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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Deliverable D8.2.3

Dissemination, Liaison and Standardization Activities Report Y3

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Abstract

This document outlines the dissemination, liaison and standardization activities in the final 3rd year of the IoT Lab project including collaboration with the International Telecommunication Union and other organizations and projects.

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Abbreviations and acronyms

IoT	Internet of Things
ITU	International Telecommunication Union
URL	Uniform Resource Locator
FIRE	Future Internet Research and Experimentation
FIA	Future Internet Assembly
DCOSS	Distributed Computing in Sensor Systems
USC	University of South Carolina
NTU	Nanyang Technological University
TEMU	Telecommunications and Multimedia
ENoLL	European Network of Living Labs
ECFI	European Conference on the Future Internet
ACM	Association for Computing Machinery
ISPIM	International Society for Professional Innovation Management
TBA	To be announced
CPS	Centre for Promotion of Science

Executive Summary

Dissemination, liaison and standardization activities have been carried out as part of the work specified within WP8 during the 3rd and final project year and has resulted in following achievements:

T8.1: Dissemination and communication M1-M36 (Task Leader: DNET)

An outreach and communication strategy established in Y2 has been followed and further tailored to specific use cases implemented in Y3 taking into account inputs from several work packages (WP5 to WP8) and following the principles of digital marketing strategy to enable us to achieve an effective end user outreach and recruitment. Different communication channels developed in Y2 have been used and tailored to different use cases deployed in Y3 as well as to identified target user/stakeholder groups.

Communication tools further improved and channels used in Y3 include:

- **Website and Web portal**: The Website designed in Y2 has been continuously updated during the final project year providing important information and news about the project, publications, conferences and dissemination events. All public information about the platform developments and activities of its users of public interests is covered through the public part of the Website. Use Cases implemented during the final year are also reported on the public side of the Website in the Use Case library. The Web portal side of the Website has been extended providing the access control management for different users' roles including Researchers, Testbed Owners, Sponsors, Charities and Platform Administrator and providing to each of them a tailored user interface. Video Animation is also available through the Website providing the information about the main aspects of the IoT Lab platform and how different stakeholders can use it.
- **Online and social media** presence has been established in Y1 and Y2 and has been extensively used in Y3 to disseminate and promote IoT Lab developments and implementation of new features to different stakeholders as well as for the promotion of use cases and recruitment of users.
- A number of outreach campaigns were held related to the implementation of selected set of use cases.
- 12 **public events** have been used to promote the IoT Lab project and/or demonstrate the Crowdsourcing tool.
- Published 14 **papers** at conferences and journals including 3 book chapters.
- Established dissemination strategy beyond the project.

T8.2: Liaison with the ITU and other research projects M3-M36 (Task Leader: MI)

IoT Lab has maintained close cooperation links with other research projects. Among the most relevant development in this area, we should mention the close cooperation with Fed4FIRE and One Lab. The three testbed federations have agreed to work together and pave the way to a convergence of their respective infrastructures. The coordinators of the three federations have successfully initiated two joint research projects to further support the integration between IoT Lab and Fed4FIRE, including:

- F-Interop, which is a three years European research project. It is researching and developing online interoperability and performance test tools supporting emerging IoT-related technologies from standardization to market. It intends to support researchers, product development by SME, and standardisation processes.
- Fed4FIRE plus, which will continue the development of the Fed4FIRE platform over the next five years.

Both projects will enable to support a deeper convergence and integration of the three federations.

IoT Lab has also been very active with the International Telecommunication Union (ITU). The IoT Lab project has been presented in several ITU-related meetings, and the Project Coordinator has continued to support the new Study Group 20 of the ITU on the Internet of Things and Smart Cities. This effort has led to the adoption by the ITU members of a new work item on "*Requirements and Functional Architecture of IoT-related Crowdsourced Systems*" that will leverage on IoT Lab research results. The Work Item will be co-led by MI and UniGE.

1 Introduction

This deliverable outlines IoT Lab's main aims and results in terms of dissemination, collaboration and standardisation activities in the project's final year, such as:

- Dissemination of IoT Lab project results: Reaching the public through crowdsourcing and researchers to promote IoT technologies, and more specifically IoT testbeds.
- Collaborating with other projects and organizations: Exchange know-how, experiences and tools to maximize chances of the project success and reuse existing knowledge.
- Cooperating with standardisation bodies (e.g. ITU): Benefit from and eventually contribute to emerging standards in the area of IoT virtualisation and cloudification.
- Outreach activities to facilitate engagement of people and their participation in representative use cases as described in D8.3.2 Exploitation plan updated-Year 2 and D8.3.3 Exploitation plan - Final report.

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 partie 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 the following:

- **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 standardisation 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.

In the project's third year, WP8 results are presented through the following deliverables:

Table 1: WP8 Deliverables for IoT Lab Y3

Deliverable Number	Deliverable Title	Dissemination level	Delivery date
D8.2.3	Dissemination, Liaison and Standardization Activities Report Year 3	PU	M36
D8.3.3	Exploitation plan - Final report	RE	M36
D8.4	Synthetic Handbook for IoT Testbeds	PU	M36

The D8.2.3 report is related to dissemination and collaboration activities, while D8.3.3 is the final iteration of the Exploitation Plan both outlining the Y3 achievements. D8.4 represents a Synthetic Handbook for IoT Testbeds for the future users of the IoT Lab platform.

1.3 Purpose and scope of Tasks T8.1 and T8.2

WP8 has two main tasks related to dissemination, liaison and standardization activities:

1.3.1 Task T8.1: Dissemination and communication (M1-M36)

Task T8.1 is related to dissemination and communication, and the following main results have been achieved:

- The Website has been reshaped and updated with online access to the Testbed as a Service.
- The social media pages have been further promoted: LinkedIn, Twitter and Facebook pages were set up and the strategy was developed for using them to promote the project and platform to different stakeholders. These channels were used actively in Y3 during platform exploitation and implementation of use cases described in D8.3.3 in which planned outreach campaigns were successfully realized.
- Disseminated IoT Lab plans and results through: Conferences, science fairs, events and publications as well as 3 book chapters were published based on work and results achieved in the project.

1.3.2 Task T8.2: Liaison with the ITU and other research projects (M3-M36)

Task T8.2 dealt with the liaison with the standardization body ITU and other research projects. The main objectives of this Task were to set up a strategy of cooperation with the International Telecommunication Union (ITU) and with the other European research projects. Relevant projects were identified and a matrix of cooperation was devised to distribute responsibilities among the consortium members, based on their respective areas of expertise. Proposed cooperation was monitored during the project duration and final results are reported in this document. Results achieved through cooperation and interaction with the ITU are reported.

1.4 Purpose and Scope of the Current Document

This document outlines results from the activities in Task T8.1 and Task T8.2. It gives the current status of the dissemination activities using different communication and presentation channels such as: Website, Twitter, LinkedIn, Facebook, and presents future plans and strategy to further increase the number of different stakeholders interested in utilizing results from the IoT Lab project. The data are being gathered to assess how to involve the public further (crowdsourcing) in proactively participating in using different testbeds and scenarios, as well collating experiences from other projects and IoT solutions. It also presents promotion of project results and ideas via partners through conferences, workshops, meetups, summer schools and publications, etc. Liason and collaboration activities with ITU and other organisations and projects have also been presented.

The information on IoT Lab project is readily available on the project Website http://www.iotlab.eu/. The contact form is presented under the “Consortium” tab http://www.iotlab.eu/IOTLabProject/Consortium.

The document is subdivided into Sections which detail the Dissemination, Liaison and Standardization Activities: Section 1 provides a brief outline of the IoT Lab Project, the Purpose and Scope of WP8 and a description of Task T8.1 Dissemination and communication and Task T8.2 Liaison with the ITU and other research projects; Section 2 outlines Dissemination Activities through the Web pages, social networks, presentations and conferences, workshops, events, meetups, as well as through written publications;Section 3 covers the Outreach and Communication and Conclusions from the Use Case; Section 4 covers IoT Lab Dissemination Strategy; Section 5 provides the Internal Dissemination Activities; Section 6 provides the Liaison and Collaboration with the International Telecommunications Union (ITU); Section 7 provides the Liaison and Collaboration with other Organisations; Section 8 provides the Liaison and Collaboration with other Research projects and Section 9 provides the Concclusion of the deliverable.

The Annex in Section 10 provides various documentation regarding ITU Liasion Statements and conferences in which IoT Lab participated.

2 Dissemination Activities

A number of different dissemination activities have been conducted throughout the project duration. In order to maximise the impact of these activities, an internal marketing strategy was devised. In addition, an information collection process was defined that facilitated sending the relevant information about the project progress to DunavNET contacts who were responsible for communicating the information to the right audience at the right time.

Valuable information that has been shaped into content for the Website and Social Media included: News about the project itself / phases / milestones; public presentations; workshops; meetings with partners on the project; meetups; deliverables, event attending (conferences, fairs etc.), conducting use cases, release of the new apps etc. Most events have been covered with the announcement prior to the event, reporting during the event and follow up reports after the events.

2.1 IoT Lab Logo

The IoT Lab Logo was developed at the beginning of the project in order to provide the project with a clear visual identity. It is embedded in all dissemination material (see Figure 1).

Figure 1: IoT Lab Logo

It was later replaced by a new Logo supporting graphical identity in mobile applications as shown in Figure 2.

Figure 2: IoT Lab Logo for Mobile Apps

2.2 IoT Lab Website

2.2.1 Public Website

This section summarises information about the IoT Lab Public Website and its development path over the three project years.

The project URL has been registered, and a Website has been designed and published: http://www.iotlab.eu (also www.iotlab.com). The Website is regularly maintained and updated. As an initial contact and information point for the general public and IoT stakeholders, the project Website presents an overview of the work being carried out by IoT Lab.

In Y1, the IoT Lab Project Website (Figure 3) contained mainly general information about the project such as public project deliverables and all other information relevant to the project, such as objectives, architecture (see Figure 4), crowdsourcing, consortium and WPs.

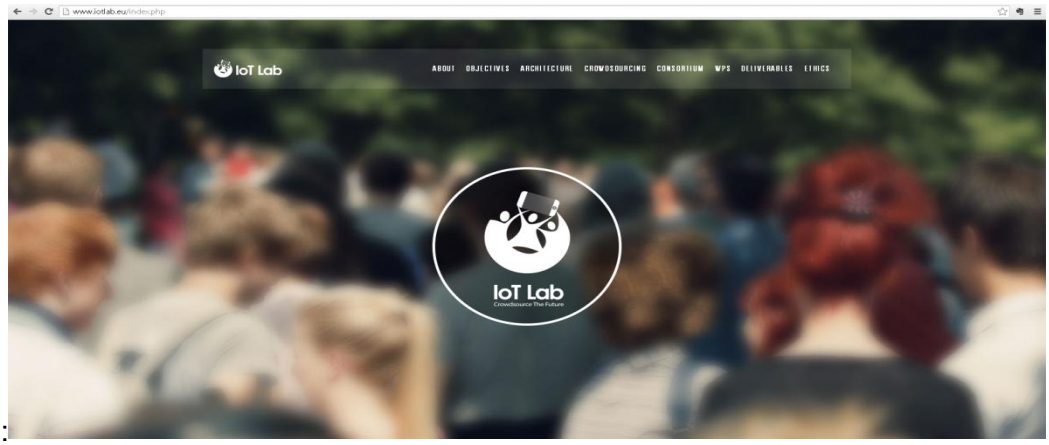


Figure 3: IoT Lab Website Landing Page Y1

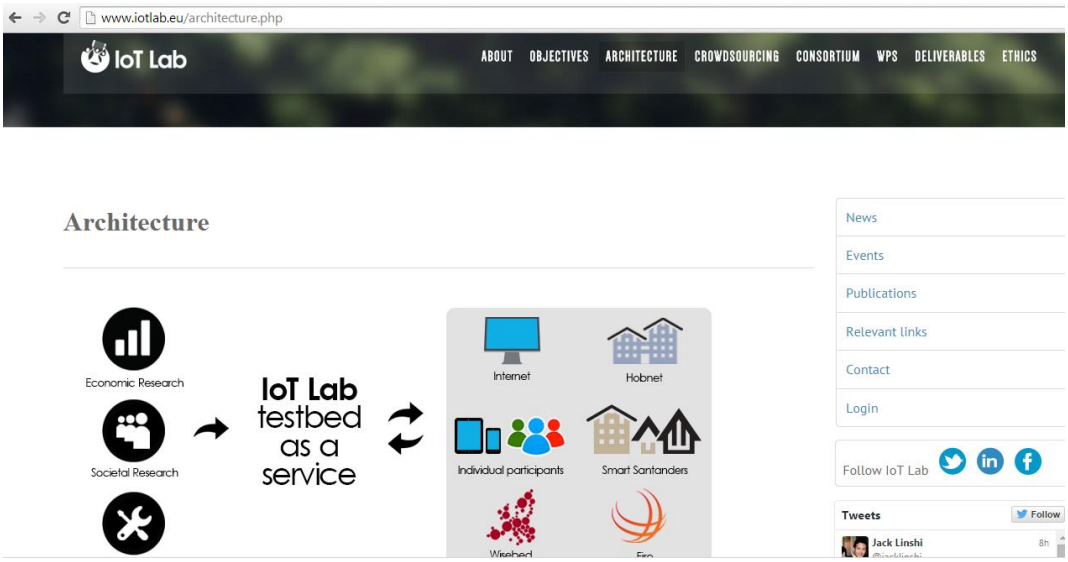


Figure 4: IoT Lab Website Components Y1

The content of the Web pages was dynamically updated to reflect project progress in Y1, as well as other information relevant to the project. The News Section was used to communicate the latest on the project, upcoming meetups, events, and conferences, etc. Social networks, such as Twitter, LinkedIn and Facebook were used to disseminate the latest news and crowdsourcing for the purpose of extending IoT testbed infrastructure for multidisciplinary experiments.

In Y2, the project's Website structure evolved to reflect the aims of the project and the solutions that were incrementally being implemented leading to specific Sections for public, crowd and research conduction, while "IoT Lab in a Nutshell" component of the Website provided information on how to use the IoT Lab results and information all about the project.

During Y3, the Website structure set in Y2 was maintained and deeply extended with new functionalities of which some require an access through the online tool namely the IoT Lab Testbed as a Service (TBaaS). Additional information has been provided on the new Association that will take the relay for the platform maintenance beyond the project duration. The public deliverables have been uploaded for download. A list of dissemination/promotional events has been included. New publications have been listed on the Website and are now available for download or linked to the original source. The number of unique visitors of the Website has been monitored. Use Case library with reports on implemented use cases has also been made available.

Figure 5 shows the latest Website architecture which reflects the main components that have been implemented through the Webpage illustrated in Figure 6 and these include:

- ***Crowdsourcing – Join the wisdom of the crowd:*** How and where to join existing crowdsourcing initiatives as a participant and how to access the tools developed for the crowd.
- ***Leading a research:*** *Testbed as a Service* as an on-line tool for researchers (requires login).
- ***IoT and Crowdsourcing***: General information on the topic as well as the use case library of implemented use cases.
- ***IoT Lab community and experiments:*** The resources to take part in and consult on-going experiments as participants or as part of the public. It is also possible to support/fund the IoT Lab researchers/research.

Components of the Website architecture illustrated in Figure 5 have been implemented through the Web page shown in Figure 6 (the part framed in a red rectangle).

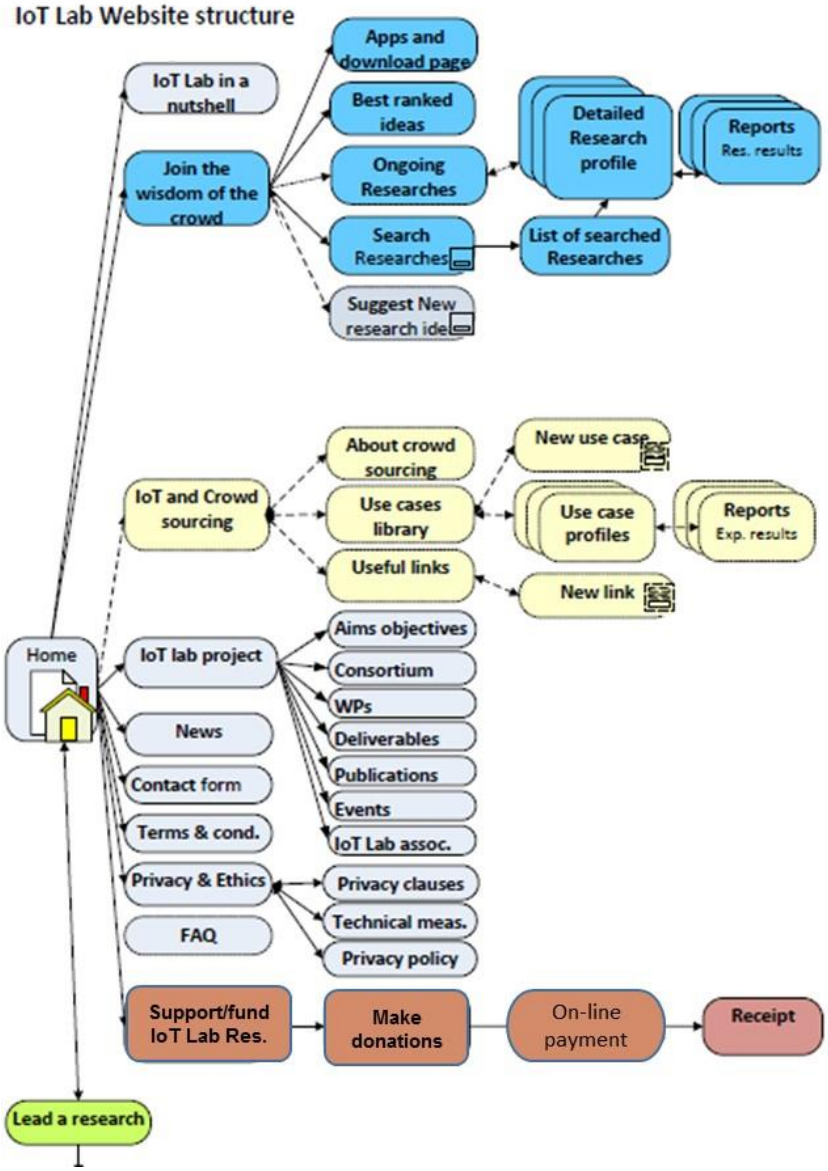


Figure 5: IoT Lab Website Structure about the Project and Crowdsourcing

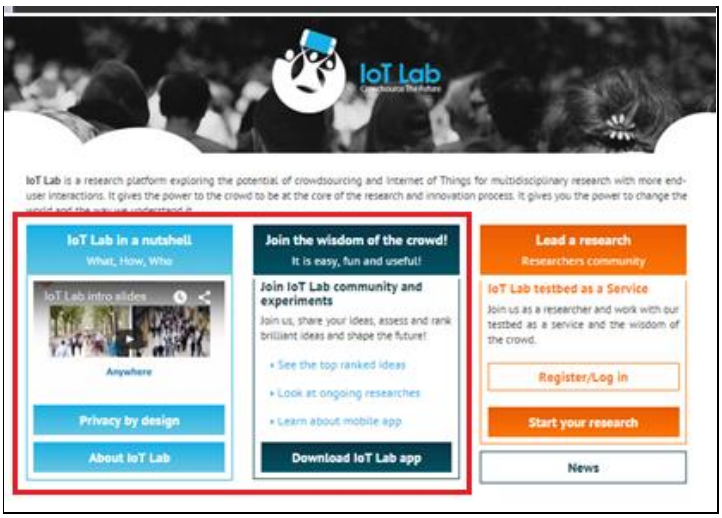


Figure 6: IoT Lab Website with general information "IoT Lab in a Nutshell"

The main Website functionalities implemented in Y3 include:

- Browsing and accessing information about ongoing researches.
- Use case library (for implemented use cases) with reports included.
- Supporting/funding the IoT Lab research (note, completion of the payment to support selected research or researcher requires registration/login as a Sponsor).
- Finding out about different crowdsourcing projects which are publicly available and being able to join them through mobile app or to share the information about them through social networks.

