CREATE-IoT

H2020 Work Programme 2016-2017
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European Large-Scale Pilots Programme

CROSS FERTILISATION THROUGH ALIGNMENT, SYNCHRONISATION AND EXCHANGES FOR IoT

H2020 – CREATE-IoT Project

Deliverable 07.07

Report on International Collaboration 2018

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Summary					
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Comments					

Document history

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2.00	30-04-2019	SINTEF	Final version revised and released (Revision 2.0)

Table of contents

1. EXECUTIVE SUMMARY

1.1. Publishable summary

This document describes the work carried out related by the International Collaboration activities for the CREATE-IoT project and IoT European Large-Scale Pilots (IoT-LSPs) Initiative during the current period.

This report covers all the activities that occurred with international community, so to raise awareness for the LSP Initiative. These activities cover a broad range of actions and communities during these months:

- Participation (and presentation) at relevant IoT events;
- Sponsoring meetings between international community.

The activities carried out during this period, and reported in this document, will not be continued in the next period and for the remainder of the project, due to a request from the European Commission (EC), which requested CREATE-IoT consortium to stop these activities in order to focus on the collaboration with the LSPs.

The current version of the document is a revised version of the initially document delivered in November 2018 and is based on comments from the experts. It includes a new section on international IoT standardisation and interoperability and some additional updates.

1.2. Non-publishable information

This document is public.

2. INTRODUCTION

As part of CREATE-IoT's objectives, there is a need to engage with the international community, with the purpose to strengthen the role of the EU on the global IoT scene, in particular in terms of access to foreign markets. It links the European activities with international initiatives through reciprocity by promoting cooperation and the sharing of findings and conclusions.

This is targeted by organising and/or participating in events or workshops with the international community so to share plans, ideas and potential solutions in each location.

2.1. Purpose and target group

This document reports on the international collaboration activities, which are part of WP7, during the first 18 months of the project. The objective was to report on all the activities carried out by CREATE-IoT, attending events and sponsoring meetings with key international players, in order to raise international awareness for the IoT-LSPs Initiative.

2.2. Contributions of partners

UNP is the leader of "Task 7.2 - IoT Global activities and cooperation" and also the responsible for this deliverable. UNP was the key partner organising all the sessions in the IoT Week 2017 and IoT Week 2018, as well as sponsoring the meetings with the international community. Other contributors to this document are IDC, SINTEF, W3C, ETSI, MI and TL.

2.3. Relations to other activities in the project

This document reports on all the international activities carried out by CREATE-IoT partners and so it relates to all other project tasks.

3. INTERNATIONAL COLLABORATION 2017 - EVENTS

This section regards the CREATE-IoT International Collaboration events that have been carried during 2017.

Table 1 below presents each event with the respective date, time and place where it was organized. All of these sessions were organized in part or in whole by the project partners UNP, leader of the international collaboration activities and MI, which coordinated the IoT Week 2017 in association with the IoT Forum, with the purpose of fostering international collaboration activities.

Table 1: CREATE-IoT International Collaboration activities

Event Name	Place	Date/Time
Emerging IoT Solutions in Developing Countries	IoT Week 2017 - International Conference Centre of Geneva (CICG)	Friday, 9 June – 09:00 AM to 10:00 AM
IoT Inclusion & Cooperation with the South	IoT Week 2017 - International Conference Centre of Geneva (CICG)	Friday, 9 June – 10:00 AM to 11:00 AM
International Cooperation on IoT	IoT Week 2017 - International Conference Centre of Geneva (CICG)	Friday, 9 June – 11:30 AM to 12:30 PM

3.1. Emerging IoT Solutions in Developing Countries

This meeting included three relevant presentations performed by the participants who disseminated some emerging IoT solutions from Africa and Brazil as well as the services and smart cities in India.

Table 2 provides the name and role/institution of all the participants who joined in the "Emerging IoT Solutions in Developing Countries" session that took place on June 9, during the IoT Week 2017 held at the International Conference Center of Geneva (CICG).

Table 2: List of participants in the event

Participant	Role/Institution
Alberto Paradisi	Vice-President on Research and Development at CPqD
M.P. Gupta	Professor and Head of Department of Management Studies at Indian Institute of Technology of Delhi
Louis Coetzee	Chief Engineer and Research Group Leader for the Internet of Things at the Council for Scientific and Industrial Research Meraka Institute in South Africa

Emerging IoT solutions from Brazil: This presentation was carried out by the Vice-President of Research and Development at CPqD, Alberto Paradisi that presented the innovation case for IoT in agriculture of CPqD and São Martinho group in Brazil.

São Martinho is a large farm dedicated to the sugar cane plantation that has a private LTE network, the first 250MHz network, with large area coverage, spectrum availability for broadband services and whose licensing cost is low.

The CAO project (Centre of Agriculture Operation) began in the harvest of 2017/2018 and will end in the harvest of 2019/2020 with the aim of automation and IT deployment in the rural area to make it possible to collect information from the agricultural machines and transmit this information to the private network LTE to be processed and analysed.

The case of São Martinho is also an example of operational excellence, focused on people, management and technology as it has a great operational logistics, where the harvesting machines cover 3,500km per day, where its entire fleet travels in one day the equivalent of two trips around the world.

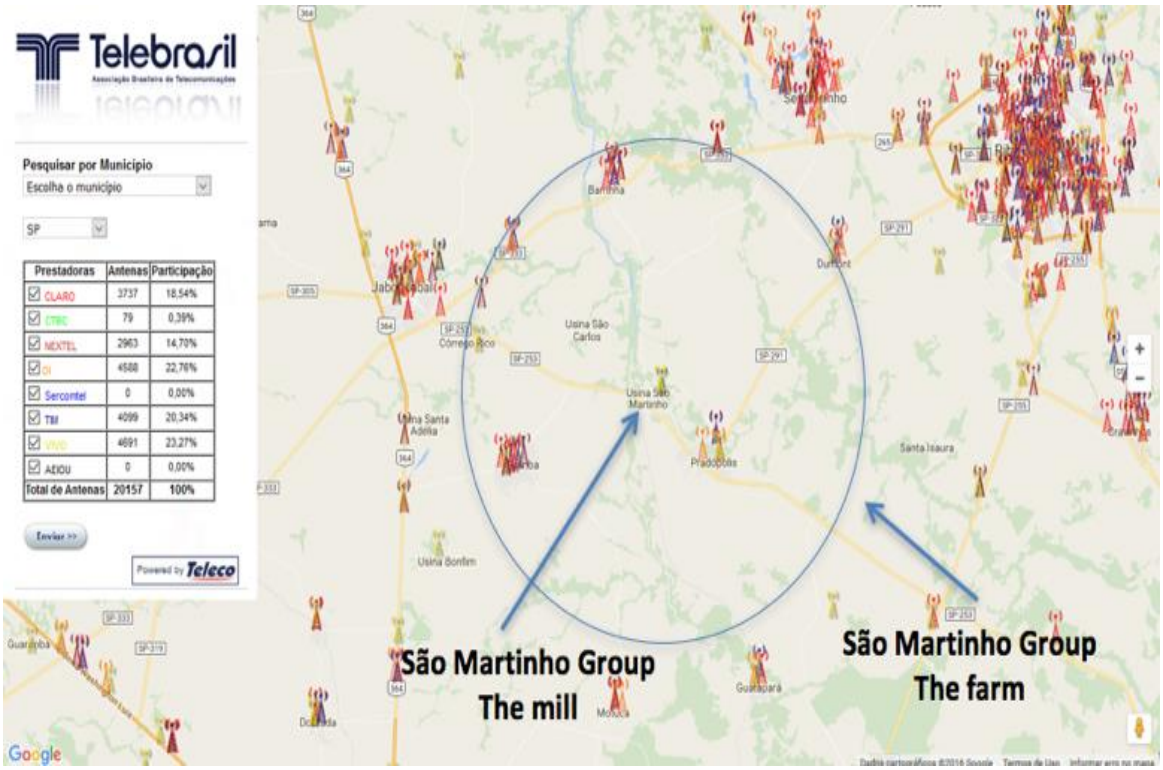


Figure 1: Typical Cellular infrastructure in the field

São Martinho is a Digital Farm with a digital factory allowing a change of level, a revolution in management, a better quality since its origin and improvement in reaction time.

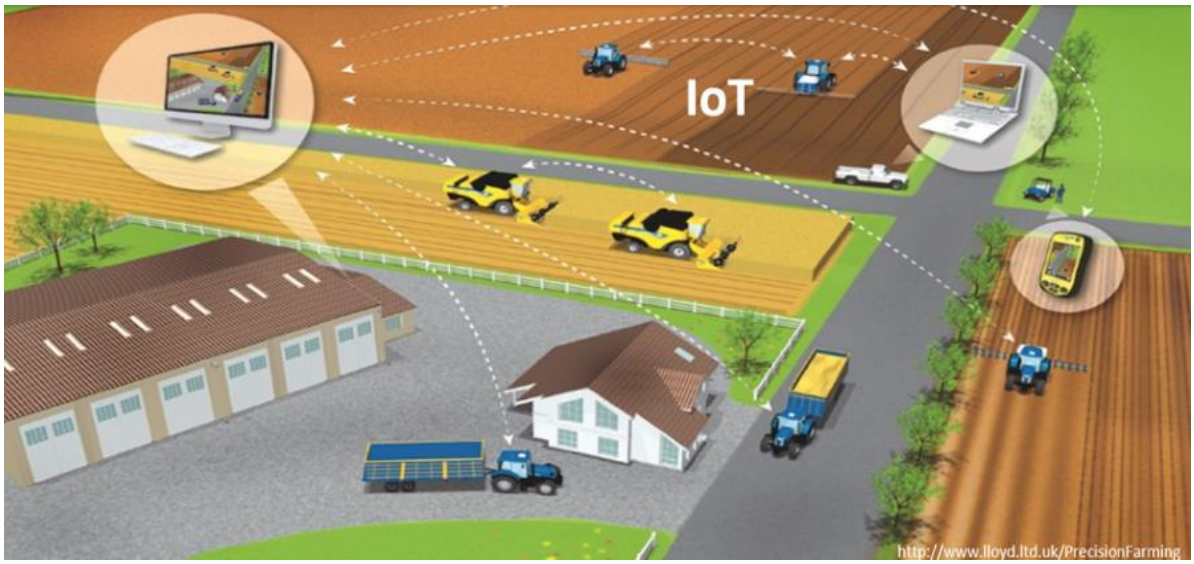


Figure 2: São Martinho Digital Farm

Smart Cities and Services in India: This presentation was carried out by Prof. M.P. Gupta, Head of Department of Management Studies at the Indian Institute of Technology of Delhi that presented emerging IoT solutions in developing countries and the perspective of India on IoT in smart cities and services.

India has several national priority programs, such as Make in India, Skill India, Start-up India, Swachh Bharat, Jah Dhan Yojona, PM Adarsh Gram Yojana, Gram Jyoti Yojana, Fasal Bima Yojana, but, of these, Digital India and Smart Cities stand out.

Digital India focuses on digital infrastructures that are useful for everyone, on services at the request of citizens and on digital empowerment of citizens and consists of the nine key points of Figure 3.

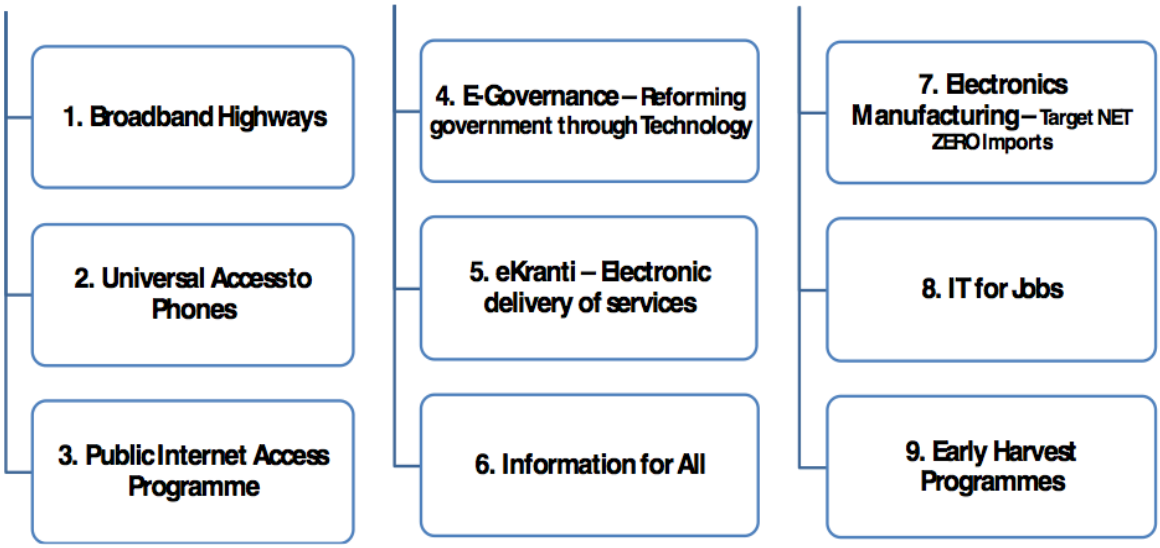


Figure 3: Nine key points of Digital India

Another advantage of Digital India is that it will benefit the common man in the several areas shown in Figure 4.

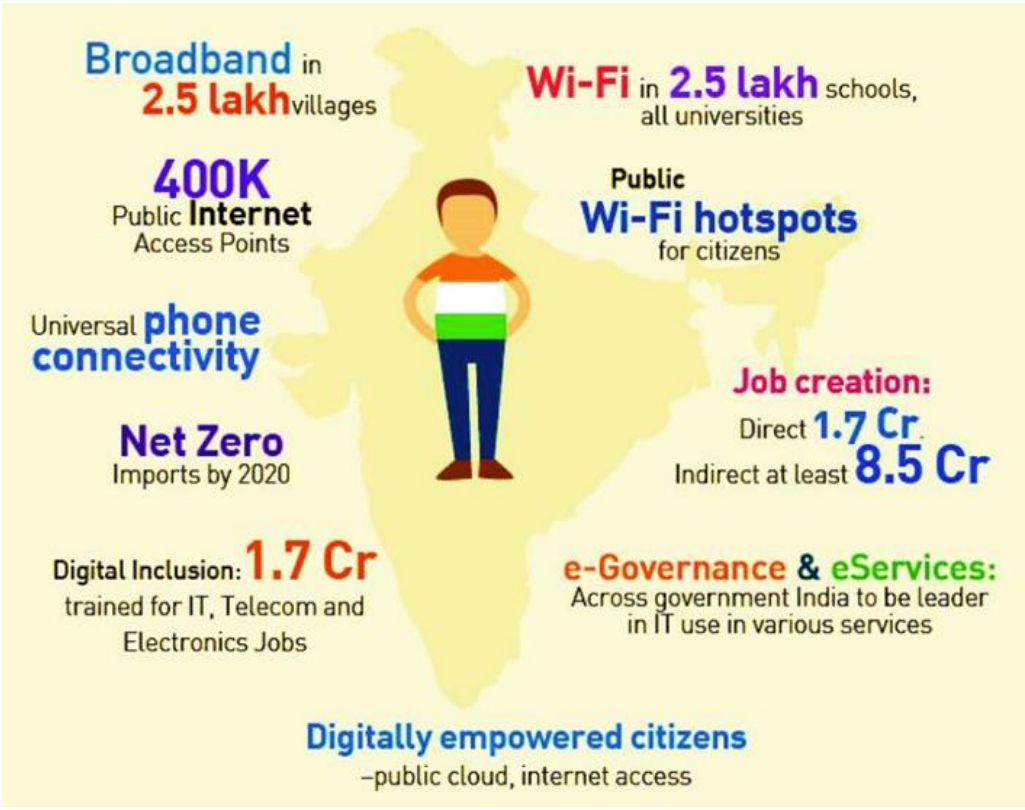


Figure 4: Benefits that Digital India will offer to the common man

The Smart Cities are a subset of the Digital India program, with the mission to develop 100 smart cities, such as satellite in larger cities, modernizing them and developing an IoT industry ecosystem in the country. In order to advance this development, US$15 billion has been approved and a process of city selection is already available, where all cities can participate in the challenge.

There are several European Union partners involved in the development of Smart Cities in India and each one helps one or more cities in their development or provides investment:

- France – will help to develop cities of Chandigarh, Puducherry and Nagpur;
- Sweden – will help to develop states like Karnataka, Telangana and Maharashtra;
- Spain – will help turn Delhi into a Smart City;
- Germany – will help to develop cities of Bhubeneswar, Kochi and Coimbatore;
- The Netherlands – has shown interest in investing in India for developing smart cities;
- Italy – will invest $1.2 trillion over the next 20 years in its own initiatives.

IoT is the key to Smart Cities planning through which it is possible to improve infrastructure, minimize pollution and congestion, make cities more sustainable and improve quality of connectivity to convert data into useful information for City-wide command and control operation, unique user experiences, management of assets and their services in a supply chain, health, safety and many more possibilities.

India's policy on IoT aims to achieve the creation of a US$15 billion IoT industry by 2020, develop specific sets of IoT skills for national and international markets, R&D companies for all assisting technologies and the development of IoT products to Indian needs in all possible domains. This policy should impact B2B and B2C companies with data from billions of sensors being processed by various IoT platforms. Figure 5 below presents the Indian IoT policy framework.

