



IoT WEEK GENEVA

JUNE 6 - 9, 2017



IoT GOES LARGE SCALE

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FOREWORD

On behalf of the IoT Forum, I would like to thank all my colleagues and members of the Host Committee (from HES-SO, ITU, Mandat International and IoT Forum), as well as all our speakers, sponsors, partners, participants, media and volunteers for supporting the ground breaking IoT Week 2017 conference.



Figure 1: Sébastien Ziegler President of the IoT Forum

This 7th edition of the IoT Week offered about 200 sessions and activities. It gathered **over 800 experts who are active in the Internet of Things domain, and over 300 speakers**, which is a new record compared to past editions.

The IoT Week 2017 was also unique because we launched new initiatives such as the first edition of the **Global IoT Summit** (endorsed by the IEEE) with over 80 papers presented by worldwide academia experts and the integration of the **United Nations Sustainable Development Goals** in our program.

Thanks to the support and initiative of the International Telecommunication Union (ITU), the IoT Week 2017 has also been an opportunity to bring together the international IoT community and the United Nations system, to adopt the **International Declaration on the Internet of Things for Sustainable Development**. This unique Declaration voluntarily positions the IoT as an industry that cares and generates positive developments for the society. It intends to ease the convergence between the industry, the end-user expectations and the sustainability requirements, for a better market adoption.

With so many activities and intense sessions in parallel (Hackathon, Exhibition Area, Workshop, Site Visits, Private Meetings etc.), we are aware that these 4 days were a great platform of contents exchange and therefore in addition to the attached report, we have asked our speakers to allow us to publish their presentations on our website. As you will see, over 100 presentations are already online on www.iotweek.org.

As you may know, the IoT Week is an independent and self-financed event which could not have come into being without the personal efforts and financial contribution of each participant and I want to thank you once again for making it possible.

In order to develop new activities and projects, your organization is also welcomed to join the IoT Forum as a member and take part in the strategy development and organizing of the next conference and other initiatives. More information is available on our website www.iotforum.org.

We are looking forward to welcoming you to the next IoT Week edition **that will take place in Bilbao, in Spain, from 4th to 7th June 2018**.

Sincerely,

Sébastien Ziegler
President of the IoT Forum

A BRIEF OVERVIEW OF THE IoT WEEK 2017

Geneva hosted the 7th annual conference IoT Week 2017 together with the Global IoT Summit. This unique gathering on the Internet of Things (IoT) was held from 6th to 9th June 2017 at International Conference Centre of Geneva.

The entire week, dedicated to the state-of-the-art research and innovation in IoT domain, was a great success. The stupendous week concluded with the *Adoption of the "International Declaration on the Internet of Things for Sustainable Development"*.

Conference Attendance

With about 200 sessions and activities, the event gathered over 800 experts' active in the Internet of Things domain, including over 300 speakers and keynote speakers such as:

- **Robert Kahn**, CEO and President, CNRI and Father of the Internet Protocol.
- **Mauro Dell'Ambrogio**, State Secretary for Education and Research, Federal Department of Home Affairs - SERI
- **Chaesub Lee**, Director, Telecommunication Standardization Bureau (TSB), International Telecommunication Union (ITU)
- **Paul Nemitz**, Director, Fundamental Rights and Union Citizenship at Directorate-General Justice of the European Commission
- **Ralf Michael Wagner**, COO Data Services, Siemens
- **Martin Bürki**, Country Manager, Ericsson Switzerland AG
- **Vlad Mihail Trifa**, Head of Digital Lab, Swisscom
- **Andrea Onetti**, Vice President, MEMs Sensor Division General Manager at ST Microelectronics
- **Domenico Arpaia**, CEO, OrbiWise SA
- **Marianne Janik**, General Manager, Microsoft Switzerland
- **Nasser Saleh al Marzouqi**, Chairman, ITU-T Study Group 20 on IoT and smart cities and communities
- **Benoit Revaz**, Director, Swiss Federal Office for Energy
- **Latif Ladid**, President, IPv6 Forum

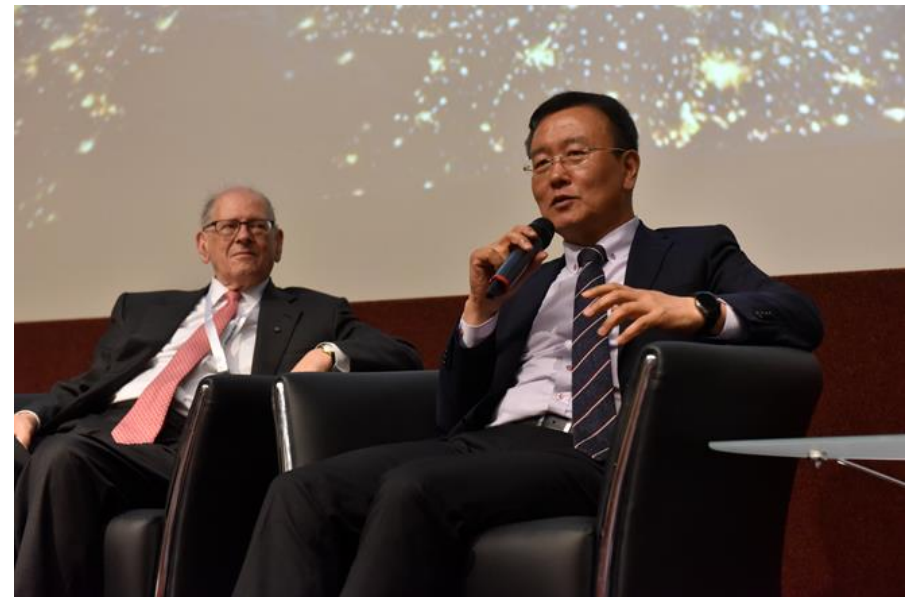


Figure 2: Robert Kahn of CNRI and Chaesub Lee of ITU

The IoT Week 2017 reviewed the latest developments and emerging technologies from the IoT research and innovation sector. It also discussed specific challenges, such as IoT security and privacy, IoT market and industry 4.0, smart cities, IoT big data and data analytics.



Figure 3: Speakers of the “High level Vision on IoT” Plenary Session

Adoption of the International Declaration on the Internet of Things for Sustainable Development

The participants of the IoT Week 2017 conference in Geneva adopted the International Declaration on the Internet of Things for Sustainable Development by acclamation. It presents a vision and a strategy for leveraging the Internet of things to support the achievement of the 17 Sustainable Development Goals (SDGs) adopted by the United Nations and the international community. This Declaration will pave the way to a closer collaboration between the international community of experts and researchers in the realm of IoT, to turn sustainable development into reality. The main elements of the Declaration will be followed up through the future editions of the IoT Week.



Figure 3: Bilel Jamoussi, of ITU and Sébastien Ziegler of IoT Forum chairing the session of the SDG Declaration

A Successful Global IoT Summit

The IoT Week has hosted the Global IoT Summit (IEEE endorsed), which presented industry sessions and selected peer-reviewed scientific articles on the most recent IoT innovations from all over the world.

This first edition of the GIOTS presented about 80 papers, which were peer-reviewed and selected from a larger number of submissions. The selected papers will be published by IEEE. The next GIOTS will be collocated with the next IoT Week conference in 2018.



Figure 4: Christopher Uwaje of Mobile Software Solutions Limited during a GIOTS Session

A New Master on the Internet of Things with the University of Geneva

The University of Geneva and the IoT Forum have launched a Master in Advanced Studies on the Internet of Things. This master will be taught by top experts and leading professionals on the Internet of Things from all over Europe. It intends to provide comprehensive and in-depth insights on the Internet of Things, encompassing the technological, societal and economic aspects. The Master will also cover pertinent topics including security and data protection within the IoT ecosystem.

This one-year Master programme will commence in October 2017 at the University of Geneva and is organized to enable participants to continue with their existing professional commitments.

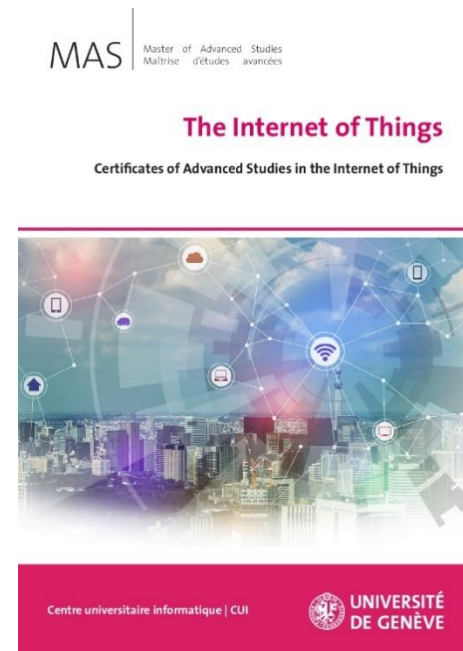


Figure 5: MAS on IoT Flyer

More information at: <http://mas-iot.unige.ch/>

Extending the Open and Agile Smart City (OASC) Alliance towards Switzerland

The IoT Week 2017 has been chosen by the Open and Agile Smart City (OASC) Alliance to announce that the cities of Carouge and Geneva have decided to join the alliance. This has enabled Switzerland to join this global initiative that gathers cities interested to collaborate and develop common requirements and data interoperability. The OASC is already engaged in the European Large- Scale Pilot on IoT for Smart Cities: Synchronicity. This project supported by the European Commission gathers cities, industries and research centres from different continents. Several cities such as Milano, Helsinki and Manchester are already involved in this project. On the Swiss side, the City of Carouge with the collaboration of Mandat International and UDG Alliance is associated.



Figure 7: Nicolas Walder, Mayor of Carouge at the Welcoming Reception

Next year. Next stop: Bilbao.

The IoT Week 2018 will be hosted by the City of Bilbao from 4th to 7th June 2018. Bilbao will host the event in a brand new international conference centre. Within Europe, the city is known to be extensively involved in research and development, both in terms of the investments made and the percentage of the population active in the IoT research domain.

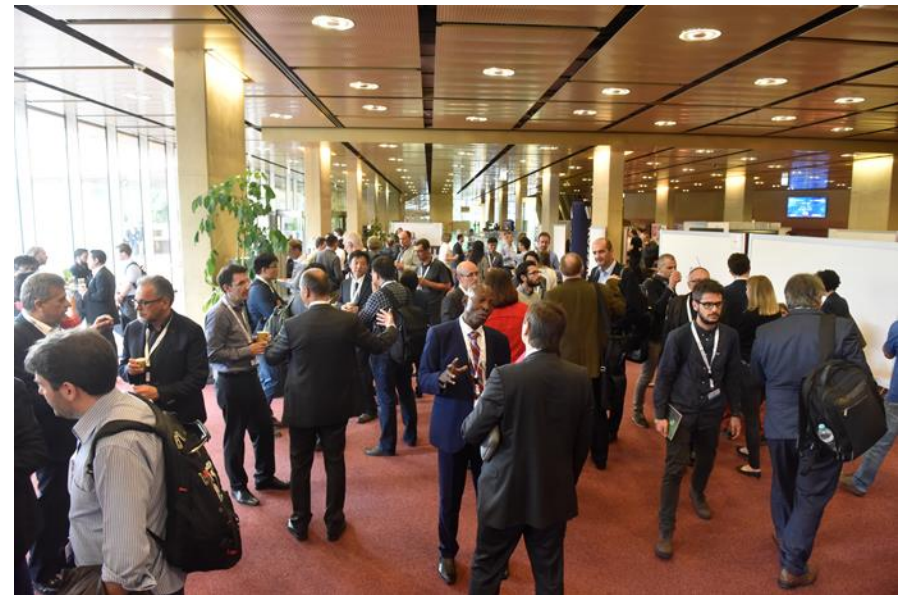


Figure 8: Networking and Coffee Break

THE INTERNATIONAL DECLARATION ON THE INTERNET OF THINGS FOR SUSTAINABLE DEVELOPMENT

The International Declaration on IoT for Sustainable Development was developed through the following process:

- The initial draft consisted of various inputs on IoT and the SDGs from experts within the Internet of Things and Sustainable Development domains;
- The draft was then posted on the IoT Forum website and extensively shared with the speakers and various entities.
- Various consultations were conducted and over 60 comments were received, which were integrated in the draft and shared with all the speakers.
- The final Declaration consists of ten key articles that have been carefully mapped into the 17 SDG goals.

The Declaration is available in six languages i.e. English, Arabic, Chinese, French, Russian and Spanish. The Declaration was presented by respected keynote speakers from the private and public sector, academia and United Nations agencies.



Figure 9: Keynote Speakers from different constituencies and stakeholders in charge of reading the Declaration,

Background

The Internet of Things (IoT) is emerging as a powerful enabler in many application domains, such as water and energy management, environmental monitoring, health, smart cities, smart industry and supply chain management. The IoT has the potential to address some of the most acute human, economic and environmental needs. It can also directly contribute to achieving the targets in the Sustainable Development Goals (SDGs). Accordingly, the emerging IoT paradigm has the potential to create an efficient, effective and secure ecosystem taking advantage of connected devices for managing the major global challenges faced by this, and future generations. In this context, at the 7th IoT Week, the IoT research and industry community, together with the International Telecommunication Union (ITU) and other stakeholders, took the opportunity to express their support for researching, developing and leveraging IoT technologies for sustainable development and for building a brighter future for our planet and its inhabitants.

