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CROSS FERTILISATION THROUGH ALIGNMENT, SYNCHRONISATION AND EXCHANGES FOR IoT

H2020 – CREATE-IoT Project

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IoT FA Conference

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1. EXECUTIVE SUMMARY

1.1 Publishable summary

The successful development and deployment of IoT solutions relies on multi-dimensional IoT reference architectures that address the different functional layers, the cross-cutting functions and system properties. These include the requirements for data and device security, device discovery, provisioning and management, data normalization, analytics, and services.

The IoT reference architectures are key for standardisation, as they define guidelines that can be used when planning the implementation of IoT systems in order to address the complexity of IoT solutions and ensure trustworthy, secure, scalable, interoperable IoT deployments.

The "Navigating IoT Architectures and standards Days" event included keynotes, plenary and expert workshop sessions bringing answers to what has been achieved by the IoT European Large-Scale Pilots Programme and what remains to be done by the IoT and DEI Large-Scale Pilots Programme funded under Horizon 2020.

With the help of the coordination and support actions CREATE-IoT, NGIoT and OPEN-DEI, these projects are expected to team up together in order to have significant contributions to piloting European platforms, Data ecosystems, standardisation and pre-normative activities.

1.2 Non-publishable information

The document is public.

2. INTRODUCTION

2.1 Purpose and goal of the Conference

This "Navigating IoT Architectures and standards Days" event [1], is the continuation of a series of conferences and workshops that CREATE-IoT has used to increase the community while introducing and establishing synergies with other communities that are related to IoT.

The successful development and deployment of IoT solutions relies on multi-dimensional IoT reference architectures that address the different functional layers, the cross-cutting functions and system properties. These include the requirements for data and device security, device discovery, provisioning and management, data normalization, analytics, and services.

The IoT reference architectures are key for standardization, as they define guidelines that can be used when planning the implementation of IoT systems in order to address the complexity of IoT solutions and ensure trustworthy, secure, scalable, interoperable IoT deployments.

The event included keynotes, plenary and expert workshop sessions bringing answers to what has been achieved and what remains to be done by the IoT European Large-Scale Projects Programme and DEI Large-Scale Pilots Programme funded under Horizon 2020.

With the coordination of CREATE-IoT and the support of AIOTI and the coordination and support actions NGIoT and OPEN-DEI the event provided the arena to team up together in order to exchange ideas and present the achievements and best practices on European IoT pilots, IoT platforms, data ecosystems, standardisation and pre-normative activities:

2.2 Structure of the Conference

The event program was divided into several sessions and World Cafés over three days [2].

Program Wednesday 19 February 2020 - On the first day the work was centred around the outcome of the STF547 work – lesson learned and key elements: The development and the adoption of IoT standards is facing important issues related in particular to privacy, security, semantic interoperability or the availability of standardised platforms.

Program Thursday 20 February 2020 - On the second day the work was centred around the handover of best practices from the IoT European Large-Scale Projects Programme to the DEI LSPs Cluster, enabling to capitalise on the experience built-up and ensure continuation of work. One session included different **World Cafés** that had as objectives to ignite open discussions on the achievements of past LSPs/projects, and/or build on the current state of play of the newly launched LSPs and identify the necessary future priorities and actions.

Program Friday 21 February 2020 - During the last day AIOTI working groups were presenting their relevant position papers, new priorities for standardisation related activities addressing the gaps identified and outlined in the EC Communication on ICT Standardisation Priorities of for the Digital Single Market, and annual Rolling plan for ICT standardisation.

The **World Cafés** discussed concrete actionable items, such as:

- Topics that require further work in the short to medium term either by sector working groups or cross sector group.
- Practical actions to take existing actions from past projects and move them further in existing or new cross sectorial working groups.
- Mapping of ongoing projects, use cases, architectures and activities on the relevant topics.

Each **World Café** was attended by one representative from the LSPs, CSAs, and at least one EC PO who steered the table discussions and reported at the wrap up session. Rotations between the various world café tables made it possible for project representatives to contribute to several topics of major interest to their projects. POs and when possible, CSAs representatives did not rotate.

2.3 Participants

The event attracted approximately between 50 to 75 participants, representing among others, H2020 ACTIVAGE, H2020 AUTOPILOT, H2020 IoF2020, H2020 MONICA, H2020 SYNCHRONICITY, H2020 CREATE-IoT, H2020 Open-DEI, H2020 Synergy, H2020 BD4OPEM, H2020 Platone, H2020 Interconnect Coordinate, H2020 DEMETER, ETSI STF 547 members, IDSA members, AIOTI members, 5GACIA, EFFRA,GAIA-X, W3C, GS1, Siemens, BDVA/AI-PPP, Huawei, John Deere, Ubiwhere, Innovalia, ETRA, EC DG Connect, EC DG Grow, etc.

European Commission:

- DG Connect (EC DG Connect E4 IoT Unit):
  - Rolf Riemenschneider
  - Franck Boissière
  - Peter-Wintlev Jensen
  - Jan Komarek
  - Olavi Luotonen
  - Emilio Dávila Gonzalez
- DG Grow:
  - Antonio Conte (EC DG Grow B3 Standards for Growth Unit)

3. CONFERENCE SUMMARY

3.1 First Day - ETSI STF547 Public Dissemination Workshop

Wednesday, 19 February 2020.

3.1.1 Overview and objectives

On the first day of the workshop, the work was centred around the outcome of the ETSI Specialist Task Force (STF) 547.

The Content of the presentations addresses the work carried out, the lessons learnt and the main guidelines for the development of IoT systems especially in the fields of security and privacy.

The STF 547, funded by the EC and supported by ETSI, was launched with the intention of addressing some of the most important issues that the development and the adoption of IoT standards are facing, in particular in the area of privacy, security, semantic interoperability and the availability of standardised platforms.

The workshop gave the opportunity to discuss – and challenge – the guidelines and recommendations that STF 547 has developed in 7 Technical Reports (including Teaching Materia on privacy and security) which were discussed during the meeting.

- ETSI TR 103 591 Privacy study report – Standards Landscape and best practices.
- ETSI TR 103 533 Security study report – Standards Landscape and best practice.
- ETSI TR 103 534-1 Teaching material – Part 1: IoT Security and Teaching material.
- ETSI TR 103 534-2 Teaching material – Part 2: IoT Privacy and Teaching material.
- ETSI TR 103 535 Guidelines for using semantic interoperability in the industry.
- ETSI TR 103 536 Strategic/technical approach on how to achieve interoperability /interworking of existing standardized IoT Platforms.
- ETSI TR 103 537 Plug tests preparation on Semantic Interoperability.

Some of the questions addressed in the discussions were the following:

- How can privacy regulations be supported by standards?
- Is there anything specific to IoT regarding security?
- How to enable a wider adoption of semantic interoperability in various industry sectors?
- Are there available standardised platforms that can reduce the role of proprietary platforms in the development of new IoT systems?

All sessions were highly interactive. The work of the STF was presented and followed by and extensive Q&A session with some of the panellists together with the audience.

The results of the STF have given ample room for the presentation of a set of guidelines that may be subject to feedback and to the identification of further work.

3.1.2 Workshop programme

The program of the first day was centred around the presentation of the results of the Specialist Task Force 547 (STF 547) funded by the European Commission and undertaken within ETSI' Technical Committee SmartM2M.

Table 1: Workshop program 19th February 2020

Workshop Program 19 February 2020

08:30-09:00	**Registration – Venue: Avenue de Beaulieu 25, 1160 Brussels, Belgium**
Meeting Room: BU25 0/S1	
09:00-09:30	***Welcome and Introductions,*** *NN, DG CONNECT EC, Belgium, CREATE-IoT*
Session 1: Security - Q&A – Panel Discussions Session	
09:30-10:45	*IoT security: what is specific to IoT and what is not?* ***Moderator:*** *S. Cadzow*
10:45-11:15	**Coffee/Tea Break**
Session 2: Privacy - Q&A – Panel Discussions Session	
11:15-12:30	*How to take account the new regulation and what is needed from standardisation?* ***Moderator:*** *H-J. Arendshorst*
12:30-13:30	**Networking Lunch**
Meeting Room: BU25 0/S1	
Session 3: Semantic Interoperability - Q&A – Panel Discussions Session	
13:30-14:45	*What is needed to reduce the roadblocks to a wide adoption of semantic interoperability by the industry, beyond the academics?* ***Moderators:*** *M. Wetterwald, K. Drira*
Session 4: Platform Interoperability - Q&A – Panel Discussions Session	
14:45-16:00	*Are IoT platforms meant to be largely proprietary or is there room for standardised platforms in support of greater interoperability?* ***Moderator:*** *E. Darmois*
16:00-16:30	**Coffee/Tea Break**
16:30-17:30	***Summary/Wrap-up and closing.*** *Are the guidelines suggested by STF 547 in-line with the findings of the audience (and it not why)? What needs to be subject to follow-up in IoT standardisation?*
17:30	**Closing**

Welcome and Introduction

Franck Boissière, DG Connect, E4 Unit welcomed the session on IoT architectures and standards as an important part of an itinerary to define a common framework for IoT and presented the objectives of the EC regarding the IoT and how they are implemented though a number of actions amongst which those related to architecture and standardisation.

Figure 1: Franck Boissière, EC DG Connect, E4 Unit

Introduction of Day 1

Emmanuel Darmois started by presenting an introduction to the work of the ETSI specialist task force (STF) 547, which has EC funding to develop a framework for IoT standardisation that addresses interoperability across IoT domains. STF 547 focuses on (semantic) interoperability, an end-user centred approach to privacy, and methods and techniques for secure IoT.

