Euro-5g – Supporting the European 5G Initiative

D4.3: Final Liaison Report

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Abstract

The Final liaison deliverable reports on European and global 5G initiatives and established contacts that have been initiated and or established with related initiative in Europe and worldwide.

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v0.1	16/03/17	First version of the doc layout, ToC, and structure of sections and information	Giovanni E. Corazza (Unibo)
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v1.0	26/06/2017	Complete version of the deliverable	Giovanni E. Corazza (Unibo)

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Executive Summary

This Deliverable D4.3, entitled "Final Liaison Report", collects the conclusive remarks on the international initiatives that have been carried out in Euro-5G to interconnect our 5G PPP network with what has been happening in other regions of the world, such as the Far East and the Americas, as well as with other National actions within Europe.

The underlying mission to establish liaisons and opening up dialogues with related national and international initiatives was considered to be a critical issue in the perspective of supporting a leadership role for the European 5G PPP initiative in the global scenario.

Besides the specific efforts undertaken by the individual 5G PPP Phase 1 (and future Phase 2) projects and players, the role of the Euro-5G project, as CSA for the whole community, and more specifically of *WP4 Liaison: International, National and peer Initiatives*, has been to ensure that liaisons are established and supported based on the agreements entered into by the 5G-Infrastructure Association (5G-IA) and the European Commission (EC) relating to 5G.

A major diplomatic move, carried out in the course of the Euro-5G lifetime, was to set up a Multilateral Memorandum of Understanding (Multilateral-MoU) between the regional industry-representing entities, 5G Infrastructure Association (5G IA, Europe), IMT-2020 (5G) Promotion Group (China), The Fifth Generation Mobile Communications Promotion Forum (5GMF, Japan), 5G Forum (Korea) and 5G Americas (Americas), later extended to Telebrasil (Brazil). This has led to the organization of three Global 5G Events in the course of the lifetime of the Euro-5G support action:

- 1st Global 5G Event, May 31-June 1, 2016, Beijing (China)
- 2nd Global 5G Event, November 10-11, 2016, Rome (Italy)
- 3rd Global 5G Event, May 24-25, 2017, Tokyo (Japan)

The macro-economic relevance of 5G was clearly testified by the structure of these Global 5G Events, which have all been opened by high level political figures, and where industrial interests were always represented at a confederated level, without ever falling into micro-marketing exercises. Indeed, the impact of 5G research and development goes well beyond a mere technical profile, touching upon policies, regulation, standardization, and in general macro-economic factors.

In addition, peer research initiatives in the 5G domain in other regions of the globe and within Europe have been being monitored and interactions established. Very interesting information has been obtained through online questionnaires, as reported in the Deliverable. 5G related activity has been found in the following countries: Finland, Germany, Ireland, Latvia, Luxembourg, Moldova, The Netherlands, Slovenia, Sweden and the United Kingdom.

This is of particular relevance to steer R&D&I efforts in a way that guarantees cohesive efforts and European leadership to be ensured. On the other hand, the monitoring and coordination activities within Europe are of great relevance, in order to ensure that all efforts based on public spending are synergistic and not simply overlapping.

By observing all the work that been carried out by Euro-5G in this area, reported in the three deliverables D4.1, D4.2, and D4.3, we can safely state that all the objectives for International, Regional, and National cooperation that were set out for the Euro-5G support action have all been achieved and in some cases exceeded.

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Abbreviations

CSA	Coordination and Support Action
EC	European Commission
EU	European Union
ICT	Information and Communication Technology
IoT	Internet of Things
IP	Internet Protocol
IT	Information Technology
ITU	International Telecommunications Union
ITU-R	International Telecommunications Union – Radio Sector
MoU	Memorandum of Understanding
NCP	National Contact Point
R&D	Research and Development
TCP	Transmission Control Protocol
WP5D	Working Party 5D
WRC	World Radiocommunications Conference
3GPP	Third generation Partnership Project
5G	Fifth Generation
5G-IA	5G Infrastructure Association
5G PPP	5G Public Private Partnership

1 Introduction

The overall purpose of establishing liaisons and opening up dialogues with related national and international initiatives has been a critical aspect in the perspective of ensuring leadership for the European 5G PPP initiative in the global scenario.

Indeed, it is essential that the results produced by the 5G PPP projects and related initiatives be broadly disseminated by being exposed to other regions and initiatives for their value recognition, uptake and as a mean to build consensus on various technical and policy matters. This is essential to pioneer the way to international standardisation efforts and ensure leadership of the European contributions.

Besides the specific efforts undertaken by individual 5G PPP Phase 1 (and future Phase 2) projects and players, the role of the EURO 5G project, as CSA for the whole community, and more specifically of *WP4 Liaison: International, National and peer Initiatives*, has been to ensure that liaisons are established and supported based on the agreements entered into by the 5G-Infrastructure Association, 5G-IA, and the European Commission, EC, relating to 5G.

A fundamental dimension of the 5G-PPP liaison work has been the promotion and representation of the 5G PPP work in global fora. This involved presentations and in selected cases demonstrations at intercontinental meetings. It was soon realized that too many events on 5G were being organized around the world, without any coordination and therefore with possible conflicts and unwanted but inescapable competition. Therefore, a major diplomatic move was to set up a Multilateral Memorandum of Understanding (MoU) between the regional industry-representing entities, 5G Infrastructure Association (5G IA, Europe), IMT-2020 (5G) Promotion Group (China), The Fifth Generation Mobile Communications Promotion Forum (5GMF, Japan), 5G Forum (Korea) and 5G Americas (Americas), later extended to Telebrasil (Brazil). This has led to the organization of three Global 5G Events in the course of the lifetime of the Euro-5G support action, which took place respectively in China, Europe, and Japan, as described in this deliverable.

In addition, peer research initiatives in the 5G domain in other regions of the globe have been being monitored and interactions established. This is of particular relevance to steer R&D&I efforts in a way that guarantees cohesive efforts and European leadership to be ensured.

Another strategic aspect of the external relationships has been to cooperate with projects outside of the 5G PPP Programme on the use and uptake of the 5G PPP network architecture and interfaces. This involved supporting relationships to national programmes through contacts established to various National Contact Points, EUREKA Clusters (in particular the Celtic-Plus Cluster) and other related EC initiatives, including the Future Internet Research and Experimentation, FIRE, and the Internet of Things, IoT, initiatives.

1.1 Liaisons approach and core strategy: an overview

This deliverable takes on from the strategy depicted in deliverable D4.1, with the aim of facilitating the establishment of international cooperation to support harmonisation activities related to the 5G vision, requirements, design goals, system concepts, and architectures, to build consensus ahead of future standardisation.
In line with the above major goals, Euro 5G's strategy has focused on actions to:
- Establish and maintain necessary contacts and cooperation on the global level with similar initiatives in other regions and countries like China, Japan, Korea, North America and others, such as Brasil and India.
- Establish liaisons with other national and European R&D programs (e.g. Eureka clusters) for the inclusion of the 5G related topics as appropriate, and foster the creation of synergies.
- Analyse international activities on 5G and ensure proper positioning of the European 5G PPP initiative so as to identify and pursue collaboration opportunities e.g. by means of MoUs.
- Support the coherence and maximum impact of the 5G PPP and its projects through liaisons with other relevant R&D programs, including related EC-driven initiatives like for instance the FIRE programme.

The strategy outlined above, required a close collaboration with bodies part of the 5G PPP programme, and in particular:

- the 5G Infrastructure Association and its policy-oriented Working Groups;
- 5G PPP projects and;
- technology-oriented Working Groups in the 5G Initiative.

To support the liaison and collaboration of the 5G PPP programme with international and national bodies active on the 5G thematic it has been very important to develop an appropriate communication strategy. The strategy encompassed different tools, content and media in accordance to the scope of the collaboration and the involved stakeholders. A fundamental role in the communication strategy has been covered by the 5G Global Events (see Section 2).

The timeline of the strategy implementation has foreseen the following milestones:

1. Kick-off meeting with all participants from 5G PPP beginning of 2016 after Association Working Groups and 5G PPP projects have developed first material, which could be used in international cooperation.
2. First quarter 2016: Identification of national and other European 5G research initiatives and establishment of contacts.
3. First quarter 2016: Establishment of contacts with European initiatives by means of liaisons with the Idealist NCP.
4. First half of 2016: Alignment on the 5G vision and requirements in discussions with other research initiatives based on the ITU-R vision.
5. First half of 2016: Common understanding on 5G system concepts.
6. First quarter of 2016: Initial documents about how 5G PPP can support the preparation of WRC 2019 for discussion at international level based on the agenda agreed at WRC 2015.
7. First quarter 2016: Initial documents about how international standardisation can be supported for discussion at international level.
8. **Second quarter of 2016: 1st Global 5G Event in Beijing, China**
9. **Fourth quarter of 2016: 2nd Global 5G Event in Roma, Italy, Europe**
10. **Second quarter of 2017: 3rd Global 5G Event in Tokyo, Japan**
11. **Second quarter of 2017: Extension of the Multilateral MoU to Brazil**
12. **Second quarter of 2017: Update of the contacts with European and national initiatives.**

This deliverable focuses on the milestones in bold. Previous achievements have been described in D4.1 and D4.2.