Mapping of Key Activities with the 17 Sustainable Development Goals

KEY ACTIVITIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
7	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
8	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
9	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

We, the participants of the IoT Week 2017 (6-9 June 2017), strive to promote international dialogue and cooperation for innovation in IoT with regard to the following key activities [1]:

1. **Promoting the development and adoption of IoT technologies for the benefit of humanity, the environment and sustainable development.** This includes promoting the research and the use of IoT technologies to address the 17 Sustainable Development Goals adopted by the United Nations and the international community. Governments and policy-makers from developed and developing countries should be encouraged to examine the future challenges and benefits to their economies and accelerate global competitiveness of their economy, region, continent and people by establishing plans and strategies to leverage IoT for SDGs.
2. **Supporting the implementation of the IoT in urban and rural context to foster the application of ICTs in providing services to build smarter and more sustainable cities and communities.** This will allow urban and community stakeholders to take advantage of technological advances and offer new opportunities for quality of life for different strata of society, by promoting accessibility to amenities, technologies and services (including social infrastructure, energy, water and healthcare), and by supporting IoT systems and data interoperability.
3. **Promoting a broad, vibrant and secure ecosystem for IoT, including support for start-ups and incubators.** This includes promoting policies to facilitate research, innovation and development of new solutions and eliminating policies that restrict job creation, hinder economic growth or prevent innovation. It may also include appropriate incentives, and policies to promote IoT deployment, privacy protection and secure data management. This will gradually assist in fostering an IoT data market, which contributes to the consolidation of sustainable business models and cooperation among stakeholders.
4. **Encouraging the development and implementation of standards that facilitate interoperability among IoT technologies and solutions in order to pave the way to an open and interoperable IoT ecosystem,** with cost-effective solutions in line with the vision for an open economy.
5. **Adopting new and innovative IoT applications to deal with challenges associated with hunger, water supply, and food security** through resource monitoring to cope with the increasing consumption needs of a global population. By leveraging IoT, sensors can detect and monitor water leaks, potential contamination, soil moisture, pollutions, weather conditions, livestock movements, while remotely managing and controlling harvesters and irrigation equipment to improve the quality, quantities, yield rates, cost-effectiveness, energy efficiency and sustainability of agricultural production, including the packaging and transportation of food supplies. IoT can also be used for research and analysis into water-borne diseases and potentially new types of diseases.
6. **Galvanizing interest in the use of IoT for risk reduction and climate change mitigation,** taking into consideration the diversity and complexity of the Earth's geography and vulnerable populations. The IoT framework has the ability to gather and analyze real-time information for proactive prevention and faster response to deal with toxic wastes and pollutants, disasters and other natural calamities.
7. **Identifying and supporting the growing trend of using IoT technologies for education** and improving the access of disadvantaged and excluded groups to ICT infrastructure by promoting basic ICT literacy, virtual classrooms and interactive vocational training programs for vulnerable segments of society.
8. **Embracing the application and use of IoT for biodiversity conservation and ecological monitoring** to protect the natural life and its diversity on land, air and below waters. IoT can help monitor natural ecosystems, as well as sanctuaries, detect threats linked to poaching, overfishing (or

illegal fishing) and deforestation and can send alerts in real-time to authorities for immediate response.

9. **Contributing to global research and discussions on IoT for smart and sustainable cities through global initiatives** such as United for Smart Sustainable Cities (U4SSC). ICT-based transformative action for sustainable urban development can help highlight efficient, transparent, and equitable regulatory frameworks, inclusive planning systems, effective financial management with increased transparency and accountability to all inhabitants and urban stakeholders alike, which should help accelerate the transition to smart sustainable cities and communities.
10. **Promoting international dialogue and cooperation on the IoT for sustainable development** by bringing the various stakeholders together, including inter alia the academic and research community, the specialized international organizations and fora, the industry, SMEs and start-ups, the governments and public authorities (including smart cities), and other relevant stakeholders such as specialized NGOs and indigenous peoples.

The participants of the IoT Week Forum look forward to implementing the strategies mentioned for the achievement of SDG goals through collaborative efforts.



THE FIRST EDITION OF GLoTS

The Global IoT Summit (GloTS) conference, launched this year, was collocated with the IoT Week 2017 at the International Conference Centre in Geneva. The objective of this conference is to bring together the research and industry communities active in the IoT domain.

This conference highlighted that the IoT paradigm envisions a highly networked future, where every object is integrated to interact with each other, allowing for communications between objects, as well as between humans and objects, which enables intelligent systems to improve our daily lives. Additionally, the conference was designed to examine key critical innovations that will impact research and real-world application of IoT technologies to transform our world.



Figure 10: GLoTS Opening Speakers

There are several challenges in terms of turning the vision of IoT into reality. This includes architecture, communication, services, computational intelligence, storage, governance apart from core areas of sensor development and material engineering. This conference brings together researchers from diversely cross disciplinary areas to address challenges in this emerging discipline. Co-located with 2017 IoT Week organized by the IoT Forum, GLoTS-2017 discusses the path-breaking advances related to the Internet of Things and the feasibility of extending IoT, including wireless sensor network technology, to become truly ubiquitous with new cloud and edge computing technologies, big data analysis, citizen engagement, privacy and cybersecurity, and governance.

This conference is a key place for industry leaders, academics, professionals, government officials, and students, to discuss and foster knowledge on emerging technologies, business cases and social impacts in this technological area:

Keynote Speakers

- Patrick Wetterwald, Cisco Engineering Manager
- Joe Klein, CISSP - Disrupt 6 Founder and CTO
- Geoff Mulligan, LoRa Alliance Founder & Chair
- Jan Camenish, IBM Research Principal Research Staff Member
- Marianne Janik, Microsoft Switzerland CEO

79 technical papers, selected from 133 submissions, aggregated into technical track sessions such as:

- IoT Enabling Technologies,
- IoT Applications, Services and Real Implementations
- IoT Experimental Results and Deployment Scenarios
- Security and Privacy for Internet of Things
- Workshops on hot and emerging topics:
- Workshop on Edge Computing for IoT;
- Workshop on Internet of Energy Neutral Things - IoENT 2017;

- 3rd International Workshop on Internet of Things for Active and Assisted Living – IoTAAL;
- Workshop on Energy Efficient Solutions based on IoT - EESIoT 2017;
- 2nd Workshop on User-centric security, privacy and data governance in smart cities - USP4SC;
- Two industry sessions
- 5G IoT Large Scale Pilots
- IPv6-based IoT Deployment Around the World
- IPv6 Day: Enabling New Generation IPv6-based IoT Innovation - Full-Day Workshop



Figure 11: Keynote Speaker Patrick Wetterwald at the GloTS Opening Session

We would also like to thank the public and private organizations that supported the meeting in different ways. We are truly indebted to the IEEE Comsoc and IEEE Initiative on Internet of Things.

We would like also to thank the keynote speakers, the workshop and special session chairs, the authors, and all attendees- your vibrant participation, your sharing of core expertise and experiences, and your active personal networking has made this event memorable and has placed the seed of knowledge and innovation which will bloom and grow in the years to come for the benefit of the economy, the society and the daily lives of individuals.



Figure 12: GloTS Audience

We wish and hope that you will continue your association with us and cherish the diverse agenda and aspire to meet new IoT experts to collectively drive and frame the IoT roadmap in the right direction.

PROGRAM OVERVIEW

PLENARY SESSIONS



Figure 16: IoT Week 2017 Plenary Session at the CIGG

The plenary sessions involved high quality keynote speeches and presentations with no or very little parallel activities. The sessions included the following:

1. IoT Week 2017 Welcoming Remarks
2. High Level Visions on IoT
3. Telco Industry Perspectives on Future IoT
4. Ubiquitous Perspectives
5. Adoption of the SDG Declaration
6. IoT Week 2017 Closing Remarks

THEMATIC SESSIONS

There were several emerging IoT technologies, topics and issues which were carefully addressed and discussed during the plenary sessions. The sessions were grouped into the following tracks:

1. Emerging IoT Researches and Technologies

The IoT Week gave the floor to high level speakers on IoT-related hot topics. The event presented the latest developments and trends in IoT research and innovation by highlighting emerging technologies, solutions and trends in the IoT landscape and societal challenges (such as personal data protection and end-user adoption). This track included the following sessions:

Game Changer of IoT Innovations

International Cooperation for IoT

IoT & Big Data

IoT 4 Developing Countries- Emerging IoT Solutions in Developing Countries

IoT 4 Developing Countries- IoT Inclusion and Cooperation with the South

IoT Experimental Infrastructure

IoT Networks

IoT Standards Ecosystem- What's New?

IoT Trends in Smart Cities

IoT, Smart Living and Ageing Well

M2M Interoperability

Multi- Access Edge Computing (MEC)

Nanolo Tech- the Future of Nanotechnologies for IoT & Smart Wearables

Smart Agriculture

Smart Transportation

Web of Things



Figure 14: Ana García Robles of BDVA chairing the Big Data Session

2. IoT Finance, Market and Industry 4.0

The track “IoT Business, Finance, and Industry 4.0” discussed market perspectives, new financial and business models, as well as the impact of IoT on the industry and factories of the future. The sessions of this track included the following:

Industry 4.0 and Smart Factory and Delivery

IoT and the Fourth Industrial Revolution

IoT Market Perspectives

IoT Start-Ups- Accelerating Innovation and Market Penetration



Figure 15: Abhishek Sharma of Beyond Evolution Tech Solutions speaking at the IoT Market Perspectives Session

3. IoT Security and Privacy

The track IoT Security and Privacy addressed inter alia issues such as cybersecurity development for the IoT and the impact of the recent evolution of personal data protection and privacy norms at the European level (GDPR, WP29, etc.) and in other regions. The sessions of this track were:

GDPR & IoT

IoT Security and Privacy

IoT Risk Management

IoT Threats

Security Trends on IoT and Constrained Devices

Drones, Privacy and Ethics



Figure 16: “SDG & IoT for Inclusiveness Reduction of Inequalities” Speakers

4. IoT & Sustainable Development

The IoT Week has closely cooperated with the ITU and the United Nations system to review and address the potential of the Internet of Things to achieve the 17 Sustainable Development Goals (SDGs) adopted by the UN, including topics such as water management, smart cities, industry, poverty, etc. The sessions included the following:

SDG: IoT for Clean Energy, Responsible Consumption and Production

SDG: IoT for Clean Water and Sanitation

SDG: IoT for Environment

SDG: IoT for Good Health and Well Being

SDG: IoT for Inclusiveness Reduction of Inequalities

SDG: IoT for Industry, Innovation and Infrastructure

SFG: IoT for Peace, Justice and Strong Institutions

SDG: IoT for Sustainable Cities and Communities

SDG: IoT to Overcome Hunger and Poverty

WORKSHOPS



Figure 17: Wise IoT Workshop

The IoT Week 2017 allowed IoT Forum members as well as IoT Week Partners and Sponsors to host both public workshops and private meetings in parallel to the thematic sessions. The workshops topics were the following:

1. Big Data

Big Data, CPS and IoT: Enabling the Digital Transformation of European Industry

Globally Interoperable IoT Identification and Data Processing: Industrial Challenges for Linking Clouds

Globally Interoperable IoT Identification and Data Processing: Digital Object Architectures

2. Smart Cities

Internet of Things for Urban Innovation (INUIT)

IoT Platform Convergence for Smart Cities: International IoT Platforms for Smart Cities Initiatives

IoT Platform Convergence for Smart Cities: Leading Examples of IoT Enabled Smart Cities

IoT Platform Convergence for Smart Cities: Personal Data Protection Strategy

IoT Platform Convergence for Smart Cities: Platform Integration and Interoperability

IoT Platform Convergence for Smart Cities: Standardization Strategy

IoT Platform Convergence for Smart Cities: Towards Interoperability and Convergence Among IoT Platforms for Smart Cities

3. End-User Engagement: Multi-Stakeholder Co-Creation for IoT Contexts IoT European Large-Scale Pilots Program Session

IoT Accelerator Ecosystems and Market Place Activity Group

IoT Focus Area Sustainability Activity Group

Trusted IoT, privacy, security and legal frameworks activity group

4. Swisscom Workshops

An Inside Look at IoT Enablers

IoT Data Analytics Platform

5. Building Web of Things

6. Brazilian Initiatives in IoT- Planning, Research, Innovation and Deployments

7. Combining IoT And Intelligent Robotics, Challenges and Opportunities

8. FIESTA-IoT. Experimentation as a Service over Interoperable IoT Testbeds

- 9. Innovative IoT Platform Technologies (EPI Workshop)
- 10. IoT @ Geneva
- 11. IoT In Medical Science and Healthcare
- 12. IoT Standards Convergence
- 13. IoT Workshop on Energy and Home Comfort

SOCIAL EVENTS

In addition to the working sessions, a key feature of the IoT Week 2017 was the networking sessions to promote familiarity among participants.

For this reason, with the active support and coordination of HES-SO (University of Applied Sciences and Arts Western Switzerland), as one of the Host Committee members, we organized several distinctive events to foster an effective networking environment.

- all our *Coffee Breaks* during the week were organized next to the Exhibition Area at the CCG to allow participants to visit the stands.
- A *Welcoming Reception* took place on 7 June at the terrace of the CIGG with the distinguished participation of **Dr. Houlin Zhao**, ITU Secretary General and **Mr. Nicolas Walder**, Mayor of Carouge.



Figure 18: ITU Secretary-General, Houlin Zhao at the Welcoming Reception

- *The Official GIOTS and IoT Week 2017 Gala Dinner* was on a magnificent Boat Cruise on the Geneva Lake with the presence of **Dr. Luciana Vaccaro**, Rector of the HES-SO.



Figure 19: Luciana Vaccaro Rector of the HES-SO at the Gala Dinner

1. Carouge City Visit

The City of Carouge organized a site visit to show the smart cities projects they are developing on 7 June 2017. The ITU also invited the participants to a VIP visit to its headquarters especially the ICT Discovery Exhibition on 8 June 2017.