The essential objectives were to identify guidelines and best practices, to build a bridge to potential designers and implementers of IoT systems, and to provide comprehensive material for information, teaching/learning, and demonstration with a practical usage and implementation perspective.

In 2019, the task force produced a coordinated set of deliverables with seven technical, including two intended for use as teaching materials. A special report (SR 003 680) will be published at the end of February 2020 that presents a global overview of the technical reports and is targeted broadly at all stakeholders rather than just technical and standards experts. The report covers security, privacy, semantic interoperability, and platforms interoperability. It addresses the main issues that stakeholders have to deal with across the life cycle of IoT systems, guidelines for strategic, operational and technical aspects, and the major take away messages. It further includes an analysis of relevant use cases in eHealth, smart buildings, industrial IoT and critical communications.

Figure 2: Introducing the Day 1 sessions

3.1.3 Session 1: Security

Emmanuel Darmois presented the session and the special task force that has been running to work on standards tackling issues such as security, privacy, semantic interoperability IoT LSPs.

3.1.3.1 Objectives session 1

Security is an important aspect for IoT deployments and standardising security solutions for an IoT ecosystem presents several challenges. The session gave an overview of the IoT standardisation challenges, the standardisation work in different SDOs and identified a number of gabs and provided future recommendations for future work.

3.1.3.2 Technical Presentations

This session, moderated by Antonio Kung (Trialog), was fully dedicated to the issue of Security in IoT systems and to the presentation made by Scott Cadzow of the results of STF 547:

- The presentation and discussion of the nature and the role of Security methodologies, in particular Security by Design, in the development of IoT systems and how general-purpose security methodologies are applicable and how far they need to be modified and complemented in order to address the specifics of IoT systems;
- The presentation and discussion of the guidelines proposed by the STF team.
- The presentation of the Teaching Material on Security developed for teachers (in academics or the enterprise) for training students, designers and all stakeholders with an interest in understanding the basics of security in IoT systems.

Scott has described the technical reports that have been produced by STF 547 on security.

- **TR 103 355**: **"**SmartM2M; Security; Standards Landscape and best practices**"** - This provides an overview of the standards landscape and best practices for applying security to IoT. The report includes:
  - A simplified security model of IoT
  - An introduction to the security purposes of IoT as a specialization of the generic cyber-security domain and introduces some of the paradigms used in security analysis, design, and implementation.

- An overview of the regulatory domain as it impacts IoT security.
- An overview of the security ecosystem and identifies the stakeholders in standards development and development of best practices.
- An overview of the specific technologies of security that may apply to IoT.

- **TR 103 354-1**: "SmartM2M; Teaching material; Part 1: Security" - This report presents teaching material to allow readers, identified by role, to gain knowledge of the fundamentals of IoT security. The document is structured as a set of annexes each containing the outline of training material. The more detailed training material, in the form of a set of PowerPoint slides is provided on demand from ETSI.

Figure 3: IoT Security presentation

In conclusion, Scott outlined that IoT security is difficult yet essential, with attackers having greater access to the toolkit for exploiting IoT compared to many other ICT systems. Risk, liability and responsibility is shared across a much greater set of actors. IoT is a catch all term covering many complex elements, e.g. virtual networking, mobility, cloud services, composite services and distributed services.

3.1.3.3 Q&A

The technical presentation was followed by a Q&A session introduced by Antonio Kung presenting a list of questions structured along the 4 blocks described CREATE-IoT delivery D06.11.

The Q&A have revolved around some of the following issues:

- Hierarchical security and possible alternatives
- Education to security
- The potential compromise between liability and the cost of good security

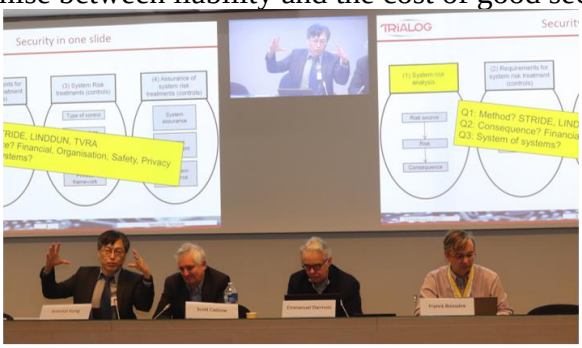

Figure 4: IoT Security - Q&A Session 1

3.1.4 Session 2: Privacy

3.1.4.1 Objectives session 2

The session objectives were to address the challenges of IoT privacy, how can privacy regulation be supported by standards and discuss how GDPR strengthened the role of standards and what are the gaps and the need for the creation of new standards.

3.1.4.2 Technical Presentations

The session was moderated by Pasquale Annicchino (Archimede Solutions) and presented by Jumoke Ogunbekun for the STF 547.

Jumoke has presented a description of the privacy work in STF547 based a human centric approach to privacy in IoT. The STF has published two reports:

- ETSI TR 103 591: addressing the standards landscape and best practices
- ETSI TR 103 534-2: presenting teaching material

Jumoke introduces privacy as the ability of an individual to be left alone. This concept overlaps but doesn't coincide with the concept of data protection. She distinguishes between physical privacy (e.g. of one's home) and informational privacy (information about oneself). The right to privacy is enshrined in the Universal Declaration of Human Rights (Article 12) as well as in the European Convention of Human Rights (Article 8).

Three categories of data: non-personal (e.g. number of employees), personal data (e.g. date of birth) and special categories (e.g. racial or ethnic origin, sexual orientation, religious affiliation). This was followed by an overview of GDPR, along with some examples of privacy scandals involving Facebook (Portal) and Amazon (Alexa). Non-EU organisations are subject to GDPR if they offer goods or services to EU residents or monitor the behaviour of EU residents.

Jumoke talked us through a privacy FAQ and then summarised the **key takeaways**:

- The requirements set under the GDPR are mandatory.
- The effective protection of privacy and (personal) data protection, within the IoT environment requires appropriate technical and organizational measures.
- The implementation, monitoring and optimisation of measures are to be planned and taken in advance during related data collecting, data processing and data management pertaining to the life cycle of the respective IoT ecosystem.
- The GDPR further requires organizations not only to be able to ensure, but also to deliver documented and continuous proof of appropriate levels of compliance – defined in the GDPR as: accountability on a continuous basis.
- A holistic approach of IoT would presume the engagement of all IoT stakeholders and would, therefore, possibly, increase the likelihood of their wide adoption and actual implementation.
- GDPR strengthens the role of standards without necessarily dictating the creation of new standards.
- The STF547 work showed that there does not appear to be any new standards or regulations needed with respect to privacy.
- The effective use of existing standards and regulation in a circular manner would seem to be enough to maximize the possible resulting benefits.
- The oneM2M architecture is an example of demonstrated Privacy design for IoT system
- Compliance with GDPR should not be a mere a ''box-ticking exercise'' but should aim at the effective protection of personal information in reality.

Figure 5: IoT Privacy presentation

One common element is that there is a need for standardisation along different verticals.

3.1.4.3 Q&A

The technical presentation was followed by a Q&A session introduced by Pasquale Annicchino with Jumoke Ogunbekun and Harm-Jan Arendshorst answers on behalf of STF 547.

The Q&A have revolved around some of the following issues:

- Targeted advertising: pull based approach in contrast with the current push-based model.
- Centralised models giving way to more distributed approaches that give users more control.
- Further legislative work under consideration.

Figure 6: IoT Privacy – Q&A Session 2

3.1.5 Session 3: Semantic Interoperability

3.1.5.1 Objectives session 3

The industry attempts to address IoT interoperability challenges through standardization and different activities are focusing to establish standards for providing interoperability between IoT devices, networks, services, data formats. Th session objectives were to discuss the main issues related to IoT semantic interoperability, how to enable a wider adoption of semantic interoperability in various industry sectors, identify the gaps and provide recommendations for future activities.

3.1.5.2 Technical Presentations

The session was moderated by Dave Raggett (W3C) and Michelle Wetterwald and Khalil Drira presented for the STF 547.

The STF has published two reports on Semantic Interoperability (SI):

- ETSI TR 103 535: addressing guidelines for the adoption of SI in the industry
- ETSI TR 103 537: addressing how to test sematic interoperability

Figure 7: IoT Semantic Interoperability presentation

There are different ways to define semantic interoperability. Ontology is the most common method to classify data.

Different levels of interoperability exist within and among IoT platforms. IoT ontologies have been described in different EU projects.

Guidelines for IoT semantic interoperability adoption in the industry:

The main question addressed by the STF were:

What is needed to reduce the roadblocks to a wide adoption of semantic interoperability by the industry, beyond the academics?

How do we enable data interoperability between devices and applications without prior agreement?

Can we support generic interworking and automated management of devices?

Ideas for semantic based discovery/matching and binding of devices and apps. The use of reasoning to infer new knowledge from facts. Better monitoring and understanding of the surrounding environment. Smart decisions to dynamically adapt to changes in the environment.

Some market drivers are supporting the case for semantic interoperability:

- Enhancing existing services
- Providing new services
- Public policy support
- Wider integration

Some corresponding market inhibitors:

- Lack of familiarity with semantic
- Lack of killer applications and successful cases
- Complexity and immaturity
- Uncertainty regarding scalability and performance
- Difficulties to perceive immediate value

Some guidelines are proposed:

- Strategic
  - Decide adoption and promote it
  - Invest in communication and training
  - Outline expectation upfront
  - Promote success and expand diffusion
- Technical guidelines:
  - Use an upper ontology
  - Reuse existing domain ontologies
  - Insert ontologies in the development process

Testing Semantic Interoperability:

Interoperability involves different capabilities: exchange of meaningful, actionable information, shared understanding of the exchanged information, and an agreed expectation for the request and for the response to the exchange of information.

