driven research", the consortium performed the following steps:

Step 1: Needs assessment and state-of-the-art review
The City Buyers Group acquired an extensive understanding of the end-user requirements, innovation expectations and potential for impact per Smart City related domain for such a platform.

In addition, a first analysis of existing IoT platform solutions in the market was undertaken, in order to assess their potential to answer the SELECT for Cities challenge and meet the cities' expectations/visions. For that purpose numerous domain related projects and commercial tools were analysed.

Finally, the City Buyers Group concluded that the current market offering doesn't satisfy the innovative needs and requirements outlined in the SELECT for Cities challenge in its entirety.

This outcome served as basis for the following stage, the Open Market Consultation (OMC).

Step 2: Open Market Consultation
The objective of the Open Market Consultation (OMC) stage was to validate the City Buyers Group needs assessment, expectations and innovation potential with regards to the future platform executability and ambition. The OMC also provided opportunity to gain a deeper insight into the current market situation from a market offer perspective, as well as the assessment of potential suppliers.

In addition to potential tenderers, the consortium reached out to subject matter experts and city officials to get another viewpoint on the Select for Cities ambition and goals.

The OMC encompassed a survey, locally organised workshops and a webinar. Combined, over 250 people participated in the various events. This newly formed community provides a good basis for the promotion of the PCP, and has given potential suppliers a strong understanding of the intentions and needs of the procurers.

Based on the feedback received in the survey, a 2nd market analysis focused on existing solutions was performed. Again, the consortium concluded that no currently existing solution covers the defined needs and the level of openness and innovativeness the consortium is looking for.

The full OMC report is available on the Select for Cities website: www.SELECT for Cities.eu.

Step 3: The preparation and launch of the joint Pre-Commercial-Procurement
The results of the OMC and the initial needs assessment review formed the basis of this PCP and related tender documents.

2 Challenge Overview

The envisioned platform that forms the focus of this PCP is a Smart City platform that can support any city in Europe to become a Smart City. A platform which citizens, developers and companies alike, can use to create experimental solutions which not only solve their problems, but also answers the requirements of government, e.g. to have a dashboard**.**

For cities and governments it is important that the platform helps them in:

- Implementing United Nations Sustainable Development Goals see: http://europa.eu/rapid/press-release_MEMO-15-5709_en.htm;
- Implementing the quadruple helix, where city, citizens, research institutes and private companies collaborate to co-create solutions for the city, based on Open Innovation 2.0: https://ec.europa.eu/digital-single-market/en/open-innovation-20;
- Help cities achieving both their current and future challenges, examples are the use cases defined in the Request for Tenders, Section 2.4.

The objective of the PCP process is NOT to provide a final deliverable which meets a set of well-defined criteria. The purpose of the PCP process is to guide a set of innovation efforts towards solving a set challenges for the involved organisations.

The requirements, both functional and non-functional, for such an innovation effort will be loosely defined to allow for innovation over the course of the process. Requirements should be considered more as expectations or outlines. Alternatives and innovation are always encouraged.

The overall challenge is stated as: **design, research and development of "cities as linked and large-scale Internet of Everything (IoE) labs".**

As such the Buyers Group wants the participating tenders to develop and test an **"open, standard based, data-driven, service-oriented and user-centric platform for European cities that enables**

large-scale co-creation, testing and validation of urban IoE applications and services"

When defining functional requirements for a platform it is important to consider the different user profiles and their different interactions with the platform. Each of the functional requirements will provide value and consequences for one or more of the different user groups affected by the platform. Examples of different user groups could be:

- Citizens of the cities
  - Commuters
  - Teenagers looking for cultural events
  - Newlyweds looking for housing
  - Elderly requiring health care
  - …
- Companies and organisations (like research institutions, schools, …)
  - Doing business in the city
  - Application for permits
  - Delivering services to the city
  - ...
- Municipalities
  - Politicians
  - Planners
  - City workers within waste, health and child care, transport …
  - …

The **tender** needs to take into account that this list of stakeholders will become more fine-grained during the PCP, and recognise it also has regional and national dimensions, which will add a specific context to the requirements. The Buyers Group expects the product to support multi-tenancy and to be able to implement the specific cases per city.