2. ITU VIP Visit



Figure 20 and below: ITU Visit



3. Official GloTS and IoT Week 2017 Gala Dinner on Geneva Lake



Figure 20 bis: Gala Dinner

CONCLUSION

This 7th edition of the IoT week has consolidated our event as the global conference that attracted experts in IoT technology not only from Europe but also from all over the world. With around 200 sessions and activities, the event gathered over 800 experts from 49 countries who are active in the Internet of Things realm.

One of the main outcomes of this year has been the adoption of **the international declaration on the internet of things for sustainable development** which has been supported by the ITU together the IoT community and the United Nations System.

In addition to the strong involvement and participation of international organizations and the European Commission, the IoT Week 2017 was also able to attract more researchers and academia experts through the organization of the first **IEEE endorsed Global IoT Summit (GloTS)**. **This summer underscored over 80 Scientific Articles and Publication of the most recent IoT innovations.**

The facilities of the Geneva International Congress Centre (CICG) also allowed us to promote international dialogue and cooperation for the Internet of Things, organizing an Exhibition Area, the Hackathon, numerous private meetings and workshops in parallel, site visits and other social events to foster synergies among its participants.

A clear example of this spirit was the Welcome Reception with the participation of **Houlin Zhao**, ITU Secretary-General and Nicolas Walder, Mayor of the City of Carouge.

On this occasion, the IoT Forum announced officially the launch of a new **Master of Advanced Studies on Internet of Things** in collaboration with the University of Geneva and Mandat International.

This intensive programme has been implemented through the full collaboration of the Host Committee composed of the IoT Forum, the International Telecommunication Union (ITU), the University of Applied Science Western Switzerland (HESSO) and Mandat International.

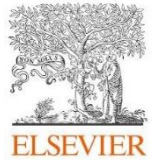
The IoT Week is a nomadic yearly conference and following the previous editions hosted in Barcelona, Berlin, Venice, Bald, Helsinki, London, Lisbon, Belgrade and Geneva, we were pleased to announce at the Closing Plenary Session that the next IoT Week Conference will take place next year for the first time in Bilbao (Spain) from 4th to 7th June 2018.

Looking forward to meeting you again at the



IoT Week Bilbao 2018
4-7 JUNE 2018, BILBAO (SPAIN)
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APPENDIX 1: PLENARY SESSIONS

IoT Week 2017 Opening Session

Welcoming Remarks

The IoT Week President and the Host Committee welcomed all distinguished guests, speakers, moderators and participants to the IoT Week Conference. Over 300 speakers, highly qualified in different aspects of Internet of Things attended the event. They briefly introduced an overview of the programme and keynote sessions. The IoT Week 2017 was a diverse conference as participants from different countries gathered to share their ideas. The IoT Week 2017 also incorporated social events such as the Cruise Ship Gala Dinner, Carouge City Visit and ITU Visit.

High Level Visions on IoT

The second part of the session comprised of distinguished keynote speakers who shared their respective visions on IoT;

Sébastien Ziegler

President, IoT Forum & Director, Mandat International

Mauro Dell'Ambrogio

Federal Department of Home Affairs - SERI

State Secretary for Education and Research

Chaesub Lee

ITU Telecommunication Standardization Bureau

Director

Benoît Revaz

Swiss Federal Office for Energy

Director

Nasser Saleh Al Marzouqi

ITU-T Study Group 20 Internet of Things (IoT) and Smart Cities and Communities (SC&C)

Chairman

Robert Kahn

CNRI - Corporation for National Research Initiatives

CEO and President

Ralf Michael Wagner

Siemens

COO, Data Services



Figure 21: High Level Vision Keynote Speakers

Investing in Research and Innovation

Everything in IoT is in the process of emerging or has already emerged and will reshape our lives. Digitalization is a positive opportunity but others may view it negatively. Digitalization produces both challenges and benefits. Will digitalisation lead to a paradigm shift? Policies should be formed; sensible rules must be drawn up to create a free environment which encourages innovations to occur. The state has a key role to play as it must create an innovation friendly environment, through a highly equipped education system, promoting research and removing administrative barriers.

The world of science, technology and innovation are without borders. With the spread of globalization, this automatically leads to digitalization. The Swiss Government has set aside 26 Billion CHF for research and innovation. The Swiss Government will fund vocational training and invest in the development of competitive universities. As a result, digitalization will benefit from these strategies.

IoT and ITU

What is the real meaning of IoT from the ITU point of view? In general, IoT is described as an infrastructure. This has opened the gate for engaging cyber space which has led to concerns related to securing devices. Through IoT, we can also implement and create our own smart cities.

The proposed IoT infrastructure has the capacity to produce data (data manning) and act on the Big Data dreams. It also helps address important questions including:

- How can Data be used by everyone?
- How can this Data be secured?

ITU-T has launched the Focus Group on Data Processing and Management, which will address how data can be managed within the IoT and smart city ecosystem. Smart ABC (Artificial Intelligence, Banking and Cities) is also another project that has been launched by ITU to implement IoT technologies.

IoT and Energy

Nuclear energy has its own disadvantages. The horrific events in Fukushima is an example of why countries should move towards sustainable methods of energy conservation and consumption.

Recently, Swiss citizens chose to withdraw from nuclear energy. The Swiss Government has decided to focus on upgrading the Swiss energy system, secure energy supply and reduce dependency on fossil fuels.

IoT will play a key role in this energy transformation. Storage of electricity has been possible through conservation of dams which has led to a shift towards distributive energy systems. There needs to be a permanent balance between demand and supply. Therefore, the full infrastructure should include dimensions that accommodate varying trends and increases in demand for energy. IoT will contribute to the modification of market models to meet demands.

Example: Through energy demand management, making conventional appliances smarter can help respond to external stimuli like price signals without expanding the grid. By expanding energy infrastructure and building automation, new services will emerge. A framework is needed for these ideas to be adequately implemented.



Figure 22: Ralf Wagner of Siemens at the High Level Vision on IoT

Telco Industry Perspectives on Future IoT

The session started with a short introduction of the panellists from Swisscom and Ericsson.

Srdjan Krco

DUNAVNET

Co-Founder and CEO

Martin Bürki

Ericsson Switzerland

Country Manager

Vlad Mihai Trifa

Swisscom

Head of Digital Lab



Figure 23: Telco Industry Perspectives Discussion

The panellists presented their views on the growing IoT domain, focusing on the role of telecom operators and vendors as well as the current approach and plans of their companies.

The presentations were followed by an interactive Q&A session. The main points addressed during the sessions concerned the role of the IoT ecosystem and how Ericsson and Swisscom are addressing this aspect. The main issues discussed were:

- Whether IoT is still a technology push or customer pull,
- The importance of 5G technologies for success of IoT,
- Comparison of NB-IoT with other LPWAN technologies,
- Other strategies in regard to IoT platforms etc.

Feedback from the audience after the session was excellent. The panellists were eloquent and provided clear and precise answers to the questions.

Ubiquitous Perspectives

Sébastien Ziegler

President, IoT Forum

& Director, Mandat International

Domenico Arpaia

OrbiWise SA

CEO

Andrea Onetti

STMicroelectronics

Vice President, General Manager MEMS Sensor Division

Making MEMS Communicate from anywhere and the LoRa Project were the main topics of discussion. The Keynote Speakers were from Orbiwise and STMicroelectronics. Digital Technologies are transforming nearly every aspect of our lives. IoT can be defined as any system that is able to leverage the internet and its ecosystem. Connected sensing and actuating is a key part of the Internet of Things.

They are at the heart of IoT applications. Sensors are required to become more accurate but with strict power budget constraints. Artificial intelligence reaches its full potential when connected to a network of smart sensors and actuators. Smart Home and City, Smart Industry and Smart Driving applications are enabled thanks to common IoT device building blocks.



Figure 24: Orbiwise Presentation by Domenico Arpaia

STMicroelectronics has comprehensive approach to the IoT to make deployment easy and fast. Orbiwise provides a carrier-grade Network server for LoRa-based networks. Ensures that all features and devices classes are supported. The system is essential for securing reliable communication between network and devices while maximizing overall network capacity. High configuration allows operators to configure MAC according to local regulatory requirements. Standard region configurations are available for all major regions.

Closing Remarks

The IoT Week President and representatives of the Host Committee thanked all the participants (speakers, attendants, partners sponsors and volunteers) to the IoT Week 2017 Conference. They highlighted that this new edition was larger than expected with over 800 participants from 49 countries.



Figure 25: Plenary Audience

It was also the occasion to announce the GloTs Best Papers and the three best Hackathon projects. These were selected and awarded by the jury:

- BRB - Be Right Beach (1st prize)
- FreeOcean (2nd prize)
- ThinkMilk (3rd prize)



Figure 26: Hackathon Winners

Finally, Mikel Larrañaga from IK4 Tekniker, the local host the IoT Week 2018, introduced the next edition which will take place in Bilbao (Spain from 4 to 7 June 2018).

APPENDIX 2: THEMATIC SESSIONS

Emerging IoT Researches and Technologies

Multi Edge Computing (MEC)

The panel discussion on MEC involved representatives from different stakeholders, i.e. standardization body, network operator, infrastructure vendor and research institution. The panel focused on introducing Multi-access Edge Computing from a standardization perspective and discussions on selected MEC topics related to 5G and IoT.

MEC is a system providing IT cloud computing capabilities at network edge, and it is providing an API framework for the development of end user applications. ETSI MEC secretary and Lead of Industry Group Relationship discussed about the role of Edge Computing in 5G system defined by 3GPP, and alignment of the work done in ETSI to standardize MEC. Activities in ETSI MEC include normative work (e.g. architecture, MEC APIs, application enablement framework) and are also focused on engaging all the stakeholders, e.g. by means of Proof-of-Concepts, as an important way to show MEC as a viable technology and help to develop a diverse and open ecosystem.

A presentation from Orange focused on networks slicing as an important concept for 5G networks, and defined it as a collection of logical network functions that supports the communication service requirements of particular use case(s). Network slices are created in order to meet certain network characteristics required by the Service Instance(s). Thus, in that perspective, the panel discussed also about the possible role of MEC as a supporting technology and generic infrastructure for the implementation of network slices (e.g. including IoT use cases).



Figure 27: Sheng Ann Yu of Ericsson at the MEC Panel Session

Distributed Cloud is an important concept for 5G introduced by Ericsson, as “an execution environment for Cloud applications across multiple sites, including required connectivity in between, managed as one solution and perceived as such by the applications also when it is heterogeneous”. The definition of Distributed Cloud focuses on unified management and orchestration of network resources for multiple workloads. ONAP is addressing some of the aspects. More industry efforts would be required to align Distributed Cloud Infrastructure with architecture principles. In that perspective, the aim would be to see more efforts from MEC on Cloud execution related topics.



Figure 28: MEC Panel Discussion

MEC and Open Source aspects were discussed by Fraunhofer FOKUS Institute. They presented a comprehensive set of software toolkits enabling the setup and development of 5G applications in an end-to-end testing environment. The presentation began on the fact that 5G is based on a comprehensive software system that uses all the resources available in the system. The network functions are becoming software only, thus convergence with IT is the central point. The role of software communities (driven not only by academia but also by industrial partners) can be an important booster for 5G (and Open Source activities often result beneficial for standardization work). The presented use case on “Edge Intelligence in Enterprise Networks” showed the importance of moving the intelligence towards the edge, and opportunities given by MEC for a customized deployment of 5G networks.

Game Changer IoT Innovations

Rather than everyone remaining inward looking and copying each other in the game changing IoT innovation sector, we better look for ways to engage as much as possible end-users to help create them. Technology push doesn't work in IoT but who dares to offer a platform in an open eco-system for experimentation. Data is only one ingredient for successful IoT applications. The other one that is often disregarded, is domain/application knowledge. And it will take some time before owners of data without application knowledge have figured out what relevant applications they can serve. This is the opportunity for teaming up. Examples: Close to home, I believe the Philips HUE personal lighting system is an example of a very relevant IoT innovation and what makes it game changing is that this platform with open API's is leveraging more than 200 external developers and partners.

On the smart city activities, I believe that the Synchronicity project with more than 40 partners are applying the right mindset which will lead to a 'game changing' trend (rather than a single use case). Large scale piloting is the way to go. We need to start selling results, return of investment and enhancements to the state of the art, we should avoid making things just because we can, technology is here to solve real needs; let's understand what the business models are and how IoT can be exploited in a new shared and open economy. Examples: Bike sharing solutions in Smart Cities are offered by private companies who invest to offer it based on return of investment, energy Services Companies based on results, sharing economy solutions, private infrastructures made public (Uber, Airbnb, etc.) What is the real value and the maximum cost of making it beneficial to the generation of connected solutions?



Figure 29: Game Change IoT Innovations Panel Discussions

New IoT technologies and building blocks can enable a reconfiguration of traditional value chain and business. I will talk about, Two game changing technologies; Low power wide area networks, and Distributed ledger technologies.

There is a war going on. The winners are the ones with the largest data lakes. Regions and nation states are dying. There is a lot of trouble ahead. If leaders are not taking drastic measures, it will be every man for himself.

IoT 4 Developing Countries: IoT Inclusion and Cooperation

Panel members presented their experience in international cooperation for smart cities, influencing the benefit for small companies, the value of platform creation for multiple partners accessing the resources. They stressed also the need and the right time to engage in collaboration for the benefit of developing countries. For small companies, it is not easy to develop large scale experimentation facility, and through international cooperation, many resources can be saved and the companies can deliver competitive high-quality output. Also, it was pointed out that many joint initiatives have been generated through various EU level projects including FP7 and H2020 involving various international partners including developing countries.