2.2.2 IoT Lab Web Portal

IoT Lab Website (http://www.iotlab.eu/) is also an access point to the Web portal representing the research crowdsourcing platform and providing the access to the interactive tool, Testbed as a Service (Figure 7). This tool can be exploited by different types of users who are assigned different roles depending on their selected mode of interaction with the platform. Registration/login page is shown in Figure 8.

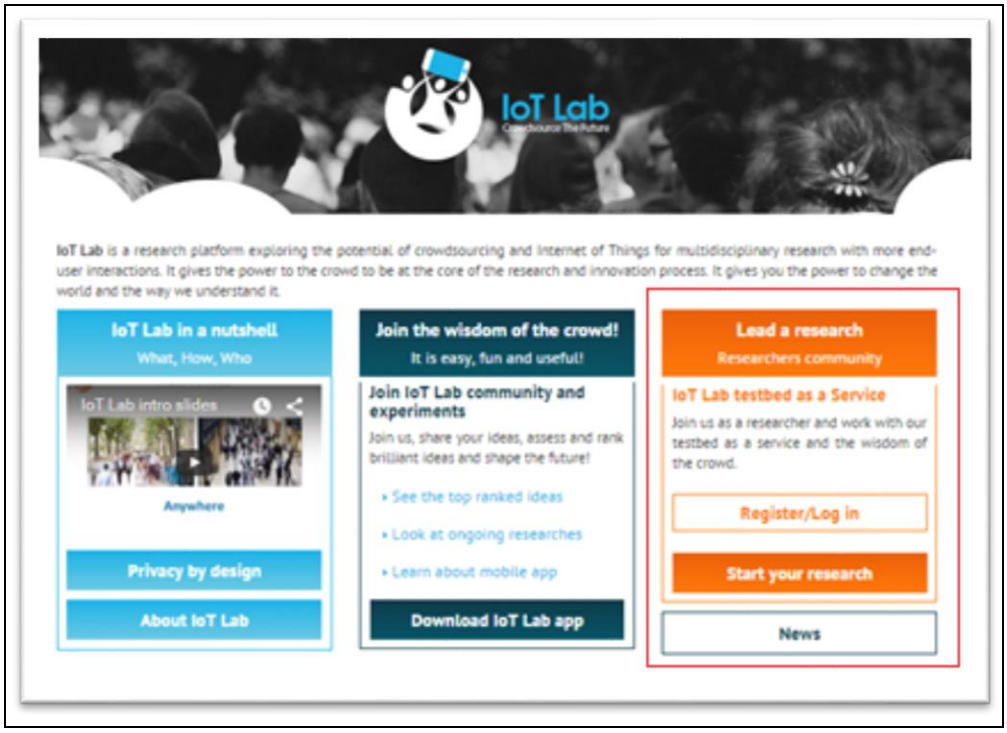


Figure 7: IoT Lab Web portal (framed in red rectangle)

Different roles are presented here and for each are listed main functionalities available (see D4.3 for detailed role descriptions). These are:

1. Researchers or those who want to lead the research through:
   - Interactions with the crowd through surveys.
   - Interaction with IoT resources belonging either to users' smartphones or to static or portable testbeds integrated within the platform.

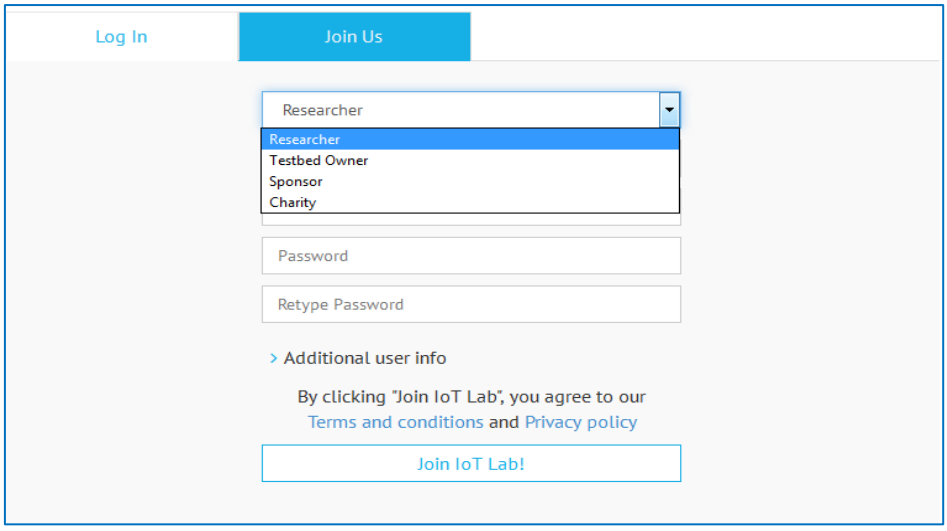


Figure 8: IoT Lab Web Portal Login

Upon registering and logging in, researchers create their own research projects, reserve resources using various filtering criteria, setup surveys or experiments involving reserved resources, conduct them and collect results that can be published within the report.

Participants get an active involvement with the platform exclusively through the mobile application that can be downloaded from the Website. Their participation can include:

- Providing data from mobile phone sensors.
- Providing data by responding to surveys.
- Proposing and sharing their ideas which can potentially extended into use case scenarios.

1. Testbed owners

IoT Lab Web portal enables testbed owners to integrate their resources within the IoT Lab platform and make them available to researchers. Testbed owners need to belong to entities such as universities, companies or foundations. They have, through the Web portal, access to all reservations of their resources made by researchers which they can manage (e.g. cancel).

2. Sponsors

Users registered as Sponsors can make donations to specific researches (public list of researches opted for donations is available on the public side of the Website too) or directly to researchers who can then allocate donation to one of his/her researches. They have access to the list of their donations and can follow its status.

3. Charities

Only registered charity organisations can register as a Charity within the IoT Lab platform. They do not have real interaction with the platform but once registered their names will appear on the list of charities within the mobile app used by the crowd. Each crowd participant can select their favorite charity so that any points earned by the participant through participation in research projects can be converted/exchanged for money donation to the specified charity.

4. Platform Administrators

Platform Administrator is not an external role but is given to internal platform users who can

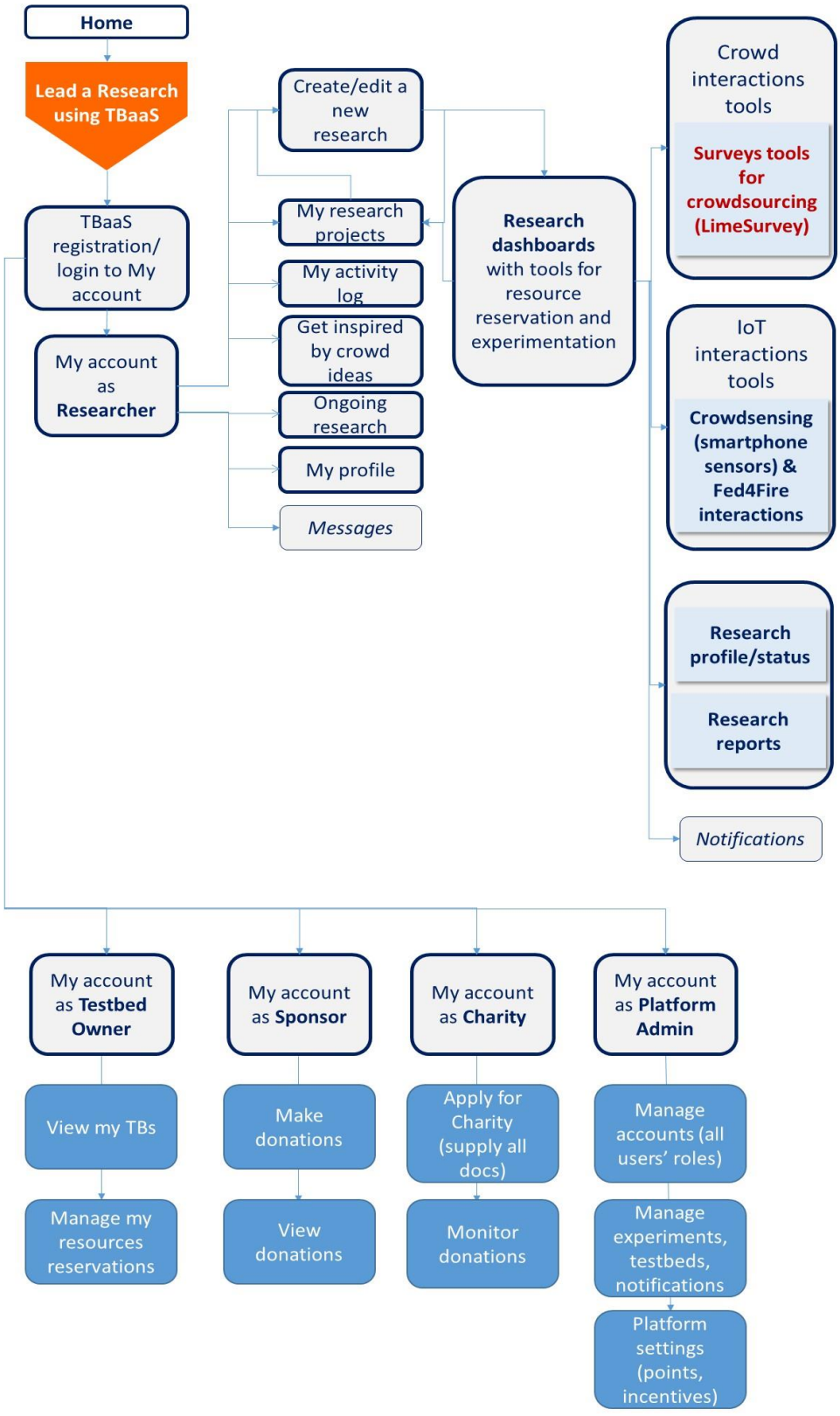


Figure 9: IoT Lab Web portal structure

manage all users' accounts and monitor/manage all platform activities including experiments (e.g. cancel/delete them), resources reservations for all testbeds (e.g. cancel them), notifications, etc. Platform Administrator also sets the points' distribution scheme which is used for distribution of donations towards platform maintenance as well as to favorite charities of best performing participants (globally as well as in a donated research project).

The diagram in Figure 9 shows the Web portal structure illustrating all the components of the IoT Lab platform available to different users' roles.

2.3 Strategy to Increase Visibility of IoT Lab Website

An overall strategy for the Website has been to keep it active, through sharing news via social networks and increase its visibility using SEO in order to attract more IoT Lab platform users.

- ***SEO** (Search Engine Optimization) has been* used to increase general visibility of the site. Meta description has been used as an html tag summarising each IoT Lab page's content.
- ***News Section*** has been regularly updated with important developments and events. A person has been allocated with the Task to collect important information and compile the news items. Links to social networks have been placed at the most visible section of the Website and all relevant events and news have been shared through them.
- ***Video*** that explains the idea behind the IoT Lab platform and how different stakeholders can use it has been made. It has been kept on the Website home page and shared through social networks. It achieved more than 1500 views.

2.3.1 Visitors Monitoring

The IoT Lab Webpage views achieved during Y3 are provided in Figure 10 below. Data shows that during the third project year the number of unique visits to the Website has been maintained at around 2000 per month which can be related to the continuous promotion of the project at various dissemination events as well as the regular updates about IoT Lab activities through social networks and the Website. The number of unique visitors achieved a bigger increase in the last two months of the project when most of the use cases have been run and more intensive outreach activities have been performed.

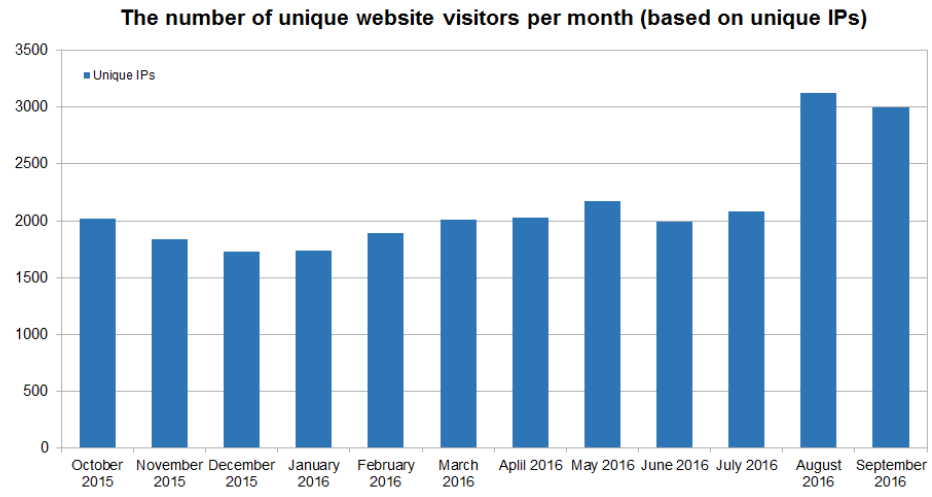


Figure 10: The number of unique Website visitor

Website activities per country are shown in Figure 11, while some general statistics figures are shown in Figure 12. The platform statistics is summarised in Table 2 as of the end of October 2016. The up to date information on platform scores is available on the Website: http://www.iotlab.com/JoinTheWisdomOfTheCrowd/PlatformScores.

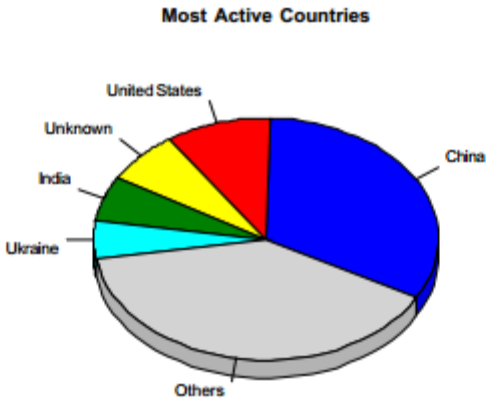


Figure 11: Activity per country – most active countres shown

Time range: 1.10.2015 00:01:05 - 13.10.2016 13:03:53 Generated on Fri Oct 14, 2016 - 10:06:53

General Statistics

Summary

Summary

Hits	
Total Hits	1,324,121
Visitor Hits	1,243,575
Spider Hits	80,546
Average Hits per Day	3,493
Average Hits per Visitor	31.29
Cached Requests	40,105
Failed Requests	53,945
Page Views	
Total Page Views	894,290
Average Page Views per Day	2,359
Average Page Views per Visitor	22.50
Visitors	
Total Visitors	39,738
Average Visitors per Day	104
Total Unique IPs	17,624

Figure 12: IoT Lab Website – general statistics

Current platform scores (end of October 2016)	
Total number of registered researchers	106
Total number of end user participants	1074
Number of researches	278
Number of Surveys	84
Number of crowdsourced sensors	2124
Number of testbed sensors	498

Table 2: Platform scores (figures at the end of October 2016)

2.4 Social Networks

It is crucial for IoT Lab to reach a wide audience for sustainability and to have a public involvement through promotion of the crowdsourcing concept. It was recognized that in order to achieve this aim, an internal marketing and dissemination strategy is requred which will help to focus the effort of reaching different stakeholders through the most suitable mechanisms. This included also use of social networks: Twitter, Linked-in and Facebook

2.4.1 Strategy to Maximise Visibility on Social Media

The dissemination strategy also specified use of social networks: Twitter, Linked-in and Facebook. There are different ways to maximize the content visibility on social media using tools for sharing as well as regularly publishing fresh content, this will in return help build the traffic and increase search rankings. Some of the implemented strategies are presented below:

1. Adding Social Buttons on IoT Lab Website

Social buttons have been added to the Website and it is possible to share the information about the ongoing researches.

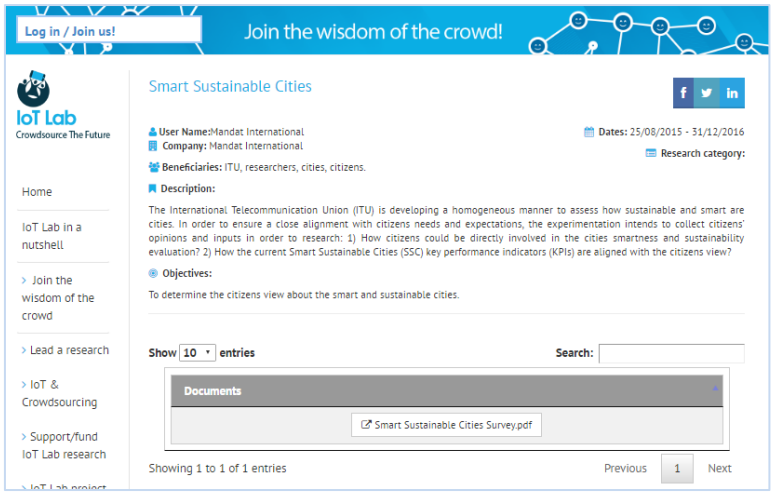


Figure 13: Social buttons available on the Website

2. Organising Contests

Giveaways and contests are popular ways to attract attention to IoT Lab platform. It however depends on the availability in the budget to organize such contests. One such contest was organised at ICT 2015 in Lisbon (Figure 14). In addition to demonstrating the capabilities of the mobile app and Testbed as a Service, IoT Lab partners also organised the competition during the event in which competitors needed to download the IoT Lab app and propose a research topic. IoT Lab mobile app users voted for proposed ideas and the best ranked idea won the moto 360 Android watch, while the second best idea won a bottle of Portuguese wine "Duas Quintas Tinto Reserva 2011". The first place and the best average score were achieved with the idea on Open Innovation for Healthy and Active Living, whilst the second best idea was for Smart Citizens.

Figure 14: Organised contest for the best research topic by IoT Lab as ICT2015

3. Promoting events and breaking news related to the IoT Lab project

IoT Lab tried to stay active on social networks on a regular basis by getting likes, retweets, @iotlab comments and #iotlab feedback and hashtaging trend words such as #IoT, #crowdsourcing, #crowdfunding, #crowd, etc.

IoT Lab activity on social networks, namely, Twitter, Linkedin and Facebook, during Y3 is described in more detail in the following sections.

2.4.2 IoT Lab on Twitter

Events and breaking news related to the IoT Lab project were published on Twitter. The online repository contains information about the project, training events, and links to upcoming events. It is accessible to everyone, all the time. People are able to connect instantly to the most important feeds, follow experts, favorite celebrities, and breaking news in the area of IoT.

Figure 15: IoT Lab Twitter

The strategy for activities via Twitter has been as follows:

- Connect to other social media groups to spread our brand and to tap into other groups
- Starting up discussions
- Hashtag trend words #IoT#Internetofthings #crowdsourcing, #crowdfunding etc.
- Get likes, retweets and @iotlab comments and #iotlab feedback
- Being active regularly with the latest information, start up discussions, posting questions, and publish polls
- Using conferences to feed tweets
- Keeping up to date and being informed to sort out interesting topics, articles, news to the followers and to become a trusted authority in the field

This tool has been used as a main communication channel at ICT2015, NetFutures, Sensations etc. It has also been used as a channel form promoting the ekoNET Use Case and attracting participants as shown in Table 4.

An IoT Lab Twitter statistics as of 27th September 2016 is listed below in Table 2 and in Figures 16 through 20.

