Researching crowdsourcing to extend IoT testbed infrastructure for multidisciplinary experiments, with more end user interactions, flexibility, scalability, cost efficiency and societal added value

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Synthetic Handbook for IoT testbeds

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Abstract

This document represents a very concise Synthetic Handbook for users of the IoT Lab Platform which is a two-sided platform connecting Researchers using the TBaaS with participants with smartphones. It provides guidance for a number of situations related to the use of the platform. It also provides a guidance on how users with different access rights obtained through different roles can use the platform, which requirements are for which specific role and what functionalities they can use. In addition, this Handbook provides an insight into privacy mechanisms embedded within the tools to protect the platform users and gives instructions on what to do in case of a privacy breach. Different tools used within the platform are explained and necessary instructions on how to use them are provided. The Handbook concludes with the FAQ section.

Acknowledgements

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## Abbreviations and acronyms

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<td>API</td>
<td>Application Program Interface</td>
</tr>
<tr>
<td>CoAP</td>
<td>Constrained Application Protocol</td>
</tr>
<tr>
<td>DMZ</td>
<td>Demilitarised Zone</td>
</tr>
<tr>
<td>DNS</td>
<td>Domain Name System</td>
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<tr>
<td>EC</td>
<td>European Commission</td>
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<td>EUAL</td>
<td>End user application layer</td>
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<tr>
<td>FP7</td>
<td>Seventh Framework Programme</td>
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<td>GPS</td>
<td>Global Positioning System</td>
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<tr>
<td>GUI</td>
<td>Graphical User Interface</td>
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<tr>
<td>HTTPS</td>
<td>Hypertext Transfer Protocol Secure</td>
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<td>ICT</td>
<td>Information and Communication Technologies</td>
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<tr>
<td>IoT</td>
<td>Internet of Things</td>
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<tr>
<td>IP</td>
<td>Internet Protocol</td>
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<tr>
<td>IPR</td>
<td>Intellectual Property Rights</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
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<tr>
<td>ITU</td>
<td>International Telecommunication Union</td>
</tr>
<tr>
<td>KPI</td>
<td>Key Performance Indicators</td>
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<tr>
<td>LAN</td>
<td>Local Area Network</td>
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<tr>
<td>SSH</td>
<td>Secure Shell network protocol</td>
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<tr>
<td>TBaaS</td>
<td>Testbed as a Service</td>
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<tr>
<td>UI</td>
<td>User Interface</td>
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<tr>
<td>WP</td>
<td>Work Package</td>
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<tr>
<td>WPL</td>
<td>Work Package Leader</td>
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<tr>
<td>XML</td>
<td>Extensible Markup Language</td>
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Executive Summary

The IoT Lab Platform Handbook is a useful guidance material for future users of the Platform. This refers to all types of platform users such as Researchers of different backgrounds, Providers of resources (testbed owners), Sponsors, Charities or Participants providing their data or knowledge and information through the mobile applications on their smart phones.

The Handbook provides also information about the privacy mechanisms embedded within the tools to protect the users’ privacy including the information about sensitive data and what to do in case of a privacy breach. Measures undertaken to ensure secure data storage, transfer and collection of data are also presented. Incentivise support for crowd participants is also explained and the Handbook concludes with the FAQ section.
1 Introduction

This deliverable represents a Handbook for users of IoT Lab Platform.

1.1 The IoT Lab Project in Brief

IoT Lab is a European research project exploring the potential of crowdsourcing to extend European IoT testbed infrastructure for multidisciplinary experiments with more end user interactions. The project researches and develops:

1. Crowdsourcing mechanisms and tools enabling testbeds to use third parties’ resources (such as mobile phones), and to interact with distributed users (the crowd). The crowdsourcing enablers will address issues such as privacy by design, identity management, security, reputation mechanisms, and data ownership.

2. Virtualization of crowdsourcing and testbed components by using a meta-layer with an open interface, facilitating the integration and interaction with heterogeneous components. It should ease data integration and reduce the cost of deployment in a real environment.

3. Ubiquitous Interconnection and Cloudification of the testbeds resources. It will research the potential of IPv6 and network virtualization to interconnect heterogeneous and distributed resources through a Virtual IoT Network and will integrate them into the Cloud to provide an on-line platform of crowdsourcing Testbed as a Service (TBaaS) available to the research community.

4. End user and societal value creation by analysing the potential end users and crowdsourcing participants to propose an optimized model for end user adoption and societal value creation.

5. “Crowdsourcing-driven research” as a new model in which the research can be initiated, guided and assessed by the crowd. It will compare it to other models.

6. Economic dimension of crowdsourcing testbed, by analysing the potential markets and business models able to monetize the provided resources with adequate incentives, in order to optimize the exploitation, costs, profitability and economic sustainability of such testbeds. It will also develop tools for future experiments.

7. Performing multidisciplinary experiments, including end user driven experiments through crowdsourcing, in order to assess the added value of such an approach.

The project is adopting a multidisciplinary approach and address issues such as privacy and personal data protection. To achieve these ambitious goals, the consortium consists of seven international academic or research partners and a SME that provides an expertise from complementary research areas, including Information and Communication Technologies, End user interaction, and Economics.
1.2 Purpose and scope of WP 8

The main goal of WP8 consists of disseminating and exploiting the scientific and technological knowledge acquired during the course of the project towards all relevant stakeholders: industry, research community and general public.

The overall objective of the WP8 Dissemination, Liaison and Exploitation is to increase the outreach of the IoT Lab project. Specific objectives are as follows:

- **Objective 1**: Proactively raise awareness of the project results through Web and social media, publications (conferences and journals), organisation of workshops, summer schools (SenZations and ENoLL) and participation in the IoT cluster concentration meetings.
- **Objective 2**: Contribute to IoT Labs activities and events.
- **Objective 3**: Develop individual exploitation plans and analyse the feasibility of joint exploitation.
- **Objective 4**: Develop a support pack for European IoT Labs interested in using the IoT Lab results and tools.
- **Objective 5**: Monitor and where appropriate, contribute to the standardization process, in particular with the ITU.

The above objectives were defined in order to achieve the IoT Lab goals in terms of connecting and using existing IoT testbeds, and proactively involving participation of the public through crowdsourcing, as well as Researchers taking part in the IoT experiments. In addition, the consortium is actively trying to find ways to jointly exploit the project results and use them beyond the duration of the project.

1.3 Purpose and scope of Task T8.1

In addition to defining the project communication strategy and setting up the project communication tools and media, the purpose of this Task is to ensure regular communication of the project results. Providing a Handbook (D8.4) for future users of the developed IoT Lab Platform is a good way of presenting the results and promoting the tool. Furthermore, the Handbook provides a useful material for Researchers and SMEs who want to create new use cases and applications utilising the crowdsourced data.