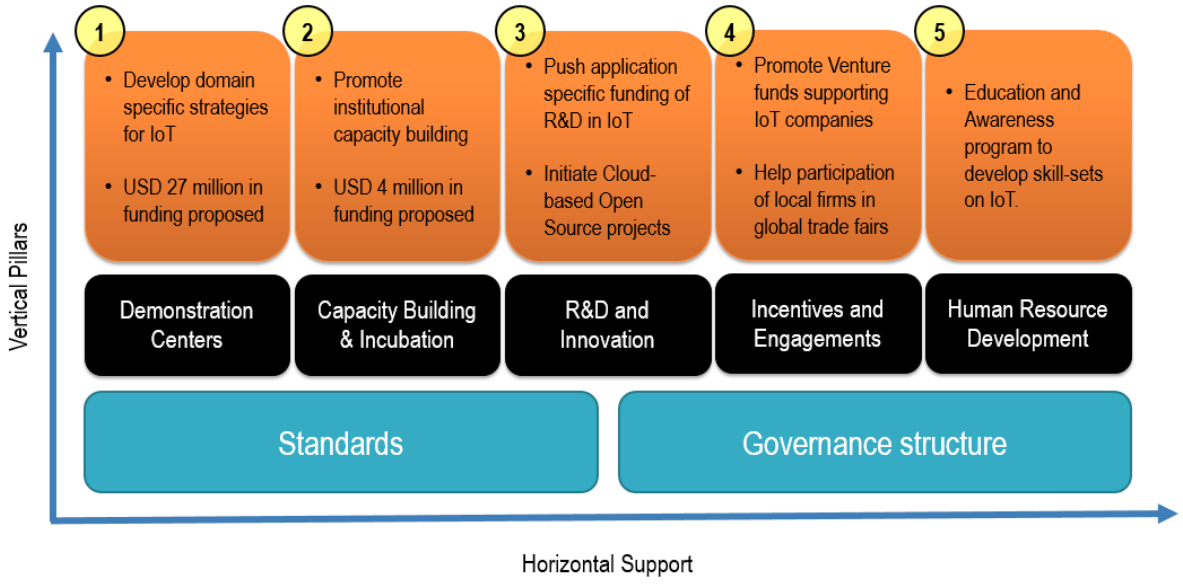


Figure 5: Indian IoT policy framework

Some of the problems and issues that can occur in the development of these smart cities in India are:

- Global cooperation in the development of standards around IoT process, technologies, services and interoperability such as spectrum energy communication protocol standards, standards for communication inside/outside the cloud, international integrity and quality standards for data creation and traceability, standards in terms of energy consumption, device security data privacy, data accuracy and standards of integrity.
- Strong legal framework where privacy law must be reformulated in view of the development of the IoT paradigm;
- Facility for R&D and innovation, including support for start-up enterprises and for global members;
- Make the global IoT ecosystem interoperable between IoT technologies.

Emerging solutions from Africa: This presentation was carried out by Chief Engineer and Research Group Leader for the Internet of Things at the Council for Scientific and Industrial Research Meraka Institute in South Africa, Louis Coetzee that presented the emerging IoT solutions from South Africa.

The awareness of IoT solutions has been increasing in South Africa where several multinationals are already working to establish a footprint; some network operators are already conducting some initiatives (MTN & Sigfox) and there has been the emergence of South African companies such as IoT.nxt.

Some of the problems and challenges for the implementation of IoT in Africa are energy (national blackouts), connectivity (it is expensive and only networks LoRa and Sigfox), support and maintenance (limited access to qualified maintenance) and high costs.

Some IoT solutions have already been implemented in several areas such as:

- Lumkani - Fire Detection: applied to Informal records (fossil fuels used for heating and cooking); early warning system for fire; sending message to alert the community; and GPS location distribution for emergency response.

Figure 6: Lumkani - Fire detection

- Smart Water Handpump: applied to water, sanitation and hygiene (WASH), Oxford (UK); Remote supervising of hand pumps (accelerometer and GSM); Use of the pump (e.g. maintenance required); Daily and seasonal patterns; Proof of operational concept in Kenya.

Figure 7: Intelligent water handpump

- Smart Water Management System: applied to detection of water leaks in a municipal water infrastructure; Based on LoRa communication; and uses dynamic hydraulic models (location and leak detection).

Figure 8: Intelligent water management system

Some of the Insights about the emerging IoT solutions in Africa are:

- Nowadays everything is IoT and has already been done and solved;
- For sellers, it is essential that they have a careful viable investment and a business that is already in operation;
- Policies and rules should be studied and established;
- IoT high-cost investments are limited;
- IoT has a major impact on vandalism and crime, making it an important asset in security;
- Continuity by movement of people in public/private sectors;
- Tension between R&D vs operational.

This session was the first of the day at IoT Week 2017 and started 10 minutes late resulting in the discussion on the themes being postponed for the subsequent session. Here, and due to the great interest in the implementation IoT technologies in developing countries, Africa in particular, the discussion focused a lot on how it is possible to implement these technologies in the field. The WAZIUP approach was discussed and revolves around three aspects:

1. Promote and carry out IoT competitions and animations (e.g. Wazihacks) in order to promote links with the local communities of practice/interest;
2. Create a connection with existing living labs or competence centres to look for local operational structures and work with them on promoting IoT solutions;
3. Take advantage of tools that are the basis for teaching how to implement IoT technologies (e.g. IoT Catalogue), to promote guidance on developing IoT solutions.

This approach has been used in Africa and could be used in other regions or countries. The following Figure 9 and Figure 10 provides an overview of this session.

Figure 9: Session Photos

Figure 10: Discussion photos

3.2. IoT Inclusion & Cooperation with the South

This meeting was focused on five important presentations performed by the participants in order to overview the IoT inclusion and cooperation with nations in the Southern Hemisphere. Table 3 shows the names and roles/institutions of all the participants who joined in the "IoT Inclusion & Cooperation with the South" session which took place on June 7, during the IoT Week 2017 held at the International Conference Center of Geneva (CICG).

Table 3: List of participants in the event

Participant	Role/Institution
Ramy Fathy	Vice Chairman at the ITU-T Study Group 20 at the International Telecommunication Union
Marimuthu Swami Palaniswami	Professor at University of Melbourne
Gabriel Marão	President of the Brazilian IoT Competitiveness Forum
Ricardo Rivera	Head of the ICT Industries Department at BNDES
Corentin Dupont	Senior Researcher Engineer at FBK CREATE-NET
Levent Gurgen	R&D Projects Manager at CEA-LETI

Views of the ITU on IoT for Developing Countries: This presentation was carried out by Dr. Ramy Ahmed Fathy, Vice Chairman at the ITU-T Study Group 20 at the International Telecommunication Union, who presented the views of the ITU on IoT for developing countries.

According the vision of ITU, there are several challenges on IoT for developing countries such as the access to fundamental services (drinking water, sanitation) while electricity is still considered

a problem in many areas. The economic sectors are labour-intensive, the social impact on specific social segments needs to be assessed and developing countries' markets are price-sensitive. The ITU-T Study Group 20 has set a standardization for the development of countries that focuses on several areas of action as is visible in Figure 11.

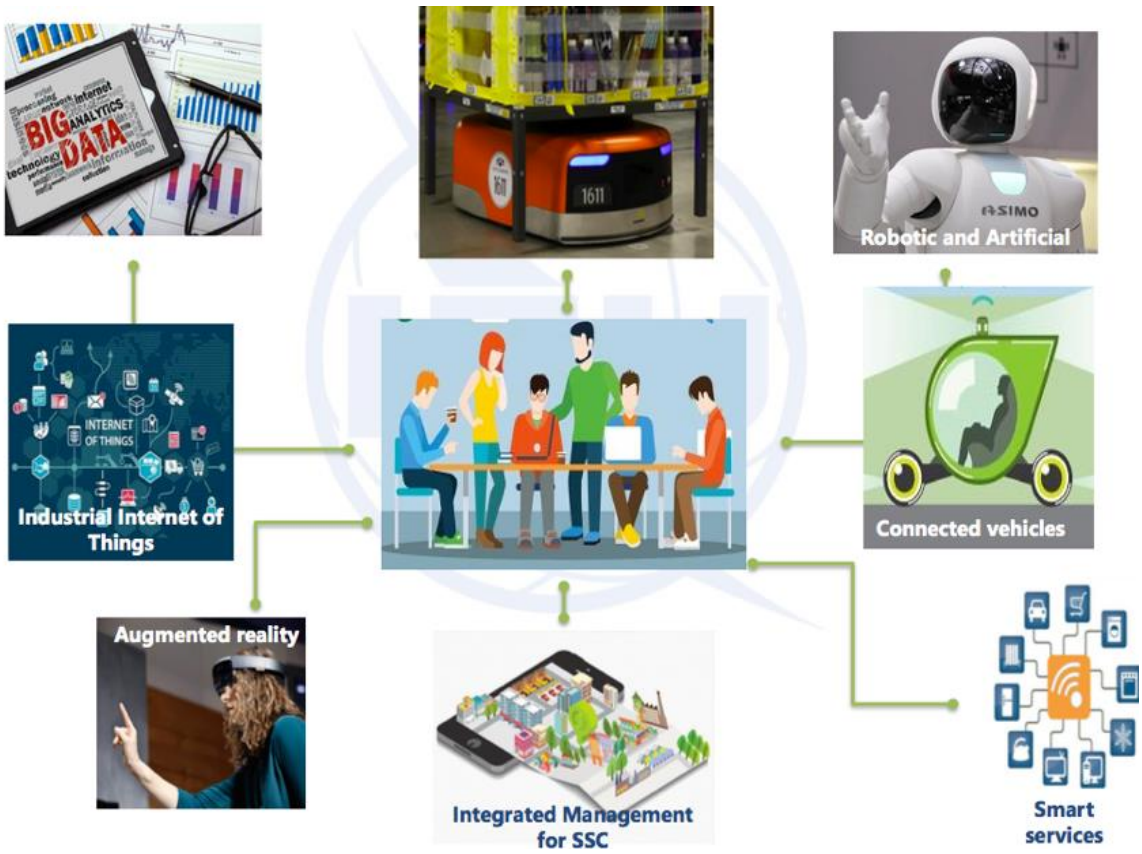


Figure 11: ITU-T Study Group 20 Standardization for Development

There is a set of development aspects in terms of Big Data & AI in IoT that stand out:

- No Poverty: Map poverty with predictive big data analytics. Use IoT to gather field data correlated with poverty (i.e. health, pollution, food production, etc).
- Zero Hunger: Increase agricultural productivity. Use IoT in precision agriculture and farming applications, soil mapping, soil properties measurements, nitrogen supervision, etc.
- Good Health and Well-Being: Analyse vast amounts of healthcare data. Use IoT sensors, IoT platforms for device supervision, analytics and diagnostics.
- Quality Education: Revolutionize classrooms with individualized learning. Use IoT AR/VR, for lab testing, scientific demonstration, examination and training.
- Gender Equality: Unequal division of unpaid care and domestic work (cleaning, cooking and caring for children or the elderly, is performed usually by women and girls). Use IoT in elderly- and child-care applications, sensing incidents, healthcare-supervising and triggering actions in incidents/emergencies.
- Clean Water and Sanitation: Improve efficient and clean water provision. Use IoT to identify water pollutants and waterborne diseases and control water quality.
- Affordable and Clean Energy: Improve photovoltaic energy capture. Use IoT to identify weather/luminance conditions and adjust photovoltaic arrays for ideal efficiency.
- Work and Economic Growth: Increase productivity through intelligent automation. Use Industrial IoT sensors and actuators in order to monitor worker's health and productivity and performance.

Figure 12: List of standardization activities

It also recognized the application of IoT in Smart Cities and Communities (SC&C) that allows us to identify the following aspects:

- General requirements and abilities of IoT applications and services;
- Frameworks and functional architectures of IoT to support networks and gateways;
- Precise IoT services covering transportation safety services and e-health services;
- IoT-based smart greenhouses, farming, manufacturing and Big Data problems;
- Security, trust and privacy protection in IoT;
- Key emerging technologies like crowdsourcing, intelligent control and blockchain of things;
- SC&C-related ecosystems, applications, services and use cases;
- Standards that are directly related to SC&C with a focus on urban planning, water, logistics, healthcare, e-government, transport, energy and others.
- Open Data;
- Spatio-temporal modelling for SC&C;
- Integration of sensing and supervision for smart sustainable cities.

The KPIs for the project on smart sustainable cities to reach sustainable development goals are presented in Figure 13 below.

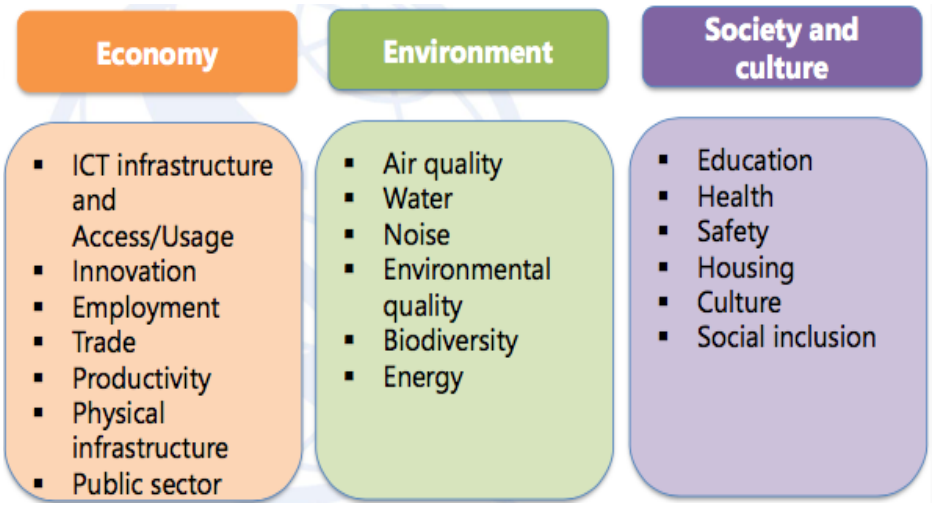


Figure 13: KPIs Project for Smart Sustainable Cities to Reach SDGs

The ITU-T Study Group 20 developed two relevant publications on IoT and Smart Sustainable Cities. The *Flipbook on Unleashing the potential of the Internet of Things* presents a collection of the first set of ITU international standards for IoT, offering a resource of great value to standards experts interested in contributing to the work of ITU-T SG20.

The *Flipbook on Shaping smarter and more sustainable cities - Striving for Sustainable Development Goals* is a collection of technical reports and specifications details policy and technical considerations relevant to the development of SSC, providing policymakers and engineers with valuable reference material to guide the pursuit of happier, safer lives in our cities.

Views from Asia: This presentation was carried out by Marimuthu Swami Palaniswami, Professor at the University of Melbourne and Director of a large ARC Research Network on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP) with about 100 researchers on various interdisciplinary projects who presented the Asia perspective on IoT for developing countries.

At the University of Melbourne, they have access to a broad network of more than 200 researchers and postgraduate students as well as extensive links across Australia, USA, Europe and Asia, have 50 leading participants, 50 affiliated researchers and post-Docs, 75 research students, 10 Australian universities and partner organizations, 30 industry links, sensor network research infrastructures across the country, and IoT.

Figure 14: Broad Network at University of Melbourne

This presentation focused on the impact of climate change on the Great Barrier Reef where the increase in CO2 (acidification of the ocean) and the increase in temperature cause the corals to contract disease.

In 2008, censuses show that, around the world, 20% of reefs have already been lost, another 15% are in critical condition and another 20% are under threat in the long term.

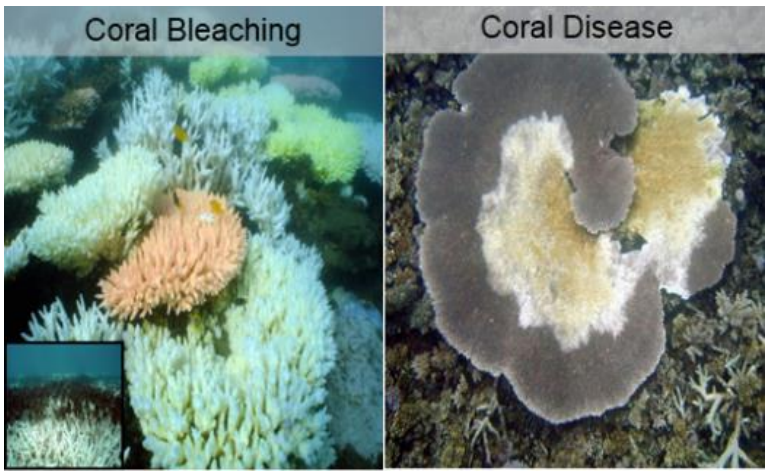


Figure 15: Effects on coral due to the increasing temperature in GBR

To study the oceans and the corals, a set of float sensors were placed on the Heron island, which each have a single thermistor mounted under the float at a depth of about 60cm. This set of sensors collects data, stores it in the internal memory, and transmits this acquired information to the base station every 10 min.

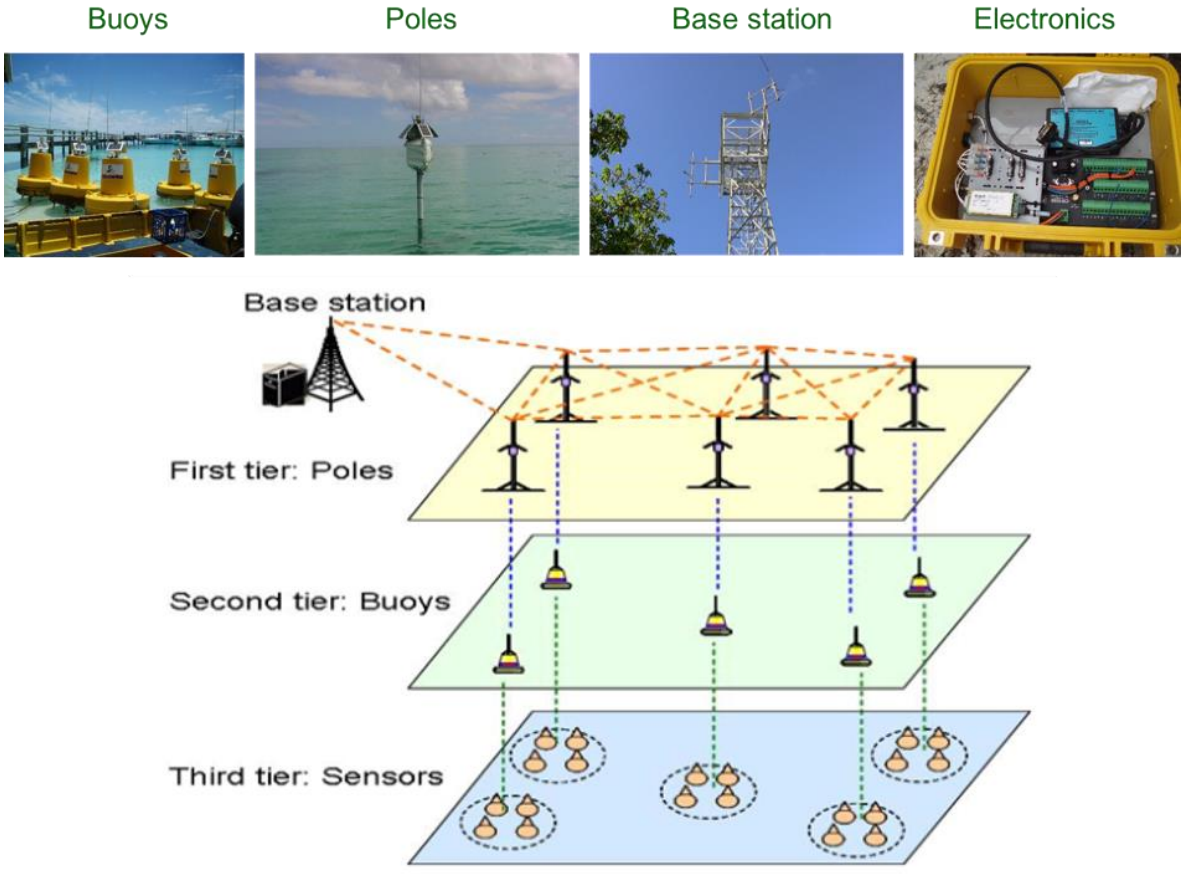


Figure 16: Sensors placed on Heron Island to study the oceans

Views from Brazil: This presentation was carried out by the Head of the ICT Industries Department at BNDES, Ricardo River, who presented the IoT action plan study for Brazil. This study delivers a five-year plan for the Brazilian Government with recommendations for horizontal problems as well as identifying three to five segments where the country can become a worldwide reference in IoT.

