Deliverable 2.1

First Expert Group Meeting Report, Washington D.C.

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Abstract: The First PICASSO Expert Group Meeting was hosted by NIST at the Department of Commerce in Washington DC on May 20, 2016. During the individual Expert Group morning sessions, key challenges and needs for each domain were defined, aiming at revealing gaps and strategic opportunities for EU-US collaboration in the related topics. The EU-US ICT Policy Expert Group focused on the horizontal overarching policy issue of Privacy and Data Protection, relevant for EU-US collaboration in these domains, and on identifying other key policy issues that are applicable across the PICASSO domains. The findings were shared and discussed with the entire audience in a joint public session, which also comprised the presentation of the ICT landscape (drivers, barriers, programmes, projects, initiatives, networks…) currently underway in Europe and the US as well as the opportunities for EU and US ICT specialists to participate in EU and US research and innovation programmes. In total 66 people registered for the event including Expert Group members and invited key actors, i.e. from NIST, NSF, NITRD, IMS, as well as PICASSO project partners.

Keywords: Smart Cities, Smart Energy, Smart Transportation, 5G, Big Data, IoT, CPS

Disclaimer

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Acronyms and Definitions

Acronyms	Defined as
AIOTI	Alliance for the Internet of Things
CPS	Cyber-Physical Systems
CPSoS	Cyber-Physical Systems of Systems
CSA	Coordination and Support Actions
DARPA	Defense Advanced Research Projects Agency
DoD	Department of Defence
DOE	Department of Energy
DOT	Department of Transportation
DSM	Digital Single Market
EC	European Commission
ECSEL	Electronic Components and Systems for European Leadership
ETP	European Technology Platforms
ETSI	European Telecommunications Standards Institute
EU	European Union
ICT	Information and Communications Technology
IEC	International Electrotechnical Commission
IoT	Internet of Things
IMS	Intelligent Manufacturing Systems
ISO	International Organization for Standardization
IT	Information Technology
ITA	International Trade Administration
ITU	International Telecommunication Union
LTE	Long Term Evolution
NIH	National Institutes of Health
NIST	National Institute of Standards and Technology
NBD-PWG	NIST Big Data Public Working Group
NITRD	Networking and Information Technology Research and Development
NSF	National Science Foundation
SMEs	Small and Medium-sized Enterprises
SysML	Systems Modeling Language
SRA	Strategic Research Agenda
Tbps	Terabit per second
UAV	Unmanned Aerial Vehicle
US	United States of America
WG	Working Groups
5G	Fifth Generation

1 Executive Summary

The PICASSO First Expert Group Meeting was organised and held in Washington D.C. on May 20th 2016. The PICASSO project has the intention to reinforce EU-US ICT collaboration in pre-competitive research and innovation related to key societal challenges: smart cities, smart energy and smart transportation, and in key enabling technologies: 5G Networks, Big Data, Internet of Things and Cyber-Physical Systems. These areas were chosen because they are key enablers for tackling the societal challenges mentioned above.

Notably large ICT research and innovation efforts exist in both the EU and the US in these areas and they are also priority topics in various funding programmes in the EU and the US. As a consequence networks and critical mass in these subjects is present on both sides of the Atlantic which affords the opportunity for collaboration. In the morning Expert Group Meetings were held of the 4 PICASSO Expert Groups with very good bilateral attendance. In the afternoon a public meeting was held to disseminate the results of PICASSO, highlight funding opportunities and feedback the findings of the Expert Groups to a wider audience.

Both the Expert Group Meetings and Public Meeting were very well attended with 66 registrants showing the interest in collaboration between the two sides. A number of key messages were highlighted. It was clear from the panorama presentation that there were many areas where it would be possible to collaborate in smart cities, smart energy and smart transportation and also in the key topics identified: 5G, Big Data and IoT/CPS. There are also a number of H2020 and Federal Programmes which are directly funding research in these topics. A difficulty is in identifying programmes where it is possible for EU and US partners to participate together in projects. There is thus a need to align funding and also coordinate programmes on both sides of the Atlantic. The presentation from Intelligent Manufacturing Systems (IMS) showed how this could be achieved in practice. IMS is a multi-national programme that has been running for 20 years that has enabled $600M of funding. It is clear that in order to be successful there are two key requirements, the first is funding to make the collaboration possible and the second is coordination between both sides.

There are also other barriers to successful collaboration and exploitation of results. Here there is a need to harmonise legislation and regulations. At the meeting the PICASSO policy group had identified two key areas for discussion, data protection and privacy. The discussion highlighted a need for awareness raising of the issues and also the need to address other key areas such as security and standardisation.

2 Introduction

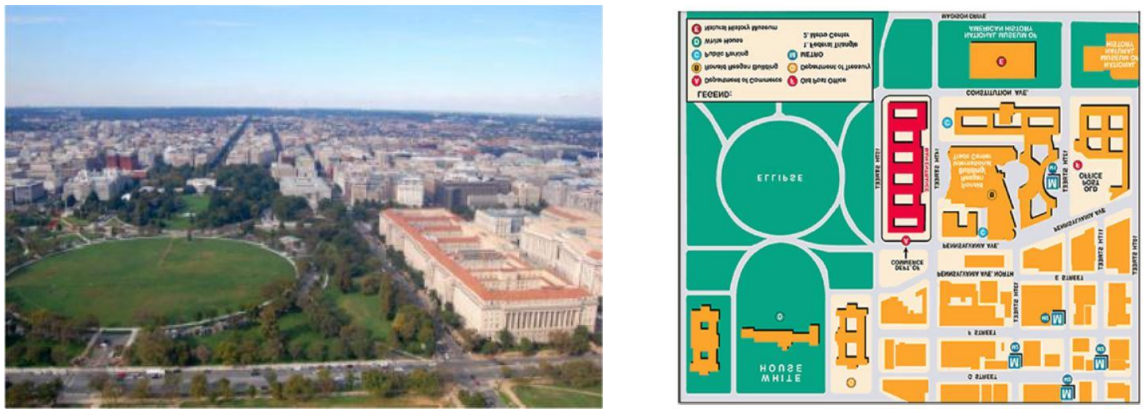

Figure 1. Herbert Hoover Building, Department of Commerce

The meeting was held in the Herbert Hoover Building Department of Commerce, Washington D.C. on 20th May 2016. The building has a central location in Washington as shown in Figure 1 and allowed for good participation from US government bodies. The meeting was hosted by NIST with 66 registrants. The attendees had a variety of backgrounds but were interested in the topics of Smart Cities, Smart Energy, Smart Transportation and also the areas of the PICASSO Expert Groups: 5G, Big Data and IoT/CPS. Each Expert Group has a mix of EU and US experts in the defined topics, however, in the meeting additional participants were also welcomed to join the Expert Group meetings. The aim of the Expert Groups is to discuss areas where it is believed collaboration is possible and put forward recommendations for joint EU-US cooperation.

2.1 Meeting Goals and Agenda

The meeting goals are shown below.

PICASSO EU-US Expert Group Meeting
20th May 2016

Organised by PICASSO and hosted by NIST at the Department of Commerce

1401 Constitution Avenue, NW, Washington, D.C.

www.picasso-project.eu

Mission: Enhance EU-US ICT research and innovation collaboration responsive to societal challenges and industry needs, supported by harmonious policies, to enable economic growth in both the EU and US

5G Networks, Big Data, Internet of Things and Cyber Physical Systems – for smart cities, smart transport and smart energy

This document includes information about:

- Goal of Meeting
- Stakeholders
- Expected Outcomes
- Agenda
- List of confirmed participants
- Contact

Goals of Meeting

The aim of the meeting is to reinforce EU-US ICT collaboration and support the policy dialogue on pre-competitive research and innovation related to the societal challenges - smart cities, smart energy, smart transportation and in key enabling technologies: 5G Networks, Big Data, Internet of Things and Cyber Physical Systems. The meeting will present a panorama of the ICT landscape and programmes currently underway in Europe and the US as well as programmes in the rest of the world. Existing funding opportunities for collaboration will be highlighted. The views of the three EU-US ICT Expert Groups on 5G Networks, Big Data and IoT/CPS will be presented identifying gaps and opportunities, a map of challenges, open problems, and the needs for supporting policy measures and strategic EU-US initiatives (both policy and research related). Key actors, i.e. NIST, NSF, IMS, will be invited to highlight existing opportunities for collaboration. In order to assess policy issues that touch upon the domains in the focus of PICASSO, the EU-US ICT Policy Expert Group will take the results of the three technical ICT expert groups into account. A first horizontal overarching policy issue, Privacy and Data Protection aspects relevant for EU/US collaboration in these domains will be addressed both during the morning session of the ICT Policy Expert Group and during the afternoon plenary.