1.4 Purpose and Scope of the Current Document

It is the purpose of this document to provide a useful Handbook and a guidance material for the future users of the IoT Lab Platform. This refers to providing information for:

- Crowd participants who access the platform anonymously via mobile application.
- Researchers with different scientific backgrounds, testbed owners, sponsors and charities who access the Platform via TBaaS (Web application).
- All roles informed about the registration process as well as about the available functionalities.
- All users are provided information on privacy protection (focus on crowd participants) and security measures included in the Platform, and on other aspects of the Platform trustworthiness as well as on incentives mechanisms supported by the Platform.
1.5 Structure of the Document

The structure of the document is as follows:

- The Introduction is provided in Section 1.
- A brief overview of the IoT Lab Platform capabilities is provided in Section 2.
- How to access the Platform is provided in Section 3.
- Introduction to the Web tool and information on how to register to the Platform with different users’ roles is provided in Section 4.
- A detailed guidance on how to use the Platform as a Researcher, Testbed owner (resources provider), Sponsor or Charity respectively is provided in Sections 5 to 8.
- LimeSurvey as a third-party tool that is integrated within IoT Lab and used for collection of crowd inputs in a crowd interactions section of the tool is provided in Section 9.
- A detailed guidance for crowd participants on how to use the Platform and contribute to different types of multidisciplinary researches is provided in Section 10.
- A brief information on incentives mechanisms provided to end user participants is provided in Section 11.
- A detailed description of privacy and security mechanisms incorporated within the Platform that ensure protection of identities and data respectively is provided in Section 12.
- Information on support for other aspects of trustworthiness is provided in Section 13.
- A list of frequently asked questions is provided in Section 14.
- A quick reference table is provided in Section 0.
- The Document concludes with Section 16.
2 Brief Overview of IoT Lab Platform

This section provides a brief overview of IoT Lab Platform capabilities through pictures and gives an initial idea on what it can offer to its users.

Do you want to support and take part in research activities? Join a smart community? Contribute to addressing important issues and build a better world? Or you might be interested in leading a research and collecting data for your research?

IoT Lab is here to make all this possible!

Wonder how it works?

By using the IoT LAB smartphone app, you propose, vote and rank research ideas
and take part in research projects by providing your inputs and mobile phone sensor data.

For example, by providing noise or pollution level data, you are directly helping the Researchers who are part of the community.

In return, the IoT Lab provides you with the results and a certain amount of points. Moreover, in some projects your points can be exchanged for money donations to your favourite charities.

This is the main page of the IoT Lab mobile app enabling you as a crowd member to take part in researches of interest for you.

You can be both an IoT Lab crowd participant and researcher at the same time. Each of us can contribute to identifying and solving problems related to noise, pollution, energy consumption and many more that we encounter in our communities.

For example, as a researcher registered on IoT Lab Platform you can manage the
research process, involve the community and school members, deliver experiments and gather results. Results can help you to recognize necessary measures for addressing your problems.

IoT Lab Platform can be through the homepage of the Website: www.iotlab.com.

The IoT Lab is ideal for you as a crowd participant if you are in the mood to:
- Join research activities
- Support charities
- Have fun in a smart community

If you are a researcher, the IoT Lab is there for you to:
- Access a community of voluntary participants from different regions
- Access a testbed as a service with crowdsourcing tools and IoT testbeds
- Join a community of Researchers
IoT Lab community wants to change the way research is performed by enabling new forms of interaction between the Researchers and the end users through crowdsourcing and crowdsensing.

- Members can lead, suggest, select and take part in all sorts of experiments, and researches.
- What’s most important is that YOU share your knowledge and data that YOU decide to share. All collected data are fully anonymized because the IoT Lab is completely privacy friendly.
- Be a part of the smart people community! Join us today and participate, discover, initiate or manage innovative research within IoT Lab community! Crowdsource the future!
3 IoT Lab Platform – who can use it and how?

IoT Lab Platform is a two-sided platform connecting Researchers and participants in different types of multidisciplinary research projects aiming to achieve a richer and more distributed experimentation.

The Researchers’ side of the platform is called Testbed as a Service (TBaaS) and it can be accessed via Web portal http://www.iotlab.com/ through the ‘Lead a Research’ section of the homepage.

The crowd participants, on the other side, access the platform via their smartphone devices. IoT Lab mobile application is available on https://play.google.com/store/apps/details?id=uk.ac.surrey.ccsr.iotlab&hl=en.

4 Testbed as a Service - Web tool

IoT Lab Testbed as a Service represents a user-friendly Web tool for Researchers of different backgrounds. In addition to the Researcher’s role, representing the central role within the TBaaS, there are four additional roles implemented within this tool.

Each role as seen in Figure 1 requires a separate account and provides an access to different functionalities relevant for the role.

![Figure 1: Different users of IoT Lab Platform – TBaaS](image-url)
4.1 User registration (for any role)

Registration to the IoT Lab Platform for any role is performed through the form illustrated in Figure 2 which can be accessed through the section on the IoT Lab homepage called Lead a Research. The user selects the role (Researcher, Testbed owner, Sponsor or Charity), completes the corresponding registration form and submits the request by pressing the Join IoT Lab! button.

Upon sending the registration request with a unique username and email address and gaining the approval from the Platform Administrator, the user receives an email with the activation link. The user’s password is saved in an encrypted form in a database. Note, that the application for the Charity role is different – it is a 2-step process and it is explained in detail in Section 8.

Description of functionalities available for each role is provided in Sections 5-8.
5 TBaaS for Researchers

This section includes a collection of instructions on how to use the Platform as a Researcher via TBaaS (Web app).

Figure 3 shows functionalities available to the Researcher through his or her page My Account as Researcher upon successful registration.

![Figure 3: TBaaS for Researchers](image-url)
5.1 My Account as Researcher

Upon successful registration as described in Section 4, the Researcher will arrive to the central place for Researchers My account as Researcher page as shown in Figure 4, which is the starting point for all research related activities.

![Figure 4: My Account as Researcher – Main Page](image)

From this page, the Researcher can perform various activities as explained in this section.

Create a New Research Project

The Researcher is prompted to include details about the research project such as title, start/end date, description, objectives, category, and beneficiaries etc. as shown in Figure 5. Once saved, it will appear on the list of My Research Projects.

![Figure 5: Create a new research project interface](image)
My profile

The Researcher’s profile, as entered during registration, can be edited and the Researcher can set his/her account to accept donations as shown in Figure 6.

![Figure 6: My profile as Researcher page](image)

My activity log

This page provides an information about the Researcher’s activity in the Platform as shown in Figure 7. The total ratings for the Researcher and his or her experiments are provided.

It also provides an up to date status of the budget for the Researcher, which he/she can allocate to his/her researches.

![Figure 7: Activity Log for the Researcher](image)
Get inspired

This page provides an access to crowd proposed and ranked ideas as shown in Figure 8. It is available to the public and the rating and ranking of an idea is calculated automatically as a weighted sum that takes into account average value of the users’ evaluations for this idea, the number of users that evaluated the idea as well as the lifetime of the idea.

![Figure 8: Top ranked research ideas](image)

Ongoing research

This page as shown in Figure 9 provides a view to all published and ongoing researches that can easily be filtered using the key words or dates and it is available to the public at:

![Figure 9: List of publicly available researches](image)
My Research projects

This page displays the Researcher's research projects and provides an access to the project management as shown in Figure 10.

Each research can be:

- Set active/archived
- Set public/private
- Edited (profile)
- Deleted

![MY RESEARCH PROJECTS](image)

*Figure 10: List of My Research projects*

5.2 Research dashboard

Upon creating the Research Project Profile and selecting it, the Researcher gets transferred to the Research Dashboard page where all activities related to the selected research project can be conducted. The research dashboard page is illustrated in Figure 11. The page contains the information about the research project name, if it accepts donations as well as information about the research budget status. If the research is set to accept donations, the banknote sign will appear next to the research and also the research budget will be displayed as shown in the inset figure. This page also provides an access to:

- Research profile
- Crowd interactions section
- IoT interactions section
- Upload reports section
- Notifications
Below is an explanation in detail of each of these functionalities.