The impact of IoT levers in markets with a large manufacturing sector and large populations presenting a great opportunity to leap into legacy technologies. Brazil already launched the study titled "Internet of Things: A Plan of Action for Brazil", with ambitious goals to define the initial aspirations for IoT in Brazil, prioritize vertical and horizontal for IoT development, and prepare an action plan for 2018-22 to implement the study proposals. The study is divided into four phases and is currently at the end of the second phase.

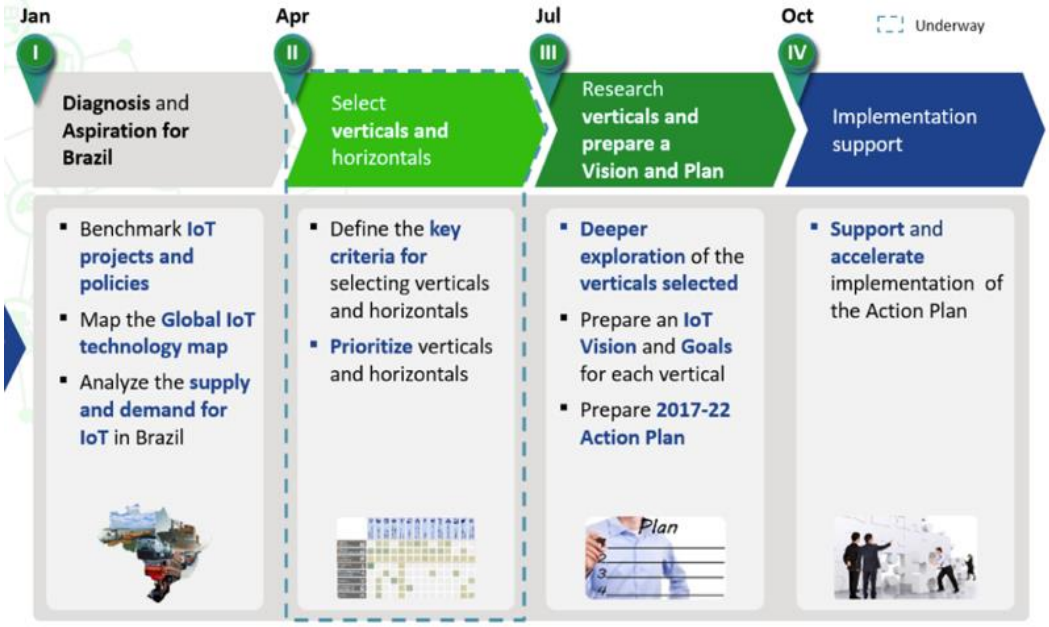


Figure 17: The study four phases

A broad IoT environment with key stakeholders in the construction of the plan already includes more than 2,000 people, companies and other agents, boards (IoT Chamber, Consulting Board, Policy makers Committee), specialists, leadership and project team, BNDES and the MCTIC.

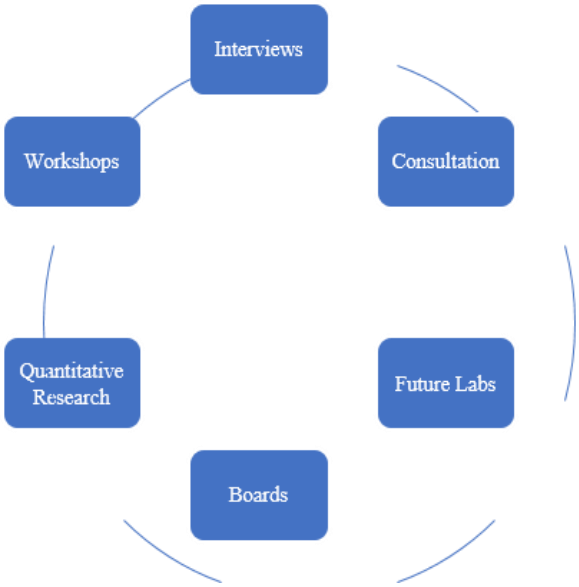


Figure 18: Broad IoT ecosystem with key stakeholders

This is supported by five major surveys with the objective of extracting relevant responses to ongoing IoT initiatives and aspirations in Brazil, Brazil IoT Map, key horizontals and relevant proposals of public policies and projects.

The aspiration for IoT in Brazil covered the competitiveness, a connected and digital society, and the IoT production chain by accelerating the implementation of IoT as a tool for the sustainable

development of Brazilian society. Competitiveness fosters growth and advancement of the economy, improves productivity, creates innovation business models, and develops IoT-based value-added goods and services. A digital and connected society promotes ownership of the benefits of IoT society to manage the city's resources, provide intelligent services and prepare Brazilians for work using the new technologies of the 21st century. The IoT production chain increases the local production, innovation, SMEs, exports and the internationalization of local technologies and enterprises.

In order to prioritize verticals, a set of ten areas that share common interoperability problems was identified as presented in Figure 19.

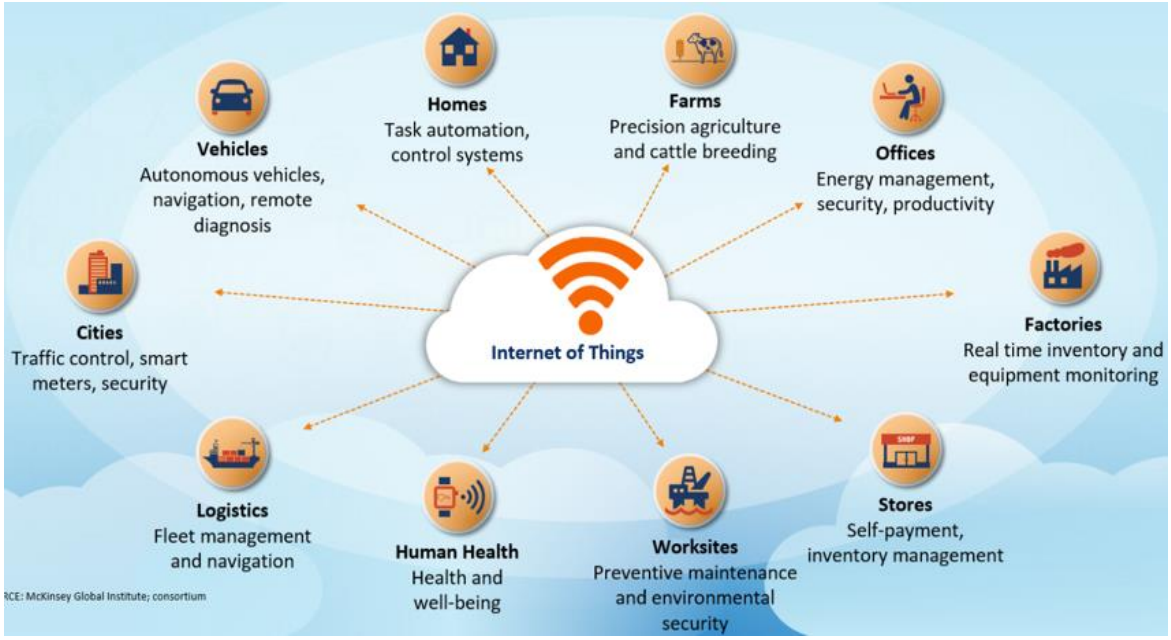


Figure 19: Concept of settings used in areas with common interoperability problems

In the Brazilian Action Plan for short, medium and long-term initiatives for testbeds and innovation hubs, pilot projects and public calls for innovation as well as international cooperation are expected.

A relevant example of the development of IoT in Brazil is the Digital Farm of São Martinho, which is the 5th largest producer of sugarcane and has a private 4G network (LTE 250 MHz). By day, harvesting machines travel the equivalent of two trips around the world and its management focuses on logistics, precision farming, asset management and planning.

Views from EU-Africa on IoT and Big Data for Africa: This presentation was carried out by Corentin Dupon, a Senior Researcher Engineer at FBK CREATE-NET research centre who is working on the WAZIUP project where they are responsible for the Cloud-IoT platform of WAZIUP.

The IoT technical challenges in Africa include rural access to technology and the internet; hardware costs, development and implementation applications; and service quality and the fragmentation of mobile phone use.

The WAZIUP project focuses on the adaptation of IoT technology applications to rural areas in Africa by using several IoT sensors and LoRa communication.

LoRa is a low-cost, energy-efficient, long-range communication technology that is compatible with Arduino and Raspberry-PI. In addition to these advantages LoRa is available to be implemented on a large scale.

In the use cases, one intends to perform an IoT transformation of African farms in which, through IoT applications, it is possible to monitor devices and user-notification systems and still control and act on systems and devices.

Through the Big Data applications, it is possible to have a descriptive analysis, a prescriptive analysis and a forecast.

In Senegal, there is already a laboratory that works as a testbed where the gateway and the LoRaWan is tested, as shown in Figure 20, and that performs validation tests on the sensors of the final device.

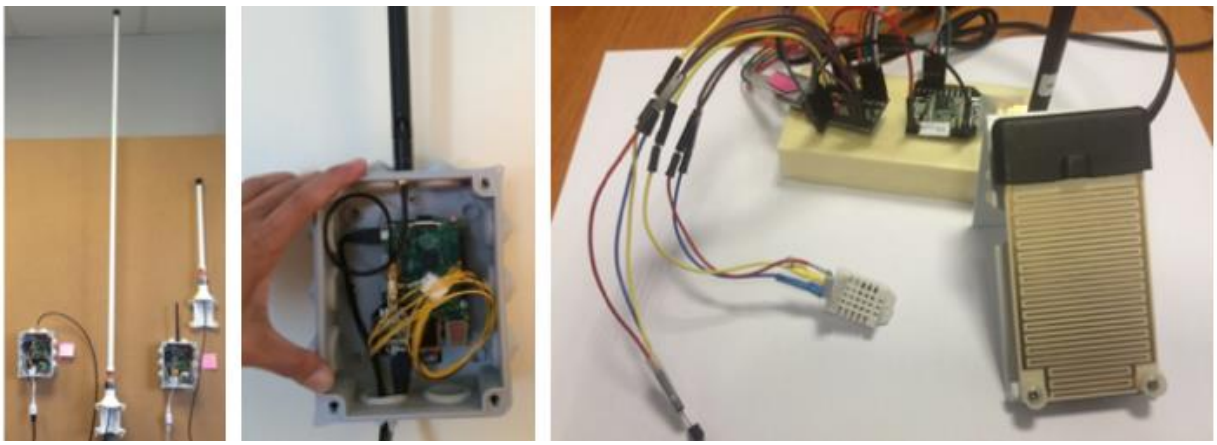
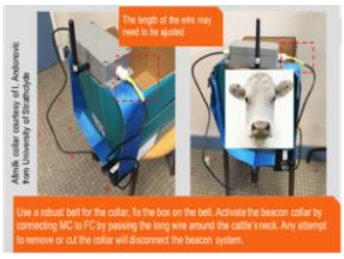


Figure 20: LoRa Gateway placed in a laboratory at Senegal

In the WAZIUP project a set of MVPs in different areas of activity is being deployed in some countries as shown in Figure 21: cattle rustling in Senegal, fish farming, a weather station in Ghana, and urban waste and soil moisture in Togo.



Cattle rustling - Senegal

Fish farming - Ghana

Weather Station - Ghana

Urban waste - Togo

Soil moisture - Togo

Figure 21: Different MVPs deployed in Ghana, Togo and Senegal

The IoT ecosystem in Africa is increasing through its presence on social media, due to the WaziHack models (were organized three WaziHacks in Senegal, Ghana and Togo), via about 40 innovation training and workshops and several IoT activities such as the IoT Forum Africa and IoT Africa Summit. The continent is ready for the IoT and big data technology adaptation in order to improve the social and economic conditions.

Views of IoT-EPI International Collaboration Task Force: This presentation was carried out by Pedro Malo, a senior researcher and seasoned scientific advisor at Unparallel Innovation that holds a PhD in interoperability methods and tools for large-scale and massively heterogeneous data environments, who presented the views of the IoT-EPI International Collaboration Task Force.

The IoT-EPI is a European initiative, addressing the EU-funded H2020, in order to build a sustainable IoT ecosystem and increase the opportunities to the increase the development of IoT platforms. This initiative has as its objectives:

- Describe the strategy and actions for international collaboration with global players (industry research, innovation ecosystems and public administrations);
- Promote the EU's success stories to international markets in order to encourage them to adopt EU IoT platforms worldwide.
- Recognize opportunities, trends, markets outside of Europe in forefront markets, and disseminate EU R&D in IoT;
- Establish liaisons with key stakeholders outside the EU and coordinate the interaction with them.

Figure 22 and Figure 23 includes an overview of this session.

Figure 22: Session photos

Figure 23: Discussion photos

3.3. International Cooperation on IoT

In this meeting, there were three significant presentations, given by the participants, in order to disseminate some relevant aspects that may arise by the international cooperation on IoT. Table 4 presents the list with the names and roles/institutions of all the participants who joined in the "International Cooperation on IoT" session that took place on June 9, during the IoT Week 2017 held at the International Conference Center of Geneva (CICG).

Table 4: List of participants in the event

Participant	Role/Institution
Marimuthu Swami Palaniswami	Professor at University of Melbourne
Srdjan Krco	Co-founder and CEO of DunavNET
Ovidiu Vermesan	Chief Scientist at SINTEF DIGITAL Force
Kees van der Klauw	Head of the Research Program at Philips Lighting
Ziqin Sang	Vice Chairman at the ITU-T Study Group 20 on IoT and Smart Cities and Communities

International Cooperation on IoT and Smart Cities: This presentation has carried out by Prof. Ziqin Sang, Vice Chairman at the ITU-T Study Group 20 on IoT and Smart Cities and Communities, who presented the International Cooperation on IoT and Smart Cities focused in five areas:

1. The Belt and Road Initiative, that is a cooperative development strategy for:
   - Infrastructure networks in order to bridge the infrastructure gap;
   - Financial institutions including the AIIB (Asian Infrastructure Investment Bank) and the Silk Road Fund;
   - Geo-economics of continental integration;
   - Culture and education.

Figure 24: China's One Belt, One Road initiative

2. The collaboration between EU-China regarding the research on 5G and IoT, which had its first meeting in March 2017 in Beijing and its second in June 2017 in Geneva, has as its main objectives:
   - Dissemination and communication on 5G and IoT with stakeholders around the world;
   - Establish partnership plans between EU-China collaboration proposals and policy white paper;
   - Large-scale pilot, EU-China test platform, cooperation framework and best practices;

- Standardization and interoperability through 5G coordination and guidance for IoT.

3. Establish a partnership between China-EU on the urbanization area originated from the High-Level Conference of the China-EU Partnership in May 2012 held in Brussels, in which the theme was "to communicate and learn from each other, to achieve mutual benefits and winning results."
4. The China-France cooperation on Science and Technology that, in June 2011 in the XIIIth Session of the Joint Franco-Chinese Scientific and Technical Commission, included the Smart Cities in the six priority areas of cooperation. The other areas are: Sustainable development, biodiversity and water resources management; green chemistry and technology; energy; life science; information science and technology; and advanced materials.

China-UK Cooperation on Smart Cities was established in October 2015. The "China-UK cooperation memorandum on smart city" signing ceremony was held in the British foreign office where three companies (British Arup, Chinese iSoftStone and Venturous) established a strategic cooperative partnership.

International Collaboration Task Force: This presentation was carried out by Ovidiu Vermesan who holds a Ph.D. in microelectronics, a Master of International Business and who is also Chief Scientist at SINTEF DIGITAL, who presented the IoT-EPI initiative and the IoT European Large-Scale Pilots Program.

The IoT-EPI is a European initiative that has a network of partners from 120 companies and organizations and a total funding of €50M with the objective of developing projects of innovative platform technologies. The project also aims at finding strategies and enhancing activities with international stakeholders in IoT domain projects and establishing strong liaisons with key stakeholders outside the EU.

The IoT European Large-Scale Pilots Program (IoT-LSPs) has the objective of promoting the development of IoT solutions in Europe through the integration of advanced IoT technologies in several actuation areas.

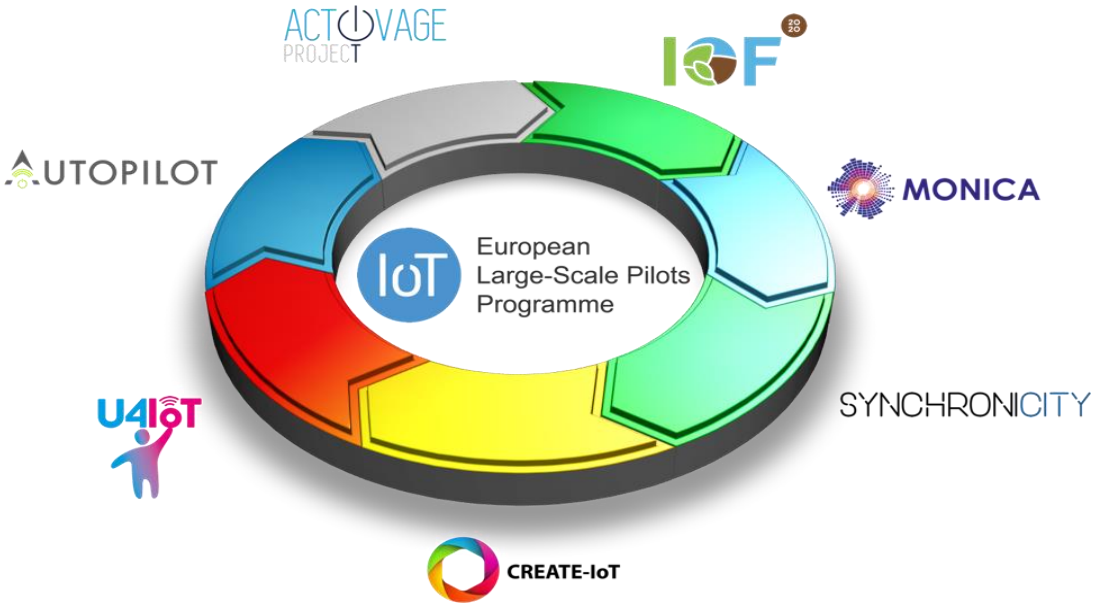


Figure 25: IoT European Large-Scale Pilots Program

This program encompasses the two CSAs - Coordination and Support Actions - (U4IoT and CEATE-IoT) and five LSPs - Large-Scale Plots – (SYNCHRONICITY, MONICA, IoF2020, AUTOPILOT and ACTIVAGE) and includes projects addressing the IoT applications based on European relevance, technology readiness and socio-economic interest in Europe.