The functional requirements are described on a high level to maximize the creativity and innovation of the Tenderers. When answering the challenge through the PCP process, the Tenderer needs to take into account the user group for which the requirement is intended and take into account the benefits and downsides for this group.

2.1 Functional requirements list

2.1.1 F1: Serve as a city dashboard

The platform should enable one or more city dashboards to be built. The dashboard is to provide an overview, and enable different actions by the city's governing bodies. Some of the information for such a dashboard to report and make actionable is:

- Traffic information to firemen, health, transport, police;
- Incident & event information for police, fire-man, health;
- Routes planning for waste management;
- Information about public transport;
- Intelligence for the city council to make informed decisions;
- Simulation of effects of policy decisions on short and long term.

Basic requirements (must-have):

- A dashboard that can run on multiple end-user devices without (or as little as possible) installation;
- A dashboard that can show online historical data and that can filter and sort data dynamically. The dashboards must enable drill-down into the data;
- Visual exploration of the data should be possible, drilling down into data to find new relations;
- Show data in different type of charts, but also on maps;
- Be able to cope with large sets of data and shows this data in a fast way;
- Be able to define actions based on the information and events of the dashboards;
- Allow new dashboards to be build and be able to explore the data.

Innovation (Nice to have, at least provide a roadmap or show the ability to achieve this)

The platform is expected to be an innovative solution that gives us an intuitive and user friendly way of seeing the city and its KPIs for the different use cases. This can be in the form of dashboards and overviews, or the form of APIs and interfaces to other presentational tools. The platform can also excel in the way it deducts its information from the different sources and gives insights into the city.

Evaluation method: evaluate how the product matches the criteria.

2.1.2 F2: Serve as an Open City Platform

The platform should act as an Open City platform and support citizens, local companies, research institutes and government to work together and realise for example:

- Help citizens with connected homes, and provide them information with about traffic, city infrastructure, public transport, but also provide them with cultural information, points of interest, tourism;
- Help companies to determine the best moments for deliveries, plan activities,... but also let them develop apps on top of the platform to attract customers;
- Connect cars to result in less traffic by people who are searching for parking spots;
- information for utilities smart grids;
- Let citizens provide feedback on city services (transport, roads, waste, ecologic, …);
- Give incentives for citizens and companies to use the platform to make better decisions regarding environment, mobility.

Basic Requirements (must-have):

- Deliver an open API that provides real time open data streams. The data can flow in both directions;
- Deliver bulk open data sets for analytical purposes;
- Provide an environment where companies/citizens/organisations can plug in their solutions/services.

Basic Requirements (nice-to-have):

- Implement the CitySDK API[1] where applicable

Innovation (nice to have, at least provide a roadmap or show the ability to achieve this)

The platform is expected to excel at delivering information to the city, meaning its citizens, the companies, research organisations and other organisations. The platform should present the information in intuitive ways and give different stakeholders the tools for building applications on the platform. These applications will present information from the platform, but will also provide data to the platform.

The platform may also excel in the way it gathers its information from the different sources and gives insights into the stakeholders.

Finally, the platform should also allow incentives for the stakeholders to use and build upon the

[1] http://www.citysdk.eu/

platform. The target is a living platform that evolves together with the city.

Evaluation method: assess how the product matches the criteria.

2.1.3 F3: Real time communication

The platform needs to interact in real-time with sensors, streams of data and actuators in both directions. Examples are:

- Smart sewers to avoid floods;
- Pollution & climate sensors (can be placed by citizens, with the right incentives);
- Parking information & sensors;
- Social streams about the city (Twitter, Facebook, Instagram, …);
- Traffic and mobility information real-time measured (traffic lights, sensors, …).

Communication patterns:
In communicating with things the platform should support multiple communication patterns. Several patterns, not limitative, are mentioned below:

- Discovery: Be able to discover new devices that are sensed by the platform;
- Telemetry: Reading out devices, for example temperature;
- Inquiries: Devices that ask information from the platform to initiate activities;
- Commands: Send commands to devices to perform specific tasks;
- Notifications: send out notifications to all devices - they can choose whether they'll react to them.