Testing involves reaching an agreement across stakeholders on the scope and objectives for tests, and preparing a test framework that can exercise all relevant aspects, for instance, the ability to correctly process good data, and to reject bad data passing through the specified interfaces.

A methodology is needed for test reporting and if necessary, for updates to the ontologies and mappings.

The recommendation is to do so at the border of a system rather than internally. This also applies when there is a need to map data and metadata from one ontology to another.

Semantic interoperability is a key challenge in the IoT domain. There is a clear need to have rich resources and data description methods and to define ontologies.

3.1.5.3 Q&A

The technical presentation was followed by a Q&A session introduced by Dave Raggett with Michelle Wetterwald and Khalil Drira answers on behalf of STF 547.

In his introduction, Dave listed some questions relating to semantic interoperability:

- What is it and why does it matter?
- What is the relationship to the Internet of Things?
- What is the relationship to AI and machine learning?
- How to test for semantic interoperability?
- What are we (i.e. you) doing to help this?
- How is semantic interoperability supported by IoT platforms?
- Do we need semantic interoperability in IoT platforms?
- What are the benefits of implementing semantic interoperability in IoT platforms?
- To what extent semantic interoperability can be implemented in IoT platforms?
- Can semantic interoperability be implemented for any IoT platform?
- Is there a reference model for semantic interoperability?
- What are the main interoperability issues due to the lack of a common semantic data model in IoT platforms?
- How can semantic interoperability between two IoT devices, platforms or applications be assessed?

Figure 8: IoT Semantic Interoperability – Q&A Session 3

3.1.6 Session 4: Platform Interoperability

3.1.6.1 Objectives session 4

Many existing IoT platforms promote their own IoT infrastructure, proprietary protocols and interfaces, incompatible standards, formats, and semantics which creates closed ecosystems.

Incompatibility between IoT platforms results in creating applications to the platform specific API and information models for each different platform, which prevents cross-platform exchange, and the creation of applications that operate on multiple platforms and across-domains.

The objectives of the session were to review the past, present and future developments related to IoT platforms interoperability and solutions for addressing and discuss the available standardised platforms that can reduce the role of proprietary platforms in the development of new IoT systems.

3.1.6.2 Technical Presentations

The session was moderated by Georgios Karagiannis (Huawei) and presented by Emmanuel Darmois for the STF 547.

The major point addressed by the STF 547 work on Platform Interoperability is: Are IoT platforms meant to be largely proprietary or is there room for standardised platforms in support of greater interoperability?

ETSI TR 103 536 addresses the following questions:

- What is a platform and what are the relevant ones for IoT?
- What are the main requirements of Interoperability and Interworking?
- How these requirements are fulfilled by typical platforms.
- How those elements are fulfilled in specific sectors such as Industrial IoT.
- Which recommendations can be made for an effective selection and usage?

In more detail, the report starts with an analysis of platform interoperability in the context of IoT, including roles, reference architectures and guidelines. It provides an overview of the landscape of IoT platforms, and the strategic and technical approaches to interoperability, along with associated frameworks. It further addresses industrial IoT from the platform perspective.

The TR provides a list of guidelines and recommendations, including further work for oneM2M.

Figure 9: IoT Platforms Interoperability presentation

There are different IoT platforms. Several dimensions should be identified:

- Scope and breadth
- Openness
- Origin and governance

- Ecosystem
- Maturity

3.1.6.3 Q&A

The technical presentation was followed by a Q&A session moderated by Georgios Karagiannis with Emmanuel Darmois answers on behalf of STF 547.

Some of Q&A have revolved around the following questions:

- Are the guidelines suggested by STF 547 in-line with the findings of the audience?
- What needs to be subject to follow-up in IoT standardisation?
- How to deal with systems of systems?

Figure 10: IoT Platform Interoperability – Q&A Session 4

3.1.7 Wrap-up

A first part of the wrap-up was dedicated to the on-line announcement to the European Parliament of the AI white paper produced by the EC.

Emmanuel Darmois summed up today's workshop and thanked everyone for the part that they have played. ETSI STF 547 has now finished its work.

Franck Boissière EC DG Connect, E4 Unit has stressed the importance of collaborating across projects to be able to look further into the future and to improve collaboration across IoT, Big Data and AI.

3.2 Second Day - IoT and DEI Large Scale Pilots Workshop

Thursday, 20 February 2020.

3.2.1 Overview and objectives

On the second day the work centred around the handover of common activities from the IoT European Large-Scale Pilots Programme to the DEI LSP Cluster enabling to capitalise on the experience created and ensured the continuation of work on the gaps identified in the new projects' cluster and the AIOTI working groups [3][4].

After three years of intensive activity, the IoT European Large-Scale Pilots Programme projects launched in 2017 presented its highlights, best practices and the standardisation activities, and the new DELI Large-Scale Pilots projects launched in 2019 were introduced.

The new projects address the Agri-Food sector, Energy, Health and Care and Smart Manufacturing.

A parallel break-out session was also organised addressing topics of common interest to identify and organise common work teams for the coming year.

3.2.2 Workshop programme

Table 2: Workshop program 20th February 2020

Program 20 February 2020

09:00-09:30	Registration – Venue: Avenue de Beaulieu 25, 1160 Brussels, Belgium
09:30-09:45	*Setting the Scene, Franck Boissière EC E4 DG CONNECT*
Session 1 - European Large-Scale Pilots Projects – Presentations, panel and discussions	
09:45-10:45	• *IoT European Large-Scale Pilots Programme Projects: ACTIVAGE, AUTOPILOT, IoF2020, MONICA, SYNCRONICITY,* • *CREATE-IoT, NGIoT, OPEN-DEI* • *Entering the Scene - DEI Large-Scale Pilots Projects - Factories of the Future* • *Pitch presentations – Synergy, Platoon, BD4OPEM, Platone, Interconnect Coordinate* • *Moderator: Peter Wintlev-Jensen EC E4 DG CONNECT*
10:45-11:15	Coffee/Tea Break
Session 2 –Large-Scale Pilots Showcase – World café-type themes	
11:15-12:45	• Building an ecosystem, leverage open calls Room BU25 0/S2 (Moderator: Olavi Luotonen, EC) Main deliverables: Call package IoF2020 SYNCHRONCITY and ACTIVAGE, open calls statistics, idea of club of SMEs. • Ways to share, document, promote huge number of use cases Room BU25 0/S1 (Moderator: Rolf Riemenschneider, EC) Main deliverables: Booklet IoF2020, AUTOPILOT, Communication, showcasing strategy IoT Week • IoT Interoperability architectures, AIOTI, standardisation organisations Room BU25 0/S5 (Moderator: Franck Boissière, EC) Main achievements: MIMS, work with ETSI CIM, ITU, G20, JTC1-AG8 Key pitches: SYNCHRONICITY, AUTOPILOT • Innovation support: CREATE-IoT – Brochures, market landscape Room BU25 0/S1 (Moderator: Jan Komarek, EC) White paper on GDPR, IERC cluster books, Security approach, KPIs LSPs, eBook, IoT Handbook, IoT Policy Framework, Wiki, use case mapping. Key pitches: CREATE-IoT, ACTIVAGE
12:45-13:45	Networking Lunch
13:45-14:00	*Setting the Scene, Rolf Riemenschneider, EC E4 DG CONNECT, Meeting Room: BU25 0/S1*
Session 3 – Parallel Sessions	
14:00-15:30	• IoT Data Space, sharing, conceptual reference model Room BU25 0/S1 (Moderator: Rolf Riemenschneider, EC) • IoT Data lakes, platforms, economics of data-driven services and marketplaces Room BU25 0/S1 (Moderator: Jan Komarek, EC) • IoT Security, privacy policy framework (GDPR, planned data strategy) – Room BU25 0/S2 (Moderator: Peter-Wintlev Jensen, Salvatore Scalzo, EC) • Navigating the future of IoT Technologies/Applications towards edge computing– Room BU25 0/S5 (Moderator: Franck Boissière, EC)
15:30-16:00	Coffee/Tea Break
Plenary Session	
16:00-16:45	*Reporting from the Sessions – Take away, Highlights. Short presentations from moderators (2 slides)*
16:45-17:00	*Looking back and aiming forward. Main take away. Future actions. Rolf Riemenschneider, EC*
17:00-19:00	Networking Session – Cocktails

3.2.3 Session 1: European Large-scale Pilots projects – Presentations, panel and discussions

3.2.3.1 Objectives session 1

The objectives of the session 1 were to present the results and achievements of the IoT European Large-Scale Pilots Programme projects discussing the highlights, best practices and the standardisation activities, and providing recommendations for future activities. The session introduced the new DEI Large-Scale Pilots projects launched in 2019 that described their objectives, demonstrations, standardisation activities and expected impact.

3.2.3.2 Presentations, discussions and takeaways

The five IoT European Large-Scale Pilots Programme Projects are ACTIVAGE, AUTOPILOT, IoF2020, MONICA, and SYNCHRONICITY, while the new entering the Scene are representing by the DEI Large-Scale Pilots Projects.

- Pitch presentations - Synergy. Platoon, BDFOPEM, Platone, Interconnect Coordinate
- Moderator: Peter Wintlev-Jensen EC E4 DG Connect.

AUTOPILOT - Francois Fischer briefly introduced the AUTOPILOT project [5]. OneM2M is

used as the interoperability solution for (private) IoT platforms.


Figure 11: AUTOPILOT presentation

MONICA –MONICA project [6] had a significant impact on Article 9: of Directive 2014/53/EU.