Table 3: Key figures on 27th September 2016

Number of Followers:	694
Nomber of Following:	1225
No of Tweets:	423

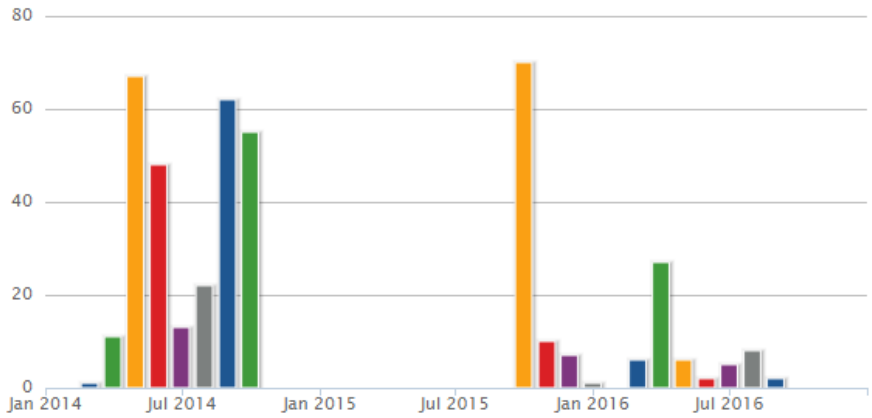


Figure 16: Tweet Timeline: 2.4 tweets per day / 22 tweets per month (source: www.tweetstats.com)

Figure 17: Top # Used (HashCloud for IoTLab) source: www.twitonomy.com

Figure 18: The last month stats (source: Twitter Analytics) last 28 day summary

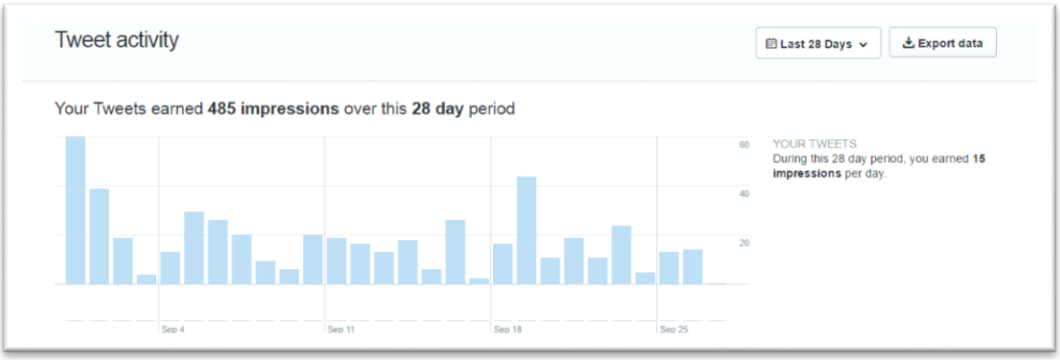


Figure 19: IoT Lab Tweet impressions over the last 28 day period

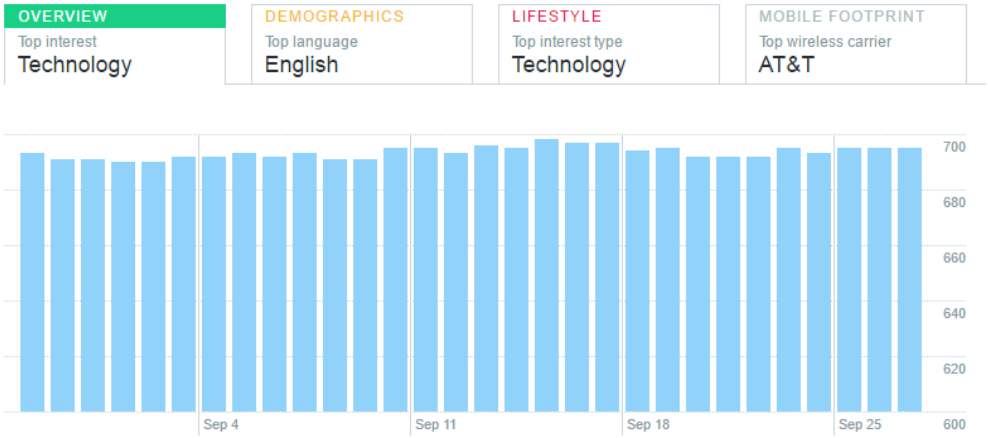
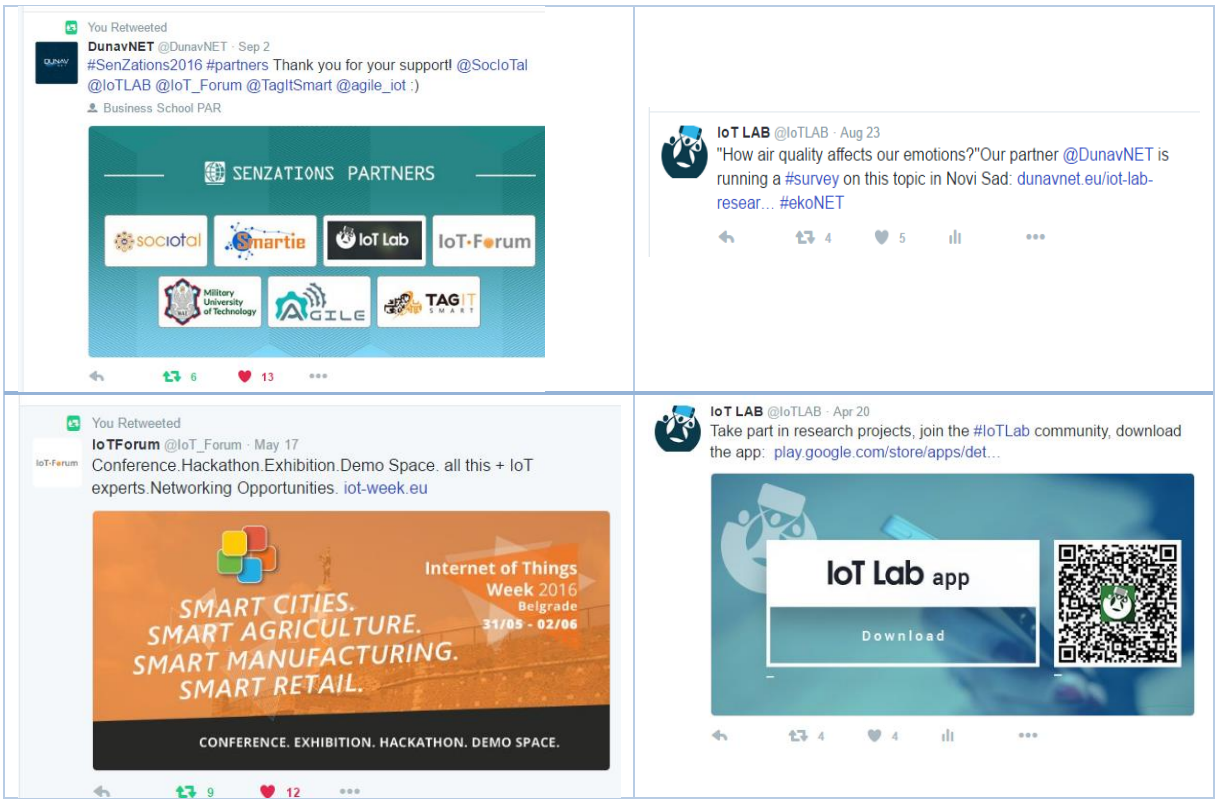


Figure 20: The IoT Lab Twitter number of followers

Some examples of tweets are shown in Table 4 below:

Table 4: Example of IoT Lab posted tweets during Y3



IoT LAB @IoTLAB · Apr 20
Waiting for you at our booth :) #netfutures16 Come and meet us!

2 4

IoT LAB @IoTLAB · Apr 15
Meet us next week @netfuturesEU! Till then, read more about the current #FIRE landscape: bit.ly/1V6pEI7
FIRE

4 1

IoT LAB @IoTLAB · 24 Dec 2015
We wish you a Merry Christmas and a Happy New Year! Enjoy the Holiday season! :)

1 3

IoT LAB @IoTLAB · 30 Oct 2015
We bring together end-users& #researchers of the world. Become a part of our "smart #crowd"! bit.ly/1Ge7xUo

3 1

IoT LAB @IoTLAB · 28 Oct 2015
[VIDEO] This is how we do it: Check out how our platform works & join the crowd! #crowdsourcing #crowdsensing

IoT Lab
IoT Lab is crowd sourcing and crowd sensing platform with the participants as the core of research and innovation process. The IoT Lab provides a unique T...
youtube.com

5 3

IoT LAB @IoTLAB · 22 Oct 2015
Less than 1 hour left to vote the best idea.The winner announcement during the Prize Award Ceremony at 13:00h.

1 1

IoT LAB @IoTLAB · 21 Oct 2015
Hall No.2, Booth No.T22.Visit us and play to win Android watch and/or take the #FIRE_quiz and win a tablet! #ICT2015

5 1

IoT LAB @IoTLAB · 20 Oct 2015
Visit us @ict2015eu! Join the demonstration of our mobile app and Testbed as a Service iotlab.eu/News

4 4

2.4.3 IoT Lab on LinkedIn

The project's LinkedIn group has been created. An IoT Lab group on LinkedIn allows registered users to maintain a list of contact details of people in the IoT area. The contact network consists of direct connections, the connections of each of their connections and also second-degree connections.

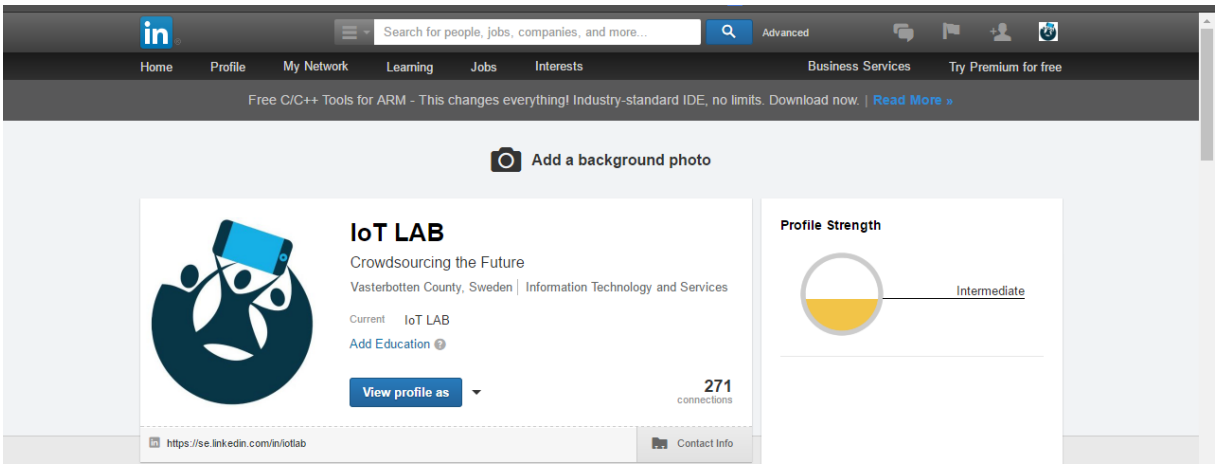


Figure 21: IoT Lab on LinkedIn

This channel has primarily been used to offer information about the tools.

Table 5: Linkedin statistics 27.09.2016.

Number of connections	271
Group IoT Lab	52 members
Companies that IoT Lab Follows (14):	University of Southampton, University of Surrey, Alexandra Instituttet, IOT, University of Geneva, Sher Garner Cahill Richter Klein and Hilbert, LLC, Robinson & McElwee, CDT - Centre for Distance-Spanning Technology, rt health fund, DunavNET

It is a part of the future plan to intensify the activity on LinkedIn social media by targetting mainly professionals (researchers, private sector companies) and providing a more extensive information about the tool tailored for different stakeholders.

2.4.4 IoT Lab on Facebook

The IoT Lab project has a Facebook profile to promote the project ideas and enable crowdsourcing through social networks. In this way, different stakeholders can be notified of certain events, or different ideas can be targeted at certain groups which are already present on Facebook. Also, the personal IoT Lab Open Group on Facebook allows adding other users as members, and exchanging messages, including automatic notifications when members update their profiles.

Figure 22: IoT Lab Facebook profile

Facebook profile has been given more prominence at the end of the project and served as the vehicle for national and regional subgroup communication. Our Facebook account has so far generated 906 likes.

Twitter has been the main channel for information sharing, but Facebook has been used more extensively in later stages of the project when more results became available, such as well-defined use cases and collaborations. Facebook page has been tied closer to the specific IoT Lab experiments and targeted groups in different geographical areas/age segments, etc

In the Jumpology Use Case run by LTU, they posted an invitation at a Facebook site (“Helvetes jävla mobiltelefon, åhh nu funkar den”) having 63,556 members, where they reached 3279 people with their invitation to contribute to science by shaking their phone.

LTU also posted an invitation at a Facebook page (“Digital tjänsteutveckling”) for their students at their candidate programme with 140 members, reaching 39 and they posted the invitation with instructions at the LTU Website and at their own Facebook walls. Hence, the invitations reached at least 3500 potential users.

In parallel, the Alexandra Institute survey through Facebook reached more than 4000 users with their survey.

2.5 Meetups

Meetups are a great way to exchange knowledge and create a network of people with whom one can share ideas in an informal setting. They can also be used to disseminate the project results as well as for crowdsourcing. It would be of great benefit to the project if partners from different countries can attend or organize meetups in their cities or countries. There are number of meetups organized in Europe which deal with IoT (http://www.iotevents.org/calendar-views#meetups), where project partners can participate and exchange ideas.

IoT Lab ‘Crowdsource the Future’ platform is part of the programme at the IoT Guildford Meetup organised to discuss IoT, Crowdsouring and Smarter Services to take place on 8th November 2016 at Guildford Uk (goo.gl/owppia).

2.6 YouTube and Videos

The video slide presentation and the video animation developed during the first periods has been actively used to present and promote the project. They are available on line at: https://www.youtube.com/watch?t=3&v=Ra7d6tYesdg

https://www.youtube.com/watch?v=ak8P8bB0u-o&feature=youtu.be

Figure 23: IoT Lab Project Slides on YouTube

The IoT Lab project video was uploaded on YouTube on 28th September 2015 and had more than 1500 views.

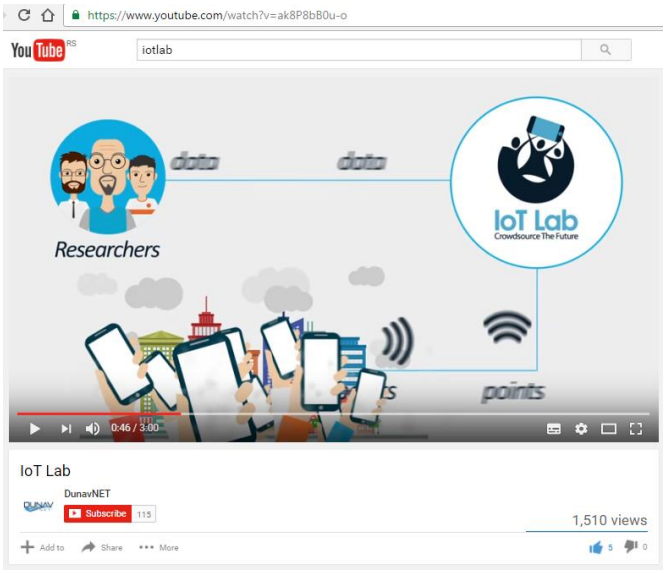


Figure 24: IoT Lab Project Video on YouTube

2.7 IoT Lab Flyer

IoT Lab project flyer was created at the beginning of the project and is available for the download on the project Website (http://www.iotlab.eu/IOTLabProject). The flyer was used as promotion and dissemination material which in a clear and brief manner outlines what the project is about, presents members of the consortium, and explains the system architecture.

The design of the initial flyer made in the Y1 (Figure 25) was replaced by a new flyer developed in Y3 (Figure 26).

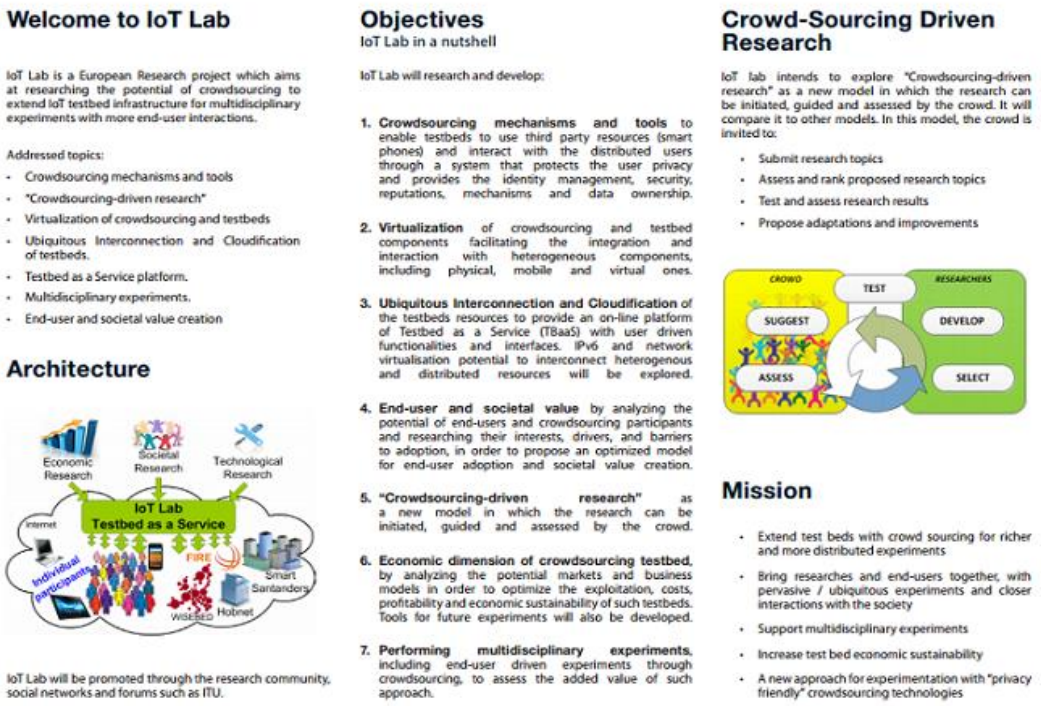


Figure 25: IoT Lab Flyer Y1

Design of the Y3 Flyer encompasses all the necessary information about the IoT Lab project and developed tools such as the Web tool for researchers and the mobile app for the crowd. It

was used at various venues to inform and invite the crowd to install the mobile app and take part in competition by proposing the research ideas.

Figure 26: IoT Lab Flyer Y3

2.8 CEBIT

IoT Lab was presented at CEBIT, in March 2016 in Hannover. The presentation of IoT Lab was led by MI and promoted the platform and collected feed back from SMEs and the industry. IoT Lab was also presented in a session in the IoT Hall, together with SigFox and LoRa.

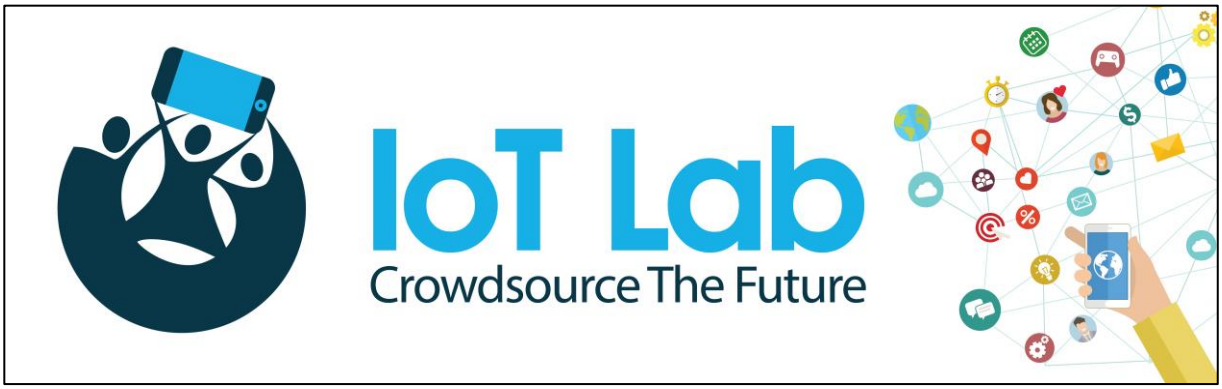


Figure 27: IoT Lab Banner on the CEBIT Booth

Figure 28: CEBIT Pictures

2.9 IoT Lab Poster

Over the duration of the project, three posters have been designed. Figure 29 shows the outline of the poster used to promote the project in Y1.