Figure 2. Goals of Meeting

The participants were provided with information introducing the project, the expert groups and the goals of the meeting as shown in Figure 2. This was to ensure that the invitees were clear on what the project was trying to achieve and the scope of the work proposed within PICASSO. There were 3 key aims for the public meeting. These were to:

- Present a Panorama of ICT landscape programmes in Europe and the US
- Present the views of the 3 Expert Groups on 5G, Big Data and IoT/CPS
- Present policy related issues, particularly the areas of Privacy and Data Protection

Stakeholders

The core expert groups comprise representatives from the EU and US who are all recognised experts in their domains. Membership in the groups is also open for representatives from related H2020 and US-funded industry-driven projects and ICT associations, networks and PPPs. There is strong industrial participation from SMEs, large corporations, leaders of key European networks, research & innovation clusters and leaders of roadmapping activities. The afternoon public workshop will allow the opportunity for engagement with the wider community from ICT-related projects, both from the EU and US, and for exploring opportunities for accompanying policy measures to further facilitate ICT research and innovation collaboration.

Expected Outcomes

The key expected outcomes of the meeting will be to:

- Increase the awareness of EU and US ICT policies relating to 5G, Big data, IoT/CPS, identify barriers and explore practical ways forward towards enhancing EU-US collaboration in ICT research and innovation;
- Increase the visibility of key programmes in the EU and US on smart cities, smart energy, smart transportation and in key enabling technologies: 5G Networks, Big Data, Internet of Things and Cyber Physical Systems;
- Highlight the key challenges in 5G Networks, Big Data and IoT/CPS and how these can be addressed by accompanying policy measures;
- Highlight the opportunities for joint research funding and other policy measures for improvement of EU-US ICT research and innovation collaboration;
- Identify areas for joint EU-US collaboration.

Figure 3. Stakeholders and Expected Outcomes

Invitees were also provided with information on who the meeting would be most relevant to with a view of the stakeholders that PICASSO wishes to engage with and also the expected outcomes from the meeting as shown in Figure 3. Here the key outcomes were to, firstly, raise awareness of activities that were going on in the EU and the USA in the areas of Smart Cities, Smart Energy, Smart Transportation, 5G, Big Data, and IoT/CPS by presenting of the results of the panorama work. Secondly, to identify joint challenges in the Expert Domains in 5G, Big Data and IoT/CPS through engagement with the Expert Groups and via discussion. Thirdly, to address horizontal policy issues identified by the Policy Expert Group and identify areas for joint research funding and policy measures to enable collaboration. A key overall aim was to identify areas for joint collaboration where the EU and US could work together. The meeting agenda is shown below.

Agenda

Morning: Private Meetings of 4 PICASSO Expert Groups

Breakout Rooms: IOT/CPS (A005), 5G (A004), Big Data (C005), Policy (C006)

9.00 Welcome from Expert Group Chair

9.15 Identification of Key Challenges and Needs within Domain

10.30 Coffee Break

11.00 Formulation of Feedback for Public Meeting

- Gaps and opportunities
- Challenges and open problems
- Needs for future policies and strategic EU-US initiatives

12.00 Lunch (Room 1412)

Afternoon: PICASSO Public Meeting (Room 1412)

1.00 Welcome from NIST

1.05 Welcome from PICASSO (ppt)

1.10 Introduction to the overall PICASSO Project (ppt)

1.25 Planned Activities (Brief overview of each Working Group + Aims – Expert Group Chairs)

2.00 Panorama of Existing Projects in the EU and US (THINK)

2.40 Overview of Access Opportunities (APRE)

3.00 Coffee Break

3.30 Working Group Reports

- Report Back from 5G Expert Group + Discussion (Expert Group Chair)
- Report Back from Big Data Group + Discussion (Expert Group Chair)
- Report Back from IoT/CPS Working Group + Discussion (Expert Group Chair)

4.30 Open Floor (Opportunity for invited EU/US Participants, i.e., NIST, NSF, IMS … to present collaboration opportunities relating to the domains to be explored by PICASSO)

5.10 DISCOVERY Transatlantic ICT Forum (European-American Chamber of Commerce - New Jersey)

5.20 Report Back from Policy Group and Panel Discussion on Key Policy Issue - Privacy and Data Protection Issues relating to the three PICASSO domains (Expert Group Chair)

5.50 Round Up and Next Steps (ppt)

6.00 End of Meeting

Figure 4. Private Expert Group Meetings and PICASSO Public Meeting

The overall agenda was divided into private Expert Group Meetings in the morning for the 4 Expert Groups and then a Public Meeting in the afternoon for a wider audience (see Figure 4). Notably around 20 additional participants expressed an interest in also attending the Expert Group Meetings. As a result the private Expert Group Meetings were very well attended and had a much greater mix of representatives and input.

3 IoT/CPS Expert Group Report

3.1 Scope of the Expert Group on IoT/CPS

The Internet of Things (IoT) is a paradigm that describes a large number of devices with sensing capabilities connected via the internet, providing large streams of real-time data that can be used for monitoring and for providing intelligent services. Until now, most of the IoT research and development has been focused on sensors and on providing connectivity. In the future, using the information provided by the sensors and networks in a smart fashion and by connecting sensing to actuation will bring value to users and to societies.

Cyber-physical systems (CPS) are systems where real-time computing elements and physical systems interact tightly. Cyber-physical systems are ubiquitous since computing devices and software are enabling and enhancing the performance of all except the simplest technical systems. The most challenging class of cyber-physical systems are cyber-physical systems of systems (*CPSoS*, see www.cpsos.eu) which are characterized by being spatially distributed, having distributed control, supervision and management with partial autonomy of the subsystems, are dynamically reconfigured on different time scales, and can show emerging behavior. Examples of cyber-physical systems of systems are the electrical grid, railway systems, the public transport system of a city, smart buildings, and production processes with many cooperating elements, e.g. robots, machines, warehouses, or large processing plants with many process units.

These large-scale systems are already equipped with a large number of sensing devices. The Internet of Things will make the access to the information provided by these sensors much simpler and more flexible. Thus, the connectivity provided by the Internet of Things will become an enabling technology for cyber-physical systems of systems in which the loop from a myriad of sensors to the way the systems are operated and also to the demands of the users is closed. This will enable improved monitoring, management and hence new levels of energy and resource efficiency, product and service quality, and safe and reliable operation.

The enormous potential of these technologies has been recognized by the European Union, as CPS and IoT are key pillars of the Europe 2020 initiative Digital Agenda for Europe and of other research and innovation programmes, e.g. the ECSEL Joint Undertaking, EUREKA/ITEA, and the ARTEMIS Industry Association (see the latest Strategic Research Agenda of ARTEMIS, https://artemis-ia.eu/publications.html). Privacy, security, and standardised communication are key aspects to realize cyber-physical systems of systems which are connected via the Internet of Things. Engineering trustable, reliable, evolvable and affordable cyber-physical systems is a scientific and technological challenge that requires huge efforts and where joining forces will help to advance more quickly and to meet societal challenges and to compete on the world markets for both US and European companies.