1.2   Deliverable's organisation

The remainder of this document is organised as follows:

- Section 2 reports on the activities resulting from the international liaison, contacts and relations identified in D4.1. In particular, it reports the achievements related to the Global 5G Events.

- Section 3 reports on the update of 5G National programmes and initiatives through the NCPs, and on the ongoing collaboration with other relevant H2020 programmes and initiatives.

- Finally, Section 4 drafts the conclusion on the international liaison activities.

2   International Liaisons, Contacts and Relations

2.1   The Multilateral MoU Agreement

As discussed in the Introduction, a major diplomatic initiative, which was led by Europe, was to set-up a Multilateral MoU with China, Korea, Japan, and the Americas for the exchange of information on policies, regulatory strategies, as well as technological developments regarding 5G. The Multilateral MoU was signed in Lisbon, Portugal on October 20, 2015.

Indeed, due to the growing number of regional 5G events currently occurring, the parties have agreed to jointly organize two "*Global 5G Events*" per year in the coming years to focus their efforts and leadership. The Global 5G Events are hosted on a rotating basis between the signing associations during each half of the year on a different continent between the Americas, Asia and Europe.

The Global 5G Events intend to support multilateral collaboration on 5G systems across continents and countries. Basic areas of interest for the *"Global 5G Events"* include, but are not limited to:

- Vision and requirements of 5G systems and networks
- Basic system concepts
- Spectrum bands to support the global regulatory process
- Future 5G global standards
- Promotion of 5G ecosystem growth

In the course of the lifetime of the Euro-5G support action, three Global 5G Events have taken place in China, Europe, and Japan. These are described in the following subsections.

The Multilateral MoU was extended to Brazil in the course of the 3rd Global 5G Event in Tokyo, with signature on May 24, 2017.

2.2   The 1st Global 5G Event in China

The 1st Global 5G Event was organized by the IMT-2020 Promotion Group (China) with the support of 5G-PPP (Europe), 5G Forum (Korea), 5G Mobile Forum (Japan), and 5G Americas (USA). The event took place on May 31-June 1 2016 in Beijing, at the Friendship Hotel.

The Technical Programme Committee (TPC) was formed with a representative from each of the five signatories of the multi-lateral MoU, namely:

- Giovanni E. CORAZZA (5G PPP - Europe)

- Hyun Woo LEE (5G Forum - Korea)

- Zhendong LUO (IMT-2020 PG - China)

- Takehiro NAKAMURA (5GMF - Japan)

- Chris PEARSON (5G Americas - USA)

The TPC worked primarily by email, given that the time-zone difference made it difficult to find convenient time slots for conference calls. Give that the IMT-2020 Promotion Group was hosting the event, they had the lead in the organization.

The event was attended by approximately 450 people, most of them from China. The European participation can be estimated at around 30-40 persons.

Considering the Programme, the Event was organized with a opening session and six content specific session. The Event was opened by Mr. Miao Wei, the Minister of Industry and Information Technology (MIIT) in China, testifying the high-level consideration that this multi-lateral effort received in China.

The opening session speakers were:

- Dr. Werner Mohr (5G-PPP) – Research and development of 5G systems in Europe by involving vertical sectors

- Prof. Susumu Yoshida (5GMF) – Overview of 5GMF Current Activities

- Prof. Youngnam Han (5G Forum) – 5G Forum: Status Quo

- Chris Pearson (5G Americas) – 5G in the Americas: Next Generation Technology and Spectrum Recommendations

- Ms. Cao Shumin (IMT-2020 PG) – Research Status of IMT-2020 (5G) Promotion Group

Opening session moderators were Prof. You Xiaohu and Ms. Wang Xiaoyun, both from the IMT-2020 Promotion Group. This was followed by a panel Discussion on "Jointly Establishing A Global 5G Ecosystem", participated by IMT-2020 PG, 5G PPP, 5GMF, 5G Forum, 5G Americas.

Figure 1. Panel composed by the opening session speakers at the 1st Global 5G Event

The topic for session 1 was: "5G System Design", and it was moderated by Prof. Giovanni E. Corazza from 5G-PPP. Session 1 speakers were:

- Dr. Wen Tong (CTO of Huawei Wireless Networks & Huawei Fellow) - Accelerating the Global Momentum to Make 5G a Reality

- Edward Tiedemann (Senior Vice President, Engineering, Qualcomm) - The 5G Voyage, We Have Cast Off: Progress, Vision, and Technology

- Dr. Jiying Xiang (Chief Scientist of ZTE Corp.) - Commit to Global 5G Ecosystem

- Kimmo Kettunen (5G Program Lead, Nokia Bell Labs) - 5G System to Enable Programmable World

- Chengjun Sun (Senior Director, Samsung Electronics) - 5G Mobile Communications

The topic for session 2 was: "5G Air Interface", and it was moderated by Ms. WANG Zhiqin, Vice Chair of IMT-2020 (5G) Promotion Group. Speakers were:

- Dr. Chih-Lin I (Chief Scientist, China Mobile Research Institute) - Close to 5G

- Dr. Wang Yingmin (CTO & Chief Scientist, Datang Telecom) - 5G New RAT for Context Era

- Peter Pitsch (Executive Director, Global Public Policy, Intel Corp) - Global 5G Spectrum Development and Intel 5G

- Gabriel Lin (Senior Director, Advanced Communications Technology Division, MTK) - Close Encounters of the Fifth Generation

- Jan Färjh (Vice President, Head of Standardisation and Industry, Ericsson) - 5G Standardization: The Enabler of the Networked Society

The session was closed by a Panel Discussion on "Building Global Consensus on 5G Standardization

Roadmap". This essentially ended the first day of the Event.

The second day, June 1, was opened by Session 3, dedicated to "5G Network & Operation", moderated by Dr. Kohei SATOH, Secretary General of 5GMF. Speakers for Session 3 were:

- Dr. Cao Lei (Director, Technology Department, China Telecom) - The New Generation Network and 5G

- Mr. Takehiro Nakamura (VP and Managing Director of 5G Laboratory, NTT DoCoMo) - 5G Deployment in 2020 and Beyond

- Jean-Sebastien Bedo (Head of Networks Foresight and Strategy, Orange Labs Research) - 5G: A Global Platform for the Digitalization of Vertical Industries

- Dr. LEE Jongsik (Vice President, 5G TF, Institute of Convergence, KT) - Paving the Road to 5G

This session was followed by the release of two White Papers, one by the IMT-2020 PG and one by the 5G PPP Architecture WG. The presenters of the two White Papers were:

- Mr. LI Xiayu (Vice Chair, Network Technology WG, IMT-2020 PG) - The Novel Design of 5G Architecture

- Simone Redana (Chairman of Architecture WG, 5G PPP) - View on the architecture for the 5G era

Session 4 was dedicated to "Technologies for 5G Terminals", and moderated by Prof. Kim DongKu, Vice Chair of Executive Committee, 5G Forum. Speakers in Session 4 were:

- Ying Huang (Vice President, Lenovo) Looking forward to the 5G era

- Yi Kang (Global Vice President, Spreadtrum) - 5G: From Concept to Reality

- Mr. LEE Joo Hee (Fellow, Mobile R&D Center, LG Electronics) - >6GHz Antenna: Challenges and Solutions

- ZHANG Yunfei (Head of Industrial Standards Dept., Coolpad) Opportunities and Challenges: Terminal Small Cell (T-SC) for 5G

The afternoon of the final day was opened by Session 5, dedicated to "Testing Technologies for 5G", moderated by Yang Fengyi, Expert of IMT-2020 Promotion Group. Speakers in Session 5 were:

- Dr. Wei Kejun (5G Trial Lead, IMT-2020 (5G) Promotion Group, CAICT) - 5G Trial Status in China

- Mr. Satish Dhanasekaran (Keysight VP, General Manager of Wireless Device & Operators, Communications Solutions Group, Keysight Technologies) - Test & Measurement ensure 5G's success, the challenges and solutions

- Lifang Kirchgessner (VP of Wireless & Mobile Com., Rohde & Schwarz GmbH & Co.) - The Road to IMT 2020 - R&S 5G Test Solution

- Mr. Zhang Ping (President & CEO, StarPoint) - 5G Testing Technology and Platform

- Mr. Wu Jie (Director of Asia-Pacific Service Development, Spirent) - 5G Network Testing Technology

Finally, Session 6 was dedicated to "5G and Vertical Industries", moderated by Chris Pearson, (President, 5G Americas). Speakers in Session 6 were:

- Dr. Nigel Jefferies (WWRF Chairman) - What do vertical industries want from 5G and how do we make it happen?

