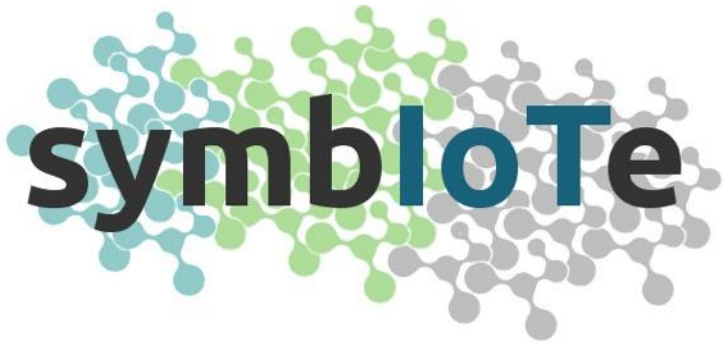


# Symbiosis of smart objects across IoT environments

*688156 - symbIoTe - H2020-ICT-2015*

# Documentation of Trial Preparation Procedures

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# Document Control

**Number:** D5.5

**Title:** Documentation of Trial Preparation Procedures

**Type:** Public

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**Doc ID:** D5.5-v1.0.docx

# Amendment History

| Version | Date | Author | Description/Comments |
|---|---|---|---|
| v0.1 | November 18th | L. De Santis (Navigo) | Initial ToC |
| V0.2 | December 4th | L. De Santis (Navigo) | Added the "Tentative time-plan" paragraph for each use case trial description; expanded the "Smart residence" paragraph to include a separate description for each application; corrected the partners in charge of the contribution; general check of the TOC with Toni Paradell (WLI) |
| V0.3 | December 22nd | L. De Santis (Navigo), Karl Kreiner (AIT), Reinhard Herzog (IOSB), Raquel Ventura Miravet (S&C), Matteo Pardi (NXW), João Garcia (UW), Toni Paradell (WLI) | First integration of all contribution by project partners. |
| V0.4 | February 9th | L. De Santis (Navigo), Mario Drobics (AIT), Matteo Pardi (NXW), João Garcia (UW) | Updated contributions; finalization of deliverable; first final candidate. |
| V0.4.1 | February 13th | L. De Santis (Navigo) | Minor spelling corrections. |
| V0.4.2 | February 17th | L. De Santis (Navigo) | Updated time-plan for Smart Yachting and Smart Residence (Smart Area Controller and Home Comfort) trials. |
| V0.5 | February 27th | L. De Santis (Navigo), M. Bianco (CNIT), M. Płóciennik (PSNC) | Updates after revisions by M. Bianco (CNIT) and M. Płóciennik (PSNC). Added paragraphs on ethical aspects that must be considered in trials. |
| V0.6 | March 9th | L. De Santis (Navigo), Karl Kreiner (AIT), Reinhard Herzog (IOSB), Raquel Ventura Miravet (S&C), Matteo Pardi (NXW), João Garcia (UW). | Contributions and update. |
| V0.7 | March 12th | L. De Santis (Navigo), Mario Drobics (AIT), Toni Paradell (WLI) | Contributions and update. Final candidate version. |
| v1.0 | March 15th | L. De Santis (Navigo) | Final version. |

# *Table of Contents*

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# 1 Executive Summary

symbIoTe is an applied research project, with an ambitious scientific vision but also strongly rooted on a practical ground. The trials in the project represent the perfect chance to verify in practice how the technical requirements behind the project have been met.

At the same time, the “real-life” use of components developed in symbIoTe can help to identify, before the end of the project, design problems, technical difficulties or performance issues, that are nearly impossible to detect in a lab environment.

This way it is possible to assess the quality of the outcomes and to provide feedback to the software developer team, that can correct or change some of the initial assumptions, in order to produce a better product.

Feedback in trials allows the symbIoTe software team to know how the modules really work or what needs to be changed. It also helps to realign priorities, since crucial parts needed in the trials must be completed or corrected as soon as possible.

In this sense, the trials are not simply a set of software test sessions but represent a real “trial by fire” of the soundness and quality of the symbIoTe vision and implementation.

As this document shows, the trials in symbIoTe are very diverse in nature and are strongly rooted in practical exploitation scenarios.

The use of IoT technologies in the domains involved – mobility, healthcare, assisted living, smart city, yachting – is raising a growing interest and might have soon (and in some case, is already having) a strong economic impact. To confirm this, the industrial partners involved are currently pursuing the commercial exploitation of the outcomes of the project and of the trials in particular.

The present deliverable documents the plan for the implementation of the trials. As it is shown, work has already started. As described in the document, most of the trials need specific preparatory works in the venues and locations where they will be held.

Moreover, ethical issues, especially in those trials that deal with sensitive data, have been considered: specific lines of actions have been therefore defined to cope with these issues.

All these considerations have been taken into account in the plans described here, together with the metrics that will be used to assess the quality of the outcomes. According to this, we can confirm that the current status of the work is in line with the general project time-plan.

# 2 Introduction

This section describes the purpose of the document, provides an overview of the objectives of the T5.4 Task, as defined in the description of work (DoW) of symbIoTe, and presents the document structure.

## *2.1 Purpose of the Document and Scope*

The purpose of the Deliverable D5.5, entitled “Documentation of Trial Preparation Procedures”, is to provide a complete description of the strategies envisioned for the preparation of the trials foreseen for each symbIoTe use case. It presents the results of the work performed within Task T5.4.

## *2.2 Task T5.4 Objectives*

The purpose of this task is to guarantee that the integrated symbIoTe platforms and applications, developed respectively in Tasks T5.1 and T5.2, undergo extensive trials with end users and are deployed in a number of relevant environments.

All partners involved in the development of the use cases must plan trials with great care, by planning the scenarios to set-up the tests to perform and the metrics (e.g. KPIs) to measure the outcomes.

## *2.3 Document Structure*

Section 0 presents an overview of the general logic and strategies for the implementation of the trials in symbIoTe. Section **Error! Reference source not found.** presents, for each use case, a detailed description of the trials that are going to be performed, including also the strategies for monitoring the trial effectiveness. Section 0 concludes the deliverable.

# 3 symbIoTe Trials Preparation

## *3.1 General goals of the trials*

The trials represent the opportunity to perform extensive testing of the integrated symbIoTe platform, developed in task T5.1, together with the applications developed in T5.2 for each of the five symbIoTe use-cases (Smart Residence, EduCampus, Smart Stadium, Smart Mobility, Smart Yachting).

To verify the real-life quality of the outcomes, it is important that the trials involve end-users and are deployed in a number of relevant environments. The participation of final users in these activities should mimic a situation as close as possible to an actual deployment of the system. To this end, external persons representing various target groups must be involved in the trials.

Since the project is approaching its final phase, timing is essential: for each trial a plan has been provided, that also includes the identification of pre-conditions that must be satisfied before the actual steps are taken.

Finally, it is also necessary to measure the results of the trials through KPIs that can easily and clearly assess the obtained quality.

## *3.2 Guidelines for the management of ethical issues*

In those cases where trials involve the collection and processing of sensitive data, it is necessary to guarantee that privacy aspects are respected, the related laws and guidelines are followed and, wherever applicable, local authorities are informed and provide their explicit approval.

To start with, data collection must be made in respect of the forthcoming General Data Protection Regulation (GDPR), in particular when it relates to identified or identifiable people and concerns with the collection of their personal data.

In order to guarantee the privacy of the participants, the following aspects must be taken into account:

- all trials must ensure that the collection and storing of personal data will be limited to the absolute minimum
- any data or information about a person will be held private and strictly confidential, regardless of how this data was acquired. Therefore, data obtained incidentally within trials will be handled with confidentiality
- the acquired data will, under no circumstances, be used for commercial purposes or shared with any third parties outside symbIoTe consortium
- personal data will be collected and further processed respecting data subject rights and complying with the national legislation of the country where the data is collected and/or used, and with the GDPR.

It is also necessary to guarantee that users are presented with all the details of the trials. In particular they must be informed about:

- the kind of personal data that is collected in each trial (if any)

- how these data will be managed during the trials and after their ends.

While informed consent is advisable for every trial, it becomes essential and mandatory for those that deal with sensitive information about the users (e.g. health conditions, positioning, etc.). In those cases, it is necessary to have the explicit, written approval of the users before onboarding them.

These issues must be addresses in every trial.

While the implementation details can differ, every trial must systematically take into account the following aspects, before starting the actual work:

- Identification of users: typology, number, etc.
- Identification of personal data that must be collected
- Define the strategy for data collection and storage
- Verify if the aforementioned points are compliant with European and local laws (GDPR in particular)
- Provide detailed information to users about data collection in the trial
- Receive written consent before involving them in the trials, if personal data are collected
- If needed, involve local ethical committee about the ongoing trial and receive their explicit approval before starting the trial.

In the descriptions of trials that follow, the strategies to address these issues will be reported.

# 4 Use cases Trial Plans

## *4.1 Smart Residence Trial Plan*

In the Smart Residence use case four different applications are implemented to offer comfort, automation, security, energy efficiency and healthcare services. All of them use advanced and ubiquitous technologies including sensors and other devices that are integrated in the residential infrastructure. The applications are:

- (S&C) Smart Healthy Indoor Air: This application is based on the indoor/outdoor air quality monitoring and pursues to improve indoor air quality by giving recommendations and alerts.
- (NXW) Smart Area Controller: this application is related to the Dynamic Interface Adaptation scenario, where the user's control interface automatically reconfigures itself, according to the controllable CPS in range.
- (NXW) Home Comfort: this application demonstrates the Energy Saving scenario, which shows how to automatically control home devices, in order to keep environmental parameters (e.g. light, temperature, humidity, etc.) to some predefined comfort values.
- (AIT) Smart Health Mirror: It is an Ambient Assisted Living (AAL) application to help people, in particular elderly people, to live independently for longer.

We provide a description of the trials foreseen for each application.

### 4.1.1 Smart Healthy Indoor Air Trial Plan

#### *4.1.1.1 Overview*

This application is based on the indoor/outdoor air quality monitoring and pursues to improve indoor air quality. Indoor air quality (IAQ) refers to the quality of the air inside buildings as represented by concentrations of pollutants and thermal (temperature and relative humidity) conditions that affect the health, comfort and performance of occupants. It is important to ensure that the air inside the building we inhabit on a daily basis is of a good quality. Outdoor generated air pollution is relevant for indoor air quality and health. Exposure to indoor air pollution has been linked to the development of different diseases from infections to asthma or to poor sleep. It can also cause less serious side effects such as headaches, dry eyes and nasal congestion.

Sensing and Control Systems SL partner's (S&C) roadmap aims to create a smart home/office connected with the city. The current S&C's platform, nAssist[1], monitors and controls a number of direct parameters related to indoor air quality, such as $CO_2$ levels, humidity and temperature. In addition, this platform monitors and controls other factors that are important for indoor environmental quality considerations such as light and noise since they also affect occupants.