Figure 29: IoT Lab Poster Y1

DNET and MI designed a new general rollup poster in September 2014 which was presented at the IoT360° Summit in Rome on 28th - 29th, October, 2014 as shown in Figure 30, which has been finally replaced by a new poster presented in Figure 31 inviting the researchers to join the Testbed as a Service and the crowd to download the app and start participating in experiments.

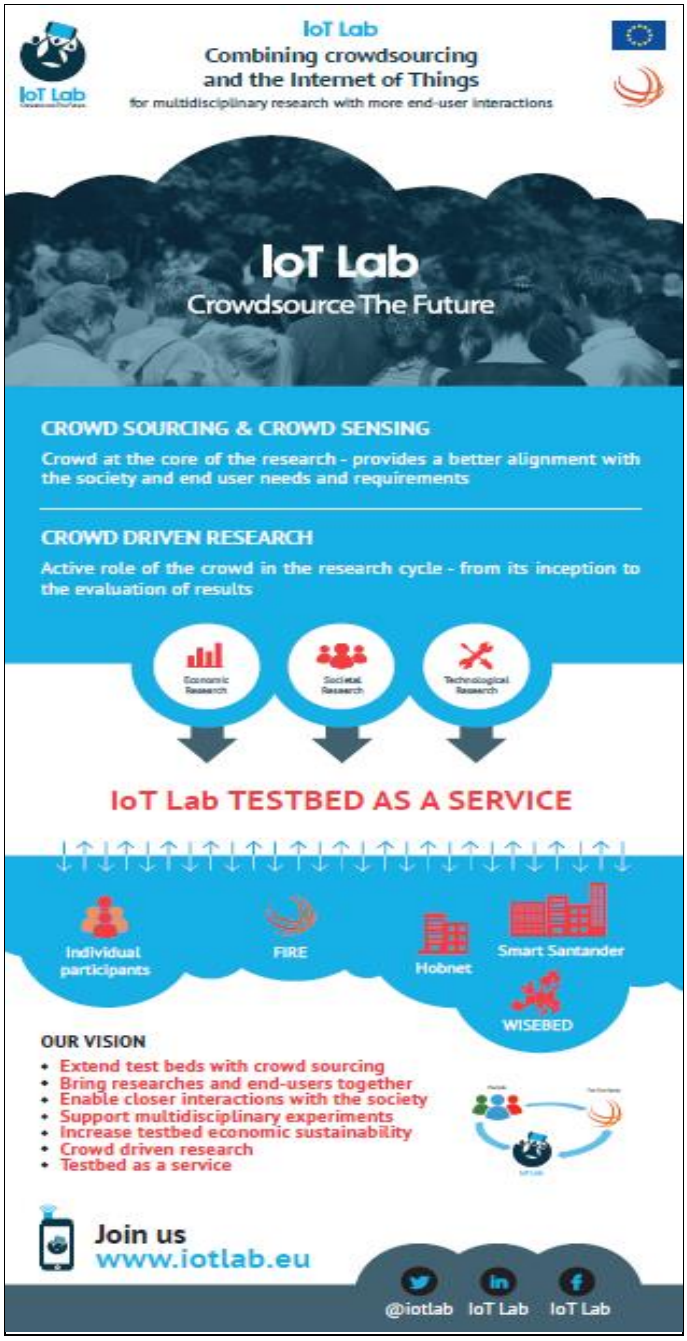


Figure 30: IoT Lab Roll Up Y2

Figure 31: IoT Lab Roll Up Y3

2.10 Disseminating Knowledge in Y3

2.10.1 Conferences and Workshops in Y3

Table 6 Conferences and Workshops in Y3

No	Start Date	End Date	Name	Role	Type	Type of audience	Scope	Size of audience	Partners
1	20.10.2015	22.10.2015	ICT 2015	Project presentation + booth	Conference	Scientists and engineers	Europe	2000	AI
2	26.10.2015	27.10.2015	IoT Interop	Project presentation	Conference	Scientists, researchers, companies, EU commissioners	International	100	MI
3	5.11.2015	6.11.2015	FOKUS FUSECO Forum	Project presentation	Conference	Scientists, researchers, companies	Europe	>200	MI
4	20.11.2015	20.11.2015	Privacy-friendly crowdsourcing & crowdsensing Paving the way to a new research paradigm	Project presentation	Workshop	European Commission	Europe	15	All partners
5	14.12.2015	16.12.2015	IEEE World Forum on IoT	Project presentation	Conference	Scientists, researchers, companies	International	1000	MI
6	14.12.2015	18.12.2015	ITU - Green ICT Week	Project presentation + session organizer	Conference	Members States, scientists, researchers, companies	International	300	MI

7	12.01.2016	12.01.2016	Open and Agile Smart Cities	Project presentation	Conference	Smart cities, researchers, authorities	Europe	200	LTU
8	16.01.2016	23.01.2016	ITU - Study Group 20 Meeting	Project presentation + session organizer	Conference	Members States, scientists, researchers, companies	International	200	MI
9	14.03.2016	18.03.2016	CEBIT	Project presentation	Event	Everybody	All the world	> 200.000	MI
10	23.03.2016	25.03.2016	30th IEEE International Conference on Advanced Information Networking and Applications (AINA)	Project presentation + session organizer	Conference	Scientists and researchers	International	400	MI
11	18.04.2016	20.04.2016	Global Experimentation for Future Internet Workshop	Project presentation	Event	Scientists, Engineers, Academia, Public administrations	Europe	100	MI
12	20.04.2016	21.04.2016	Net Futures 2016	Booth	Event	Researchers	Europe	1000	CTI, MI, AI
13	09.05.2016	11.05.2016	ITU - Study Group 20 - Rapporteur Meeting Q1	Standardization effort	Conference	Members States, scientists, researchers, companies	International	200	MI
14	12.05.2016	12.05.2016	HES-SO master module at Lausanne	Project presentation & Workshop	Workshop	Students	Switzerland	50	MI
15	23.05.2016	24.05.2016	Open Innovation Conference 2.0	Project presentation	Conference	Scientists, researchers, companies, EU commissioners	All the World	50	LTU

16	31.05.2016	02.06.2016	IoT Week 2016	Project presentation & Workshop	Event	Scientists and Engineers	All the world	200	CTI, MI, DNET, UNIS, LTU
17	14.06.2106	14.06.2106	MIKT- open conference days	Project presentation	Event	Scientists, Citizens, companies	Sweden	100	LTU
18	25.07.2016	27.07.2016	International Conference on Telecommunications and Multimedia (TEMU)	Project presentation & Workshop	Event	Scientists and Engineers	Europe	50	MI, CTI
19	28.07.2016	05.08.2016	ITU - Study Group 20 on IoT	Standardization effort	Conference	Members States, scientists, researchers, companies	International	200	MI, UniGE
20	06.09.2016	08.09.2016	Softec Asia 2016	Project Presentation & Workshop	Conference	Scientists, Engineers, Academia, Industry	All the World	1000	UNIGE
21	12.09.2016	16.09.2016	Week of the sustainable development at HEPIA	Project presentation & Workshop	Workshop	Students	Switzerland	20	MI
22	27.09.2016	27.09.2016	FIRE Forum	Project presentation	Meeting	Scientists and Engineers	Europe	80	MI
23	27.09.2016	28.09.2016	Technology for Marketing	Booth	Event	Everybody	Europe	120	DunavNET
24			FIRE Dissemination Working Group phone calls	Representation of the project	Phone calls	FIRE community	Europe	10-20	MI, LTU

2.10.2 Publications in Y3 (All)

The following Table 7 presents the overview of papers published in Y3 up to 1st, October 2016.

Table 7: Papers published in Y3

Dates	Publication	Type	Title	Authors
2/11/2015	Proceedings of the 18th ACM International Conference on Modeling, Analysis and Simulation of Wireless and Mobile Systems, MSWiM 2015, Cancun, Mexico, November 2-6, 2015. ACM 2015, ISBN 978-1-4503-3762-5	Paper	Traversal Strategies for Wireless Power Transfer in Mobile Ad-Hoc Networks.	Constantinos Marios Angelopoulos, Julia Buwaya, Orestis Evangelatos, José D. P. Rolim:
14/12/2015	IEEE WF on Internet of Things, 14-16 Dec 2015. Milan, Italy	Paper	Internet of Things and Crowdsourcing – a Paradigm Change for the Research on the Internet of Things	Sébastien Ziegler, Sotiris Nikoletseas, Jose Rolim, Srdjan Krco, João Fernandes
14/03/2016	Computer Networks, Volume 97, 14 March 2016, Pages 98–112	Paper	Hierarchical, collaborative wireless energy transfer in sensor networks with multiple Mobile Chargers	Adelina Madhja, Sotiris Nikoletseas, Theofanis P. Raptis
25/03/2016	30th IEEE International Conference on Advanced Information Networking and Applications (AINA) proceedings	Paper	Internet of Things, Crowdsourcing and Systemic Risk Management for Smart Cities and Nations, Initial insight from IoT Lab European Research project	Sébastien Ziegler, Sotiris Nikoletseas, Jose Rolim
26/05/2016	IEEE 36th International Conference on Distributed Computing Systems (ICDCS), Nara, Japan, 2016, pp. 262-270.	Paper	Interactive Wireless Charging for Energy Balance	Sotiris Nikoletseas, Theofanis Raptis and Christoforos Raptopoulos

26/05/2016	12th IEEE International Conference on Distributed Computing in Sensor Systems, Washington D.C., USA, (DCOSS 2016).	Paper	Interactive Wireless Charging for Weighted Energy Balance	Sotiris Nikoletseas, Theofanis Raptis and Christoforos Raptopoulos
26/05/2016	12th IEEE International Conference on Distributed Computing in Sensor Systems, Washington D.C., USA, (DCOSS 2016).	paper	Greedy routing on virtual raw anchor coordinate system	Pierre Leone and Kasun Samarasinge
1/6/2016	International Journal of Public Information Systems	Journal paper	Clash! The Open Data Policy Meets an Organizational Context	Runardotter, Mari & Ståhlbröst, Anna
1/6/2016	Living Labs –Innovating by Co-Creating with Users in Real-Life Environments	Book Chapter	Stakeholders in Living Lab Innovation Processes	Ståhlbröst, Anna
4/7/2016	Ad-hoc, Mobile, and Wireless Networks - 15th International Conference, ADHOC-NOW 2016, Lille, France, July 4-6, 2016, Proceedings. Lecture Notes in Computer Science 9724, Springer 2016, ISBN 978-3-319-40508-7	Paper	A Service Based Architecture for Multidisciplinary IoT Experiments with Crowdsourced Resources.	Panagiotis Alexandrou, Constantinos Marios Angelopoulos, Orestis Evangelatos, João Fernandes,Gabriel Filios, Marios Karagiannis, Nikolaos Loumis, Sotiris E. Nikoletseas, Aleksandra Rankov,Theofanis P. Raptis, José D. P. Rolim, Alexandros Souroulagkas:
22/07/2016	13th IEEE International Conference on Mobile Ad hoc and Sensor Systems, Brasília, Brazil, (MASS 2016).	Paper	Energy Balance with Peer-to-Peer Wireless Charging	Sotiris Nikoletseas, Theofanis Raptis and Christoforos Raptopoulos
13/10/2016	MOBIWAC 2016: The 14th ACM* International Symposium on Mobility Management and Wireless Access	Paper	A distributed algorithm using path dissemination for publish-subscribe communication patterns	Stephane Kundig, Pierre Leone and José D.P. Rolim

TBC	Beyond the Internet of Things: Everything Interconnected	Book Chapter	Crowd-driven IoT/IoE ecosystems: a multidimensional approach	Xenia Ziouvelou, Panagiotis Alexandrou, Constantinos Marios Angelopoulos, Orestis Evangelatos, Joao Fernandes, Nikos Loumis, Frank McGroarty, Sotiris Nikoletseas, Aleksandra Rankov, Theofanis Raptis, Anna Ståhlbröst, Sebastien Ziegler
TBC	To be submitted to the Economic Journal	Journal paper	The impact of the Internet of Things on productivity	Héctor Espinoza, Mary O'Mahony, Gerhard Kling, Frank McGroarty and Xenia Ziouvelou

3 Outreach and communication: Conclusions from the Use Cases

Key actors for the IoT Lab platform were identified at the first stage of the project: researchers/experimenters, crowd/media, the EC, authorities and potential customers. By close interaction between IoT Lab partners and different stakeholders, we continued to iteratively define more specific segments and actual organizations which can be targeted with our campaigns by using established channels. The main pre-conditions for enabling this approach, such as setting up the strategy and all communication tools and making the project public and visible have all been met.

A number of use cases has been conducted in the last year of the project. Different strategies and actions have been applied for the outreach and interactions with different stakeholders. Based on the results from the use cases carried out in WP7, it is evident that the segments to target with outreach activities are two-folded. Firstly, it is the researchers who are the drivers of the process and who should design engaging research projects. Secondly, the target groups are people in close engagement with the research projects. This means, for instance, that the citizens engaged in researches should be recruited on a case by case basis. One aspect of this is the importance of the Incentives Model that triggers the crowd motivation such as having fun, becoming “famous”, earn a fortune and/or having a feeling of fulfilment. Another aspect is related to the people’s willingness and demand to be engaged and commit to a research project in a long term, not only by providing their data to an unknown researcher, but also by being an active participant in the research project as a whole, taking part in workshops and other engaging events. The crowd wants to feel that their engagement makes a difference and contributes to a greater good and that is what triggers them.

The Incentive Model has been implemented late in the project but it is based on a Social Good Business approach that allows its community members to allocate the points/credits collected by participating in the research to a Charity of their choice. This is seen a good crowd motivator that will enhance further the intrinsic motives of the crowd participants, as they will be contributing to a greater cause that goes beyond just contributing to an emerging research. Hence, the target groups that the IoT Lab solution should aim for with outreach activities are mainly two. The research community where the current IoT Lab system mainly supports sensor-driven research hence, researchers in need of this type of data to support their research are the main target group for the TBaaS system. For this target group, it is of vital importance that the services IoT Lab offers are explicit. By combining TBaaS and the participatory sensing application, a powerful tool for research is offered, and can benefit from being complemented with more human-oriented approaches to stimulate the crowd to contribute with their data. For example, a researcher wants to understand how people are moving around in a city during winter time together with the city planners who wants to develop the local traffic system. Here we see that in a case like that, the main interest for the researcher is to communicate with a defined crowd living in the specific city. The citizens might also be more willing to share their data with the city and the researcher if they see that it might be directly beneficial for them. In this process, the data being collected is only one part of a holistic research to get a view of on-going contextual activities which can be combined with co-creative workshops with citizens to gain deeper insights and understanding. In this way, the IoT Lab system becomes a research tool that facilitates real-time, real-world measurements with real people who can also commit to the process of citizen science. However, we argue that to keep the crowd motivated it is not

enough to merely collect data and ideas from them but it is important to put the IoT Lab system into a broader context in which the crowd can be engaged in different ways.

Potential communication channels for the IoT Lab system is to continue to promote it to other research projects both H2020 project, and also local projects across Europe. This can be done at research conferences, networking events, through research publications and also in personal networks such as FIRE, EnoLL, OASC and IoT Forum, to mention a few. In these channels, the TBaaS Website (Web tool) should be promoted at which a clear offering should be presented to the researcher. Target researchers can also be reached through citizen science organizations such as European Citizen Science Association, Zooniverse and SciStarter. To these organisations IoT Lab can offer an opportunity to use the tools we offer as a part of their citizen science research projects which could add a new dimension to these initiatives which usually collects data through observations and data collection from citizens. The IoT Lab system would offer a new avenue to citizen science not only viewing citizens as data collectors, but also as data producers.

4 IoT Lab Dissemination Strategy Beyond the Project

In the course of the IoT Lab project a variety of dissemination tools have been employed in order to reach the different stakeholders segments that the project addresses and align with the different dissemination targets at each phase of the IoT Lab project.

Based on the experience gained throughout the project's lifetime, the IoT Lab partners have observed that the effectiveness of these tools varies by the type of stakeholder. As it can be seen in Table 8 below, different tools exhibit a high level of effectiveness for distinct stakeholder segments. However, all the employed tools provide dissemination value for IoT Lab as a whole. Consequently, these tools will be utilised in order to achieve the different dissemination needs of the IoT Lab as a post-project dissemination strategy.

Table 8: Dissemination tools effectiveness for different IoT Lab stakeholders

	Dissemination tool effectiveness for the IoT Lab Stakeholders						
	Crowd participants	Researchers	Universities/ Research Centers	Companies	Public Organisations	Testbed Owners	Charities/ NGOs
Project website	✔	✔	✔	✔	✔	✔	✔
Email/Newsletter		✔	✔	✔	✔		✔
Brochures	✔	✔	✔	✔	✔	✔	✔
Conferences		✔	✔				
Publications		✔	✔				
Press and media releases	✔			✔	✔	✔	✔
Presentations		✔	✔	✔	✔	✔	
Workshops	✔	✔	✔	✔	✔	✔	
Focus groups	✔	✔	✔	✔	✔	✔	✔
Online questionnaires	✔	✔	✔	✔	✔	✔	✔
Social networks	✔	✔	✔	✔	✔	✔	✔

The planned dissemination strategy for the post-project expiration phase of the IoT Lab entails a phased approach that aims to engage users, as it can be seen in Figure 3232.

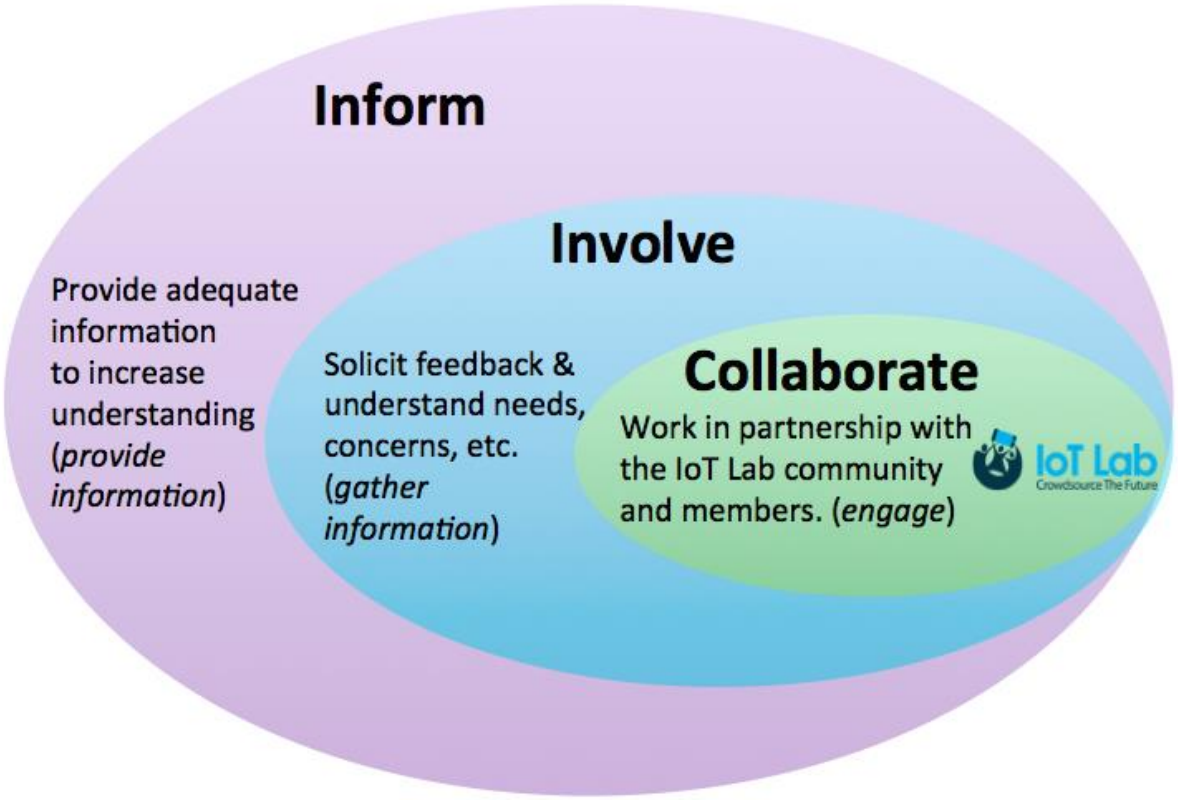


Figure 32: IoT Lab Dissemination Strategy for the post-project expiration phase

As such, the focus will be on:

a) ***Providing information***: "informing" users by providing adequate information so as to trigger interest and increase understanding.

b) ***Gathering information:*** "involving" users by soliciting feedback and understanding the needs and concerns of each of the stakeholder segments.

c) ***Engage:*** "collaborating" with the IoT Lab community and its individual members in order to fulfill the aims and objectives of the IoT Lab Association for the benefit of the society as a whole.

