



# 5-Alive

## 5G: A Leadership Vision for Europe

### D2.2 Report on community building and events

|                                |   |                 |
|--------------------------------|---|-----------------|
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#### Abstract

*The D2.2 deliverable is a report on community building and events related to the activities performed in 5-Alive in particular in relation with the 5G PPP and the NetWorld2020 European Technology Platform. It describes the events organised and attended by the 5-Alive project, as well as the set-up and facilitation of various working groups.*

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### Imprint

|                          |                   |                                    |
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## Executive Summary

The final scope of the 5-Alive project is to build up momentum within and beyond the European networking community and related application area for driving the 2020 infrastructures evolution towards holistic 5G networks.

One of the work packages designed to address this scope has been defined to establish needed working groups (Task 2.1), to support considerations of the 5G Infrastructure KPIs (T2.2), and to provide necessary logistics for related meetings and workshops (T2.3).

This deliverable is, as the title implies, a report on community building activities including the events organised and attended by 5-Alive, in relation with Task 2.1, and the set-up and facilitation of working groups, from Task 2.3. The activities performed in Task 2.2 are reported in a separate deliverable 2.1 “Evaluation of the 5G PPP KPIs”.

During the project lifetime, the main outcomes in terms of community building and events organisation and attendance were as follows:

- The 5G Vision & Societal perspective, the Enabling 5G via pre-standards, the SME and the Spectrum for 5G Working Groups were established;
- Beside support provided to the WGs, the 5-Alive project successfully supported the organisation of the NetWorld2020 ETP main meetings;
- 5-Alive supported the collaboration between the NetWorld2020 and NEM (New European Media) ETPs, which are working together on several issues of common interest;
- In accordance with the project plan, the NetWorld2020 Expert Group, including NetWorld2020 SatCom Working Group, has been re-established and extended. The 5-Alive project maintained communication within the Expert Group, provided necessary communication and collaboration tools, as well as facilitated various discussions within the group;
- 5 majors events were organised by 5-Alive, co-located with relevant European events:
  - The *NetWorld2020 event* was organised in Brussels on December 2014; 118 people participated.
  - At the MWC event 2015 in Barcelona, the 5-Alive project coordinated activities on the *EU 5G Research booth*, where five projects selected by EC presented their results through demonstrations, and organised a major press conference.
  - At the EUCNC 2015 conference, the 5-Alive project organised a special session: *Introducing the 5G Infrastructure PPP – Launching the European 5G Initiative*.
  - A special session on *5G for vertical industries* was organized at EUCNC 2015.

In addition, the 5-Alive partners represented the 5G PPP in several other European events.

## List of Authors

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| Eurescom     | Ellen Tallas, Uwe Herzog, Halid Hrasnica         | Contribution on support for NetWorld2020 ETP, NetWorld2020/NEM cooperation, Expert Group, events organised by the project |
| NOKIA        | Werner Mohr                                      | Contribution to event descriptions  |
| Orange       | Jean-Sébastien Bedo, Pierre-Yves Danet           | Contribution to Chapter 2 on Report on Community building, WG1 and WG2, and NetWorld2020/NEM Working Group                |
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## Abbreviations

|              |  |
|--------------|--|
| 5-ALIVE      | 5G: A Leadership Vision for Europe   |
| 5G           | 5 <sup>th</sup> Generation   |
| 5G IA        | 5G Infrastructure Association  |
| 5G PPP       | 5G Public-Private Partnership  |
| CTO          | Chief Technology Officer   |
| EC           | European Commission  |
| ETP          | European Technology Platform   |
| ICT          | Information and Communication Technology   |
| ITG          | Informationstechnische Gesellschaft im deutschen Verband der Elektrotechnik (Society on information technology within the association for Electrical, Electronic and Information Technologies) |
| KPI          | Key Performance Indicator  |
| NetWorld2020 | The ETP for communications networks and services   |
| PPP          | Public Private Partnership   |
| WG           | Working Group  |

# 1 INTRODUCTION

The D2.2 deliverable is a report on community building and events. It describes the set-up and facilitation of working groups related mainly to the 5G PPP and the NetWorld2020 ETP, as well as the events organised and attended by the 5-Alive consortium in relation with activities performed in Tasks 2.1 and 2.3.