Basic Requirements (must-have):

- Be able to communicate with things in various communication patterns;
- Be able to easily manage the things from one environment;
- Be able to easily connect new sensors;
- View and monitor the communication in an interactive way.

Innovation (nice to have, at least provide a roadmap or show the ability to achieve this)
The platform is expected to be an innovative solution that helps the Buyers Group not only to monitor, but also to steer the city. This can happen by having a solution that allows machine to machine communication, interaction between humans and machines, etc.

The platform should allow users to discover the city, for example by using sensors. The platform could help stakeholders connect their sensors to provide larger views of the city (examples could be

water flooding or CO2 sensors that citizens install).

Social and cultural use case are also important to take into account.

Evaluation method: assess how the product matches the criteria.

2.1.4 F4: Data Referential

Gathering referential data is necessary to make sure that data (from sensors) and other information can be easily transferred and that analysis on combined data is enabled. Examples of referential data are:

Events happening in the city

- Statistics about crimes happening in the city;
- Distilled information from camera's;
- Statistics from government institutions regarding income, demographic characteristics;
- Historical information from the city, pollution, emissions, financial.

Basic Requirements (must-have)

- Be able to import different formats of files, examples are CSV, XML, JSON;
- Be able to integrate with different services of existing back-end applications, this can be via web services or rest services.

Innovation (nice to have, at least provide a roadmap or show the ability to achieve this)
The platform should allow new ways to gather background information about the city. An example would be to use open datasets from other cities, to validate the information in the platform.

Evaluation method: assess how the product matches the criteria

2.1.5 F5 platform

Data Driven (must-have): the platform should be able to store different kinds of data in the most efficient way to transform the data into information, the platform should be data driven. The data must easily be cross-linked with other datasets and transformed into information.

Real-time analytics (must-have): the platform should be able to transform real-time data into insights, by using real time analytics

Metadata (must-have): the platform should annotate the data with metadata in the most efficient

and automatic way. Where human effort is necessary to interpret, the platform should find the balance between human effort and value of the meta-data.

Searchable (must-have): the data, both structured and unstructured, should be easily searchable, in a user friendly way.

Micro-services (must-have): The platform should be setup in a micro-services way, so that services can be easily added and replaced. The introduction of new services or the removal of retired services should be as frictionless as possible.

Machine learning (nice-to-have): the platform should learn new algorithms from incoming and historic data (and from obtained data sets). In this way the platform can become self-learning, detect cause and effect situations and find hidden insights without being explicitly programmed.

Innovation (nice-to-have)
The platform is expected to be as open source as possible, fostering co-creation and thus allowing different parties to work together to create a living platform that constantly evolves and innovates.

2.2 Non-functional requirements

The following requirements adhere to the quality of the platform that is subject of this PCP. The platform is expected to be architected and built in such a way that it fulfils these requirements.

2.2.1 Q1: Open Source

The platform created during the PCP is expected to be open source and the Contractor has to enable a community that will collaborate on the platform. Tenderers are asked to answer the open source requirements with their own proposition, with the level of open source they deem necessary and appropriate. Tenderers will be scored depending on their compliance with the below criteria.

In order of importance (high to low) the following are expected:

- Any software/artefact created during this PCP should be made available under an open source license
- Any core components that the platform depends on (databases, integration platforms, …) should be open source or should be easily swappable with potential open source variants.

- Any component that the platform uses (but not relies on) should be available under an open source license or should be easily swappable with potential open source variants.

Measurement: assess the level of open source, and inform about the license, this should be part of the framework agreement.

2.2.2 Q2: Open Standards

The standardization in this area is in full development. Therefore, the Contractors will not be limited to the use of existing standards. The use of new and evolving standards will also be allowed and encouraged.