[1] http://www.sensingcontrol.com/solutions/customizable-iot-platform.html

The idea is to increase this framework to understand how indoor and outdoor sources of pollution, heat and humidity, together with the ventilation and air conditioning systems, affect the indoor air quality in buildings. It also begins to address methods of controlling those factors in order to improve quality of the indoor air for occupants' health, comfort and performance. To achieve this goal, the smart home will communicate with outdoor air quality data received from other federated platforms. Such data can include air and noise pollution levels. The smart home will react to changes in temperature, humidity, $CO_2$ levels and noise and maintain a healthy and safe indoor environment by recommending actions to the user such as using air purifiers, ventilation systems and opening/closing the windows to eliminate unpleasant impacts. S&C aims to provide more robust solutions with focus on clean environment and optimised energy use.

In particular, we will use an application capable of monitoring real-time indoor and outdoor air quality information. Without this information, usually we ventilate late and too long. This application (Smart Healthy Indoor Air) will indicate when, how and how long a room should be ventilated taking into consideration that windows are the easiest ventilation option but not the healthiest one depending on the outdoor air quality. There are other ways to provide healthy flow of air throughout the room, such as turning on the air conditioner, or individual air purifiers. The automatic control of some devices, as air purifiers, ventilation and air conditioning systems are out of the scope of this application.

A more robust application could fit within Smart Energy City concept by taking into consideration energy efficiency to adjust levels of air purifiers, ventilation and air conditioning systems. This will be pursued when partners related to energy efficiency apply and join symbIoTe. A goal of S&C is to engage and attract such actors.

#### *4.1.1.2 Preparation and preconditions*

This trial involves three different actors:

- **S&C:** It is responsible of (i) providing the smart home system, (ii) developing the application for both monitoring real-time indoor/outdoor air quality information and providing recommendations about how, when and how long should ventilate the home, and (iii) connecting with symbIoTe to get estimation values from the Enabler Logic functionality from symbIoTe. S&C will make available to symbIoTe data related to the indoor air quality at home: temperature, humidity, CO levels, noise and luminosity. As already explained, exposure to indoor air pollution has been linked to the development of different diseases from infections to asthma to poor sleep. It can also cause less serious side effects such as headaches, dry eyes and nasal congestion. This information can be helpful for remote healthcare applications.
- **Public service:** The Atmospheric Pollution Vigilance and Forecast Network[2] (the XVPCA) from the Ministry for Territory and Sustainability at the Generalitat of Catalonia will provide the outdoor air quality data. Outdoor air quality data could be provided by other federated platforms dedicated to offering Smart Cities' services but not in this trial.

[2] http://dtes.gencat.cat/icqa/start.do?lang=en

- **Enabler Logic from symbIoTe:** Given the limited number of monitoring stations available and placed at representative spots to record the outdoor air quality, an accurate assessment of spatial variation is highly required. Spatial interpolation techniques applied to the available monitoring data to provide air quality information closest to the location of the smart home will be used. This functionality is provided by the component named as Interpolator, implemented within the module Enabler Logic from symbIoTe. The smart healthy indoor air application will send the GPS location of the smart home and will get the estimated value about the air quality for this specific location from symbIoTe. This is the main benefit of using symbIoTe for this application which enables S&C to offer a more robust and precise application without developing new functionalities.

#### *4.1.1.3 Venues/locations of the trial*

The trials will involve a number of 5 installations (4 homes and 1 office) located in different districts of Barcelona (Eixample, Gràcia, Nou Barris, Les Corts and Sant Marti), as showed in the next figure:

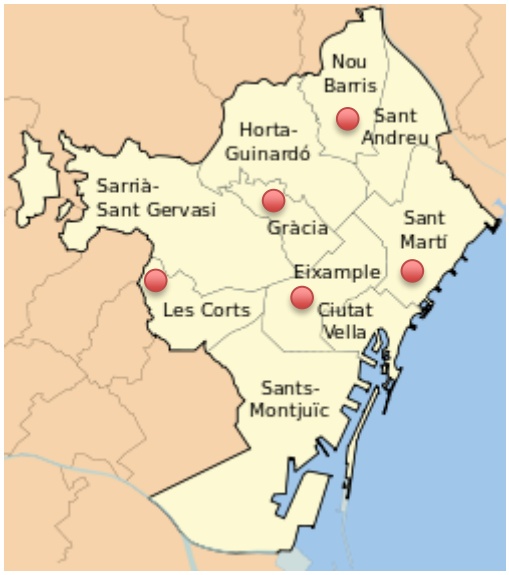


*Fig. 1 – Locations of the Smart Healthy Indoor Air trial in Barcelona*

#### *4.1.1.4 Description of the trial*

The initial functional tests will be done with current home installations located in Barcelona. S&C accesses the outdoor air quality data recorded by the Atmospheric Pollution Vigilance and Forecast Network[3] (the XVPCA) from the Ministry for Territory and Sustainability at the Generalitat of Catalonia. The outdoor air quality can be acquired through other federated platforms more dedicated to offer Smart City services, while the location-specific estimation will be provided by symbIoTe throughout the Enabler.

A set of sensors dedicated to measure in real time the quality of the indoor air will be installed at each home. These sensors acquire information about temperature, humidity, luminosity,

[3] http://dtes.gencat.cat/icqa/start.do?lang=en

and pollution. Data from outdoor sensors will be acquired each hour and sent to the Enabler to get an estimation value based on the house's location. Taking into consideration both values, indoor and outdoor air quality, the application will send recommendations to the user in order to improve the indoor air quality.

#### *4.1.1.5 Strategies for monitoring the trial effectiveness*

The trial effectiveness will be based on some metrics that will be defined during the first phase of the trial planning: IAQ standards for home, IAQ metrics and different methods to ventilate a home based on indoor/outdoor quality relationship.

Also, the trial effectiveness includes a technical validation to make sure that the quality of data acquired at home is reliable. This will be done during the second phase of the trial planning.

Finally, the user evaluation through questionnaires will allow to assess how the user perceive the system. The first questionnaire is used to measure perceptions of usability by using the System Usability Scale (SUS). It consists of a 10 items questionnaire with five response options for respondents, from strongly agree to strongly disagree. The second questionnaire is focused on measuring the reduction of the most common symptoms of indoor air pollution, such as coughing, sneezing, watery eyes, fatigue, dizziness, headaches, upper respiratory congestion. This questionnaire is based on dichotomous questions asked for a Yes/No, such as 'Have you noticed that you are coughing less than before?'. The questionnaires will be paper-based and will be delivered to the users after trials.

#### *4.1.1.6 Tentative time-plan*

The trial planning includes three different phases:

1. **Preparation: Define strategy to run the pilot (January 2018)**
    - Final selection of the homes to be tested (4 homes and 1 office). Different locations inside Barcelona were selected in order to monitor different air pollutions levels.
    - To define indoor air quality (IAQ) standards for homes.
    - To define IAQ metrics: CO2, temperature, humidity
    - To define smart ventilation system based on rule-based reasoning (RBR). The idea is to capture the knowledge of experts in this domain and store it as rules. The knowledge is acquired from specific web pages.
2. **Pilot deployment and technical validation (March 2018)**
    - Installation of smart home system at 5 locations: temperature, humidity, CO2, luminosity, motion, and energy consumption..
    - To run controlled trials.
    - Technical validation of the application.
3. **Pilot execution and user evaluation (April-June 2018)**
    - To monitor and archive indoor and outdoor air quality conditions over time.
    - User evaluation and improvement of quality of life through questionnaires explained in section 4.1.1.5.

#### *4.1.1.7 Management of ethical issues*

The only inclusion criteria used to select participants was that the location of their homes was in Barcelona and the need of having internet connection at home. Five locations are monitored: 4 houses and 1 office. The only personal data collected is the location of the house, since the rest of parameters are contextual data (humidity, CO2, luminosity, etc.).

A Participant Information and Consent Form (PICF) will inform participants about the project and explain the tests involved. The user will consent to the treatment of personal data expressed by the PICF. S&C guarantees the confidentiality of data provided by users and its treatment in accordance with current legislation on the protection of personal data (Constitutional Law 15/1999, of 13 December, for the protection of personal data, Royal Decree 1720/2007, of 21 December, which approves the Regulation of the development of the law, in addition to all legislation applicable to this issue).

The collection, processing and transmission of personal data will be analyzed under the principles of:

- The Universal Declaration of Human Rights and the Convention 108 for the Protection of Individuals with Regard to Automatic Processing of Personal Data.
- Directive 95/46/EC & Directive 2002/58/EC of the European parliament regarding issues with privacy and protection of personal data and the free movement of such data.
- The Spanish laws applying its provisions.

Data managed during the trial will be processed only under the following preconditions which need to be met (Art. 7, Directive 95/46/EC): 1.-When the data subject has given her/his consent; 2.-When the processing is necessary for the performance of a contract; 3.-When processing is necessary for compliance with a legal obligation; 4.-When processing is necessary in order to protect the vital interests of the data subject.

To this end personal data managed by S&C will be pseudonymized and stored in a form which does not permit identification of users without permission. Moreover, data processing in this trial will be done in respect to the purposes for which the data were collected or for which they are further processed, while ensuring appropriate protection for personal data stored for longer periods for historical, statistical or scientific use, S&C establishes a data management framework that guarantees security of collected personal data from potential abuse, theft, or loss.

### 4.1.2 Smart Area Controller Trial Plan

#### *4.1.2.1 Overview*

Smart Area Controller scenario wants to showcase how to control IoT devices located in a physical space, following the user presence. The idea is to reconfigure the user's control interface, for example represented by an application on his smartphone, according to the controllable cyber-physical systems in range. Thus, the user will be able to change the temperature in the room or to move the curtains and change the illuminance level, depending on where he/she is.

From a symbIoTe viewpoint the use case is compliant to L3 level: homes and buildings are seen as Smart Spaces (running the S3M) and thus home resources can be registered from different Platforms or can be Smart Devices.

Users interact with the resources of the Smart Space with an application installed in their smartphones. The application connects to the Smart Space and gathers data from resources through an Enabler called *Location based resource filtering*, that is able to search and filter resources on the Core based on their symbolic location (as the name suggests). By doing this, every time that the user changes its current position (in a list), all the controllable resources located there are showed.

#### *4.1.2.2 Preparation and preconditions*

The main precondition of this use case is to deploy a S3M on the trial location. Therefore, a local machine will be made available to do this. Then, sensors and actuators will be physically installed there and they will be registered into symbIoTe SSP together with the platforms/SDEVs they belong to. An Enabler will be deployed as well, in order to provide specific features for the scenario.

The Smart Area Controller leverages on the user location tracking. GPS coordinates are not enough accurate to be used in a home space and moreover the signal can be lost in an indoor environment. Therefore, user must specify his/her position. The second concept to introduce is the concept of symbolic location, since, as previously stated, GPS coordinates can't be used. Thus, resources (and so users) are tracked basing on the set of places defined as strings in the description of the resources themselves. Different platforms, though, can use different names for the same spaces, areas, locations, therefore for example a platform could split a building in many *floors*, and register devices indicating to which floor they belong, as well as another platform can use *rooms* to indicate symbolic locations for its resources, or even a SSP could be an area that covers more than a single building.