The objective of the Expert Group on IoT/CPS is to identify the key societal challenges where this technology will offer a large potential for improvements, to analyse technology strengths and technology gaps in the EU and in the US, and to make proposals for future EU-US collaborations in the intersection of IoT and CPS, in particular on how to handle the huge amounts of real-time data produced by IoT-connected sensors and how to transform it

into useful knowledge and actions that will improve the performance and the safety of cyber-physical systems of systems.

3.2 IoT/CPS Meeting Participants

Prof. Dr. Sebastian Engell (chair)

- Head of the Process Dynamics and Operations Group, TU Dortmund, Germany
- Background: Automation and control, systems management, cyber-physical systems

Prof. Dr. Tariq Samad (co-chair)

- Professor at the Technological Leadership Institute (TLI), University of Minnesota, US (previously: Corporate fellow, Honeywell, US)
- Background: Industrial automation

Dr. Chris Greer

- Senior Executive for Cyber Physical Systems, Associate Director for Programs, National Coordinator for Smart Grid Interoperability, NIST, US
- Background: Computing, cyber-physical systems

Dr. Paul Nielsen

- Director / CEO, Software Engineering Institute, Carnegie Mellon University, US
- Background: Software development, cyber-physical systems, cyber-security

Prof. Dr. Haydn Thompson

- Managing Director / Director, THHINK Wireless Technologies Ltd., UK / Japan
- Background: Wireless sensors / transportation / manufacturing / smart cities

Dr. O. Sinan Tumer

- Senior Director, SAP Co-Innovation Lab, US
- Background: Co-innovation, research commercialization

Dr. Ovidiu Vermesan

- Chief Scientist, SINTEF ICT, Norway
- Chair of Working Group 1 (*IoT European Research Cluster*) of the *Alliance for Internet of Things Innovation* (AIOTI)
- Background: Internet of Things

External Meeting Participants

- **Marty Burns**, NIST, US
- **Giulio Busulini**, Scientific Attaché, Embassy of Italy, Washington, US
- **Dr. Edward R. Griffor**, Associate Director for Cyber-physical Systems, NIST, US
- **Ellen Nadell**, NIST, US
- **Dan Nagy**, Managing Director, IMS (Intelligent Manufacturing Systems) Inter-regional Secretariat, US
- **Dr. David Shaw**, Mississippi University, US
- **Dr. David A. Wollman**, Deputy Director, Smart Grid and Cyber-physical Program Office, NIST, US

3.3 IoT/CPS Meeting Agenda

09:00 – 09:15	Opening and Round of Introductions
09:15 – 09:30	Scope of the Expert Group on IoT/CPS Sebastian Engell (chair), TU Dortmund, Germany
09:30 – 09:45	Panorama of Ongoing Projects in IoT/CPS Haydn Thompson, THHINK, UK
09:45 – 10:30	Findings of the EU Project CPSoS and Discussion Sebastian Engell, TU Dortmund, Germany
10:30 – 10:50	**Coffee Break**
10:50 – 12:00	Statements by the Expert Group Members and Discussion
12:00	**End of Meeting**

3.4 Key Messages and Outcomes

The main objective of the meeting was to understand and analyse the views of EU and US experts on notions and concepts relating to the Internet of Things (IoT), to cyber-physical systems (CPS), and particularly to their intersection, i.e. the large increase in connectivity delivered by the IoT to modern CPS, on challenges, needs, and opportunities that arise from this intersection, and on existing EU-US collaborations and future opportunities.

After a brief introduction to the scope and goals of the expert group, and overviews of the current panorama in IoT/CPS and of research and innovation priorities that were identified in the European CPSoS project (www.cpsos.eu), the session focused on brainstorming and discussions, with additional input provided through brief statements by several of the expert group members on their views of challenges, needs, and opportunities, and where cooperation between all technical PICASSO Expert Groups will be important since 5G networks and Big Data technology are seen as enablers for IoT/CPS/CPSoS.

The discussions disclosed that while the IoT and CPS worlds partly exhibit similar concepts, there are differences in understanding in the IoT and CPS domains, not the least of which is that some people view CPS as a subset of IoT while others separate the two domains and state that CPS make use of IoT. Furthermore, in the US there are differing views of what the Internet of Things is: One view restricts the IoT to middleware and connectivity, while a broader view sees the IoT as the unification of the physical, the computing, the virtual, and the human worlds. What is needed is a consolidation effort that concretises and unifies the existing definitions, concepts, and understandings. Furthermore, there are several IoT reference models, and it is an open question how to unify them or interface between them. Generally, the interconnection of different platforms is a challenge, e.g. in the area of smart cities.

At the intersection of IoT and CPS, dependability, security, and trustworthiness are major challenges. Many systems that were never meant to be connected to the internet are now connected, and the resulting vulnerability of IoT-connected devices is worrying, as several successful cyber-attacks in the energy/production sectors have shown in recent years. Vulnerabilities may also be fostered by the fact that new applications come to the market quickly and establish de-facto architectures that may not be as dependable and secure as necessary. Open questions in this area are to which extent regulation is needed, how existing applications can

be migrated to more reliable, secure, and extensible architectures, and if localization and expiration of data are useful concepts to increase trustworthiness.

Another important issue is that of autonomy, which will increase significantly in the next years (example: self-driving cars). Autonomy means that systems are not confined, thus a deep knowledge of the world around the system is needed. An open issue is how the knowledge can be bounded such that successful autonomous operation becomes feasible. Although autonomy will increase, it is expected that full autonomy is not likely in the near future. One reason for this is that people only trust systems if humans are in the loop. Humans assume a central role in such semi-autonomous IoT and CPS systems, which will require research into cognition, situation awareness, and the deeper levels of human understanding.

The Expert Group agreed that there are many options for transatlantic collaboration, and it was discussed which topics and areas are most suitable for collaboration initiatives. A major obstacle to collaboration is to get competing companies involved and to convince them to share their IP. Thus, topics that are not too reliant on the involvement of competing companies (e.g. that address world-wide societal challenges, or that focus on low-TRL fundamental research) are promising candidates. A major part of the discussion was devoted to the analysis of the EU and US funding initiatives and agencies, and on the identification of suitable agencies for EU-US collaboration projects.

In conclusion, the meeting led to a fruitful discussion of numerous important aspects that helped both sides to understand in more detail the initiatives, the players, and their focus on the other side.

4 Big Data Expert Group Report

4.1 Scope of the Expert Group on Big Data

Figure 5. Data Group Expert Meeting

The PICASSO Big Data Expert Group convened for the first time in Washington DC on May 20, 2016 to tackle the following themes:

- Charted the high level status of the Big Data (BD) sector in Europe, the US and worldwide.
- Performed in-depth discussions on specific areas of Big Data expertise which will include:
  - Software Engineering for Big Data and Big Data for Software Engineering
  - Infrastructure – Current situation and critical needs to go forward
  - Application areas that present the greatest challenges and opportunities
  - Big Data from and for Internet of Things
  - Research greatest achievements and current promising areas
- Defined the greatest opportunities for collaboration between EU and US by utilizing the most competitive strengths of each side

4.2 Big Data Expert Group members

Dr Nikos Sarris (chair)

- Head of the ATC Innovation Lab
- Member of the General Assembly of the Big Data Value Association
- Member of the Steering Committee of the European Technology Platform NESSI (dedicated to Software, Services and Data)

Prof. Dr. Sören Auer (co-chair)

- University of Bonn
- Head of Enterprise Information Systems group
- Member of the leadership council of Fraunhofer-Insitute for Intelligent Analysis and Information Systems (IAIS)
- Coordinator of Big Data Europe (http://www.big-data-europe.eu) the CSA currently coordinating all EC-funded Big Data projects and relevant communities
- Member of the Big Data Value Association

Dr Andreas Metzger

- University of Duisburg-Essen
- Head of Adaptive Systems and Future Internet Applications,
- Chief technical architect of the European Future Internet Public Private Partnership project on transport, logistics and agri-food (FIspace),
- Deputy General Secretary of the Big Data Value Association (http://www.bdva.eu), which represents the Private part in the European Big Data PPP
- Vice Chair of the Steering Committee of the European Technology Platform NESSI (dedicated to Software, Services and Data)