The platform should be based on open standards so that it can be extended easily. As a definition of the open standard the Buyers Group has used the following (ref. European Interoperability Framework for PAN-European e-Government Services):

To attain interoperability in the context of pan-European e-Government services, guidance needs to focus on open standards. The following are the minimal characteristics that a specification and its attendant documents must have in order to be considered an open standard:

- The standard is adopted and will be maintained by a not-for-profit organisation, and its ongoing development occurs on the basis of an open decision-making procedure available to all interested parties (consensus or majority decision etc.);
- The standard has been published and the standard specification document is available either freely or at a nominal charge. It must be permissible to all to copy, distribute and use it for no fee or at a nominal fee;
- The intellectual property - i.e. patents possibly present - of (parts of) the standard is made irrevocably available under fair and reasonable conditions;
- There are no constraints on the re-use of the standard.

From the platform the following features are expected:

- The platform should communicate with devices based on open standards, examples are REST, AMQP, MQTT, CoAP. The platform is expected to be open and be able to support multiple standards;
- The components in the platform should communicate with each other using open standard protocols like rest and soap. And should use APIs (examples are monitoring API, device registration API);

- The events, data and information that the platform provides should use open standards (REST, JSON, SOAP, XML);
- The platform should be able to consume services that are provided using open standards;
- The APIs that the platform provides should be well-documented and easily discoverable (for example swagger).

Measurement: asses the level on which the platform is compliant with open standards.

2.2.3 Q3: Scalable

The platform should be able to scale to big cities like London or Berlin, but should also be able to serve smaller cities. It is foreseen that the number of devices which will connect to the system delivering data for storage and processing will grow exponentially. Therefore the following requirements are pertinent:

- The system must be highly scalable to support streams of data both today and in the future. This means both up- and out-scaling;
- The platform has to support both large and small cities and a growing stream and volume of data;
- The platform should be able to scale elastically;
- The scaling or the platform should be (near) linear.

Measurement: asses how the platform scales. Scaling is the ability of a request to maintain its performance under increasing load.

2.2.4 Q4: Robustness

It is expected that the end platform solution will fulfil the robustness criteria. However, during the PCP, robustness will be evaluated based on the 3 predefined use cases.

The platform prototype needs to support the use cases. It is important that the system implements robustness in such a way that the use cases continue to run and the platform remains available even when components fail.

Requirements to be fulfilled by the platform as verified by the 3 use cases are:

- Since a lot of components and networks are necessary in the platform prototype, failure is a certainty, the platform should be able to cope with this;

- The platform and applications should support a resilient architecture to avoid single-point-of-failure. The platform should be self-healing when errors occur;
- The platform should enable an architecture of low-maintenance and high availability;
- The platform architecture ensures 100% (or near) availability for its services, e.g. zero-downtime by implementing preventive and predictive maintenance principles for critical parts.

Measurement: test reports, figures of guaranteed availability.

For your information, examples of tests are Chaos Monkey by Netflix, Game Day by Amazon and DIRT by Google.

2.2.5 Q5: Distributed and Decoupled

The platform needs to run on a distributed architecture and the components should be decoupled. This must enable the easy addition and removal of components without a large impact on the system.

The requirements seen here are:

- The architecture must be "pluggable" and components in the platform must be easily replaceable with minimum impact. The removal and addition of components needs to happen without a great impact on the platform;
- Decoupled components with clear responsibilities and minimal dependencies;
- Components can easily be installed distributed across containers, infrastructure, and cloud.

Measurement: assess the architecture and deployment of the platform, see the different options of deployment.

2.2.6 Q6: Heterogeneous

The IoT market is a rapidly moving environment with new services and components arising on a regular basis. The platform should be able to cope with these fast-paced changes by running in a heterogeneous environment utilising components from different vendors and organisations.

The platform should implement the following requirements:

- Technologies within the IoE market will continue to change rapidly. The platform must be able to cope with both new and legacy components and handle different versions of the components;
- Idem for protocols: impact of adding new protocols must be minimal.

Measurement: assess how many protocols are supported and how the platform is extendable with new protocols. Assess how technology-agnostic the platform is.