Figure 12: MONICA presentation

SYNCHRONICITY - Martin Brynskov briefly presented the SYNCHRONICITY project [7]. Build around Minimal Interoperability Mechanisms (MIMs). Five MIMs, where the first three are realized in the project. MIM 1: Context Information management, MIM 2: Common Data Models, MIM 3: Ecosystem Transaction, MIM 4: Personal Data Management, and MIM 5: Fair AI. 50 services in 21 cities; Noise ability, Atomic and application services, and OASC catalogue. Contributed to policy and regulation, etc.


Figure 13: SYNCHRONICITY presentation

ACTIVAGE – Martin Serrano briefly introduced the ACTIVAGE project [8]. Nine deployment sites and 46 partners. Activating Innovative IoT, ACTIVEAGE Foundations, Societal dimension and impact, and AHA Ecosystem involvement and Integrated care. Work with SAREF for Health regarding standardization. The ACTGIVAGE domains are: Sensor Domain (IoT), Wellbeing Domain (AHA), Security Domain (DPA, ICO, ENISA), and Healthcare Domain (HL7).

Figure 14: ACTIVAGE presentation

IoF2020 - Pedro Malo briefly presented the IoF2020 project [9]. In this context the IoT Catalogue were presented including the projects use cases, technologies, products etc. [10].

Figure 15: IoF2020 presentation

Big Data Factories Boost 4.0 - Óscar Lázaro (Innovalia) briefly presented the Big Data factories, Boost 4.0 [11]. Focused on European Industrial Data Spaces, Data sovereignty, Data Spaces, and European IDS.

Figure 16: Boost 4.0 presentation

IDSA - Lars Nagel briefly presented the International Data Spaces Association (IDSA) [12]. More focus was given to the IDSA connectors. IDSA connectors are as well used in the GAIA-X architecture [13][14].

DEMETER - Nuria de lama (ATOS) briefly presented the Development of a European multi-model ensemble system for seasonal to interannual prediction project (DEMETER) [15]. Standardisation and interoperability are important, Big data program (if a farmer cooperates with someone that brings a machine, then he has to sign consent to make the collected data available), Cooperate with DG Agriculture (Multi-actor approach), etc.

Figure 17: DEMETER presentation

InterConnect - Antonio Kung briefly presented the Interoperable solutions connecting smart homes, buildings and grids project (InterConnect) [16].

Main solutions for energy efficiency, using SAREF and providing support for cascading initiatives.

Figure 18: InterConnect presentation

CoordiNet –CoordiNet project [17] addresses large scale TSO-DSO Consumer demonstrations of innovative network services through demand response.

On the consumer and market participant side, the designed market principles and rules shall prepare the development of a seamless pan-European electricity market.

Figure 19: CoordiNet presentation

Platone – The Platform from Operation of Distribution networks project (Platone) [18] aims at defining new approaches to increase the observability of renewable energy resources and of the less predictable loads while exploiting their flexibility.

Figure 20: Platone presentation

Qu4lity - Óscar Lázaro (Innovalia) presented the Qu4lity project on manufacturing [19]. It is the biggest European project dedicated to Autonomous Qu4lity (AQ) and Zero Defect Manufacturing (ZDM) in the Industry 4.0. It will demonstrate, in a realistic, measurable and replicable way an open, certifiable and highly standardised, SME-friendly and transformative shared data-driven ZDM product and service model for Factory 4.0 through 14 pilot lines. It will also demonstrate how European industry can build unique and highly tailored ZDM strategies and competitive advantages through an orchestrated open platform ecosystem,

ZDM atomized components and digital enablers across all phases of product and process lifecycle.

The main goal is to build an autonomous quality model to meet the Industry 4.0 ZDM challenges.

Figure 21: Qu4lity presentation

MIDIH - Susanne Kuehrer presented the Manufacturing Industry Digital Innovation Hubs project (MIDIH) [20]. The project aims at realizing services to support the ICT Innovation for Manufacturing SMEs.

Figure 22: MIDIH presentation

New projects:

BD4OPEM - Jose Gato Luis (ATOS) briefly presented the Big data for Open innovation Energy Marketplace project (BD4OPEM) [21].

Figure 23: BD4OPEM presentation

SYNERGY - Eva Muñoz Navarro (ETRA) briefly presented the SYNERGY project [22]. The overall goal of the SYNERGY project is to overcome the limitations of the current initial-stage research in multi objective optimization at the Jožef Stefan Institute (JSI), Ljubljana, Slovenia, where efficiency measures have only been explored at a very small scale and with no collaboration with other partners. Dealing with big data analytics that gather energy data and create value for this data. Started in January 2020, 24 partners from EU countries, and five large demonstrators.

Figure 24: SYNERGY presentation

OpenDei - Sergio Gusmeroli (Pol. of Milano) presented the OpenDei CSA project [4]. Similar to what CREATE-IoT has done for the first four LSPs. Focuses on four domains: Healthcare, Manufacturing, Agriculture, and Energy.

Figure 25: General overview of the participants

Figure 26: Workshop participants during the second day

3.2.4 Session 2- Large Scale Pilots Showcase

3.2.4.1 Objectives session 2

The objectives of session 2 were to present the achievement of IoT European Large-Scale Pilots Programme projects, discuss the challenges, the experiences, and present the results and highlight the best practices.

3.2.4.2 Presentations, discussions and takeaways

World-Café Table 1: Building an ecosystem, leverage open calls:

- Moderator: Olavi Luotonen, EC
- Main deliverables: Call package IoF2020, Synchronicity and ACTIVAGE, open calls statistics, idea of club of SMES

Figure 27: Olavi Luotonen, EC DG Connect, E4 Unit

World-Café Table 2: Ways to share, document, promote huge number of use cases:

- Moderator: Rolf Riemenschneider, EC
- Main deliverables: Booklet IoF2020, AUTOPILOT, Communication, showcasing IoT Week

Figure 28: Rolf Riemenschneider, EC DG Connect, E4 Unit

World-Café Table 3: IoT Interoperability architectures, AIOTI, standardisation organisations:

- Moderator: Franck Boissière, EC
- Main achievements: MIMS, work with ETSI CIM, ITU, G20, JTC1-AG8
- Key pitches: SYNCHRONICITY, AUTOPILOT

Figure 29: Franck Boissière, EC DG Connect, E4 Unit

World-Café Table 4: Innovation support: CREATE-IoT - Brochures, market landscape:

- Moderator: Jan Komarek, EC
- White paper on GDPR, IERC cluster books, Security approach, KPIs LSPs, eBook, IoT handbook, IoT Policy Framework, Wiki, use case mapping.
- Key pitches: CREATE-IoT, ACTIVAGE

Figure 30: Jan Komarek, EC DG Connect, E4 Unit

3.2.5 Setting the Scene for the afternoon sessions

Rolf Riemenschneider presented the four dimensions of EU's digital future underlying the importance of the human centric approach with technology that works for people.

Location data is in the core of the marketplaces. There is more value when data flows and there is collaboration among the stakeholders.

Nowadays to build an IoT ecosystem, we have to focus also in the analytics and security of data having into account AI, edge and how to include SMEs and start-ups in the ecosystem.

Figure 31: Rolf Riemenschneider, EC DG Connect, E4 Unit

3.2.6 Session 3: Parallel Sessions

3.2.6.1 Objectives session 3

The objective of the parallel sessions was not to have an open discussion on their respective topics, but rather to start from achievements of past LSPs/projects, and/or build on the current state of play of the newly launched LSPs and identify from that concrete actionable items, such as:

- Topics that require further work in the short to medium term either by sector working groups or cross sector group.
- Practical actions to take existing actions from past projects and move them further in existing or new cross sectorial working groups.
- Mapping of ongoing projects, use cases, architectures and activities on the relevant topics.

3.2.6.2 Parallel Session 1: IoT Data Space, sharing and Conceptual Reference Model

- EC: Rolf Riemenschneider
- CREATE-IoT: Martin Serrano
- OPEN DEI: Lars Nagel, Silvia Castellvi

The subject of the table is to elaborate on the data strategy taken by Large-Scale Pilot projects or initiatives. The long-term objective is to seek:

- A common understanding of the data interface to be harmonised.
- An agreement on a generalised conceptual data reference model that can be applied to different pilot sites, across different pilots of a domain and eventually across different sectors.
- Analysis of the envisage data exchange layer, e.g. between industries (B2B) and/or for data-driven services (B2C).

Some guiding questions both for past and new projects:

- What data sources / connected objects are demonstrated in your pilot project? (one machine data / mixed machine – personal data)
- What network connectivity is used, what is the main topology, or you approach (object to object / object – gateway / object – cloud?
- What data sharing arrangements do you have or need to conclude with whom? For what type of data? What does that require from the market participants in terms of IT infrastructure?
- If so, who do you design the data exchange layer? Use of an open API? How to facilitate access to proprietary data you need? Use of DLT or Blockchain?

Achievements

- Projects focus on Data Formats:
- Domain specific
- Some (standard) components
- First tech on EDGE
- Standardization mature?
- Marketplaces fashionable:
- Exploitation based on data services
- Open APIS
- Governance?
- Value of data

Way forward:

- Promote a concept/ Framework

- KPIs for Infrastructure // Sandboxing
- Ecosystem for services for data infrastructure; look at governance model.
- Finance: how to use the infrastructure project with sandboxing
- Data Quality on AI
- AI learning in Clouds and edge

Figure 32: Parallel Session 1 - Rolf Riemenschneider, EC DG Connect, E4 Unit

3.2.6.3 Parallel Session 2: IoT Data lakes, economics of data-driven services and marketplaces

- EC: Jan Komarek
- CREATE-IoT: Marcos Alvarez
- OPEN DEI: Oscar Lazaro

The subject of the table is to elaborate on the platform strategy taken by Large-Scale Pilot projects or initiatives. The objective is to seek:

- An understanding of the Platform strategy of the pilot project under the Focus Area DT?
- To learn about innovative business models and barriers to scale up?
- A common understanding of a data marketplace concept(s) like AirBnB in relevant domains and its governance model

Some guiding questions:

- What are the main drivers in your initiative for innovative services, in which domain/use cases?
- Does your project envisage developing open APIs and interfering with innovators / developer communities? How to characterize them?
- Does your project have plans to contribute to open data standards? How to access proprietary data collected in the pilot initiatives? Any links to standardisation organisation initiatives?
- Are P2P services part of the portfolio? If, yes what does it take to scale up? What investment in infrastructure is needed? Possible governance models?