Michail Bletsas

- Director of Computing at the MIT Media Lab
- Head of the Network Computing Systems (NeCSys) group

Dr David Belanger

- Stevens Institute of Technology
- Senior Research Fellow, Leader IEEE Big Data Initiative
- Member of the Board of Advisors - IEEE Transactions on Big Data, IEEE Transactions on Internet of Things

Wo Chang

- Digital Data Advisor for the NIST Information Technology Laboratory (ITL)
- Convener of the ISO/IEC JTC 1/WG9 Working Group on Big Data
- Co-chair of the NIST Big Data Public Working Group

4.3 Big Data Meeting Agenda

9:00-9:15 Welcome from Expert Group Chair

- Dr Nikos Sarris: Introducing PICASSO and the General Scope of the Expert Group

9:15-10:30 Identification of Key Challenges and Needs within Domain

- Prof. Dr. Sören Auer: The semantic layer of Big Data
- Dr Andreas Metzger: Big Data Software Engineering
- Michail Bletsas: Infrastructure challenges for Big Data
- Dr David Belanger: Moving to Big Data Generation II
- Wo Chang: Big Data Architectures and Infrastructure

10:30-11:00 Coffee Break

11:00-12:00 Formulation of Feedback for Public Meeting

- Gaps and opportunities
- Challenges and open problems

12:00 End of Meeting

4.4 Key Messages and Outcomes

Challenges and Opportunities

- Big Data will only continue getting Bigger and more complex
  → Software Engineering need to adopt with customised principles
- Applications will continue getting more and more difficult to exploit
  → Need to address fragmentation of efforts with standardised ecosystems
- New professional skills are needed to support technologies and applications
  → Educational curricula are still in their infancy, in under and post-graduate levels
- New application areas keep appearing with the availability of new data
  → Applications need to follow with intelligent use of data and technologies
- Critical application areas need to be addressed with great care (e.g. healthcare, energy,…)
- ISO BD WG identified 16 potential standardization gaps to enable Big Data Systems interoperability
- Integrated policies still not adopted to address issues as:
  → Personal data protection
  → Data ownership

Important topics identified

- Interoperability and Standardization
- Adding a semantic layer to Big Data technology
- Integrating Linked Data and Big Data technology
- Enable discovery of deeper, fresher insights from all enterprise data resources
- Improve efficiency, effectiveness, and decision-making

- Facilitate more timely, agile response to business opportunities, threats, and challenges
- Provide a single view of diverse data resources throughout the business chain
- Support tighter security, protection, and governance of data throughout its lifecycle
- Improve the scale, efficiency, performance, and cost-effectiveness of data/analytics platforms

Opportunities for EU/US Synergies

- Standards
- Education
- Research Infrastructures
- Critical Applications
- Repositories of data, tools, best practices
- Creating a common ecosystem for discovering and making use of Big Data
- Create common communities
- Coordinate research

Action plan for Expert Group

- Annual physical meetings
- Continuous off-line collaboration for formulating a common report with recommendations for joint EU-US initiatives
- Encourage participation from additional members from external organizations
- Collaboration with EU and US networks and associations (e.g. IEEE, BDVA)
- Organise networking opportunities in relevant events to encourage EU-US research and commercial collaboration
- “Public” Big Data Event at the end of the project, open to external participants

5 5G Expert Group Report

Figure 6. 5G Expert Group Meeting

5.1 Scope of Expert Group on 5G

5G stands for 5th generation mobile networks, which will be the successor of 4G/ LTE. 5G will not only be an evolution of mobile broadband networks. It will bring new unique network and service capabilities. Firstly, it will deliver high data rates up to several Gbps to ensure user experience. In addition, 5G will be a key enabler for the Internet of Things by providing a platform to connect a massive number of sensors and actuators with stringent energy constraints. Furthermore, mission critical services for steering and control, requiring very high reliability, and very low latency, will become natively supported by the 5G infrastructure.

The 5G Expert Group met for the first time in Washington DC on May 20, 2016 to address the following topics:

- Sharpen 5G Vision, by identifying gaps and opportunities
- Identify joint EU-US Research topics, based on experts' input by
    - Identifying key challenges and opportunities in 5G Networks domain, w.r.t.
        - Technology/ research topics,
        - Regulatory and policy issues
        - Socio-economic impact
- Identify socio-economic impact

5.2 5G Expert Group Members

Gerhard Fettweis (chair)

- Vodafone Chair Professor at TU Dresden
- Coordinator 5G Lab Germany
- Co-leader IEEE 5G initiative
- IEEE Tactile Internet (sub-) Committee and Standardization P.1918
- Principal Investigator at ICSI, Berkeley

Leif Johansson (co-chair)

- Principle Engineer National Instruments
- RF Communications Market Development
- Lead User Manager

Olav Queseth

- Ericsson Research
- EU/5GPPP
- Project coordinator for METIS-II

David Kennedy

- Director of Eurescom,
- Project manager for the 5G-PPP Euro-5G project

Amitava Ghosh

- Nokia Fellow
- Head of Small Cell Research at Nokia Bell Labs

Chengshan Xiao

- Program Director with the Division of Electrical, Communications and Cyber Systems in the Engineering Directorate at the US National Science Foundation (NSF)

Deborah Crawford

- Vice President of Research at George Mason University (GMU)

Steffen Watzek

- Programme Manager at TU Dresden's Vodafone Chair

External Meeting Participants

- **Nada Golmie** - Chief of Wireless Networks Division at National Institute of Standards and Technology (NIST)
- **Grant Miller** - Senior Technical Coordinator for Large Scale 5G Project at National Coordination Office (NCO) for Networking and Information Technology Research and Development (NITRD)

5.3 5G Meeting Objectives and Agenda

Since it was the first meeting of this group, one meeting objective was to get to know each other and get a common understanding of the mission and objectives of PICASSO and 5G Expert Group approach. The main objective was to identifying needs for EU-US joint research by detecting key challenges and opportunities in 5G networks domain.

9:00 – 9:15 Welcome and Round Table

9:15 – 9:30 Introduction PICASSO & 5G Expert Group Approach

9:30 – 10:30 Partner introduction and input collection of challenges and opportunities

10:30 – 11:00 Coffee Break

11:00 – 12:00 Aggregation of Key Messages

12:00 End of Meeting

5.4 Key Messages and Outcomes

The participants each presented their view on challenges and opportunities in the area of 5G from their perspectives w.r.t. technology, regulatory and policy issues, socio-economic impact:

TUD Viewpoint (Gerhard Fettweis)

- Tactile Internet applications: Mission critical vs. Non critical
- Net neutrality (differentiate between mission-critical and non-critical applications)
- Regulation 6-300 GHz
- Spectrum Access Policies

NI Viewpoint (Leif Johansson)

- Prototyping and testing to verify technology
- Spectrum allocation (esp. 28 GHz harmonization)
- Flexible regulatory framework
- Privacy control
- 5G Business cases
- Geographic coverage both in country and world-wide, incl. rural areas

ERICSSON Viewpoint (Olav Queseth)

- Regulation for increasingly autonomous things
- Global harmonized spectrum
- 5G as a driver for improving people's life
- Balance the needs of different interest groups
- Increasing inequality
- Need for further Research beyond first few releases in 3GPP standardization

NOKIA Viewpoint (Amitava Ghosh)

- Higher frequency bands offering higher capacities
- Spectrum sharing models open up access to new bands
  (similar to Sharing 3.5GHz band with the US Navy, especially by indoor mobile users)
- Smart blending of unlicensed and licensed spectrum provides capacity while preserving QoE / or even QoE boosting
- Explore frequencies btw. 100 – 300 GHz for wireless/mobile communications
- Spectrum brokers open up new business models for wireless communications
- (Gerhard added: Spatial spectrum management - via space / angular separation - at higher frequency should be investigated)

GMU Viewpoint (Deborah Crawford)

- Social Impact Study on 5G would be good, to evaluate acceptability of 5G usage scenarios and technologies

Eurescom Viewpoint (David Kennedy)

- Consistent Architectures
- Interoperability,
- Environmental impact
- Performance management
- Security & Liability – when things don't work
- Furthermore David presented "Europe on the road to 5G" incl. 5G-PPP Vision and drivers

NSF (Chengshan Xiao)

- Overview on existing NSF International Collaborations
- Overview on Existing and new initiatives related to 5G Networks in
  - The EARS program is in the 5th and final year, it will evolve to a new cross-cutting program aiming to future wireless research. Both ENG/ECCS and CISE/CNS are working on this evolution.
  - 5G/Advanced Wireless event at the White House in July is being planned, CISE and ENG are making contributions to it.