5.2.1 Research profile

This section provides project details as specified by the Researcher in the research profile. It is possible here to set the research to accept donations (this button disappears once it has been selected). Also, upon completion of the research, the Researcher triggers the research completion action by selecting the option shown in Figure 11 Set project to ‘completed’ which initiates automatic distribution of available donated funds for this research to three different recipients according to the Incentives support framework as described in Section 12.

5.2.2 Notifications

Researchers can, from the Research Dashboard, select the notifications button and use the pop-up window to send notifications to crowd participants as shown in Figure 12. It is possible to use the filter based on the Research Code or geo-location to define the target crowd participants’ group. For example, this can be used to inform all participants on the Platform about the upcoming research project requiring their participation and ask anyone who wants to participate to use the Research Code in their app’s setting. The Researcher can then in the project perform the filtering based on the Research Code.

Figure 11: Research Dashboard page (view on research profile tab)

Figure 12: UI pop-up window for sending notifications to crowd participants
5.2.3 Crowd interactions

Crowd interactions refer to engaging the crowd participants in IoT Lab research through surveys.

This is enabled through interactions between IoT Lab TBaaS and LimeSurvey as shown in Figure 13. Access to LimeSurvey through IoT Lab requires separate logging and specific settings as described in Section 9.

![Diagram of Crowd Interactions](image)

**Figure 13: Conducting interaction with the Crowd: process steps**

Crowd interactions can be performed from the Crowd interactions tab shown in Figure 14 by following the steps below:

![Research dashboard page and available functionalities](image)

**Figure 14: Research dashboard page and available functionalities**
Step 1: LimeSurvey editor: Create a survey on LimeSurvey

In order to create a Survey on LimeSurvey and integrate results with the IoT Lab, it is necessary to follow the instructions explained in Section 9.2 (Note: these instructions are also available on a Research Dashboard UI shown in Figure 14). Once the LimeSurvey and steps listed in the instructions are completed, it is possible to go to Step 2.

Step 2: Create survey on IoT Lab (wizards)

To proceed further with the crowd interactions, it is necessary to complete the survey creation in the IoT Lab Platform also.

![Figure 15: Create survey in IoT Lab and connection with LimeSurvey](image)

This assumes the following actions: provide survey name, description and include SurveyLink from the LimeSurvey survey. It is then possible to open the LimeSurvey from this window as illustrated in Figure 15.

Step 3: Participants’ list wizard: Use wizard to create Participants’ list

In order to create the target group of end user participants, the Participants’ list wizard is used as shown in Figure 16. It includes 3 steps:

1. Specify the name
2. Perform filtering using different criteria including geo-location
3. Make a final selection of participants
Figure 16: Participants’ list wizard

Note: It is possible to push the survey towards all participants or a selected group of participants filtered by using the socio-economic profile, towards a geographic area (geofencing) or to subscribe users of a specific research using the Research Code for filtering.

Step 4: Send Survey wizard

Once the survey and the participants’ list has been created, the Send Survey wizard can be used to post the survey to the target list as shown in Figure 17.
All participants’ lists created by the Researcher can be accessed from the main Crowd interactions page (View my lists) as seen in Figure 18.

**Figure 18: View on the created participants’ list**

**Step 5: Access to data**

Results collected through surveys are stored in the LimeSurvey database and can be extracted in an Excel format. Socio-economic profile of all users that took part in completing the survey are stored in IoT Lab and can be accessed through the button Respondents’ profile. The common column in these two files is ResponseID which is used to perform the final merging of two data sets as shown in Figure 19.

**Figure 19: Merging users’ responses from LimeSurvey with their socio-economic profiles available in IoT Lab**
5.2.4 IoT interactions

Conducting experiments using IoT resources is performed through the IoT interactions interface as shown in Figure 20.

![Figure 20: Research dashboard – IoT interactions](image)

In order to set up an experiment, it is required to first reserve resources.

**Resources reservation**

This can be done by selecting the Reserve Resources button that transfers to the page Resources Reservations as shown in Figure 21. A list of available resources is given to the Researcher who can view, filter and reserve a subset of them for his/her research and use them in subsequent experiments. Available filters are also shown in Figure 21 below and it shows how a search has been performed using the key word entered in the Search field. Once the set of required resources has been found, they need to be reserved by ticking the box on the left-hand side of each resource including the reservation time frame in Start and End Date fields. Upon successful reservation, the Researcher is transferred back to the main IoT interactions page (as shown in Figure 20) where he/she can view all reserved resources as shown in Figure 23. Reserved resources can also be seen on the map as shown in Figure 23.
Figure 21: Resource Reservation page with filters available

Figure 22: My Reserved Resources (an option provided to include them in an experiment)
Note: The Researcher can also see his/her past and expired reservations. It is also possible to cancel the reservation of each resource by selecting the Cancel button in Figure 22.

Create a new experiment

To create a new experiment, the Researcher needs to select from the My Reserved Resources List all resources that will be included in the experiment and to select a Create a new experiment button. This will show a dialog window as in Figure 24 requiring naming of the specific experiment and a short description.

Resources provisioning

The first step in composing the experiment is provisioning resources as shown in Figure 25 that include definition of the experiment duration, and sampling frequency for each resource, etc.

Scenario composition

This module receives the information on how reserved resources will be used using the If This Then That type of scenarios. This function sets the conditions for the selected set of sensors and defines the outcome of that experiment if/when the condition is met.
Figure 25: Possible scenario of getting a value from a sensor: Sampling the temperature and CO2 every 10 minutes in a given time interval

Possible scenarios include:

Get a reading value from a specified resource (sensor): Getting the value from specified resources (sensors) with a specified sampling rate (frequency of reading) over a specified time frame. An example is a value from the temperature and CO2 sensors every 10 minutes over 5 hours as illustrated in Figure 25.

Set a condition: A condition can be absolute, average, minimum or maximum value of one or more resources being greater, equal or lesser than a set value. Logical operators can be used in case more conditions apply. An example is ‘if the average value of sensor 1 OR average value of sensor 2 is smaller than 0’.

Set an outcome: This refers to setting the action that needs to be taken if specified conditions are met. Actions can refer to collecting more readings from the sensors or actuating the actuator. Logical operators are included here too. An example is to actuate the selected (reserved) actuator if all specified conditions are met (logical AND).

Define an action: Actions are combinations of conditions and outcomes. Actions are set in an "IF-THEN" form in order to clarify their meaning. An example of an action can be \( \text{IF condition 1 AND condition 2 are true THEN perform outcome 1} \). The logical operator AND is actually defined in the outcome and not in the conditions, as specified above.

One example of scenario composition is illustrated in Figure 26.
Experiment execution

Upon finalizing the experiment composition and submitting the scenario, the Experiment Execution Module is activated which starts running the experiments based on the submitted information.

Submitted experiment is then shown within the table IoT Experiments in the IoT interactions section of the Research Dashboard (Figure 20) providing also the access to the experimental results.

By selecting the Results of Experiment, this will display the page with all results as shown in Figure 27 which can then be exported to Excel (or CVS format).

![Figure 26: Scenario composition enabling specifying the condition and outcome](image)

![Figure 27: Results of the experiment](image)
5.2.5 Upload reports

Upon completing the research/experiments, the report with research results can be published in TBaaS by uploading them in the *Upload Reports* section. Uploaded reports become available on both the public side of TBaaS and within the mobile application (in a section of ongoing public researches.) as shown in Figure 28.

![Figure 28: Upload reports tab within Research Dashboard page](image)

5.3 Anonymised communication with crowd participants

Crowd participants can send anonymised messages to Researchers as explained in Section 10. The Researcher will receive a notification about newly arrived messages. The number of new unread messages will appear on the *My Account as Researcher* page as shown on the left-hand side image of Figure 29. The Researcher can respond to received messages from the crowd participant from the *Messages* window as shown in Figure 29.