- Lars Danielson (SVP, Volvo Car Group and CEO, Volvo Car Asia Pacific) - The requirements to 5G technology from autonomous driving development perspective

- Other speeches by Baidu, Foxconn., and SANY

Closing Remarks were finally given by Ms. Wang Zhiqin and Dr. Werner Mohr, who commented on

the successful event and invited everyone to join the 2nd Global 5G Event, to be hosted by 5G-PPP in Rome (Italy).

Lessons to be learned from the first Global 5G event: 1) The event was high level, with participation from political figures, testifying a clear industrial policy in China towards the development and deployment of 5G networks. We should show an equal level of commitment in Europe. 2) In the organization, there wasn't sufficient time for interaction between speakers and audience. This shall be improved in future events. 3) Also, it was clear that the event was somewhat dominated by one of the five region; it should be possible to improve on this by making the event more balanced, even though it is clear that the hosting Region will always play the major role. 4) The exhibition space was quite small, and no real demonstration was shown.
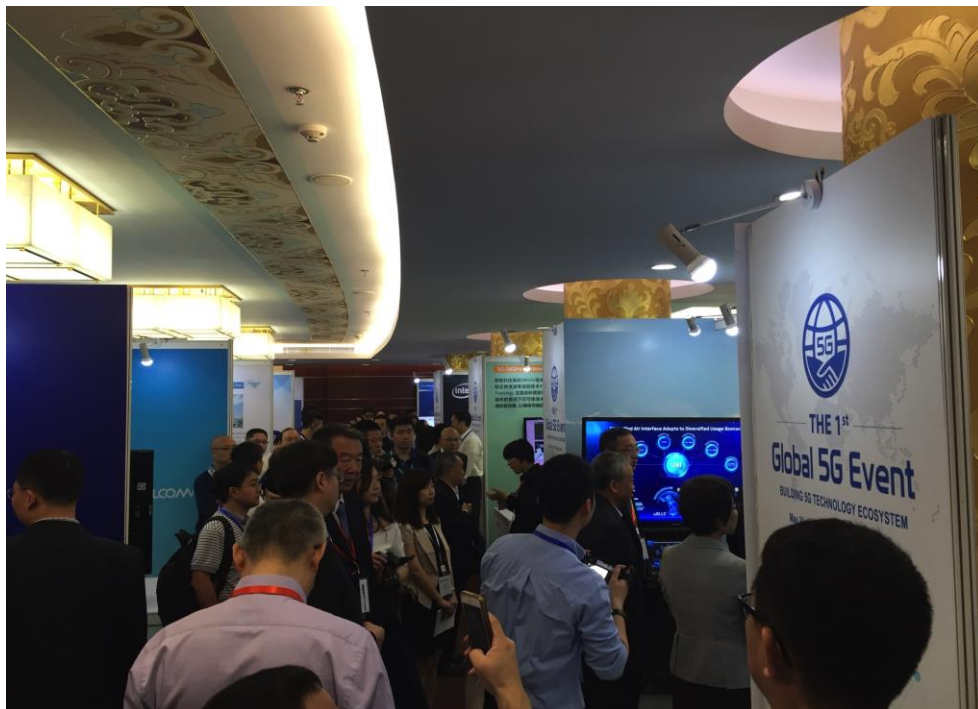

Figure 2. Exhibition at the First Global 5G Event

2.3   The 2nd Global 5G Event in Europe

The 2nd Global 5G Event was organised by Europe, and as such 5G-PPP, EC, 5G IA, and the Euro-5G support action played a crucial role. In particular, Euro-5G spent a very considerable supporting effort in order to ensure that the event was successful. In terms of participation, the result was beyond expectations: in fact, there were 360 registrations from 26 different countries.

The International Technical Programme Committee for the 2nd Global 5G Event was confirmed to be:

- Giovanni E. CORAZZA (5G PPP - Europe)

- Hyun Woo LEE (5G Forum - Korea)

- Zhendong LUO (IMT-2020 PG - China)

- Takehiro NAKAMURA (5GMF - Japan)

- Chris PEARSON (5G Americas - USA)

Two local organizing committees have been formed:

- Conference Organizing Committee: Jean-Sébastien Bedo, Giovanni Emanuele Corazza, Bernard Barani, Didier Bourse, Simone Redana, Terje Tjelta, Uwe Herzog.

- Exhibition Organizing Committee: Werner Mohr, Nicola Blefari Melazzi, Jean-Sébastien Bedo, Didier Bourse.

Euro-5G supported both committees and has also took care directly of the venue and logistics details. The 2nd Global 5G Event took place at the Marriott Hotel in Rome, 15 km away from the Leonardo da Vinci Airport in Rome, which provided easy access for travellers. The venue provided large rooms for the conference, and also very adequate space for the Exhibition, which was very appreciated. The 2nd Global 5G Event Exhibition was indeed much larger that those of 1st and 3rd Global Events.

The following picture represents the artwork designed with the support of Euro-5G for the event.

Figure 3. Artwork for the 2nd Global 5G Event

In order to improve with respect to the previous event (see "lessons learned" in the previous section), it was decided that each session would follow this organization: six speakers per session, one from each of the five MoU signatories plus an "independent" speaker from an institutional body, that would give high level indications from the global perspective. Each speaker would have a 10 minutes slot (total 60 minutes), which would then be followed by a panel of 50 minutes. This organization was very successful as it allowed to have vivid interaction between the session moderator, the speakers, and the audience.

The Italian Government provided a warm welcome to the Event in the person of Mr. Antonello

Giacomelli, Undersecretary for the Ministry of Economic Development.

Figure 4. Giacomelli's speech at the 2nd Global 5G Event in Rome

In the following pictures, we report the schedule for the 2nd Global 5G Event, session by session:

Figure 5. 2nd Global 5G Event in Rome - Opening 1 schedule

Figure 6. 2nd Global 5G Event in Rome - Session 1 schedule

Figure 7. 2nd Global 5G Event in Rome - Session 2 schedule

Figure 8. 2nd Global 5G Event in Rome - Session 3 schedule

Figure 9. 2nd Global 5G Event in Rome - Session 4 schedule

Figure 10. 2nd Global 5G Event in Rome - Session 5 schedule

At the end of Day 1, we had the pleasure to receive the visit of the EC Commissioner Mr. Günther Oettinger, who addressed the audience by clarifying the importance and priority of 5G developments in Europe.

Figure 11. Commissioner Oettinger's speech at the 2nd Global 5G Event in Rome

Regarding the Exhibition, 24 booths were accommodated. Exhibitors included 5G-PPP projects which demonstrated the technology they developed in the course of phase 1, industry, and operators. Coffee breaks and lunches were organized in the Exhibition area, so that large numbers of visitors and consequent discussions were possible.

Figure 12. Floor plan for the Exhibition at the 2nd Global 5G Event

In conclusion, we can safely state that the 2nd Global 5G Event organized in Europe was very successful, as also testified by the many expressions of positive feedback received from many partiicipants.

Press Release on the 2nd Global 5G Event: Brussels, Belgium – November 10, 2016.

"**The 5G INFRASTRUCTURE ASSOCIATION (5G-IA) hosted the 2nd Global 5G Event "Enabling the 5G EcoSphere**"

The conference took place in Rome (Italy) on November 9-10, 2016

The 5G-IA, the leading 5G visionary organisation in Europe, organised the Second Global 5G Event together with peer organisations from the Americas, Japan, South Korea and China to work towards global solutions for 5G

Leading global 5G associations from the world's regions joined together to offer the second of a series of Global 5G Events in Rome, Italy, on November 9 and 10, 2016. This series of events is based on a Memorandum of Understanding (MoU) to cooperate on building global consensus on 5G, that was signed in October 2015 by the 5G Infrastructure Association (on behalf of the European 5G Public Private Partnership: 5G PPP), 5G Americas, (Americas), The Fifth Generation Mobile Communications Promotion Forum (5GMF) (Japan), 5G Forum (Republic of Korea) and IMT-2020 (5G) Promotion Group (non-profit organization, China).