It is necessary for this use case to manage all the symbolic locations defined into the SSP, to classify them hierarchically, in order to allow the enabler to understand the actual SSP's topology. This operation is provided by a manual configuration made by the SSP administrator, that must be able to rearrange all the registered areas to specify whether one *contains* or *is contained* by another (e.g. floors in buildings, rooms in floors, etc.); to this purpose, an administration console has to be provided to the SSP supervisor.

Starting from February 2018, around 10 people from NXW have been selected to take part to the initial evaluation. The results from this phase will be used to refine the application. During the last phase, starting from May, the trial will involve more users.

#### *4.1.2.3 Venues/locations of the trial*

The evaluation will take place within Nextworks' premises in Pisa. The location doesn't need a special preparation, but only the fulfilment of the preconditions described above.

The type of devices involved in the trial will be lamps, dimmers, RGB lights and curtains. Environmental sensors (that measure temperature and humidity) and a weather station are available as well.

The following pictures depict possible installations inside the building:

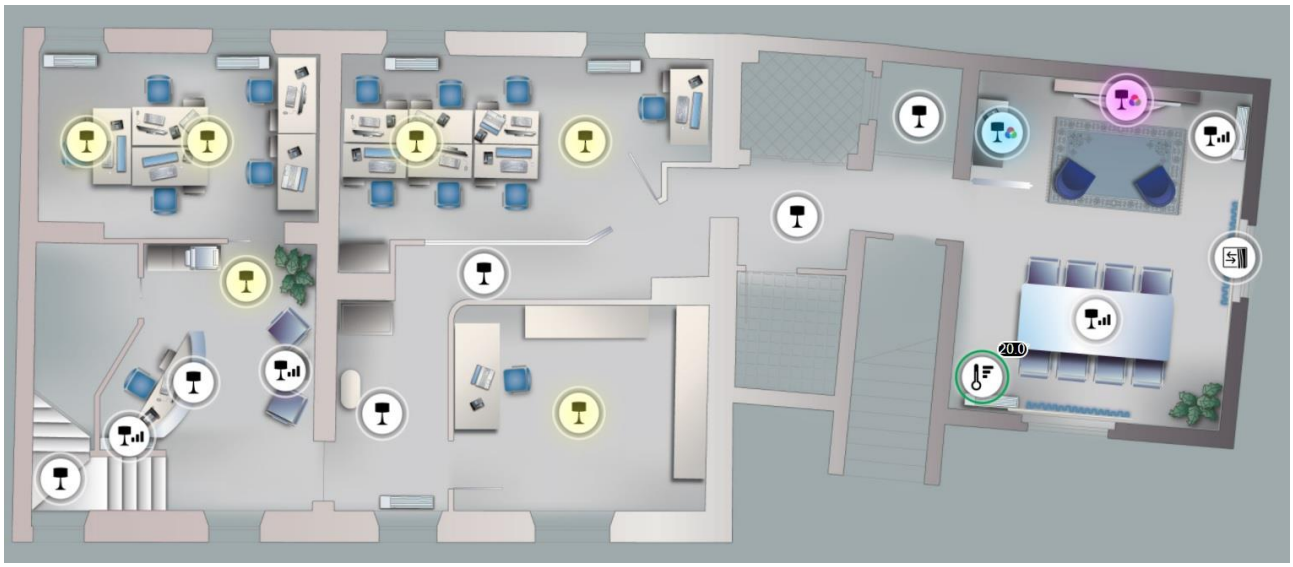

*Fig. 2 – Ground floor*

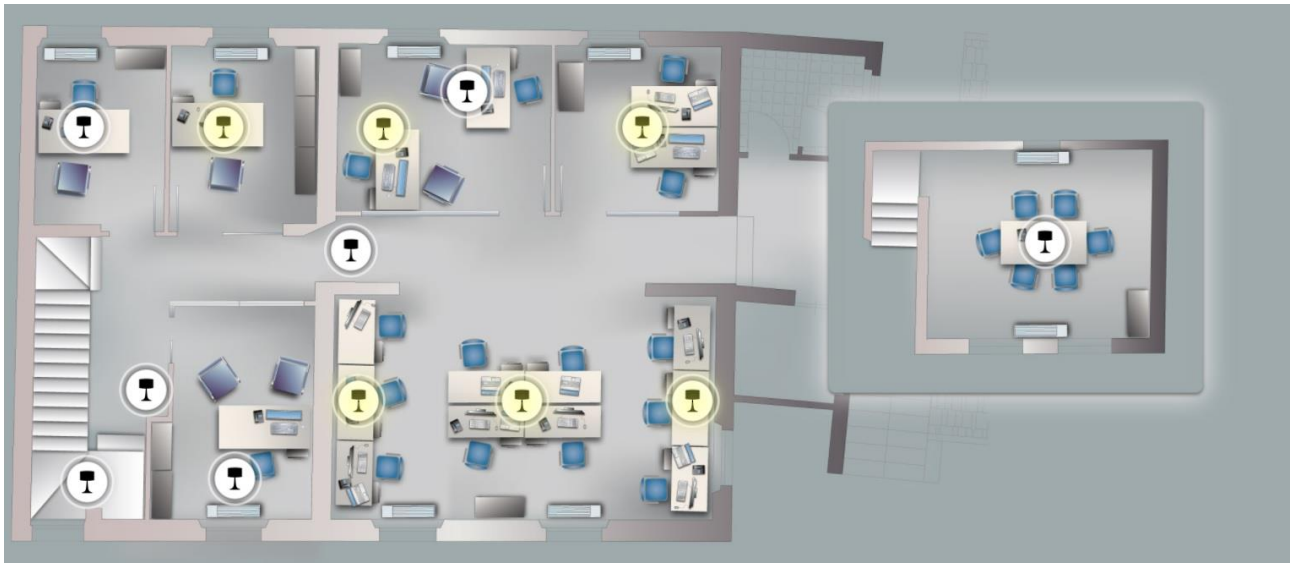

*Fig. 3 – First floor*

*Fig. 4 - External area*

And a photo of the real location:

*Fig. 5 – NXW premises*

It is planned to conduct this trial with up to 10 people during the first phase and then to extend it to a larger number of users.

#### *4.1.2.4 Description of the trial*

The evaluation will follow a simple user story which can be described as follows:

1. A person enters a room, bringing the device that hosts the application with him/her (e.g. his/her smartphone).
2. The user opens the application and selects one of the possible location (the one where he/she is currently located)
3. After the user input, the application reconfigures itself, showing a list of the controllable devices. This is done according to the information on the user location.
4. As the list has showed up, the user is able to interact with the devices in range. So, for instance, he/she will be able to set the level of light or to open/close curtains.
5. Afterwards, if the user changes room or floor, he/she can specify the new location and so the application can show the new set of devices.

#### *4.1.2.5 Strategies for monitoring the trial effectiveness*

The primary goal of the trial is to evaluate the usability of the system, with a view to end-user concrete benefits.

A preliminary list of KPIs to monitor the trial effectiveness, has been defined as follows:

- Technical accomplishment of all the preconditions described in the paragraphs above
- User satisfaction in terms of software usability
- Effectiveness of the solution based on the interoperability among different platforms within the same SSP
- Ease of use of the solution.

#### *4.1.2.6 Tentative time-plan*

The possible time-plan follows:

- January – March 2018: deployment of Smart Area Controller software
- April 2018: First evaluation phase
- May 2018 – September 2018: Second evaluation phase.

In details, these are the planned phases:

1. Preparation
    a. Agree on physical scenario
    b. Agree on the physical devices to be installed
2. Venue set-up
    a. Deploying and configuring IoT devices
    b. Deploying and configuring S3M, Enabler and platforms/SDEVs

c. Deploying and configuring application

3. Trials
    a. Test devices, platforms and applications
    b. Report and correct issues
4. Real Event Monitoring
    a. Monitor the execution of the application
    b. Gather data and KPIs to allow assessment

#### *4.1.2.7 Management of ethical issues*

Since this trial is deployed on NXW premises, all involved users will be NXW employees. No personal data will be collected or stored neither in the application nor in the symbIoTe enabler involved.

### 4.1.3 Home Comfort Trial Plan

#### *4.1.3.1 Overview*

Home Comfort scenario aims to showcase a situation where devices are controlled in order to keep user's predefined comfort values. The user must pre-configure the desired targets in the application and afterwards the system will automatically control the environment. For instance, temperature and lux levels have been pre-set to some desired values: the system will act on dimmer lights to control illuminance and on automated curtains. Moreover, it will also set the fan coils to reach and maintain the requested temperature.

From a symbIoTe viewpoint the use case is compliant to L3 level: homes and buildings are seen as Smart Spaces (running the S3M) and thus home resources can be registered from different Platforms or can be Smart Devices.

The application connects to the Smart Space and gathers data from resources through an Enabler called *Location based resource filtering*, as described in par **Error! Reference source not found.**.

#### *4.1.3.2 Preparation and preconditions*

The preconditions of this use case are the same of the Smart Area Controller scenario, already described in par 4.1.2.2.

Starting from January 2018, the initial evaluation has involved a single user, in order to test the environment and to gather the first results. Afterwards, at most 5 people from NXW will be selected to take part to the second phase. This can be considered an average number of users for a typical house environment.

#### *4.1.3.3 Venues/locations of the trial*

The evaluation will take place within Nextworks' premises in Pisa. It is planned to conduct this trial with up to 5 people, during the second phase. The location doesn't need a special preparation, but only the fulfilment of the preconditions described above. Some pictures are available in par 4.1.2.3.

#### *4.1.3.4 Description of the trial*

The evaluation will follow a simple user story which can be described as follows:

1. A person configures the home environment by accessing to a setup interface and he/she specifies comfort targets for some ambience parameters illuminance level, curtain positions, light colors)
2. From here on out, the backend application can send commands to the cyber-physical devices in order to keep user comfort values in the building.

#### *4.1.3.5 Strategies for monitoring the trial effectiveness*

The primary goal of the trial is to evaluate the stability of the system, testing the control-loop (monitoring/actuation/monitoring) whether it works well, actually following the user configuration. The second step is to evaluate the challenges and issues connected to a multi-user scenario.

A preliminary list of KPIs to monitor the trial effectiveness, has been defined as follows:

- Technical accomplishment of all the preconditions described in the paragraphs above
- User satisfaction in terms of software usability
- Ease of use of the solution
- User satisfaction in terms of home comfort.

#### *4.1.3.6 Tentative time-plan*

The possible time-plan follows:

- January 2018 - March 2018: deployment of Home Comfort software
- April 2018: First evaluation phase
- May 2018 - September 2018: Second evaluation phase.