![Figure 29: Web interface for exchange of messages with crowd participants (note: participants remain anonymous)](image)
6 TBaaS for Testbed owners

Registering as Testbed owner via the Web portal presumes that you or your institution already have the testbeds/resources integrated within the IoT Lab Platform.

Integration of testbed resources within IoT Lab Platform

IoT Lab is a conjunction of a diverse set of IoT testbeds. It has federated devices ranging from simple to sensors to mobile phones. Their characteristic parameter is the ability to call them in a RESTful manner. To overcome complex migration problems with the heterogeneity of resources, we adopted the RSpec (resource specifications) scheme. RSpec is an XML schema used to describe all available resources in the architecture. RSpec provides tags that describe several properties of each resource such as an IP address, a protocol for communication, an access port, or a location. In particular, the tags above are aligned with the types and function sets defined by the IPSO Application Framework. For instance, a luminance sensor following the IPSO Application Framework is categorised as “ipso.sen.lum”.

The schema provides tags that describe nodes (<node> </node>) which include properties allowing the system to access the resources of each node directly. These properties include the IP address (IP), the protocol the node understands (protocol) and the port (port).

Inside the <node> tag, the schema provides tags for individual resources (<resource> </resource>) that describe in detail the relative path that must be used by the architecture to request values from each resource, as well as the type of the resource (e.g. sensor or actuator). Inside the <resource> tag, the schema describes the resource using tags that follow the types and function sets defined by the IPSO Application Framework.

Other information that contained inside the <node> tag includes an <interface> tag that provides more information about the component ID and a <location> tag that provides information about the physical location of the node. In the Figure 30 below, we provide a snippet from an indicative RSpec XML file that describes some nodes in Geneva’s testbed.

```xml
<nodes>
    <node component_manager_id="urn:publicid:IDN+iotlab:ctctestbed+authority+cn"
        exclusive="false" component_name="node_8.cti" ip="2001:620:607:8f00:8"
        protocol="tcp" port="5683">
        <interface component_id="urn:publicid:IDN+iotlab:ctctestbed+node:node_8.cti"></interface>
        <location longitude="21.7333" latitude="38.25"/>
        <resource name="Transformers" path="/gpio" type="actuator" unit="None">
            <gpio>
                <data_type="interface_def="a" name="Transformers"
                    path="/transformers" resource_type="ipso.gpio.dout" resource_id="593"/>
            </gpio>
        </resource>
        <resource name="Energy Meter" path="/gpio" type="sensor" unit="KWh">
            <gpio>
                <data_type="KWh" interface_def="a" name="Energy Meter"
                    path="/energy" resource_type="ipso.gpio.din" resource_id="594"/>
            </gpio>
        </resource>
    </node>
</nodes>
```

**Figure 30: Rspec description**

Two procedures exist through which federation can take place on his or her tested with IoT Lab:
The first procedure targets organised entities such as universities. IoT Lab’s Administrator provides them with a Debian virtual machine with preinstalled SFAWrap. Using a simple script, they can configure SFAWrap and fill in some function stubs with the description of their resources. From these functions, the RSpec describing their resources is generated.

The second procedure targets individuals. They have to contact a Platform Administrator who checks their resources validity and conformity with that of the platforms. If the conformity level is high, the Administrator proceeds with the integration of their resources.

**Functionalities available to Testbed owners through IoT Lab Platform**

Testbed owners are users that belong to entities that make physical testbeds available. These entities can be either universities, companies, foundations or individuals. They are responsible for maintaining their testbed resources in a coherent way, which entails inserting/updating new resources and specifying the resource accessibility using related database APIs.

Figure 31 depicts the Testbed Owner role on the IoT Lab site.

Every testbed owner can register through the IoT Lab Platform and via this role they can see their resources (Figure 32) as well as all reservations of resources (past, current and future) made by the Researchers (Figure 33). They can also cancel reservations of their resources.

**Figure 31: TBaaS for Testbed owners**
Figure 32: Testbed owner’s view on their resources. Cancellation of any reservation can be done from this page.

Figure 33: Testbed owner’s access to the list of all reservations for the selected resource.
7 TBaaS for Sponsors

Register as a Sponsor and make donations to researches and/or Researchers

One can register as a Sponsor if wishing to donate money to a specific Researcher or directly to the selected research.

The page My Account as a Sponsor on Figure 34 looks similar to Figure 34 and provides access to the following functionalities:

- Make donations to Researchers/researches that accept donations
- List and view all past donations
- View or edit your profile as a Sponsor

![MY ACCOUNT AS SPONSOR](image)

*Figure 34: My Account As Sponsor – Main page*

List of Researchers and researches accepting donations can also be found on the public side of the Website (see Figure 35).

http://www.iotlab.eu/SupportAResearchAndIoTLab/Donations

![Figure 35: Public side of Website showing the list of researches and researchers accepting donations (left) and specifying the donation amount for selected research (right)](image)

Payment transaction requires registration as a Sponsor and it is conducted using the PayPal payment gateway. Upon successful payment, the user gets confirmation and the donation gets allocated to the sponsored Researcher or research.

Each Sponsor has an access to the list of all donations performed and can follow the status of his or her donations. Once the research donation allocation is complete, it gets distributed based on settings provided by the Platform owner which is valid for the whole Platform.
Based on Platform settings controlled by the Platform Owner, a small portion of donated money is given for the platform maintenance (IoT Lab Association is responsible for this). The remaining amount is distributed to the participants’ favourite charities based on their earned points which reflect their level and quality of participation in the Platform. This is divided in the following way: Platform sends the set portion of donated money to the favourite charity of the best performing participant globally while the remaining donations are distributed to favourite charities of all participants taking part in the sponsored research in proportion to their earned points.
8 TBaaS for Charities

Register as a Charity

An organisation wanting to register within the IoT lab Platform as a Charity go through the 2-phase registration process. Upon providing the basic registration information on the IoT Lab Website (the common entry point for all users of IoT Lab TBaaS), a new page will appear as “My Account As Charity” which will prompt additional inputs, as shown in Figure 36 and the entire process flow is described in Figure 37.

![Figure 36: Applying for the Charity Account in IoT Lab](image)

These include:

- Upload formal documentation about being registered as a charity organisation
- Include bank account details in the profile form including other required information
- Include short description of activities proving in such a way the legal status

This is obligatory since charities appear as possible recipients of sponsorship funds through platform participants who selected them as favourites.
At the moment, the Charities have no real interaction with the IoT Lab Platform. Their names appear on the list of available charities within the mobile app used by the crowd upon successful validation process by the Platform Administrator. Each user can select their favourite charity during the registration process or upon joining the specific research.
9 Third party tools in IoT Lab Platform

9.1 LimeSurvey as part of the Crowdsourcing tools

LimeSurvey is a part of the Crowd Interactions Tool within the IoT Lab TBaaS Platform and its purpose is explained in detail in Section 5.2. LimeSurvey is hosted by IoT Lab Web server and it is used through the IoT Lab Platform for the creation of surveys and collection of users’ responses. Points of interaction between the two tools are illustrated in Figure 13 shown earlier.

IoT Lab TBaaS is used for creating the participants’ list based on different filtering criteria (socio-economic profile, geofencing, and Research Code based etc.) and sending the survey to that list of participants. LimeSurvey is used for creating the surveys, collecting responses and exporting collected results. At the end, LimeSurvey results are merged with the socio-economic profile of its respondents available through the Platform.