The summary of the most important topics with potential synergies for EU-US collaboration, which have been identified by the 5G Expert Group is given in the table below:

Topic	Challenges	Opportunities

Spectrum Allocation	• Harmonisation
	  ○ Which frequencies
	  ○ Which bandwidth
		• Spectrum Brokerage/ Smart blending
		• Technology (Spacial Spectrum Mgmt)
		• Policy (licenced, unlicensed, managed)

mmWave Technology	• RF/ Antenna subsystem for massive MIMO	• Explore spectrum beyond 100 GHz • Broadcast and control channel strategies
Net neutrality	• Separation - Mission critical vs. Non-critical applications	• Network slicing+++
Coverage	• Covering the “last ¾" of the world • regional fairness: connecting the remaining 2B people to the mobile internet	• Large cells, not only small cells • Manage and connect small cells

Other	• Massive IoT
	  ○ Network & Device management
		• Vertical Industries
		  ○ Markets & Sectors

	• Privacy/Security
	  ○ Secure Communities
	  ○ Trustable IoT
	• Big Data Crunching
	  ○ Distributed
	  ○ Edge Cloud
	  ○ Beyond Edge Cloud (Locally)
	• Autonomous Things
	  ○ Owner is responsible/ liable, on case of accident/ failure
	• Bridge the gap between societal technology readiness US-EU
	  ○ Tactile Internet
	  ○ Massive IoT
		▪ Existing (Industrial, automotive/mobility/ transportation, e-health, agriculture, energy) / Partnership for joint innovations to step “out of the box"
		▪ New Markets (e.g. drones) with new requirements
		
		○ Applications
		▪ Massive IoT (Smart metering, ...)
		▪ Tactile Internet (Robotics, ...)

The following action points for the 5G Expert Group have been defined:

- Annual physical meetings
- Continuous off-line collaboration to refine and substantiate topics for recommendations for joint EU-US initiatives
- Stimulate discussions on Spectrum allocation, harmonisation and management
- Further analysis of the EU and US funding initiatives and agencies, and identification of suitable agencies for EU-US collaboration projects with academic and industrial partners
- Information exchange with other Expert Groups to identify common areas and topics of interest
- Detect networking opportunities in relevant events to encourage EU-US research collaboration

6 Policy Expert Group Report

6.1 The ICT Policy Expert Group

Figure 7. Policy Expert Group and invited participants

One of the objectives of the PICASSO project is to bring forward policy recommendations that are designed to improve EU/US ICT collaboration. The Policy Expert Group explores opportunities to support EU/US ICT collaboration improvement by identifying and addressing key policy challenges and opportunities for ICT collaboration. The Policy Expert Group is open to anyone who wants to constructively contribute to its tasks and is willing to engage in a respectful, open dialogue on the issues identified. Its core consists of the following 6 experts:

- Chair: **Maarten Botterman** – GNKS, PIR Chairman, IGF DC IoT Chairman
- Co-Chair: **David Farber** – Carnegie Mellon University, IEEE fellow, ACM fellow
- Member: **Jonathan Cave** – Warwick University, GNKS, UK regulatory Committee Member
- Member: **Robert Pepper** – Aspen Institute
- Member: **Avri Doria** – Technicalities
- Member: **Ilkka Lakaniemi** – Chairman of EU Future Internet Public Private Partnership

Together, they have a good perspective of the different "stakes" in society, ranging from technical community, to business, civil society and public policy. In addition to the core group, the following people contributed to the ICT Policy Expert Group dialogue in Washington DC:

Camille E. Sailer, Esq. (President, European American Chamber of Commerce - New Jersey, USA); Yolanda Ursa (Director Innovation Management, Inmark Europa, Spain); Jim Clarke (EU Strategic Liaison Manager, Telecommunications Software & Systems Group (TSSG), Waterford Institute of Technology, Ireland); Jesse Szeto

(Director, NCURA Global, USA); Ann Ngo (International Trade Administration, USA); Daniel Caprio (Co-founder and Executive Chairman, the Providence Group, USA); Marie Geiger (International Trade Administration, USA); Eva Fadil (Project Manager, inno TSD, France); Margot Bezzi (APRE - Agency for the Promotion of European Research, Italy).

6.2 Privacy and Data Protection

One of the objectives of the PICASSO project is to bring forward policy recommendations that are designed to improve EU/US ICT collaboration, specifically in the areas of 5G networks, Big Data, and IoT/CPS. One of the most contested issues across the board is personal data privacy [1], which is not only a matter of concern to private sector and civil society stakeholders, but is also an increasing bone of contention between national and supranational governments in relation to criminal justice, national security and other vital national interests.

Whereas PICASSO will not be able to satisfy all concerns across all stakeholders, the aim will be to explore how EU/US collaboration in ICT can be served best, taking into account the differences in approach towards privacy and data protection in the USA and in Europe, with respect for law and citizens' expectations, as well as the approaches by industry towards benefiting from the new opportunities, and keeping the widest possible space for innovation and deployment.

Cultural differences underlying

In addition to being an important topic in its own right, privacy and data protection issues complicate trade negotiations, freedom of information rules, digital rights, intellectual property protection and financial regulation. With particular reference to the transatlantic dimension and the specific PICASSO domains of 5G networks, Big Data, and IoT/CPS, it features in the evolving arrangements over corporations' personal data collection, storage, processing and access (on one side the EU-US Privacy Shield, which tends to restrain businesses, and on the other those provisions in TTIP, TPP and especially TSIA that effectively protect corporations from government restraint). Beyond this direct consideration of transatlantic data flows are indirect tensions arising from divergent legislative and legal developments. A framework for collaboration needs to fully reflect the shared democratic and individual rights-based values, which are expressed on the EU side in the Lisbon Treaty and the Charter of Fundamental Rights and on the U.S. side by the U.S. Constitution.

Whereas the draft *Privacy Shield* which is under development to replace the *Safe Harbour* agreement that was dismissed by the European Court of Justice may be a step in the right direction, it is still under discussion as some parties feel it may not adequately include appropriate safeguards to protect the EU rights of the individual to privacy and data protection also with regard to judicial redress – and thus may be subject to a negative ECJ ruling, as its predecessor. Furthermore, *Privacy Shield* is created this year, while knowing that from May 2018 onwards new legislation will be in place in Europe – hence the validity under the current legal framework may need adaption by that time.

In the discussion, it was argued that privacy and interoperability of systems are two sides of the same coin, both being important. Participants agreed that it would be important for industry to explicitly consider the human element from the outset when developing industrial solutions to ensure interoperability and empower services with data streams.

Towards policy decision makers and citizens/consumers, there is a call for awareness raising. It would be important to provide better insight in what operational level technologies can do, and do, today. It was concluded that there is often limited insight in what is happening on the ground.

Privacy – is that something we have? We have witnessed massive disclosures and debates on the level of surveillance that is "proportional". Furthermore, it is clear that the Internet (and many information systems)

today is not built to be secure, which raises the question: what can we do where things are not secure? Knowing that there is a rapidly growing base of hardware and software facilitating our societies: how do we survive in a world with billions of machines of the past, that are not secure by outset, and that are not going away? This is to be considered at some point, otherwise the danger is we get into realities we can no longer deal with.