Examples Core (critical) data

- Clinical data
- Machinery
- Logistics
- Maintenance
- Input in crop data

Examples: Secondary data

- Well-being data context
- Recycling

Example manufacture sector

- No-one wants to give open data on operation, i.e., critical data
  - There are situations where critical data becomes less critical (after time, or in other regions); In this case, this data is no longer critical, the data can be anonymized and be opened
- Secondary data can be opened and shared
- Incentives to share data:
  - More Business and societal drivers need to be investigated
  - More efficient & safety & keeping IPR
  - Case by case approach to data collection and sharing
  - Sharing Data provider controls also the data use
- Challenge: make sense of federation of data sets
- Opportunity: reuse of Business to Government data sets
- Anonymization/pseudo-anonymization procedures can be applied to support sharing of open data

Figure 33: Parallel Session 2 - Jan Komarek, EC DG Connect, E4 Unit

3.2.6.4 Parallel Session 3: IoT Security, privacy policy framework (GDPR, planned data strategy)

- EC: Peter Wintlev-Jensen, Salvatore Scalzo
- CREATE-IoT: Antonio Kung, Emmanuel Darmois
- OPEN DEI: Antonio Jara

The subject of the table is to elaborate on the cybersecurity and data privacy strategy taken by Large-Scale Pilot projects or initiatives. The objective is to seek:

- An understanding of the security and privacy requirements strategies?
- Identify existing best practices and ways forward

Some guiding questions:

- What are the main drivers in your domain/use cases for security and for Privacy?
- How/where did you (/Do you intend) address your cybersecurity requirements in your system architecture/operational setup for your pilots? How have you tackled the GDPR compliance?
- What were/are the main challenges to address your requirements in your pilots? Have you performed a detailed Risk/vulnerability and impact analysis?
- What are the major future technical solutions that you are using/need to use to effectively address IoT security and privacy by design?
- Based on your experience, do you see a need for regulators 'intervention to harmonise requirements/practices and build a level playing field in those areas?

Figure 34: Parallel Session 3 - Peter Wintlev-Jensen, EC DG Connect, E4 Unit

Findings/Learnings from LSPs:

- LSPs addresses these issues overall successfully
- Risk management principles and security/privacy by design generally operated
- Requirements/checklists were produced
- Lack of an assurance path seen as a major problem
- Data protection vs privacy
- Strong multi-stakeholder engagement in the context of the LSPs
- Detected need for multidisciplinary approach in analysing these issues
- Ethics seen as a separate and crucial dimension
- Positive consideration of data privacy being one of the objectives in LSPs

Recommendations for the future:

- Future assurance/certification scheme seen as highly beneficial
- Multidisciplinary/multi-stakeholder approach in addressing these issues in essential
- Setting of legal responsibility for actors other than manufacturers to be considered
- Interaction between data protection and ethics
- Need for model/mechanism to screen and identify project outputs that could be really
- exploited and moved forward when projects and ethics
- Introduction of requirement for data protection strategy (together with exploitation plan)
- Links among different projects to be strengthened, notably on privacy/security issues (make the best possible use of relevant cluster) including sharing templates
- Educational aspect seen as important (both on demand/supply side)
- Need for standardisation in the field (with 2 caveats: 1. Global level standardisation 2. Standardisation is unlikely to cover all aspects)
- Considering tools to map standards vs legal requirements
- Cross-fertilization among project practices essential
- Develop practices/methodologies to deal with lifecycle related aspects
- Adapt regulation/standardisation to the ecosystem concept
- Specific issue linked to algorithms

3.2.6.5 Parallel Session 4: Navigating the future of IoT Technologies/Applications towards Edge Computing

- EC: Franck Boissière
- CREATE-IoT: Ovidiu Vermesan
- OPEN DEI: Sergio Gusmeroli

The subject of the table was to explore innovative technologies and solution adopted by Large-Scale Pilot projects or initiatives, with a special focus on the Cloud/edge components for data storage and processing. The objective is to seek:

- An understanding of the evolutions of main technologies.
- Identify existing best practices and ways forward

Some guiding questions:

- What are the main drivers in your domain/use cases which required processing data at the edge? What were the limitation of other solutions?
- How to map the various use cases on the data architecture and system architectures?
- Did you identify cross use cases common requirements and how to discover commonalities?

Conclusion on Navigating the future of IoT Technologies/ Applications towards edge computing

- Performance related: requirements
  - reliability/latency/safety/robustness
- Architecture optimisation requirements
  - device/edge/cloud off loading
  - federation and orchestration cloud/edge
  - intelligent connectivity (wireless, cellular 5G/6G, optical ...)
  - Data exchange/motivation
- DLT/Shared Ledger/decentralization identification/smart contracts
  - data structure
- Analytics/ML, deep learning/AI
  - preserving data privacy at the edge
- Societal coverage (gender equality, etc.)
- Green deal recommendations will be considered

Figure 35: Parallel Session 4 - Discussions

3.2.7 Reporting from the parallel sessions – Takeaways, highlights, short presentations from moderators

Final panel with the POs of the IoT-LSP projects summarising the highlights of the sessions today: edge IoT cloud off loading, decentralised identification of data, intelligent connectivity preserving privacy at the edge.

All these findings from IoT-LSP lead to recommendations as the need to address a multidisciplinary/multi-stakeholder approach having always in mind the need of a data protection strategy.

Rolf Riemenschneider, EC. IoT-LSP projects have focused on data models and they have created attractive marketplaces with open questions on who are running them, and which are the governance rules.

Figure 36: Discussions and recommendations

Jan Komareck, EC. It is needed a case by case approach to understand the groups that are willing (machines, logistics, maintenance...) or not (clinical, health...) to share data. The challenge is to federate data from many partners.

Figure 37: Reporting from World-Café tables - Jan Komareck, EC DG Connect, E4 Unit

Figure 38: Reporting from World-Café tables - Discussions

3.2.8 Looking back and aiming forward. Future actions

Rolf Riemenschneider, EC, congratulates for the great exercise today mixing previous and new LSPs. A special emphasis in the technology for citizens and the need to communicate in the language of each user.

Figure 39: Rolf Riemenschneider, EC DG Connect, E4 Unit

3.3 Third Day - EC-AIOTI Workshop: Breaking down silos for IoT and DEI Standardisation

Friday, 21 February 2020

3.3.1 Overview and objectives

The Workshop focused on how AIOTI addresses the upcoming challenge for digitizing European industry and what are the approaches on standardization to promote open, active collaborations and IoT/IIoT as enabler for platform developments and marketplaces in the industrial sectors. Challenges like gaps in IoT standardization and IoT enabled data marketplaces were also discussed. In particular, the focus was on:

- **Session 1: Digital Transformation:** What are the standardization, regulation and policy needs for the successful implementation of the digital transformation in Europe, considering 5G deployments among others?
- **Session 2: IoT-enabled Data Marketplaces:** Transformative journey from building infrastructure to the local enablement of cross-domain marketplaces is underway across many domains and geographies; What are the standardization, regulation and policy needs associated with these IoT-enabled Data marketplaces?
- **Session 3: Breaking down the technology silos and how the AIOTI approach can address the horizontal harmonization.** This session focused on the work already carried out by AIOTI on the current gaps in IoT standardization and it addressed the opportunities and barriers on leveraging technologies like 5G, IoT/IIoT, AI, Robotics, Cloud and Edge Computing as well as Automation and required standards, governance, policy and rules to address the Horizontal Harmonization.

3.3.2 Workshop programme

Table 3: Workshop program 21st February 2020

Workshop Program 21 February 2020

08:30-09:15	Registration – Venue: Avenue de Beaulieu 25, 1160 Brussels, Belgium
	Meeting Room: BU25 0/S1
09:15-09:30	*High-level introduction and keynote message, Nikolaos Isaris –Head of Unit (acting) IoT Unit E4, EC DG CONNECT*
Session 1: Digital transformation - Q&A – Pand and Discussions	
09:30-10:55	• *Johannes Nitschke, 5G ACIA, Siemens* • *Ana Garcia, BDVA/AI-PPP* • *Henning Banthien, Plattform-i40 (TBC)* • *François Fischer, AIOTI WG Smart Mobility* • *Marco Carugi, Telecom supply* • *Peter Thoene, John Deere, Vertical Industry demand side* • *Ricardo Vitorino – Ubiwhere, Industry supply side* ***Moderators: Antonio Conte EC DG GROW***
10:55-11:15	Coffee/Tea Break
Session 2: IoT- Enabled data marketplaces - Q&A – Panel and Discussions	
11:15-13:00	• *Silvia Castellví IDSA, GAIA-X* • *George Saleh, Nokia* • *Chris Decubber, EFFRA. Vertical Industry, Manufacturing* • *Oscar Lazaro, INNOVALIA Manufacturing* • *Tom de Block, AIOTI* • ***Moderators: Franck Boissière, EC DG CONNECT, Sergio Gusmeroli, Open DEI***
13:00-14:00	Networking Lunch
	Meeting Room: BU25 0/S1
Session 3: Horizontal harmonization -AIOTI solutions on breaking down the technology silos - Panel and Discussions	
14:00-15:30	• *Dave Raggett W3C, IoT semantic interoperability* • *Michelle Wetterwald, AIOTI, Standardisation Gaps* • *Marco Carugi, AIOTI High Level Architecture* • *Ovidiu Vermesan, AIOTI IoT Research* • *Franck Boissière, EC DG CONNECT, IoT Standardisation Activities Overview* • *Patrick Guillemin, ETSI* • *Francesca Poggiali, GS1* ***Moderator: Wael Omar EL HASSAN EL RIFAI, AIOTI***
15:30-16:00	***Summary/Wrap-up and closing. Rolf Riemenschneider, EC E4 DG CONNECT***
16:00	Closing

3.3.3 High Level introduction and keynote message

Nikolaos Isaris – Head of Unit (acting) IoT Unit E4, EC, DG Connect, stated that we are in a very interesting point of the Digital Age in which a digital package has been launched.