Access to the LimeSurvey tool through the IoT Lab Platform requires a separate user account, different from the IoT Lab account. Common LimeSurvey account is currently available for all IoT Lab Researchers of which the username and password are provided within the Tool. If the IoT Lab Researcher wants to get a personal LimeSurvey account that can be used only by him or herself for interactions with the crowd through IoT Lab, he or she can request it by pressing the button - Request A Personal LimeSurvey Account from the Crowd interaction page which will send the email request to Platform Administrator.

In order to be able to access the LimeSurvey results from IoT Lab Platform, every IoT Lab Researcher need to adjust the LimeSurvey setting in a way explained in the next section.

9.2 LimeSurvey settings for IoT Lab Researchers

<table>
<thead>
<tr>
<th>INSTRUCTIONS FOR SURVEY CREATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>To be able to perform crowd interactions through IoT Lab it is necessary to adjust the settings in LimeSurvey in a way explained here:</td>
</tr>
</tbody>
</table>

1. Add an "End URL": (Figure 1)
   - a. Edit Text Elements (Pencil icon and then the small pencil icon)
   - b. Change End URL to: `http://iotlabcb.iotlab.eu/insertSurveyResult.php?userId=[PASSTHRU:userId]&surveyId=[PASSTHRU:surveyId]&limeSurveyId=[SID]&limeResponseId=[SAVEDID]&limeToken=[TOKEN]`
   This is a static value and should be entered exactly like this on every survey.

2. Make the above URL automatic: (Figure 2)
   - a. Edit General Settings (Pencil Icon and then Gauges Icon)
   - b. Go to Presentation & navigation
   - c. Change Automatically load URL when survey complete? to "Yes"

3. Add 2 URL parameters: (Figure 3)
   - a. Edit General Settings (Pencil Icon and then Gauges Icon)
   - b. Go to Parameters & navigation
   - c. Click "Add URL parameter"
   - d. Enter "userId"
   - e. Click "Add URL parameter" again
   - f. Enter "surveyID"

Please, log in first and go to "create a survey".
Once the form for the survey creation appears, scroll down and include in “End URL” field the url as provided in Step 1.

Go to Presentation and navigation tab and follow the Step 2 as shown in figure below.

As a final step, include 2 URL parameters as described in Step 3.
### Edit survey settings

<table>
<thead>
<tr>
<th>Action</th>
<th>Parameter</th>
<th>Target question</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>userId</td>
<td>(No target question)</td>
</tr>
<tr>
<td></td>
<td>surveyId</td>
<td>(No target question)</td>
</tr>
</tbody>
</table>

**Figure 3**

Add 2 URL parameters

---

*Step 3.*

Add 2 URL parameters
10 Smartphone app - Crowd Tool

As mentioned earlier in Section 3, the crowd participants access the IoT Lab Platform via the mobile application. This application is free of charge and can be downloaded by any device that runs Android 4.4 or newer, from the official Google Play Store.

After selecting the appropriate « Install » button, the application will be automatically downloaded and installed to the user’s device. It is now ready to start and be personalised.

Personalisation takes place during the first boot of the app. A simple wizard guides the users through the necessary steps. Choices concerning device connectivity, sharing policies, and commercialised participation can be made. Moreover, one can provide some anonymous socio-economic profile that will eventually help the user become part of the crowd. It’s important to highlight the fact that the personalisation steps can be skipped and that the default policy is set as “opt-in”.

After the initial set-up, the user is now on the main screen/dashboard of the application. All the important information concerning new surveys/researches are displayed clearly. Additionally, a slide-in menu can navigate the user to different functionalities available.

Propose Idea

This activity includes a simple wizard that helps the user to propose a new research idea as shown in Figure 38. Editable text boxes and some predefined multiple choice menus pave the path and make the user experience smoother and friendlier. At the end of the process, an information message is displayed to the user.

Browse Available Researches – Participate

By selecting this option, the user comes across all the available-to-join researches in the form of a list as shown in Figure 39. By touching one of them, he or she is redirected to a more detailed view. Information concerning the research and the Researcher is displayed in detail. Additionally, a floating button will enable him or her to take part or quit the selected research.
Figure 39: Participate in selected research

Browse Proposed Ideas – Rank

Similar to available researches, proposed ideas are presented in the form of a list. However, the detailed view is a bit different as shown in Figure 40. Information about the crowd rating is displayed, accompanied by the “Rating” button. When the user presses it, an instruction dialogue is presented accompanied with a rating system that will eventually send the user’s opinion to the back end.

Figure 40: Browse and rate proposed ideas
Contact Researcher

In a detailed view of a research project, there is a “Contact” button as shown in Figure 41. When the user presses it, a dialogue is displayed. This dialogue gives instructions to the user on how he/she can send an anonymised message directly to the Researcher leading the selected research project.

![Figure 41: Contact the Researcher anonymously](image)

Connection/Communication with the TBaaS

Since the IoT Lab mobile application is the Tool used by the crowd, it is evident that there is a plethora of interactions happening with the back end and the TBaaS.

**Registration:** During the first boot of the application, a background mechanism is responsible to register the device and the user to the backend. Additionally, all the embedded sensors/resources of the phone are registered by calling the corresponding API.

**Update:** Whenever a user changes his/her socio-economic profile or the sharing policies, the application is communicating with the TBaaS to update the appropriate variables.

**Crowdsourcing:** During the experiments, sensor data is generated from the users’ mobile devices. All this data is stored in the back end by calling the corresponding API. Later on, the experimenter can see, filter, and export it.

**Content fetching:** The application offers the ability to view available researches, ideas, ratings, surveys, and resources. All of this information is dynamically acquired by the TBaaS and the dedicated IoT Lab database.
11 Incentivisation of end user participants

IoT Lab provides a support for incentives in order to better motivate the crowd to participate in the experimentation process. Actors related to the Incentives Framework are Sponsors, Researchers/researches, End user participants and Charities.

The implemented scheme enables a Sponsor to allocate a budget either to a research directly or to a Researcher who can then freely distribute these funds to his/her researches. Research participants are not directly rewarded by this budget, however they have a possibility to exchange earned and allocated points for money donations to a charity of their choice which they can specify in the mobile app settings (Figure 42).

Part of the budget (set by the Platform) is used for Platform maintenance, whereas the rest is allocated proportionally to the charities based on credits/points distribution.

Upon completion of a research, the Researcher triggers the research completion action. When this is initiated, the Platform automatically distributes available funds for this research to three different recipients: the Platform budget for maintenance, the top scorer of all the participating users, and to all users of this research proportionally depending on the points gathered. Upon distributing the money to the favourite user’s charity, notification is sent to the user as shown in Figure 43.

During the lifetime of the particular research project, end user participants can earn the points by taking part in completing some specific actions such as providing sensor measurements and/or providing survey responses. Points are given on a research-basis and are used only for distributing funds upon the end of the research. The number of points for specific actions are set by the Platform Administrator.

![Preferred Charity and App Settings](image)

*Figure 42: Selection of the favourite Charity by the crowd end user*
Figure 43: Notification sent to the end user participant about his/her donation to the favourite Charity
12 Privacy and security mechanisms

12.1 Role based authentication and authorisation system

For the purposes of the IoT Lab project, an identity management scheme is implemented with a role-based authentication and authorisation policy. In this scheme, individual identifiers are assigned to all the types of users of the Platform that are used for their authentication, authorization and management of privileges across the Platform. For all types of users, individual identifiers (username and password) are used for accessing the Platform. The access rights differ from user to user, depending on the role of the user (e.g. Administrator, Researcher, Participant, Sponsor, Charity, etc.).