This has provided opportunities for many developing countries to have access to advanced research capabilities and research resources. The audience asked several questions in relations to the IoT theme for cooperation. There was a pertinent question about the degradation of soil as a result of poor use and its implications. The panel members addressed the benefit of IoT in accurately measuring moisture level at various depths and how it can be used to protect the soil for sustainable management and use. It was a well-attended session that generated interesting questions

IoT 4 Developing Countries: Emerging IoT Solutions for Developing Countries

The objective of the session was to communicate and discuss IoT solutions from developing countries/regions so that the audience can gain knowledge and understands the specific requirements and constraints of developing and deploying IoT systems. The session further intended to promote collaboration between researchers and practitioners from EU and developing countries/regions to debate on ways and approaches for developing IoT technologies that promote sustainability. The session consisted of the following panellists; CPQD Vice-President, Head of Department DMS, IIT Delhi and CSIR, South Africa.

In the first presentation, “Emerging IoT Solutions from Brazil”, the focus was IoT for Agriculture in the São Martinho farm. Being an outstanding example of IoT implementation, the farm is dedicated to the sugar cane plantation and has a private LTE network. The network has a large area coverage, spectrum availability for broadband services and the licensing cost is low. In the farm, a project was implemented, project CAO (Centre of Agriculture Operation), which began during the harvest of 2017/2018 and ended during the harvest of 2019/2020. The project consists of collecting and analysing information through an agricultural machine. São Martinho is a large operational logistics operation where harvesting machines cover 3,500 km per day; the fleet, in one day, travels the equivalent of 2 trips around the world.

In the second presentation, “Smart Cities and Services in India”, the focus was the two of the national priority programs: Digital India and Smart Cities. Digital India focuses on digital infrastructures that are useful for everyone, on services at the request of citizens and digital empowerment of citizens. The Smart Cities are a subset of the Digital India program which aims to develop 100 smart cities, such as satellite cities in larger cities, modernising them and developing an IoT industry ecosystem in the country. To advance this development, USD 15 Billion and a process of city selection is already available, where all cities can participate in the challenge.

In the last presentation, “Emerging solutions from Africa”, focus was set on the current situation, problems and challenges of implementing IoT in Africa. Some of the problems and challenges of this were highlighted as follows:

- Energy: national blackouts and solar being used;
- Connectivity: it is quite expensive connectivity for IoT systems;
- Support and Maintenance: limited access to qualified maintenance;
- Cost: High costs of the IoT solutions considering the Africa economic context.

Three IoT solutions that have been implemented were presented:

- Lumkani: fire detection – this device is an early warning system for fire, send message alerting messages the community and having a GPS location for emergency response.
- Intelligent water hand pump – this device has a remote monitoring of hand pumps, daily and seasonal patterns and proof of operational concept in Kenya.
- Intelligent water management system – this device makes detection of water leakage in a municipal water infrastructure, is based on LoRa and uses dynamic hydraulic models (location and leak detection).



Figure 30: Speakers of the Session on Emerging IoT Solutions for Developing Countries

Due to the great interest in the implementation of IoT technologies in developing countries and Africa, the discussion focused a lot on how it is possible to really implement these technologies in the field. The WAZIUP approach was discussed and revolves around the following aspects:

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

This approach has been used in Africa and could be used in other regions.

Nano IoT Tech- The Future of Nanotechnologies

During this one-hour session, the four panellists portrayed a broad future of Nanotechnologies for IoT, which spanned from the physics of molecular design, touched upon semiconductor technology roadmaps and also covered concrete applications of those in life-saving personal systems.

It is indeed fascinating to see that we can dynamically control the properties and motion of nanostructures, super-low power micro-electronics technologies are being developed and will soon enable complete IoT-on-a-chip design, permanent yet non-invasive sensing of a human body's vital signs may save lives by automatically learning and detecting 'anomalies'. An interactive Q&A session explored the links between those trends.



Figure 31: Philippe Quinio of STMicroelectronics introducing the Nano Tech Speakers

IoT Smart Living and Ageing Well

There are more and more social and economic implications from an ageing population in Europe. Some sources from the European Union are mentioning that today the population of elderly people (above 60 years) in Europe is around 25% of the total population. Based on current population trends, by 2050 this will likely exceed 35%.

As a society, we need to face the challenges related to Ageing and turn them into opportunities. By creating opportunities for Smart Living, the Internet of Things creates a huge opportunity, perhaps the largest technology movement of our lifetime. We see the following challenges:

Acceptance of Smart Living aids, Use-cases, Impact assessment and measurement, Evangelization, Sustainability & Expansion.

Acceptance

Being reluctant to change is part of human nature. This is even more the case in Elderly people. They don't want or cannot deal with Smart Living technologies that often require complex installations. Especially if they are far from being convinced that any new equipment will benefit them.

Therefore, adoption of Smart Living technologies requires open interoperable and affordable platforms that are based on Plug-and-Play principles and minimize intrusion as much as possible. Here IoT technology will be a key solution to develop personalized intuitive smart services for an ageing population. This is a new whole market offering excellent business opportunities.

Use Cases

Smart services for ageing populations fall into several IoT Verticals:

- Smart Cities: Technology enabling cities to make more efficient use of available resources.
- Smart Home and smart buildings: Technology that makes Homes smarter for better – more convenient and productive living.
- Smart Health: Technology to empower people, especially the elderly and disabled, by giving them access to smarter healthcare with preventive health applications.
- Smart Mobility: Technology that makes mobility Safer and more connected.

To support the development and acceptance of innovative and smart services, we need to prototype them and then ensure large scale pilots of the most promising and valuable use cases. Just to mention a few of those services and use cases we can see: Health and Activity monitoring, Instant risk alert, Physical rehab, Social communication and Mobility. The

translation of these services into opportunities for new devices and new applications represents a huge opportunity for both technology providers and enablers and, by expanding the use of microcontrollers, sensors, connectivity elements, and power and signal conditioning circuits, increases the semiconductor content of historically passive devices or equipment.

More generally, the key functional requirements of IoT devices are sensing, embedded computing and connecting. For mobile connected things, power management, low power operation and standby are essential.

Finally, data in any critical applications, must be protected against cyberattacks and hacking.

STMicroelectronics offers a unique portfolio with all the key technologies and products for the IoT, addressing the specific requirements for the smart living environment that will help our ageing population continue to live well. This portfolio includes: Sensors and actuators, MCUs, Connectivity, Energy management and Security.

We believe that Smart Living for Ageing Well is a topic that raises social and economic challenges that can be met by the adoption and use of innovative smart services, supported by the latest advances in IoT technologies; those solutions are today mature enough to enable large scale deployments.

Smart Agriculture

What are the main ingredients for global success of European IoT applications in the whole agricultural chain?

There must be a clear identification of the stakeholders involved. However, identifying where the money will come from has been the biggest block of innovation in Ag tech and potentially the route to the market. For a lot of Ag tech products, the farmer is the primary customer and is targeted with large scale platforms (similar to investments in on-farm equipment and machinery); However, they are often not the sole beneficiary of the outputs (e.g. the processor, the retailer or government agencies also benefit) but the costs aren't shared. The agriculture sector in EU has suffered for decades with trust issues along the supply chain, which restricts innovative business models from alleviating these barriers. IoT technology has a role to play in securing the values and concerns of the producers and the entire supply chain.

Scalability is also a necessary ingredient. Designing for the EU with IoT solutions should be prioritized as well as scaling it up for other regions. The EU can make cost effective IoT Solutions on a global scale, such projects include; H2020 EU-US DISCOVERY H2020 EU Brazil Cloud FORUM and the EU-India FI-MEDIA projects, which is funded directly by the Delegation of the European Union to India. Participants from these countries are welcome to work together with us on topics of mutual interest.

Is the innovation in Ag Tech currently more driven by larger industry players or by smaller SMEs and start-ups? It is driven by the large Industry - Monsanto, John Deere. (Intel, IBM, Analog, Ericsson, and others). However, in Ireland, we are seeing some exciting research focused Small and Medium Sized Enterprises (Dairymaster and Keenans are two prime Irish examples) along with Agri-tech focused accelerators (THRIVE in California and WIT's hosted NDRC digital accelerator program, which is a catalyst launch program for digital SMEs). Larger players have access to the scale and technology (Since IoT is in the early stages). Soon we can see smaller players

too coming in to picture due to commoditisation of sensors and open source platforms.

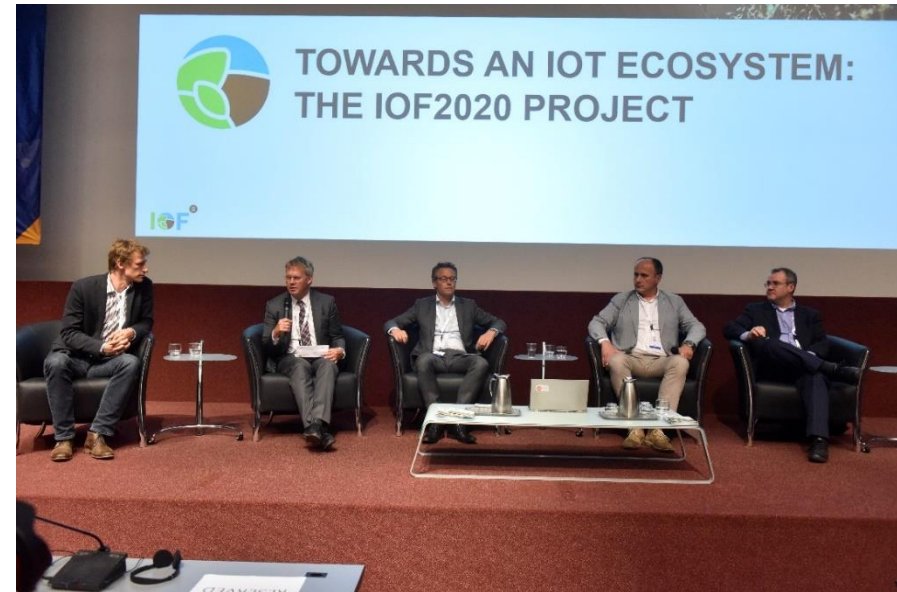


Figure 32: Smart Agriculture Panel Discussion

What are in your opinion the most striking challenges of agriculture in the next decade and how can IoT help to solve them?

In terms of innovation maturing over the next decade, the following was suggested:

Precision agriculture for sustainable farming is a very broad topic.

- In dairy/ beef, the biggest challenge will be to intensify production but with an overall reduction in greenhouse gas emissions. Advances are being made on this front by using IoT devices to capture very granular data about how the animal is performing in relation to the environment it is in. We have a project involved in developing this technology and running trials. This data is being passed to decision support systems that

are shaping the actions and processes of farmers. It is also being analysed on aggregation by genetics organisations for breed selection etc. We are seeing advances in on-farm automation technologies (automatic milking and feeding technologies) and while they have impacts on sustainability, their impacts are predominantly on labour saving currently. Future advances will see automation as a key driver of precision dairy farming.

- Within intensive indoor farming, managing waste is a key problem; However, the problems here are typically financial (cost of transporting slurry outweighs the value of it; cost of bio-digesters also outweighs the value of energy, etc.) It is still unclear whether IoT will have a major role to play here – as it may involve more financial incentives.
- Arable. The challenges here are identifying subtle changes in the crops, which indicate a nutrient deficiency/saturation during the growing period and also identifying key time to harvest (right amount of dry matter/water ratios). This is primarily being driven by R&D in satellite imagery (visible/ non-visible (IR) spectrum) and building services to government, producers and retailers. The machinery manufacturers are focusing on IoT technologies built in to their farm machinery to detect these changes. High value crops (wine) and indoor soft fruit and vegetables, where automation is already prevalent, the systems are getting smarter and more autonomous.

Web of Things

The IoT is a science primarily focusing on creating the most complex ways of turning lights on. The Web of thing is a refinement of the internet of things by integrating smart things not only into the internet but into the web architecture application.

Some of the questions addressed were: What do you think the Web can bring to the IoT? Do you think we will see convergence in IoT protocols? Why does interoperability matter? What future evolutions of the Web itself could benefit the IoT? What are the requirements for the interaction model exposed to applications? How are end to end trust and security across different IoT platforms enabled? How to enable semantic interoperability (after explaining what that means)? How are variations across vendors and IoT standards dealt with in respect to capabilities?



Figure 33: Web of Things Panel Discussion

IoT Finance, Market and Industry 4.0

IoT Fourth Industrial Revolution

The panel “IoT & the Fourth Industrial Revolution” aimed at studying and debating the role of IoT technologies in the implementation of Industry 4.0, or the so-called Fourth Industrial Revolution. The panel was representing some leading-edge EU H2020 projects mostly active in the Factories of the Future CPPP and addressed both the most innovative technological offers and the most urgent needs and challenges from the manufacturing industry CEA LIST representing a steel moulds manufacturer SME.

They highlighted the importance of a holistic approach to Industry 4.0, where strategy definition, maturity assessment and roadmap planning are fundamental phases for a successful take up of new IoT technologies in industry. It was also debated whether it is easier to implement an Industry 4.0 project in a large manufacturing enterprise (such as WHIRLPOOL) where investment resources could be adequate, but decision making processes are sometimes too complicated and long; or it is easier to implement it in a SME (midcaps in particular), where an innovation inspired top management could proactively drive the process, but where economic and financial constraints could prevent Industry 4.0 from being fully adopted and implemented in the field.

IBM solutions drive the transition from SCADA to IoT, which are currently experimented in the PSYMBIOSYS project in the furniture and textile industrial sectors. Uri concluded his presentation with a more detailed description of PROTON (Proactive Technology Online, FIWARE generic enabler) Complex Event Processing tool and of the “Cognitive Computing of Everything” approach derived from WATSON platform.