2.2.7 Q7: Interoperability

Cities often have an existing infrastructure with which the platform needs to integrate. Next to that, different organisations and companies can provide data (or datasets) to the cities. The platform should be able to interoperate with these different components:

- The platform should be able to communicate with existing and new systems of the cities;
- The platform should provide mechanisms and tools to perform analytics on combined data, including different device and data sources and streams;
- Use of accepted and emerging standards and open platforms (e.g. The Open Group IoT standards O-DF, O-MI, AIOTI Architectures suggestions, IOT EIP pre-standardisation work, XML, JSON, SOAP, REST, etc.).

Measurement: assess the supported protocols and the ability to integrate with other software.

2.2.8 Q8: Communication with things

The platform should be able to communicate with different types of devices:

- The platform should be able to integrate with almost any connected device and harmonize with the applications used by the device;
- The platform must be able to communicate with different sensors and devices, the so called things;
- The platform should ensure interoperability with different systems. The IoT devices can operate with different protocols like AMQP, COaP, MQTT, Rest API, or the proprietary APIs exposed by OEMs. The platform should be able to communicate with any of these APIs.

Measurement: evaluate the communication with things capability.

2.2.9 Q9: Security by design

The platform should conform to security-by-design principles:

- The platform implements different levels of security and ensures that authentication, authorisation, and accounting is implemented through the platform;
- The platform ensures the required protection across multiple communication protocols. Security has to be at the same level for all types of connection and regardless of whether the app is connected to the device over the Internet or locally;
- The platform can integrate with existing authentication mechanisms;
- The platform should provide data provenance, so that it allows for auditing of data access and update on secured data;
- The platform should be easy to protect and isolate parts from vulnerabilities;
- The platform should allow for monitoring access and changes;
- Platform should manage log records from its own components and from the underlying devices and systems in order to be able to track any breaches and to identify patterns and prevent problems that can pinpoint problems before they happened;
- The platform should support end-to-end encryption (protocol and message), automatic standard-based encryption from device to the application and encrypting data in transit between platform elements;
- The platform should have a secure store for keys and be able to integrate with key stores.

Measurement: evaluate the implemented security.

2.2.10 Q10: Privacy by design

The platform should conform to privacy-by-design principles:

- The platform must implement privacy rules as stated by the European Union;
- Any personal data on the platform should require signed consent by the relevant parties covering its intended use;
- When a new intention with the data arises, the platform should be able to request a refit for purpose to the party;
- Personal data should be stored in a protected way (e.g. encryption, hashing);
- Whenever functions within the platform could be performed without the use of personal data or with the use of anonymized data, this should be preferred;
- Whenever personal information is visible to others, this should clearly indicated to users;

- In instances when personal information is stored, users should be able to audit the access to any personal information they have on the platform;
- System architecture should prevent the possibility of creating central surveillance on users or groups of users.

Measurement: evaluate the implemented privacy.

2.2.11 Disclaimer

Additional sub-criteria may be added for the call-offs for phases 2 and 3, as a way of making the award criteria more precise, provided that they do not substantially change the existing criteria.

Should there be any doubt as to any of these criteria, tenderers may be requested to provide additional information.

2.3 Phase 2: Technical lab test

2.3.1 Introduction

This is a technical lab test in which the proof-of-concept (further noted as POC) has to demonstrate that the prototype realises the different criteria. In order to do so, the prototype will firstly be tested in a technical controlled environment, and then later, if the Contractor advances to Phase 3, it will the prototype will be piloted in living lab environments and tested against one use-case per city (see section 2.4 Phase 3 for more information). The use-cases foreseen in phase 3 are:

- Managing city traffic congestion with mobility RTI, Antwerp;
- City IoE service provisioning to diabetes patients in Smart Homes, Helsinki;
- Integrating real-time IoT city sensor networks in the areas of air quality, noise and mobility, Copenhagen.

2.3.2 Environment

The POC-phase technical lab test is to be done remotely. The prototype should be installed on the premise of the Contractor or in a cloud, but must be capable of integrating with live sensors or feeds from the different Buyers group cities.

This means the Buyers Group can check the functionalities of the platform without having to visit the Contractor's office or lab.

2.3.3 Testing the functionalities

During technical lab testing the Buyers Group will test the functionalities of the platform and evaluate how it realizes these different requirements.