In details, these are the planned phases:

1. Preparation
    a. Agree on physical scenario
    b. Agree on the physical devices to be installed
2. Venue set-up
    a. Deploying and configuring IoT devices
    b. Deploying and configuring S3M, Enabler and platforms/SDEVs
    c. Deploying and configuring application
3. Trials
    a. Test devices, platforms and applications
    b. Report and correct issues
4. Real Event Monitoring
    a. Monitor the execution of the application

b. Gather data and KPIs to allow assessment.

#### *4.1.3.7 Management of ethical issues*

Since this trial is deployed on NXW premises, all involved users will be NXW employees. No personal data will be collected or stored neither in the application nor in the symbIoTe enabler involved.

### 4.1.4 Smart Health Mirror Trial Plan

#### *4.1.4.1 Overview*

The idea of the smart home AAL use case is to evaluate a “smart mirror” assisting chronically ill people with daily measurements of vital parameters relevant to therapy. The story behind the use case revolves around a 77-year-old person suffering from chronic heart failure. As regular daily weight measurements are imperative for therapy, the smart mirror is connected to a Bluetooth Low Energy (BLE) scale guiding the end-user through a simple weight measurement and questionnaire, thus during end-user evaluations (1) body weight and (2) personal wellbeing (recorded through voice input) are collected through the smart mirror and stored in the KIOLA database. During the trials end-users are asked to fill out a questionnaire related to user experience and expectations related to the smart mirror. Questionnaires ask for age group (e.g. 50-60 years) and gender. All participants are asked to sign a written consent form indicating the purpose of the study, data collected and how data is processed.

#### *4.1.4.2 Preparation and preconditions*

The initial evaluation took place at a living lab at the University of Vienna as a 2-day evaluation between Nov 6th and Nov 7th 2017 and was successfully completed with 10 people consisting of computer science students This evaluation was done primarily to evaluate the technical setup.

Starting with January 2018 recruitment of 10 elderly people has started in the area of Vienna for follow-up evaluation. In January and February results from the initial evaluation will be incorporated into the smart mirror software. Recruitment will be done through advertisements in retirement homes and through appropriate elderly people associations, targeting people (male/female) older than 55 years with low computer literacy.

#### *4.1.4.3 Venues/locations of the trial*

The evaluation with elderly people will again take place within the living lab at the University of Vienna. It is planned to conduct this trial with up to 10 people for 2 days. Following this evaluation, it is planned to install at least two mirrors at selected peoples’ homes to conduct a long-term evaluation in a real-life setting.

#### *4.1.4.4 Description of the trial*

The living lab evaluation will follow a simple user story which can be described as follows:

1. A person enters the bathroom wearing a Bluetooth beacon.
2. The mirror uses the beacon to resolve the identity of the person. (Alternatively, a smart watch / wristband is used in the second stage of the evaluation.)

3. The mirror reminds the person of the importance of daily weight measurements and asks the person to step on the scale.
4. As the measurement is in progress, the mirror displays the current weight. It acoustically notifies the person when the measurement is done.
5. Finally, the mirror asks the person questions related to the subjective wellbeing and forwards the result to KIOLA.

This setting will also be applied to the long-term evaluation at users' homes.

#### *4.1.4.5 Strategies for monitoring the trial effectiveness*

The primary goal of the trial is evaluation of end-user acceptance and usability. Trial effectiveness is therefore evaluated through structured interviews and standardized questionnaires. The key performance indicator is the number of tests as described in 4.1.4.4 that have been successfully conducted by end-users.

#### *4.1.4.6 Tentative time-plan*

1. January – February 2018: Recruitment and adaption of Smart Mirror software
2. March 2018: Living lab evaluation with elderly people
3. April 2018 – July 2018: Evaluation at elderly peoples' homes.

#### *4.1.4.7 Management of ethical issues*

In order to ensure privacy, the KIOLA database does not store any personal information (e.g. gender, name, addresses) that could be used to identify participants of the trial. This also applies to all questionnaires related to user experience and expectations.

## *4.2 Smart Mobility and Ecological Routing Trial Plan*

### 4.2.1 Overview

The Smart Mobility and Ecological Routing Use Case addresses the problems regarding environment pollution and air quality in the major European cities. It does so by collecting air quality data from multiple IoT platforms in different countries and uses such measurements for runners, joggers and cyclists in order to plan the best routes to their destination.

Through symbIoTe, air quality measurement will be obtained from different platforms. Due to the nature of routing algorithms, these data go through substantial pre-processing with the purpose of associating air measurements to the map's street segments.

With the streets correctly classified by their air quality, routing engines can take that information into account when computing the most ecological routes to the application's users. These paths can also benefit from other factors such as traffic and available parking, in case the platforms have access to these kinds of sensors.

Finally, users should be able to search for Points of Interest (POIs) following certain criteria, including data from sensors such as available parking or noise levels. Routes for the selected POI can be computed using the previously mentioned service.

All in all, this use case will showcase platform interoperability within the application and cloud domain, where more details can be found in section 6.4 of Deliverable D1.3.

There are three platforms providing services and data to the use case:

- OpenIoT from UNIZG-FER provides air quality data from users' wearables,
- openUWEDAT from AIT, provides air quality data from stationary sensors and a routing service for the city of Vienna,
- MoBaaS (Mobility Backend as a Service) from Ubiwhere provides their routing service.

During the trials, there will be two main actions that will be monitored:

- Air quality measurement obtained from fixed stations and wearables used by the citizens
- Ecological routes requested by the users.

As such, the trials will involve citizens (and fixed air quality stations) providing air quality readings and users using the provided applications to obtain routes. The quality of the obtained readings and the feedback users provide from using the applications will be analyzed in order to improve the applications (and the underlying enablers) and evaluate the performance of the use case in general.

### 4.2.2 Preparation and preconditions

In preparation of the trial, a smart phone app to access the routing information and to transmit sensor measurements will be prepared. Additionally, the integration of measurements from stationary sensors and of local routing algorithms needs to be setup.

Moreover, in **Vienna** AIT will integrate data from the official environmental monitoring stations of the municipality. Furthermore, AIT will provide its modified routing engine for the Vienna region. To acquire additional measurements, a small number of sensors (approx. 10) will be installed in facilities of UniVie and AIT.

### 4.2.3 Venues/locations of the trial

The trials are planned to be run in Vienna, Zagreb and Porto between May and September 2018.

### 4.2.4 Description of the trial

**Porto:**

Ubiwhere will coordinate the trial in the city of Porto. UW will be in contact with entities such as Porto Digital[4] and the University of Porto[5] in order to obtain participants to partake in the performance of the trial. It is expected that at most 20 users, during a period of 30 days, will participate. The users will be required to carry the wearables, which will provide air quality measurements, and/or to use the provided mobile application to obtain ecological routes or

[4] https://www2.portodigital.pt/index.php
[5] www.up.pt/

to search for POIs. At the end of the trial, the participants will fill out a questionnaire where they will evaluate their experience during the trial.

**Vienna:**

The recruitment will be done by UniVie with support from AIT. It is planned to ask students to participate in the trial and use the application for one week. Over a period of 4 weeks, 4 batches of 10 users will be participating. The users will be equipped with the mobile app and a sensor and are asked to calculate at least 2 routes per day and to take measurements when they are traveling on foot or by bike. At the beginning and at the end the users are interviewed on the expected / perceived utility of the application. Additionally, technical parameters regarding stability, response time, data coverage are collected and evaluated from a technical point of view.

**Zagreb:**

The coordinator of the trial in Zagreb is UNIZG, which will provide technical support through OpenIoT installation integrated with symbIoTe ecosystem, wearable sensor units that will measure air pollutants and coordinate and manage citizens that participate in the trial. The target group is the student population which will be recruited in order to collect measurements throughout the city area. The trial is planned with 20 users that will carry wearables for 30 days. The users will collect data while they are moving around the city doing their usual activities, but also UNIZG plans to conduct coordinated measurement campaign during that time period of 30 days, where users will get specific instructions on which part of the city they need to cover. The user group will provide their experiences with the SMEUR use case at the end of the trial through a questionnaire.

### 4.2.5 Strategies for monitoring the trial effectiveness

The primary goal of the trial is to gather data from the mobile sensors and evaluate the technical stability of the system. As it is difficult to assess the actual value symbIoTe creates for the users, the secondary goal is to assess the utility of the solution for the users.

The KPI’s measuring the trial effectiveness will be monitored using the number of transmitted measurements and the number of requested routes.

Additionally, the participants of the trials will fill a questionnaire where they provide feedback regarding the trials. More specifically, they will evaluate their experience using the app, how useful it was to them and the quality of the routes and the system in general.

The SMEUR trial will be organized by symbIoTe partners in coincidence with the implementation of the Extensions funded through the 2nd symbIoTe Open Call, which launched a specific topic for Trials. The extensions funded through the Open Call will be strictly linked to the SMEUR trial in such a way that the communities of users involved in the extensions will be using the app and related experience evaluation questionnaire.

### 4.2.6 Tentative time-plan

- January – March 2018: Preparation
    - Agree on the expected data and application feedback from users
    - Agree on the number of wearables and stations to be used
    - Agree with cities and organizations on how the pilots will function

- April 2018: Set-up
  - Sensor calibration
  - Mobile and Web Application preparation
  - Deploying and configuring enablers and applications
  - Test devices, platforms and applications
  - Report and correct issues
- May – September 2018: Trials
  - Monitor the gathered data from the wearables and stations
  - Retrieve feedback from application users
  - Gather data and KPIs to allow assessment.

### 4.2.7 Management of ethical issues

There are two different cases to consider regarding this subject within this use case:

- For data provided by public entities
- For data provided by users.

For the Smart Mobility Use Case, data can be provided by the municipalities, be it from air quality stations, traffic indicators, PoIs, etc. These data are public and are not related to any person in particular, so no special care has to be taken.

On the other hand, when it comes to air quality sensors from wearables, special care has to be taken to protect the user identity. For the OpenIoT platform, anonymization of data is achieved by using virtual sensors which represent certain geographical areas (1 x 1 km cells) rather than exact identifier of user and its device that is performing measurements. So, there is no direct correlation between user device and stored measurement.

As such, all the stored data is either from the public domain or anonymized.

Data managed during the trial will be processed only under the following preconditions which need to be met (Art. 7, Directive 95/46/EC): 1.-When the data subject has given her/his consent; 2.-When the processing is necessary for the performance of a contract; 3.-When processing is necessary for compliance with a legal obligation; 4.-When processing is necessary in order to protect the vital interests of the data subject.

**Further actions for the trial in Vienna**

The only inclusion criteria used to select participants was their willingness to use the application at least two times a day and to use the sensor whenever commuting either by bike or by foot. The participants are recruited from the University of Vienna and the AIT staff.

A Participant Information and Consent Form (PICF) will inform participants about the project and explain the tests involved. The user will consent to the treatment of personal data expressed by the PICF. UniVie guarantees the confidentiality of data provided by users and its treatment in accordance with current legislation on the protection of personal data.