Figure 34: Sergio Gusmeroli of Politecnico di Milano at the IoT 4.0 Industrial Revolution Panel

The FAR EDGE H2020 Research and Innovation Action stresses the need of new architectural and computational layers between the Real World of Factory Automation (e.g. Machines, Robots, Conveyors) and the Digital World of advanced analytics, usually implemented in Cloud environments and sometimes in HPC advanced data centres. A new edge-oriented computational paradigm is in fact emerging, especially pushed by Fog Computing concept (e.g. the Open Fog specifications, the Nebbiolo implementation) and by factory automation advanced highly distributed architectures such as the Local Clouds developed in the ARTEMIS Arrowhead project and currently at the basis of the new ECSEL Productive 4.0 initiative. A further challenge pointed out by John was the possibility to integrate advanced Distributed Ledger Technologies (e.g. Blockchain) in Factory Automation scenarios where real-time responsiveness is often a hard requirement.

It is important to have an Industry 4.0 strategy before undertaking any advanced technology adoption process. WHIRLPOOL integrated solution path towards Industry 4.0 was presented as well as the role of EC-funded H2020 projects in the realization of this plan. Most importantly, the PERFORM reference architecture for plug & produce factories of the future, the BEinCPPS experimentation for a portable CPS-oriented Testing Unit for white goods quality assessment and the FAR EDGE industrial case for highly distributed factory automation architectures infinite goods internal movement and logistics.

Finally, the Smart Mold industrial case of the BEinCPPS project, implemented by Georges Pernoud, a successful mid-size producer of steel moulds for plastic injection machines in the automotive value chain. The industrial case is a typical case of a smart Product-Service System where on the one side the product (the mould) is equipped with advanced sensors and IoT devices, on the other side collaborative and coordinated business process in the whole value chain must be carefully designed and put in place, including workers awareness, education and training.

The panel was concluded by a short debate about the competitiveness of EU-led digital platforms and IoT platforms in the implementation of the Fourth Industrial Revolution. More in particular, a slide from EC DG CNECT showing examples of community-led and market-led Digital Platforms for Manufacturing was commented and positioning of the relevant projects identified and discussed.

IoT Start-Ups – Accelerating Innovation and Market Penetration

"Success stories will be written by people thinking out of the box, proposing disruptive technologies, and going where no man has gone before".

Shared experiences on how important it is for SME to make decisions about putting focus – on HW, SW, Platform, Sector specifics or being sector agnostic.

Other important topics that were discussed included: open innovation 2.0 and the context for IoT start-ups.

IoT is too new with great expectations. Success stories will be written by people thinking out of the box, proposing disruptive technologies, and going "where no man has gone before." IoT is about things, as a start-up where should you focus? In hardware or in software? or are platforms/SDKs mature enough to be in both?

There are 4 main components in IoT-based IT Modernisation; Sensors, Communication protocols, Platforms and Applications.

Do we have to innovate with technologies or alliances? Are you an IoT product or an IoT platform? We can sense what technologies will emerge, but what about alliances and for which reasons?

What are the accelerated growth factors and how can customer values be understood on an IoT platform?

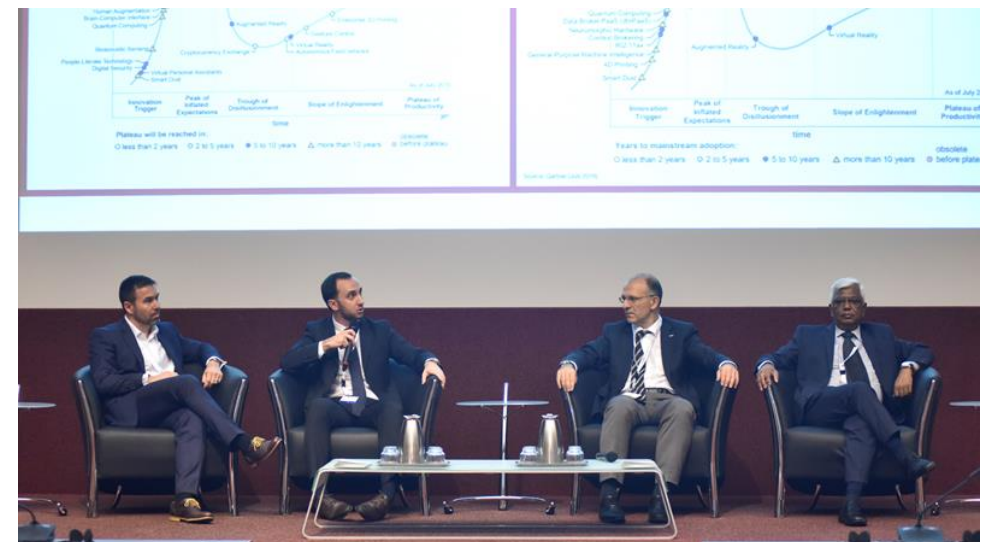


Figure 35: IoT Market Perspectives, Panel Discussion

IoT Security and Privacy

Security and Privacy

The Deputy Commissioner of the FDPIC, Chair of the French speaking Association of Personal Data Protection Authorities (AFAPDP) and Vice Chair of the Committee of Convention 108 presented an overview of Convention 108. The convention 108 of the council of Europe for the protection of individuals regarding Processing of personal Data is a legally binding international instrument which ensures protection of every individual, whatever his or her nationality or residence, with regard to the processing of their personal data, thereby contributing to respect for his or her human rights and fundamental freedoms, and in particular their right to privacy (Article 1). A Modernised Convention will be more consistent with European Union law. Convention contains basic data protection principles that are already universally recognized. Data protection will become more effective. In a globalised and digitalised world, a universal framework for data protection is an absolute necessity.



Figure 36: IoT Security and Privacy Speakers

The Deputy Director of Information Technology Laboratory presented the program overview of National Institute of Standards and Technology. IoT has the potential for enormous societal benefits in health, safety, energy, security, productivity and environment. NIST Information Technology Laboratory has extensive expertise related to IoT. Examples of research areas include: Security and Privacy, Networking, Data Analytics, Timing. The Program builds on the decades of cybersecurity research and experience on technological underpinnings of IoT.

IoT Risk Management

The session focused on how risk management in IoT should be a process aiming at an efficient balance between realizing opportunities for gains while minimizing vulnerabilities and losses. The debate was spurred by the reflections of prof. IoT Risk Management should be considered as an integral part of management practice and an essential element of good corporate governance. Risk Management should be an endlessly recurring process consisting of phases which, when properly implemented, enable continuous improvement in decision-making and performance improvement.

The heterogeneous, distributed, and dynamically evolving nature of Cyber Physical Systems (CPS) based on Internet of Things (IoT) and virtualized cloud architectures introduces new and unexpected risks that cannot be solved by current state-of-the-art security solutions. The solutions for IoT Risk Management are being explored by ANASTACIA and will deliver paradigms and methodologies that will build security into the system at the outset, adapt to changing conditions, reduce the need of finding flaws and repairing them when the system is already deployed and provide assurance that the ICT systems are secure and trustworthy at all times.

An analysis of the Normative Framework applicable to IoT was presented together with a consideration of privacy and security challenges arising from the GDPR and the NIS Directive that need to be considered in devising a IoT Risk Management strategy.

Privacy risk management in the IoT is also another important aspect that was discussed. This was discussed through the policy maker's viewpoint, the impact on standards, the impact of IoT on engineering, which should be conceived in a privacy oriented mode. To do so, it appeared essential to map the different stakeholders involved in the IoT value chain, as well as to have a privacy by design and privacy by default approach in engineering the IoT.



Figure 37: IoT Risk Management Speakers

Drones Privacy and Ethics

The discussion on the Unmanned aerial vehicles (UAVs), colloquially known as "drones", evolved around social and ethical implications of IoT-connected drones. The topic was explored by three different angles. The first speaker presented a concrete approach for commercial drones deployed in agriculture. The case was that of drones used to spray on vineyards in Switzerland in order to comply with the pesticide reduction plan voted by the local government. The second speaker focused on all the issues related to personal data protection. As drones become increasingly used for civil purposes, such as goods delivery, infrastructure monitoring, agriculture, humanitarian action safety and privacy risks spread. For this reason, suggestions and strategies to cope with data protection in drones were mentioned:

- Include data protection in «sense and avoid» solutions: limit/delete data collection/collected.
- Safety by design: temporary coded key.
- Include data protection in flight control devices: geo-blocking avoiding flight over specific zones.
- Include data protection in video systems.

The final speaker, provided a comprehensive view on what are the social and ethical implications connected to the large use of drones, such as the necessity to avoid surveillance practices, safety and security in the context of drones connected to IoT networks, since approximately 2.3 billion connected things will be used only in 2017, a 42% increase in the number of connected objects since 2016. The case of regulation of drones in UK was also a topic of discussion, and concluded for more discussion and communication with the public to clarify what drones are being used for.

IoT and Sustainable Development

SDG: IoT for Industry Innovation and Infrastructure

The session on “Structure of IoT for Industry Innovation and Infrastructure” was organized during the Internet of Things week on 9 June 2017. The session was chaired by Head of the United Nations Industrial Development Organization (UNIDO) Office in Geneva, and speakers from the UN agencies and private sectors discussed about the utilization of technology in various projects and explained the IoT role in SDG9.

In developed EU countries, some companies are leading in the IoT field. At the same time, the EU countries have strong competitors from non-European countries. For example; companies such as Apple and Google, etc. Therefore, the European countries need to focus on skills and workforce since digital transformation requires a skilled population. Moreover, there is need to eliminate the legislative and regulatory gaps. Value chains are developing different models of technologies that will drive to the Eco-System, which is important for the economic development. There are new business opportunities related to IoT that provide smart environment such as smart energy, transport, manufacturing, homes, etc.

Ericsson has been supporting SDG 9 and has implemented many projects and activities related to the IoT which will accelerate achieving the goal. For instance, students from the Eindhoven University together with Ericsson, developed a solar car project. In addition, Ericsson is collaborating with the Netherlands on a project named ‘Talking Traffic’ which connects to traffic lights, recommends speed and helps improve the traffic situation in the country.

Ericsson is using the IoT technologies for various measurements of its projects, including water quality and its temperature measurements. The IoT technology is being used for air quality measurements such as humidity, temperature, pressure and CO2. All measurements are available on the public website; therefore, citizens can have direct and real-time information and feedback about conditions of water and air. The Government can also

receive information or complaints from citizens in regard to the quality of water.

Siemens focuses on the development of technology and infrastructure by using IoT tools for 20 years. For Example; analysing data, providing applications and bringing new ideas to the market. One of the main challenges in the IoT field is security of technology which include: monitoring of quality, identifying solutions such as potential failures in baggage trail in the airport. For Example; If the defect appears in the equipment, customer has 2 months to replace the equipment. UNDP is working with private sectors, government, civil societies of 170 countries. In addition, the UNDP focuses on poverty, governance, climate change, gender equality and health related issues.



Figure 38: Benjamin Kumpf of UNDP at the SDG Session on IoT for Industry Innovation and Infrastructure

Achieving the SDGs is a challenge because it involves monitoring 17 goals which have 230 indicators, 84 are TFI which lack a methodology to measure them. This challenge creates an opportunity for the Internet of Things Market for finding measurement methods for these indicators.

In Conclusion, Connectivity is important for developing countries. However, different countries need different technologies which is a challenge for IoT. Centralized manufacturing approach is needed for developing countries. Many people have access to mobile phones, the coverage of 2G network is more than 90% of world population. The coverage of 3G and 4G which are essential for internet access are much less, utilization of 3G is 65% and 4G is 4% of world population. It is expected that the mobile internet will increase in developing countries in the next five years.

SDG: IoT for Environment

Senior Policy Analyst from ITU, moderated this Session. In her introduction, she noted different definitions of IoT exist. ITU-T Recommendation Y.2060 defines IoT as “a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies”.

The development literature often views IoT as synonymous with sensor networks for development purposes (e.g. for detecting fire, monitoring crop growth and yield rates, water pump outputs). Ericsson’s definition of connected devices and IoT includes sensors, but the GSMA’s definition of IoT excludes both sensors and Wi-Fi. So, it is not always clear how IoT is defined, but generally it covers a condition of a growing number of devices, more and more devices being connected.

In the Sustainable Development Goals (SDGs), environmental protection is (mainly) perceived as applying to SDGs 13, 14 and 15. In fact, environmental protection underpins all other Goals – it is not possible to feed a growing world population now or in future without finding an equilibrium that enables sustainable agriculture, while respecting and protecting our

environment. Indeed, the World Wildlife Fund (WWF)’s Living Planet 2017 report effectively gives us a definition of truly sustainable development – according to this report, in 2012, humanity consumed the equivalent of 1.6 times the Earth’s biocapacity. For development to be truly sustainable, we need to use our natural resources more efficiently to bring our consumption into line with the resource capacity of the Earth – even more challenging as the UN predicts that the Earth’s population may reach

With regards to the environment, IoT is already being used by conservationists to monitor and protect and preserve the environment (e.g. to monitor river flow rates, pollution levels). However, other groups and people are using IoT to make more efficient use of natural resources, to exploit resources even more efficiently to feed a growing population. This panel reflected both aspects – with the example of using IoT to monitor the temperature and conditions on the Great Barrier Reef, while using IoT in smarter agriculture. When discussing the use of IoT for the environment, we need to be aware of the purpose for which IoT is being used, and of the different values in the room.