F1: Serve as a City Dashboard

Demonstrate that the platform can show a dashboard for a city. The platform should have the following features:

- Give an overview of the current traffic, air quality and patient interventions;
- Give a detailed overview of each use case with the ability to drill down into historical data and show prognosis for data.
- Show that a city can easily build its own dashboard from the information provided;
- Show other feeds (like: Twitter, Facebook) on the dashboard.

The Buyers Group would like as an outcome innovative ways of seeing the city through the data that is provided. Specifically, which are the Tenderer's suggestions of how these use cases can be more manageable.

F2: Serve as an Open City Platform

Demonstrate that the platform is able to deliver data via open standards and open data to other applications. The platform should have the following features:

- Be able to have a rest API from the use case data of the platform (for example: current mobility issues, current air quality). This can be demonstrated by an app;
- Show that the platform can integrate and manage personal data (for example: blood glucose level measurement data of a diabetic person). This can be demonstrated by an app and any commercially available blood glucose level meter that delivers its' measurements to cloud. The personal data integration in this stage can be demonstrated by working integration to any commercial personal well-being data repository, or the platform can manage the personal data itself;
- Show that the platform can show the data real-time (or near real-time) and in batch;
- Show how the platform allows to get feedback back into the platform to enrich the data;
- Show that the platform can integrate the data from the different use cases, especially integrating personal data to non-personal data (e.g. personal wellbeing data to the public transport data and or the air quality data).

It is also expected that the Tenderer shows innovative ways of enabling citizens and companies to participate in the platform. The Tenderers should show how they will enable and support the building of such a community.

F3: Real Time communication
Demonstrate that the platform can communicate with "sensors". For the uses cases, for example, there are air quality sensors, traffic sensors and traffic cameras.

The platform should have the following features:

- Manage the different sensors/things that are connected to the platform (for example sensor labs);
- Show that the platform can read a stream from these sensors;
- Show that the platform can send messages to the sensors (support the different communication patterns);
- Show how new sensors will be provisioned;
- Demonstrate how security and privacy is handled for this communication;
- Integrate with a test bed like https://www.iot-lab.info/

It is also expected that the Tenderer shows innovative ways of communicating and managing sensors/things.

F4: Data referential
Demonstrate that the platform can load different datasets both real-time and in batch. The platform should have the following capabilities:

- Read feeds like Facebook and twitter and combine them with. for example. traffic or event data;
- Read in other open datasets such as demographic data;
- Foresee this data with the necessary meta-data;
- Management of the different data sources.

The Tenderer is expected to show innovative ways of gathering data. Finding new sources of data and management of this data

F5: The platform
The platform should showcase following capabilities:

- **Data Driven**: Demonstrate how the platform allows to crosslink data and get new insights.
- **Real-time analytics**: Show how the platform transforms real-time data into insights, by using real time analytics.
- **Metadata**: Show how the platform foresees the data with metadata in the most efficient way. Show the amount of manual work that is needed (preferable none).
- **Searchable**: Show how the platform can find information both structured and unstructured.
- **Micro-services**: Demonstrate the architecture of the platform.
- **Machine learning**: Show how the platform learns new algorithms from incoming and historic data (and from obtained data sets).

It is expected the Tenderer will show the innovation of this platform, where it excels above the current market level to go beyond the state-of-the-art

2.3.4 Testing the quality requirements

During the Technical Lab testing, the prototype needs to demonstrate how it will implement the different quality attributes. The Contractor will determine how the prototype complies with the following quality requirements:

- Scalability;
- Robustness;
- Distributed and Decoupled;
- Heterogeneous;
- Interoperability;
- Communication with things;
- Privacy by Design: Show how the platform implements privacy by design. The platform should comply with the new GDPR rules (for more information see here: http://ec.europa.eu/justice/data-protection/);
- Security by design.

2.4 Phase 3: Living Lab pilot

In the third phase of the PCP – Pilot deployment of the platform prototypes in Living Lab scenarios against the use-cases predefined by the Buyers Group. This process is designed to ensure that Contractors can demonstrate the real-life applicability of their solution in the three procuring cities.