Hosted by the 5G INFRASTRUCTURE ASSOCIATION, the "enabling the 5G ecosphere" conference

was jointly organized by: The 5G Public Private Partnership (5G PPP, Europe), IMT-2020 (5G) Promotion Group (China), The Fifth Generation Mobile Communications Promotion Forum (5GMF, Japan), 5G Forum (Korea) and 5G Americas (Americas). During this second event in the Global 5G Series, experts from all corners of the globe discussed 5G progress through a series of focused sessions on 5G policy perspectives, 5G system architecture, spectrum, 5G air interface and radio resource management, network management & software networks and 5G for verticals in the new economy.

For more information on the program and conference please visit:

https://5g-ppp.eu/event/second-global-5g-event-on-9-10-november-2016-in-rome-italy/

These Global 5G Events are intended to support multi-lateral collaboration on 5G systems across continents and countries.

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Werner Mohr, Chair of the Board, 5G PPP, declared: "After the successful first event in Beijing last June, we were delighted to host the second round of our Global 5G Series in Rome. This conference in Rome with sessions on the "hot" topics of 5G gathered experts from the five organisations involved and enabled fruitful presentations and debates. Participants discovered the latest results and demos from 17 5G PPP projects. This event has also strengthened the collaboration on 5G research and development between our organisations."

CAO Shumin, Chair of IMT-2020 (5G) Promotion Group, stated, "This event provides the industry an opportunity to share information and views on 5G policy, spectrum, technology, and standards. The consensus to build a globally unified 5G standard is clearly indicated in this event once more. 5G should support the usage scenarios defined by ITU for both enhanced Mobile Broadband (eMBB) and Internet of Things (IoT). Especially, the integration of 5G and vertical industry should be strengthened to extend the application in the future."

Susumu Yoshida, Chairman of 5GMF, stated, "5GMF proposed two aggressive key concepts for 5G: 'Satisfaction of End-to-End (E2E) quality' and 'Extreme Flexibility' in the White Paper (ver1.0) which was released in May 2016. 5GMF will continue to promote research and development, international standardization activities, and international collaboration towards 5G realization by 2020, Tokyo Olympic and Paralympic Games."

Youngnam Han, Chair of Executive Committee, 5G Forum, "Various technical effort to expedite the deployment of 5G worldwide and endeavor to provide even pre-5G services, specially on those occasions of sports events, Winter Olympic in 2018, PyungChang, Korea, and Summer Olympic 2020 in Tokyo, Japan can be comprehensively provided and discussed throughout the 2nd multi-fora event. Participants will experience the-state-of-the-art researches on broad scope of 5G elements, such as spectrum, mmWave technologies, testbed and enabling services from vertical industries.

Chris Pearson, President of 5G Americas, stated, "This event highlighted the importance of sharing information by the leading companies, associations and government regulators to progress the 5G ecosystem. To be globally successful, 5G will require all key wireless stakeholders to work together in technology development, regulatory policies and spectrum harmonization."

2.4   The 3rd Global 5G Event in Japan

The 3rd Global 5G Event took place at the Hilton Hotel Odaiba in Tokyo. Number of participants was around 270.

The audience was welcomed by the Ministry of Internal Affairs and Communications of Japan and by the Chairman of 5GMF, **Prof. Emeritus Susumu Yoshida** of Kyoto University.

Opening Session 1: Designing the policy for 5G promotion (moderated by **Mr. Isao Sugino**, Ministry of Internal Affairs and Communications of Japan)

Mr. Pearse O'Donohue (Acting Director for Future Networks, DG Connect, European Commission) described the policy framework within which 5G is being developed in Europe, comprising the 5G Action Plan and the 5G PPP. He discussed the "Single-Market" approach to EU 5G introduction, which will see three major milestones: 2018 early launch and trials, 2020 commercial launch in major cities, 2025 in all urban areas and along major routes. Pioneer bands: 700 MHz (harmonised, ongoing assignment), 3.6 GHz (harmonised, available, partly used), 26 GHz (in preparation for WRC-19). There is no time to lose for spectrum re-farming and assignment. He also touched upon the European Trials Roadmap, and gave large emphasis to the International cooperation initiatives taking place with Japan, Korea, China, USA, Brazil, and Taiwan.

Figure 13. 3rd Global 5G Event in Tokyo – Speech by Pearse O'Donohue at Opening 1

Mr. Julius Knapp (Chief of the FCC's Office of Engineering and Technology, U.S. Federal Communications Commission) described how wireless transformed the way we live, work, and play. Many of today's common ways to interact were not predictable 10-15 years ago. This is FCC's position on 5G: identification of more and more spectrum, based on flexibility. And also the technical rule for deployment have been defined. An operator can use any wireless spectrum band without permission by the FCC. The number of bands that are under consideration is impressive: there is no real final frontier in view.

Mr. Ce Zhao (Deputy Director, Division of High-Tech Department of Science and Technology, Ministry of Industry and Information Technology P.R. of China) discussed 5G progress in China. This is a high priority at political level in China, led by MIT. 5G is seen as a key infrastructure for economic growth. Many international companies have participated in 5G development activities in China. The 5G Promotion Group at the end of 2016 launched the largest 5G trial. China has used the 5.9 GHz band for V2X demonstration in Shanghai, Beijing and other cities.

Mr. WonSek Heo (Director, ICT and Broadcasting Technology Policy Division, Ministry of Science, ICT and Future Planning, Korea) described the trajectories for 5G in Korea, including its relationship with the 4th industrial revolution. An autonomous vehicle could generate 4 TBytes of data per day: this cannot be handled with today's technologies. Convergence with other industries will be fundamental. Time plan: pre-commercial 5G trial in 2018; world's first commercial service in 2019; 5G era fully enabled by 2022. Trials are ongoing in PyeongChang, the site of 2018 Winter Olympic games (Feb. 9-25, 2018). He finally discussed 5G certification systems. The 4th Global 5G event will be held in Seoul, Korea, on Nov. 22-24, 2017.

Mr. Isao Sugino concluded by describing the 5G development roadmap in Japan. Their Information and Communication Council will issue a report in the summer of 2017. The field trial plans will take place in 2017-2019, in Tokyo and other areas, targeting all key capabilities and below and above 6 GHz frequency bands, in particular at 28 GHz.

Opening Session 2: New trends of industrial interest towards the 5G era (moderated by **Prof. Hiroyuki Morikawa**, University of Tokyo, Chairman of Strategy & Planning Committee in 5GMF)

Mr. Jean-Pierre Bienaimé (5G IA Secretary General) presented the status of the works in 5G PPP from the perspective of 5G IA, in particular in terms of the new industrial perspectives. He introduced the change of governance: NetWorld2020 is not part of the 5G PPP anymore; all other structures are active. Number of members is around 70. Phase 2 of the projects will start on June 1st, 2017. Great stress on the standardization process, to avoid "early 5G announcements".

Mr. Chris Pearson (President of 5G Americas) described the moves in the Americas considering LTE, LTE-Advanced and 5G technologies and systems, to enable new business models including vertical industries. 5G can affect all of the aspects of our lives: we need to move from use cases to business cases.

Ms. Zhiqin Wang (Vice Chair of IMT-2020 (5G) Promotion Group) gave an update on 5G R&D efforts led by the IMT-2020 PG in China. Two new working groups have been formed: C-V2X WG, for cellular V2X solutions, and the 5G Trial WG, for the organization of 5G technology trials, which are targeted for 2018. Eight demonstration cities have been identified, and trial deployment is running at full speed.

Prof. DongKu Kim (Chairman of the Executive Committee, 5G Forum) discussed the ongoing activities inside the 5G Forum. Great emphasis on international cooperation, Korea-China and Korea-Europe (5G Champion) in particular. A 5G PoC will be developed for the 2018 Winter Olympics by the 5G Champion project.

Prof. Hiroyuki Morikawa (University of Tokyo, Chairman of Strategy & Planning Committee in 5GMF) provided details about the activities carried out by 5GMF, specifically in terms of: 1) services and 2) trials. For services and applications, two 5GMF committees have been formed, with 11 meetings since 2015. Usage scenarios and application platforms have been identified. For trials, a dedicated working group has been formed, with the start of demonstration activities in 2017, end in 2019.