Managing Partner of Schuttelaar & Partners, described his IoT2020 project to strengthen European farming and food chains using IoT technologies. This project aims to develop an ecosystem of farmers, food companies, policy-makers, tech providers, research institutes and end-users to apply technologies and maximize their benefits throughout the entire food chain, maintaining its competitiveness and increasing sustainability. This project has 5 use cases (arable crops, dairy, fruits, vegetables and meat) in 19 trials throughout Europe demonstrating the value of IoT solutions for the food and farming sectors; however, interoperability remains a challenge. The ultimate success of this project could even enable farmers to manage their farms from an indoors screen! This project could also help adapt and bring modern digital lifestyles into more traditional farming scenarios, maintaining the interest of a new generation of young farmers. Questions after his presentation focused on the different approaches to smart agriculture being following in different countries and regions.



Figure 39: Questions from the Audience

Professor of Electrical and Electronic Engineering at the University of Melbourne described the use of IoT on five different sites on the Great Barrier Reef (including Heron Island and One Tree Island) to monitor water temperature, ocean acidification and dissolved carbon dioxide in the water, and relate this to coral health and survival. He described some of the technical challenges which the project has overcome in the deployment and reporting. Questions focused on the need to move to action.

Chief of the World Weather Research Division of the World Meteorological Organization (WMO), described the use of sensor networks and global information systems for monitoring weather, climate and extraordinary weather events. Climate influences multiple aspects of society, and WMO has developed an Integrated Global Observing System (GOS). The amounts of data generated are enormous, it is now becoming a big problem to

handle the amounts of data which it is possible to generate (up to 10 Tb). Questions focused on how the interpretation of the data can still depend on the purpose and methodology – important questions persist with regards to climate change, despite the large amounts of data available. Resolving information problems requires getting all Member States to work together on this issue to provide better and richer information to monitor progress and enhance decision-making.

- **Why is this topic important?**

This topic is important, because environmental preservation and global warming will soon affect the quality of life on the planet of every single inhabitant. The IoT offers many important opportunities for gaining information about our environment, and enhancing decision-making.

- **How will it affect you?**

Environmental change and degradation affects us all, in terms of quality of life.

SDG: IoT for Peace, Justice and Strong Institutions

The discussion opened with an introduction to SDG 16 and the proposed targets to guide work going forward (Report of the Inter-Agency and Expert Group on Sustainable Development Goal Indicators (http://www.un.org/ga/search/view_doc.asp?symbol=E/CN.3/2016/2/Rev.1))

The Moderator observed that the aspiration for peace in Goal 16 was to promote peaceful and inclusive societies with a view to sustainable development, not peace in the abstract. Further, since the discussion was taking place with a view to exchanging information about the development of the Internet of Things, there should be a focus on what technical mechanisms and applications might be put in place to promote such targets as the provision of public access to information to assist persons having limited experience and education. While technology may be helpful in managing information, the importance of respect for the rule of law to ensure equal access to justice was also stressed.

The first Speaker presented seven basic issues relating to crime and security in an Internet environment, particularly in cities: when people gather, opportunities are created – both positive as well as negative. The rise of “cybercrime” presents significant challenges for traditional security operators and governments to meet. A state’s legitimacy is normally built on its potential to protect its constituencies – first by providing physical security, later economic and social; and this is now under serious stress. Our societies are becoming ever more complex and specialized/ fragmented. It was observed that there is a need for public/private sector cooperation to create a “smarter security” ecosystem. This may entail self-regulation measures taken by the private sector such as setting norms/standards through professional organizations.

The following Speaker noted that the main and basically only benchmark that should be addressed in reaching consensus on the advisability of a proposed information management system is to prove that such a

systematic approach would potentially lead to less evil; and he noted four requirements that may be crucial to cope with evil:

- Cultivation of moral imagination because it changes the internal conditions and makes evil-doing less likely,
- Enforcement of strong prohibitions,
- Enforcement by threatened or actual punishment for violation, and
- Holding evil-doers responsible.

He described a proposed “cybernetic system” and argued that, if IoT and the proposed scheme were instrumental in identifying personal talent, in giving feedback on physical and mental health, and in creating social cohesion, then there would be a positive match for the first requirement.

While many other targets set for Goal 16, such as identity management or equitable access to information, were important to address in an IoT context, further discussion remains for another day.

APPENDIX 3: WORKSHOPS

A) One-day International Seminars

Globally Interoperable IoT Identification and Data Processing

The overarching theme in the discussions was how we can stimulate data exchange (science), data trading (industry) and thus re-use in different contexts. Two sub-topics seem to be most crucial:

How can data creation, organisation and management be changed in a way to make data intensive projects in science and/or industry much more efficient and thus enable re-use effectively? What is the right level for global interoperability and which steps could stimulate re-thinking? Is the Digital Object Architecture which puts global Persistent Identifiers (PIDs) that are resolved to useful property information in the core a good kick-off point?

How can an open data forum be created where data is offered to foster exchange/trading and how does it need to be structured? How can data collectors in industry be convinced to respect the rights of all stakeholders and based on clarified rights become willing to trade data on such a forum.

This report is not the place to give answers to these questions, but the Research Data Alliance (RDA) plenary P11 in Berlin in March 2018 and its side meetings could be a good place to address the questions in more detail.

Introduction: Peter Wittenburg

Our current data practices are highly inefficient, too costly, not scalable and excluding many. IoT with its many smart devices all creating data streams requires a fundamental change.

RDA is working on removing barriers at global level to make data work more efficient and produced already several relevant results.

Globally resolvable persistent identifiers are in the core of new concepts such as Global Digital Object Cloud and Type-Triggered Automatic

Processing which may give directions of how to overcome the huge fragmentation. RDA is ready to make the bridge towards industrial data challenges.



Figure 40: Peter Wittenburg of Max Planck Computing and Data Facility

Discussion: Robert Kahn

Internet was successful due to its simplicity, openness, device independency and scalability. Internet on purpose did not address higher level issues such as what to do with the data that is being exchanged via its protocols. CNRI1, designed the Digital Object Architecture (DOA) to deal with digital objects on top of the Internet without dealing with the underlying infrastructures and technologies.

It would be "simple" again since PIDs that can be resolved to relevant state information are the anchors supported by a common PID access protocol.

The DOA is a perfect answer to the complexity of the IoT data domain.

Tobias Weigel

The international climate modelling community is preparing its new model phase as a preparation for the next climate report. The CMIP62 data model will be core for interoperability of the 100-250 PB of data PIDS will become a central role and will be generated for all digital objects and associated with standardised properties which are relevant for efficient data management within their global federation.

PIDS and standardised data types will also be the basis for automatic processing which is a requirement for the future. The systematic virtualisation as being suggested in RDA's global digital object cloud is a promising way to let the user simply operate with digital objects (do) and abstract away from all infrastructure and implementation details.

Tian Ye

Persistent identifiers (e.g. Handle, Ecode, OID, CSFT, etc.) are important for proper data management in many sectors in China and a few systems are in use already for different application scenarios.

Some examples indicate the massive use of PIDs in Chinese IoT industry, such as product traceability, supply chain management, smart agriculture, industrial Internet, and so on. CNIC has built the NIOT platform on top of the various independently operating PID services, thus accepts the variety which has emerged and relies on web services (the current major demands) to be able to resolve PIDs.

NIOT is a unique ID platform in China. It provides an application layer routing and addressing solution that establishes a mapping relationship between IoT object ID and its data ID. So, in the network layer, NIOT can adopt TCP/IP architecture or any other network layer routing protocol.

With NIOT, China has realised a national identification service platform that must cope with the various demands put forward by IoT and other industrial fields. The service platform is based on an increasing number of nodes to support high resolution demands

Peggy Irelan

Data can be seen as the new oil, but it is yet not traded at all - a Marketplace platform for data is urgently required. A separation of the collection and the transaction process is the basis for more trading.

A few other measures such as a safe place for data, powerful search engines and flexible analytics services are required as well. Standardisation is relevant, however there are many initiatives that deal with different levels of interoperability. Ways for data processing at the earliest point (on the chip) need to be explored as technical innovation must be paralleled with business model innovation.

André Zwanziger

For T-Systems3 the development of a Multi-IoT Service platform is an urgent need, since it offers amongst others the integration of data from many different sources.

T-Systems is currently focussing on an all-in-one solution to satisfy the needs of their customers, i.e. they use internal identifiers for the digital objects in addition to the identifiers, type descriptors etc. that identify for example the sensors that are creating the data. Their system would be flexible enough to work with global name spaces. Their Multi-IoT Service platform makes use of the most optimal features from different cloud solution providers which also is a reaction on the customer wishes to not create dependencies. They see the need of a data market place to improve trading and seem to be ready to react on new market needs

Alexander Ntoko

For ITU4 combating counterfeiting in its various forms is one of the big challenges because its solution requires addressing different issues such as trust and interoperability which are considered important for IoT.

At each step in a production/delivery chain, provenance information including precise identification is essential to trace what happened and

using the built-in Public Key Infrastructure (PKI) to establish trust throughout the process.

Steps in a supply chain will all come with their specific identifiers making interoperability a vital element for a solution. Identifiers need to be associated with the properties of the object (including the unique fingerprint of the object) to check for authenticity.

ITU-T X.1255 provides the open architecture framework for trust and interoperability for IoT identification. The Handle System has the required features for implementing interoperability and trust in IoT.

Jürgen Heiles

Identification is of course required in any system of interacting components, i.e. identification in IoT is of high relevance. Different entities are involved in IoT systems such as the "thing", its virtual entity, an IoT device, an IoT service and finally also a user - they all need to be identified to make interaction between them happen.

The thing in IoT is the object in the interest of the user. IoT devices like sensors and actuators are used to interact with the Thing, but they are not the Thing except for the case the user is interested in the IoT device itself (e.g. supervision and maintenance of the IoT device).

Identifiers of different entities in an IoT system are associated with different requirements and there are practices which cannot be ignored

Communication identifiers like IP or Ethernet MAC addresses are an integral part of each communication protocol. They are essential to setup the communication in IoT, but they should not be used as identifiers for things as communication addresses and interfaces of a thing may change.

AIOTI6 has a special task force to discuss IoT identifier issues in depth and a survey has been done in the wider IoT standardization, research and user community in order to stimulate the discussion.

Juanjo Hierro

Smart solution finding requires gathering and managing context information at large scale.

FIWARE7 offers a simple standard API to manage context information and supports many IoT protocols. FIWARE is working out a few data models for different application domains which are at this moment at a high abstraction level defining terminology.

FIWARE meets the requirements of the Industrial Data Space initiative which is a German initiative that defines and organises industrial data space which promotes data trading. FIWARE is developing a first open source implementation of this Industrial Data Space .



Figure 41: Robert Kahn of CNRI

Panel

Here we list some of the major statements made by the panellists, often questions describe best what was said. For the huge IoT domain we obviously need new types of search engines to find useful data, semantic mapping costs a lot of time and in interface designing semantic specification is often neglected

We need to work on a "data market" and need to understand how we can structure it and which role brokers for example can take. A big question is how we can make data valuable so that data trading becomes popular and a related question is whether academia can help by testing methods.

Obviously, complexity of systems for IoT data become so complex that only plug & play components will help to not collapse. Of greatest relevance is to create a basic interoperability layer which will synchronise efforts. Need to accept the basic and fundamental role of globally resolvable identifiers for a functioning data universe. IP provides worldwide interoperability at the network layer, data interoperability is especially required at the semantic layer as one of the complex dimensions in the data domain, finding agreements at the semantic layer is not trivial - but they would ease world wide data exchange also across different application domains enormously. The usage of registered types which are also associated with an identifier will be essential to improve automation

The blockchain model is a way to structure data so that provenance is inherently included.

How can we ensure that the rights of data owners (who is the owner in case of wearables) is taken care of, will a complete identification of all participating actors and its store in the PID record for example be sufficient to negotiate rights in an automatic scenario?

The lack of quality in data and metadata is a huge problem, i.e. much effort is put in cleansing before data can be re-used, is there a better way to improve quality. How to decide about the correctness and authenticity of

data before re-usage. Metadata is obviously crucial to determine whether data can be re-used in different contexts, how much context information is required to decide about usability. In IoT for all steps in a transaction chain validation measures are crucial to make data valuable.

Security at all steps is a major concern in IoT chains to establish trust in the created data, different levels of security can be applied dependent on the application

IoT Platform Convergence for Smart Cities



Figure 42: Martin Brynskov of OASC leading the Workshop on Smart Cities Convergence

Ten new cities joined the OASC global initiative at the IoT Week in Geneva. Together with the Mayor of Carouge, OASC chair Martin Brynskov announced a 6th Wave of new members working together with over 100 other cities worldwide to establish a global smart city market based on city needs. On stage at the official conference reception for IoT Week, OASC announced the 6th Wave of new members. Carouge and Geneva are the first cities to join from Switzerland. Cuiába, Garanhuns, Parnamirim and Recife are four cities joining nine current member cities from Brazil. Logan and Ipswich are the new cities joining three existing member cities from Australia. Fredrikstad and Gjesdal are two cities joining three current member cities from Norway.

The OASC initiative now includes 114 cities from 23 countries working together as they share best practices and shape technological underpinnings of economic and social benefits that global smart cities can offer. Together with current members, these new cities bring a wealth of smart city knowledge and concrete activities to the network.

Mayor Nicolas Walder of Carouge spoke at the reception and stated: “The City of Carouge, member of the SynchroniCity IoT Large Scale Pilot for smart cities, is leading the Swiss innovation in the smart city area. We are thrilled to join this fantastic group of motivated cities and we really look forward to work together to share experiences from across the globe that will enhance our ability to serve our citizens locally, to increase the sustainability and to protect the climate of our planet.”