International Cooperation in IoT: This presentation was carried out by Kees van der Klauw, the Head of the Research Program at Philips Lighting, who presented some relevant points of view about why the international cooperation in IoT is important and also how and when this cooperation can be done:

Why:

- Acquire economic value: is necessary scalability in the industries because most countries are small for a company (is a European challenge);
- International cooperation to minimize "waste" for governments, schools, companies, end users and industry;
- Companies do not differentiate: need many common functionalities;
- The internet is beyond borders but can be disrupted politically;

What:

- Cooperation with end-users allow international learning.
- Functional requirements: interoperability, architectures, mutual languages...
- Non-functional requirements that have high costs (legal characteristics, data storage policies and privacy) involving end users in pilots, protection, code of conduct and energy consumption standards.

How:

- Practical terms: global real-scale learning projects (LSP's), producing international cooperation and convergence, and evolving local stakeholders.
- Cooperation between consortia: allows duplication and achieving complementarities.
- Attractive plans: offering benefits for who achieve convergence/international development.

When:
(Already and for the next years)

- Some bigger countries do not have the challenge of international collaboration and can begin to control the market now.
- Cleaning up a divergent legacy will cost a fortune and no offer value to end-users;

An overview of this session is provided by the following Figure 26 and Figure 27.

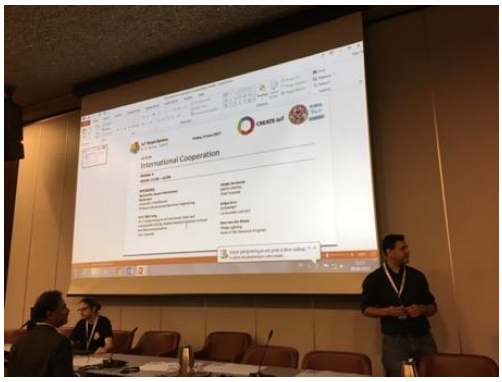


Figure 26: Session photos

Figure 27: Discussion photos

Collaboration with ITU

Seven sessions on IoT and Sustainable Development Goals (SDGs) were organized during the IoT Week 2017 in Geneva. These sessions were organized together with the International Telecommunication Union (ITU) and were attended by several other UN entities. These sessions were centred around the work of CREATE-IoT and the various LSPs

Following on from the discussions during the SDG sessions, IoT Week 2017 culminated in the development and adoption of the IoT Declaration on Sustainable Development Goals. This Declaration was unanimously adopted by 900 participants at the IoT Week 2017.

4. INTERNATIONAL COLLABORATION 2018 - EVENTS

This section regards all the CREATE-IoT International Collaboration activities that have been carried out in 2018 so far. Table 5 below presents each event with the respective date, time and place where it was organized.

All of these sessions were also organized by the CREATE-IoT partners Unparallel Innovation, leader of the international collaboration activities and Mandat International, who coordinated IoT Week 2018 in association with IoT Forum, with the purpose of fostering international collaboration activities.

Table 5: International Collaboration activities in 2018

Event Name	Place	Date/Time
IoT for Sustainable Development in Africa	IoT Week 2018 - Euskalduna Jauregia Conference Centre	Wednesday, 6 June – 09:45 AM to 10:45 AM
EU-Asia Collaborations on IoT Sustainable Development	IoT Week 2018 - Euskalduna Jauregia Conference Centre	Wednesday, 6 June – 04:45 PM to 05:45 PM
Eu-Brazil Collaboration on IoT Sustainable Development	IoT Week 2018 - Euskalduna Jauregia Conference Centre	Wednesday, 6 June – 03:15 PM to 04:15 PM

4.1. IoT for Sustainable Development in Africa

This meeting was moderated by the senior researcher of Unparallel and Uninova, Pedro Malo and by Philippe Cousin of EGM and included four relevant presentations performed by the participants who disseminated some emerging IoT for Sustainable Development in Africa.

The following Table 6 provides the name and role/institution of all the participants who joined in this session that took place on June 6, during the IoT Week 2018 held at the Euskalduna Jauregia Conference Centre.

Table 6: List of participants in the event

Participant	Role/Institution
Alexander Ntoko	Chief of the Operations & Planning Department at ITU
Congduc Pham	Professor of Computer Science of Pau University
Fifii Baidoo	Co-founder and Chief technology officer of iSpace
Mamour Diop	Researcher at UPPA

IoT Week 2018, held four sessions on the SDGs including one specific session on implementing SDGs in Africa. This session was opened by one of the Deputy Directors of Telecommunication Standardization Bureau, ITU, Alexander Ntoko. It focussed on the core themes of the SDGs which would bridge the standardization gap in various African countries which are at different levels of transition

Interoperability in IoT Identification: This presentation was carried out by the Chief of the Operations & Planning Department at ITU, Alexander Ntoko, that approached the Interoperability in IoT Identification and presented a case of study for combating counterfeiting for ICT devices.

The Interoperability in IoT identification is composed by the architectural components presented in Figure 28 and needs to satisfy four fundamental and key characteristics:

- Be Extensible, allowing to present local namespaces globally without conflicts issues;
- Offer International Support (Unicode 3.0 Character Set with UTF-8 encoding);
- Be Secure, where can be defined standard mechanisms for client/server authentication through integrated public key infrastructure;

- Deliver distributed administration and service, permitting respectively secure management over the public network by the owner in any location and replication of any service on several service sites, which can be distributed in a server cluster.

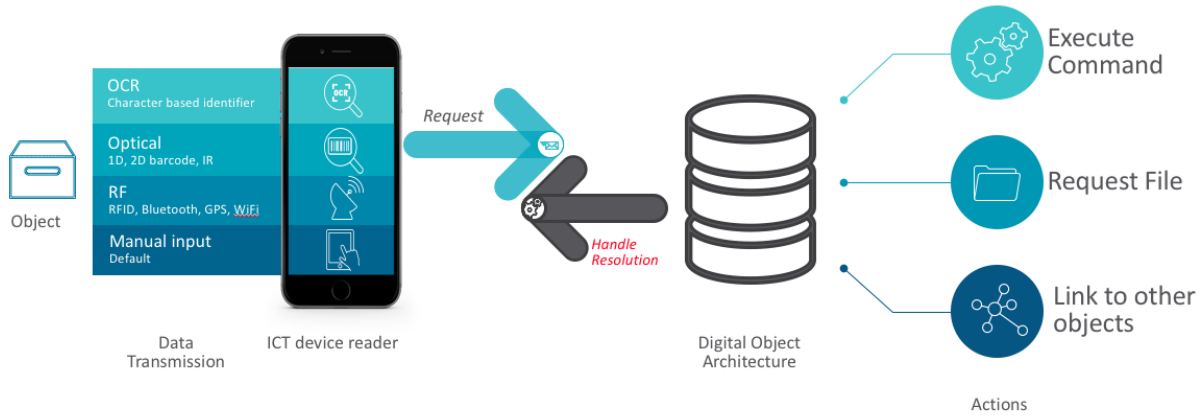


Figure 28: Architectural components for Interoperability in IoT Identification

In order to combat counterfeiting of ICT devices different identifiers such IMEI number, MAC address, product code, distributor's ID, retailer's ID, serial number, warehouse ID and Manufacture's ID need to work together. It is also necessary to comply three essential steps that allow to create, register, distribute and verify all the ICT devices:

- Create & Register – to create and register the ICT devices is required the generation of a digital fingerprint and handle ID;
- Distribute – to distribute the ICT devices the shipping information is added from each phase of the supply chain;
- Verify – the customer retrieves the data of device data and verify its authenticity.

In the following Figure 29 is shown the authentication process for an ICT device:

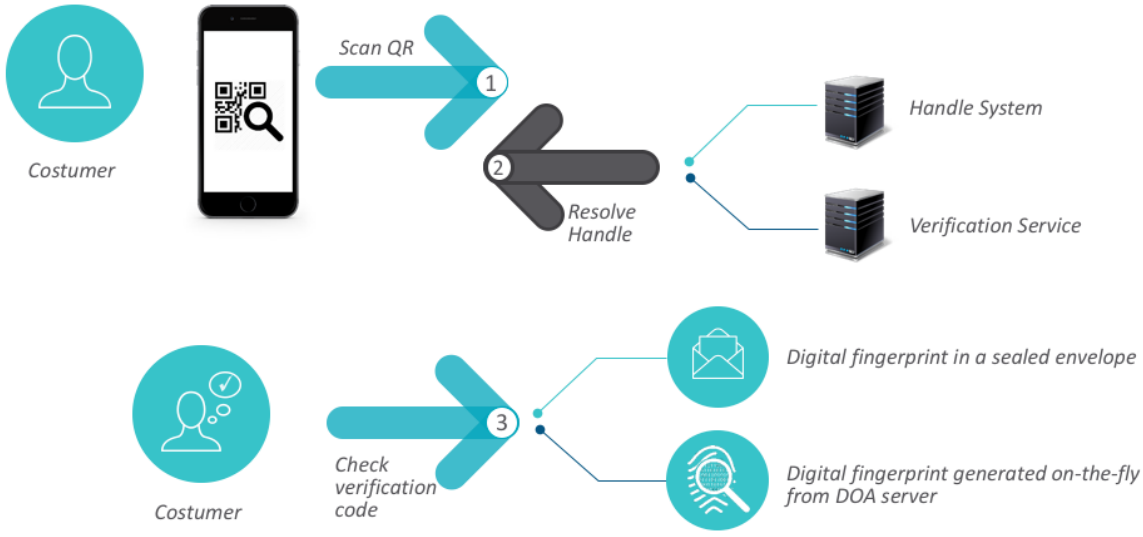


Figure 29: Authentication process for an ICT device

Importance of Long-Range – Low Energy Radio Technologies for Africa: This presentation was carried out by Congduc Pham, Professor of Computer Science of Pau University in France that presented the importance of Long-Range and Low-Energy Radio Technologies for Africa.

Regarding the goals of the new sustainable development agenda adopted to end poverty, protect the plant and ensure prosperity for all, the implementation of IoT solutions for rural areas in Africa

contribute to the progress of several areas (as shown in Figure 30) such irrigation, livestock farming, fish farming, aquaculture, storage, logistic, agriculture and environment.

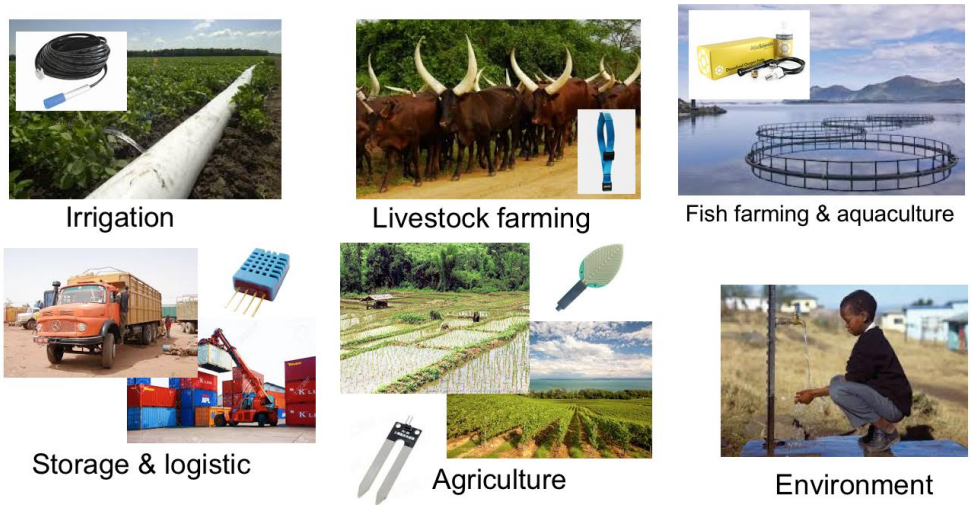


Figure 30: IoT development for rural areas

In this context, the use of technologies for long-range sensing applications such as GSM/GPRS that can cover 10-15Kms usually require a subscription, have coverage limitations and high-power consumption. This scenario leads to the use of low-power and long-range radio technologies such as Sigfox, LoRa, Weightless (N, P), LTE (Cat-M1, Cat-M2), RPMA (Ingenu), 802.11ah, NWave, Telensa, Amber Wireless, Waviot, and NB-IoT. Some of the characteristics of these technologies are: In generally, robustness and sensitivity can be increased when transmitting much slower; A Sigfox message is sent relatively slowly in an ultra-narrow band of spectrum (Max throughput=~100bps); LoRa also increases time-on-air when maximum range is needed but uses spread spectrum approach (Throughput=~300bps – 37500bps).

Using a private ad-hoc LoRa network not need subscription, can be deploy own network and have low energy consumption. A LoRa network allow to follow the long-rage IoT architecture, shown in Figure 31, where can be used different LoRa radio modules (such HopeRF, Libelium and others) and by install together a LoRa gateway allow to start collecting data.

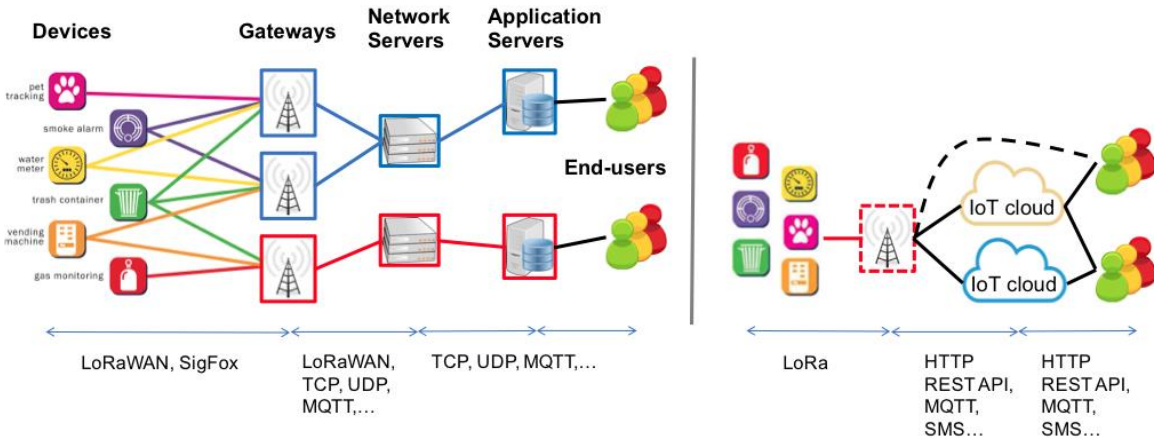


Figure 31: Long-Range IoT architecture

In a deployment of a LoRa network in a real-world case, such as the WAZIUP project, it is essential to reach connectivity with the gateway in rural and remote situations and use a long-term approach that allows to insert an intelligent and transparent relay node at any time between the end devices and the gateway to order to increase the reach.

Figure 32: WAZIUP MVP solutions

The Internet-of-Things is emerging fast, with new cutting-edge radio technologies and frameworks. NB-IoT is pushed hard by most of operators but they are also developing out large-scale SigFox and LoRa networks. In the Africa context, both operator coverage and internet access issues must be considered. Good long-range radio candidates must permit ad-hoc deployment and local gateway on customer premises.

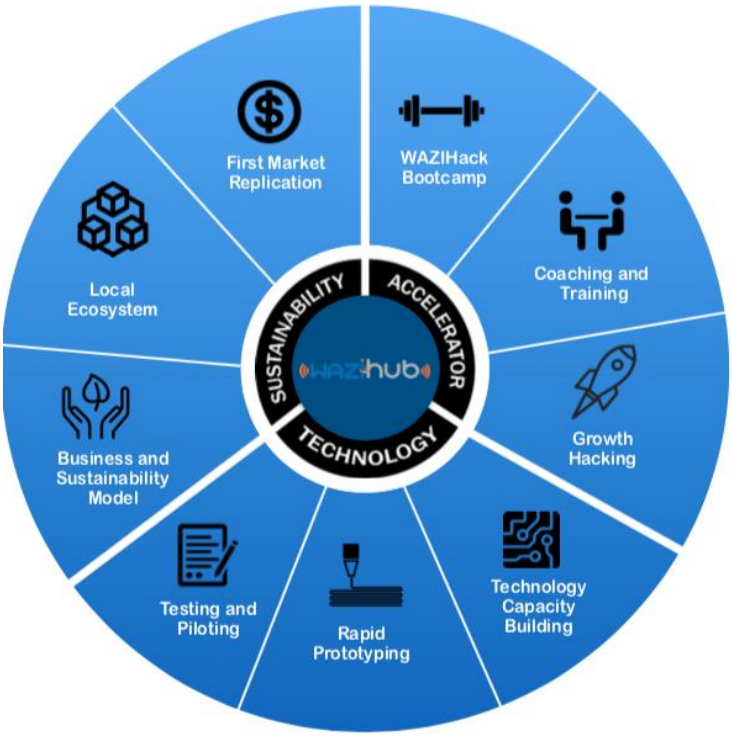


Figure 33: WAZIHUB value proposition

Supporting IoT innovations in African IoT hubs: This presentation has carried out by Fiifi Baidoo from ISpace Foundation who presented the supporting IoT innovations in African IoT hubs with the objective of iterate and extract value from IoT innovative services on the technologies in WAZIUP and FIWARE projects and with the strategy of exploring and sharing IoT Technologies' practices through regional IoT ecosystems made up of innovation communities and stakeholders.

It is estimated that in 2020 there will be more devices connected to the internet than people and the WAZIHUB ecosystem will cover several entities such tech hubs, entrepreneurs and start-ups, financial institutions, industry and SMEs, end users, research communities, policy makers and agencies. Will also support those interested in connecting intelligent and embedded systems being a value proposition, as shown in Figure 33, with technology support, accelerator programs, and sustainability.

- Technology Support - Increase the capacity for Hubs, entrepreneurs and start-ups for rapid prototyping, testing and validation of users. The tech Hubs will obtain development kits for fast development of applications on the WAZIUP platform and will also receive the technical training from the core technical partners and training on how to use the smart village reference infrastructure for testing applications.
- Accelerator - Accelerator programs for technical and business capacity building through training, seminars and workshops. The project will develop accelerator program model that will be run by other Hubs (as well those are not part of the consortium).
- Sustainability - The roles of Hub are also to develop a sustainable business model and local IoT ecosystem development. Will create a database of stakeholders and maintain communication and relationship between them. WAZIUP will offer the detailed support to those companies to adapt IoT Big Data open-source platform for the next general IoT high-tech SMEs in Africa.