- AI white paper
- European Strategy on data
- Data for citizens and roll-out of the new EU Data Spaces

A big challenge to achieve the aims of the digital package is to break silos meaning sound actions on interoperability and standardisation. We have to be aware of the importance of the crosscutting sectors and how data flows among them.

Figure 40: Nikolaos Isaris, EC DG Connect, E4 Unit

3.3.4 Session 1 Digital Transformation:

3.3.4.1 Objectives session 1

The objectives of session 1 were to discuss the standardization, regulation and policy needs for the successful implementation of the digital transformation in Europe, considering IoT/IIoT, 5G, AI and other technology developments and provide recommendation for supporting and accelerating the process of digitisation across industrial sectors.

3.3.4.2 Presentations, discussions and takeaways

Moderator: Antonio Conte-EC DG GROWTH

Figure 41: Antonio Conte, EC DG Grow, B3Unit

Johannes Nitschke, Government Affairs, Siemens AG:

- 5G addresses 3 application scenarios, but there is no "one fits all" scenario for everything
  - Enhanced Mobile Broadband (eMBB)
  - Massive Machine Type Communications (mMTC)
  - Ultra-Reliable Low Latency Communications (URLLC)
- Possible 5G deployment scenarios

- Public deployment
- Semi-public deployment
- Local, private deployment

- Industrial private wireless networks need private spectrum!
  - Advantage of wireless network ownership in OT:
    - Self-management guarantees flexibility in production
    - Qualified IT experts with OT knowledge on site
      - 24/7 support and maintenance of the network
    - QoS based on dedicated network for industrial use
      - support ultra-reliable and low latency communication
- Maximum data privacy and security:
  - Data stay on premises
  - Protection of trade secrets, production data and patents
- What needs to be done until we can say 5G is fit for industry?
  - Industrial 5G:
    - Support industrial protocols
      - PROFINET
      - OPC UA
      - Engineering
- **Key points:**
  - Interoperability between public and private networks without interferences.
  - Private networks bring additional security to wireless networks compared to public deployments.

Figure 42: Siemens presentation

Johannes Nitschke explained possible 5G deployment scenarios in which the interoperability between public and private networks without interferences will play a basic role.

Ana García Robles (Secretary General BDVA):

- Adoption challenges: Open collaboration needed, this is included in the Strategic Research, Innovation and Deployment Agenda for an AI PPP (A focal point for collaboration on AI, Data and Robotics):
  - EU public-private investment environment
  - Skills and Know-How
  - Research Landscape
  - Access to AI / Data Infrastructure and test environments
  - Standards
  - Overarching Ecosystem

  - High complexity in development and deployment (business impact + technology + processes)
  - Policy and Regulation
  - Digital Single Market
  - Societal/Business Trust
- AI to create value: Holistic view needed
- Fast deployment needed, secure environments to digitalize faster
- For Digital Transformation: All the ecosystems + sustainability + interoperability => Standards

Figure 43: BDVA presentation

Having identified the main challenges for digital transformation it is clear that open collaboration is needed. For AI creating value a holistic view is needed.

Francois Fisher (ERTICO):

- Introduced AUTOPILOT
- Open Issues
  - Still lack of commitment to adopt open data access strategy
  - Value chain controlled by OEMs but evolving towards new collaboration models
  - Well established industry and service practices not easy to evolve
  - High competition making cooperation difficult
  - Other higher priorities to address:
    - Emission impact
    - Urbanisation
- Perspectives
  - Digital transformation will significantly impact the Mobility sector
  - Need to ensure the ICT and service platform are managed by EU organisations and based on standardised architectures and Data models
  - Innovation is expected by new, small and more local players
  - IoT is the essential catalyst to ensure Smart Mobility Digital
  - Transformation is successful and creating value in Europe
- State of Play in Europe
  - 2017-2020: IoT LSPs have identified and partially addressed the challenges
  - AUTOPILOT has used only OneM2M device management in all
  - platforms and integrated with Open and Vendor IoT solutions
  - AUTOPILOT results to be used for the 5G/CCAM deployment –considering the needs for Data ownership and management issues Challenges

Figure 44: AUTOPILOT presentation

Presents the challenges for smart mobility underlying the need to break data silos, new business models, ensure the acceptance of the whole value chain, develop a common vision on IoT and creating and ICT and policy environment that allows sharing data.

Marco Carugi (Huawei):

- Digital transformation in IoT: emerging IoT applications and communications enhanced by new IP network capabilities
- It is needed to enhance the capabilities of the future networks
  - Holographic type communications
  - Tactile Internet for remote operations
  - Industrial IoT with cloudification
  - Seamless coexistence of heterogeneous network infrastructures (ManyNets)
- New IP network capabilities
  - High precision communications (time engineered services)
  - Qualitative communications
  - Support for Compound Services [services depending on more than one constraint
  - A global framework for New IP based Networks
    - current discussions within ITU T for Next Study Period (2021 2024)
- "New IP" and standardization
  - New IP is promoted by a set of partners from both industry and academia
  - The supporters of New IP highlight that
    - New IP is not only a novel Internet Protocol, but rather a new architecture with
    - associated signalling, control, management and transport capabilities
    - New IP is currently under work by engineers and research scientists from both industry
    - and academia across multiple countries
    - Some prototypes have been already presented in public
    - Some operators/service providers have shown strong interest in New IP to support new applications
- Standardization of New IP has not yet started
  - Discussions on New IP standardization are currently ongoing in ITU T in the context of the Next Study Period 2021 2024 preparation new study areas and new ITU T
    - Study Group 13 (Future Networks)
    - Study Group 11 (Protocols and test specifications)
    - TSAG (Telecommunication Standardization Advisory group)

Figure 45: ITU-T presentation

Marco Carugi, ITU new challenges related to tactile IoT, IIoT in which we have to ensure qualitative communications. There is a new global framework for new IP based networks linked with new standardisation works.

Peter Thoene, John Deere, Vertical Industry demand; EU Driven Standards:

- The digital transformation impacts production processes and products
- This is a game changer where security, innovation, and digital policy are combined to shape the global digital regulation
- EU standards and the European legislation provide the framework for the technology to be used in Europe but also beyond this region
- Data Exchange:
  - Extended Agriculture Functions:
    - MyJohnDeere:
      - On Board Diagnostic for Safety/Security/emissions
    - Service Provider:
      - JD Servers / Machine Data
    - Third party:
- AG Industry Examples
  - Tractor Implement Management
    - ISO Bus Data Exchange
    - Conformity Test with “Digital” Certificate
  - Data Connect: planned as open cloud to cloud solution includes the machine position, past machine positions, fill level of the diesel tank, current working status and machine speed.
- Standardization is a strategic lever for the legislation
  - Standards create market opportunities and contribute to shaping the markets
  - Standardization policy increases industry competitivity and help commercialization in many regions in the world
  - Standardization is an industry driven bottom up approach, but can be a top down regulatory driven approach when it comes to safety
- Why to design top down regulatory approach to address safety?

- Member States in Europe are responsible for ensuring the health and safety on their territory of workers, consumers, animals and goods in relation to the risks arising out of the use of connected machinery.
- The industry needs to analyse the essential data processing requirements in terms of trust, security and effective conformity assessment when they put on the market a machinery.
- The industry needs to explain how a single registry at the cloud level can be used by the OEM to provide trust to organizations, and operators when hardware, and software are deployed on the connected machinery.

Figure 46: John Deere presentation

The digital transformation should include all the ecosystem, not only the industry. Data connect open network to exchange data form manufacturers cloud in order the farmer can choose the best solution.

Ricardo Vitorino, Ubiwhere, Industry supply side: Suiting the future of smart cities:

- By designing cities in a way that values everyone's experience, we can make cities that help us all get stronger, more resilient, more connected, more active and freer. We just have to decide who our cities are for. And we have to believe that they can change.
- How can cities become truly smart?
  - Placing changes and being able to measure them.
  - Following the good practices on Smart Cities implementation.
  - Avoiding vendor lock-in and isolated solutions with no-integration.
  - Investing in data harmonization.
  - Allowing a proper analysis and data correlation/integration.
- Use cases for Smart City:
  - Real time status of the city
    - Information from several verticals in a single map
    - General overview of short-term historical data capability to take decisions on real-time
  - KPIs Analysis
    - Dynamic, contextual insights about the city ecosystem to foster smooth operations
  - Sustainability
    - Well-defined metrics to help cities benchmark their progress towards the UN's Sustainable Development Goals

Figure 47: Ubiwhere, presentation

Open standards on IoT connectivity to now the real-time situation of the Smart City, integrating citizens perspectives and also the respect of the Green Deal.

Figure 48: Panel discussions

3.3.5 Session 2: IoT- Enabled data marketplaces

3.3.5.1 Objectives session 2

IoT-enabled Data marketplaces: transformative journey from building infrastructure to the local enablement of cross-domain marketplaces is underway across many domains and geographies.