Chair of the IoT Week and President of the IoT Forum said: “The extension of OASC towards new countries, such as Switzerland, and its inclusiveness strategy is paving the way towards more IoT interoperability within and among smart cities, at a global level.”

Martin Brynskov, Chair of OASC, announced that OASC, which is based in Brussels, is incorporating as a nonprofit association. Brynskov indicated that the legal formation should be completed within weeks.

“This shift is a natural evolution of our original intent when OASC was formed as a more informal, bottom-up movement,” Brynskov noted. “Incorporating now makes sense as it matures our capacity to give cities a strong voice when establishing standards, while allowing us to be more globally responsive to market and policy opportunities as they arise.

Breakout Discussions

The breakout discussion group dealt with "Personal data protection strategy". City representatives, industry and academic experts participated in the discussion. The session was moderated by Nikolaos Kontinakis (NK, EUROCITIES) and Lucio Scudiero (LS, Mandat international) and evolved around the provisions of the new EU General Data Protection Regulation (GDPR) and how SynchroniCity large scale project will work for its implementation. The points raised and discussed can be seen in the presentation that LS had prepared (link for PPT). Key take-aways include:

- There is a need to map the stakeholders that participate in data operations and the different roles they can play. From the design, procurement, deployment and operation of city systems, several different stakeholders can potentially take any of the roles identified in the GDPR: cities, citizens, data processors, data controllers, data integrators and data suppliers;
- The definition of personal data is pivotal in the implementation of the GDPR. Projects and initiatives that deal with this topic, need to be identified and studied;
- Users need to engage more in the data privacy discourse. Cities that lead the way could lead the way by establishing first "codes of conduct" on data privacy in EU level, thus setting the scene in the name of public interest.
- Standardisation and adoption of common practices is seen as a "sine qua non".

SynchroniCity is working in the direction of helping cities quickly and efficiently implement the GDPR through creating and testing Privacy Impact Assessment templates for cities; establishing a network of Data Protection Officers, at least for the eight cities that participate in the project.



Figure 43; SynchroniCity Workshop

B) Workshops in parallel

Brazilian Initiatives in IoT - Planning, Research, Innovation and Deployments

The Workshop covered almost all aspects of the current stage of IoT in Brazil.

With presentations made by very key people from the Brazilian environment the topics were covered as follows:

Ricardo Rivera and José Gontijo talked about the efforts of different Brazilian Ministries and agencies in preparing IoT plans and actions for the near future.

Marcelo Zuffo presented innovations being made in USP - CITI Lab both in HW and SW.

Sergio T. Kofuji made an explanation in efforts in Universities for Communications, Fiware and new IoT projects.

Alberto Paradisi presented IoT projects being made in his institution in partnership with end users.

Paradisi and **Gabriel Marao** presented a very large deployment in progress in Brazil.

To conclude there was a debate with the attendants.

IoT @ Geneva

This session presented IoT R&D projects carried out (or under way) in the canton and the city of Geneva. Five projects, targeting several domains and involving both the public and private sectors, were presented. They were followed by a panel discussion that addressed the problem of federation of several IoT applications throughout the same city.

Presentation 1: From field to screen: an analytics approach in public transports. Speaker: Giovanna Centonze, TPG

Presentation 2: CityFeel: portable monitoring device for urban microclimate. Speaker: Peter Gallinelli, HES-SO

Presentation 3: “IoT in modern Industrial Control Systems”. Speaker: Robert Gómez-Reino, CleverDist

Presentation 4: Title: “Noise pollution monitoring: a practical IoT case”. Speaker: Didier Héral, Orbiwise

Presentation 5: Title: “Delivering energy savings with smart street lighting, a CityZen success”. Speaker: Marc-Elia Bégin, SixSq



Figure 44: Nabil Abdennadher of HES-SO leading the IoT @ Geneva Session

Combining IoT and Intelligent Robotics: Challenges and Opportunities

The goal of the workshop was to investigate the added value and the challenges associated to build integrated IoT and Robotic systems. The workshop was attended by 20 delegates in addition to the panel of speakers.

The introduction presented the view of an Internet of Robotic Things (IORT) as the next evolution of IoT, which can potentially transform the IoT landscape currently dominated by business models built on simple (passive) devices, moving the IoT a step further toward real integration between digital and physical world and enabling novel applications and business opportunities in almost every sector where robots assistance and IoT technology can be imagined.

An overview of the outcomes from the previous workshop was mentioned, from the European Robotics Forum (ERF) in Edinburgh, Scotland, UK (<http://www.erf2017.eu>). In particular, the attendees at the ERF workshop commented on the lack of shared understanding of techniques, methods and value proposition from platforms available across Robotics and IoT, and how the community needs common venues, including international workshops and journals, as well as open test-beds where to test integrated IoT & Robotic solutions. Furthermore, the gap between the level of financial investment and global success experienced by AI R&D in the US, and the fragmentation of research and business fronts in EU R&D. In order to address these problems, the Commission recommends the creation of a European "AI-on demand platform". This should become a "one-stop shop" platform to support integration of diverse AI solutions - including across IoT and Robotics platforms - and to promote the re-use and incorporation of AI technology in multiple applications, both in research and industry.

Discussions

The workshop included four discussions (see online presentations), respectively by:

- **Dr. Davide Bacciu**, Computer Science Department, Università di Pisa, Italy.
- **Prof. Pieter Siemens**, Ghent university, IMEC, Belgium.
- **Dr. George Michalos**, Laboratory for Manufacturing Systems and Automation, University of Patras, Greece.
- **Dr. Filippo Cavallo**, Bio Robotics Institute of Scuola Superiore Sant'Anna, Pisa, Italy.

The speakers had been instructed to respond to the following questions in their presentations:

Question 1 - Added value: What is the (observed or potential) added value of integrating IoT and Robotics solutions in your experience?

Question 2 - Enablers: What AI and cognition enabler - if any - have you used?

Question 3 - Platforms: What IoT and/or Robotics platforms you consider mature for your needs?

Question 4 - Obstacles: What are the obstacles to build integrated IoT-Robotics-AI systems today?

Question 5 - Lessons learned: can you share ONE single lesson learnt in your experience about integrating IoT, Robotics and AI?

The workshop concluded with a Q/A and general discussion session.

Dr. Michalos illustrated how in the domain of advanced manufacturing applications, IoT infrastructure have been first used to collect, analyze and visualize real-time production performance indicators, e.g. to inform existing optimization processes, and also to support human-robot collaboration, as in the EU project ROBO-PARTNER (<http://www.robo-partner.eu/>). Dr. Cavallo stressed the synergy between IoT (providing data), AI (analyzing data and providing actionable information) and Robotics (providing actuation and interaction capabilities). Prof. Siemens illustrated how IoT & Robotic integration can be exploited to support all phases of service provision, including task generation, task planning and task

execution. In his talk, Prof. Simoens had highlighted how his group in IMEC has released an OSGI-based middleware for robots, sensors and the cloud (<http://dianne.intec.ugent.be>). Dr. Bacciu emphasized how cloud platforms increasingly integrate data-analytics and machine learning services but also that they do not yet satisfy the IORT requirements for embedded intelligence and online adaptation. In his talk, Dr. Bacciu informed the audience of the release of an automated learning framework (Reservoir Computing Python library -ReCoPy) soon to be released by his group at the University of Pisa. He also remarked the lack of autonomous management of learning systems. Dr. Dragone commented that we are still at an early stage in IoT & Robotic integration. However, although the term IORT has been proposed only recently, the use of connectivity with other robots and sensors as part of distributed systems has been a growing and converging trend in robotics, e.g. in the ubiquitous robotics and robotic ecology paradigms implemented in EU projects such as RUBICON (<http://fp7rubicon.eu/>, Dr. Dragone was project manager of this FP7 project)) and Robot-ERA (<http://www.robot-era.eu/>, Dr. Cavallo was the project manager of this FP7 project). It was also proposed that IoRT systems may be seen as distributed robot systems. The panelists cautioned that IoT platforms may need to face significant scientific & technical challenges to cope with the sheer complexity, and security, safety and privacy concerns brought about by multiple things sensing, taking autonomous decisions, and moving, acting and interacting within every day physical environment, and suggested that bringing results from Robotics & AI R&D into IoT platform will be instrumental to address these challenges.

The workshop concluded with a discussion of future activities. The panelists announced that they are working on a white paper and that they will request contributions from both the Robotics and IoT communities to provide the seeds for a roadmap for integrated IoT, Robotics and AI.

Innovative IoT Platform Technologies

The session was targeted towards startups / SME's and other organizations operating the IoT sector. We used the session to showcase the attractiveness of IoT Projects operating with EU-funded framework and to invite relevant entities to join the European Platforms Initiative (IoT-EPI). The IoT-EPI involves 7 innovative projects around IoT Platform Development with inter-operability at its core. Two projects within IoT-EPI, that recently concluded their open calls, presented successful collaboration projects with IoT Startups. We also had the CEO of FIWARE Foundation, as another EU funded project in the IoT Space, talk about success stories from their FIWARE Accelerator. Finally, two projects with current open calls presented their solutions and invited startups & SME's to collaborate.

End-user Engagement: Multi-stakeholder Co-creation for IoT Contexts

During this 4-hour workshop, U4IoT provided a hands-on introduction on Multi-Stakeholder Co-Creative Workshops, a methodology designed to support Large Scale Pilots (LSPs) to engage end-users in their projects. The workshop was facilitated around the topics Smart Cities and Smart Health. Enabled by the Co-Creative Toolkit, the attendees of the workshop experienced a co-creative cycle of four phases. In these phases, they co-analyzed, co-designed, co-evaluated and co-implemented two solutions informing the future design and development phases of the LSP projects SynchroniCity and ActivAge.

For the topic Smart Cities, a solution for the following design challenge was co-created: "How can delivery systems of small packages be optimized to reduce traffic and pollution in the city centre during rush hours", simultaneously the Smart Health group co-created a service based on smart locks granting caregivers access to the homes of elderly on predetermined times a day or in case of an emergency.

The workshop was closed with a discussion exploring the possibilities on how U4IoT could support these two LSPs to implement the Co-Creative Workshop methodology into their projects and provide LSP partners with

training to autonomously organize and facilitate Co-Creative Workshops.

U4IoT is a CSA (Coordination and Support Action) that supports European Large-Scale Pilots to engage end-users in their projects. In the coming three years, a variety of end-user engagement tools and support services will be made available with the aim to make end-user engagement an integral and continuous part of large scale technical projects.

More information about the project can be found on the website: www.u4iot.eu.



Figure 45: U4IoT Workshop

IoT for Home Comfort and Energy Management

The aim of the session was to present the ongoing works of the European Commission on interoperability of smart homes & IoT solutions for building & grid energy management within the broad policy background stemming from the Commission priorities: Digital Single Market- Digitizing European Industry and Energy Union- Clean Energy for All Europeans. Specifically, this workshop was the follow-up on the high-level meeting on 'Interoperability for the Internet of Energy' organized by DG ENER and DG CNECT on the 11 May in Brussels to announce and promote the planned call for proposals under Horizon 2020 on IoT for smart homes and grids, which will be open in 2018. The Commission invited to the discussion representatives from industry to provide insights from the business perspective on smart home & IoT solutions ensuring energy optimization and comfort at home and to discuss interoperability challenge. The presentations made reflected on the different angles of the topics. Different aspects of home solutions were presentation in detail, the user expectations and the grid and policy perspective.

The vision on digitizing EU Industry through IoT and cross-sectorial industrial platforms was presented. Significant steps have been made since the launch of the European Commission's plan to help industry, innovators and public authorities to make the best of the digital transformation among which the latest is a joint initiative thriving the Internet of Energy. The Commission's strategy on Digitizing European Industry (DEI) will help European industry across sectors to fully use digital opportunities to stay competitive. H2020 already supports interoperability through IOT large-scale pilots under the Focus Area Internet of Things in WP2018-20 that focuses on smart architectures and standards. The creation of Internet of Energy relies on new business models that will sustain investment in an intelligent infrastructure for smart energy. IoT creates new business opportunities through cross-sectorial solutions and convergence of IoT, cloud and data analytics. Global standards definition and operationalization is still a significant challenge.

The next presentation involved the opportunities IoT creates for energy management providing flexibility to the system and enabling the consumer to actively participate in energy market. Smart homes can help maintaining the balance between grid needs, local conditions and comfort/user needs where interoperability is a key enabler. The Commission will support interoperability demonstration for smart home and grid communication through the large Pilot on IoT and Energy planned in the 2018 H2020 Work Programme.

Mr. Pellarin from the company SOMFY, quoted Commissioner Šeřčovič "Fight against climate change begins at home", and he also highlighted the high potential for energy savings in homes and offices. IoT and home/building automation can foster simultaneously energy efficiency, comfort and wellbeing. Central to this is the Internet of Things (IoT), which is the concept of connecting buildings and devices such as phones, lamps and washing machines to the internet, so that they can be remotely controlled.

Another key driver of the digitalization of energy is the idea of combining innovation with collaboration. It's a concept through which Somfy is fostering new partnerships through the Thread Group. Innovation needs to open to networks of innovators, to identify the most efficient technological solutions.

The IoT transformation also means that every device is potentially going to become a smart sensor, allowing energy companies to monitor generation plants, power grids and appliances in an unprecedented way. Mr. Kung, from TRIALOG, presented the relevant projects and initiatives at European and national level (France) which aims at smart grids development and demonstration (Interflex, Smart Grid Task Force, BRIDGE, Linky/Enedis, G3-PLC alliance).

"Smart devices, coupled with the increasing penetration of electricity, will bring a more dynamic and efficient market, with increased consumer participation. Mr. Ovidiu Vermesan from SINTEF defined the concept of

Internet of Energy, where flows of energy, data and money are simultaneous, bidirectional and decentralized.