Session 1: Global harmonization on 5G Spectrum collaboration (moderated by Prof. HyeonWoo Lee, Chair of Global Strategy Committee, 5G Forum)

Mr. Colin Langtry (Chief, Study Group Department, ITU-R) provided the view of ITU on the family of standards IMT-2000, IMT-Advanced, IMT-2020. Main message is that IMT-2020 covers a much broader range of requirements and applications than previous standards

Mr. Yoshio Honda (Ericsson Japan, Frequency Working Leader, Technical Committee in 5GMF) discussed new frequency bands considered in Japan around 4 GHz. These need to be harmonized. Above 6 GHz, Japan divided the spectrum in three parts: low (6-30 GHz), middle (30-60 GHz) and high range (60-100 GHz), and studied their specific characteristics. Also, he dwelled on the problems in worldwide harmonization.

Mr. Yves Bellego (Director of Network Strategy, Orange) underlined the necessity for harmonization

for operators working in fragmented scenarios. The investment in 4G is still growing, and spectrum is needed for that: planning ahead is necessary. For future services, contiguous spectrum of 100-500 MHz will be needed. Three main bands for Europe: 700 MHz, 3.4-3.8 GHz, 24.25-27.5 GHz.

Mr. Julius Knapp (Chief of the FCC's Office of Engineering and Technology, U.S. Federal Communications Commission) discussed the US policy for spectrum regulation for 5G. He described the Mobile Now Act (now oending: study 3100-3550 & 3700-4200 GHz

Ms. Zhiqin Wang (Vice Chair of IMT-2020 (5G) Promotion Group) divided in Low Frequency (LF, below 6 GHz) and in High Frequency (HF, above 6 GHz), and classified their usability for the three ITU service scenarios. China already identified trials in the 3.4-3.6 GHz band since January 2016. Other bands to be identified by the end of 2017 at most. For HF, 26 and 40 GHz ar the priorities for China. Compatibility with FSS has been verified.

Prof. EenKee Hong (Kyung Hee University, 5G Forum) described the Korean's government policy for spectrum, identified as K-ICT plan, issued in January 22017. Spectrum needs estimation was based on a methodology considering application demand, expected user density, activation rate, etcetera.

Session 2: 5G Deployment plans towards 5G implementation (Moderated by **Mr. Chris Pearson**, President of 5G Americas)

Mr. Akira Matsunaga (KDDI, Acting Chairman of Technical Committee in 5GMF) discussed the inter-relation between network configuration and frequency band utilization.

Mr. Yves Bellego (Director of Network Strategy, Orange) presented the view of a large operator, considering all the techno-regulatory-economical constraints that are of great relevance in 5G.

Dr. Rao Yallapragada (Director of Advanced Technologies, Intel) underlined the need for "connectedness". Vendors like Intel may aspire to cover the end-to-end architecture.

Dr. Chih-Lin I (Chief Scientist, China Mobile Research Institute) described the migration strategy for China Mobile between several cellular generations. The numbers of China Mobile clarify that they detain approximately 30% of the LTE market. Even though 4G is still on a steep growing curve, there is great enthusiasm for 5G nonetheless. Traffic is growing, but revenue is slower and profit growth is around zero. Clearly a problem in terms of business chain.

Dr. Lee, JongSik (Vice President, 5G TF, Institute of Convergence, KT) put emphasis on the upcoming Winter Olympics in PyeongChang, and the opportunity these represent for the early demonstration of 5G technology. Initial focus is on immersive media, but also connected cars and autonomous drones.

Special Session: Security in 5G (Moderated by Prof. Sylvain Guilley, TELECOM-ParisTech)

The threats in 5G are potentially enormous. Security must be ensured by design. It impacts all parts of the system, including core, applications, devices.

Dr. Anand R. Prasad (NEC Corporation, Chairman 3GPP SA3 - Security)

Mr. Koji Nakao (National Institute of Information and Communications Technology)

The first day was concluded by the important **extension of the Multi-lateral MoU to Brasil**, with a signature ceremony with Telebrasil.

Figure 14. 3ʳᵈ Global 5G Event in Tokyo - Signature of the Multilateral MoU extension to Brazil

Session 3: **Potential collaboration on 5G Trial Plans** (Moderated by **Ms. ZHOU Tao**, Deputy Director of China Telecom Shanghai Research Institute)

Dr. Yukihiko Okumura (NTT DOCOMO, Leader of 5G Trial Promotion Group in 5GMF) described the structure of the 5GMF TPG (Trial Promotion Group). Activities started in 2017 and will run through 2018. A report (in Japanese) was published in March 2017, contemplating 6 use cases: 1) entertainment (e.g. 5G at stadium), 2) security and disaster relief, 3) logistics (massive IoT), 4) robots and drones (remote control), 5) connected and automated cars, 6) High speed mobility (trains, helicopters).

Mr. Didier Bourse (Director, European R&I Programs at Nokia) described the European strategy under the framework of the 5G manifesto and Action Plan. The strategy covers the 2017-2020 period, with six streams: private trials; 5GAP trial events; platforms; vertical pilots; international trials cooperation; regulation and policy. The 5G Pan-EU Trials Roadmap V 1.0 was released on Tuesday May 23. UEFA EURO 2020 championship is an opportunity for showcasing new technologies.

Dr. Wanshi Chen (Qualcomm Technologies, Inc., 3GPP RAN WG1 Vice Chair) discussed the increasing number of delegates and contributions on 5G at RAN1 meetings, which have respectively grown to 500-700 and about 2000 per meeting. Documents are now numbered with 5 digits. There is an increasing acceleration on 5G NR (first release R15), while LTE continues to evolve in parallel. Main technical elements include optimized waveforms, flexible frame structure, advanced wireless technologies. Amazingly, sub-2 ms latency also leads to increased system throughput, thanks to lowered probability of being interfered!

Dr. Lei Wan (IMT-2020 (5G) Promotion Group, Director of Wireless Standard Department) presented a view on the 5G ecosystem with more vitality and a long life cycle. She recapped the global 5G trials plans. Also, she underlined the importance of 4G/5G spectrum sharing instead of refarming. Speed of deployment must be accompanied by quality.

Figure 15. 3rd Global 5G Event in Tokyo - Global 5G Trial Spectrum Plan slide by Huawei

Mr. Masao Akata (VP, Leader of SEJ-Technology Team/ Sumsung Electronics) concluded the session by showing Samsung's results, in particular at mmWave frequencies. Several measurements, including propagation loss characteristics and transmission performance were presented, confirming the feasibility of using this extremely high frequency spectrum.

Session 4: **Building collaborative relationship with Verticals** (Moderated by **Mr. Bernard Barani**, EC, Acting Head of Unit Future Connectivity Systems, DG CONNECT)

Figure 16. 3rd Global 5G Event in Tokyo - Bernard Barani moderating Session 4

Mr. Junya Inoue (Senior Director of ICT Solutions, The Tokyo Organising Committee of the Olympic and Paralympic Games) started by illustrating the design of the Games' logos. Three core concepts: achieving personal best, unity in diversity, connecting to tomorrow. The introduction of 5G technologies at the Games is expected to create a large impact.

Mr. Takashi Sueki (General Manager, ITS Planning Dept., ITS Planning Div., Connected Company, TOYOTA MOTOR CORPORATION) discussed car-centred connectivity issues, to achieve the goal of zero traffic casualties. Cooperation in ITS will be instrumental. Toyota Safety Sense will be installed in all cars by the end of 2017.

Dr. Sun Shaohui (Chair of 3GPP Standard WG of IMT-2020 (5G) Promotion Group, Chief Expert of Datang Telecomm Group) provided Datang's view on the necessary development of V2X in 5G, beyond what LTE and LTE-Advanced will be able to offer. Latency and reliability will be crucial.

Dr. JongHan Park (5G Core Architect Tech Lsb, SK Telecom) started by suggesting a change in terminology: "verticals" is too mobile industry-centric, it should be substituted by "business partners". He emphasized the fact that in 5G the decoupling between traffic and profit might be even more dramatic than in 4G: operators must therefore reach-out to other markets in order to survive. He

displayed the demonstrations carried out by SK Telecom at 28 GHz in the automotive, AR/VR sectors.

Dr. Colin Willcock (Chairman of the Board, 5G Infrastructure Association) underlined with strength the fact that if we fail with the vertical markets, we will fail with 5G. True collaboration must be established, not only in the automotive sectors, but also in health, entertainment, etcetera. Standardization is a marathon, not a sprint: 5G standardization will be a long process. Research must be continued, even though trials are ongoing. There is a commercial reality: public funding is useful, but must be coupled with private investment, the must be commercial sustainability in order for vertical stakeholders to join in. The business model can and must change with 5G.