Experience with IoT in Africa: This presentation was carried out by Dr. Mamour DIOP, a researcher at UPPA that presented the Experience with IoT in Africa where regard that there are many opportunities to develop and implement several IoT application in Africa.

The WAZIUP project is an EU-African cooperation action that purposes to accelerate innovation in Africa through edge IoT cost-effective communication and big data technologies. Address the IoT requirements and demand of the developing countries and to tailor the IoT and Big-Data platform in the context of Africa in order to offer value-added services. The consortium covers 12 partners that coming from four African countries (Burkina Faso, Togo, Senegal and Ghana) and from European countries (Portugal, France, Germany and Italy). Offer a low-cost, low-power and long-range platform to several generic sensor IoT devices and permit transfers of technologies to user communities and stakeholders.

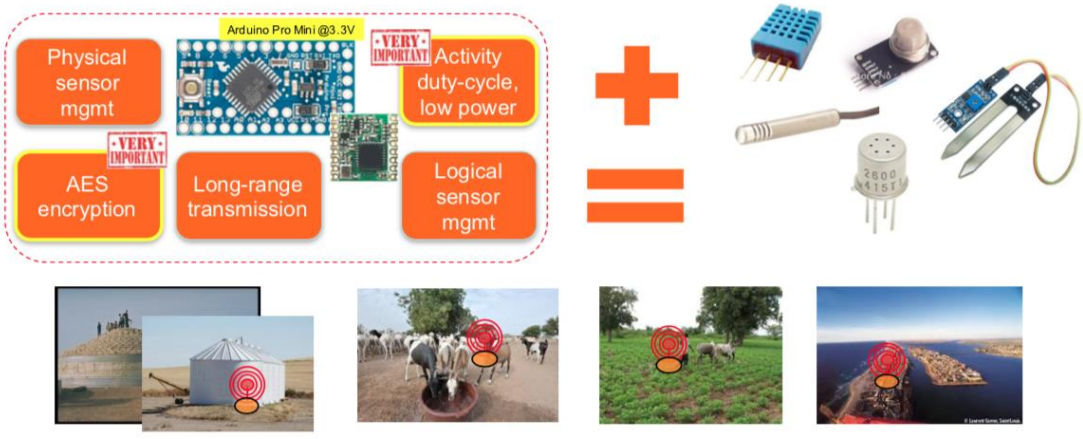


Figure 34: WAZIUP Generic sensor IoT device

Some IoT solutions have already been implemented in several domains such as:

- Low-Cost Collar - Cattle rustling: In Africa, the cattle rustling in the animal farming is the farmers main problem. In CIMEL farm of Senegal, the Low-Cost Collar send the animal location into the gateway and a web interface shows the position of the gateway those of the remote GPS devices.

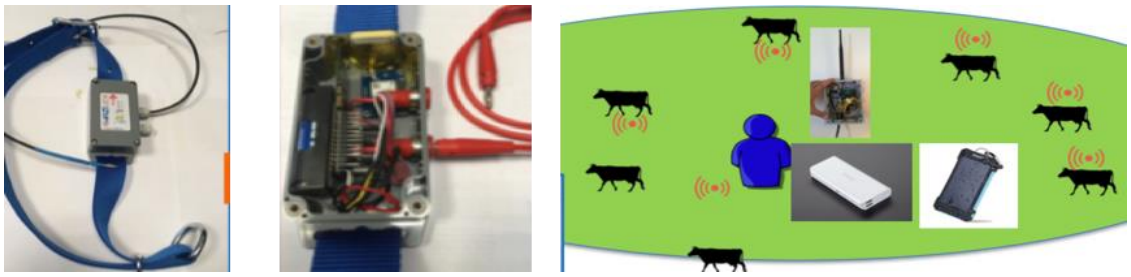


Figure 35: WAZIUP Low-Cost Collar

- Low-Cost Buoy – Fish Farming: The volume of natural captured fish does not meet the population's request and increasing the production of aquaculture help to reduce the amount of imported fishes in Africa. The Low-Cost Buoy allows to monitor in real-time different parameters in order to control water quality and prevent some fish's diseases. The Low-Cost Buoy is being used at the Kumah Farm in Ghana, at Sanar Farm in Senegal and in a hatchery experiment at the LERNSE laboratory in Burkina Faso.

Figure 36: WAZIUP Low-Cost Buoy (deployment in Senegal)

- Soil Humidity Sensor - Agriculture: The WAZIUP Soil Humidity sensor monitor the soil moisture and other parameters to deliver useful recommendations and notifications to farmers and is being used on the UBG Farm in Senegal, on Nasso site in Burkina Faso and on urban gardens in Togo.

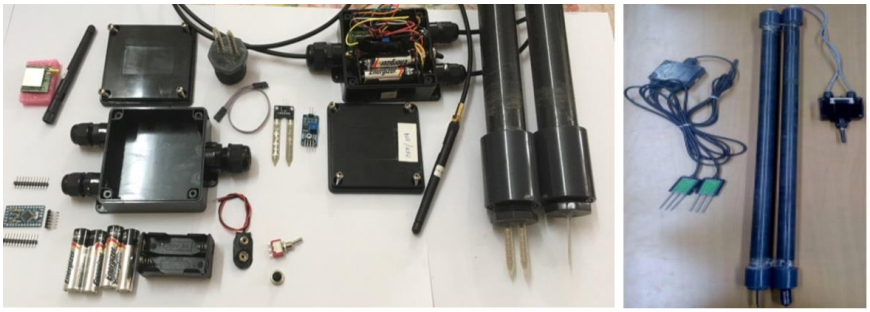


Figure 37: WAZIUP Soil Humidity sensor

- Local Weather Station - Agriculture: In agriculture several factors need to be monitored and capabilities to control them is the main key to increase the productivity.

  The WAZIUP Weather Station have pilot sites in Senegal, Togo, Ghana and Burkina Faso where acquire and produce weather information that is used to advise local farmers. Get the

local weather measurements and also combine them with the open weather data to get more accurate predictions.

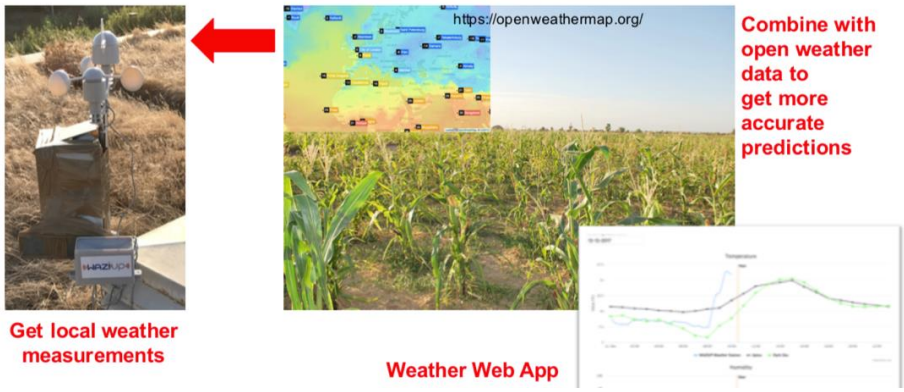


Figure 38: WAZIUP Weather Station

The following figures provides an overview of this session.

Figure 39:Session photos

4.2. EU – ASIA Collaborations on IoT Sustainable Development

This meeting was moderated by the senior researcher of Unparallel and Uninova, Pedro Malo and by Philippe Cousin of Easy Global Market (EGM) and included four relevant presentations performed by the participants.

Table 7 shows the names and roles/institutions of all the participants who joined in the "Eu – ASIA Collaborations on IoT Sustainable Development" session which took place on June 6, during the IoT Week 2018 held at the Euskalduna Jauregia Conference Center.

Table 7: List of participants in the event

Participant	Role/Institution
Philippe Cousin	Founder of Easy Global Market
Congduc Pham	Professor of Computer Science at Pau University
SeungMyeong Jeong	Senior Research at Korea Electronic Technology Institute (KETI)
Webin Li	Researcher at Easy Global Market

WISE-IoT, EU-KR Collaboration: This presentation was carried out by SeungMyeong Jeong, a Senior Research at Korea Electronic Technology Institute (KETI), who presented the WISE-IoT project, an EU-KR collaboration, and some relevant points of view why horizontalizations is urgently required. Horizontalizations are essentials to build a global IoT mobility for:

- highly fragmented market with small vendor-specific applications;
- same services are developed again and again;
- each contains its own technologies without interoperability;
- end-to-end platform:
- a layer with mutual service capabilities;
- interoperability at the level of communications and data;
- perfect interaction between devices and applications.

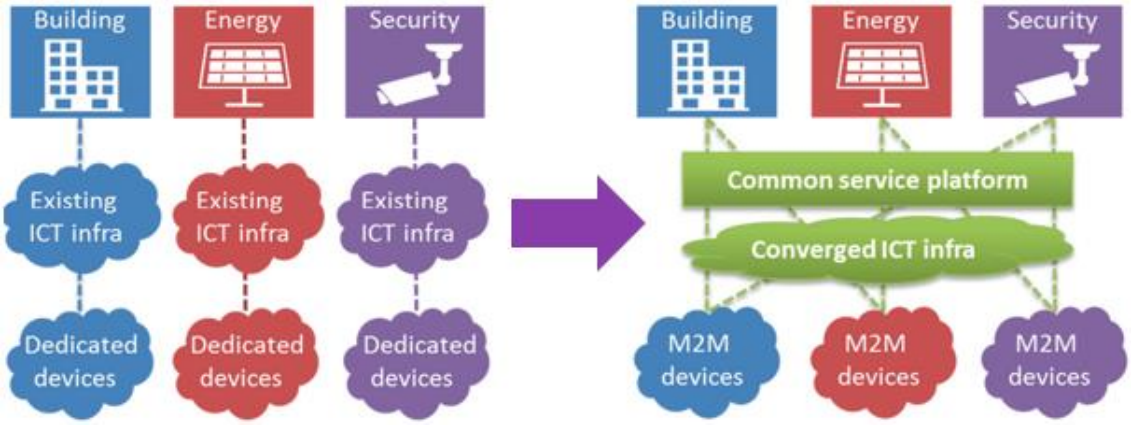


Figure 40: Building Global IoT

Concerning the challenges and goals are included security interoperability and privacy consciousness in order to allow openness and scalability:

- Application and service portability in difficult situations: Replicate services across the test sites and re-use enablers across ecosystems;
- Semantic interoperability and Smart objects: Include edge intelligence, reach semantic interoperability and establish added value;
- Standards Interoperability & Interworking: Multiple test sites and protocols, research integration methods and cross-testbed situations;
- Common IoT reference architecture: Integration of IoT systems and contribution of standards.

The WISE-IoT approach to solve the fragmentation of IoT technologies and deployments problem is using layered view that match technologies, as shown in Figure 41, and that is based on a semantic interworking between FIWARE and oneM2M where app and device developers may work on one stack.

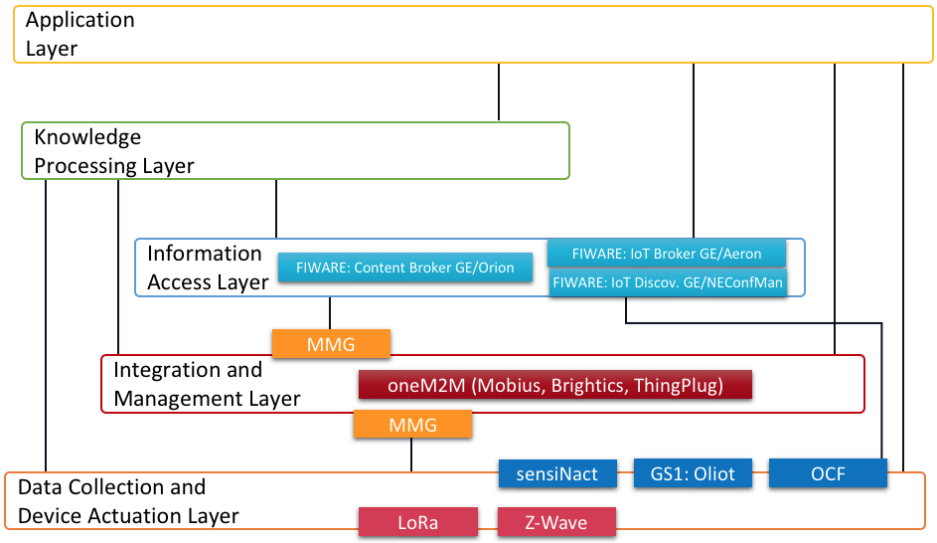


Figure 41:WISE-IoT layered view

Some WISE-IoT applications solutions cover several domains such as smart parking, bus information system and smart resort management:

- Smart Parking Application (EU Approach): Improve user parking experience cities by delivering information about parking spots, areas and routes based on recommendations.

Figure 42: Smart Parking Application (EU Approach)

- Smart Parking Application (KR Approach): Improve user and manager parking experience in cities by offering information and services related to parking spots, areas and routes on geolocation.

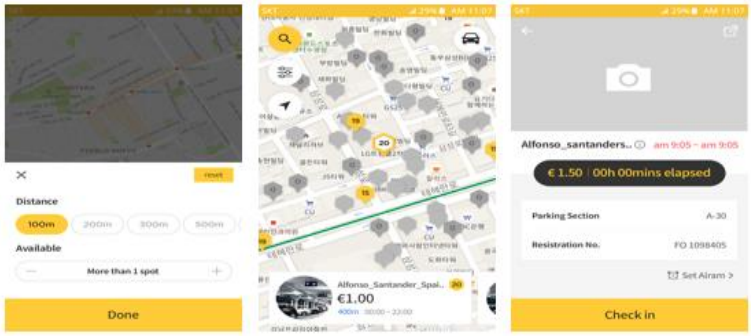


Figure 43: Smart Parking Application (KR Approach)

- Bus Information System (KR & EU Approach): Collect and present real-time bus information to interested parties. Increase user experiences while use and manage bus and deals with missing transparency and situation awareness.

Figure 44: Bus Information System (KR & EU Approach)

- Smart Skiing (EU Use Case): Provides IoT services to both skier and ski resort managers to improve users' experiences and increases the efficiency of the actions taken by the resort managers.

Figure 45: Smart Skiing (EU Use Case)

- Smart Resort management (KR Approach): Provides operational information to the resort managers with visualization of location and status data of not only rescue teams, children, seniors and disabled visitors, but also valued belonging of visitors, vehicles and even equipment which belong to the resort.

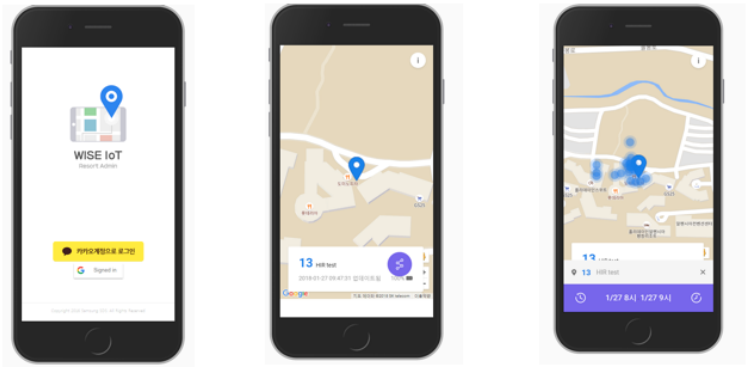


Figure 46: Smart Resort management (KR Approach)

- Fitness Use Case: It analyses the daily healthcare of the smart city of Daegu to access the feasibility of using fitness related use cases in both EU and KR. Develops WISE-IoT devices, services and applications related to good form and introduces users in both the EU and KR.

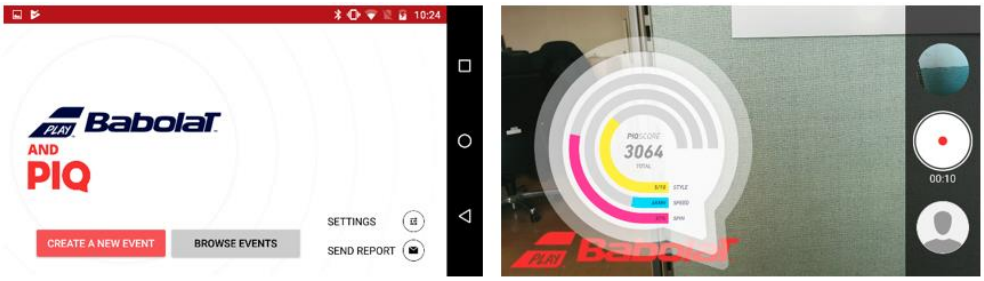


Figure 47: Fitness Use Case

EU-China IoT Cooperation – Moving on from WhitePaper 2016: This presentation was carried out by Philippe Cousin, Founder of Easy Global Market (EGM), who presented the "EU-China IoT Cooperation – Moving on from WhitePaper 2016" and why IoT is so important.

The development of IoT in China covers several domains such the Industrial Internet-Of-Things (IIoT), smart farming, smart grid and applications to handle with the urban management of smart cities, transportation, security and health. The importance policies for IoT in EU cover the monitoring of innovation performance, development of policies to foster the broad commercialization of innovation and development and coordination of policies to accelerate the uptake of innovative manufacturing technologies. There are mutual challenges regarding IoT between EU and China such business models and new methods of cooperation, interoperability, technical environment, trust and societal environment.

The development of IoT in the future intends to regard a hyper-connected society; E-health and smart living; smart farming and safety of food; massive and secure IoT deployments enable by 5G; fusion of IoT, big data, cloud computing and generic connectivity; benefit from other technology fields; industrial IoT; focused zones in smart cities. The proposal for the EU-China cooperation will follow an approach to handle with policy level cooperation, technical cooperation, standardisation and market cooperation.

FED4IOT: 2018-2020 EU-JP: This presentation was carried out by Webin Li, a Researcher at Easy Global Market (EGM) who presented the FED4IOT: 2018-2020 EU-JP. The Fed4IoT is federating IoT and cloud infrastructures to provide interoperable and scalable smart cities applications thought the introduction of new IoT virtualization technologies. The FED4IOT have pertinent visions, as shown in Table 8, in order to handle with some problems in terms of interoperability and expenditure.

Table 8: FED4IoT Visions

	Problems	FED4IoT Vision
Interoperability	• IoT systems are vertical-oriented and/or closed; • Cloud Infrastructure are vendor-controlled and limited to third parties; • IoT devices have proprietary protocols.	• Integration and improvement of mature interoperability solutions for smart city applications, not to propose another interoperability standard.
Expenditure	• Smart Cities: large number of infrastructures and sensors; • Silo model and IoT systems: low reusability and accessibility.	• Exploration of sharing concepts in the IoT arena to enable small stakeholders and SMEs to enter the market of smart city applications.