The collection, processing and transmission of personal data will be analyzed under the principles of:

- The Universal Declaration of Human Rights and the Convention 108 for the Protection of Individuals with Regard to Automatic Processing of Personal Data.
- Directive 95/46/EC & Directive 2002/58/EC of the European parliament regarding issues with privacy and protection of personal data and the free movement of such data.
- Austrian laws applying its provisions.

To this end personal data managed by UniVie will be pseudonymized and stored in a form which does not permit identification of users without permission. Moreover, data processing in this trial will be done in respect to the purposes for which the data were collected or for which they are further processed, while ensuring appropriate protection for personal data stored for longer periods for historical, statistical or scientific use, UniVie establishes a data management framework that guarantees security of collected personal data from potential abuse, theft, or loss.

The experiment in **Vienna** will generate 40 person-weeks worth of data. As stated, participants will be recruited from the student body at UNIVIE, the staff at AIT, and possibly other volunteer contributors. The study only targets adults (18 years and older as by Austrian law), and has no upper age limit.

Personal data that must be collected for the experiment includes the participants' smartphones' position and timestap, device interactions, frequency of app use, POIs and addresses searched, and routes planned using the service. These data are Personally Identifiable Information (PII), and are carefully handled to minimize the chance of privacy mishaps.

Furthermore, data that must be collected clearly *excludes* names, addresses, smartphone IDs, telephone numbers, MAC addresses, or other information relating to the participants or their devices. While participant names will be used for logistical handling and test planning, they will not be associated with measurement data or data recorded by the route service.

## *4.3 EduCampus Trial Plan*

### 4.3.1 Overview

The EduCampus Trial will be executed in cooperation with the Karlsruhe Institute of Technology (KIT), specifically with the Research Group Cooperation & Management (C&M), led by Professor Dr. Abeck. The EduCampus use case is embedded in a long term cooperation between Fraunhofer IOSB and C&M, dedicated to research, education and evaluation of topics linked with IoT technologies. The focus for the EduCampus use case will be the indoor location using BLE beacons for the purpose of navigation and room information and reservation.

### 4.3.2 Preparation and preconditions

Both partners in this trial have been developed and deployed an indoor location solution, using BLE beacons to sense the distance between a smartphone and a beacon with a fixed location. The KIT solution provides navigation support and room information. The IOSB solution provides room information and reservation services.

The participants of the trials will be selected employees of the KIT and the IOSB, as well as students from the KIT. All participants will be informed about the data collected and the evaluations done during the trials.

The KIT participants will use the navigation solution extended to the facilities within the IOSB building. The IOSB participants will be able to get room information on KIT facilities.

### 4.3.3 Venues/locations of the trial

The trials will be executed in selected parts of the KIT and the Fraunhofer IOSB premise. For the KIT trials the beacon equipped rooms will be located in campus Süd, close the Karlsruhe Castle, as shown in the figure below.

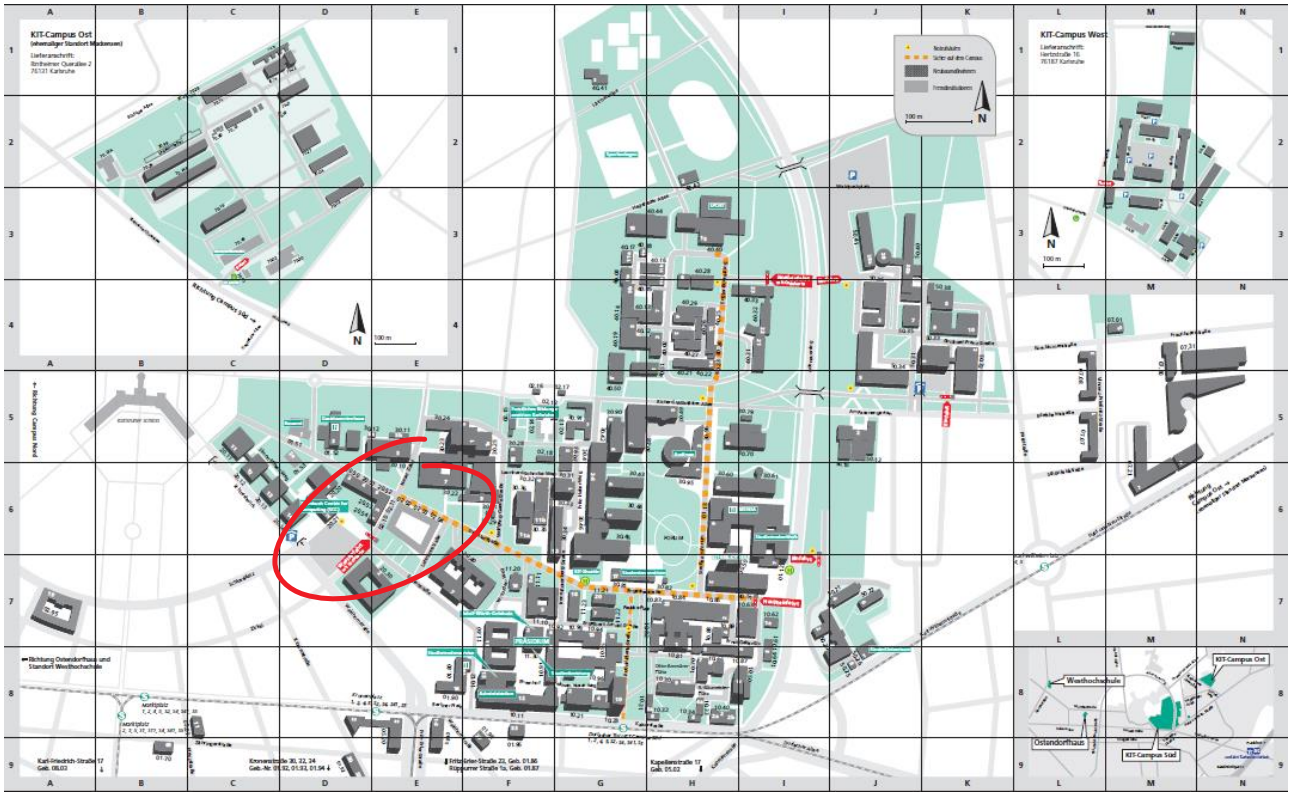

*Fig. 6 - Trial Venue Site KIT*

The IOSB trials will take place in the Fraunhofer Institute building in Karlsruhe, as shown in the figure below. Several offices and meeting rooms will be equipped with BLE beacons and the users participating in the trial will be equipped with smartphones.

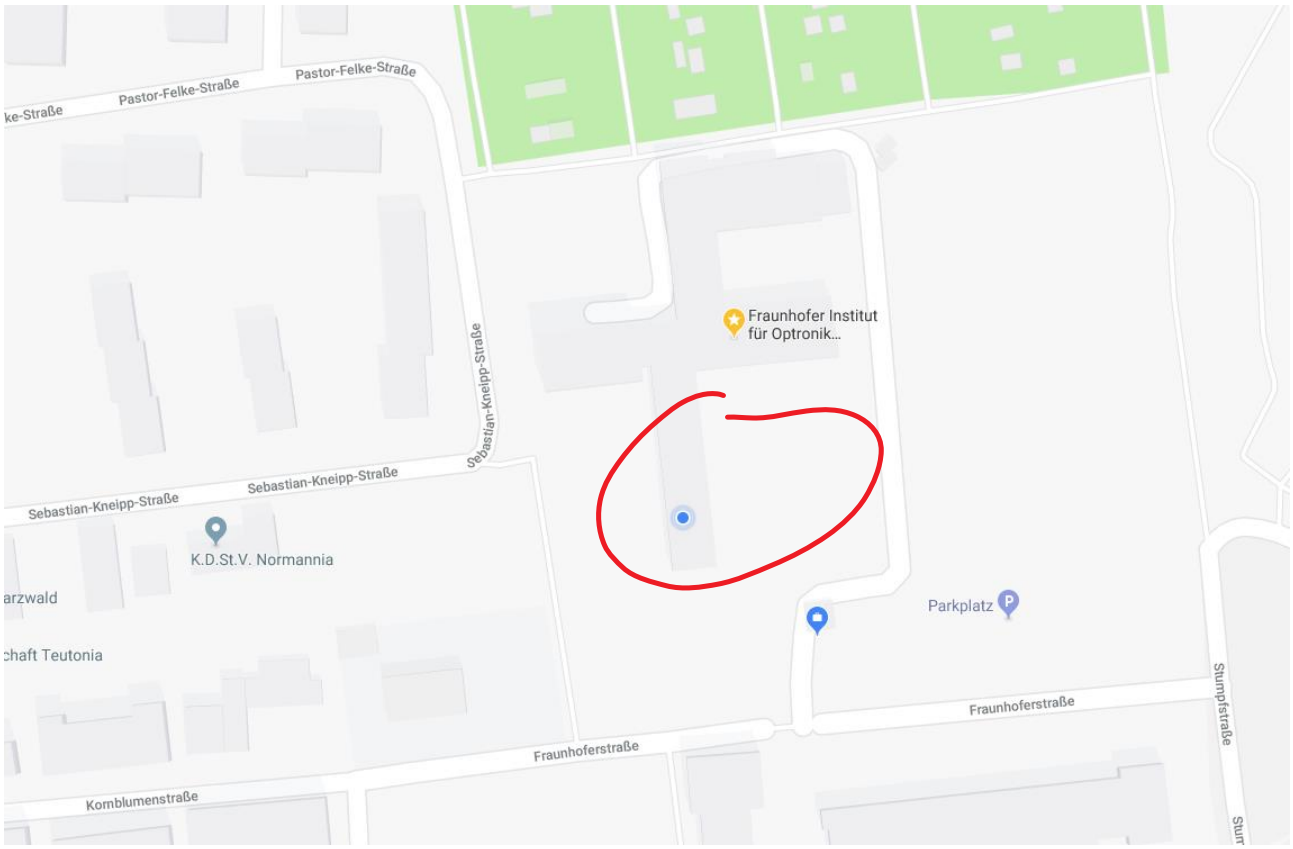


*Fig. 7 - Trial Venue Site IOSB*

### 4.3.4 Description of the trial

The trial will be executed by voluntary participants from the C&M department within the KIT and the Fraunhofer IOSB. Each participant will have a smartphone with a mobile app provided either by KIT or IOSB. These apps will be different and will use their specific backend server environment, running the IoT frameworks for their campus. Both servers will be extended by symbIoTe adapters, in order to federate both IoT platforms.

The figure below shows the idea of the trial. The KIT trial members are using the native “aquire room information”, which is different from the native IOSB use case “aquire room reservation”. Only the backend Server will be extended by symbIoTe adapters to exchange remote resource when users are visiting a foreign campus.