Figure 17. 3ʳᵈ Global 5G Event in Tokyo - Colin Willcock's speech in Session 4

Wrap up panel: **5G Roadmap for Global platform towards 2020 realization** (Moderated by **Mr. Takehiro Nakamura**, NTT DOCOMO, Acting Chairman of Strategy & Planning Committee in 5GMF)

Prof. Seiichi Sampei (Osaka University, Chairman of Technical Committee in 5GMF) confirmed the fact that the Multilateral MoU framework is performing well in favouring the exchange of information between the various regions.

Prof. Akihiro Nakao (University of Tokyo, Chairman of Network Committee in 5GMF) advocated the softwarization of the network to achieve the necessary flexibility, which is required in order to reach the wanted Key Performance Indicators.

Dr. Colin Willcock (Chairman of the Board, 5G Infrastructure Association) underlined the fact that we have both opportunities and threats for 5G in the future. Commercial viability is essential.

Mr. Chris Pearson (President of 5G Americas) emphasized that collaboration between regions is essential, as well as standardization as the enabler for widespread growth.

Mr. Wang, Xinhui (Vice Chair of International Cooperation of IMT-2020 (5G) Promotion Group, Director of Wireless Standardization and Industrial Relationship of ZTE) discussed the need to develop in parallel and with equal priority both mobile broadband and the Internet of Things.

Dr. Chung, HyunKyu Vice President, Electronics and Telecommunications Research Institute, South Korea (Korea 5G Forum) dwelled on the fact that 5G services can lead to convergence of several industries, which can translate into new opportunities for the telecom industry.

The event was closed with remarks by **Prof. DongKu Kim** (Yonsei Univ., Chairman of Executive Committee, 5G Forum) and by **Dr. Kohei Satoh** (Secretary General of 5G MF). The next event will be held in Korea, as detailed below.

Press release for the 3rd Global 5G Event

"Creating the Crossover Collaboration for 5G Eco-Society"

24-25 May 2017, Tokyo, Japan

The 5GMF (The Fifth Generation Mobile Communications Promotion Forum), the leading 5G visionary organization in Japan, organized the third Global 5G Event with world's 5G promotion organizations : 5G Forum, 5G Americas, IMT-2020 (5G) PG, 5G-IA.

Tokyo, Japan – 24 May 2017.

The Fifth Generation Mobile Communications Promotion Forum (5GMF) organized the 3rd Global 5G Event in Tokyo on 24-25 May 2017.

The Workshop of the 3rd Global 5G Event was held in Pegasus Hall, Hilton Tokyo ODAIBA on 24-25 May 2017. In parallel with the Workshop, the 5GMF was also planning the Exhibition for the world's 5G promotion organizations in Wireless Technology Park (WTP2017), Tokyo Big Sight on 24-26 May 2017.

5G is aimed at the practical use on 2020 and beyond. On the 3rd Global 5G Event, we introduced the hot news on "5G Field Trial Project in Japan" that will be started in 2017, and discussed the latest global topics on the 5G spectrum harmonization, collaboration with Verticals and so on.

About Global 5G Event:

Global 5G Event is an event where the world's leading 5G organizations discuss the latest Research and Development achievements and views on 5G technologies, spectrum, standardization, field trial, applications, the future Roadmap and the global collaboration. The series of events is based on a Multi-Lateral MoU to cooperate on building global consensus on 5G with world's 5G promotion organizations : The Fifth Generation Mobile Communications Promotion Forum (5GMF, Japan), 5G Forum (Korea), 5G Americas (Americas), IMT-2020 (5G) Promotion Group (China), 5G Infrastructure Association (5G-IA, Europe).

The event is held twice a year in rotation. Last year, the 1st Global 5G Event was held in Beijing, China by IMT-2020 (5G) Promotion Group and the 2nd event was held in Rome, Italy by 5G-IA.

The next 4th Global 5G Event organized by 5G Forum will take place in Seoul Korea on 22-24 November 2017.

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Susumu Yoshida, Chair of 5GMF declared

"Inviting leaders and industry experts from all over the world, it is an honor to be organized the 3rd Global 5G Event in Tokyo Japan. In this Event, 5GMF proposed a theme "Creating the Crossover Collaboration for 5G Eco-Society". The Crossover Collaboration means a barrier-less cooperation between various industries on the 5G platform that has enhanced capabilities. 5GMF believes that this is a key to maximize the true value of 5G. We expect exciting discussion and the strengthening of relationships and collaboration to realize a 5G Eco-Society. Thank you for your understanding and cooperation."

DongKu KIM, Chair of Executive Committee, 5G Forum, stated

"The theme of the 3rd Global 5G Event, 'Creating the Crossover Collaboration for 5G Eco-Society' is very timely on the course of on-going development of 5G networks. 5G would be a business driven network, where much of its demands are expected to come from other industries. 5G networks shall be designed as an open architecture to embrace open innovations from various industries, including small and medium sized enterprises. We believe that Global 5G Event with WTP2017 will show not only 5G networks but also how 5G could be leveraged by other industries to create greater value."

Chris Pearson, President of 5G Americas, stated

"5G has made great progress over the past year including the work on standards, trials, infrastructure, devices and chipsets. The 5G ecosystem is gaining significant momentum toward the realization of commercial 5G deployments due to the output of collaboration from conferences such as the 5G Global MOU Events."

CAO Shumin, Chair of IMT-2020 (5G) Promotion Group, stated

"First of all, we sincerely congratulate the third Global 5G Event is successfully held in Japan. IMT-2020 (5G) Promotion Group is committed to promoting 5G R&D, standardization, spectrum planning,

trials, and deployments in a globally open manner, and thus creating a globally unified 5G technology and industry ecosystem. By strengthening the deep integration of 5G and vertical industry applications, we will be able to make 5G a key cornerstone of social and economic development. "

Colin Willcock, Chair of 5G-IA, stated

"The 3rd 5G Global event takes place In Tokyo this week, illustrating the success of this multilateral partnership & cooperation between Europe, Japan, China, South Korea and North America, that will shortly be extended to Brazil and other regions of the world. A highlight is the diversity of the topics covered at this event, putting an accent on new domains such as collaboration with verticals, 5G trials roadmaps and security in 5G…Moreover, this series of global events has an unique advantage in offering a benchmark of 5G developments around the world, enabling on the one hand to be informed on what is being done elsewhere by our peers, and on the other hand to encourage the convergence of solutions and roadmaps between the actors & partners, towards a globally harmonized standard. The 5G-IA, in conjunction with the associated 5G PPP projects are ready to take an active part in this way towards ubiquitous and powerful future communications systems."

2.5   Future Global 5G Events

The series of Global 5G events is planned to continue, and there is a clear plan up until the fall 2018 event. In particular, three events are already agreed:

- 4th Global 5G Event in Korea (Seoul, 22-24 November, 2017)

- 5th Global 5G Event in the USA (May, 2018)

- 6th Global 5G Event in Brazil (November, 2018)

This will complete a first round of global events hosted by the signatories of the Multi-lateral MoU. Regarding 2019, discussions are on-going between IMT-2020 PG and 5G-IA for the order of events in the two regions of China and Europe.

3   Liaisons and Contacts to European Initiatives

3.1   Beyond the 5G PPP Framework

In order to grow the 5G PPP initiative, its impact and relevance for the whole Digital Society, cooperation with other European R&D programmes is a core objective of which the Euro 5G Project aimed to provide support to. The creation of strong pan-European and international liaisons are a critical part of positioning the European leadership on 5G at a global scale. In particular, it is important that the information collected within the Euro 5G context is made available to all 5G PPP community players for review, validation, further contribution and consensus building, which also acts as a precursor to international standardization efforts.

In order to reach this goal, the first step has been to map the European Peer Research Initiatives in the 5G domain, in order to establish contacts for future interactions and grow the global socio-economic impact of 5G-driven efforts for all active players. This objective has involved supporting as many relationships as possible to national programmes such as EUREKA Clusters (in particular via the Celtic-Plus Cluster) and other objectives within Horizon 2020 or in related R&D&I contexts.

In all cases, what was considered crucial was to ensure that knowledge, technology, concepts and adoption mechanisms generated by the 5G PPP projects and vice versa by those initiatives (public and private outside of the EC programme) are shared and possibly made available for broad uptake. Only via synergetic efforts Europe will be able to keep its leadership position in mobile/wireless communications and networks.

A premise that should be made is that to reach out of the 5G PPP projects and more directly related initiatives has not been an easy exercise, as often the National Contact Points have been not very reactive and often times they did not provide very valuable information. At the EURO-5G level we tried to overcome this limitation, by trying to engage all ongoing 5G PPP project participants and the members of the 5G IA in order to get a more complete map.

3.2   Mapping the 5G R&D National Programs

As an important factor to implement a productive collaborative interaction, the following critical information to be gathered to map European 5G R&D initiatives has been defined.