In the course of this strategic plan all abovementioned dissemination tools will be utilised but the emphasis will change depending upon the phase of the dissemination strategy. As it can be seen in Figure 33, each phase will focus on different dissemination tools while also takes into account the different stakeholder segments. For this reason, diverse dissemination campaigns will be created for each stakeholder segment and each channel (i.e., different dissemination campaign for Facebook, Twitter, LinkedIn, etc.)

	Inform	Involve	Engage
Project website	✔	✔	✔
Email/Newsletter	✔	✔	
Brochures	✔		
Conferences	✔	✔	✔
Publications	✔		
Press and media releases	✔		
Presentations	✔	✔	✔
Workshops	✔	✔	✔
Focus groups	✔	✔	✔
Online questionnaires		✔	✔
Social networks	✔	✔	✔

Figure 33: Dissemination tools that will be utilised across the three-phased approach of the IoT Lab Dissemination Strategy (post-project expiration)

With this plan, IoT Lab partners aim to reach effectively all stakeholder segments and at the same time manage to actually engage with the community members.

5 Internal Dissemination Activities

5.1 Face-to-Face Meetings

Face-to-face meetings were organized throughout Y3, as well as meetings at various IoT events. The list of project meetings is given below:

Table 9: The List of IoT Lab Project Meetings

Event	Location	Date	Project partners
Project review	Brussels, Belgium	November 2nd – 3rd, 2015	ALL
Project meeting	Geneva, Switzerland	April 14th, 2016	ALL
Project meeting	Stockholm, Sweden	June 23rd, 2016	ALL
Project meeting	Geneva, Switzerland	September 19th – 20th, 2016	ALL

5.2 Project File Repository

Project folder files are stored in the Dropbox, so that they can be easily accessed by all the partners. In this way, all the results can be quickly internally disseminated. The folder structure is expandable and can accommodate all the documents that will be produced throughout the project lifetime.

In parallel, folders in progress were stored into OneDrive to support collaborative editing of documents with a large storage capacity (Figure 34). No personal data is stored in these repositories.

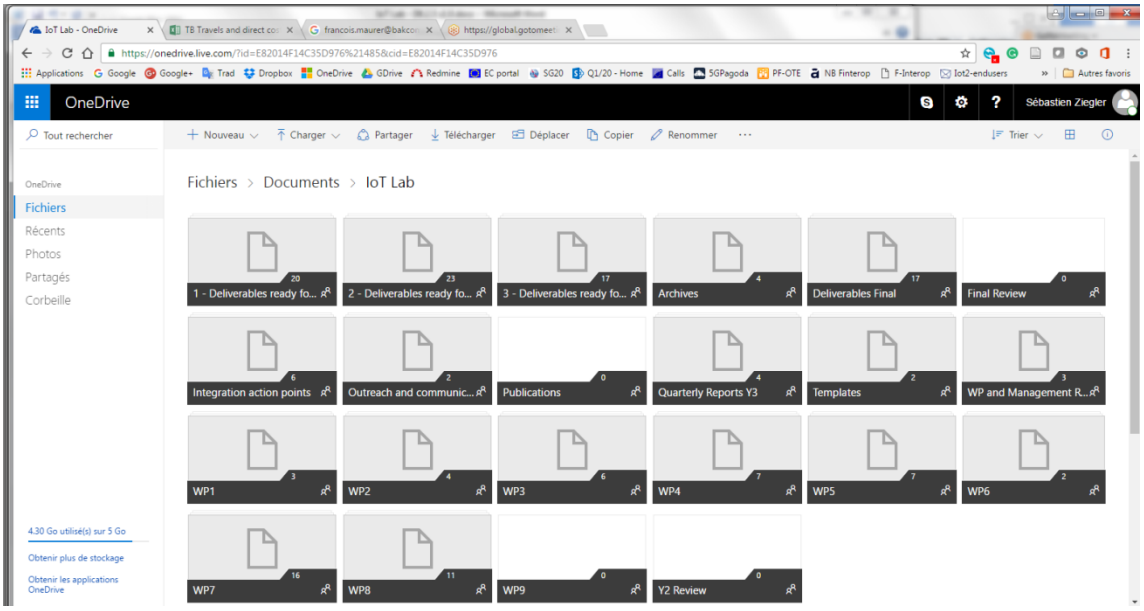


Figure 34: IoT Lab OneDrive Document Share

5.3 Regular Phone Conferences

GoTo Meeting was used to arrange regular meetings between the project partners in Y1. Skype was used as way of communication on a per needs basis (several Skype phone conferences regarding technical and architectural issues have been held between DunavNET, UniGe, CTI and UniS). Also, technical teleconferences were held among the technical partners (i.e. testbed owners CTI, UNIGE, MI, UNIS and DNET) with regards to virtualisation and integration activities (general architecture, software components to be used, and workplan to be followed, etc.).

Many Skype calls and teleconferences were organized between all partners, and project partners working together on specific issues. Regular monthly teleconferences were held via GoToMeeting.

5.4 Mailing Lists

The mailing list for the project is at iotlab@genevaproxy.com and is actively used on a regular basis.

6 Liaison and Collaboration with the International Telecommunication Union (ITU)

The collaboration with the ITU has been further developed during Y3 of the project. The effort has led to the creation of a new work item. This work item has been officially created at the ITU in August 2016 to work on and adopt a *Recommendation on Crowd-Sourced platform in Question 1 of ITU-T SG20*. It is a direct outcome and achievement of IoT Lab on the basis of the project contributions to the ITU. This work item has been discussed over several ITU SG20 meetings and was enriched through several communications made by MI as a ITU-T sector member. The work item will be led by the University of Geneva, the University of Bournmouth and Mandat International.

MI took advantage of its ITU membership to engage with the ITU since the beginning of the project. It contributed to several meetings and conferences organized by the ITU. The ITU strategy has been organized around several axes, as detailed below.

6.1 Joint Coordination Activity on Internet of Things (JCA-IoT)

MI has presented the IoT Lab project at the JCA-IoT meeting during the first year of the project and has attended several JCA-IoT meetings to relay relevant outcomes of IoT Lab. JCA-IoT constitutes a central body for information sharing on IoT activities.

6.2 ITU Green Standards Weeks

MI has been invited to several Green Standards Week organized by the ITU to contribute and present the project, including in Beijing (from September 22nd - 25th, 2014) and Nassau (from December 14th to 18th, 2016).

The 2015 Green Standards Week has been organized by the International Telecommunication Union (ITU), the Basel Convention, the Economic Commission for Latin America and the Caribbean (ECLAC), the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Human Settlements Programme (UN-Habitat), the United Nations Industrial Development Organization (UNIDO) and the United Nations University (UNU). The Green Standards Week 2015 was dedicated to the theme of “Cities and Climate Change: From the New Climate Agreement to the New Urban Agenda”.

The Green Standards Week (Figure 35) acts as global platform for discussion and knowledge-sharing in order to raise awareness of the importance and opportunities of using information and communication technologies (ICTs) to expedite the transition to smart sustainable cities and ensuring a sustainable urban future.

MI has been invited by the ITU to present the IoT Lab project at the conference and the results of the Sustainable Smart Cities KPIs use case. The Green Standards Week 2015 has led to the adoption of an international declaration on “Powering Smart Sustainable Cities, Nations & Islands”. The Article 4 of this declaration has been led and driven by IoT Lab presentation, and commits to:

*“Lead with vision: Develop and foster the adoption of policies, international standards, key performance indicators, innovative ICT-based sources of information (**such as those provided by the Internet of Things (IoT) and crowdsourcing to collect citizens perceptions**), and best practices to shape smart sustainable cities, countries and islands to promote the use of green ICTs for sustainable development including climate change adaptation and mitigation as*

well as e-waste management."

It is a direct recognition of the work and innovative approach proposed by IoT lab.

Figure 35: ITU Green Standards Week

6.3 World Summit on the Information Society

Following the invitation made at the Green Standards Week 2014, MI had been invited to set up a presentation and a booth at the ITU World Summit on the Information Society (WSIS) Forum held in Geneva between May 25th –29th, 2015. MI had also chaired a joint session between the ITU and MI on "Internet of Things (IoT): The Way to Smart Sustainable Cities" on the Opening day. This event has paved the way towards ongoing discussion and cooperation between MI, the ITU-T and the European research community, with an interest to engage more actively the European research community in ITU-T SG20 activities.

6.4 Focus Group on Smart Sustainable Cities (FG-SSC)

MI had actively contributed to the work of the ITU Focus Group on Smart Sustainable Cities. The FG-SSC had been established as an open platform for smart-city stakeholders to exchange knowledge in the interests of identifying the standardized frameworks needed to support the integration of ICT services in smart cities. In this context, MI had proposed to include crowdsourcing and crowd-sensing technologies enabling closer interactions with citizens. MI also directly contributed to the elaboration of the recommendation of this Focus Group presented in the *"Draft Technical Specifications on Key Performance Indicators (KPIs) related to the sustainability impacts of Information and Communication Technology (ICT) in Smart Sustainable Cities"* (SSC-0269-rev3). The work initiated in FG-SSC has been replaced by the Study Group 20.

6.5 MI active role in the new ITU Study Group 20 (SG20)

In June 2015, the ITU has established a new study group: the ITU-T SG20 on IoT and its applications including smart cities and communities (SC&C). This study group is gathering most questions related to IoT and smart cities.

As stated by the ITU: *"The Study Group 20 is working to address the standardization requirements of Internet of Things (IoT) technologies, with an initial focus on IoT applications in smart cities and communities (SC&C). SG20 develops international standards to enable the coordinated development of IoT technologies, including machine-to-machine communications*

and ubiquitous sensor networks. A central part of this study is the standardization of end-to-end architectures for IoT, and mechanisms for the interoperability of IoT applications and datasets employed by various vertically oriented industry sectors. The deployment of IoT technologies is expected to connect an estimated 50 billion devices to the network by year 2020, impacting nearly every aspect of our daily lives. IoT is contributing to the convergence of industry sectors, and SG20 provides the specialized IoT standardization platform necessary for this convergence to rest on a cohesive set of international standards. An important aspect of SG20's work is the development of standards that leverage IoT technologies to address urban-development challenges. IoT is a key enabler of the Information Society and offers an opportunity to transform city infrastructure, benefiting from the efficiencies of intelligent buildings and transportation systems, and smart energy and water networks. SG20 will assist government and industry in capitalizing on this opportunity, providing a unique platform to influence the development of international IoT standards and their application as part of urban-development master plans. ITU put forward a vision of IoT in the landmark "Internet of Things" report published in 2005 as part of a series of ITU reports on the Internet. The foundations of the new Study Group are provided by ITU-T's experience in the development of IoT standards and the findings of the ITU-T Focus Group on Smart Sustainable Cities (FG-SSC), which concluded its activities in May 2015 with the release of 21 technical reports and specifications."[1]

Following IoT Lab and MI's active participation in the ITU activities, MI has been invited to take part in the preparatory work to support the establishment of the new study group. MI has proposed the inclusion of a new question on research and emerging technologies. The question has been accepted and included as Question 1. This will pave the way for a direct interaction between IoT Lab and other European research projects and the ITU community on the IoT and smart cities issues.

Question 1 (Q1/20) on "Research and emerging technologies including terminology and definitions" has the following tasks:

- Identify emerging technologies and relevant research work related to IoT and smart cities and communities;
- Liaise and foster cooperation with the academia, research and innovation community on IoT and smart cities and communities;
- Study and identify new work areas linked to IoT and smart cities and coordinate with other SG20 Questions, with relevant ITU-T SGs and other SDOs and forums, to initiate studies on those identified work areas.

MI has been invited by the ITU to serve as Rapporteur on this question. The role of MI has been formally confirmed during the first SG20 meeting in October 2015 in Geneva. This position has enabled MI to channel relevant outcomes from the IoT Lab project (and from the European research community at large) directly to the ITU.

MI has submitted and presented several IoT Lab related contributions to SG20, including a contribution to propose a formal collaboration between the IoT Lab Testbed as a Service and the ITU, as well as a suggestion to include the IoT Lab research topic on the agenda of the

[1] http://www.itu.int/en/ITU-T/about/groups/Pages/sg20.aspx

SG20. These first contributions were followed by other contributions, including a *"Proposal on a new Work Item on "Crowdsourcing and Crowd-sensing APIs and Interoperability Standard for Smart Cities and Communities.", which led to the creation a new work item in Question 1 of the SG20.* Examples of contributions are included in the appendix.

6.6 Liaison Statement between the ITU-T SG20 and IoT Lab

Following the active engagement of the project represented by MI in the ITU-T SG20 activities, the ITU-T has adopted a formal liaison statement with the IoT Lab: *"ITU-T SG20 – LS14 on joint collaboration between ITU-T Study Group 20 and the IoT Lab",* which is included in the Appendix. This statement has been extended by a complementary liaison statement from SG 11, inviting IoT Lab to support SG11: *"LS93, LS/r on joint collaboration between ITU-T Study Group 20 and the IoT Lab (reply to SG20 LS14)"*

This official recognition will enable IoT Lab to directly contribute to and be formally consulted on IoT related questions.

6.7 IoT Lab Work Item at the ITU

Finally, MI and UniGE have worked together to establish a dedicated work item for IoT and Crowdsourcing. After several meetings, this effort has successfully led to the creation of a new Work Item in Question 1 of the SG20. This new Work Item on *"Requirements and Functional Architecture of IoT-related Crowdsourced Systems*" is in charge of developing a draft Recommendation to be adopted as a formal ITU-T Recommendation.

The scope of the Recommendation encompasses:

- Concept of IoT-related Crowdsourced Systems (CS) platforms;
- Use cases related to IoT-related Crowdsourced Systems (CS) platforms;
- Requirements for IoT-related Crowdsourced Systems (CS) platforms;
- Functional architecture of the IoT-related Crowdsourced Systems (CS) platforms.

The summary description of the new work item is based on IoT Lab research and results and is worded as follow: "*Crowdsourcing is defined as the practice of obtaining needed services, ideas, content or other system resources by soliciting contributions from a large, open and potentially undefined group of people or things, rather than from employees, suppliers or experts. IoT-related Crowdsourced Systems (CS) is an emerging paradigm of systems whose IoT infrastructure is partially or totally provided by the general public; i.e. it is crowdsourced. The expected impact of CS is significant and multi-faceted. At a technical level, CS provides a methodology for opportunistically augmenting IoT and sensing infrastructure; e.g. in the context of a smart city. From a market perspective, CS paves the way for novel business and market models to emerge based on collaborative micro-economies and bottom-up innovation, lead by the public. The main obstacles that currently hinder this potential and need to be addressed are the highly diverse and heterogeneous nature of the CS constituent infrastructure, the ad-hoc and isolated development of applications based on crowdsourcing principles and the lack of an outlined tool set that can be used as a reference for CS development by the general public. This Recommendation will mitigate these obstacles by defining the concept of IoT-related CS platforms, by providing IoT-related CS platform use cases, by laying down the requirements of IoT-related CS platforms, and by providing IoT-related CS functional architecture*."

This new work item will be coordinated by MI, UniGE and University of Bornsmouth in UK. It constitutes an outstanding achievement, as the Recommendation, if and when adopted, will constitute an international normative reference for all member States of the ITU. The impact will be geographically extensive (global) and effective as ITU-T Recommendations are by default automatically adopted by national regulators.

7 Liaison and Collaboration with other organizations

7.1.1 IoT Forum

The Coordinator of the project is hosting the *IoT Forum* (http://www.iotforum.org) and is a member of the Board. The IoT Forum is organizing the IoT Week. A close cooperation is being established with the Forum to use the IoT Week as a dissemination platform towards the research community and the industry.

Several areas of potential cooperation and synergies have been identified, including:

- Synergizing with the IoT Forum for dissemination work, by linking with the IoT research community.
- Organizing sessions presenting IoT Lab at the IoT Week.

IoT Lab presentations have been made at the three last editions of the IoT Week:

- Presented IoT Lab project at the IoT Week 2014 in London.
- Presented IoT Lab project recent evolution and results at the IoT Week 2015 in Lisbon.
- Organised a session on IoT testbeds and presented IoT Lab project at the IoT Week 2016 in Belgrade.

Figure 36: Week 2016 in Belgrade

7.1.2 European Telecommunications Standards Institute (ETSI)

In parallel to its active engagement in the ITU activities, MI has been invited to lead the privacy question in the ETSI IP6 ISG. IoT Lab results in terms of personal data protection and privacy by design achievements will be channelled through this SDO.

7.1.3 Institute of Electrical and Electronics Engineers (IEEE)

MI is Vice-Chair of the IoT Subcommittee of the IEEE ComSoc. Articles have been successfully submitted to IEEE conferences

A workshop has been organized by IoT Lab to collect and discuss scientific papers on IoT, Crowdsourcing and Privacy. The 1st International Workshop on IoT, Crowdsourcing and Privacy was collocated with the 30th IEEE International Conference on Advanced Information Networking and Applications (AINA) conference in Crans-Montana, Switzerland, from March 23rd to 25th 2016 (Figure 37). The workshop intended to explore the potential of new approaches and technologies to research and develop better interactions between end-users and IoT, including crowdsourcing approaches. More details are available in the Appendix.

Figure 37: AINAI 2016

7.1.4 Alliance for Internet of Things Innovation (AIOTI)

MI has joined the Alliance for Internet of Things Innovation (AIOTI) as a member and will ensure a close relationship with this new community. MI contributed to several discussion in the context of the Working Group 3.

7.1.5 European Citizen Science Association (ECSA)

The European Citizen Science Association (ECSA) is an Association supported by organizations from over 17 EU countries and beyond, who are working together with environmental regulators to encourage the growth of the Citizen Science movement in Europe and internationally.

They are a network of Citizen Science initiatives, research institutes, universities, museums and other organisations from across the EU and administered by a Secretariat who hosted the Museum für Naturkunde, Leibniz Institute for Evolution and Biodiversity Research (MfN) in Berlin, Germany.

ECSA is highly relevant for the IoT Lab project. In particular, IoT Lab service could be utilised by ECSA community of research institutes, universities and other EU organizations in order to conduct crowd-driven research via IoT Lab. In addition IoT Lab could create linkages with the ECSA community members in order to validate (if possible) the WP6 and Task 6.3 and Task 6.4 results.