In order to test the solution in a Living Lab environment, three obligatory use cases are foreseen, one in each city. The goal of these use cases is to demonstrate that the supplier's solution is flexible

and generic, in line with the SELECT for Cities challenge. Given the complexity of the Smart City domain and the divergent verticals involved, such flexibility and adaptability is a key feature. The specific setup and circumstances of each use case will be further detailed, together with Contractors, in the Phase 3 call-off stage. The foreseen use case domains are:

- **Antwerp**: Managing city traffic congestion with mobility RTI;
- **Helsinki**: City IoE service provisioning to diabetes patients in Smart Homes;
- **Copenhagen**: Integrating IoT city sensor networks in the areas of air quality and real-time mobility.

More about the use-cases can be found on the project webpage, and further information will be provided at the Phase 3 Call-off.

SELECT for Cities foresees five steps in the Living Lab stage of the PCP-process:

2.4.1 The Living Lab stages

2.4.1.1 INTAKE - expectations and assumptions

The Living Lab Assumption Validation matrix is a tool provided to Contractors in Phase 3 to discuss expectations of the use-cases implementation process under the three cities' based Living Labs. It will enable to highlight all assumptions and expected results that should be validated in the Living Labs.

2.4.1.2 PREPARATION - approach

The next steps ensures practical preparations for data collection tools and methods are made, that milestones to be met during the test are agreed, and the local stakeholders who will test the detailed use cases are engaged, with support from the city partners.

2.4.1.3 BENCHMARK - delta and roadmap

In this step, before the actual running of the pilot, the state of the art is explicated, all remaining assumptions are listed and a plan is devised to transform these into facts.

2.4.1.4 PILOT - gradual live trial of solution

During this step the actual pilot tests takes place. This means the Contractor closely liaises with the Living Lab city partners for all operational aspects and that the Contractor is supported by the cities in relation to their needs and request (e.g. setting up co-creation sessions, engaging stakeholders, deploying technologies, organising business clinics etc.). Furthermore, the milestones agreed upon in step 2 are evaluated. These milestone checks occur at least three times during the Living Lab tests and preferably at the same time in each city. The Contractor must iterate after every milestone based on the feedback of the Buyers Group in order to demonstrate the advancement of the prototype and the integration of the learnings from the test. This means that after each intermediate milestone, further development on the prototype will be required, per the user feedback.

2.4.1.5 CONSOLIDATE - results, outcomes, experiences

Lessons learned from all Contractors and cities are collected and evaluated in this final step in the phase. These results are provided to the Buyers Group to provide them with more detailed insight that can be used to deliberate a potential future procurement.

2.4.2 Living Lab requirements

LL1: Can the Contractors demonstrate their prototype runs in a real-life environment?

LL1.1: How will the platform be tested in all three cities, in the basic predefined use cases and with the foreseen users of the platform?

LL1.2: Can the Contractors present a preliminary business case for the platform?

LL2: Are the Contractors able to show advancement in refining their prototype during the validation phase?

LL2.1: How do the Contractors plan to reach their targeted milestones?

LL2.2: Which evolution can be expected between each milestone?

LL3: Can Contractors show the relevance of the solution for local stakeholders involved in the use case?

LL3.1: How and which local stakeholders will be involved in the local use cases, in all cities?

LL3.2: How will the prototype integrate to the predefined use cases in order to be validated in each city?

LL3.3: How will the contractor demonstrate their solution scales across Europe?

LL4: Does the prototype demonstrate a strong innovation trajectory throughout the PCP process?

LL4.1: How will the contractors show the prototype makes an advancement over the state-of-the-art and existing (potentially competing) solutions?
LL4.2: What is the potential for cities, governments and other potential buyers to actually procure the solution?

2.5 Description of integrations for the use cases - Phase 3 Living Lab

2.5.1 Integration environment

The following section, outlines the basic integration requirements for Contractors during Phase 3, tackling the Buyers group cities related Smart and IoT infrastructure, databases, devices and other "things", both of a public and private nature. This exercise is intended to provide a bird's eye view into the challenge Contractors reaching Phase 3 will be facing. It is not intended to be seen as a completed and permanent representation of the use-cases scenario and integration requirements. Smart infrastructure, Internet-of-Everything solutions, datasets, commercial applications, et al, evolve over time. The Tenderers are expected to adapt to such evolution in order to retain the innovativeness and platforms relevance to the Buyers group.