This document provides detailed information on the activities carried out by the 5-Alive project in terms of community building and events attendance and organisation.

It is composed by five main sections:

- Section 1 is the introduction;
- Section 2 “Report on Community building” summarises the activities carried out in order to establish and facilitate de Working Groups. In addition, this section underlines the work performed by the consortium to support the NetWorld2020 ETC Constituency, and the NetWorld2020 Expert Group;
- Section 3 presents the main events attended by the 5-Alive members, demonstrating the great effort spent to create public awareness and being recognised as Europe’s voice in 5G;
- Section 4 outlines the main events organised by the 5-Alive project, co-located with major European and international events;
- Section 5 presents the conclusions.

## 2 REPORT ON COMMUNITY BUILDING

### 2.1 Introduction: establishment and facilitation of discussion groups

In order to ensure significant community feedback and involvement, the 5-Alive project established and supported new working groups and maintained existing working groups, managed within the NetWorld2020 ETP and the 5G Infrastructure Association.

The main group for discussion of the strategic documents is the “NetWorld2020 Expert Group”. This WG is supported by the NetWorld2020 SatCom Working Group. In accordance with the project plan, the NetWorld2020 Expert Group has been re-established and extended. The 5-Alive project maintained communication within the Expert Group, provided necessary communication and collaboration tools, and facilitated various discussions within the WG.

Also, 5-Alive established a SME working group within the NetWorld2020 ETP, to discuss and emphasise all issues and opportunities related to the SMEs, in particular in relation with the launch of the 5G PPP.

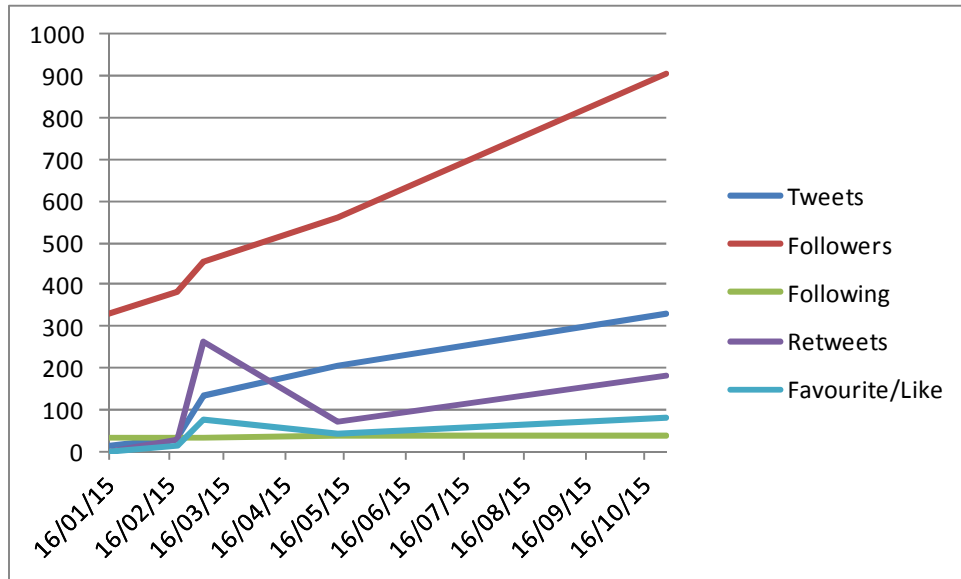
Furthermore, 5-Alive established and maintained joint working groups with other ETPs, such as the working group with the NEM ETP supporting the interaction between the NetWorld2020 and NEM (New European Media) ETPs, which are continuously working together on several issues of common interest.

Several Working Groups related to the 5G PPP were also initiated and supported by 5-Alive, in cooperation with the 5G Infrastructure Association. Those include a WG dedicated to building the “5G vision”, and WGs working on common European views on pre-standards and Spectrum issues.