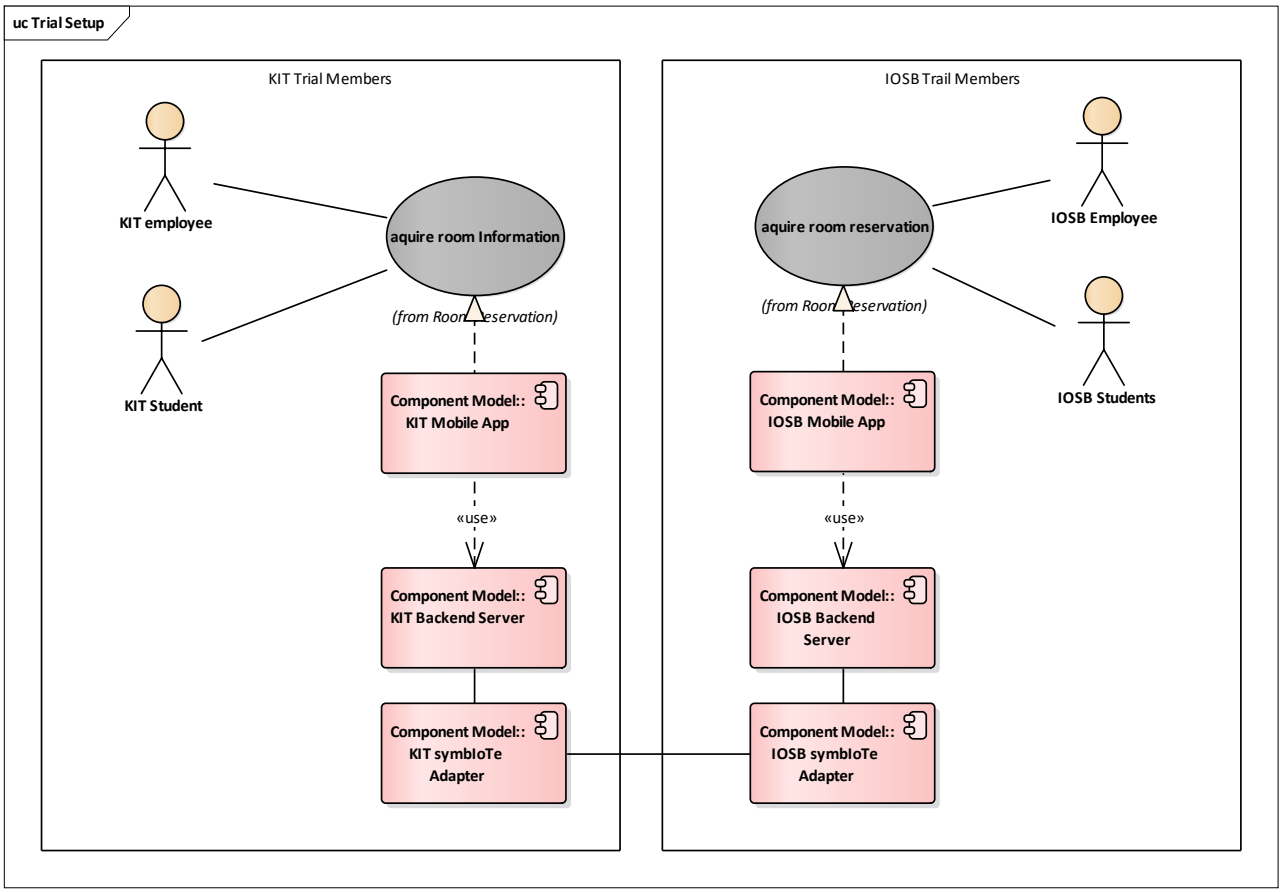


*Fig. 8 - Trial user and component setup overview*

### 4.3.5 Strategies for monitoring the trial effectiveness

The trials will measure the effectiveness of the remote resource access, including the discovery, the communication to the remote symbIoTe resource access proxy and the semantic mapping overhead.

### 4.3.6 Tentative time-plan

The trial preparation is planned to be finished within February 2018. Until then the room assignments of the beacon will be finalized and the trial evaluation scenarios will be defined. The trial evaluation KPIs will be defined.

Until the end of March 2018, the beacons will be deployed in the facilities of the KIT and the IOSB. Also, the mobile applications will be installed on the devices of the trial members.

The trials will take place between May-June 2018.

### 4.3.7 Management of ethical issues

The applications used within the trials will create proximity measurements between mobile devices and BLE-beacons with fixed locations. The trial users will only use anonymized devices, in order to avoid any recoding of personal data.

All participants of the trials will need to sign a letter of agreement before receiving any EduCampus applications and/or devices. The letter will contain information about the recoded data.

## *4.4 Smart Stadium Trial Plan*

### 4.4.1 Overview

The Smart Stadium trials aim at showcasing the feasibility, advantages and added value of smart objects for a solution that, in this particular case, is focused on retailer services for the visitors of a stadium. The trials will be based on three main applications, the visitor application, the retailer application and the promowall application, all of them discovering and taking advantage of the different symbIoTe-enabled smart objects deployed throughout the stadium (remote ordering devices for retailers, symbIoTe-enabled visitor mobile devices and promowall screens).

All smart objects will also have indoor location capabilities by means of BLE beacons that will also be deployed throughout the stadium. The number of beacons, density, transmission power and indoor location accuracy will be adapted to the specific needs of the stadium manager. Other potential capabilities, such as stadium map and location of the different smart objects over that map, will also depend on the commercial strategy adopted by the stadium manager.

Visitors will be identified through their smartphones, provided they have installed the corresponding smart stadium visitor app, while retailers (both moving carts and physical shops) are identified by their remote ordering devices and beacons. From the visitor's point of view, Smart Stadium brings the opportunity for detecting closest retailers, place orders independent of where they are, or for receiving products they bought directly in their seat.

On the other hand, retailers can broadcast their offers and promotions to all visitors inside the stadium, or those that are moving near specific areas inside the stadium. Retailers can send their promotions to large SmartTVs (Promowalls) strategically placed throughout the stadium.

### 4.4.2 Preparation and preconditions

The execution of the trials will imply some preparatory works. In particular it will first require to meet and agree with the stadium manager on the specific events that will be used for demonstrating the pilot, and hence prior to that, the dates in which Worldline team will be granted access to the stadium premises to install equipment and perform tests of equipment, platforms and applications.

Based on the specific characteristics of the stadium itself and the events in which the applications will be demonstrated, Worldline and the stadium manager will hold several meetings in order to agree and fix the precise scope of the applications and trials to be demonstrated during such events.

The execution of the tests prior to the demonstration events will only require the participation of selected Worldline employees at the beginning, while selected stadium employees will also join the tests at the later stages. The very last tests will also involve selected stadium visitors which will be encouraged to provide detailed feedback on their experience.

Finally, the demonstration events will be conducted with stadium visitors, stadium employees, and retailers operating inside the stadium, while Worldline employees will only be monitoring these demonstrations and solving potential issues when necessary. Worldline will also record a video of these demonstration events so that the outcome and conclusions can be easily showed whenever necessary.

### 4.4.3 Venues/locations of the trial

The Smart Stadium trials will take place at the premises of **Atlètic Terrassa Hockey Club** (ATHC, http://athc.cat/), a sports club located just outside the city of Terrassa, about 30 km NW from the city of Barcelona.

*Fig. 9 - Atlètic Terrassa Hockey Club logo*

The picture below shows a map of ATHC premises.


*Fig. 10 - Map of ATHC premises*

ATHC is currently running a team of field hockey that is participating in the Spanish national league, and as winner of last year Spanish league, is also participating in the European championships, the Euro Hockey League.

It is expected (still to be agreed with ATHC) that some of the demonstrations will take place taking advantage of the most important matches in which ATHC will be playing, in order to involve as many visitors as possible during the trials.

### 4.4.4 Description of the trial

The trials will be focused on evaluating the three applications developed for this use case, not only from a technical perspective but also considering the user experience and feedback with regards to smart objects added value. In addition to that of final users, feedback from stadium manager and stadium employees will also be a key aspect to be considered for use case evaluation.

The detailed description of the trials is not available yet and will be discussed with ATHC managers during several meetings with them to take place before the end of February 2018.

Nevertheless, a pre-release of the visitor application was developed for the Final 4 tournament that took place in May 2017, in order to show the technological potential to ATHC managers and the general public visiting the stadium during that event. A demo video is already available on YouTube: https://www.youtube.com/watch?v=ELzRJag-Xb8

### 4.4.5 Strategies for monitoring the trial effectiveness

#### Methodology

The Smart Stadium use case will be evaluated from 2 different points of view:

- Technical accomplishment

  The three developed applications will be tested against their corresponding test plan (details not defined yet), as well as the four platforms included in this use case.

- Client satisfaction

  We will assess the user acceptance and user experience with the symbIoTe-enabled applications. This will also include metrics to follow up on stadium manager and employees feedback.

In order to evaluate the success of the pilot we will focus on 3 different targets:

- Stadium manager and employees, to evaluate the benefits of implementing the pilot within their premises (if there is any positive impact in their business or operation).
- Stadium retailers, to check if the number of customers and profitability of their businesses, or at least their visibility and positive perception from visitors has improved.
- Stadium visitors, to assess improved user experience and positive perception of stadium innovative approach.

#### KPIs & metrics

KPIs to monitor the technical accomplishment will be defined immediately after application development completion, while KPIs related to client satisfaction will be agreed with ATHC during following meetings.

**Surveys and satisfaction**

During the demo events we will gather feedback from visitors, retailers and stadium employees through surveys (to be agreed with ATHC), questionnaires and interviews to check the usability of smart stadium applications, as well as the usefulness of the use case functionalities.

### 4.4.6 Tentative time-plan

The deployment plan for Smart Stadium use case has been divided into four phases, with estimated completion dates as follows:

1. **Preparation**: Define strategy to run the pilot (January-February 2018)
    - Agree on physical scenario
    - Define activities needed by employees to support operations
    - Agree on the physical devices to be deployed
2. **Venue Set-up** (March 2018)
    - Prepare the stadium for the trials, deploying and configuring IoT devices
    - Train employees
3. **Trials** (March-May 2018)
    - Test devices, platforms and applications
    - Report and correct issues
    - Run simulated events
4. **Real Event Monitoring** (May-June 2018)
    - Monitor the execution of the applications in the stadium
    - Gather data and KPIs to allow assessment.

### 4.4.7 Management of ethical issues

The users participating in the trials will be both employees from ATHC (and related third parties such as retailers), and general public attending the selected events in which the trials will take place.

Employees and retailers will be using the remote ordering devices which only deals with commercial information (name of the brand, products offered, or promotions) and do not collect or store any personal data at all.

General public attending the event will benefit from symbIoTe-enabled services through the smart stadium visitor app. In order to maximaze impact and number of users, in fact the smart stadium visitor app will be embedded into the ATHC app, so that all visitors downloading ATHC app will also have the possibility to access symbIoTe services in an entirely voluntary basis. This app includes three different identifications levels:

- General club information and services. Visitors access and use ATHC app in a completely anonymous way, no identification is required.