The FED4IoT extended IoT chain, shown in Figure 48, will allow to achieve some technical objectives such the development of an IoT platform offering services, IoT device virtualization and multi-tenancy, the smart city information sharing, evolutionary design and test in device, platform and information level and the demonstration of FED4IoT on EU/JP smart city pilots.

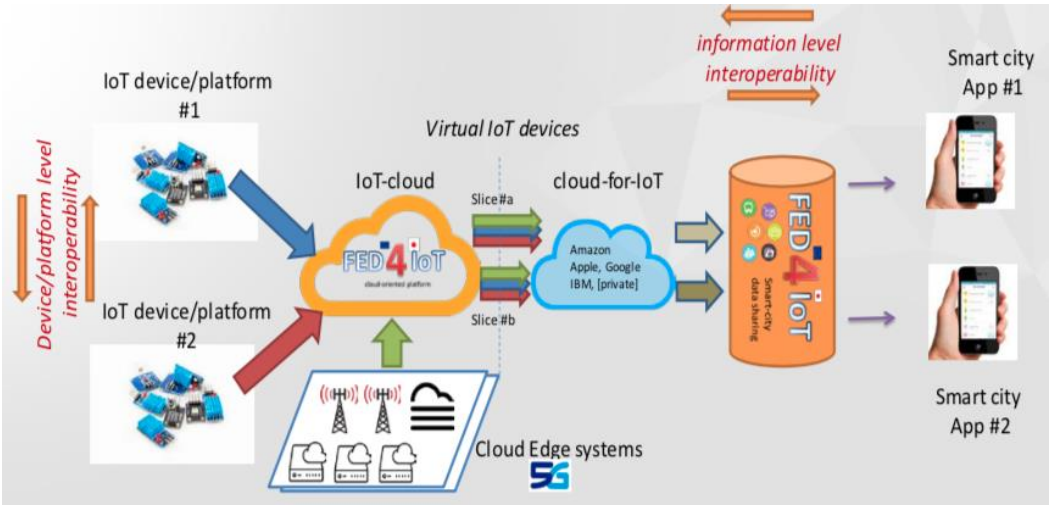


Figure 48: FED4IoT extended IoT Chain

The goals of FED4IoT are: Reliable demonstrations based on cross border business and/or societal applications of robust interoperable technologies; facilitation of the development of cloud-enabled, secure and trustworthy IoT Big Data applications; joint contributions to standardization activities under the cooperation of EU-Japan; specific implementations of interoperable solutions to integrate IoT, cloud and Big Data security and promotion of the use of data related to smart cities.

EU-South East Asia Collaborations: This presentation was carried out by Congduc Pham, Professor of Computer Science at Pau University that presented a vision of the EU and South East Asia collaborations.

According with this presentation the collaborations between EU and SEA (ASEAN) have long history. SEA is a region that is growing fast in terms of IoT, but many countries are still considered as low and middle-income countries. IoT in SEA is gaining incredible interest for a vast variety of applications. Singapore, Then Thailand and Malaysia should be considered separately from other SEA countries.

Figure 49: IoT in SEA

Some of SEA ICT/IoT Initiatives are:

- Malaysia - Malaysia is exploring the use of IoT technologies for agriculture in the ASEAN region through collaboration between government and the private sector. The Malaysia

Institute of Microelectronic Systems (MIMOS) has created some solutions that cater to agricultural development (e.g. a sensor called MIMSCAN TpH to acquire environmental data).

- Indonesia - Indonesia intends to increase the agricultural production through the use of innovative technologies. In order to meet the growing demand, they must introduce modern agricultural tools and technologies to farmers.
- Philippines - The City of Bacolod in the Western Visayas, Philippines has a Flood Monitoring system within the SMILES (Smart Management of Information for Local Ecosystem Support) system. SMILES is a traffic and water monitoring system within a range of 20-kilometre radius covering the city of Bacolod.
- Vietnam - The Saigon Hi-Tech Park Incubation Center (SHTP-IC) launched the 2016 Internet of Things Start-up Competition (IoT Start-up 2016) with the theme "Developing Smart Cities and Improving Quality of Life". This competition would be prepared every year in order to acquire new ideas for the development of a better-quality life in Ho Chi Minh City. The National Foundation for Science & Technology Development (Nafosted) is funding a project on "Context-aware multi-tier architecture for the Internet of Things" (2017-2019) with HCMUT.
- Cambodia – The SOMA Group has developed a foresight in constructing a new town that will take up approximately 60 hectares, closed of Phnom Penh, in order to aid economic development, boost performance and convenience, attain better cost efficiency, optimize resource consumption, actively connect with citizens, and in turn, advance Cambodia to the digital age.
- Thailand - ICT Ministry Minister Uttama Savanayana confirmed that the Information and Communication Technology Ministry is eyeing Phuket and Chiang Mai as smart cities that focus on tech start-ups as part of a move to turn Thailand into the digital hub of ASEAN. Under the policy the ministry planned to roll out pilot projects to drive the country forward, with the "smart city" plan one of them.
- Myanmar - Low-cost sensors and more accurate data can transform farming in Myanmar. IDEO.org went to work in Myanmar to explore new agricultural applications for low-cost sensor where they teamed up with Yangon-based Proximity De-signs to build new products that help smallholder farmers better understand their crops.

The following Figure 50 provide an overview of this session.

Figure 50: Session photos

The development of IoT in SEA can be also sustainable in long term thought some networks such the FabLab network and the Southeast Asia Makerspace Network (SEAMNET) that is a network

of makerspaces within ASEAN, working together towards a mutual mission to promote and develop the maker movement.

4.3. EU – Brazil Collaboration on IoT Sustainable Development

This meeting was carried out by the Brazilian IoT Forum President, Gabriel Antonio Marão and the Senior Researcher of Unparallel and Uninova Pedro Malo and where significant presentations were presented by the participants.

Table 9 presents the list with the names and roles/institutions of all the participants who joined in the "EU – Brazil Collaboration on IoT Sustainable Development" session which took place on June 6, during the IoT Week 2018 held at the Euskalduna Jauregia Conference Center.

Table 9: List of participants in the event

Participant	Role/Institution
Emilio Tissato Nakamura	Information Security Leader of CPqD
Samuel Moniz	Researcher and Project Manager of INESC TEC
Guilherme Corrêa	Ministry of Science, Technology, Innovation and Communications of MCTIC: Infrastructure Analyst
Carlos Kamienski	Professor ate Federal University of ABC (UFABC, Brazil)

OCARIoT – Smart childhood Obesity CARing solution using IoT potential: This presentation was carried out by Emilio Tissato Nakamura, Information Security Leader of CPqD that presented the OCARIoT pilot project.

The OCARIoT project is an EU-Brazil collaboration which purposes to encourage the improvement of eating and physical disorders as well as preventing the onset of childhood obesity (between 9 and 12 years old), which is one of the major problems in more than 224 million children in in the world, more than one in three in Brazil, Spain and Greece. OCARIoT will develop a customized IoT-based coaching solution in order to guides children to adopt physical activity and healthy eating behaviours.

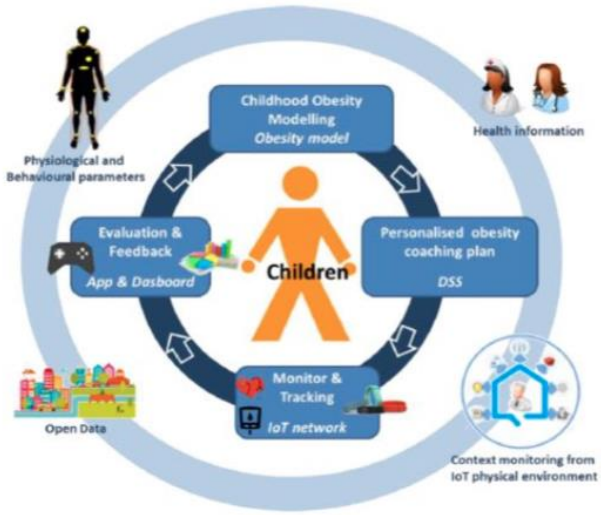


Figure 51: Macro view from OCARIoT project

The OCARIoT network will permit to control the activity patterns of the children's life, health evolution, physiological and behaviour. All this information merged with medical standards will permit OCARIoT to deliver a customized obesity training plan, allowing children to remain active and engaged in their well-being and healthy lifestyle management.

The Project had started in November 2017 and will finish in October 2020, will demonstrate and validate its results in three specific pilot sites in Spain, Greece and Brazil and have the challenge of being the first RIA consortium involvement for some Brazilian partners that will bring as benefits experience, networking and internationalisation. In terms of opportunities this collaboration may allow the emergence of new projects with BR and EU partners in the near future in order to leads to a potential evolution towards a mutual IoT framework in combination with other pilot projects.

SWAMP – Smart Water Management Platform, IoT Pilot Project: This presentation was carried out by Carlos Kamienski that is a Professor at Federal University of ABC at Brazil, who presented the SWAMP project.

The SWAMP project develops IoT based methodologies for smart water management of a precision irrigation domain, pilots them in Italy, Spain, and Brazil and that will involve different stakeholders such farmer, vendors of IoT solutions, irrigation water distributors, government policy makers and developers of IoT-based system for agriculture.

The project can also offer market and research advanced innovations. In terms of market can offer means to decrease of inefficiencies and increase in productivity, new technologies for irrigation and new business models for smart water management. Respectively to research, allows the development of smart algorithms for irrigation, integration of various technologies in a single adaptable platform and exploration of new opportunities in irrigation management.

- Italy Pilot - Emilia-Romagna (CBEC): Is an open canal-based water distribution system at Po river in Reggio Emilia with different crops and irrigation systems. The goals in this pilot are to optimize the irrigation by a supervision of the water balance at fields, reduction of water waste and energy used in pumps through innovative management practices and improve water distribution to increase usage of water passing along the canals.

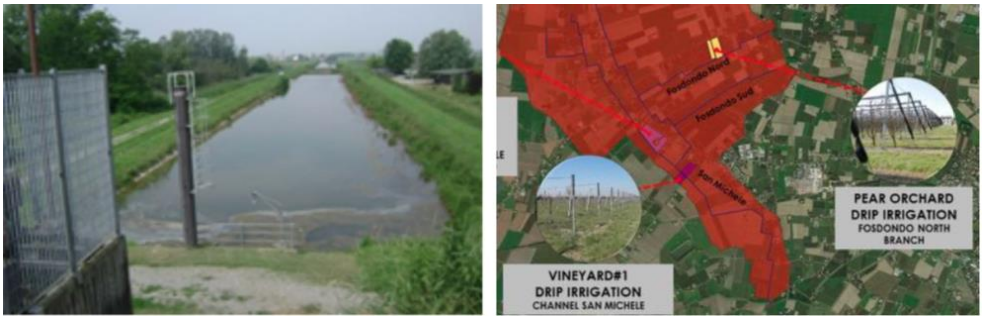


Figure 52: SWAMP Emilia-Romagna pilot

- Spain Pilot - Cartagena (Intercrop): Is a farm in southern Spain that harvests lettuce, endive, spinach, herbs and baby leaves but has an area of water lack with very limited water resources. The objectives of SWAMP in this pilot are to decrease the use of water in irrigation and to increase the yield through water monitoring plants and water balance.

Figure 53: SWAMP Cartagena pilot

- Brazil Pilot - Matopiba: This pilot has an area within four Brazilian states (Maranhão, Tocantins, Piauí, Bahia) with an irrigated agricultural that produces soybean, corn, cotton production using variable rate irrigation with central pivots. The goals are to decrease energy consumption and production highly affected by drought and the expansion depends on technologies that give progress to operating costs and sustainability.

Figure 54: SWAMP Matopiba pilot

- Brazil Pilot - Guaspari: The Guaspari Winery is a area in the municipality of Espírito Santo do Pinhal (in the state of São Paulo). The goals for this pilot are to increase the quality of grapes and wine and perform automatic measures of soil water content at different soil depths and in several vineyards, to offer quick and accurate irrigation management information.

Figure 55: SWAMP Guaspari pilot

FASTEN – Flexible and Autonomous Manufacturing Systems for Custom-Design Products: This presentation was carried out by the Researcher and Project Manager of INESC TEC Samuel Moniz, who presented the FASTEN project (Flexible and Autonomous Manufacturing Systems for Custom-Design Products).

The FASTEN project intentions is to develop, demonstrate, validate and integrated a modular structure to produce customized products with efficiency. More specifically, FASTEN will demonstrate an open and standard structure in order to produce and deliver tailor-made products capable of operating autonomously and delivering low-cost additive manufactured products.

An additive manufacturing supply chain in Brazil is being addressed with the challenge of setting up large scale maintenance services based on 3D printing technology and perform automatic picking and place. The main focus is to increase the manufacture flexibility to provide spare parts, improve the service response capability, reshape of parts and components, reduce the inventory and operational costs, improve the piece retrieval and kit preparation tasks and provide faster and reliable supply of components to a production line.

The FASTEN project can expand a foster digital manufacturing sustainability and be an enabler to IoT technologies developed between EU and Brazil that purposes to: Integrate robotics, AM and IoT and technologies; standardize data repository and decision-making integration, from end-users services to the manufacturing and supply levels; improve and synchronize coordination in real-time of the production and logistics operations; validate the FASTEN Framework in two

cross-sectorial industrial pilot cases; increase the overall supply-chain performance and decision-making effectiveness. The main results of FASTEN project that are:

- A flexible and scalable robotic system that provides technical support services through reducing the delivery time;
- An open IIoT Platform for designed and custom products (Figure 56);
- A holistic simulator-optimizer tool to model the behaviour of the manufacturing system;
- A predictive and prescriptive analytic tool.

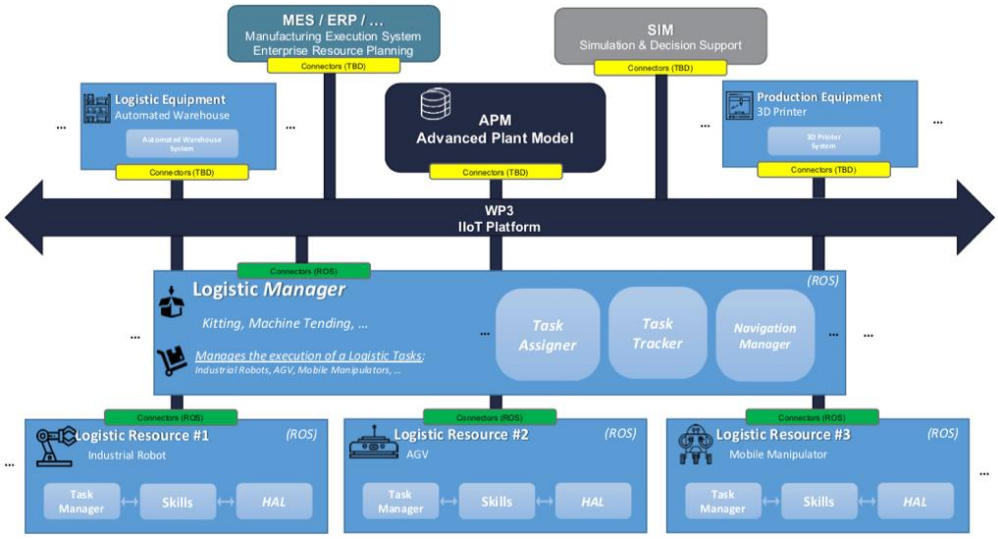


Figure 56: Open Industrial IoT Platform for custom-designed products

IoT.BR (Brazilian National Plan for Internet of Things): This presentation was carried out by the Ministry of Science, Technology, Innovation and Communications (MCTIC) Guilherme Corrêa that presented relevant aspects of the Brazilian National Plan for the IoT.

According with this presentation Brazil is an important and emerging power being the 7th biggest GDP in the world and the 1st in the raking that export sugar, coffee, oranges and beef. In technological aspects is the 1st country with more social network users in Latin America, the 4th country with the highest number of M2M connections and where approximately 60% of the population uses the internet. This vision permits to conclude that the IoT has greats opportunities in Brazil.

Figure 57: The four prioritized domains of IoT.BR plan

The IoT.BR is a five-year robust and innovative study that established an extensive IoT ecosystem with participation several stakeholders such specialists from MCTIC/BNDES, boards, companies and other agents. This is the first and concrete action that will launched as a digital book and that will be a practical guide that cover governance, innovation, platforms, the digital transformation observatory and a manual for smart cities. Offers recommendations for the horizontal problems of the four prioritized domains shown in Figure 57 (Smart Cities, Health Care, Rural and Industry) and will bring several benefits such human capital, innovation and international inclusion, regulatory, safety, privacy, connectivity and interoperability infrastructure. The aspirations and strategies of the IoT-BR plan for these four domains are:

- Smart Cities - Improve the quality of life in cities through technologies and means that allow an integrated management of services to citizens, improve mobility, public safety and the use of resources. The strategies of IoT.BR plan for Smart Cities are present in Table 10 below.

Table 10: Strategies of IoT.BR plan for Smart Cities

Mobility	Decrease travel time and increase the attractiveness of public transport
Innovation	Promote the adoption of solutions developed locally for environment challenges
Efficient use of resources	Create a public lighting network that allows IoT solutions and reduce waste of public services and
Public safety	Increase surveillance and monitoring of areas of the city to reduce situations of security risk

- Health Care - Contribute to increase the access to quality and decentralized health care, integrating patient information and improving the efficiency of health facilities. The strategies of IoT.BR plan for Health Care are shown in Table 11.

Table 11: Strategies of IoT.BR plan for Health Care

Promotion and Prevention	Uses IoT solutions to avoid risk situations and control the emergence of infectious epidemics/infectious diseases
Innovation	Adopt locally developed solutions to the challenges of the environment
Management Efficiency	Uses IoT solutions to increase the efficiency of hospitals and basic health units
Chronic diseases	Improve the effectiveness of treatments in people with chronic diseases through continuous monitoring

- Rural - Increase the Brazilians productivity in worldwide trade of agribusiness products, with high quality and sustainability. The strategies of IoT.BR plan for Rural are included in the following Table 12.

Table 12: Strategies of IoT.BR plan for Rural

Sanitary Safety	Increase information volume and accuracy to monitor biological assets
Innovation	Encourage the adoption of solutions developed locally for environment challenges
Efficient use of Machinery	Optimize use of equipment's in the rural environment by using IoT solutions
Efficient use of natural resources	Increase the productivity and quality of rural production in Brazil using data

- Industry - Increase the productivity of local industry through more flexibles and efficient processes, integration of production chains and design of products and business models with higher added value. The strategies of IoT.BR plan for the Industry are shown in Table 13.