Furthermore: it was considered useful to develop a taxonomy on "privacy sensitivity" of different categories of 5G/IoT/Big Data applications. This is because the potential privacy impact of different application varies greatly, from "not" to huge. It was further raised that we may need to also develop taxonomies for "security", and "safety", with the understanding that these issues will correlate at points.

What common ground to facilitate ICT collaboration?

Privacy and data protection would be facilitated when the following principles are followed:

- Transparency: make people understand what the environment they are in does re: data and privacy. Disclosure –opt-in and user control where possible – (publicly stated/disclosed) fair use where needed; enforceable disclosure. Data ownership clarity.
- Accountability (needed for enforceability, liability etc. building in self-enforcing mechanisms that keep actors from inflicting damage on others)
- Context: so that consumers are not surprised … requires interoperability, security, standards, etc.
    - taxonomy for on "privacy sensitivity" of different categories of 5G/IoT/Big Data applications
    - technical standards such as from the IETF Privacy considerations RFC "ask yourself …"

Next steps

In further preparation of a PICASSO paper on this subject all participants were invited to share references to useful documents, and to actively react on the drafts that are shared for comments and input on this topic. The aim is to have a full draft paper early September, to have a PICASSO ICT Policy Webinar towards the end of September, and to finalise a paper for publication supporting further dialogue by the end of October.

Call for information: Please identify relevant documents, and report them to info@gnksconsult.com. Please include a link to the document or attach it, and provide a short description why this particular document is relevant and what insight it adds.

6.3 Other Candidate Policy Subjects

Following the discussion about privacy and data protection, the following subjects came forward as priorities that, looking at the other PICASSO expert subjects (5G networks; Big Data; IoT/CPS) would seem to be relevant across the board:

- Security: without security we have "nothing"; ensuring a certain level of security will be a key requirement for all ICT applications developed in EU/US. It was decided to propose this as a candidate subject for one of the last four policy papers. David Farber (CMU) kindly volunteered to "hold the pen", thus facilitating further development of this paper.
- Standards: standards are important to ensure interoperability, but also relate to possible antitrust issues. ICT related standards today are developing on a global level, often beyond the traditional standards bodies that were very sectoral: sectors that are rapidly converging now. Avri Doria (Technicalities) kindly volunteered to "hold the pen", thus facilitating further development of this paper.
- Spectrum: for both 5G and IoT/CPS, spectrum issues arise in particular because of the differences that historically exist on spectrum policies around the world. Focus of the paper would be on how to deal with these differences, and how to find ways forward allowing new technologies to find their way.

Robert Pepper (Aspen Institute) kindly volunteered to "hold the pen", thus facilitating further development of this paper.

There was also a suggestion to consider for the 5th paper a thematic paper on "smart cities" as it would bring all these issues, and more, together in a way that is close to the people. This idea was well received, as nowadays cities around the world offer opportunities to truly deploy new technologies in ways where they are directly confronted with citizens' dreams and wishes and administrations aiming to serve in the best possible way. This thought will be further developed over time.

Overall, the aim is to produce the papers in a three-month rhythm, which means that by the time of our next public physical meeting three policy papers will have been subject to a public webinar, and will have been published to facilitate further debate. Work on the Spectrum paper will still be ongoing, and we will use the opportunity of the next PICASSO conference to kick off the work on smart cities.

6.4 Conclusions

This report was presented in outline to the PICASSO plenary meeting in Washington DC, and well received. With this the ICT Policy Expert group will move forward over the coming year developing the policy papers over time, as described above. By making best use of the deep expertise and at the same time full independence of the experts that volunteered to "hold the pen" we feel it will be possible to develop some useful papers to facilitate the EU/US ICT dialogue, in particular related to the PICASSO subjects of 5G networks; Big Data; and IoT/CPS.

7 Afternoon Plenary

7.1 Attendees

IoT/CPS Expert Group

- Dr Sebastian Engell, Professor, TU Dortmund, Germany (chair)
- Dr Tariq Samad, Technological Leadership Institute, University of Minnesota, US
- Dr Chris Greer, Director of the Smart Grid and CPS Program Office and National Coordinator for Smart Grid Interoperability, NIST, US
- Dr Paul Nielsen, Director and CEO, Software Engineering Institute, Carnegie Mellon University, US
- Dr Haydn Thompson, CEO, THHINK, UK
- Dr O. Sinan Tumer, Senior Director, SAP Co-Innovation Labs, SAP Labs LLC, US
- Dr Ovidiu Vermesan, Chair WG01 Alliance for Internet of Things Innovation (AIOTI), Chief Scientist, SINTEF, Norway

Big Data Expert Group

- Dr Nikos Sarris, member of Steering Committee Big Data Value Association, ATC - Athens Technology Centre (Chair)
- Prof. Dr. Sören Auer - University of Bonn, Head of Enterprise Information Systems group, Member of the leadership council of Fraunhofer-Insitute for Intelligent Analysis and Information Systems (IAIS)
- Dr Andreas Metzger - University of Duisburg-Essen, Head of Adaptive Systems and Future Internet Applications, Chief technical architect of the European Future Internet Public Private Partnership project on transport, logistics and agri-food (FIspace), Deputy general secretary of the Big Data Value Association (BDVA) and steering committee vice chair of the European Technology Platform NESSI - European Technology Platform dedicated to Software, Services and Data
- Michail Bletsas - MIT, Director of Computing at the MIT Media Lab, US
- Dr David Belanger - Stevens Institute of Technology, Senior Research Fellow, Co-Leader IEEE Big Data Initiative and member of the Board of Advisors - IEEE Transactions on Big Data, IEEE Transactions on Internet of Things, US
- Wo Chang, Digital Data Advisor for the NIST Information Technology Laboratory (ITL); Convener of the ISO/IEC JTC 1/WG9 Working Group on Big Data, co-chairs the NIST Big Data Public Working Group, US

5G Expert Group

- Prof. Gerhard Fettweis, Vodafone Chair, TU Dresden, IEEE Fellow, member of acatech, coordinator 5GLab Germany (Chair of the 5G group)
- Leif Johansson, BusDev Manager Northern Europe, European Lead User Manager RF/Communication, National Instruments, Sweden
- Prof. Chengshan Xiao, Missouri University of Science and Technology / NSF, US
- Dr Deborah Crawford, Director of International Computer Science Institute (ICSI), NSF - International Computer Science Institute (ICSI), US
- Dr Olav Queseth, Project Coordinator METIS I & II, Ericsson, Sweden
- David Kennedy, Director, Project Coordinator EURO 5G, Eurescom, Germany
- Dr Amitava Ghosh, Head, North America Radio Systems Research, Nokia, US

Policy Expert Group

- Maarten Botterman - GNKS, PIR Chairman, IGF DC IoT, NLnet (chair)
- Dr Jonathan Cave - Warwick University, GNKS, UK regulatory Committee Member (co-chair)
- Dr David Farber - Carnegie Mellon University, IEEE fellow, ACM fellow, US
- Dr Robert Pepper – Cisco, US
- Dr Avri Doria - ICANN/NCUC, US
- Dr Ilkka Lakaniemi - Chairman of Future Internet Public Private Partnership, Finland Chamber of Commerce, Aalto University, Finland

EC and EU Member States

- Andrea Glorioso, Counsellor, Digital Economy / Cyber, Delegation of the European Union to the USA
- Giulio Maria Busulini, Italian Embassy in Washington, Science and Technology Attaché

US Government Agencies

- Abdella Battou, NIST (Big Data)
- Ken Calvert, NSF (Big Data)
- Richard Conroy, NIH (IoT/CPS)
- Erwin Gianchancani, NSF (IoT/CPS)
- Nada Golmie NIST (5G)
- Edward Griffor, NIST (IoT/CPS)
- Robert Hanisch, NIST (Big Data)
- Graham Harrison, NSF (5G)
- Keith Marzullo, NITRD (IoT/CPS)
- Grant Miller, NITRD (5G)
- Thyaga Nandagopal, NSF (5G)
- Vinay Pai, NIH (IoT/CPS)
- Raymond Richards, DARPA (IoT/CPS)
- Jim St Pierre, NIST (IoT/CPS)
- Shyam Sunder, NIST (Big Data)
- Cliff Wang, US Army Res Office (5G)
- David Wollman, NIST (IoT/CPS)
- Marty Burns, NIST, US
- Ellen Nadell, NIST, US