- Club member services. Club members are required for an identification (user name and password registered in ATHC servers) when trying to access restricted member services, but these services are not related at all with symbIoTe or the smart stadium visitor app. Hence, identification, data collection and storage are entirely managed by ATHC and beyond the scope of symbIoTe.
- symbIoTe-enabled services. Since these services have a commercial impact, users will be asked for a social login, which will result into an anonymous identification used to personalize these services and also avoid a user placing orders in an uncontrolled way. In any case, and even if no private data will be collected or stored, users will be informed of the nature of the services being provided and related data, and the app will ask for their explicit consent prior to providing any service to them.

In all cases, employees or visitors, any questionnaire provided to them for evaluation purposes will be completely anonymous and will not include any personal data.

In any case, data collection and processing will be done in accordance with the current national Spanish legislation on data privacy, and with the European General Data Protection Regulation (GDPR).

## *4.5 Smart Yachting Trial Plan*

### 4.5.1 Overview

The focus of Smart Yachting is to provide advanced services for the Yachting industry based on IoT solutions. From an implementation viewpoint, it focuses on two specific showcases, Smart Mooring and Automated Supply Chain, which exploit data from IoT sensors to automatically acquire information from the yacht and to pass them to business applications connected to the port infrastructure.

From a symbIoTe viewpoint the use case is compliant to L1, L3 and L4 levels: yachts in fact are seen as Roaming Smart Devices (SDEV), registered in the Core together with their resources, while ports are seen as Smart Spaces. A yacht connects in symbIoTe through the port's Smart Space middleware (S3M).

The trial for this use case is therefore strongly linked to the availability of the S3M software and to the implementation of all the proposed changes in other symbIoTe components (e.g. MIM, systems registration logic, etc.) to facilitate WP4 development. While Navigo and Nextworks' teams have envisioned a strategy to allow the development of the use case even without a complete S3M implementation, for the actual execution of the trial the finalization of WP4 is of course a prerequisite.

Coming back to the use case, Smart Mooring aims to automate the mooring procedure of the port, in itself a quite bureaucratic and tedious process, since Marinas operate in strongly regulated contexts. For the use case, the workflow logic is provided by a Navigo application (Portnet).

Here we want to intercept a particular phase of the Mooring process that starts when the yacht is approaching – at a distance – the destination port and ends when it finally berths into one of the piers. We assume that the initial mooring request (a sort of "booking" for a place in port for the boat) always starts off-line or in any case outside symbIoTe: it might be performed through a phone call or a web access to the Mooring workflow management

system, where agreements are made (e.g. the boat is expected to arrive at the destination port on a specific date and time and to berth on a specific pier).

When approaching the port, the yacht – as a SDEV – is detected by the SSP's Innkeeper, which associates the SDEV to the SSP and accordingly updates its properties in the Core[6].

The use of both LoRaWAN and WiFi connections between the yacht and the port has been considered, the former to recognize when the yacht is near the port, but still at a distance, and the latter to allow the actual access to the yacht's resources by the Mooring Management application.

Automated Supply Chain (ASC) on the other hand assumes that the yacht is berthed at the port, and therefore steadily connected – through WiFi – to the port's SSP. The showcase aims to automatically identify the needs for goods and services on board of the yacht, so that automated requests for offers can be issued on the Marketplace platform of the port, provided in the trial by another application of the Navigo infrastructure (Centrale Acquisti).

While the yacht is berthed in the "smart" port, the yachtsman connects to the Centrale Acquisti Supply Chain application through a common web browser. He/she gives the authorization to Centrale Acquisti to connect through symbIoTe to the machine data of the boat, that automatically provides indication about what is needed on board, whether of maintenance or resupply nature. Needs are expressed by identifying the categories of the possible suppliers that might fulfil them by using the schema.org ontology (e.g. the schema:Electrician class is used when maintenance on the electric systems of the yacht is needed).

### 4.5.2 Preparation and preconditions

The trial for this use case is a quite challenging endeavor since it implies the involvement of different actors (Port Authorities, Yacht manufacturers, Yacht owners, Captains, Local suppliers…) with important logistic implications.

At the same time these two showcases are quite different for the perspective of the trial. Automated Supply Chain is in fact simpler to setup, since it assumes, as said, that the yacht is berthed in the port and already connected to the SSP.

Smart Mooring on the other hand needs a more complex preparation, involving the installation of several sensors in the port and the actual navigation of the yacht from a distance into the harbour itself.

Therefore, we aim, as explained below, to arrange the trial for ASC on two Italian ports (Viareggio and Marina Cala de' Medici) but only on one – Viareggio – for Smart Mooring. The actual description of the things to prepare in the two ports is described in the following paragraph, but we anticipate here that the collaboration of several actors is needed. In particular Smart Yachting will involve, together with symbIoTe's partners Navigo and Nextworks:

[6] One of the modifications proposed during the work for WP4 is to extend the registration mechanism in the Core to allow not only platforms (as it is now) but also SDEV and SSP to register resources. Moreover, two explicit properties have been defined to express if the Smart Device is "available" and to which Smart Port it is connected. The MIM ontology has been recently updated to include these changes.

- For Smart Mooring
    - Viareggio Port Authority, whose personnel uses the Portnet mooring management application and will be involved in the live testing (at least 4 operators, two in the office and two in the pier to wait for the incoming boat)
    - UNIDATA: the symbIoTe partner will collaborate in the trial by providing LoRaWAN and WiFi connectivity in the area of the port of Viareggio plus LoRaWAN sensors to be used in the trial
    - CNAV shipyard, whose pier will be used as the destination for the yacht. Several LoRaWAN compliant sensors (presence sensors, water and electricity meters) will be installed in the pier, both for the execution of Smart Mooring and for evaluating the possible commercial use of IoT sensors in a Marina.
    - Perini Navi. The company headquarter is located on a tall building overlooking the port: the LoRaWAN antenna will be installed on its roof.
    - A yacht manufacturer still to be identified amongst Nextwork's customers.
- For ASC:
    - Viareggio Port Authority, who is in charge of the management of the marketplace web application Centrale Acquisti (at least 1 operator)
    - Marina Cala de' Medici Port Authority, managing Centrale Acquisti in their port (at least 1 operator)
    - A yacht manufacturer still to be identified amongst Nextwork's customers
    - At least 3 local suppliers involved in each port.

The two Navigo's applications Portnet and Centrale Acquisti must be integrated in symbIoTe through, respectively, the Smart Mooring and the ASC enablers, currently in development.

The chosen yacht will have Nextworks' Symphony on board that will be customized to include the SDEV component (symbIoTe agent) and the software to implement the Smart Mooring and ASC services, seen in the use case as SDEV resources. For Smart Mooring a LoRaWAN sensor must be installed on board; for ASC some of the behavior of the installed software (e.g. detection of faults through IoT sensors) will be of course simulated.

In both ports, WiFi connectivity must be ensured for the yacht near the berthing pier: in Viareggio LoRaWAN connectivity will allow to detect when the yacht is approaching the destination port.

Sensors installed in Viareggio must be controlled by the Navigo Digitale IoT platform (Marina+ IoT), which must be made L1 symbIoTe complaint for the trial: Navigo and Nextworks' teams are working on that at present.

Finally, as said above, for the actual execution of the trial the finalization of WP4 and the set-up of the SSP middleware for the Viareggio and Marina Cala de' Medici ports is a prerequisite.

### 4.5.3 Venues/locations of the trial

As described in the previous paragraph, the Smart Yachting trial will take place in the ports of Viareggio and Marina Cala de' Medici.

While ASC doesn't need a special preparation but only the fulfilment of the preconditions described above, Smart Mooring in Viareggio is a more complex task. Work for the trial has already begun, with a survey in the port done by symbIoTe's partners Navigo, Nextworks and Unidata on December 11th 2017.

The following image shows the salient elements of the Smart Mooring trial scenario.


*Fig. 11 – Smart Mooring trial in Viareggio*

The image shows the route of the incoming ship when entering the Viareggio port. As said the trial in Viareggio is based on LoRaWAN connectivity: the best positioning for the antenna has been identified on the roof of the Perini Navi building.


*Fig. 12 – Location for the installation of the LoRaWAN antenna in Viareggio*

Special preparation for the antenna's base station is needed to protect it from weather conditions and the saltiness of the coastal environment. Connectivity and power supply (through Power over Ethernet) will be provided by Perini Navi.

The berthing pier for the trial belongs to the CNAV shipyard. Nearby a WiFi access point will be put in place, in an office belonging to the Viareggio Port Authority.

The work on CNAV pier will be manifold: on the one hand, presence sensors are needed to detect the final berthing of the yacht in smart mooring. For this purpose, ultrasound (see image below) or infrared LoRaWAN sensors will be installed.

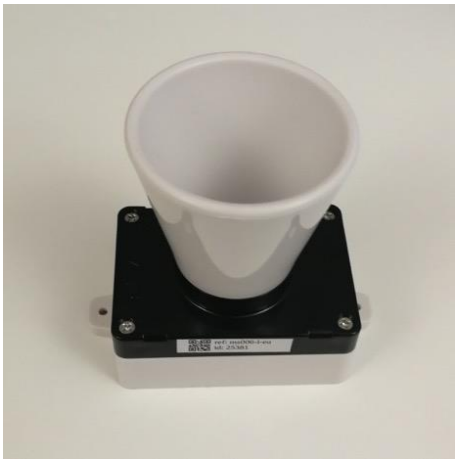

*Fig. 13 – LoRaWAN ultrasound presence sensor*

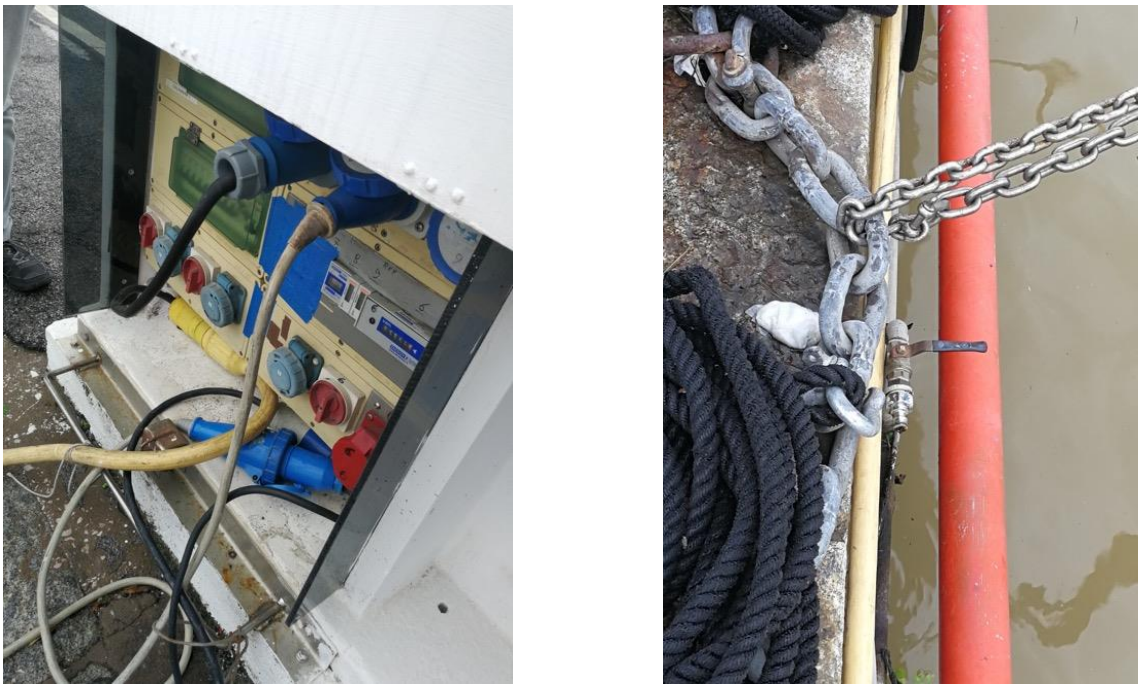

*Fig. 14 – Power and water supply on CNAV pier*

Taking the opportunity of the Smart Mooring trial, other LoRaWAN sensors will be installed in CNAV pier, to monitor water and electricity consumption of the incoming yachts. As shown in the images above, the pedestals in the pier are very old: electricity consumption can be verified manually while there is no way at present to control how much water a yacht uses. Albeit the test with the meter sensors is out of the direct scope of the Smart Mooring trial, it is worth mentioning here for its business implication.