Table 13: Strategies of IoT.BR plan for Industry

Inventory and supply chain	Promote the integration and cooperation in supplier chains of goods, components, services and inputs.
Innovation	Encourage the adoption of solutions developed locally for environment challenges
Capital goods	Encourage the development of new products and business models that incorporate IoT solutions
Resources and processes	Use IoT solutions to manage operations to increase the efficiency and flexibility of industrial processes

The following Figures below allow an overview of this session.

Figure 58: Session photos

5. INTERNATIONAL COLLABORATION ON STANDARDISATION

5.1. Introduction

A significant activity has taken place in 2018 with respect to technical standardisation. The role of CREATE-IoT, largely relying on the work of the LSP Activity Group 02 (AG02 – Standardisation, Architecture and Interoperability), is to ensure that the LSPs activities regarding technical standardisation are coordinated and have the greatest impact possible at European and international level.

All the LSPs have developed a standardisation strategy that is most often materialised in contributions to global or regional Standardisation Organisations pertaining to their domains of activity and to their architectural and technical choices. CREATE-IoT brings support to the LSP's efforts by consolidating and leveraging them into an Interoperability Framework that provides a global, coherent and consolidated view of the LSP choice in terms of Reference Architectures, Platforms and supporting standards.

A major objective of the Interoperability Framework is to ensure that its applicability (and the lessons learned) go beyond the ecosystem of the LSPs towards the IoT community at-large, in particular the global IoT standardisation community. This is made possible by the organisation of an open collaboration effort.

5.2. The Activity Group 02 and the Interoperability Framework

The Activity Group 02 (AG02) is essentially dealing with on the identification of major technical approaches and commonalities regarding: the identification of the most relevant Use Cases for the LSPs; the identification of commonalities in reference architecture models; the clarification of the LSPs interoperability frameworks; the landscaping of standards; the dissemination of reference implementation(s) of promising IoT standards, serving interoperability and openness.

The progress of the work is structured by of a series of technical workshops that have been organised through 2018. Four of these open workshops have taken place:

- Workshop #1 on 10/01/18 in Brussels;
- Workshop #2 on 26/04/18 in Brussels;
- Workshop #3 on 06/06/18 in Bilbao (during IoT Week);
- Workshop #4 on 18/10/18 in Brussels.

They have gathered experts coming from the LSP community, as well as from the standardisation community.

On the standardization front, the main inputs from CREATE-IoT have been channelled into the ITU-T Focus Group on Data Processing and Management to support IoT and Smart Cities and Communities. This Focus Group is an open platform for discussions on the topic of data management within the smart city domain. It serves as the pre-standardization platform for this topic. The approved deliverables of this Focus Group will be fed into the main technical group on IoT, the ITU-T Study Group 20 on IoT and Smart Cities and Communities for approval as international standards. The inputs from CREATE-IoT have been included in the Technical Report on Privacy Management in Smart Cities, which co-authored by MI, AS who are CREATE-IoT partners.

MI is also leading the follow-up of the IoT Declaration 2017, together with ITU for the upcoming IoT Week 2019. This follow-up to the Declaration will focus on the use of new and emerging technologies in the IoT and AI realm for the SDGs.

5.3. A Reference Architecture for LSPs

The most recent AG02 workshop (#4) has been an opportunity to present the progress of work of AG02 on the "LSP Interoperability Framework".

The LSP Interoperability Framework, based on the work developed in the LSPs and the consolidation done in AG02, is dealing with Reference Architectures, Interoperability Points and Mechanisms, Platforms and technologies and Standards and pre-normative activities. The focus of the presentation was the proposal of a common three-dimensional Reference Architecture model with Layers; Cross-cutting functions and Properties, as shown in Figure 59.

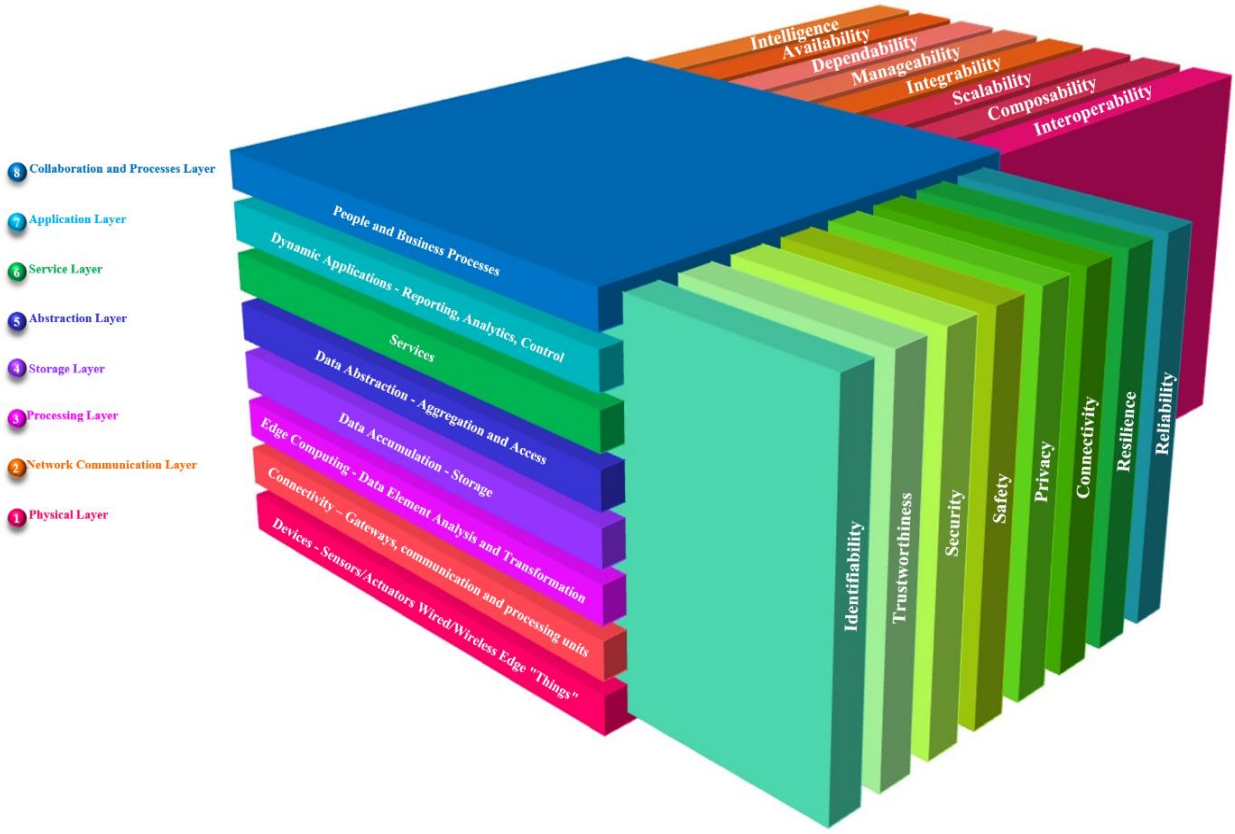


Figure 59: Three-dimensional reference architecture

The proposed Reference Architecture Model will be further consolidated and disseminated in 2019 by a series of workshops, involving in particular the global standardisation community (e.g., ISO/IEC JTC1/SC41).

5.4. SDO Collaboration

The LSPs and CREATE-IoT have a number of contributions to and other interactions with European, Global, Sectorial, National SDOs (Standards Developing Organisations) as well as collaboration with networks and ecosystems around developing standards.

The cooperation with the standardisation community is involving a number of significant actors:

- The AIOTI (Alliance for Internet of Things Innovation), in particular the AIOTI Work Group 03, is used as a channel of LSPs consolidated results towards the IoT community in many verticals as well as in the IoT standardisation community;
- Standards Developing Organisations such as ETSI (in particular towards the SmartM2M Technical Committee, the ETSI proxy to the oneM2M Partnership Project) or ISO/IEC (in particular towards ISO/IEC JTC1/SC41, the Study Committee in charge of "Internet of Things and related technologies" for which a specific section is dedicated below);

- Standards Setting Organisations such as W3C with contributions to the "Web of Things" Working Group. The Web of Things exposes sensors and actuators as digital twins with RDF identifiers (URIs) as the basis for describing the kinds of things, and how they can be accessed by applications as software objects with properties, actions and events, independently of the underlying IoT technologies. The Web of Things Working Group is developing standards for using JSON-LD for describing things, including communications metadata for common IoT frameworks.
- ITU is the oldest international organization and part of the UN System. It serves as international SDO. Several Create-IoT partners (MI and AS) are extensively involved in ITU-T Standardization activities, and more specifically in ITU-T SG20 on IoT and Smart Cities and Communities and in the Focus Group on Data Processing and Management to support IoT and Smart Cities and Communities. Several contributions have been submitted to ITU by Create-IoT partners, including a Draft Recommendation on Open API in Smart Cities on behalf of SYNCHRONICITY, and a Draft Technical Report on Privacy Management in Smart Cities on behalf of CREATE-IoT. These documents are supported to become international references and standards.

The following points regarding this international collaboration may be highlighted:

- The LSPs are very actively using (validating) and contributing to standards development; and they are consequently playing a crucial role in linking innovation and standardisation;
- The LSPs are seen as active contributors to and drivers of sectoral standards development;
- Joint outputs can strengthen the overall internal and external visibility of the standardisation contributions and added value by the LSPs.

5.5. Liaison with ISO/IEC and ITU-T

CREATE-IoT was involved in liaison activities through Trialog with ISO/IEC JTC1/SC27 and ITU-T FG-DPM on security and privacy and ISO/IEC JTC1/41 related to the following meetings:

- ISO/IEC JTC1/SC27 meeting in Hamilton in April 2017 with an involvement in the following standardization projects: 27550 privacy engineering, 20547-4 Big data security and privacy, study period on smart cities, study period on IoTs. A report was produced (Report on Security - Privacy – Trust. Standardisation Liaison with ISO, Report 1 - May 2017) and circulated within the LSPs and AIOTI.
- ITU-T meetings in July, August and September 2017
  - FG-DPM meeting in Geneva on July 2017 with an involvement in two deliverables (D4.1 framework of security and privacy in DPM, and D4.2 privacy management in smart cities).
  - ITU-T SG17 meeting in Geneva in August 2017, focusing on security and privacy.
  - ITU-T SG20 meeting in Geneva in August 2017, focusing on IoT and smart cities.
    A standardization report was produced (Report on Security - Privacy – Trust. Standardisation Liaison with ITU, Report 1 – September 2017) and circulated within the LSPs and AIOTI.
- ISO/IEC JTC1/SC41 meeting in Berlin in May 2018, with a participation on 30141 IoT reference architecture, 21823-3 IoT semantic interoperability, and an ad hoc group on standards for ecosystems. A report was produced (Report on ISO/IEC JTC1/SC41 IoT meeting - May 2019) and circulated within the LSPs and AIOTI. It was recommended to create a liaison between AIOTI and ISO/IEC JTC1/SC41.
- ISO/IEC JTC1/SC41 meeting in Berlin in October 2017 and in Wuhan in April 2018, with an involvement in the following projects: 27101 Guidelines for cybersecurity frameworks, 27030 Guidance for IoT security and privacy, 27550 privacy engineering, 20547-4 big data security and privacy, 27045 big data security and privacy processes, study period trustworthiness assessment framework, 27570 privacy guidelines for smart cities. A report was produced (Report

on Security - Privacy – Trust. Standardisation Liaison with ITU, Report 3 – May 2018) and circulated within the LSPs and AIOTI.

5.6. Interoperability & Standardisation from an international viewpoint

As part of the work on WP6, CREATE-IoT engaged the different LSPs so to understand Platforms and Technologies being used within each project, as well as standards being used, so to understand their role in terms of interoperability and standardisation. With the information provided by them, CREATE-IoT analysed it and did an created a statistical representation of both (1) platforms & technologies and (2) standards from each global area. The information used for the analysis presented in the next sections are available in Appendix A and Appendix B.

5.6.1. ACTIVAGE

ACTIVAGE LSP is currently using a total of 7 platforms & technologies and 25 standards within the project. The next 2 graphics represent the geographical representation from both platforms and standards.

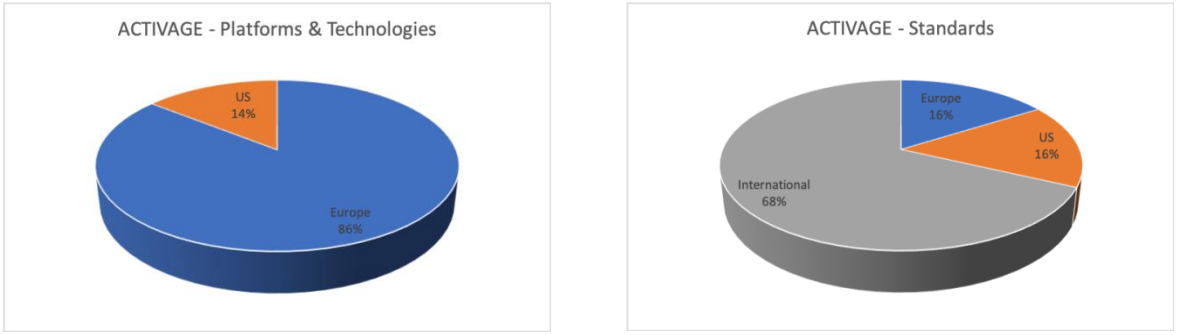


Figure 60: International scope of ACTIVAGE Platforms and Standards

5.6.2. AUTOPILOT

AUTOPILOT LSP is currently using a total of 10 platforms & technologies and 22 standards within the project. The next 2 graphics represent the geographical representation from both platforms and standards.

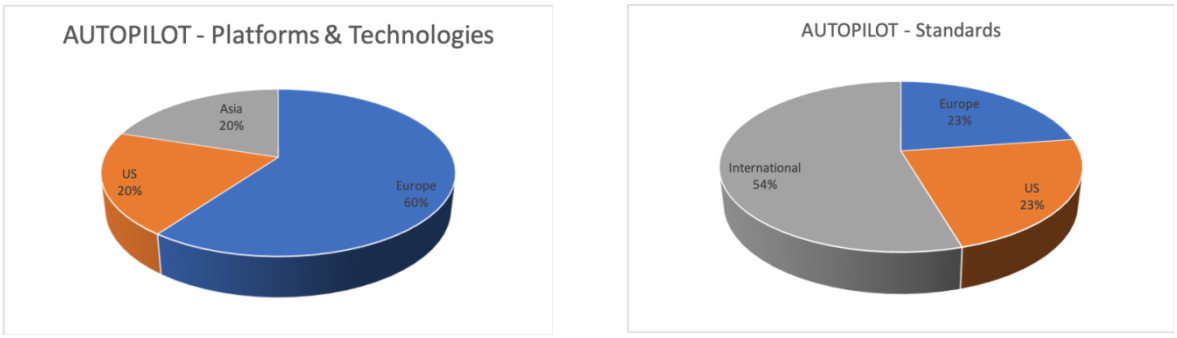


Figure 61: International scope of AUTOPILOT Platforms and Standards

5.6.3. IoF2020

IoF2020 LSP is currently using a total of 17 platforms & technologies and 38 standards within the project. The next 2 graphics represent the geographical representation from both platforms and standards.

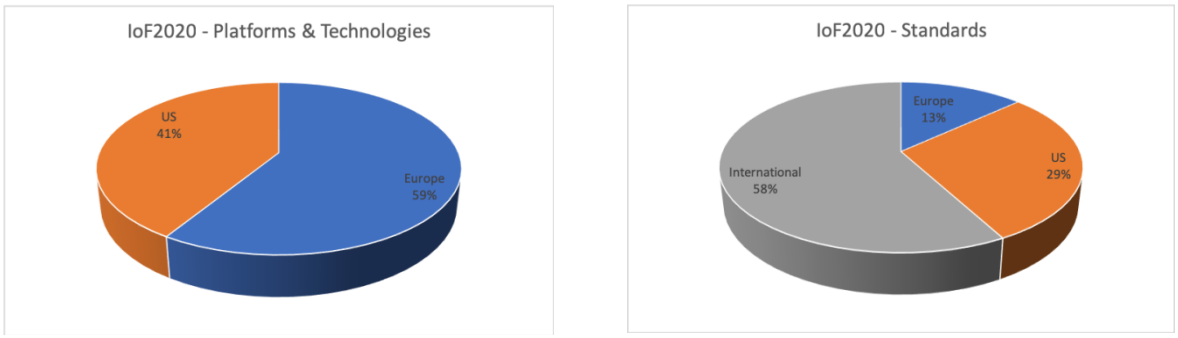


Figure 62: International scope of MONICA Platforms and Standards

5.6.4. MONICA

MONICA LSP is currently using a total of 8 platforms & technologies and 15 standards within the project. The next 2 graphics represent the geographical representation from both platforms and standards.

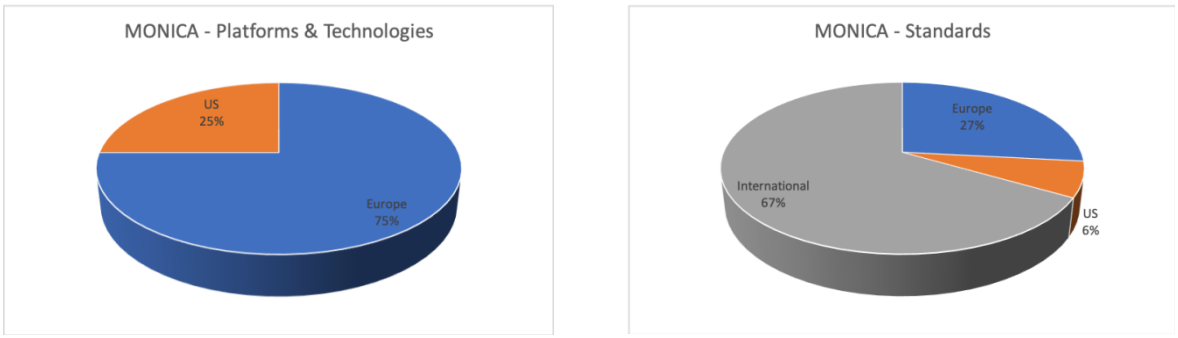


Figure 63: International scope of MONICA Platforms and Standards

5.6.5. SYNCHRONICITY

SYNCHRONICITY LSP is currently using a total of 9 platforms & technologies and 9 standards within the project. The next 2 graphics represent the geographical representation from both platforms and standards.