The distinct roles that a user can have ultimately determines the functionalities and access rights this user has on the system as explained in Sections 3 to 8. Each user is assigned a role during registration and this role defines the user’s Platform access rights for the account lifetime. Multiple roles cannot be assigned to a single user account. If this is necessary, then multiple registrations to the Platform, one for each role, are required.

Implemented roles for the IoT Lab Platform are the following: Crowd Participants, Researcher, Platform Administrator, Testbed owner, Sponsor and Charity.

12.2 Protection of identities – Privacy Protection Measures

The identities of the users are protected against various privacy risks by means of specific measures we have taken, within the context of the overall security of the Platform.

Privacy by Design is ensured through concepts of full transparency, prior informed consent, the Right to be forgotten and anonymity definition. Support for the users’ privacy protection is approached from two sides: the crowd side (anonymized) and the Researcher side (including any other stakeholder providing the personal data to the Platform).

In order to fully align with the Privacy by Design approach the following had to be ensured for each side:

Crowd participants: Data provided by the crowd is effectively anonymous which means that no identifying information about participant can be entered or stored on a platform. Interfaces accepting direct input from users do not ask for any identifying information about them. Furthermore, collection of personal data through any indirect means, such as surveys is forbidden and the community is invited to report any breach of this obligation to the Platform Administrator.

Researchers and other stakeholders: It is considered by the Platform that the crowd has the right to get clear and transparent information about the research leaders who they wish to join. The personal data obligation applies in this case to Researchers and any other stakeholders who would provide their personal data to the Platform.

- In order to protect the user’s privacy, the implemented multi-layered interactive system informs users about tasks that take place in a background. A notification mechanism is implemented that informs the user when an experiment is active;
when sending data from a device; when dispatching GPS location data to the Platform. If the app accesses the device location, an extra notification is displayed as in Figure 44 (top). Also, there is an option of a persistent icon appearing in the notification area on the top of the screen as in Figure 44 (middle) and with the related text as in Figure 44 (bottom) that can, once the user touches it, redirect him/her to the privacy setting area of the app where the sharing configuration can be changed.

![Android phone with privacy related notifications](image)

**Figure 44:** Android phone with privacy related notifications: Active location services (top); Service notification (middle); Service notification expanded (bottom)

### 12.3 Security mechanisms

In order to reduce the risk effects on the users and the Platform, we have taken a number of security measures. These measures are taken at different levels across the IoT Lab system.

#### 12.3.1 Security of Servers

Beyond activating the network firewalls in routers, we have enabled the firewalls in all servers of the Crowd Sourcing Platform. In the servers’ firewalls, only the ports that are used by the services are open while all other services, such as email, FTP, and DNS are disabled. Furthermore, for some services (e.g. SSH connections) access is allowed only from specific, trusted client computers for remote administration purposes.

The system settings are very important within this context. A very strong password for a System Administrator is mandatory while processes run in non-privileged mode to avoid causing system instability or malfunction. Also, Daemon processes that run for specific purposes (e.g. socket services) are not run with administrator privilege (root).

A backup policy is, also, enforced that schedules a system-wide backup at least once a week on a removable storage media. Organisational and technical guidelines are also issued with regard to protecting and using the removable media on which the data is stored in order to prevent unauthorised access and processing as well as accidental damage.
In addition, the system is always kept up to date. Periodically, operating system kernel patches are installed while the latest releases of installed applications are downloaded as soon as they become available. Moreover, penetration testing tools (e.g. Nessus, Backtrack) run periodically to detect possible security issues in the system.

### 12.3.2 Data storage security

Data storage is protected against any illegitimate access by external parties. We enforce database access control policies through a username/password based authentication mechanism, as well as by assigning distinct roles and access rights to different user groups.

Access to the database in production mode for obtaining user data is restricted to be effective only from computers residing in the same Local Area Network (LAN) in which the database resides for security reasons. Thus, only services that run on computers in the same LAN as the computer hosting the database are able to submit and execute database queries.

It is also important to create several user classes with different database access privileges. For example, an Administrator has full access rights, a user of the crowdsourcing tool can only insert sensor data and experimenters can access anonymized sensor data.

Special attention is paid to installing the appropriate database management tools. As recommended, we avoid using the phpMyAdmin tool for security reasons in production mode. It is preferable to connect to the MySQL database using secure tunnelling over SSH.

### 12.3.3 Network security

Sensitive data is protected against unauthorised access by implementing suitable data protection mechanisms. For instance, all the ports of a firewall are closed for all unused services such as mail, FTP, and DNS, etc.

For stronger security, in cases where remote access to a server is required (e.g. remote access by an Administrator), we have employed a DMZ (Demilitarized Zone) network configuration. The purpose of a DMZ is to add an additional layer of security to an organization's Local Area Network (LAN). An external attacker has only direct access to the equipment in the DMZ, rather than any other part of the Local Network. To create a DMZ, a two firewall configuration or a VPN server can be used.

Personal data is also protected against the risk of intrusion to the system’s infrastructure. Also, the potential effects of viruses and other malicious programmes are minimized through the implementation of suitable anti-malware techniques. These techniques are regularly reviewed and modified, at least once every six months. For proactive security, there are several IDS (Intrusion Detection System) tool systems on the market. The System Administrator uses the most appropriate one. Some IDS with which our team is familiar are:

- **Snort** is one of the most widely adopted IDS. It is open source software and it is included in the Debian Linux distribution.
- **Advanced Intrusion Detection Environment (AIDE)** which is open source and compatible with the Debian server.
- **Tiger** is a UNIX security auditing and intrusion detection tool which is freely available under a GPL license.

### 12.3.4 Security at the application level

All the customary, important security guidelines have been followed that were recommended by experts for the development of the IoT Platform applications and services.

For the Android application of the crowdsourcing tool, the official Android Webpage provides recommendations for handling several security issues. For the Web applications, our developers refer to the official security pages of the development tools they use and follow the provided guidelines.

There are also several programming languages and development tools for Web services and applications. A list of such tools along with their security documentations are as follows:

- **Perl**: [http://perldoc.perl.org/perlsec.html](http://perldoc.perl.org/perlsec.html)
- **Python**: [https://docs.python.org/](https://docs.python.org/)

Finally, we always install updates and patches for all tools on a regular basis or as soon as they are made available by the tool providers.
13 Support for other aspects of trustworthiness

In addition to providing support for the users’ privacy protection, IoT Lab Platform has also provided support for open data and IPR policy as explained in D1.4 Final IoT Lab Architecture and Components Specification.

Open data

The IoT Lab consortium decided not to authorize sharing with 3rd parties, of any data collected from the crowd smart devices and their sensors which is in line with requirements for the personal data protection and participant’s consent with respect to data re-use. Data collected from testbeds (not from crowd sourced sensors) can be made available to 3rd parties.

IPR policy

Experiments performed on IoT Lab are likely to generate Intellectual Property that may be protected. A clear IPR policy and strategy has been adopted that ensures that results of researches developed with IoT Lab can be freely exploited by SMEs and industrial partners:

- Each experiment provides a clear description of its objectives and discloses the lead Researcher in charge of it, including its expected exploitation results.
- Each participant can choose, filter and control to what experiments he/she will contribute.
- Each participant is free to use or not use the application. A clear prior informed consent process is stated, which explains that the data provided to the Platform, once anonymized, are given away to the Researchers, including the exploitation of any innovation based on the research results.