Other Organisations

- Dan Nagy, Managing Director, Inter-Regional Secretariat IMS – Intelligent Manufacturing Systems - CPS/IoT topic
- Prof. Rebecca Wright, Department of Computer Science, Director, DIMACS Center, Rutgers University, US
- Camille E. Sailer, Esq., President, European American Chamber of Commerce - New Jersey, US
- Yolanda Ursa, Director Innovation Management, Inmark Europa, Spain
- Jim Clarke, EU Strategic Liaison Manager, Telecommunications Software & Systems Group (TSSG), Waterford Institute of Technology, Ireland
- Jesse Szeto, Director, NCURA Global, US
- Eleonore Pauwels, Senior Program Associate, the Science and Technology Innovation Program, Wilson Center, US
- Daniel Caprio, Co-founder and Executive Chairman, the Providence Group, US

- Marie Geiger, International Trade Administration (ITA)
- Ann Ngo, International Trade Administration (ITA)
- Tshanda Kalombo, International Trade Administration (ITA)
- Jeff Brueggeman, Vice President Global Public Policy of ATT

PICASSO Consortium Members

- Svetlana Klessova, Director, inno TSD, France (project coordinator)
- Eva Fadil, Project Manager, inno TSD, France
- Margot Bezzi, APRE - Agency for the Promotion of European Research, Italy
- Christian Sonntag, TU Dortmund, Germany
- Steffen Watzek, TU Dresden, Germany
- Vasilis Papanikolaou, ATC, Greece

7.2 Welcome and Introduction

Figure 8. Afternoon Plenary

The afternoon plenary meeting was open to all and around 66 registrants. The meeting started with a welcome from Chris Greer (Director of the Smart Grid and CPS Program Office and National Coordinator for Smart Grid Interoperability) of NIST. Haydn Thompson from PICASSO then welcomed everyone on behalf of the project. An introduction to the overall PICASSO Project was given by Svetlana Klessova of Inno, highlighting the aims of the project, introducing the expert groups and describing the planned activities over the duration of the project.

7.3 Panorama of EU-US ICT Landscape (Haydn Thompson, THHINK)

Figure 9. Presentation of EU-US ICT Panorama

Haydn Thompson gave a presentation describing what had been found in D1.3 on the "Panorama of ICT landscape in EU and US: ICT, Policies, regulations, programmes and networks in the EU and US" [2]. This covers the key societal challenges: smart cities, smart energy and smart transportation, and in key enabling technologies that address these societal challenges: 5G Networks, Big Data, Internet of Things and Cyber-Physical Systems. Here an aim is to give an appreciation of how the different areas come together in the societal challenges. It was highlighted that there are very many projects and programmes (literally 100's) and it was not possible to cover everything. It was also highlighted that the document was live and would be updated in September. New contributions were solicited from the participants in the selected domains. The deliverable also highlights key activities in the rest of the world, where relevant, in order to put the work being performed within the EU and US in context. The aim of the Panorama document is to set the scene for the PICASSO project and as input to the Expert Groups for discussions.

Another aim of the document is to identify gaps and opportunities, the key challenges in the selected domains and open problems, and the needs for supporting policy measures and strategic EU-US initiatives (both policy and research related). Here potential areas where collaboration may be possible between the EU and US have been formulated as input for discussion within the PICASSO Expert Groups. In total 15 areas have been identified where it may be possible to collaborate on research and policy, 16 areas where there is an opportunity to work together on regulations and 9 areas where it would be beneficial to work together on standards.

It was highlighted that large ICT research and innovation efforts exist in both the EU and the US in these areas and they are also priority topics in various funding programmes in the EU and the US. As a consequence networks and critical mass in these subjects is present on both sides of the Atlantic which affords the opportunity for collaboration. It was noted that there are commercial benefits for companies to sell to the EU and US and vice versa but the world-wide market is far larger and is a compelling reason for collaboration.

7.4 Overview of Access Opportunities (Margot Bezzi, APRE)

Margot Bezzi gave an overview of access/cooperation opportunities for ICT research and innovation considering EU ICT programmes opened for US participation, and vice versa. The H2020 structure and work programme was introduced. The eligibility conditions were highlighted as was the openness to foreign participants if they can bring funding to participate in proposals. It was noted that they also need to bring added value to a consortium. It was shown that there is already US participation in some projects and there are opportunities in 5G, Big Data and IoT/CPS. US Federal Programmes are also being considered for EU participation and there is a need to identify mutual interest. APRE plan to provide a help desk service and orientation tool for those interested in establishing partnerships or applying for funds in the areas of 5G, Big Data and IoT/CPS and US Federal Programmes. It was highlighted that a helpdesk already existed that had been funded by the Bilat 2.0 project. This was still being serviced on the US side but without funding so establishment of a tool and helpdesk is beneficial.

7.5 Report Back from 5G Expert Group + Discussion (Gerhard Fettweis, TU Dresden)

Each of the Expert Groups reported back on their meetings that had been held in the morning. A brief introduction to 5G was given indicating the key aims with respect to improved data rates, lower latency to enable the tactile internet and low power consumption. It was noted that improvements in wireless technologies had followed Moore's law with a doubling of datarate every 18 months. The proposed advances towards 5G are thus very possible in the proposed timeframe for 5G standardisation. The future is massive machine type communications with a number of market prospects in monitoring and sensing (10 billion units per year), tracking and logging (1 trillion units per year) and remotely switching things on and off (100 billion units per year). With respect to the underlying technology the aim is to provide 10 years of service from a $10 sensor.

The future is also one of ubiquitous access where it is always possible to get access to someone or data. Introduction of the low latency tactile internet will provide the infrastructure for remote control. This will allow both non-mission critical and mission critical applications. Here there is a need to ensure net neutrality. The plan of the Expert Group is to build a map of what is needed and identify where it makes sense to do bilateral research to produce a sharper 5G vision.

7.6 Report Back from Big Data Group + Discussion (Nikos Sarris, ATC)

It was highlighted that Big Data is getting bigger by the day and that the applications being addressed are getting more difficult. New applications are also appearing as new data becomes available. Here there is a fragmentation

of effort and a need for standardised ecosystems. There are a number of areas for collaboration on policy with needs to address personal data protection and data ownership. New professional skills are required to support Big Data and here there is a need for educational curricula at the undergraduate and post graduate levels. Interoperability and standards are key and there is a need to develop research infrastructures, repositories and best practice. The aim is to create a common ecosystem for making use of Big Data. Collaboration is seen as a good thing but there is a need for coordination. It was noted that special care is needed when addressing critical applications, e.g. health and energy, and there may also be ethical issues.

7.7 Report Back from IoT/CPS Working Group + Discussion (Sebastian Engell, TU Dortmund)

It was highlighted that while CPS has been a topic in the US for a number of years it has only more recently been taken up by the EU and in the ARTEMIS-IA SRA. It was noted that there are different understandings of IoT and CPS in the EU and US. IoT is driven by connectivity and CPS is driven by physical connection to the world. In the Expert Group meeting it had been highlighted that the development process for CPS is more rigorous whereas in IoT it is more quick and dirty with the aim of getting to market quickly. There are also conflicting views of whether IoT comprises CPS or whether CPS makes use of IoT. Key areas that had been highlighted are dependability, security and trustworthiness. The vulnerability of IoT connected devices had been highlighted with a number of known cyber-attacks being discussed in the meeting. Increased levels of autonomy are also a concern and there is a need to understand the role for humans and a need for deeper understanding of cognition and situation awareness. There is also a need for interoperability to connect different platforms in smart cities. There are many opportunities for collaboration but it is important to find topics that are appealing to funding bodies and find areas that are non-competitive. Here a suggestion is to consider “world issues” rather than local EU-US market areas.