Several Twitter accounts were set up or “re-launched” by 5-Alive. The NetWorld2020 and SME Working Group accounts are detailed in the next paragraphs. The Twitter account **@5GPPP** was re-launched via some active promotion in January 2015 in order to better promote the visibility of the 5G PPP and start preparing for the first projects. The number of followers has almost tripled, going from more than 300 to more than 900. The statistics below show also a strong increase in the activities of the account, generating more than 300 tweets in the reported period of time, but also a much more active community following the account with more than 250 retweets and “favourite/like”. This account was handed over to the Euro-5G CSA in October 2015.

| <b>@5GPPP</b> | Tweets | Followers | Following | Retweets | Favourite/Like |
|---------------|--------|-----------|-----------|----------|----------------|
| 16/01/15      | 16     | 332       | 31        | 0        | 0              |
| 20/02/15      | 32     | 384       | 32        | 28       | 15             |
| 05/03/15      | 135    | 456       | 35        | 261      | 78             |
| 12/05/15      | 204    | 561       | 37        | 73       | 45             |
| 26/10/15      | 332    | 905       | 40        | 182      | 81             |





Statistics for the 5GPPP Twitter Account

This section provides more details on the set-up and the activities carried out by each working group, as well as the supporting role played by 5-Alive.

## 2.2 Report on established working groups

### 2.2.1 WG1: 5G Vision & Societal perspective

The Vision & Societal Challenges Working Group was established following a decision from the Board of the 5G Infrastructure Association in July 2014.

A call for participants was launched among the Association members and NetWorld2020 ETP. Close to 40 persons volunteered for this group at the beginning and we are now 64 participants in the group.

A mailing list was established and maintained up to date. A shared repository was created and used until September 2015 when we switched on a BSCW server space for a better user experience for WG members.

Terms of references and a work plan were established and updated.

Conference calls were regularly organized at a periodicity of around one conference call every two weeks. We organized a physical meeting of the WG in December 2014 to kick off the MWC white paper. We also co-organized a workshop with the European Commission on verticals in June 2015. We produced 2 major deliverables in the WG, as described below.

#### Inputs on WP 16/17

We started from the NetWorld2020 white paper entitled “5G: Challenges, Research Priorities, and Recommendations” which was delivered in September 2014 by the NetWorld2020 Expert Group. A public consultation was organized by 5-Alive to collect comments from the wide community on this document.

Then, we asked each member of the 5G Infrastructure Association to vote regarding the priority and the maturity of the 41 topics identified from this white paper. We then ranked the topics in terms of maturity and priority. We discarded the 10 most mature topics because we think they will be out of scope for R&I in 2016-2017. We then selected the 20 topics with the highest priority scores. We distributed these 20 topics into 2 clusters: one for Research & Innovation projects and one for Innovation projects based on their maturity score.

We then iterated several times with the European Commission, notably thanks to the 5G PPP Partnership Board, in order to group these 20 topics in 5 strands: Wireless Networks, Optical Networks, The software network, Network Management and Automation and Effective Systems and Networks.

In addition, we built a comprehensive document describing these 20 topics in more details (around 17 pages) with Association Members. It required close to 10 conference calls and an important editorial work (more than 10 intermediate versions were distributed for comments).

In parallel, we built a 2-page document on the test and experimentation strategy of the 5G PPP. In order to build this strategy, we started from the draft white paper delivered by the NetWorld2020 Expert Group, which was listing available experimental facilities in Europe and the desirable properties of test and experimentation platforms for 5G. We extracted and synthesized the more salient information and added some statements on the phasing of tests and experimentations in the PPP. These statements were thoroughly discussed in conference calls with Association Members. In particular, they highlighted the need to work more closely with vertical sectors players on experimentations showing the benefits of 5G.

A specific exercise was done for the EU-Korea objective of the upcoming Call. We started from the draft call text provided by the European Commission and asked the Association Members about their potential interests in the proposed topics. We then built a 2-pager based on the received inputs. We circulated this 2-pager for comments and issued a second version of the document.

### Vision document created by 5G Association

We started by collecting vision documents on 5G from companies and other organizations in the world.

We then organized a full day workshop in Brussels (December 2014) with Association Members to build a consensus on the key messages to be communicated at MWC and the table of content of the white paper. We used this opportunity of a physical meeting to organize a parallel session on spectrum which gathered 6-7 persons from both satellite and cellular industries and built the compromise which was required to achieve a consensus on this challenging issue (see the details related to the Spectrum WG in section 2.2.4).