If the research developed and performed on IoT Lab Platform generates IPR and the Researcher is not interested in protecting or exploiting it, IoT Lab Association can perform this function.

IoT Lab Platform will also encourage transparent access to the research results and make available non-sensitive results as openly accessible as possible.

Right to be Forgotten

The Right to be Forgotten is also supported for the mobile app users who can request it and have certain data deleted so that third persons can no longer trace them as if they never participated in the Platform.

Figure 45 and 46 illustrates the Right to be Forgotten functionality from the mobile application point-of-view. This option is nested inside the options area of the application.
Figure 45: Delete account action

Figure 46: Confirmation Dialog
When the user selects this option provided by the system, a message dialog appears. As shown in Figure 47 it provides more detailed information about the “Right to be Forgotten”, by indicating that the user account and all the data generated by this account will be deleted. If the user continues by selecting the “OK” button all data generated by and related to the user will be deleted from databases and all local data will be cleared. The application will be returned to its initial state at the introduction screens as shown in Figure 47.
14 Frequently asked questions

To support the users of the TBaaS, we have also developed a number of Q&A to support them in their usage.

Researcher’s TBaaS – Interactions with the mobile app

<table>
<thead>
<tr>
<th>Q:</th>
<th>Can I send the project specification to the participants so that they understand the project aim?</th>
</tr>
</thead>
<tbody>
<tr>
<td>A:</td>
<td>As a Researcher, you set up the project by accessing “Create a New Project” page from the “My Account as Researcher” page. In this page, you provide all necessary information about the project including title, start/end date, description, area, aims/objectives, beneficiaries etc. Once you save this page, your project will appear on a list of your research projects also accessible through “My Account As Researcher” page. Once you set your research “Public” it will appear on the list of ongoing research projects within the mobile app.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q:</th>
<th>In what ways can I preview how my research project will look like in the mobile phone?</th>
</tr>
</thead>
<tbody>
<tr>
<td>A:</td>
<td>If you set your research to be public it will appear on a mobile app in a similar way as it appears on the public side of the Webpage: <a href="http://www.iotlab.eu/JoinTheWisdomOfTheCrowd/OngoingResearches">http://www.iotlab.eu/JoinTheWisdomOfTheCrowd/OngoingResearches</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q:</th>
<th>Can I use both surveys and mobile data collection at the same time in my research?</th>
</tr>
</thead>
<tbody>
<tr>
<td>A:</td>
<td>Indeed. You can within one research project conduct both IoT interactions (collecting data from sensors including sensors on mobile phones) and crowd interactions (collecting users’ responses through surveys). It is even possible to include ‘share geolocation data’ within the survey so that you, as a Researcher, can make correlation between the users’ responses and sensors’ data at specific time and location.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Q:</th>
<th>Is it possible to communicate directly with individual users?</th>
</tr>
</thead>
<tbody>
<tr>
<td>A:</td>
<td>You can send messages/notifications to all users that have joined a specific project using a notification tool. Direct communication with individual end user participant is possible through a messaging system but should be initiated by the end user, so that you can only send responses. Anonymity of end user is ensured.</td>
</tr>
</tbody>
</table>

IoT Interactions - Experiment setup

<table>
<thead>
<tr>
<th>Q:</th>
<th>Can I prepare an experiment in advance even though I don’t know what exact resources I will use?</th>
</tr>
</thead>
<tbody>
<tr>
<td>A:</td>
<td>If you refer to the experiment involving IoT Interactions (sensor data and actuator actions) it is NOT possible to set it up before reserving the resources that you want to include in the experiment. If you refer to experiments involving crowd interactions, it is possible to prepare the survey in advance and then to create a target participants’ group.</td>
</tr>
</tbody>
</table>
to which you would distribute your survey.

**Q:** In what ways can I test the experiments beforehand if I don’t have an Android phone?

**A:** In order to test interaction between the Researcher using the Web portal (TBaaS) and the crowd participant using the mobile app, it is necessary that you have the Android phone or tablet with the installed IoT Lab application.

**Q:** Cancelling a running experiment: Is it possible to cancel a running experiment that e.g. was not well configured?

**A:** No, it is currently not possible.

**Q:** Sampling rate: How many samples per second is possible to retrieve from the sensors?

**A:** In TBaaS, it is possible to set a sample rate down to 1 sample/s but there is no guarantee that it can be reached. Some of our tests so far have given a sample rate of approximately 0,5 sample/s.

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**Crowd interactions – Survey tools**

**Q:** Can I import a survey that I already have in SurveyMonkey?

**A:** IoT Lab hosts the LimeSurvey so it is necessary that you import your survey to the LimeSurvey Platform.

---

**Data access and analysis**

**Q:** What sort of data analytic tools does the IoT Lab support?

**A:** IoT Lab enables you to extract data in a CSV format which you can then process externally with a preferred tool.

**Q:** How long will I have access to the data following the data collection?

**A:** As long as the platform is operational, data should be available. It can also be downloaded and saved locally.

**Q:** Does the IoT Lab Platform support multiple Researchers to work with the same data collection?

**A:** Collected data is accessible only by the Researcher who conducted an experiment. However, extracted data can be shared with others and processed using preferred data analysis tool.

---

**Data and privacy protection**

**Q:** How is the data stored so that it is secure?

**A:** Data storage is protected against any illegitimate access by external parties. See detailed description in section 12.3.2.

**Q:** How is the privacy of the crowd end user participant protected?
A: Data provided by crowd is effectively anonymous i.e. this means that no identifying information about participant can be entered or stored on a platform. Collection of personal data through any direct or indirect means is forbidden and a breach of this obligation should be reported to the Platform Administrator by community members.

Q: Does the privacy protection apply to Researchers?
A: No. The research data process is publicly visible for transparency requirements i.e. the crowd is deemed to have the right to get a clear and transparent information about the research leaders they want to join.

Open data and IPR

Q: What is the open data policy?
A: Please see Section 13 for details.

Q: Are IPR regulated by the platform and how?
A: Yes, they are. Please see the Section 13 for details.

Right to be Forgotten

Q: Is it possible to delete the account and be sure no data about myself is stored in the system?
A: Yes, there is an option ‘Right to be Forgotten’ available in the mobile application and details on that how to perform this action are described in Section 13.

Mobile operating systems

Q: Is the mobile app available on all mobile operating systems?
A: No, it is currently available only on Android, version v4.4 or newer.

Donations

Q: Do I need to be registered as a Sponsor to be able to see researches and Researchers accepting donations?
A: No. You can see this list on the public side of the Website (http://www.iotlab.eu/SupportAResearchAndIoTLab/Donations). Login as a Sponsor is only required when money donations are to be performed.
15 Reference Material Table

The purpose of this section is to provide the user of the IoT Lab Platform a quick reference to the specific platform functionality.