- The first step identified **WHO,** as contact persons and/or institutions involved in 5G initiatives in Europe as follows:
    - 5G PPP projects
    - ICT National Contact Point (NCP) Network
    - Cooperation with the Idealist2014 project
    - Cooperation with Celtic-Plus Eureka Cluster
- The second step identified **WHAT** each research initiative is focusing on and what is being developed at the national level in each EU country and affiliates.
- The third step was to publish online https://5g-ppp.eu/european/ the results of this mapping for further beneficial usage by other 5G stakeholders.

3.2.1   Reaching out – Online Questionnaire

The Euro-5G project has reached out to over 200 contacts through an online questionnaire inviting them to provide inputs regarding 5G R&D initiatives. The questionnaire was sent twice (June 2016 and November 2016) to the 5G Projects (mailing list Comms@5g-ppp.eu) and sixty-nine National Contact Points emails (mailing list details were collected and merged between the Minutes of the First H2020 Future Internet Forum of Member States and Associated Countries, 21 April 2016, Brussels and the Future Internet Forum Commission Expert Groups published online

http://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetail&groupID=3411&NewSearch=1&NewSearch=1).

Questions were as follows:

1. Country
2. Is a 5G R&D National programme active in your country?
   a. Yes, it is currently active
   b. Yes, a related programme will be activated in the near future
   c. No, and there are no plans to have one
   d. Other (please specify:)
3. In case there is an ongoing or planned 5G related programme, is there any informative website you can point us to?
4. Is there a national 5G contact address we can use to get further information?
5. We will be happy to inform you of the results, are you interested in being involved in follow up activities?
   a. Yes
   b. No

Figure 18. Screenshot Online Questionnaire

3.3   Quantitative Results – Online Questionnaire

The consolidated results of the two waves of questionnaire among the NCP:

- 31 European National Contact Points (NCPs) of Member States contacted
- 15 NCPs of Associated Countries have been contacted
- 30 NCPs replied

3.3.1   Is a 5G R&D National programme active in your country?

As shown in Figure 2, the results show a fragmented framework in which only 22% of the respondents confirmed the presence of an active 5G R&D national programme, while another 20% confirmed that there is a plan to launch a related program in the future. Over 50% of the respondents highlighted that

there is no active plan nor is it foreseen or suggested that 5G initiatives are included in wider ICT national programs.
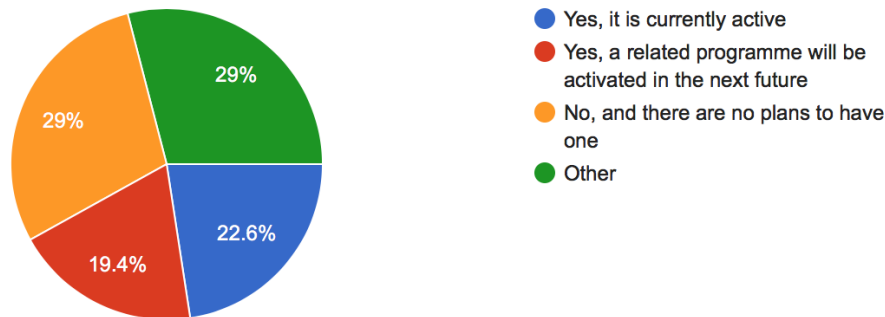

Figure 19 % National Program active/not active/planned/not planned

In detail:

- 9 countries have ongoing active 5G R&D National programme: Finland, Germany, Latvia, Lithuania, Luxembourg, Malta, Slovenia, Sweden, and United Kingdom.

- 7 countries are planning to initiate a 5G R&D National programme and/or cooperate on 5G initiatives through their ICT programs and through private initiatives: Cyprus, Netherlands, Moldova, Ireland, Israel, Poland, and the Former Yugoslav Republic of Macedonia.

- 8 countries have no plans to develop 5G National programme in the future: Albania, Belgium, Estonia, Iceland, Montenegro, Norway, Spain, and Switzerland.

3.4   Qualitative Results – Online Questionnaire

The questionnaire also offered the opportunity to provide further details regarding public and private initiatives at the national level in which some of the responses were very extensive.

3.4.1   Is a 5G R&D National programme active in your country?

National Contact Points active in 5G R&D initiatives have pointed to relevant websites where more details on each initiative is available. They are:

- Finland http://www.5gtnf.fi/

- Germany https://www.bmbf.de/foerderungen/bekanntmachung-1044.html

- Ireland
  - www.connectcentre.ie
  - www.ipic.ie
  - www.tssg.org

- Latvia http://www.lmt.lv/lv/preses-relizes?pid=755&g=2015

- Luxembourg http://www.digital-luxembourg.public.lu/en/index.html

- Moldova www.orange.md, www.moldcell.md

- Netherlands
  - http://www.economicboardgroningen.nl/programmas/digitale-bereikbaarheid

- o http://www.economicboardgroningen.nl/downloads/$447/$448
- o https://www.surf.nl/innovatieprojecten/het-open-programmeerbare-netwerk/nieuwe-draadvrije-technologie-en-dienstideeen.html and
- o http://www.5groningen.nl/

- Slovenia http://e6.ijs.s
  http://www.sicris.si/public/jqm/rsr.aspx?lang=eng&opdescr=search&opt=2&subopt=304&code1=cmn&code2=auto&psize=10&hits=1&page=1&count=&search_term=miha mohor?i?&id=8640&slng=&order_by=

- Sweden (There are several Swedish national programmes related to 5G)
  - o 5GEM – 5G enabled manufacturing – Strategic Innovation Program https://www.chalmers.se/en/projects/Pages/5GEM.aspx
  - o Drive Sweden – Strategic Innovation Program http://www.drivesweden.net/en
  - o Electronic Components and Systems – Strategic Innovation Program http://www.smartareelektroniksystem.se/
  - o PIMM, pilot for industrial mobile communication in mining – Strategic Innovation Program https://www.sics.se/projects/pimm
  - o 5G Transport Lab https://www.acreo.se/projects/kista-5g-transport-lab
  - o Wireless@kth https://wireless.kth.se/
    Urban ICT Arena http://www.urbanictarena.se
  - o Massive MIMO test bed (MATE) https://www.chalmers.se/en/projects/Pages/Massive-MIMO-test-bed.aspx
  - o The GigaHertz Centre http://www.chalmers.se/en/centres/ghz/Pages/default.aspx
  - o MAPCI (Mobile and Pervasive Computing Institute) http://mapci.lu.se/
  - o Massive MIMO @ EIT http://www.eit.lth.se/mamitheme
  - o First European field tests of 5G trial systems have been completed in Stockholm 2016 http://www.zdnet.com/article/if-you-think-4gs-quick-telia-ericssons-5g-field-tests-show-speeds-40-times-faster/
  - o 5G for Sweden https://www.ericsson.com/news/1898640

- United Kingdom https://www.gov.uk/government/organisations/national-infrastructure-commission

3.4.2 Would you like to be involved in the follow up initiatives?

It is to be noted that 13% of the respondents are not willing to be involved in the follow up activities. Most likely they are not directly involved in 5G initiatives although some of them suggested alternative point of contacts for further communication.
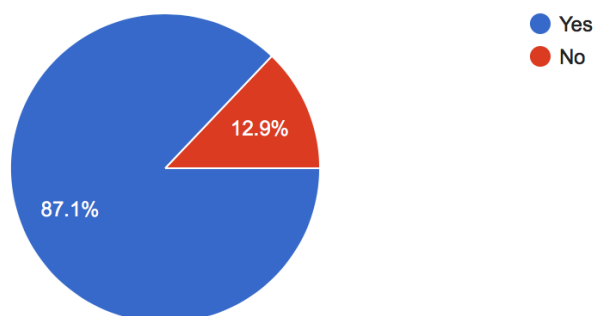
Figure 20. % of respondents interested in being involved in follow up activities

3.5   What National Initiatives are developing and how?

How is each National programme working? How is it structured? In which areas is it focusing its efforts?

Finland, 5GTNF - A joint public-private initiative

5G Test Network Finland (5GTNF) coordinates and combines the research and technology development activities from the 5G infrastructures built under Tekes which is the Finnish Funding Agency for Innovation – 5thGear programme (www.tekes.fi/5thGear). By taking advantage of the synergies between the topics of the 5thGear projects, 5GTNF creates a single coherent entity from the numerous smaller test networks around Finland and represents them as an integrated innovation platform to the research community, industry and other interested parties on both the national and international level.