During the workshop we named chapter editors who delivered 3 pages on their chapter 3 weeks after the workshop.

After that, several editorial rounds were organized to ensure a good alignment between chapters and to improve the document. We also had dedicated conference calls and e-mail work to build pictures / graphics illustrating the concepts described in the white paper.

5-alive also hired a designer to prepare a very catchy document.

Finally an approval was launched to get the endorsement from Association Members. Further to this, a 5G vision brochure was designed, printed, and disseminated at various events, along with a 4-page executive summary flyer.

### 2.2.2 WG2: Enabling 5G via pre-standards

The Pre-Standardization Working Group was established during the first semester of 2015. A call for participants was launched among the Association members, and a mailing list was established and maintained up to date.

Terms of references and a work plan were discussed thoroughly and established.

The WG objectives are the following:

- Identify standardization and regulatory bodies to align with
  - ETSI, 3GPP, IEEE and other relevant standards bodies
  - TU-R (incl. WPs) and WRC (including e.g. ECC PT1)
- Develop a roadmap of relevant standardization and regulatory topics for 5G
  - Evaluate existing roadmaps at international level
  - Propose own roadmap for 5G being aligned at international level
- Influencing pre-standardization on 5G and related R&D
  - Potentially propose where topics should be standardized
  - Influence timing on R&D work programs (e.g. EC WPs)

Conference calls were regularly organized after EuCNC: one in July, one in August and several in September.

The main deliverable of the WG was the 5GPPP contribution to the 3GPP RAN workshop in Phoenix in September 2015.

The WG participated at a workshop organized by EC in conjunction with the EU ICT Event 2015 Lisbon conference giving a presentation on the standardisation of 5G both reviewing requirements and time tables, and listing potential technologies. The WG also provided a moderator for the session. Active 5G regional organisations from Asia (China, South Korea, and Japan) and Americas participated.

### 2.2.3 WG3: SME support

The SME Working Group was set up to be “the voice of the NetWorld2020 SME community”, as well as the networking place for the SMEs dedicated to network communications and services.

The SME WG started its activities since June 2014 when it was formally endorsed by the NetWorld2020 Steering Board. It includes today almost 130 members, of which about half SMEs. It has first established a list of priorities for SMEs, which were presented at the

NetWorld2020 Steering Board and then at the General Assembly in November 2014. The main objectives of the SME Working Group are:

- Help and support SMEs participation in the 5G PPP and more generally in EU R&D projects, including (but not limited to) reaching the target of at least 20% of the 5G PPP funding going to SMEs.
- Improve visibility of SMEs in the 5G PPP and in general in EU R&D programmes, and ease/promote participation in NetWorld2020.
- Activate channels that may enable, facilitate and promote SME contribution into the NetWorld2020 SRIA and research topics, and SME involvement through other strategic documents related to NetWorld2020 and to the 5G PPP.
- Ensure that the interests of SMEs, a key player in the EU economy, are adequately taken into account, more particularly in NetWorld2020 and in the 5G PPP.
- Act as representative/interlocutor of SMEs in the telecom domain, more particularly in NetWorld2020 and in the 5G PPP.
- Help SMEs access European funds, in the 5G PPP and beyond. The WG could e.g. "pre-digest" material and help SMEs find their way into 5G-PPP related funding and beyond.
- Analyse the participation of SMEs in projects, potentially prepare questionnaire and transmit the conclusions and results to European Commission –for the 5G PPP in particular.

The activities of the SME Working Group are focusing on two main aspects:

***Objective #1: increase SME visibility towards “big players” – increase interaction between SMEs and industry & research***

This includes:

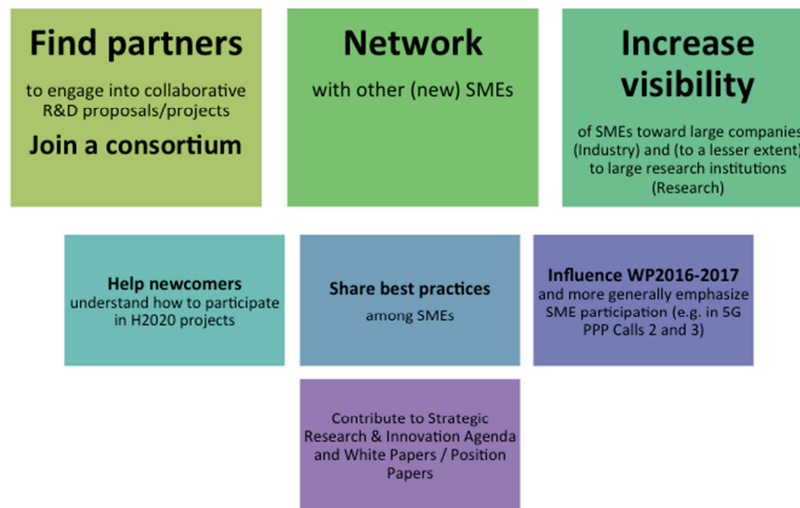
- Increase SME web and social networking presence;
- Organise booths/posters, demos, networking opportunities;
- Extend the 5G PPP online brokerage service to take better into account the needs of SMEs;
- Draw an “SME map of expertise”;
- Help the 5G PPP Vision and Roadmap WG define a “5G Value Chain” where SMEs can position themselves;
- Interact with the EC, the NetWorld2020 Steering Board and the 5G Infrastructure Association.

***Objective #2: Increase interaction amongst SMEs***

This includes:

- Use social networking to increase interaction;
- Organise networking meetings along events;
- Organise regular telcos/webinars on the SME WG.

The main expectations from SMEs have been summarized as follow:



Activities performed include a specific SME survey on the participation in the Call 1 of the 5G PPP, which showed that SMEs were not sufficiently aware of the online brokerage platforms and had difficulties to enter into consortia, although some of them were successful because they used the online platform and participated in 5G PPP info days.

Specific SMEs related questions were then added in the 5G PPP Call 1 general survey (in order to take advantage of the full survey being launched and not having another separate survey asking partly similar questions) organized by the 5G Infrastructure Association and the 5-Alive project. The survey received 126 responses, including 32 responses from SMEs (i.e. 25%). Overall there are probably more responses from SMEs as there are also 38 responses where the category of organizations is not available (at first when the survey was published this question was not asked –it was added after an intervention from the SME WG to be able to have analysis on SMEs responses). The preliminary results of this survey are:

- Most SMEs who responded are involved in NetWorld2020 and in H2020
- A majority of SMEs do not clearly understand the role of the 5G Infrastructure Association.
- Most SMEs were invited in a proposal / consortium by one or more of the partners.
- Most SMEs were aware of the 20% target set by the EC for SME participation in the 5G PPP.
- The feedback / perception of the level of participation of SMEs is lower than reality i.e. a majority of responses indicate that there is an average of 10% participation of SMEs, while the actual figure is 17%.

Other activities carried out by the SME WG are: the activation of communication channels (dedicated SME WG Twitter account and SME web page on the NetWorld2020 web site), regular telcos of the SME Working Group, and the organisation of the SME WG gathering at ICT 2015 in Lisbon. In addition, Jacques Magen from InterInnov represented the “voice of SMEs” at the Board of the 5G Infrastructure Association, and the 5G IA General Assembly,

and at the NetWorld2020 Steering Board. SMEs were encouraged to participate and contribute to the various NetWorld2020 and 5G IA Working Groups and white papers.