The objectives of the session 2 were to discuss what are the standardization, regulation and policy needs associated with these IoT-enabled Data marketplaces and what are the future development.

3.3.5.2 Presentations, discussions and takeaways

Moderator: Franck Boissière

Figure 49: Franck Boissière, EC DG Connect, E4 Unit

Sergio Gusmeroli (Politecnico di Milano):

- Market 4.0 Data Marketplaces for Smart Manufacturing
- The EC 2020 European Strategy for Data: Industrial Data Space Common European industrial (manufacturing) data space Europe has a strong industrial base, and manufacturing in particular is an area where the generation of and use of data can make a significant difference to the performance and competitiveness of European industry. In order to unleash this potential, the Commission will:
  - Address issues related to the usage rights on co generated industrial data (IoT data created in industrial settings), as part of a wider Data Act (Q4 2021).
  - Gather key players from the manufacturing sector to agree in a manner compliant with competition rules as well as principles of fair contracts the conditions under which they would be ready to share their data and how to further boost data generation, notably via smart connected products (Q2 2020 onwards). Where data generated by individuals are concerned, their interests should be fully taken into account in such a process and compliance with data protection rules must be ensured.
  - The 2018 Data PACKAGE: towards a common EU Data Sharing Space
  - Business Models for sharing Private sector Data
    - Models to B2B Data Exchange:
      - An Open Data approach
      - Data monetization on a data marketplace
      - Data exchange in a closed platform
  - Open Data: the vision of a Didactic Factories Network
    - Open Data Models for SI entities
    - Network of open Didactic Factories producing and sharing their data thanks to standard protocols and data formats (e.g. OPC UA, MQTT, ROS, AMQP).
    - Data Transformation techniques for non-public Data such as Aggregation, Filtering, Anonymization.
    - One-stop-shop for search discovery selection, Distributed Repositories for Data Storage (iSpaces).
    - Ecosystem of Innovators testing and experimenting their solutions on open data (Data AI Community).
  - Open / Closed Data Spaces: B2G & B2C Data Sharing Spa
    - URBAN MANUFACTURING: SMART FACTORIES in SMART CITIES
    - Twin UM factory and city grew together and shared very similar socio-business experiences.

- New-borne UM a new factory with no negative impact on the surrounding environment.
- Proxy UM employees have been mostly hired locally, the supply-distribution chains are extremely short.
- Garage UM Do-It-Yourself FabLab experiences 3D Printing and the Makers movement.
- Home UM production is spread in an ecosystem made of micro plants, often home based.
- ZeroKM UM slow / organic food against tastes massification and global food chains

- Data Monetization: from DIH to Marketplaces (MIDIH)
  - Using IDSA (International Data Space Association)
- Data Monetization: enabling Product Services
  - Servitization is the evolutionary pathway of the business model of a manufacturing company, moving from a product centric perspective towards Product Service Systems (PSSs), based on the provision of integrated bundles consisting of both physical goods and services, (Tukker 2004).
- Trusted B2B Data Sharing: Access Sovereignty (Boost 4.0)
- Data Exchange in Closed Platform: Predictive Maintenance in PRIMA Welding Station at FIAT Melfi Campus Plant
- Business Model Innovation
- Challenges for Data/Service Sharing Spaces
  - Open Data (operational but in other domains
    - Manufacturing Industry Managers and Decision Makers need to understand the
    - value of Open Innovation
    - Easy to use and self-explanatory algorithms for Data Preparation
    - Interoperability with existing Open Data sources like in Urban Manufacturing
  - Data Marketplaces (dynamic and SME oriented, new business models)
    - DIHs as trusted Data Marketplaces for SMEs (AI ecosystem)
    - Distributed P2P Marketplaces and dynamic on the fly Smart Contract adaptations.
    - Enabling new Business Models such as Servitisation
  - Trusted Data Networks (often dominated by Large
    - Platform Economy and multi stakeholders Innovation Models

Figure 50: Boost 4.0 presentation

Servitisation of the industrial sector is a reality in which monetisation of data generates new business opportunities
Collaboration is a must in any data value chain. For industry:

- Opendata based on the vision of didactic factories network
- Relation between SmartCities and smartfactories
- DIH as facilitator for monetisation

Chris Decubber, EFFRA:

- Factories of the Future
- Key enablers and cross-cutting factors
  - Skills and engineering tools
  - Skills for operation of technologies
  - Added value / optimisation focus
  - Business models / financial investment
  - Interoperability / standards
  - Security
  - Technology - building blocks
- Some Factory of the Future projects supported by EFFRA:
  - FAREDG3 (Factory Automation Edge Computing Operating System Reference Implementation):
    - Keep data where it belongs and not move it outside
    - DLTs are done within a factory
  - eFactory: European Connected Factory Platform for Agile Manufacturing
    - federated platforms that is being worked out in eFactory
    - Integration flow engine
    - Data spine that connects the platforms; Define policy when to share and what to share
  - Connected Factories: Service development (collaborative product services factories)
    - Autonomous Smart Factory
    - Hyperconnected Factories
    - Collaborative Product - Service Factories

Figure 51: EFFRA presentation

Data considered from different perspectives: stakeholders, increase internal efficiencies, develop new business models... in all connectivity, interoperability and data sovereignty are key aspects.

Tom de Block, AIOTI:

- AIOTI Market Drivers and High-Level Architecture for IoT-enabled Data Marketplaces
  - DLT WG in AIOTI
  - HLA for IoT enabled Data marketplaces
    - Data aggregator
    - Data seller

    - Utilities
    - Interfaces
  - Managed Data lake (Metadata)
  - Device an ID on the network
  - Sensors need to be renewed each 2 years
  - Decentralized system and business model for lake and aggregators
  - Federation of Data marketplaces is supported
  - Finance sustainability is missing
- Comment Franck: simple bridge that brings what is available and finance sustainability


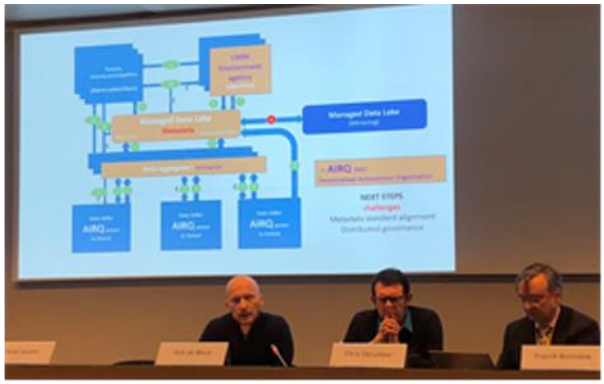

Figure 52: AIOTI presentation

How a data layer can boost new business models. It is important to develop sustainable models based on real applications

Silvia Castellvi, IDSA/GAIA-X:

- A trustworthy architecture for the data economy

Figure 53: IDSA/GAIA-X presentation

IDSA provides a standard for data sovereignty allowing trustworthy data sharing. To transform data into an economic asset it is needed an open ecosystem based on trust

GaiaX is the initiative to promote the Next generation of data federation for Europe, making possible to use and share into a common infrastructure based on #trust

Challenges:

- Data, an economy asset
  - Trading with data creates huge revenues for some focal companies in an ecosystem, which tend to assume monopolistic attitudes.
  - Rarely, the creators of data are benefitting from this value in an adequate way.
  - Companies do not take advantage of the value.

    - Making data economy really a success, there is a need for a ...
        - vendor independent data ecosystem and marketplace
        - connecting vendor specific platforms
        - open to all
        - at low (transaction --) cost and
        - easy to adopt and easy to use.
- IDSA reference architecture forms the base of
    - open, distributed data eco systems and marketplaces
    - ensuring data sovereignty for the creator of the data,
    - and proven data provenance for the user of data,
    - all above audit proof, if requested
    - based on European values.
- Open issues
    - Governance for data sharing
    - Defining usage constraints
    - Trusted manipulation of data
- Data spaces
    - Cleanrooms for a prospering data economy
- State of play in Europe
    - GAIA-X: enabler for digital ecosystems
    - IDSA provides the Gateway/connector

Figure 54: Rolf Riemenschneider, EC DG Connect E4 Unit

Figure 55: Panel discussions

3.3.6 Session 3: Horizontal harmonization - AIOTI solutions on breaking down the technology silos

3.3.6.1 Objectives session 3

The session focused on the work that has been done by AIOTI on current gaps in IoT standardisation and will discuss the opportunities and barriers on leveraging technologies like 5G, IoT/IIoT, AI, robotics, cloud and edge computing and as well automation and required standards, governance, policy and rules to address the horizontal harmonization.