With this approach, the 5GTNF covers all relevant 5G research areas ranging from the programmable core network infrastructures (including the utilization of the Software Defined Networking and Network Functions Virtualization concepts) to dense and heterogeneous access network configurations (including small cells and Internet of Things use cases).

More efficient and intelligent use of the available spectrum (including different spectrum sharing techniques and utilization of the Ultra-High Frequency band in cellular communications) is also covered together with the related business and regulation issues in collaboration with FICORA, the Finnish Communications Regulatory Authority.

The overall aim of the 5GTNF is to enable Finland to provide the best and most appealing 5G test network environment and ecosystem in the world for research and business development purposes. 5GTNF is a joint effort from industry, academia and the Finnish government with global manufacturers such as Nokia, Ericsson, Huawei, Coriant and Intel as well as internationally recognized research organizations like VTT, University of Oulu, University of Helsinki, Tampere University of Technology and Aalto University.

Luxembourg, Digital Letzebuerg, A joint public-private initiative

The government of Luxembourg sought to provide a common umbrella for the numerous public and private initiatives that make up the country's digital economy and society. Thus, in autumn of 2014, the Digital Letzebuerg initiative was launched.

Ireland, CONNECT, A joint public-EU co-funded initiative

CONNECT is the world leading Science Foundation Ireland Research Centre for Future Networks and Communications. CONNECT is funded under the Science Foundation Ireland Research Centres Programme and is co-funded under the European Regional Development Fund. We engage with over 35 companies including large multinationals, SMEs and start-ups. CONNECT brings together world-class expertise from ten Irish academic institutes to create a one-stop-shop for telecommunications research, development and innovation. https://connectcentre.ie

United Kingdom, The 5G Innovation Centre (5GIC), A public-private initiative

The National Infrastructure Commission recently published a Commission report on 5G and the UK approach to maintain digital leadership.

The 5G Innovation Centre (5GIC) at the University of Surrey is the largest UK academic research centre dedicated to the development of the next generation of mobile and wireless communications. Bringing together leading academic expertise and key industry partners in a shared vision, the 5GIC will help to define and develop the 5G infrastructure that will underpin the way we communicate, work and live our daily lives in the future. http://www.surrey.ac.uk/5gic

3.6   What Private Initiatives are developing and how?

Ericsson, 5G for Europe

Ericsson activated the 5G for Europe programme in late 2015 and kept its expansion in Hungary, Switzerland, Germany and Spain in 2016 https://www.ericsson.com/news/1952645.

Ericsson has established a cross-industry 5G research and development (R&D) programme involving a range of European markets. Ericsson will drive the research, which will focus on delivering research, innovation and industrial pilots that use next-generation 5G networks as an enabler. The programme's academic and research partners include major technical universities such as Scuola Superiore Sant'Anna in Pisa, Italy, Technische Universität in Dresden, Germany, Universidad Carlos III of Madrid, Spain, IMDEA Networks Institute in Madrid, Spain, and King's College in London, United Kingdom. Among the industry partners are enterprises such as wiseSense, Weiss Robotics and MyOmega System Technology in Germany and Zucchetti Centro Sistemi in Italy.

Telefonica and IMDEA Networks, 5TONIC

The 5TONIC initiative (https://www.5tonic.org) is an Open Research and Innovation laboratory based in Madrid focusing on 5G technologies.

The objective of 5TONIC is to create a global open environment where members from industry and academia work together in specific research and innovation projects related to 5G technologies with a view to boost technology and business innovative ventures. The laboratory will promote joint project developments and entrepreneurial ventures, discussion fora, events and conferences in an international environment.

3.7   Collaboration with related EC driven H2020 Initiatives

All along the two years of activity, the EURO-5G partners have actively ensured close collaboration with a number of related initiatives, such as the IoT/AIOTI communities, the FIRE programme, the FIWARE initiative, and the new born Next Generation Internet (NGI).

This has been done by ensuring cross-communication – via mailing lists and social media, by ensuring presence of EURO-5G representatives at various related events, by broadly distributing generated know-how, by advertising events organised by the Phase 1 projects broadly across the 5G PPP borders and by supporting the EC and the 5G IA in major promotional efforts, like participation to the 2016

and 2017 Mobile World Congress editions, organisation of press conferences events and distribution of press releases and white papers for broad uptake.

3.7.1   Collaboration with FIRE

FIRE, Future Internet Research and Experimentation - https://www.ict-fire.eu/ FIRE is an initiative launched and financed by the European Commission that has been growing since its inception in 2010 with the ambition of being Europe's Open Lab for Future Internet research, development and innovation. FIRE offers cutting edge test facilities that could not be accessible otherwise by many European players. FIRE, by embracing several related Horizon 2020 initiatives and vertical segments, including 5G, Smart Cities, Manufacturing, eHealth, etc., offers the unique possibility to experiment with networks, infrastructures and tools in a multidisciplinary test environment. This is key to investigating and experimentally validating highly innovative and revolutionary ideas for next generation networking and service paradigms at a lower cost, in a more rapid way. With the launch of the Next Generation Internet initiative in September 2016, the FIRE projects have been re-allocated to different Units within the DG Connect. The majority of them moved in fact in the 5G PPP Unit, while some stayed with the NGI and some others with the IoT Unit. Regular exchange of information about projects' outcomes both from 5G PPP Phase 1 and FIRE ones have been regularly advertised and exchanged via cross-communication that Martel has facilitated in various ways, from animation of @5GPPP and @FIRE_ICT Twitter channels, via animation of the COMMS and FIRE DWG mailing lists. Also the fact that several organisations are involved in both 5G PPP and FIRE projects has facilitated interactions and synergies, especially at the two EuCNC 2016 and 2017 editions.

3.7.2   Collaboration with FIF

After the 1st year project review of EURO-5G, there was some discussion with the European Commission on whether it would be possible for us to liaise with the Future Internet Forum (FIF) members to get more direct reach to related national initiatives in Member States. Although the CEFIMS-CONNECT project was officially in charge of the relationship with the FIF members, we have been given from the Project officer Mario Scillia access to the minutes of the November 2016 meeting between the EC and the FIF representatives and to the contact points at FIF we could then involve in the online questionnaire exercise we have been running.

Martel's proposal of elaborating an online map of all active 5G PPP initiatives and members was debated within the project, but finally could not be pushed forward because of limitation in resources within the project. This is however something that has a definite potential in providing concrete incentives to all active 5G researchers and innovators across Europe: an online map gives visibility and amplifies market reach for many of the players. This aspect, we suggest, could be put forward for the 5G PPP Phase 2.

3.7.3   Collaboration with AIOTI

Jacques Magen, InterInnov, was invited as a member of the Board of the 5G IA by the Greek representatives of AIOTI, the Alliance for IoT Initiative, in an "IoT conference" that was held in Athens on December 17, 2015. The main objective of this invitation was to share the views of the 5G IA / PPP on what 5G could bring to IoT. Jacques delivered a presentation entitled "is 5G a necessity for IoT implementations?" and participated in a panel discussing what 5G could bring to IoT. This event helped in establishing some links between the 5G PPP and AIOTI (although this activity was performed as part of WP1 in order to engage with the IoT community).

Moreover, Martel Innovate as member of the AIOTI has been regularly cross-posting news and advertising 5G PPP events and initiatives also within the AIOTI context, with specific focus on promoting initiatives of relevance to the various ongoing Phase 1 projects.

3.8   Liaison with Eureka Clusters – Celtic Plus

Some interactions have happened between the European Commission and the Celtic-Plus EUREKA Cluster in order to discuss how some 5G areas could be addressed in Celtic-Plus projects. Although Celtic-Plus follows a bottom-up process, there was a discussion to promote some 5G issues to be addressed in the upcoming Celtic-Plus calls. However, this has not materialised yet.

4   Conclusions

In conclusion, it is important to underline the fact that Liaisons are a fundamental part of the work of a coordination and support action that aims at assisting a PPP on the development of 5G, which by its own nature has an International footprint.

Indeed, the impact of 5G research and development goes well beyond a mere technical profile, touching upon policies, regulation, standardization, and in general macro-economic factors.

This macroscopic relevance is clearly testified by the structure of the Global 5G Events, which have all been opened by high level political figures, and where industrial interests were always represented at a confederated level, without ever falling into micro-marketing exercises.

On the other hand, the monitoring and coordination activities within Europe are of great relevance, in order to ensure that all efforts based on public spending are synergistic and not simply overlapping.

By observing all the work that been carried out by Euro-5G in this area, reported in the three deliverables D4.1, D4.2, and D4.3, we can safely state that all the objectives for International, Regional, and National cooperation that were set out for the Euro-5G support action have all been achieved and in some cases exceeded.