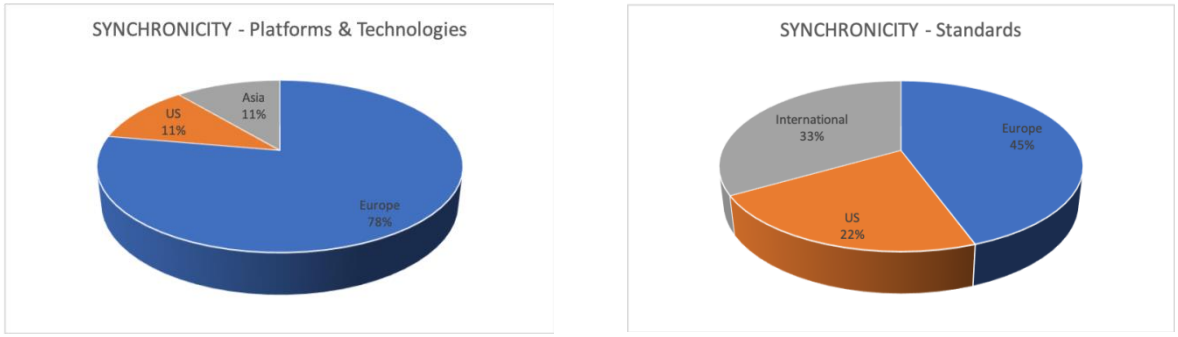


Figure 64: International scope of SYNCHRONICITY Platforms and Standards

6. MEETINGS

As part of the International Collaboration activities in CREATE-IoT, several meetings happened in order to discuss potential collaborations or synergies between international parties and the IoT-LSPs Initiative. Table 14 below shows these meetings that had the participation of several CREATE-IoT members.

Table 14: CREATE-IoT International Collaboration meetings

Event Name	Place	Date/Time
Bi-lateral concertation meeting	IoT Week 2017 - International Conference Centre of Geneva (CICG)	Wednesday, 7 June 2017– 17:00 to 18:30
Meeting with Brazilian IoT Forum - Fortaleza	UNIFOR, Fortaleza	Tuesday, 20 March 2018 – 17:00 to 18:00
Meeting with Brazilian IoT Forum - Bilbao	IoT Week 2018 - Euskalduna Jauregia Conference Centre	Wednesday, 6 June 2018 – 18:00 to 19:00
Meeting with ITU-Africa	IoT Week 2018 - Euskalduna Jauregia Conference Centre	Wednesday, 6 June 2018 – 17:00 to 18:00

6.1. Bi-lateral concertation meeting

This meeting made possible to discuss the importance and advantages about creating the EU-Brazil IoT Advisory Group. Some of the relevant objectives of this group were addressed in order to plan and strengthen this cooperation:

- Consider the opportunities and challenges arising from IoT through a mutual understanding between EU-Brazil and other important stakeholders;
- Develop IoT networks and technology architectures in terms of security, privacy, and interoperability through EU-Brazil collaborative proposals;
- Increases IoT opportunities in terms of information-sharing and interoperability through dissemination to the development and usage of open IoT platforms;
- Encourage strong liaisons in several projects, initiatives and stakeholders of the IoT ecosystem established between EU-Brazil;
- Recognize the pertinent IoT applications that contain specific backgrounds and mutual interests of the EU-Brazil cooperation;
- Facilitate mutual research initiatives and proposals on IoT as well as find research that is necessary;
- Develop contributions and support with strategic considerations about international IoT collaboration and governance.

Table 15 below shows the names and roles/institutions of all the participants who joined in the "Bi-lateral concertation meeting" which took place on June 7, during IoT Week 2017 held at the International Conference Center of Geneva (CICG).

Table 15: List of participants in the event

Participant	Role/Institution
José Gontijo	Director of the Department of Science, Technology and Digital Innovation at Ministry of Science, Technology, Innovation and Communications in Brazil
Gabriel Marão	President of the Brazilian IoT Competitiveness Forum
Srdjan Krco	Co-founder and CEO of DunavNET
Antonio Skarmeta	Professor of the Department of Information and Communication Engineering at the University of Murcia in Spain

Payam Barnaghi	Professor of the Department of Electrical and Electronic Engineering at the University of Surrey in UK
Pedro Maló	Chief Science Officer at Unparallel Innovation, Lda
Alberto Paradisi	Vice-President on Research and Development at CPqD
Ricardo Rivera	Head of the ICT Industries Department at BNDES
Marcello Zuffo	Professor of the Department of Electronics Systems Engineering at the Polytechnic School in University of São Paulo
Sergio Takeo Kofuji	Professor of the Polytechnic School in University of São Paulo

It was also discussed that the EU-Brazil IoT Consultative Group will work closely with the regular activities between Europe and Brazil in order to strengthen their collaboration and will carry out the following relevant actions:

- The EU-Brazil IoT Advisory Group will carry out technical advice and monitor the execution of the Brazilian IoT action plans;
- Will be responsible for supporting and managing the collaboration work between the IoT LSPs of the EU and the Brazilian IoT Pilots (including those of the EUB-02-2017 joint call);
- Will map all the Brazilian pilots on IoT projects that are leveraging the use of EU technologies (e.g. FIWARE) in the IoT LSP Initiative Portal;
- Encourage the BPI-IoT initiative (IoT-Brazilian Open Platforms) to conduct mutual cooperation with IoT-EPI in the development of open platforms.
- Develop and elaborate strategic and technical documents to encourage EU-Brazilian cooperation (e.g. an "EU-Brazil Joint White Paper on the Internet of Things").

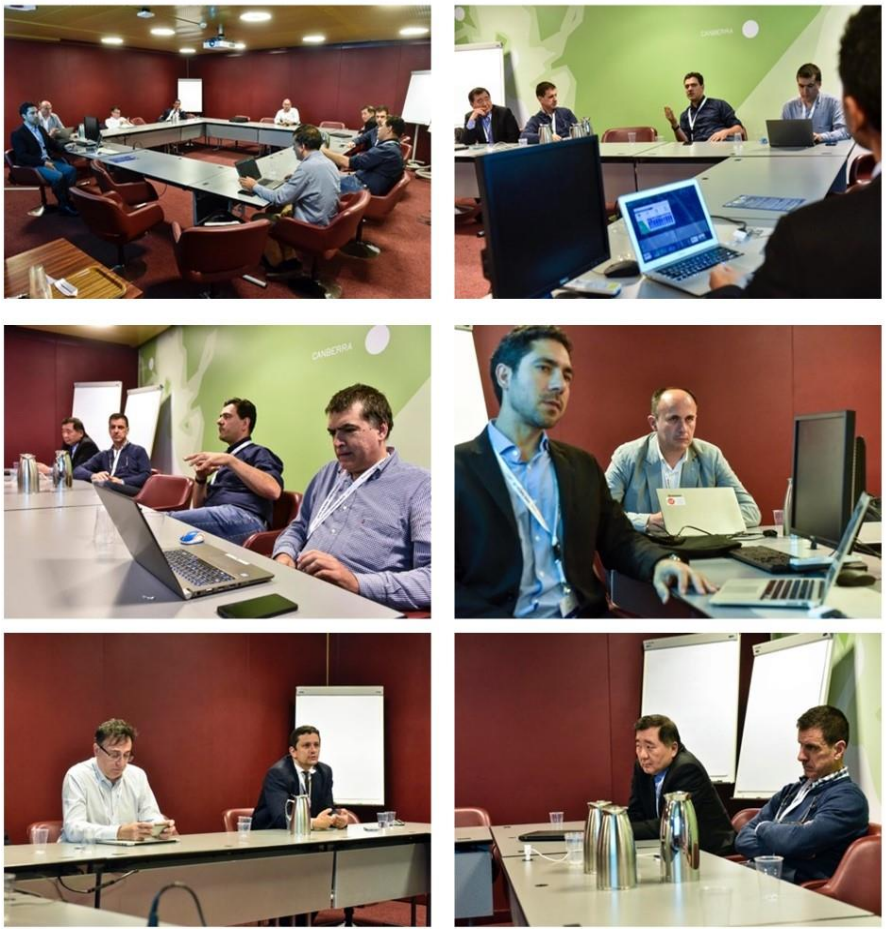


Figure 65: Bi-lateral concertation meeting (activity photos)

6.2. Meeting with Brazilian IoT experts- Fortaleza

This meeting, happened as a follow-up on the discussions during IoT Week 2017, and took place in Fortaleza, Brazil. Table 16 presents the members of the CREATE-IoT consortium that were in Fortaleza and had the possibility of discussing possible cooperation between Brazilian entities and the IoT-LSPs initiative.

Table 16: List of participants in the event

Participant	Role/Institution
Cilis Benevides	CEO - WDA Tecnologia & Inovação
Rhuan Victor	Project Manager - WDA Tecnologia & Inovação
Rodrigo Lima	Innovation and Product Marketing at CPqD
Tiago Teixeira	Researcher at Unparallel Innovation, Lda

A follow up discussion was scheduled for the IoT Week in Bilbao, where members of the IoT forum were invited to participate, with special attention to a CREATE-IoT session on International collaboration.

6.3. Meeting with Brazilian IoT experts - Bilbao

This was a meeting, as part of a set of meetings that took place during this period that were meant to straighten the link between Europe and Brazil in the IoT domain. This happened during some events where CREATE-IoT members were together with Brazilian IoT forum. The objective was to continue discussions with respect of the EU-Brazil IoT Advisory Group.

Table 17: List of participants in the event

Participant	Role/Institution
Gabriel Marão	President of the Brazilian IoT Competitiveness Forum
Srdjan Krco	Co-founder and CEO of DunavNET
Mirko Presser	Department of Business Development and Technology, Aarhus University
Pedro Maló	Chief Science Officer at Unparallel Innovation, Lda

The follow-up on these matters will not happen as part of CREATE-IoT, as the EC requested this activity to be stopped at month 18 of the project.

6.4. Meeting with ITU - Africa

As part of International Collaboration activities, where the colleagues of ITU were invited to speak at the IoT for Sustainable Development in Africa, a meeting was arranged between ITU, CREATE-IoT and WAZIUP project, to discuss possible synergies between ITU and WAZIUP and IoT-LSPs initiative.

Table 18: List of participants in the event

Participant	Role/Institution
Pedro Maló	Chief Science Officer at Unparallel Innovation, Lda
Tiago Teixeira	Researcher at Unparallel Innovation, Lda
Alexander Ntoko	ITU: Chief of the Operations and Planning Department
Philippe Cousin	Founder of Easy Global Market

The objective of this meeting was to discuss potential technologies that could be useful to be applied by ITU in Africa. A special attention was given to similar problems than the ones being tackled by WAZIUP project (Open Innovation Platform for IoT-Big Data in Sub-Saharan Africa),

which is using cutting edge technology applying IoT and Big Data to improve the working conditions in the rural ecosystem of Sub-Saharan Africa.

As a follow-up, ITU invited both WAZIUP and CREATE-IoT members to attend the ITU Telecom World 2018, being held in Durban – South Africa.

MI was actively involved at ITU Telecom World 2017 and ITU Telecom World 2018 and was a part of the Smart ABC Panel.

7. CONCLUSIONS

This document reports all International Collaboration activities carried out in the first period of the CREAT-IoT project, with the objective of raising awareness among the international research, industry and academia communities not only to the CREATE-IoT project, but for the complete IoT-LSP initiative.

All the International Collaboration sessions were co-organised by CREATE-IoT, to foster international collaboration activities, and some meetings were sponsored in order to outreach the IoT-LSPs initiative to the international community.

Several follow-up actions were planned for the next period of the project; however these activities were stopped due to a request from the European Commission for the CREATE-IoT consortium not to pursue the international collaboration, and dedicate its efforts on the collaboration with the LSPs.

8. APPENDICES

8.1. Appendix A: Platforms & Technologies

ACTIVAGE

Platform	Europe	US	Asia	Africa
FIWARE	x			
IoTivity		x		
OpenIoT	x			
sensiNact	x			
Seniorsome	x			
SOFIA2 IoT Platform	x			
universAAL	x			
Total	**6**	**1**	**0**	**0**

AUTOPILOT

Platform	Europe	US	Asia	Africa
FIWARE	x			
FIWARE Semantic	x			
Huawei IoT			x	
Kuantic Server	x			
oceanConnect			x	
oneM2M	x			
PEXSI Platform		x		
Raspberry PI	x			
Sensinov oneM2M	x			
Watson IoT		x		
Total	**6**	**2**	**2**	**0**

IoF2020

Platform	Europe	US	Asia	Africa
365FarmNet	x			
AgroSense	x			
Apache Cassandra		x		
Apache Flink		x		
Apache Spark		x		
Arvalis IoT Platform	x			
Atland FMIS				
Connecterra IoT	x			
Cygnus	x			
EBBITS	x			
EPCIS		x		
FIWARE (in particular Broker)	x			
FISpace	x			
LinkSmart (Free, Open Source IoT Platform)	x			
MongoDB		x		
OpenStack		x		
ThingWorx IoT		x		
VIRTUS (XMPP Based Architecture for Secure IoT)	x			
Total	**10**	**7**	**0**	**0**

MONICA

Platform	Europe	US	Asia	Africa
ASFCS (Adaptive Sound Field Control System)	x			
LinkSmart	x			
GOST platform (implements OGC SensorThings API)	x			
Mosquitto - MQTT broker		x		
oneM2M	x			
RIOT	x			
Raspberry PI	x			
Docker		x		
Total	**6**	**2**	**0**	**0**

SYNCHRONICITY

Platform	Europe	US	Asia	Africa
CKAN	x			
Cygnus	x			
IDAS	x			
OpenDataSoft	x			
OpenTripPlanner		x		
Organicity API	x			
Orion Context Broker	x			
STH Comet	x			
WSO2			x	
Total	**7**	**1**	**1**	**0**

8.2. Appendix B: Standards

ACTIVAGE

Platform	Europe	US	Asia	International
3GPP EDGE				x
3GPP 3G				x
3GPP 4G UMTS/HSPA, LTE				x
3GPP2				x
ITU-T G.992 (ADSL)				x
Bluetooth 3.0 / 4.0 / 4.2				x
CEN TC278 WG16 (Intelligent Transport Systems)	x			
EN 300 220-1 (Electromagnetic compatibility)	x			
EN 50 134 (Social Alarms)	x			
GPS		x		
HL7 (Health Level Seven International)		x		
IEEE 802.15.4 (Low Rate Wireless PAN)				x
ISO/IEEE 11073 (Personal Health Data)				x
ISO/IEC/IEEE 8802-3 (Ethernet)				x
ISO/IEC 14443 (Identification Cards)				x
ISO 11898 (CAN Bus)				x
ISO TC204 WG 18 (Intelligent Transport Systems)				x
MQTT				x
NFC / NDEF				x
PLC/Modbus		x		
SIP				x
USB 2.1		x		
VDE 0834/ESPA-X (Call functions)				
Wi-Fi (IEEE 802.11)				x
Z-wave (Home Automation)	x			
ZigBee				x
Total	**4**	**4**	**0**	**17**

AUTOPILOT

Platform	Europe	US	Asia	International
3GPP 3G				x
3GPP 4G				x
3GPP 4G LTE-V2X				x
3GPP 4G NB-IoT				x
6LowPAN		x		
Bluetooth				x
CAM (Cooperative Awareness Message)	x			
CAN Bus (ISO 11898)				x
CoAP (Constrained Application Protocol)		x		
DATEX (Exchange of traffic related data)	x			
DDS (Data Distribution Service)		x		
DENM (Decentralized Environm. Notificat. Message)	x			
GPS		x		
HTTP/S				x
IEEE 802.15.4 (Low Rate Wireless PAN)				x
ITS-G5 (ad-hoc V2V communications at 5,9 GHz)				x
LDM (Local Dynamic Maps, ISO/TS 18750:2015)				x
MQTT				x
oneM2M	x			
SPAT / MAP (Signal Phase and Time)	x			
USB 2.0		x		
Wi-Fi (IEEE 802.11)				x
Total	**5**	**5**	**0**	**12**

Platform	Europe	US	Asia	International
365 FarmNet	x			
3GPP GSM				x
3GPP 3G				x
3GPP 4G				x
6LowPAN		x		
ADAPT (AG Data Application Programming Toolkit)		x		
ADLS 2 (ITU-T G.992.3)				x
Bluetooth LE				x
CoRE (Constrained RESTful Environments)		x		
EFDI (Extended Farm Managmt. Information Syst.)				
FMIS (Farm management Information System)				
GPS		x		
HTTP/S				x
I2C (Inter-Integrated Circuit)	x			
ISO/IEC/IEEE 8802-3 (Ethernet)				x
ISOBUS (ISO 11 783)				x
JSON (JavaScript Object Notation)				x
LLRP (Low Level Reader Protocol)				x
LoRa		x		
LWM2M (OMA Lightweight M2M)		x		
MODBUS		x		
MQTT				x
NFC (Near-Field Communication)				x
NGSI (Next Generation Service Interface)	x			
NTAG213	x			
OAuth v2				x
QR Code (ISO/IEC 18004)				x
RFID (Radio Frequency IDentification)				x
RS-232		x		
RS-485		x		
SDI-12 (Serial Digital Interface at 1200 baud)		x		
SigFox	x			
SQL (Structured Query Language)				x
Sub-1Ghz (IEEE 802.15.4 Low Rate Wireless PAN)				x
TLS (Transport Layer Security)				x
USB		x		
Wi-Fi (IEEE 802.11)				x
XML (Extensible Markup Language)				x
XMPP (Extensible Messaging & Presence Protocol)				x
ZigBee				x
Total	**5**	**11**	**0**	**22**

MONICA

Platform	Europe	US	Asia	International
ETSI EN 300 220-2 V3.1.1 (2017-02) for the Crowd Wrist-bands operating in the frequency range 865 – 868 MHz	x			
ETSI EN 302 065-2 V2.1.1 (2016-11) for the Staff Wrist-bands using Ultra Wide Band technology (UWB) in the band 3.4 – 3.8 GHz	x			
Bluetooth LE				x
Wi-Fi (IEEE 802.11)				x
NFC (Near-Field Communication)				x
RFID (Radio Frequency Identification)				x
LoRa		x		
OGC SensorThings API				x
MQTT				x
oneM2M	x			
IEEE 802.15.4 Low Rate Wireless PAN				x
IETF 6LoWPAN				x
IETF ROLL				x
IETF CoAP				x
ETSI SAREF	x			
Total	**4**	**1**	**0**	**10**

SYNCHRONICITY

Platform	Europe	US	Asia	International
FIESTA (FIESTA-IoT Semantics Library)	x			
GTFS (General Transit Feed Information)		x		
Hypercat (hypermedia catalogue format)	x			
MQTT				x
NGSI	x			
OASC (Principles and data model)	x			
OAuth v2				x
ODF (Open Document Format)				x
OpenTripPlanner (Multimodal Trip Planning)		x		
Total	**4**	**2**	**0**	**3**