ECSA is aligned with the objectives of the IoT Lab Association. As such SOTON has already examined the potential of establishing synergies between the two initiatives.

Following the introductory activities that took place in the course of project (i.e., Y2) additional discussions have been made in order to establish collaboration and synergies with ECSA research activities (i.e., EU-funded projects that it participates). A positive response has been provided and arrangements will be made for a dedicated discussion.

Link: http://ecsa.biodiv.naturkundemuseum-berlin.de

7.1.6 Things Connected: IoT Network

The Digital Catapult launched during September 2016 the “Digital Catapult Things Connected”. This is an innovation support programme that aims to ensure that London is open and ready to innovate with the Internet of Things (IoT). This programme aims to empower digital startups and SMEs to embrace the opportunities of IoT, and help drive innovation that will transform lives across the UK capital.

Things Connected will initially provide 50 LoRaWAN base stations located across London to establish the UK’s largest IoT LoRaWAN network. The network will be free to use, the programme will provide a testbed to support evolving IoT technologies in its roll out. Things Connected has the potential to drive experimentation and innovation in IoT, in which areas include but are not restricted to infrastructure provision, traffic and transport services, energy management and environmental sensing, among others.

This innovation support programme is provided by the Digital Catapult in collaboration with BT, Future Cities Catapult, Everynet, Beecham Research, AllThingsTalk, BRE, Imperial College London, King’s College London, UCL and Queen Mary University of London.

This IoT Network is highly relevant for the IoT Lab project and the IoT Lab Association and a highly valuable synergy can be established. As such, SOTON has already started making initial attempts to exploit this collaboration further.

7.1.7 European Network of Living Labs (ENoLL)

The Luleå University of Technology (LTU) continues to collaborate with the European Network of Living Labs (www.openlivinglabs.eu). LTU is a board member of this network and will offer the opportunities IoT Lab system offers to its 400 members. These members are Living Labs spread all over the world with the main driver to develop innovations with the potential end-user in mind. There are close relations between IoT Lab and ENoLL as the key interest of IoT Lab is to empower the crowd. It is foreseen that collaboration opportunities with ENoLL members and to share experience from crowd-driven innovation can be found as well as on technologies to empower the crowd to take part in research and innovation actions. LTU has established contact with the ENoLL Board and offer IoT Lab services to be promoted to the network.

8 Liaison and collaboration with other research projects

In this Section, we give a description of different collaboration activities that have been carried out during Y3.

8.1 Collaboration through IERC

The aim of European Research Cluster on the Internet of Things is to address the large potential for IoT-based capabilities in Europe and to coordinate the convergence of ongoing activities. A wide range of research and application projects in Europe have been set up in different application fields. Communication between these projects is an essential requirement for a competitive industry and for a secure, safe and privacy preserving deployment of IoT in Europe (http://www.internet-of-things-research.eu/). Even though the IoT Lab is under the scope of Future Internet Research and Experimentation (FIRE) umbrella of projects, regular contacts were maintained with IERC.

8.2 Collaboration through FIRE (MI)

Future Internet Research and Experimentation (FIRE) (http://www.ict-fire.eu/home.html) addresses the emerging expectations which are being placed upon the Internet, by providing a research environment for investigating and experimentally validating highly innovative and revolutionary ideas.

The IoT Lab as a FIRE project covers the following subject areas (Figure 38):

- Sensors/Internet of Things/Web of Things;
- Content-centric/Social Networking/eLearning.

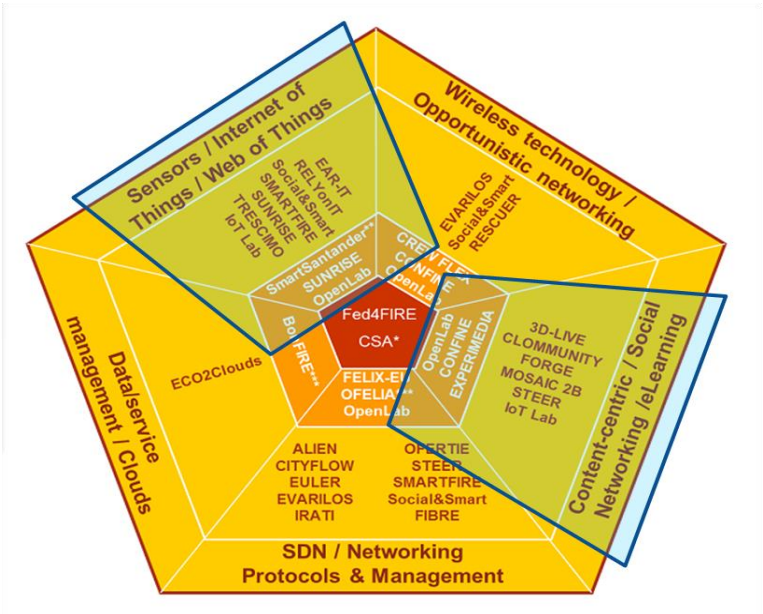


Figure 38: FIRE projects

IoT Lab partners mainly involved in the FIRE collaboration activities have been: MI, LTU and SOTON.

8.2.1 The FIRE Board and FIRE Working Groups (MI)

There is a common interest in collaboration around sustainability, Testbed as a Service, and experimentation methodologies with all ongoing FIRE projects. Partners from IoT Lab have actively been involved in FIRE related meeting and coordination activities, including several presentation of IoT Lab to FIRE Board meetings, including the latest FIRE Board in Bratislava on Septemnber 27th 2016, where MI presented the main lessons learned from IoT Lab.

8.3 Collaboration with Specific Projects

During the project, we identified a number of projects with which we initiated collaboration. The list of these projects appeared in D8.2.1 and D8.2.2 Dissemination, Liaison and Standardisation Activities Reports for Y1 and Y2. Here is an updated list of all the projects with which we have achieved some form of collaboration. We eliminated the projects which were not active anymore, as well as the projects with which no further progress was made in our collaboration efforts.

8.3.1 Fed4FIRE

Federation for FIRE
Summary: Fed4FIRE aims to establish a common federation framework by developing, adapting or adopting tools that support experiment lifecycle management, monitoring and trustworthiness. A large number of existing experimentation facilities in Europe will be adapted to seamlessly integrate in the federation. Such facilities typically focus on different kinds of networking related research or on different communities regarding services and applications. Example domains are optical networking, wireless networking, software defined networking, cloud computing, grid computing, smart cities, etc. Therefore, the federation will have to support a very heterogeneous set of requirements. To guarantee that the federation framework meets all of them, representatives of all these FIRE research communities will be actively involved in the definition of the federation architecture. Each of them will also lead the uptake of the Fed4FIRE platform in their specific community. Link: http://www.fed4fire.eu/
Areas of potential cooperation and synergies with the list of IoT Lab Tasks concerned: The IoT Lab project potentially can examine what tools have been used to support experiment lifecycle management, monitoring and trustworthiness which is applicable to the WP 7: “Integration, Multidisciplinary Tests and Validation”, and more specifically to the Task T7.1: “Integration”, which deals with the integration of different components into a comprehensive platform, and will check their respective interoperability. Furthermore, as Fed4FIRE will adapt a large number of existing experimentation facilities in Europe and integrate them into the federation, it complements efforts in WP3 Virtualisation and Mobility, whose objectives are: • To seamlessly integrate all individual testbeds resources, including crowdsourcing and FIRE labs, into a common platform. • To address scalability by integrating the IoT Lab resources in the Cloud.
List of actions done: Y1: The Coordinator organized a remote presentation of Fed4FIRE at the IoT Lab kick off

meeting and established the cooperation link between Fed4FIRE and the consortium. It was agreed that CTI and UniGE will serve as lead contact point for Fed4FIRE. We have established a communication link with the Fed4FIRE consortium. In particular, we have had several technical telcos with Fed4FIRE consortium members in order to acquire the necessary know-how for making the IoT Lab testbeds Fed4FIRE compliant. Y2: IoT Lab has aligned its architecture to Fed4FIRE and used part of its components in order to enable and ease future integration. Several bilateral discussions and teleconferences have been organized. Y3: MI has continued to cooperate with iMinds, the Fed4FIRE Coordinator, to support the convergence of both federations. MI and iMinds have initiated a new project, F-Interop, that started in November 2015. F-Interop will develop common online testing tools for the IoT on top of both testbed federations. Moreover, MI and iMinds will be partners of the Fed4FIRE+ federation, in order to ensure an ongoing convergence and interoperability between both federations.
Responsible Partner for Cooperation: MI

8.3.2 One Lab

OneLab Future Internet Testbeds
Summary: OneLab offers access to testbeds through OneLab in which you can easily test the software system that you have designed to function in any one of the following networked communication environments: ad-hoc wireless networks, with mobility and sensing capabilities, wireless broadband access networks, the public fixed-line Internet at a global scale emulated environments, both wireless and fixed-line. Wireless, sensing, and mobility testbeds - Internet of Things testing environments. These platforms offer both fixed nodes and mobile nodes with controlled mobility via robots or model trains. Some of the environments are rooms wrapped in Faraday cages, isolated from normal radio interference. Others are in typical office building environments. • FIT-IoTLab • NITOS • w-iLab.t Link: https://onelab.eu/services
Areas of potential cooperation and synergies with a list of IoT Lab Tasks concerned: There are two ways for potential cooperation with One Lab: • Use of their Website to promote IoT Lab project; • Exchange know-how in the area of IoT testing environments. Investigate whether an open source SW (e.g. tools) can be used within IoT Lab framework. For example, OneLab uses “a set of highly capable experiment control tools. These are free open-source tools designed around a set of interfaces that are being adopted worldwide, meaning that these tools are evolving to meet the needs of an ever-growing community of experimenters, and can be tailored, if needed, for particular requirements.”

List of actions done:

The Coordinator organized a remote presentation of Fed4FIRE at the IoT Lab kick off meeting and established the cooperation link between Fed4FIRE and the consortium. It was agreed that CTI and UniGE will serve as lead contact point for Fed4FIRE. Further synergies will be investigated in Y2 with a focus on the Testbed as a Service.

Y2: MI has further developed the collaboration with UPMC, the Open Lab Coordinator, to support the convergence of both federations.

Y3: MI and UPMC have initiated a new project, F-Interop, that will develop common tools on top of both testbed federations.

MI has continued to cooperate with UPMC, the OneLab Coordinator, to support the convergence of both federations. MI and UPMC have initiated a new project, F-Interop, that started in November 2015. F-Interop will develop common online testing tools for the IoT on top of both testbed federations.

Responsible Partner for Cooperation: MI

8.3.3 Privacy Flag

Privacy Flag

Summary: Privacy Flag is a European Research project combining technological and legal expertise. It develops a crowdsourcing-based solution enabling end-users to better protect their privacy with:

- Crowdsourcing mechanisms
- Privacy monitoring agents
- Universal Privacy Risk Area Assessment Tool
- Personal data valuation mechanisms
- Privacy enablers
- User friendly interface
- A global knowledge database of identified privacy risks
- In-depth privacy risk analytical tool and services
- Voluntary legally binding mechanism for companies located outside Europe
- Researching the potential for privacy standardization, labelling and certification

Privacy Flag gathers 11 European partners building a platform and a community for privacy protection. MI is the Technical Coordinator of the project.

Link: http://www.privacyflag.eu/

Areas of potential cooperation and synergies with the list of IoT Lab tasks concerned:

- Privacy protection
- Servers

List of actions done:

Y2 and Y3:

- Privacy Flag and IoT Lab have developed a close cooperation. The Privacy Flag project has requested the IoT Lab Association to host their server-based services in order to benefit from IoT Lab privacy by design infrastructure.

• Privacy Flag has provided support on personal data protection risk assessment. • Privacy Flag will use its UPRAAM Privacy Risk Assessment Methodology to test and validate IoT Lab solution and services in 2017.
Responsible Partner for Cooperation: MI, CTI

8.3.4 SocIoTal

SocIoTal: Creating a socially aware citizen-centric Internet of Things
Summary: SocIoTaL addresses a crucial next step in the transformation of an emerging business driven Internet of Things (IoT) infrastructure into an all-inclusive one for the society by accelerating the creation of a socially aware citizen-centric Internet of Things. Project objectives are: • To design a socially-aware citizen centric architecture for an IoT eco-system providing services for cities, citizens and their communities. • To explore a robust and distributed IoT governance framework based on IoT identity models that encompasses the notion of dynamically changing communities and take into consideration their impact on privacy and trust relation. • To enable more automated forms of discovery and specification of trust relationships between humans and a translation of those to their devices as well as the establishment of the reputation of IoT devices/data providers. • Enabling secure, context-sensitive, privacy-preserving communication between IoT devices through a framework and novel security enablers. • To investigate mechanisms and corresponding tools to empower citizens to manage and share their IoT devices with others in different circles of trust and to provide them with an increased awareness and control. • To understand the technological and socio-economic barriers for a citizen participation in the Internet of Things and the nature of incentives that would encourage an increased citizen engagement. • To realise and trial innovative services of high societal value based on citizen/city centric IoT infrastructure with clear benefits for communities and their citizens. Link: http://sociotal.eu/
Areas of potential cooperation and synergies with the list of IoT Lab tasks concerned: The SocIoTal project objectives as listed above indicate that the socially driven services that will be created by citizens and for citizens will focus a great deal on the following aspects: • Privacy preserving communication between IoT devices; • Security and trust mechanisms for mobile phones generated data; • Encouragement mechanisms and incentive schemes for an increased citizen engagement/participation in IoT. These functionalities of the developing SocIoTal platform are also relevant for the IoT Lab project: WP 1 Socially-aware citizen centric architecture and community APIs. • Platform selection: Analysis of existing platforms in terms of their usability, openness and extensibility that could possibly be used in both projects. WP 2 Decentralised governance and trust framework.

• Platform Architecture; • Security and Trust component; • Authorizations and trust mechanisms for sensor based readings; • Reputation framework; • Implementation of a reliable and efficient method for calculating the reputation score. WP 3 Privacy-aware communication. • Privacy-preserving communication between IoT devices (participant privacy)
List of actions done: Y1: Interactions with the project established through common project partners, UNIS and DNET. Initial collaboration plan was agreed upon and reported also in the dissemination report of the SocIoTal project. Y2: Started discussions on reputation mechanisms and approaches developed in the SocIoTal project for calculating the reputation score of IoT devices (e.g. ekoNET, mobile phones) providing data to the platform. SocIoTal users have been engaged during the Summer School SenZations in Belgrade (2015) to test IoT Lab tools. On-going discussion on how IoT Lab and SocIoTal could act together to incentivize crowd participation and continuous engagement of citizens have occurred. Y3: During Y3 UniS had discussions between projects about how algorithms for social interaction detection designed in SocIoTal could be beneficial also in IoTLab by considering authorization mechanisms which could be used for detecting anomalous behavior or as a data source. DNET also had discussions between projects to use IoT Lab tools to collect information about the citizens needs for specific services and use this to initiate crowd (citizens') participation and engagement towards crowdsourcing solutions for such problems.
Responsible Partner for Cooperation: **DNET and UNIS** (both partners are involved in both SocIoTal and IoT Lab projects).

8.3.5 CityPulse

CityPulse: Real-time IoT Stream Processing and Large-scale Data Analytics for Smart City Applications
Summary: CityPulse provides innovative smart city applications by adopting an integrated approach to the Internet of Things and the Internet of People. The project will facilitate the creation and provision of reliable real-time smart city applications by bringing together the two disciplines of knowledge-based computing and reliability testing. The main objectives of the project are: • To develop, build and test a distributed framework for the semantic discovery and processing of large-scale real-time IoT and relevant social data streams for knowledge extraction in a city environment.

- Smart city data is big data. It is multi modal and varies in quality and format and representation form. The data needs to be processed; aggregated and higher-level abstractions need to be created from the data to make it suitable for the event processing, knowledge extractions and event processing applications that enable intelligent applications and services for smart city platforms. Data needs to be integrated from various domains and the resulting knowledge exposed to various domains in a federated fashion.
- CityPulse will provide large-scale stream processing solutions to interlink data from Internet of Things and relevant social networks and to extract real-time information for the sustainable and Smart City applications.

The CityPulse framework is organised in three consecutive iteratively applied processing layers, covering federation of heterogeneous data streams, large-scale IoT stream processing, and real-time information processing and knowledge extraction. To achieve reliability, CityPulse will integrate knowledge-based methods with reliability monitoring and testing at all stages of the data stream processing and interpretation. CityPulse will provide solutions for the different life-cycle stages of data processing and utilisation, supporting application development, i.e. design-time, and application provision, i.e. run-time.

Link: http://ict-citypulse.eu/

Areas of potential cooperation and synergies with the list of IoT Lab Tasks are:

The CityPulse project objectives as mentioned above cover the integration of IoT and relevant social media data and potential areas of cooperation include:

- Common identification of relevant Smart City use case scenarios with particular focus on crowdsourcing.
- Cooperation and discussions on a common data model for both platforms.
- Discussions and feedback regarding the IoT Lab application and tools.
- Possible use and feedback of the IoT Lab platform developed tools by some of the members of the CityPulse consortium.

Moreover the work carried out in the following work packages could serve as important input for IoT Lab:

- WP 2 Requirements and Smart City Framework
  - Overall requirements and platform architecture synergies with particular focus on crowdsourcing and user privacy.
- WP 3 Large-scale IoT Stream Processing
  - Particular focus on the data models.
- WP 6 Integration and Evaluation: Smart City Applications
  - Overall implementation of relevant Smart City scenarios, particular focuses on synergies between the outcomes of this Task and the IoT Lab tools (smart phone application, Website, etc.).