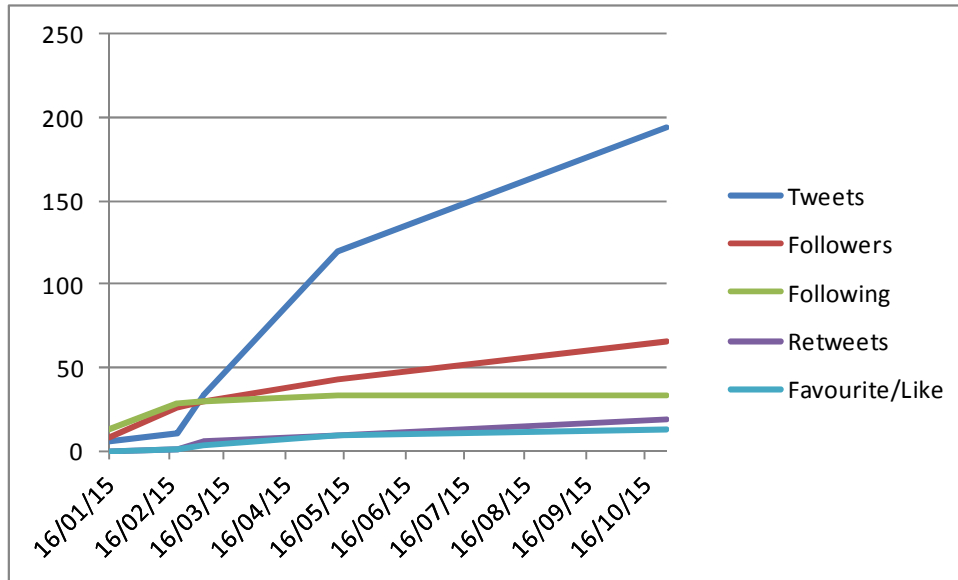
In addition to this, the 5G Infrastructure Association worked out an agreement with the Idealist project to bring 5G PPP into the B2B matchmaking brokerage event held at the ICT2015. A '5G PPP' tick box was added to the registration process, for people who would be interested to discuss proposals and ideas for the upcoming 5G PPP calls. SMEs were encouraged to register and participate in this brokerage event as a means to find new partners for upcoming proposals and projects.

Thanks to statistics on Call 1 provided by the European Commission, the SME WG and the NetWorld2020 Steering Board were informed that the participation of SMEs in 5G PPP Call 1 was around 17%, with 57 SME participation in the selected projects, and a little less than 200 SME participation in the proposals. The analysis will continue in the next few weeks as part of the Euro-5G project.

Next steps will also include drawing a 'map of expertise' of SMEs in the 5G domain, showing expertise but also how to position SMEs in the 5G value chain. This is considered as critical to make SMEs visible by the organisations building up proposals for the upcoming Calls –and more generally to make business.

A dedicated Twitter account **@NetWorld2020SME** was set up in January 2015 in order to promote the visibility of SMEs and of the activities of the SME WG, and to attract attention from 'larger players'. It has attracted since more than 65 followers and has generated a little bit of attention on Twitter, although more should be done in the future. This account will be managed by the Euro-5G CSA as of November 2015.

| @NetWorld2020SME | Tweets | Followers | Following | Retweets | Favourite/Like |
|------------------|--------|-----------|-----------|----------|----------------|
| 16/01/15         | 6      | 8         | 13        | 0        | 0              |
| 20/02/15         | 11     | 26        | 29        | 1        | 1              |
| 05/03/15         | 34     | 30        | 30        | 6        | 4              |
| 12/05/15         | 120    | 43        | 34        | 10       | 10             |
| 26/10/15         | 194    | 66        | 34        | 19       | 13             |



Statistics for the NetWorld2020SME Twitter Account

Note that there was also an attempt to set up a Twitter account to exchange information between SMEs (@SME4SME) however this account seemed to be perceived as replicating the above account and did not attract much interest. Therefore we decided to focus on the NetWorld2020SME account for all relevant information related to SMEs, both for increasing their visibility and for exchanging relevant information.

### 2.2.4 WG4: Spectrum for 5G

The WG 5G Spectrum was set up by the 5G Infrastructure Association (IA). It started its work at the end of 2014 contributing to the white paper by the IA "5G Vision, The 5G Infrastructure Public Private Partnership: the next generation of communication networks and services" issued in February 2015.

There are currently 48 individual members and 1 observer in the WG from 21 of the IA members and the 5G PPP projects 5G-Xhaul, COHERENT, FANTASTIC-5G, METIS-II, mmMAGIC, Speed-5G, and Xhaul, and the observer from the European Commission (EC).

The WG has established its terms of reference (ToR) outlining the WG objectives and activities. Its main task is to promote the spectrum for 5G issues based on the IA members and 5G PPP projects contributions and liaise with spectrum entities in regulatory and industry organisations.

The WG participated at a workshop organized by EC in conjunction with the EU ICT Event 2015 Lisbon conference giving a presentation on 5G spectrum topics including the need for more spectrum as well as spectrum management topics to better utilise the scarce resource. The WG also provided a moderator for the session. Active 5G regional organisations from Asia (China, South Korea, and Japan) and Americas participated.