These topics of home comfort and home automation have direct positive impacts on our daily lives while lowering our individual footprint on the energy grid and our environment. Preparing for modern energy systems, future system solutions any energy appliance at home or in urban environments fundamentally require to be connected to the internet for remote management and so that they can be commanded to store or consume energy in real-time in response to the availability of excess energy and the needs of the grid. IoT enables a seamless integration of home appliances with related home comfort and building automation services allowing to match user expectations on digital services with the management of distributed energy across the grid.

Novel architecture and concept are needed that will forge innovative partnerships between device providers / SMEs and DSOs for B2B and B2C services, to take advantage of the opportunity of the Smart Energy in cross-vertical application areas such as E-Mobility, building automation and home comfort.

The questions from the public concerned:

- How to measure comfort & wellbeing?
- What is the approach to interoperability?

When answering, the speakers highlighted the need for more R&D to measure comfort and the role of platforms for interoperability.

IoT in Medical Sciences and Healthcare



Figure 46: Participants Interaction

Medical sciences and healthcare has been one of the fundamental areas where the focus of global IoT community is concentrated. The workshop was aimed at discussing several aspects of IoT in Medical Sciences and healthcare, also showing a state of art and the diversified nature of research in this field.

The workshop was moderated by Prof. Parag Chatterjee from National Technological University in Buenos Aires, Argentina.

The first two speakers of the workshop were Prof. Emmanuel Bennoist and Prof. Jan Sliwa from Bern University of Applied Sciences, who discussed the key point of security and privacy in their talk titled "Blockchain for Health consent exchange."

Also, they explained the current scenario of data privacy from the perspective of Switzerland.

Dr. Jean-François Ciparisse from University of Rome Tor Vergata explained in a more practical approach, speaking about his experiment on "Optical

Techniques to detect and identify chemical agents dangerous for human health."

Dr. Sergio Guillen, the chief innovation officer of Mysphera, explained the state of art in active and healthy aging. He gave a clear idea of the key business aspects too, involved in implementing IoT in healthcare.

Finally, the entire panel of speakers invited questions from the audience, and interesting questions were raised by distinguished persons in the audience. Among all the questions, the key idea was the aspects of security and privacy of data along with the ownership of the data. Medical and healthcare data being more sensitive, the entire discussion rightly pointed to the need of devising very efficient security mechanisms while implementing IoT in medical sciences and healthcare.

The workshop was very interactive with speakers from various research fields shared their insights, followed by lots of comments from the audience as well. It's an amazing example how different research branches fuse together to make IoT in healthcare possible.

Internet of Things for Urban Innovation (INUIT)

INUIT (Internet of Things for Urban Innovation) is a large-scale research program 2013-2020 funded by HES-SO (CHF 7 millions). Its aim is to develop a complete platform for the Smart City, based on the Internet of Things. Currently 18 coordinated projects have been carried out by more than 60 researchers. Systems developed by INUIT have been deployed during some of the largest festivals in Switzerland, including the Paléo music festival with 230'000 visitors and the Swiss National Wrestling and Alpine Festival with 280'000 visitors.

The goal of this session was two-fold: firstly, it presented some of the major projects within INUIT with a focus on the technical development. Secondly, invited talks presented key technologies for IoT such as FIWARE or communication technologies.

APPENDIX 4: HACKATHON

The Hackathon took place between 6th and 9th June 2017. It was mainly organized by the University of Applied Sciences of Western Switzerland (HES-SO). The core organization consisted of a team of three persons: Andres Upegui (Hepia/HES-SO), David Da Silva (Hepia/HES-SO), and Yuliyen Maksimov (FHNW).

During The Event

During these four days, there was full access to Workshops and every participant had access to the required infrastructure (hardware and software) for implementing his/her project.

Hackathon IoT Week.

Confirmed Workshops:

- STMicroelectronics
- Eclipse **sensiNact** and **FESTIVAL** platforms
- **Fiware**
- **TagItSmart**

AWARDS:

Awards were presented in the following criteria; Competitors were expected to present their project at the end of the event in front of a jury, that will then select the best projects to be awarded. Confirmed awards:

- The **€5'000** IoT-Week Hackathon **Siemens Award**
- The **2'000 CHF** (€1'900) IoT-Week Hackathon **ABB Award**
- The **€1'000** IoT-Week Hackathon **Hasler Foundation Award**
- The **€750** IoT-Week Hackathon **FESTIVAL project Award**

Moreover, all participants will receive for free an **STM32 Nucleo** development board from **ST**.

We established a guideline for judging the projects presented in the Hackathon. The goal is not to establish a score-based ranking, but to allow

the jury to have quantitative tools to establish a common vision of the projects.

Originality: The problem identification and/or the proposed solution is original.

This means that the originality can be judged from the use-case application and/or from the technological point of view.

Impact of the solution in relation to SDGs: The project has the potential to have an impact on society by tackling one (or several) of the 17 Sustainable Development Goals.

Quality of the solution in IoT: The proposed solution exhibits a good quality respective to the State of the Art of IoT technologies. This means the overall system architecture is professional, the system is evolvable (new devices and functionalities can be easily added).

Work done during the hackathon: This refers to the amount of work performed during the Hackathon event. Some teams may have started their projects before the hackathon event, which is not forbidden. However, the goal is to evaluate the work really done during the event.

Use of the technologies presented in the workshops: The proposed solution makes use of the technologies presented during the workshops. During the Hackathon four workshops were presented to the participants to propose them basic building blocks for their projects. They were ST microelectronics, the sensinact platform (Festival project), Fiware and TagItSmart.

Demonstrator: The team presents a demonstrator which is the outcome of the work done during the hackathon. Keep in mind that the different projects have different complexities, so partial demonstrators can be also very valuable.

Feasibility: The idea and the technical solutions presented are realistic. The members of the team have a roadmap to allow their project to go further and have a real impact in society.

IoT-Week Hackathon Jury:

A jury selected the best projects following a demonstration session and presentations done by the participants.

The jury was composed of 2 award sponsors, 4 workshop lecturers, and 2 event organizers to have different points of view of the quality of the projects. They were:

- **Mr. Alexandre Martin**, Siemens
- **Mr. Pablo Furrer**, ABB
- **Mr. Fernando Lopez de Aguilar**, Fiware
- **Mr. Erez R. Mizrahi**, IoT-European Platforms Initiative
- **Mr. David DaSilva Andrade**, University of Applied Sciences and Arts of Western Switzerland
- **Mr. Yuliy Maksimov**, University of Applied Sciences and Arts North Western Switzerland
- **Mr. Bartosz Boryna**, ST microelectronics
- **Mr. Christophe Munilla**, CEA – FESTIVAL project

Awarded Projects

Three projects were awarded by the jury during the closing ceremony. Here you find a resume of these projects:

BRB - Be Right Beach (1st prize)

Have you ever heard of Sardinia? It's a beautiful Italian island sometimes compared to paradise when it comes to its shores.

Costa Smeralda, Villasimius, Chia etc. everywhere you can find your perfect place, feet in the sand, just next to the sea. It is not easy, especially for a tourist, to find a destination for a day at the beach among almost 2000 km of free shores.

Be Right Beach is the application that helps the user to choose the right place to go for the best experience. The system suggests people not to go to a beach that is affected by pollution or overcrowding; moreover, sudden

changes in water parameters or detection of a dangerous event can generate an alert useful for public authorities.

The system foresees two Control Units (CUs) for each point of interest (a beach or a site along the coast). The Sea Control Unit (SCU) is a buoy that monitors weather parameters such as water pH, turbidity, temperature and waves stirring. The Ground Control Unit (GCU) has a thermometer, a humidity sensor, an anemometer and a camera. The camera takes periodic pictures of the beach and estimates its crowdedness using computer vision and machine learning algorithms. Much attention is devoted to monitor the crowdedness that is a problem not only for the tourists, but also for coastal ecosystem. Moreover, the wave height and frequency can provide information for people safety (children especially) or useful for surfers.



Figure 47: Be Right Beach Presentation in front of the Jury

The collected data is sent to Lysis platform, implementation of the Social Internet of Things paradigm where every device has virtual counterparts. In the SIoT, objects establish social-like relationships between each other. The Social Virtual Objects (SVOs) can form their own social networks and share information in a trustworthy way. In this environment, the tourist's smartphone can receive information in a simple automatic way from the closest station and buoy.

The aim of the Be Right Beach project is to provide three different services:

- Touristic information about the best-desired beach: by selecting the parameters about crowdedness, wave status, water temperature and clearness, the application can provide a ranked list of beaches with the related path to reach them.
- Full management of the sensor network of stations and buoys for the relevant public agency: the whole sensor network is always available by means of a remote platform owned by the environment public department to evaluate the beach distress due to overcrowding.
- Provision of open data/big data services.

The first service is provided by the BRB application on the Lysis Market. Thanks to the social relationships among the users' smartphones, the stations and the buoys, the overall configuration is set up with any effort by the users.

The second service is provided by exploiting the bridging capability of the Sensinact platform. To this, the SVO source code has been upgraded by adding Sensinact API compatibility.

The third service is available by means of Fiware Context Broker (Orion). An extended API with support to NGSI protocol has been added to forward data to Fiware Orion. Our project targets Sustainable Development Goal 8 and 14. We also aim to make people aware of environmental problems such as sea and land pollution, to increase the quality of everyone's life and keep the coast clean.

FreeOcean (2nd prize)

FreeOcean is a system conceived to make oceans clean from near surface macro wastes. The idea consists in harvesting floating litter with huge nets dragged by specialized boats and/or trade ships already travelling in a specific area. Nets are then dropped and tagged with an emitter to keep a trace of its position, allowing a collector ship to pick the floating blob later. After the drop, a new collection phase is initiated by the harvester ship and the cycle continues until the latter runs out of nets.

The challenge here is to reliably monitor the net positions in a very hostile environment. We proposed to tag the garbage nets with buoys implementing an adapted long-range communication protocol based on the LoRa TM modulation. The standard protocol on top of the LoRaTM technology is focused on simplex communication; data flows from small site-specific devices to a generic relay hub connected itself to a greater network like internet.

Each relay can thus be a local star network, receiving data from devices. This topology is not possible in seas, where no relay is available and distances are too long. We propose a mesh protocol, merging low-level robustness and reliability of the LoRaTM modulation with the flexibility and scalability intrinsic of mesh networks. Leveraging the potential of such a system, we can keep a trace of the net position in a **mesh state**, each node having information about every other, thanks to an optimized state communication protocol, without any relay. Once a ship pass by any node, it can download the shared mesh state and have an updated view of the whole mesh.



Figure 48: Hackathon Free Ocean Presenters

During the Hackathon, we implemented a *Proof of Concept* of a mesh protocol based on the LoRaTM modulation. We need its capacity to implement FreeOcean, but the horizon scanning let us see a huge potential in fields such as environmental monitoring, wildlife tagging for scientific purposes, herd monitoring in no-network area (Brazil, Australia, etc.), or remote control of watering installations in wide area agriculture.

ThinkMilk (3rd prize)

In 2050, the world will need to produce 70% more food to feed an additional 2.3 billion people on the planet. Natural resources are limited and poverty is one of the biggest causes of environmental impact in the world. In the world, 570 million small and medium farmers don't have enough money or technical skills to manage the quality of their products.

Therefore, the milk harvested by them contains high rates of bacteria and somatic cell count, what makes it unfit to be consumed and so rejected by

dairy cooperatives, causing the waste of thousands of litres of milk per day in the world, enough milk to feed the 795 million hungry people.

Moreover, small and medium farmers represent 58% of the gross worth of Brazilian dairy industry, evaluated in US\$ 7 billion. Improving their revenues would bring incomes to 50 million of poor people in the country, helping the country to be closer to accomplish UN's 9th goal, "Industry, Innovation and Infrastructure".

On the other hand, laboratories control bacteria and somatic cells in milk samples using chemical analysis. This method is expensive (weekly tests are done using samples from each cow's milk), slow and produce laboratory waste. Considering 97% of the drinkable water in Brazil comes from aquifers and the country has several problems to manage its waste, Thinkmilk is focused on bringing technology to achieve responsible production in milk harvesting, as UN expects with its 12th goal, "Responsible Consumption and Production". The technology consists in an embedded system composed by two modules: first, a portable device to check the milk substances rate (fat, protein, lactose) and the presence of zoonoses (mastitis, tuberculosis and brucellosis) in milk samples.

Second, a wearable device resistant to environment conditions used by cows to check their geolocation and vital signs (heartrate, blood pressure, body temperature, stress, heat, etc.). It will be developed based on a STM32 MCU Nucleo platform and using sensors like thermistors, pulse sensors and inertial sensors.

All the collected data is stored in the cloud, based in FIWARE platform (cloud hosting, interface to networks and devices and data management) and can be easily accessed by the farmer or by the authorized veterinarians using an intuitive app for smartphones,

programmed in Python. It also generates analytics and graphs that can help the farmer to improve the quality of the milk and to quickly prevent the herd in case of risk of diseases and epidemics in the region.

Thinkmilk innovates by offering an intelligent and physical technique that reduces laboratory waste produced in traditional analysis, being safer to the environment and allowing data gathering to generate instant diagnostics and forecast by matching milk diseases and vital signs of cows with the use of machine learning.

It impacts the milk production completely, helping farmers to offer a good quality product to the market, allowing dairy cooperatives to pay the right value for milk according to its yield quality and gathering analytics to help government regulatory agencies, providing an overview on focuses of zoonosis, allowing them to take preventive actions and saving time and money usually spent in field researches.



Figure 49: Hackathon Winners

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