List of actions done:

During Y3 of the project, we have been actively collaborating with the CityPulse project by discussing synergies between the projects. During these discussions, we have identified synergies in the crowd-driven research process core of IoT Lab, present also in the CityPulse internal process for selecting use cases for implementation. CityPulse uses an online tool

(http://www.ict-citypulse.eu/scenarios/) where city stakeholders can read about 101 different relevant scenarios and rank them according to their perceived value in technological, societal and economical perspectives. By collecting the feedback from the stakeholders the consortium gets an overview of the “hot-topics” or most relevant scenarios and selects them to be further implemented in the scope of the project. This way the CityPulse project is addressing real needs and problems the stakeholders are currently facing and developing a solution that will help them overcoming these barriers. This process is very similar to the IoT Lab crowd-driven research core process, where the researchers or the crowd can propose an idea that is put to vote to all platform users. This initial step can then be picked-up and further developed by the researchers who can then run the research collecting the data from the crowd (sensing and/or sourcing). As the CityPulse project is now also completed we have now diverted this activity to the OrganiCity project that continues to look at the scenarios from CityPulse in their own scenario tool (http://scenarios.organicity.eu/). The plan is to propose a merging of IoT Lab functionality and the scneario tool under one of the OrganiCity calls via the association.
Responsible Partner for Cooperation: Alexandra

8.3.6 COMPOSE

Collaborative Open Market to Place Objects at your Service
Summary: The vision of the COMPOSE project is to advance the state of the art by integrating the IoT and the IoC with the IoS through an open marketplace, in which data from Internet-connected objects can be easily published, shared, and integrated into services and applications. The marketplace will provide all the necessary technological enablers, organized into a coherent and robust framework covering both delivery and management aspects of objects, services, and their integration. COMPOSE design, development, and validation will be based on innovative use cases highlighting different aspects of the platform. Among the use cases: • Smart Shopping Spaces • Smart City (Barcelona) • Smart Territory (Trentino) Link: http://www.compose-project.eu/
Areas of potential cooperation and synergies with the list of IoT Lab Tasks are: Different aspects of the COMPOSE project will be analyzed, in particular one related to IoT integration (IoT Lab WP4), and validation using case studies (IoT Lab WP7). CTI is leading the cooperation for open source modules for the Testbed as a Service.
List of actions done: Y1: We have had together with UNIGE a skype telco with partners of COMPOSE (Charis Doukas and Fabio Antonelli) where we introduced to them the IoT Lab and vice versa. After the introductions, we elaborated on the aspects of both projects and we agreed to exchange know-how and to further communicate in order to see where our projects could collaborate

and synergize. Y2: MI has organized several telcos and discussions with COMPOSE Coordinator. It was agreed to explore the possible integration of COMPOSE tools and applications on top of the IoT Lab Testbed as a Service. Compose services and tools and their complementarities with IoT Lab platform have been discussed and considered, however, no further plans have yet been made for the concrete cooperation. Y3: Contacts have been maintained with the project until its end in October 2015
Responsible Partner for Cooperation: CTI and LTU

8.3.7 VOICE

VOICE: Virtual Open Incubation Ecosystem
Summary: VOICE will help bridge the gap in the broader entrepreneurial development ecosystem by providing an international, virtual innovation and entrepreneurship ecosystem based on open innovation, crowdsourcing and co-creation principles; where individual users and start-ups will meet, find collaborators and partners, co-create ideas and prototypes, utilize the wisdom of the crowd to assess the value of the project idea and/or prototype, share and find connections/partners, business and technical information, knowledge on start-up related topics, online tools, online content and open educational material as well as access to capital and crowd-funding. This crowd-driven virtual business incubation ecosystem will: (a) bridge the gap between entrepreneurial need and action by providing an online, community-driven and social innovation ecosystem that will support in addition to the standard incubation phases, the "interest phase", a currently unaddressed phase where the individual has the need to be actively involved in entrepreneurial activity, but does not have any business idea or business partners or special expertise about how to proceed; (b) facilitate community-driven value, which is a core innovation element of the VOICE ecosystem. VOICE will enable individuals that aspire to become entrepreneurs to tap into the collective intelligence of the crowd and turn their entrepreneurial interest or need into a collaborative research project that will result into a prototype and to a successful "crowd-venture". One of the core competitive advantages of the proposed incubation model relates to the benefits that can be derived from the community and the crowd-capital that stems from it. VOICE focuses upon the ICT market and its key driver software and IT services (online & m-applications, open data apps, social networking apps, games, etc.) and addresses the needs of the: (a) B2C segment (i.e., individuals, students, graduates, etc.), (b) B2B segment (i.e., universities, investors, VCs, mentors & innovation consultants, business incubators, start-up associations, etc.); (c) B2G segment (i.e., EU, national governments, national ministries of innovation etc.) and (d) the community at large. VOICE ecosystem will be tested in a real-life setting for 6 months within the project lifetime and then commercially exploited by the partners. Link: http://www.voice-project.eu/index.html#
Areas of potential cooperation and synergies with the list of IoT Lab Tasks are: The collaboration with the VOICE project that was established in the course of the Year 2 of IoT Lab continued in the course of Year 3. In particular, we had discussions about the ways that the IoT Lab service could be utilised by the VOICE community of entrepreneurs in order to innovate but also co-create their products/services with the crowd and to conduct market validation of their ideas. In addition, we also discussed the potential ways that the open incubation ecosystem that is presented by VOICE could be utilised by the IoT Lab community (especially researchers) in order to commercially exploit their research ideas. This collaboration will continue and the IoT Lab Association will exploit this established synergy further.
List of actions done: Y3: Discussions have been made in order to enhance further the established collaboration between the two projects while at the same time the potential of continuing the collaboration with the IoT Lab Association has been detailed.
Responsible Partner for Cooperation: SOTON

8.3.8 SciStarter

SciStarter
Summary: SciStarter is an organization that provides a place where citizen scientists and researchers can find, join and contribute to science. Their database of citizen science projects enables discovery, organization and greater participation in citizen science projects. SciStarter aims to bring together citizen scientists in the world; the thousands of potential projects offered by researchers, organizations, and companies; and the resources, products, and services that enable citizens to pursue and enjoy these activities. Their aim is to: • Enable and encourage people to learn about, participate in, and contribute to science through both informal recreational activities and formal research efforts. • Inspire greater appreciation and promote a better understanding of science and technology among the general public. • Create a shared space where scientists can talk with citizens interested in working on or learning about their research projects. • Satisfy the popular urge to tinker, build, and explore by making it simple and fun for people like singles, parents, grandparents, and kids to jump in and get their hands dirty with science. Link:SciStarter.com
Areas of potential cooperation and synergies with the list of IoT Lab Tasks are: • SciStarter is highly relevant for the IoT Lab project. In particular, IoT Lab service could be utilised making the tools and resources available through IoT Lab visible on their Web page and thus facilitate end-user outreach.
Proposed list of actions: Make ads on their Website to offer our tools and projects to citizen scientists as soon as we have interesting projects and cases to offer.
Actions achieved: Y3: Contacts has been made to promote our tools via their Webpage.
Responsible Partner for Cooperation: LTU

8.3.9 IoT Council: The Internet of Things Council

IoT Council: The Internet of Things Council
Summary: The Internet of Things Council is a think tank for the Internet of Things. The IoT Council believes IoT constitutes a new ontology. As they mention, “Qualities and properties of citizens/end-users, industry and governance will merge to form new leading actors; these three groups have always been quite distinct and sometimes antagonistic”. Link: http://www.theinternetofthings.eu
Areas of potential cooperation and synergies with the list of IoT Lab Tasks are: • The IoT Council is very relevant for the IoT Lab project. In particular, IoT Lab service could be utilised by the Council and its community of organisations and individuals interested in IoT in order to conduct crowd-driven research via the IoT Lab platform. In addition, IoT Lab could create linkages with the IoT Council community members in order to discuss the WP6 findings in relation to business and incentive models. • The IoT Council is highly aligned with the mission and vision of the IoT Lab Association. As such SOTON will examine the potential of establishing synergies between the two initiatives.
Proposed list of actions: Further exploit the potential collaboration not only with the IoT Lab project but also between the IoT Lab Association and the IoT Council. List of actions done: Initial discussions have been made so as to exploit this collaboration further.
Responsible Partner for Cooperation: SOTON

8.3.10 CitiSense

CitiSense
Summary: CITI-SENSE will develop “citizens’ observatories” to empower citizens to contribute to and participate in environmental governance, to enable them to support and influence community and societal priorities and associated decision making. CITI-SENSE will develop, test, demonstrate and validate a community-based environmental monitoring and information system using innovative and novel Earth Observation applications. To achieve this, the project will: • Raise environmental awareness in citizen. • Raise user participation in societal environmental decisions. • Provide feedback on the impact that citizens had in decisions. It will address the EC Call’s request for effective participation by citizens in environmental stewardship, based on broad stakeholder and user involvement in support of both community and policy priorities. The project aims to learn from citizen experience and perception and enable citizenship co-participation in community decision making and co-operative planning. Link:http://www.citi-sense.eu/

Areas of potential cooperation and synergies with the list of IoT Lab Tasks are: • IoT Lab platform will be used to provide a way to collect data from different environmental sensors throughout Europe. • Crowdsourcing concept via IoT platforms will be disseminated to the CitiSense project as a way to involve more citizens. • Testbed in Belgrade will be utilized as part of the DNET Use Case in IoT Lab project.
Proposed list of actions: Contact the Project Coordinator of CitiSense to present the IoT Lab project and outline possible ways to exchange and use results from each project for mutual benefit. List of actions done: Y3 CitiSense project has finished, however, there is a potential for further cooperation with CitiSense project partners where IoT Lab could be used to crowdsource ideas on how to solve problems related to pollution identified through CitiSense.
Responsible Partner for Cooperation: DNET

8.3.11 iKaaS

iKaaS: An EU / Japan collaboration to deliver Intelligent Knowledge-as-a-Service
Summary: iKaaS aims to integrate three big technologic fields (IoT, Big Data and Cloud Computing) in order to develop a new platform, which leverages the power of IoT such as virtualization and real-time processing. This is combined with Big Data analytics, in order to generate knowledge that will be provided to users through applications that run in a multi-cloud environment, spanning over several local clouds. In such context, Supra Cloud entities are assigned with the management and coordination of resources, application deployment and data exchange, in order to foster new business opportunities, while preserving security and privacy among the different business domains and across national borders. The main objectives of the project are: • To deliver an open, adaptable and secure Multi-Cloud architecture capable of optimal service deployment, migration and parallelization as well as distributed management of smart objects, associated storage, processing and communication of data. • To provide for Knowledge-as-a-Service (KaaS) by leveraging re-usability of smart objects as well as distributed data processing capabilities. • To assure Security, Privacy and Trust among users, their data covering different business domains and providing for secure data storage and privacy-preserving analytics spanning across national borders. Link: http://ikaas.com/
Areas of potential cooperation and synergies with the list of IoT Lab Tasks are: • The iKaaS project objectives cover the generation of services based on real world knowledge provided by data generated by IoT devices. • Potential areas of cooperation include crowdsensing and crowdsourcing scenarios (i.e. the overlapping Smart Cities scenario) as a means of providing data concerning both IoT devices and their users (i.e. user preferences and socio-economic profiles), to be available in the cloud in order to derive new smart services.

- Furthermore, the secure, privacy preserving and anonymization mechanisms implemented in IoT Lab could allow synergies since those are common objectives between the two projects.

Proposed list of actions:

- Exchange of knowledge concerning mechanisms for generating knowledge from data.
- Discussions about the implementation of services for collection of crowd measurements.
- Proposition of ideas in order to benefit from the huge amount of data contributed and generated by crowd-based participatory sensing.

List of actions done:

Y2 We started collaborating with the iKaaS project and actively discussed synergies between the two projects. These discussion lead to the common agreement that crowd-driven research mechanisms for generating data from IoT devices associated to users (i.e. smartphones) could also lead to not only service provision based on such data, but also on knowledge extracted from such data. IoT Lab, thanks to its crowdsourcing application allows users to generate a huge amount of data and allows mechanisms for selecting and monitoring resources, which could be exploited to provide for smart services based on such data.

Y3 Collaboration with the iKaaS project has continued and several discussions about the projects' point of convergence have been kept. In particular, crowdsensing data and crowdsourced information have been proposed as a means to generate data that could be used to extract knowledge, and provide as a service for cloud computing platforms. Services deployed in the cloud, actually need "big data" generation capabilities in order to provide knowledge to be exploited by applications and services benefiting of iKaaS.

Responsible Partner for Cooperation: UniS

8.4 Collaborations with New Research Projects (MI)

IoT Lab has been developed to support research activities with more end-user interaction. Here are a few examples of ongoing and future research projects that are or will use IoT Lab, and with which collaboration links have been established:

- **Privacy Flag**: a three year H2020 research project on personal data protection and new risk assessment methodologies. The IoT Lab Association has been requested to provide support and hosting for the Privacy Flag online framework.
- **F-Interop**: a three year H2020 project researching and developing online interoperability and performance test tools supporting emerging IoT-related technologies from standardization to market. IoT Lab will provide its IoT motes and make them available to the F-Interop platform for interoperability, conformance and performance tests.
- **Fed4FIRE+**: a five year H2020 research project, starting on January 2017, to support the further development of the Fed4FIRE federation. IoT Lab will be made available for research and experiments through the Fed4FIRE+ platform.
- **U4IoT**: a three yearsH2020 CSA supporting end-user engagement in the five Large Scale Pilots (LSP) on IoT. The IoT Lab crowdsourcing tools will be proposed and adapted to the LSP needs.
- **SYNCHRONICITY**: a three year H2020 research project starting in January 2017. It is one of the five LSPs and will develop IoT pilots in smart cities across Europe and beyond. IoT Lab will be considered as an option to collect end-user feedbacks from the participating pilots.
- **EXCITING**: a two year H2020 project between Europe and China. IoT Lab will be used to test and demonstrate large scale IoT deployments.
- **SMARTBUY**: a two year H2020 innovation action started in January 2016. IoT Lab crowdsourcing tool has been proposed for citizen engagement.

More details are presented in the deliverable D8.3.3 on the Exploitation Strategy.

9 Conclusions

During the third and final year, IoT Lab had to revise its Dissemination Strategy. The Communication Strategy has been adapted to the evolution of the project: the personal data protection focus required to allocate more time for ensuring that IoT Lab tools and Testbed as a Service were fully respectful and compliant with the newly adopted General Data Protection Regulation (GDPR), adopted in April 2016. This has required a more targeted communication strategy, focused on the use cases and the standardization effort. It would have been risky to promote the tool without the confidence that it was fully privacy compliant.

On the Dissemination and Communication Strategy side, IoT Lab has:

- Updated and extended the IoT Lab Testbed as a Service (TBaaS), with the integration of the various resources and tools and providing different sets of functionalities for different users/stakeholders' groups,
- Regularly updated Website with news and publications,
- Used SEO to increase the general visibility of the site,
- Actively involved and present in Social Media by reporting the progress on platform development for different types of stakeholders. Twitter has been used extensively for all events and breaking news related to IoT Lab project. It has also been used for use cases together with the Facebook to inform people and increase their engagement with the platform,
- Promoted and presented of IoT Lab at CEBIT and in several other venues,
- Organized workshops and presentation sessions,
- Promoted IoT Lab at 12 public events,
- Published 14 papers including 3 book chapters and,
- Established Dissemination Strategy beyond the project.

On the exploitation side, IoT Lab has:

- Further developed the IoT Lab Association as a sustainable vehicle to maintain the IoT Lab platform beyond the duration of the project, as well as prepared the transfer of the code on a centralized GIT Lab server,
- Involved IoT Lab in several European research projects, including ongoing cooperation with Privacy Flag and F-Interop, as well as the planned exploitation of IoT Lab by the European large scale pilots on IoT and the future Fed4FIRE+ project,
- Transferred the IoT Lab main results to the ITU with the adoption of a new work item on IoT and crowdsourcing, and the managed to include the IoT Lab vision for combined IoT and crowdsourcing approaches, in the International Declaration on Powering Smart Sustainable Cities, Nations & Islands, adopted at the Green Standards Week and,
- Established a formal Liaison Statement between the ITU-T SG20 and IoT Lab Association.

10 Appendix

10.1 The Bahamas Declaration on Powering Smart Sustainable Cities, Nations & Islands

The Bahamas Declaration – Powering Smart Sustainable Cities, Nations & Islands

18 December 2015

ITU's 5th Green Standards Week, held from 14 to 18 December 2015 in Nassau, the Bahamas, on the theme "Powering Smart Sustainable Cities, Nations & Islands" has:

1. **Recognized** that uncontrolled urbanization is a widespread socio-economic phenomenon the world is witnessing in the 21st century, which significantly affects the way we live. Urban areas reflect the complexity of human societies, where social, economic and environmental issues are interconnected.

2. **Acknowledged** that while urbanization has brought economic and technological progress that has helped provide a higher quality of life, it has also burdened us with negative social, economic and environmental consequences including greenhouse gas emissions, global warming, changes in land use, overcrowding, traffic jams, unmet demand of public services, increased emission, pollution, wastewater and waste generation, among others.

3. **Been mindful** that increasing population growth brings economic competition as well as more complex environmental challenges such as climate change and increased urban sprawl that have impacted availability of potable water, increased levels of energy consumption, and have further contributed to pressures on cities and countries, particularly on small island developing states (SIDS).

Noting that, concerted planning and actions are essential for the well-being of our planet, humans and all other species.

In light of the above, achieving sustainable urbanization to contribute to inclusive and sustainable development along with the preservation of our planet, has been recognized as one of the major challenges for our society in the coming decades.

Therefore, we the participants of the Green Standards Week 2015 declare our willingness and commitment to:

1. **Contribute towards the implementation of the new Paris Agreement on climate change and the New Urban Agenda:** Improve awareness and promote information sharing on the role of ICTs to meet the targets laid out by the new COP-21 Paris Agreement on climate change, the UN 2030 Agenda Sustainable Development Goals (SDGs), ITU's Connect 2020 Agenda and to contribute to the third UN Conference on Housing and Sustainable Urbanization (Habitat III) in order to achieve sustainable urbanization along with the preservation of our planet.

2. **Foster smart e-waste management:** Raise public awareness on the potential benefits of end of life of ICT such as the reduction of the digital divide and recycling opportunities. Make efforts directed towards setting up effective e-waste management systems which can withstand the scrutiny of environment, health and safety standards. This will include detection and measurement of emissions as well as safety and protection for workers involved in e-waste recycling.

3. **Build a circular economy:** Design and promote green products and services using international standards that are developed based on life cycle assessment. Scaling up a circular economy at an international level will require government support. Support a coordinated approach by world leaders to introduce positive legislative drivers such as e-waste prevention targets and incentives based on eco-design to promote products that are easier to reuse, remanufacture and disassemble.

4. **Lead with vision:** Develop and foster the adoption of policies, international standards, key performance indicators, innovative ICT-based sources of information (such as those provided by the Internet of Things (IoT) and crowdsourcing to collect citizens perceptions), and best practices to shape smart sustainable cities, countries and islands to promote the use of green ICTs for sustainable development including climate change adaptation and mitigation as well as e-waste management.

5. **Think sustainable:** Bridge the gap between experts from the ICT, environment, urban planning, energy sectors and policy makers, to encourage the integration of ICTs into environmental, urban and energy policies in order to improve knowledge on the catalytic role that ICTs can play in reducing energy consumption, increasing environmental resilience, tackling climate change impacts, and enhancing energy efficiency and promoting a circular economy.

6. **Support greening technologies by design:** Achieve high energy performance through a fundamental change in design principles and implementing practices within the ICT industry. For example, high energy performance targeting reduced network energy consumption is a critical requirement of IMT-2020/5G. It enables the reduction in total cost of ownership, facilitates the extension of network connectivity to remote areas, and provides network access in a sustainable and more resource-efficient way. ITU-T Study Group 5" Environment & Climate Change" is called upon to develop standards that will ensure that 5G systems will be deployed based on eco-design principles including high energy performance, hazardous substances free e-products, circular economy principles and smart e-waste management.

7. Foster the development and convergence of global standards and open Application Programme Interfaces (APIs) for IoT: ITU-T Study Group 20 on "Internet of Things and its Applications including Smart Cities and Communities" is called upon to support the development and convergence of global IoT standards and open APIs and interfaces, including for open data, in view of enabling interoperability among technologies, services and applications.

8. Develop a global smart sustainable index for cities, countries and SIDS: Develop a scoring system that would allow to measure how each city, country or island would score on an accepted global smart sustainable index.

9. Building trust and develop secure and privacy by design approaches for IoT lifecycle, sustainability issues with the devices, applications and solutions: ITU-T Study Group 20 is called upon to identify solutions aimed at building trust and ensuring privacy compliance of IoT devices and services, according to modalities that preserve their efficiency and economic value.

10. Ensure end-user involvement and user-centric approaches: ITU-T Study Group 20 is called upon to consider approaches and models for active involvement of end-users in IoT technology development and deployment, such as crowdsourcing, in particular in smart city environment.

11. Demonstrate success and feasibility: Carry out pilot and flagship projects to demonstrate "smart" ICT solutions to enable a smart environment by utilizing new technologies and standards to enable countries, cities and islands to become smarter and more sustainable. Identify strengths and weaknesses of implementation strategies, and report success stories and cost implications in dealing with the challenges met, and innovative solutions used.

12. Boost partnerships and mobilize expertise: Enhance cooperation at international, regional, and national level, between organizations, research institutes, academics, governments, small medium enterprises (SMEs) and civil society, on the use of ICT for a smart sustainable world. Create business models that would encourage partnerships among stakeholders through win- win solutions.

13. Shape the global agenda: Establish an Initiative on "Powering Smart Sustainable Cities, Nations & SIDS" that will assist countries, cities and SIDS to become smarter and more sustainable across their respective territories.