3.3.6.2 Presentations, discussions and takeaways

Moderator: Wael Omar El Hassan El Rifai

Figure 56: Panel Session

Dave Raggett:

- Briefly presented the outcomes of the AIOTI WG03 Semantic Interoperability taskforce
- Semantic Interoperability Sub Group – chaired by Martin Bauer and Laura Daniele
  - Two Joint White Papers from AIOTI, EC, oneM2M, W3C, ISO/IEC JTC1 and IEEE-SA
  - Semantic IoT Solutions - A Developer Perspective [23].
  - Towards Semantic Interoperability Standards based on Ontologies [24].
- What are the barriers?
  - Technology is available, some tools
  - Limited to relatively small community
  - Wrong perception: academic, for experts only, difficult
    - Spread the word
    - Make it easier for all stakeholders
    - Best practice

Michelle Wetterwald:

- Briefly presented the outcomes of the AIOTI WG03 IoT Gaps taskforce
- Update Release 1.0 of the report
- Release 2 of the "High Priority IoT Standardisation Gaps and Relevant SDOs" has been published by AIOTI WG03 in January 2020 [25].
- It covers:
  - an up-to-date analysis of previously identified standardisation gaps,
  - as well as tools to obtain an overview of standardisation activities and specifications related to IoT
- Main outcome (for standardisation)
  - Technical topics are well understood
  - Interoperability is making its way

- Market enablers are starting to raise attention
- Deployment and societal topics need further focus in standardization

Marco Carugi presented:

- The outcomes of the AIOTI WG03 High Level Architecture (HLA) taskforce
  - Release 4.0, published in June 2018 [26].
  - Current HLA report (Release 5 ongoing (2020) status; concrete advances and potential studies.
- Three areas have concretely progressed
  - Security, Interoperability among platforms, Virtualization
- Potential HLA extensions and new studies:
  - New clause/Reference architecture for Data Market Place ("data lake" being one approach), including consideration of IDS
  - 3D architecture (decentralized, cloud edge coordination) including integration with HLA
  - Meta data architecture
  - Next generation of data How the data will flow
    - Business IoT Consumer IoT
    - Industrial IoT
    - Tactile IoT
    - NB-IoT
  - Convergence of technologies
  - Intelligent connectivity
  - IIoT Edge capabilities
  - Capabilities that data is collected
  - Tactile edge capabilities
  - IoT research priorities

Emilio Davila Gonzalez (EC DG Connect - Head of ICT Standardisation Sector – Digital Innovation and Blockchain Unit):

- Mentioned that the 2019 ICT Rolling plan for standardization has been released and thanked the AIOTI for the provided contributions [27].
- Number of priority actions that are identified
  - URRLC for industrial automation
  - Semantic standards in interoperability
  - Coordination with reference architectures
  - In terms of standards in 5G and IoT that are good examples
  - We need to do the same for blockchain and data usage
  - Interplay between IT and OT
  - Go and move beyond the next generation
  - Find a way to go beyond the consistencies
  - Industrial association as AIOTI and BDVA are very important

Comment Franck Boissière:

- Comments:
  - Need to rethink
  - Provide to Emilio ideas on what needs to be done
  - What is the role of partnership in that domain?

- Look into details on to replicate what has been done in IOT (AIOTI) and possible look that contributed to the global welfare'
- Working very well
- Need to revisit and have a best impact on the new sectors

Patrick Guillemin / Emmanuel Darmois, ETSI:

- Standardization is not what it is used to be
- Facing many issues and problems in domains
- IoT: a major priority for ETSI activities
  - IoT: pervasive and intrinsically complex
  - Complex landscape
  - Standardisation challenges
- Developing things and have maximum collaboration in IoT; AIOTI is an important driver
- Collaboration required: the rationale for the strong investment of ETSI in AIOTI
- The ETSI main IoT channels in TC SmartM2M and oneM2M
  - ETSI SmartM2M is supporting and promoting oneM2M
  - ETSI SmartM2M is currently working on:
    - Supporting the European industry and institutions on the identification and adoption of standards, in particular, regarding the oneM2M framework
    - Bridging the European needs in the area of M2M/IoT towards oneM2M Smart Applications Reference ontology SAREF toward IoT Semantic Interoperability with many extensions in Smart-Appliances, Buildings, Environment, Energy, City, Industry and Manufacturing, Agriculture and more to come on Automotive, Water, Wearable, eHealth.
- ETSI, IoT and H2020
  - ETSI was a partner of H2020 Smart City project ESPRESSO, IoT Platforms UNIFY-IoT and is still in IoT Large Scale Platform supporting action CREATE-IoT, part of the EC cluster of all IoT research and innovation projects.
- Meta Standards
  - The examples of the Reference Architecture
  - The LSP 3 D Architecture Model (developed in the LSP Activity Group 02)
  - Extends some of the current IoT reference architectures and is aiming at:
  - Ensuring a common view of the different layers of the IoT systems from Physical up to Business
  - Providing additional viewpoints to the different stakeholders (not just to the developers) regarding some additional cross systems functions such as security, privacy or safety and the shared analysis of some properties (e g integrability) between different stakeholders
  - The additional dimension of properties is a new way to discuss the properties of the IoT system between different involved parties (e g users, contractors, designers) and identify the elements in support (e g functional building blocks, APIs) and those missing
- Stakeholders guidelines
  - The example of ETSI STF 547
- Citizens involvement
  - The example of ETSI STF 561

Francesca Paggiali, GS:

- The challenge: avoiding data silos
  - Use Common language
- GS1 open standards for supply chains

  - Identify
    - Globally recognised unique identification of products, assets, locations and more
  - Capture
    - Real time accurate and automatic capture of data
  - Share
    - Efficient sharing of information from trusted and authentic sources
- Focus on product digital twin
  - Have strict rules
  - All actors included in the supply chain
  - Collaboration among all supply chain actors
- Connected Consumers
  - Empowered by Consumer Apps
- Regulations driving the change
  - EU Green Deal
  - Circular Economy
  - EU strategy for data
  - Fight against Illicit Trade
- Digital identities, interoperability
- Circular data for a circular economy
  - Trusted source & Data quality
- Beyond (behind) labels
  - Standards for upstream Event data
- From a linear supply chain to a real time value network
- Decarbonation of Supply Chains
  - Location Data & APIs

Ovidiu Vermesan, SINTEF/AIOTI IoT Research:

- Research Priorities for IoT
- Next Generation IoT How the Data will Flow
  - Next Generation IoT
    - Industrial IoT
    - Business IoT
    - Tactile IoT
    - Consumer IoT
  - Next Generation IoT objectives:
    - Convergence of technologies:
    - Intelligent Connectivity - Platform Services and Applications (Wireless cellular 5G NR):
      - AI, IoT, Edge Computing, DLT, Network Slicing, Virtualization, Digital twins
    - Move from centralised to decentralized and distributed
    - AI embedded everywhere at the edge and into IoT devices. Internet of Robotic, Things.
    - Heterogenous IoT platforms IoT/DLT
    - IoT platforms functions embedded in the intelligent edge infrastructure
    - Virtualised IoT functions in edge computing infrastructure
    - Distributed heterogenous multi-dimensional IoT architectures
- IoT Research Priorities
  - IoT DLTs Heterogeneous Platforms and Interoperability
  - IoT and AI Methods and Techniques

- IoT and Distributed Ledger Technologies
- IoT Privacy, Safety, Security, and Trust
- Tactile and Industrial Tactile IoT
- Digital Twins for IoT
- IoT Business Consumer Industrial Tactile:
  - Integrated Information Technology (IT) and Operational Technology (OT)
  - Semantic and Syntactic Interoperability
  - IoT Identification Technology
  - Standardization

Conclusions Rolf Riemenschneider (EC DG Connect):

Figure 57: Rolf Riemenschneider, EC DG Connect E4 Unit

- EC will continue to work with AIOTI and BDVA and other associations and PPPs.
- Find gaps related to data strategy and adapt to market trend; Note that support of Data markets will include more stakeholders in the value chain.
- Find the dimension that you need to tackle; Follow the example of the AIOTI on using a reference architecture (High Level Architecture).
- Be timely; How to close the loop; which standards are available, and which are not .
- What are the Incentives for data sharing?
- Note that Majority of revenues are coming with cloud.
- Focus on the cross sector.
- Focus on metadata exposure.
- Focus on federation of data marketplaces.
- Role of technologies in semantics are prominent and IoT is the catalyst.
  - AI, cloud, edge IoT; and aware of data strategy.
- Standardize as much as possible the description at meta data level.
- Incentives for data sharing need to be elaborated.
- Investigate whether legislative rules in Regulations on data sharing will help data sharing.
- Find balance between local and global.
- There is a need to focus on a holistic manner on AI, cloud, edge IoT and be aware of the Data Strategy and the AI white paper.
  - The White Paper on Artificial Intelligence is open for public consultation until 19 May 2020. The Commission is also gathering feedback on the data strategy. Based

on the input received, the Commission is planning to take further action to support the development of trustworthy AI and a data-agile economy.

- EC representatives thanked AIOTI, CREATE-IoT and Frank Boissière for their support in organising the workshop.

4. CONCLUSIONS

The present document summarizes the results of the 3 days event focused on the IoT European Large-Scale Pilots Programme with the objective of following the progress of its relation to AIOTI and the new DEI Large-Scale Pilots projects launched in 2019.

The current report shows that a considerable amount of work and effort has been put into the different LSPs and AIOTI.

As a direct result, the work performed has contributed to:

- Increase the IoT community, not only among the IoT European Large-Scale Pilots Programme projects by consolidating their cooperation, but on a wider scale through all the dissemination, communication and engagement activities with a larger community of stakeholder.
- Improve the coordination of joint activities between IoT European Large-Scale Pilots Programme projects and facilitate the transition, increasing as such the efficiency and impact of these activities.
- Clustering results of horizontal nature (interoperability approach, standards, security and privacy approaches, business validation and sustainability, methodologies, metrics, etc.).
- Improve the quality of the IoT European Large-Scale Pilots Programme projects work through fluid communication and exchange of knowledge, experience and best practices, and using common methodology and tools.
- The integration and further research and development of IoT technologies across the value chain (components, devices, networks, middleware, service platforms, application functions) and their operation at large scale to respond to real needs of end-users (public authorities, citizens and business), based on underlying open technologies and architectures that may be reused across multiple use cases and enable interoperability across those.
- IoT technologies and applications acceptance by addressing, issues of trust, security and privacy through pre-defined privacy and security impact assessments, liability, regulation and standardisation.
- The validation of the related business models to guarantee the sustainability of the approach beyond the projects' lifetime.
- Mapping the pilot architecture approaches with validated IoT reference architectures.

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