In Marina Cala De' Medici only the ASC trial will be performed: all the port area is already covered by a WiFi network so no special preparation is needed there.


*Fig. 15 – Marina Cala De' Medici port*

### 4.5.4 Description of the trial

Smart Yachting trial will consist of separate tests for Smart Mooring and ASC, the former to be performed in Viareggio while the latter both in Viareggio and Marina Cala De' Medici ports.

For Smart Mooring a real yacht, with all the hardware and software components foreseen for the showcase, will navigate towards the Viareggio port. Before, a mooring workflow procedure will be initiated on the Portnet application, to make sure that all systems are ready for the arrival of the boat.

To make the trial successful it is necessary that the following events are correctly recognized and managed by the involved systems:

- The yacht is detected through LoRaWAN when still at a distance from the port; accordingly, a message is sent to the Portnet application which successfully manages this communication (e.g. by updating the workflow and alerting the workforce in the port area).
- The yacht, when is near the berthing pier but before its actual berthing, connects to the port's WiFi network. The SSP Innkeeper of the port establishes a connection with the yacht and updates its properties (availability and connection to the port's Smart Space) in the Core. A new message is sent to the Portnet application so that the mooring workflow can be updated and communication to the port personnel sent.
- Portnet, through the Smart Mooring enabler, accesses the yacht services to receive information about the latest route of the boat and the values detected by a series of sensors on board. This data is attached to the workflow of the current mooring procedure.
- The presence sensors on the CNAV pier detects when the yacht has finally berthed: a communication is sent to the Portnet application that can successfully close the workflow.

While the trial concentrates on the yacht arrival in the port, a possible "disconnection" mechanism from the SSP will be also tested to emulate the Yacht departure: we assume that it will be based on an explicit communication sent by the symbIoTe Agent of the SDEV to the SSP's Innkeeper, that can update the yacht properties in the Core (basically setting "availability" to false and removing the "connectedTo" properties amongst the SDEV and the SSP).

ASC will be tested in Viareggio and Marina Cala De' Medici: both ports already have the Centrale Acquisti marketplace application.

The trial will again involve yachts, this time berthed on a pier of the port and connected through WiFi at the port's S3M. The yacht will be configured (through real actions or simulations) to express a certain amount of maintenance or supply needs.

The trial will consist of the following steps:

- from the Centrale Acquisti web interface a request to access the yacht's machine data is made

- Centrale Acquisti will access the yacht's resources – through its enabler – to have the list of the needs on board. The application must perform a corresponding match-making with the possible providers in the port area.

The test will be repeated simulating different conditions (and therefore needs) on board.

### 4.5.5 Strategies for monitoring the trial effectiveness

The success of the trial can be easily assessed by the outcome of each step described in the previous paragraph.

Moreover, a preliminary list of KPIs to monitor the trial effectiveness, has been defined as follows:

- Ease of use, as experienced by port personnel, of the solutions prepared for Smart Yachting
- Savings in time by the port personnel in managing the mooring procedure through symbIoTe
- Accuracy of the data acquired from the boat and attached to the mooring workflow, respect those managed manually
- Number of possible suppliers to fulfill the yachts needs in the two ports
- Percentage of the most common resupply yacht's needs that can be mapped through IoT sensors and therefore managed by ASC.

### 4.5.6 Tentative time-plan

For the Smart Yachting trial the following plan has been proposed:

- Preparation
    - Goal: Define strategy to run the pilot
    - Time: December 2017 - January 2018
    - Tasks:
        - Agree on use case setting (obtaining authorizations from ports, agreement with – at least - one yacht builder, identification of the yachts to use for the trials, identifications of local suppliers, choice of the sensors to use)
        - Define which activities will be performed "live" and which should necessarily be simulated (e.g. detection of faults of the yacht)
- Venue Set-up
    - Goal: Preparing the ports and yachts for the trials
    - Time: February-March 2018
    - Tasks:
        - Install and configure IoT sensors in the ports
        - Deploy and configure enablers to integrate port's applications in the symbIoTe ecosystem

        - Deploy and configure applications, symbIoTe Agents and IoT platforms on the yachts
- Trials
    - Goal: Test devices, platforms and applications; report and correct issues
    - Time: April-June 2018
    - Main task:
        - Run simulated events
- Real Event Monitoring
    - Goal: Monitor the execution of the applications in the ports & yachts
    - Time: July-September 2018
    - Main task:
        - Gather data and KPIs to allow assessment.

### 4.5.7 Management of ethical issues

For the Smart Yachting trial no personal data will be specifically acquired. Its two showcases will collect machine data, taken from sensors on board of the yachts.

Information about users or their ownership (e.g. the Yacht) is not directly managed or stored in the symbIoTe enablers developed for the project: it is instead managed by the two existing Navigo applications – Portnet and Centrale Acquisti – that will be integrated in the trials, whose compliance with privacy laws (e.g. GDPR) is of course beyond the scope of symbIoTe.

The only information that might have, if crossed with users' profile, some relevance for privacy, is the latest routes of a yacht involved in the Smart Mooring trial. In any case, as said, these data won't be stored in any symbIoTe component, but it is managed on the Portnet application only. Moreover the description of the latest routes is already managed in Portnet, albeit at present it consists only in a textual field filled up by the port operator with the information declared by the yachtsman.

For what has been said above, we don't consider Smart Yachting as a critical trial for what concerns privacy and, more generally speaking, ethical issues.

In any case, all users involved in the two showcases will receive a description of the trials and how the Navigo applications will deal with the machine data acquired through the symbIoTe infrastructure.

# 5 Conclusions

The present document describes the trials planned in the project. Every use-case foreseen in symbIoTe has been considered and at least one trial has been scheduled for it.

For Smart Residence four different trials have been foreseen, for each one of its applications developed in symbIoTe. In particular, the Smart Healthy Indoor Air trial will take place in Barcelona. Smart Controller and Home Comfort will be both tested at Nextworks' premises in Pisa, while Smart Health Mirror's trial will take place within the living lab at the University of Vienna.

The Smart Mobility and Ecological Routing Use Case trial is based on a rich scenario involving three European locations: Porto, Vienna and Zagreb. EduCampus trial will be executed at the Karlsruhe Institute of Technology (KIT) and at Fraunhofer IOSB. Finally, for Smart Yachting there will be two trials arranged on the Italian ports of Viareggio and Rosignano (Marina Cala De' Medici), both in Tuscany.

The detailed time-plan for each trial has been presented, together with an update on the current state of activities. Work therefore is proceeding in line with the general project planning.

# 6 References

[1] DoW - symbIoTe Description of work

[2] D5.5 - Documentation of Trial Preparation Procedures (symbIoTe deliverable)

[3] D1.3 - Final Specification of Use Cases and Initial Report on Business Models (symbIoTe deliverable)

[4] D2.4 Revised Semantics for IoT and Cloud Resources (symbIoTe deliverable)

# 7 Acronyms

| | |
|---|---|
| AAL | Ambient Assisted Living |
| AIT | Austrian Institute of Technology GmbH |
| APP | Application |
| ASC | Automated Supply Chain showcase of the Smart Yachting Use Case |
| ATHC | Atlètic Terrassa Hockey Club |
| ATOS | ATOS Spain SA |
| B2B | Business-To-Business |
| BLE | Bluetooth Low Energy |
| C2C | Business-To-Consumer |
| C&M | Research Group Cooperation & Management |
| CNIT | Consorzio Nazionale Interuniversitario per le Telecomunicazioni |
| DOW | Description of Work |
| EU | European Union |
| FER | Faculty of Electrical Engineering and Computer Science, University of Zagreb |
| GDPR | General Data Protection Regulation |
| IAQ | Indoor air quality |
| ICOM | Intracom Sa Telecom Solutions |
| ICT | Information and Communication Technology |
| IOSB | Fraunhofer Gesellschaft zur Förderung der Angewandten Forschung ev |
| IoT | Internet of Things |
| KIT | Karlsruhe Institute of Technology |
| KPI | Key Performance Indicator |
| LoRaWAN | LoRa Alliance Technology Low Power Wide Area Network |
| MIM | Meta Information Model |
| MoBaaS | Mobility Backend as a Service |
| NAVIGO | Na.Vi.Go. Società Consortile a Responsabilità Limitata |
| ND | Navigo Digitale platform |
| NXW | Nextworks |
| OSS | Open Source Software |
| POI | Points of Interest |
| PSNC | Instytut Chemii Bioorganicznej Polskiej Akademii Nauk |
| QoS | Quality of Service |

| | |
|---|---|
| RAP | Resource Access Proxy |
| R&D | Research and Development |
| REST | REpresentational State Transfer |
| S3M | SymbIoTe Smart Space Middleware |
| S&C | Sensing & Control Systems SL |
| SDEV | (Roaming) Smart Device |
| SLA | Service Level Agreement |
| SSP | Smart Space |
| symbIoTe | Symbiosis of Smart Objects across IoT Environments |
| ToC | Table of Contents |
| UC | Use Case |
| UNIDATA | Unidata Spa |
| UNIVIE | Universität Wien |
| UNIZG-FER | Sveučilište u Zagrebu, Fakultet Elektrotehnike i Računarstva |
| UW | Ubiwhere Lda |
| VIP | Vipnet Društvo sa ograničenom odgovornošću za usluge javnih komunikacija |
| WLI | ATOS Wordline International |
| WP | Work Package |