Additional information on 5th Green Standards Week can be found at: http://www.itu.int/en/ITU-T/Workshops-and-Seminars/gsw/201512/Pages/

10.2 MI Contribution on Assessing the potential of crowdsourcing for the IoT

INTERNATIONAL TELECOMMUNICATION UNION

COM 20 – C 010 – E

TELECOMMUNICATION STANDARDIZATION SECTOR
STUDY PERIOD 2013-2016

September 2015

English only
Original: English

Question(s): All/20

STUDY GROUP 20 − CONTRIBUTION 010

Source: Mandat International

Title: Assessing the potential of crowdsourcing for the IoT

The IoT is expected to be highly pervasive and ubiquitous. It will encompass domains such as smart city deployments, eHealth and smart homes, which will enable to collect information and data on end-users and citizens.
In this context, the end-user perception and acceptance will be critical factor of success. Emerging areas of research include the possibility to use crowdsourcing to better assess and address end-users acceptance.
Emerging research projects, such as IoT Lab (www.iotlab.eu), are precisely exploring the interaction between IoT deployments and crowd sourcing. IoT Lab is a European Research project which aims at researching the potential of crowdsourcing to extend IoT testbed infrastructure for multidisciplinary experiments with more end-user interactions.
IoT Lab is addressing topics such as:

- Crowdsourcing mechanisms and tools
- "Crowdsourcing-driven research"
- Virtualization of crowdsourcing and testbeds
- Ubiquitous Interconnection and Cloudification of testbeds
- Testbed as a Service platform
- Multidisciplinary experiments
- End-user and societal value creation

In this context, we propose:

- To invite the SG20, through the Question X, to collect information and identify innovative solutions related to IoT and crowdsourcing to better assess end-user acceptance;
- To invite projects and initiatives, such as IoT Lab, to share their expertise with Question X of the SG20;
- To assess the relevance and consider the possibility to develop Recommendations or Supplements on the use of crowdsourcing in IoT policies and deployments.

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10.3 MI Contribution on IoT testbeds and formal collaboration with the IoT Lab platform

INTERNATIONAL TELECOMMUNICATION UNION TELECOMMUNICATION STANDARDIZATION SECTOR STUDY PERIOD 2013-2016	**COM 20 – C 008 – E** September 2015 English only Original: English	
Question(s):	All/20	
STUDY GROUP 20 − CONTRIBUTION 008		
Source:	Mandat International	
Title:	IoT testbeds and formal collaboration with the IoT Lab platform.	

This contribution has been submitted by Mandat International and developed together with the IoT Lab European research project and association (www.iotlab.eu).

The IoT Lab (www.iotlab.eu) European research project is researching the potential of crowdsourcing for the Internet of Things. It is among others researching the potential of crowdsourcing to extend IoT testbed infrastructure for multidisciplinary experiments with more end-user interactions. IoT Lab is addressing topics such as:

- Crowdsourcing mechanisms and tools
- "Crowdsourcing-driven research"
- Virtualization of crowdsourcing and testbeds
- Ubiquitous Interconnection and Cloudification of testbeds
- Testbed as a Service platform
- Multidisciplinary experiments
- End-user and societal value creation

IoT Lab is currently federating several IoT testbeds into a common testbed as a service platform enabling researcher to remotely access and perform experiment on the integrated testbeds.

In order to maintain the platform beyond the duration for the project, an IoT Lab non-for-profit association has been established in Geneva to serve the research community.

In this context, we propose:

- To invite the SG20, through the Question X, to assess the possibility to leverage on IoT testbeds and experimental platforms for the ITU IoT-related activities;
- To explore the possibility to leverage on IoT Lab to further extend the platform towards other IoT testbeds in different regions of the World;
- To assess the relevance and consider the possibility to develop Recommendations or Supplements on the use of IoT testbeds and federation of testbeds.

10.4 ITU-T SG20 Liaison Statement: LS14 on joint collaboration between ITU-T Study Group 20 and the IoT Lab

INTERNATIONAL TELECOMMUNICATION UNION TELECOMMUNICATION STANDARDIZATION SECTOR STUDY PERIOD 2013-2016		**COM 20 – LS 014 – E** English only Original: English
Question(s):	1, All/20	Geneva, 19-23 October 2015
Ref.: TD 045 (GEN/20)		
Source:	ITU-T SG20	
Title:	LS on joint collaboration between ITU-T Study Group 20 and the IoT Lab	

LIAISON STATEMENT	
For action to:	**IoT Lab**
For comment to:	**-**
For information to:	**JCA-IoT&SCC, SG11**
Approval:	ITU-T Study Group 20 meeting (Geneva, 23 October 2015)
Deadline:	**December 2015**

Contact:	Personal data withdrawn	Tel: E-mail:

A new ITU-T Study Group 20: IoT and its applications including smart cities and communities (SC&C) has been established in June 2015 and held its first meeting from 19 to 23 October 2015 in Geneva, Switzerland.

The decision to create ITU-T SG20 was made by the Telecommunication Standardization Advisory Group (TSAG) at its meeting at ITU Headquarters in Geneva, 2-5 June 2015, exercising TSAG's authority to modify ITU-T's structure and work programme between quadrennial World Telecommunication Standardization Assemblies.

SG20 is working to address the standardization requirements of Internet of Things (IoT) technologies, with an initial focus on IoT applications in smart cities and communities (SC&C). ITU-T SG20 develops international standards to enable the coordinated development of IoT technologies, including machine-to-machine communications and ubiquitous sensor networks. A central part of this study is the standardization of end-to-end architectures for IoT, and mechanisms for the interoperability of IoT applications and datasets employed by various vertically oriented industry sectors.

Please see: www.itu.int/en/ITU-T/studygroups/2013-2016/20/Pages/default.aspx

An important aspect of ITU-T SG20's work is the development of standards that leverage IoT technologies to address urban-development challenges.

ITU-T SG20 would like to invite the IoT Lab to collaborate with and contribute to its work. The expertise of the IoT Lab would be highly appreciated.

In order to facilitate collaboration between both organizations, ITU-T SG20 is pleased to invite the IoT Lab to nominate a Liaison Rapporteur to attend and contribute to ITU-T SG20 activities. Please be informed that Mr Sébastien Ziegler has been designated as Liaison Rapporteur from ITU-T SG20 to IoT Lab.

ITU-T SG20 looks forward to cooperating with the IoT Lab.

10.5 ITU-T SG 11 Liaison Statement: LS93 LS/r on joint collaboration between ITU-T Study Group 20 and the IoT Lab (reply to SG20 LS14)

INTERNATIONAL TELECOMMUNICATION UNION TELECOMMUNICATION STANDARDIZATION SECTOR STUDY PERIOD 2013-2016		**COM 11 – LS 93 – E** English only Original: English
Question(s):	12/11	Geneva, 2-11 December 2015
Ref.: TD 1042 Rev.2 (GEN/11)		
Source:	ITU-T SG11	
Title:	LS/r on joint collaboration between ITU-T Study Group 20 and the IoT Lab (reply to SG20 LS14)	
LIAISON STATEMENT		
For action to:	SG20	
For comment to:	-	
For information to:	JCA-CIT, ITU-T CASC	
Approval:	ITU-T SG11 plenary meeting (Geneva, 11 December 2015)	
Deadline:	April 2016	
Contact:	Withdrawn personal data	
Contact:	Withdrawn personal data	

SG11 would like to thank SG20 for your liaison statement on joint collaboration between ITU-T Study Group 20 and the IoT Lab. We are very pleased to see the initiative of SG20 and keen to collaborate with SG20 for standardization on IoT and Smart Cities.

By this liaison statement SG11 would like to inform SG20 on the latest activities on IoT testing. Currently, SG11 is studying testing of internet of things (IoT) in Q12/11. Q12/11 has currently three work items, as follows:

- Draft Recommendation ITU-T Q.39_Q.FW_IoT Test "Framework for IoT Testing"
- Draft Recommendation ITU-T Q.39_IoT_MN_test "The architecture and facilities of Model network for IoT testing"

In particular, we would like to draw your attention to a new work item which was initiated by Q12/11 at the latest SG11 meeting (Geneva, 2-11 December 2015):

- Draft Recommendation ITU-T Q.39_FW_Test_ID_IoT "The framework of testing of identification systems used in IoT"

This draft recommendation aims to provide descriptions and test suites for identification systems used in Internet of Things. The baseline document is contained in TD 1007 (GEN/11). With the aim to foster coordination on IoT issues, SG11 looks forward to receiving any comments as well as inputs and contributions from SG20 on IoT-related work items ongoing in SG11. SG11 would also appreciate further information from SG20 on any IoT issues which request testing and measurements.

Following your LS, SG11 also would like to inform SG20 that any collaboration between ITU and testing laboratories, including IoT Lab, are under discussion in the Conformity Assessment Steering Committee (ITU-T CASC). ITU-T CASC was established by SG11 in April 2015. It aims to implement a test laboratory recognition procedure in ITU-T which is defined (high level) in ITU-T SG11 Guideline *"Testing laboratories recognition procedure"*. The first meeting of ITU-T CASC was successfully held on 3 December 2015; it was chaired by Mr Isaac Boateng who

is one of the Vice-chairmen of SG11. More information is available at https://www.itu.int/en/ITU-T/studygroups/2013-2016/11/Pages/CASC.aspx.
SG11 kindly asks all testing laboratories and other interested parties, who wish to establish a framework of collaboration with ITU-T, to join the discussion in CASC. The next meeting of ITU-T CASC is scheduled on 12 April 2016, it will be held using remote capabilities.
SG11 hopes that this information is helpful for future standardization activities of SG20.
SG11 are looking forward to establishing a collaboration with SG20 on IoT Conformance and Interoperability testing.

10.6 ITU-T SG20 New Work Item on "Requirements and Functional Architecture of IoT-related Crowdsourced Systems"

INTERNATIONAL TELECOMMUNICATION UNION TELECOMMUNICATION STANDARDIZATION SECTOR STUDY PERIOD 2013-2016		STUDY GROUP 20 **TD 492 Rev.6 (GEN/20)** English only Original: English
Question(s):	1/20	Geneva, 25 July - 5 August 2016
TD		
Source:	Co-Rapporteurs Q1/20	
Title:	Proposal on a new Work Item on "Requirements and Functional Architecture of IoT-related Crowdsourced Systems"	

This document is the outcome of the drafting session of Q1/20 held on Tuesday August 2nd in the afternoon session on the basis of the contribution 315, with additional inputs from proponents.

Recent technological advancements and corresponding trends have driven the rise of new networking and computing paradigms. Crowdsourcing is defined as the practice of obtaining needed services, ideas, content or other system resources by soliciting contributions from a large, open and potentially undefined group of people, rather than from employees, suppliers or experts. IoT-related Crowdsourced Systems (CS) are systems that employ crowdsourcing in order to augment their constituent infrastructure and the set of provided services. Crowdsensing Systems are a special case of IoT-related CS in the application area of collecting sensing data via crowdsourced resources. However, the scope of applications of IoT-related CS in general is broader; e.g. it could refer to crowdsourcing computing power from personal devices. It is also noted that crowdsourcing in IoT-related CS refers not in harvesting information or knowledge from the public but hardware or services.

The emersion of CS is driven by key technology enablers. On one hand, high acceptance rates of smartphones, smart watches and other smart gadgets have led to an abundance of devices with significant communication and sensing capabilities. On the other hand, the increasing trend of Do-It-Yourself Computing enables the use of highly affordable platforms (such as the Arduino and the Raspberry Pi) in the context of "made at home" projects.

These two technology enablers have fuelled new networking and computing paradigms. For instance, *Mobile Crowdsensing Systems (MCS)* [1] are distributed crowdsourced systems consisting of ICT infrastructure provided by the general public (e.g. smartphones). The distributed resources of an MCS operate in a collaborative manner in order to perform a task by using their embedded computational and sensory capabilities.

Safecast [2] is a real-life application example of a CS. It enables citizens to build their own DIY radiation monitoring sensor kits by employing open source and open data methodologies. Another nice indicative example of a collaborative project based on crowdsourced infrastructure is FLOAT [3] in which citizens of Beijing where able to generate their own data on air quality in the city using kites. Finally, the European research project IoT Lab [4] investigating the use of crowdsourced resources both in IoT experimentation and as a means of interaction with participants.

In terms of use-case examples anticipated in the future, consider a smart/green airport where travellers provide luminance measurements via the embedded sensors of their devices (in exchange for some incentive; e.g. internet access). These are then aggregated into a live luminance map that is used to optimise the indoor light units of the airport [editorial note: reference to be provided, clarifying if it is effectively implemented. It is proposed to separate the effective use cases and another section for potential use cases].

The aforementioned examples of *Crowdsourced Systems* (CS) are indicative of a significant paradigm shift that is taking place. A clear trend is being formed of moving from vertical

application silos that push generated data to Cloud-based centralised services, towards more open and distributed architectures deployed close to the Edge of the network. Due to their nature, at the core of CS lies the human factor and as such they carry unique characteristics that clearly distinguish them from other IoT-related systems.
The main problems that CS currently face mainly relate to reaching the critical mass of the participating crowd. Firstly, the constituent CS infrastructure (smartphones, DIY computers, etc) is characterised by a high degree of heterogeneity. In terms of smartphones, there exist three main software platforms – Android, iOS and Windows Mobile – and it is not foreseen in the near future that either one is going to prevail the market. Similar issues are also present for DIY computers. This market fragmentation drastically increases the complexity of developing and deploying CS applications. Absence of common development libraries, middleware and virtualization techniques further stresses this problem.
A second major problem that hinders the emersion of CS is related to their users/participants. Due to the absence of a common reference, applications are developed independently and in an ad-hoc way. Therefore, a different piece of software (either a mobile app or a DIY computer middleware) needs to be downloaded, installed and configured for every CS application. This install-based deployment model poses significant obstacles in terms of rapid deployment and scalability.
Furthermore, it is worth noting that CS largely rely on bottom-up and collaborative development schemes coming from the crowd. Therefore, there is strong motivation to outline the necessary standardised toolset as this will enable the general public to be directly engaged. This will further promote the development of CS and will create corresponding opportunities for the CS stakeholders. Finally, a CS runs the risk of being biased by adversaries providing fraudulent or compromised input to the system.
The anticipated impact of CS is significant and multi-faceted. First of all, CS provide a method for opportunistically augmenting IoT and sensing infrastructure in a scalable and financially viable way. For instance, CS can be used to complement and extend the already available infrastructure for smart cities and communities. Furthermore, CS enable the integration in real time of citizens' inputs and mobile sensors. They can also contribute to better address citizen's perspectives as well as to develop systemic models for identifying problems and reducing related-risks in almost real time.
Following our previous contributions and given the strategic importance and the wide anticipated impact (e.g. the formation of local micro-economies and the promotion of bottom-up innovation), we propose:
To create a new Work Item in Question 1, with the following scope:

- concept of the IoT-related Crowdsourced System platform;
- use cases related to IoT-related crowdsourced systems platform;
- requirements for the IoT-related Crowdsourced System platform;
- functional architecture of the IoT-related Crowdsourced System platform;

References

[1] R. K. Ganti, F. Ye, and H. Lei, "Mobile crowdsensing: current state and future challenges," IEEE Communications Magazine, vol. 49, no. 11, pp. 32–39, 2011.
http://ieeexplore.ieee.org/xpl/login.jsp?arnumber=6069707

[2] Safecast. http://blog.safecast.org/

[3] Float Beijin citizen-generated data on air quality,
http://civicus.org/thedatashift/wp-content/uploads/2015/07/Float-Beijing-case-study.pdf

[4] IoT Lab European project, http://www.iotlab.eu/

10.7 Proposal to submit a new Recommendation in the work programme

Question:	1 /20	Proposed new ITU-T Recommendation	July 25th – August 5th 2016	
Reference and title:	Draft Recommendation ITU-T <Y.Req-Arch-CS> "Draft Recommendation on Requirements and Functional Architecture of IoT-related Crowdsourced Systems"			
Base text:	C315		Timing:	March 2018
Editor(s):	Dr. Marios Angelopoulos, Bournemouth University, U.K. Sébastien Ziegler, Mandat International, Switzerland Dr. Orestis Evangelatos, Univeristy of Geneva, Swtizerland		Approval process:	AAP

Scope:

The scope of the Recommendation includes:

- concept of IoT-related Crowdsourced Systems (CS) platforms;
- use cases related to IoT-related Crowdsourced Systems (CS) platforms;
- requirements for IoT-related Crowdsourced Systems (CS) platforms;
- functional architecture of the IoT-related Crowdsourced Systems (CS) platforms;

Summary (provides a brief overview of the purpose and contents of the Recommendation, thus permitting readers to judge its usefulness for their work):

Crowdsourcing is defined as the practice of obtaining needed services, ideas, content or other system resources by soliciting contributions from a large, open and potentially undefined group of people or things, rather than from employees, suppliers or experts. IoT-related Crowdsourced Systems (CS) is an emerging paradigm of systems whose IoT infrastructure is partially or totally provided by the general public; i.e. it is crowdsourced. The expected impact of CS is significant and multi-faceted. At a technical level, CS provides a methodology for opportunistically augmenting IoT and sensing infrastructure; e.g. in the context of a smart city. From a market perspective, CS paves the way for novel business and market models to emerge based on collaborative micro-economies and bottom-up innovation, lead by the public. The main obstacles that currently hinder this potential and need to be addressed are the highly diverse and heterogeneous nature of the CS constituent infrastructure, the ad-hoc and isolated development of applications based on crowdsourcing principles and the lack of an outlined toolset that can be used as a reference for CS development by the general public. This Recommendation will mitigate these obstacles by defining the concept of IoT-related CS platforms, by providing IoT-related CS platform use cases, by laying down the requirements of IoT-related CS platforms, and by providing IoT-related CS functional architecture..

Relations to ITU-T Recommendations or to other standards (approved or under development):

[ITU-T Y.2012] Recommendation ITU-T Y.2012 (2010), Functional requirements and architecture of next generation networks.

[ITU-T Y.2060] Recommendation ITU-T Y.2060 (2012), Overview of the Internet of things. [ITU-T Y.2066] Recommendation ITU-T Y.2066 (2014), Common requirements of the Internet of things
Liaisons with other study groups or with other standards bodies: IoT Lab, IEEE, IPv6 Forum, ETSI ISG IP6, IoT Forum, IETF, OneM2M, ISO, IEC.
Supporting members that are committing to contributing actively to the work item: Bournemouth University, Mandat International, University of Geneva.

(This forms an integral part of this Recommendation)

10.8 Call of the 1st International Workshop on IoT, Crowdsourcing and Privacy at IEEE AINA Conference

1st International Workshop on IoT, Crowdsourcing and Privacy

Collocated at IEEE AINA Conference

LE REGENT CONGRESS CENTRE, CRANS-MONTANA, SWITZERLAND,

MARCH 23-25, 2016

The Internet of Things (IoT) is moving towards pervasiveness and increasing end-user interactions. Beyond the purely technical improvement in the IoT technology, there is a need to better interact with the end-users in order to ensure a high level of acceptance and to leverage on their active use of the IoT. The workshop will explore the potential of new approaches and technologies to research and develop better interactions between end-users and IoT, including crowdsourcing approaches. In parallel, privacy and personal data protection is becoming a critical issue and will be one of the key factors of success for future IoT applications. The workshop will review recent developments in this domain. We encourage contributions describing innovative work on IoT-end-user interaction, including crowdsourcing, crowd-sensing and privacy protection. The topics of interest include but are not limited to:

- IoT and crowdsourcing applications enabling closer interactions with end-users
- Crowdsourcing and crowd-sensing technologies
- Large scale testbeds integration
- IoT testbeds with end-user interactions
- IoT Privacy and personal data protection
- Privacy risk assessment methodologies
- IoT and end-user interaction: innovative approaches, prospective analysis

We encourage submission of recent developments in the form of presentations as well as submissions reporting on more mature and completed work in the form of papers (up to 6 pages long) which will undergo regular peer review process. For further information, please contact the workshop co-chairs.