Tenderers applying to SELECT for Cities, will need to be able to cope with change, and account for it in their Tender and budgeting.

2.5.2 Antwerp use case: Managing city traffic congestion with mobility RTI

The integrations for the mobility case in Antwerp are at this moment high level, but we see the current datasets as relevant (today)

- Integration with Slim naar Antwerpen (https://www.slimnaarantwerpen.be/nl);
- Datasets/integrations with public transport;
- Datasets/integrations with alternative transport (bikes);
- Datasets/integrations with current traffic (jams, lights);
- Datasets/integrations with public parking;
- Datasets/integrations with private parking;
- Datasets/integrations with route planners.

The City of Things Living Lab infrastructure operated in Antwerp by imec offers (at the time of writing):

- 40 deployed gateways offering various IoT networking standards (aiming for 100 gateways by the end of 2017);
- An own LoRa and SigFox network covering the entire city;
- Data capturing and processing back end available in a first stable version;
- The basis of a data broker system that manages processing, storage and transmission of sensor data;
- A modular sensor platform that allows custom sensors sets to be deployed in the city;
- Real-time air quality data from mobile sensors (on 2 vehicles of the Belgian Post) since summer 2016.

2.5.3 Copenhagen use case: Combining air quality data and traffic control

The platform should be able to pick up air quality data from different sensors in the cities LivingLab, and based on a series of simple and complex rules, be able to control different traffic controls.

Currently there is one set of air quality sensors in our living lab. They are currently picking up different values:

- Temperature
- Humidity
- CO
- NO2
- SO2
- Traffic noise levels might be available at the time of testing.

It is expected all interfaces to be available via the Copenhagen open data platform http://data.kk.dk/

The data is delivered by open API and is available as “real-time” and historical sets. At the time of integration there might be several different sets of sensors delivering different data relevant to the concept of air quality. All should be delivered via open APIs.

Regarding traffic controls, currently there is no access in our Living Lab. However it is expected this data will be made be available as part of a bigger ITS project during 2017.

Typical control commands will be traffic light change commands like change frequency sent through open APIs.

2.5.4 Helsinki use case: City IoE service provisioning to diabetes patients in Smart Homes

The platform should be able to integrate with key wellbeing data repositories, health measurements devices and the application front-ends. At this moment the following integrations are seen as obligatory to deliver the core part of the use case:

- Integration to city's eldercare IoT system backend (existing Azure IoT-based system);
- Integration to any wellbeing data cloud service that complies to EU security and privacy legislation (possible reference implementation: chino.io);
- End-to-end demonstration of integration from a device with sensors to app. This can be demonstrated with any widely commercially available blood glucose measurement device;
- Integration demonstration to the end-user front-end apps: demonstration of integration to City's open source front-end apps Helsinki App (viewing of personal wellbeing data) and Digitransit (integrating personal wellbeing data to personal mobility navigation suggestions).

The following integrations will enable delivery of a deeper or more sustainable approach to the use case:

- It is expected to see HL7/FHIR as key standard in the wellbeing data integration during the next 2-5 years
- Integration to such smart home solutions that are in place to manage the users' connected blood glucose level meter devices (for example Philips Lifeline and similar solutions)
- Integration to behaviour change aspects available with using Mobility real-time data (for example integrating mobility real-time data and personal wellbeing data to improve the use case with navigation suggestions based on current health status, user's mobility history, and the location of the public transport vehicles -- see dev.hel.fi, dev.hsl.fi and digitransit.fi for more information about APIs)
- Integration to a large variety of cloud-based diabetes self-management services, either directly or through wellbeing data repositories (for example www.accu-chek.com, www.mendor.com, www.dottli.com, www.mealtracker.com)

Note: the platform is **not** expected to directly integrate to clinical and EHR systems during the project timeframe and no clinical trials are expected to take place in the project.