7.8 Open Floor Session (Dan Nagy, IMS)

Figure 10. Dan Nagy from IMS

An open floor session was then held where invited EU/US participants could present collaboration opportunities relating to the domains to be explored by PICASSO. Dan Nagy, Managing Director of Intelligent Manufacturing Systems, presented an overview of this initiative. IMS is an industry-led, international business innovation and research and development (R&D) program established to develop the next generation of manufacturing and processing technologies through multi-lateral collaboration. IMS provides services to institutions from supporting Regions including the EU, Mexico, South Africa, and the US. Other Regions can also join the IMS program. IMS offers international consortium building and coaching services provided at no charge to researchers from member countries, a listing of projects seeking partners, and a project database with valuable research information. To date $600M of projects had been performed. IMS is also a key sponsor of the World Manufacturing Forum where high-level government officials and industry executives discuss issues and solutions to challenges in manufacturing.

7.9 DISCOVERY Transatlantic ICT Forum (Camille Sailer, European-American Chamber of Commerce – New Jersey)

The DISCOVERY project (Dialogues on ICT to Support Cooperation Ventures and Europe-North AmeRica sYnergies) officially started on 1st January, 2016 and will run for two years. The aim is to support dialogue between Europe and North America (both the U.S. and Canada) and foster cooperation in collaborative ICT Research & Innovation under Horizon 2020, U.S. and Canada funding programmes. The Transatlantic ICT Forum has been established and is operational through a variety of activities to provide an on-going medium to support policy debate and provide opinions. The project is focused on political dialogue on funding mechanisms, ICT policy and regulations, and cybersecurity, as well as ICT priority areas of strategic interest. The project also aims

to stimulate industry engagement and innovation partnerships between industry, research and academia, by reinforcing networking between ICT European Technology Platforms (ETPs) and U.S./Canada innovation partnerships using a new partner search tool.

7.10 Report Back from Policy Group and Panel Discussion on Key Policy Issue – Privacy and Data Protection issues relating to the three PICASSO domains (Maarten Botterman, GNKS)

In PICASSO's aim to facilitate US/EU ICT collaboration it is important to consider how such a collaboration is affected by policy issues that are not subject to technology development, directly – but that do influence how products and services can be developed and employed. The PICASSO Policy Expert Group focused at issues that influence specifically one or more of the PICASSO domains (5G; Big Data; IoT/CPS). One of the policy domains that currently affect development and deployment of ICT most is Privacy and Data Protection. With the current ongoing changes in this and the differences in approach of US and EU policy makers the call from ICT developers is for clarity and stability on requirements here – and requirements that are not contradictory for EU and US contexts. The conclusion presented to the meeting was that it is key to ensure meaningful transparency and effective accountability, in its core, and that there is a need for taxonomies relating to privacy aspects; security aspects; safety aspects of specific ICT applications and services. During the plenary meeting issues like explicit consent, data minimization, data ownership and data localisation were raised, and the importance of addressing these issues well to ensure (continued) trust of citizens in ICT was underlined. The message that the policy expert group intends to subsequently look into security; standards; spectrum; and end up with a paper on smart cities was well received.

7.11 Round Up and End of Meeting

Svetlana Klessova gave an overview of the next steps to be undertaken in PICASSO. Tariq Samad highlighted that the next joint meeting of the expert groups was planned to be held in Minneapolis in conjunction with the PICASSO public event, and encouraged people to attend this. Brief details are provided below:

> ***Trans-Atlantic Symposium on ICT Technology and Policy for a Smart Society***
> *The PICASSO project is organizing a "Trans-Atlantic Symposium on ICT Technology and Policy for a Smart Society," planned to be held in Minneapolis on May 31 - June 1, 2017 and hosted by the Technological Leadership Institute (TLI) at the University of Minnesota. The Symposium will focus on EU/US collaboration in the ICT (Information and Communication Technologies) topics of the Internet of Things, cyber-physical systems, big data, and 5G networks. Research and innovation priorities in these areas will be covered and we will also discuss cross-cutting policy aspects. Application domains of specific interest include the "smart society" elements of smart cities, smart energy, and smart*

transportation. Academia, industry, policy makers, and representatives of funding bodies will participate.

PICASSO is inviting other groups that have common interests with PICASSO-including related EU and US projects, networks, and organizations-to organize sessions at the Symposium. These sessions can be used, for example, to showcase achievements of the participating groups and to discuss potential collaborations. We anticipate over 100 attendees with an interest in learning about research, innovation, and policy priorities in key ICT topics, related initiatives and projects from the EU and US, and current and upcoming funding opportunities. The Symposium will also be an outstanding venue for all participants to enhance their trans-Atlantic networks for future collaborations.

Symposium sessions can be organized for half- or full-day durations and can cover any of the ICT topics in PICASSO's scope or related policy issues. The PICASSO team is available to discuss ideas.

Andrea Glorioso then gave a few words on behalf of the EC delegation in support of the aims of PICASSO and EU-US Collaboration.

Chris Greer thanked the participants and finally Haydn Thompson summed up the meeting highlighting the enthusiasm expressed by the participants to collaborate, the many opportunities for collaboration identified by the panorama study and the expert groups, and the needs for funding and coordination to allow collaboration to be possible. The barriers to collaboration were also highlighted. Finally, everyone was thanked for their participation in the meeting.

8 Concluding Remarks

The PICASSO First Expert Group meeting was successfully held in Washington D.C. on May 20th 2016. At the meeting the areas of smart cities, smart energy and smart transportation, and key enabling technologies: 5G Networks, Big Data, Internet of Things and Cyber-Physical Systems were discussed. Additionally, horizontal issues of data protection and privacy were also considered, and the areas of security, standards and spectrum were identified as subsequent subjects of interest. Notably both the Expert Group meetings and public meeting were very well attended with 66 registrants resulting in the need to move the public meeting to a larger room. This clearly demonstrates that there is interest in collaboration between the two sides in pre-competitive research and innovation. Already there are similar ICT research and innovation efforts in both the EU and the US in the areas being addressed by PICASSO. In the morning Expert Group Meetings were held for the 4 PICASSO Expert Groups. These “private” meetings were opened up to wider participation due to demand as there was considerable interest in being involved in discussions. This proved to be highly beneficial collecting a much wider viewpoint and providing greater consensus on the key topics being addressed by the project. The aim of the afternoon public meeting was to disseminate the results of PICASSO, highlight funding opportunities and to feedback the findings of the Expert Groups to a wider audience. Here again the interest from the US side was also very noticeable with specific questions on how US partners could engage with EU partners.

There were a number of key messages. The panorama presentation highlighted that there were many areas where it would be possible to collaborate in smart cities, smart energy and smart transportation and also in the key topics identified: 5G, Big Data and IoT/CPS. Already a number of H2020 and Federal Programmes are directly funding research in these topics, however, the principle difficulty is in identifying programmes where it is possible for EU and US partners to jointly work together. Here there is a need to allocate/align funding and also coordinate programmes on both sides of the Atlantic. The presentation from Intelligent Manufacturing Systems (IMS) showed how this could be achieved in practice with $600M of funding for projects over the past 20 years.

It was also highlighted that there are horizontal issues, e.g. data protection, privacy security and standardisation that cut across domains that also need to be addressed to ensure successful collaboration and exploitation of results. Here there is a need to raise awareness of the issues and explore useful ways forward that respect legislation, regulations and standards, and raise the flag where the US and EU frameworks are complicating ICT collaboration in the three PICASSO domains considerably, for instance because of possibly mutually exclusive requirements.

9 References

[1] M. Botterman and D. Farber, “Privacy and Data Protection and its impact on EU/US ICT Policy collaboration”, PICASSO, 2016.

[2] H. Thompson and D Ramos-Hernandez, “Deliverable 1.3 Panorama of ICT landscape in EU and US: ICT, Policies, regulations, programmes and networks in the EU and US”, PICASSO, 2016.