### 15.1 Smartphone App install and set up

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Availability/Reference material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Validate the terms of use</td>
<td>Yes</td>
</tr>
<tr>
<td>Optional socio-economic profile</td>
<td>Yes</td>
</tr>
<tr>
<td>Change configuration</td>
<td>Yes</td>
</tr>
<tr>
<td>Link towards the IoT Lab Website</td>
<td>Yes</td>
</tr>
<tr>
<td>Find the app from Google Play</td>
<td>Yes</td>
</tr>
<tr>
<td>Icon indicating if sensor / GPS data are collected. Persistent notification</td>
<td>Yes</td>
</tr>
<tr>
<td>icon when IoT Lab is running</td>
<td></td>
</tr>
</tbody>
</table>

### 15.2 Idea crowdsourcing section (mobile app)

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Availability/Reference material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propose an idea in a category</td>
<td>Yes, Section 10</td>
</tr>
<tr>
<td>Vote for ideas of others in selected category (ranking)</td>
<td>Yes, Section 10</td>
</tr>
<tr>
<td>Check ranking of ideas per category</td>
<td>Yes, Section 10</td>
</tr>
<tr>
<td>Search for ideas/researches according to criteria</td>
<td>Yes, Section 10</td>
</tr>
</tbody>
</table>

### 15.3 Researcher’s TBaaS – Interactions with the mobile app

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Availability/Reference material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Researcher registration / account set up</td>
<td>Yes, Section 0</td>
</tr>
<tr>
<td>Research profile creation ( --&gt; visible on the app))</td>
<td>Yes, Section 0</td>
</tr>
<tr>
<td>Survey creation (can be created in Lime survey and accessed via TBaaS)</td>
<td>Yes, Section 9.2, Section 5.2.3</td>
</tr>
<tr>
<td>Participants group creation</td>
<td>Yes, Section 5.2.3</td>
</tr>
<tr>
<td>Pushing a survey towards all participant</td>
<td>Yes, Section 5.2.3, Step 3</td>
</tr>
<tr>
<td>Pushing a survey towards a selected group of</td>
<td>Yes, Section 10</td>
</tr>
<tr>
<td>Functionality</td>
<td>Availability/Reference material</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Pushing a survey towards a geographic area (geofencing)*</td>
<td>Yes, Section 5.2.3, Step 3</td>
</tr>
<tr>
<td>Accessing collected data from survey</td>
<td>Yes, Section 5.2.3, Step 5</td>
</tr>
<tr>
<td>Exporting collected data with socio-economic profile of participants when available into an Excel file from the survey</td>
<td>Yes, Section 5.2.3, Step 5</td>
</tr>
<tr>
<td>Pushing a notification towards all participants</td>
<td>No</td>
</tr>
<tr>
<td>Pushing a notification towards a selected group of participants (research code)</td>
<td>Yes, Section 5.2.2</td>
</tr>
<tr>
<td>Pushing notification towards a geographic area</td>
<td>Yes, Section 5.2.2</td>
</tr>
<tr>
<td>Uploading a research pdf report</td>
<td>Yes, Section 5.2.5</td>
</tr>
<tr>
<td>Implementation of Roles</td>
<td>Yes, Section 4</td>
</tr>
</tbody>
</table>

### 15.4 Participants – Researcher interaction

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Availability/Reference material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Look for ongoing researches</td>
<td>Yes, Section 10 (mobile app); Section 0 (Web)</td>
</tr>
<tr>
<td>Research profile</td>
<td>Yes, Section 10 (mobile app); Section 5.2.1 (Web)</td>
</tr>
<tr>
<td>Complete a survey</td>
<td>Yes, Section 10 (mobile app); Section 5.2.3 (Web)</td>
</tr>
<tr>
<td>Search for researches according to criteria (included topic selection when defining the research project)</td>
<td>Yes, Section 10 (mobile app); Section 0 (Web)</td>
</tr>
<tr>
<td>Join / quit a research</td>
<td>Yes, Section 10 (mobile app)</td>
</tr>
<tr>
<td>Access &quot;My researches&quot;</td>
<td>Yes, Section 10 (mobile app)</td>
</tr>
<tr>
<td>Bidirectional communication with the Researcher</td>
<td>Yes, and it is anonymised. Section 10 (mobile app); Section 5.3 (Web)</td>
</tr>
<tr>
<td>Consult the pdf report of one of the researches (Note: pdf can be published now by Researchers)</td>
<td>Yes, Section 10</td>
</tr>
<tr>
<td>Access &quot;My credits&quot; (incentives)</td>
<td>Only for the Web app users,</td>
</tr>
<tr>
<td>Participants to have up-to-date information regarding their contribution(s)</td>
<td>Participants get notifications about their contributions</td>
</tr>
<tr>
<td>Allocate/distribute credits collected through a specific research to a charity of his/her choice</td>
<td>Yes, automated distribution set by Platform Administrator and executed upon completion of the Web app users.</td>
</tr>
</tbody>
</table>
Exploit gamification dimension of credits collection: display ranking, etc.  
Through notifications

15.5 Researchers – IoT interactions

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Availability/Reference material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select and reserve IoT devices</td>
<td>Yes, Section 0</td>
</tr>
<tr>
<td>Configure IoT experiment</td>
<td>Yes, Section 0</td>
</tr>
<tr>
<td>Perform IoT experiments</td>
<td>Yes, Section 0</td>
</tr>
<tr>
<td>Collect IoT experiment collected data</td>
<td>Yes, Section 0 (raw data provided)</td>
</tr>
<tr>
<td>Export experiment data towards Excel file</td>
<td>Yes, Section 0</td>
</tr>
</tbody>
</table>

15.6 (Platform) Management (for platform owners only)

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manage researches (archive, edit, public/private option etc.); display public on-going researches on a public Website and in a mobile app</td>
<td>Yes</td>
</tr>
<tr>
<td>Manage Researchers and other users’ accounts (validate, suspend)</td>
<td>Yes</td>
</tr>
<tr>
<td>Manage crowd participants access (in case of misbehaviour)</td>
<td>Yes</td>
</tr>
<tr>
<td>Manage incentives/donations</td>
<td>Yes; set at the platform level</td>
</tr>
<tr>
<td>Enable donations by Sponsors for a selected research/Researcher</td>
<td>Yes</td>
</tr>
</tbody>
</table>

15.7 Multilinguism management

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Availability/Reference material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic translation of user/researcher content from one language to another</td>
<td>Yes</td>
</tr>
<tr>
<td>Switch from one language to another for the Graphical User Interface</td>
<td>Yes</td>
</tr>
</tbody>
</table>
16 Conclusions

This document represents a Handbook for future users of IoT Lab Platform providing the following:

A brief overview of the IoT Lab Platform and its capability to connect Researchers and crowd participants to different types of multidisciplinary research projects and provides information on possible modes of platform use and thus possible roles for the users. This includes crowd participants on one side of the platform that access the platform via mobile app in order to contribute to different types of researches. On the other side are Researchers running the experiments, testbed owners providing the resources, Sponsors donating to specific Researchers or researches and charities receiving the donations through incentives scheme that allows participants to select their favourite charity and exchange their points earned through participation in researches for donations to these charities. They access the Platform through the Web as Testbed as a Service.

Detailed guidance on available Platform functionalities for each role as well as on third party tools used is also provided as well as information on privacy protection measures and security mechanisms implemented and on support for other aspects of Platform trustworthiness.

A number of different use cases has been implemented through the Platform and reports on them can be found on the Project Website, in the section on Use Case Library. These represent a useful material for future users of the Platform and include:

**Researcher driven Use Cases:**

- Measuring Smart Sustainable Cities (ITU SSC KPIs)
- Smart HEPIA datacentre monitoring
- Workshop during the HEPIA week of the sustainable development
- ekoNET solutions for addressing air-pollution in Smart Cities
- Smart Energy Management and Comfort at University of Patras
- Smart Energy Management and CO2 Monitoring in a Beer Factory
- Jumpology

**Crowd driven Use Case**

- Idea competition at ICT2015 - collecting crowdsourcing ideas and ranking them
17 References and end-notes

References

[1] IoT Lab D1.4 – Final IoT Lab architecture and component specification
[2] IoT Lab D2.3 – Identity management and reputation mechanisms report