### 2.2.5 Support for NetWorld2020 Constituency

Beside support provided to the particular working groups within the NetWorld2020 ETP and the 5G Infrastructure Association mentioned above, the 5-Alive project also supported the main meetings of the NetWorld2020 ETP:

- The NetWorld2020 Event - General Assembly - 2014 (more details in Section 4), and
- NetWorld2020 Steering Board meetings:
  - 12 December 2014 in Brussels,
  - 25 February 2015 in Madrid, and
  - 3 July 2015 in Paris.

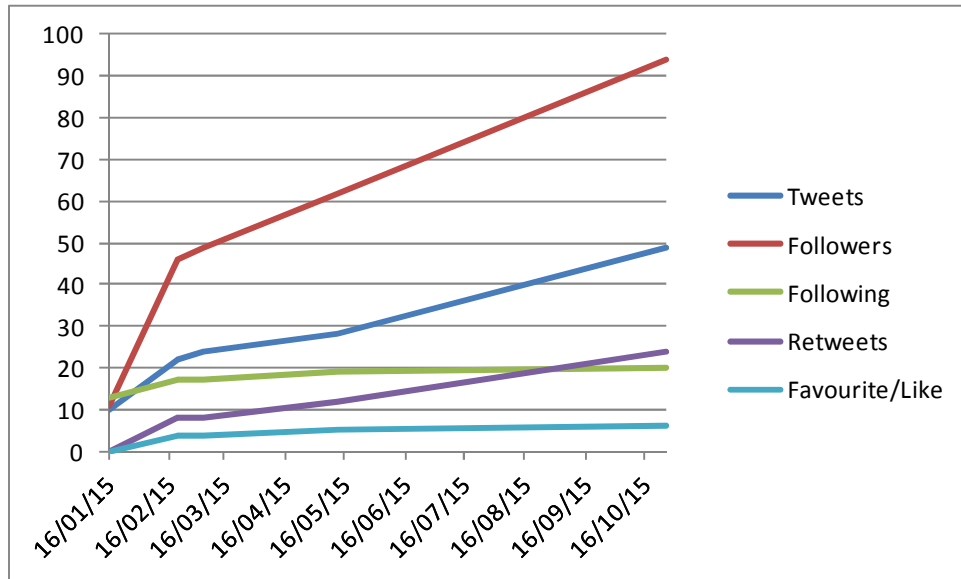
The General Assembly and the Steering Board are the most important regular occasions where the European networking research and industry community meet, in order to launch and follow-up various activities, such as provision of inputs for the EC Work Programmes, initiation of creation of position/white papers on actual technical and policy subjects, discussion of topics to be discussed within the NetWorld2020 Expert Group, etc., and, therefore, were very important for the project to support, which included:

- Preparation of agendas/programmes of the meetings,
- Securing venues for the meeting and organisation of necessary logistics;
- Provision of minutes/reports from the meetings; and
- Follow-up on agreed action points among the meeting participants.

The Twitter account **@NetWorld2020** was “re-launched” via some active promotion in January 2015 in order to better promote the visibility of the NetWorld2020 ETP. It has attracted since then more than 90 followers and has generated a little bit of attention on Twitter. However since a lot of activities around community building is now focusing on the 5G PPP, we could think of concentrating on some activities that are performed by the ETP and not by the 5G PPP. This account will be managed by the Euro-5G CSA as of November 2015.

| <b>@NetWorld2020</b> | Tweets | Followers | Following | Retweets | Favourite/Like |
|----------------------|--------|-----------|-----------|----------|----------------|
| 16/01/15             | 10     | 11        | 13        | 0        | 0              |
| 20/02/15             | 22     | 46        | 17        | 8        | 4              |
| 05/03/15             | 24     | 49        | 17        | 8        | 4              |
| 12/05/15             | 28     | 62        | 19        | 12       | 5              |
| 26/10/15             | 49     | 94        | 20        | 24       | 6              |





Statistics for the NetWorld2020 Twitter Account

### 2.2.6 NetWorld2020/NEM Collaboration

The NetWorld2020 and NEM (New European Media) ETPs are continuously collaborating on several issues of common interest, which was supported by the 5-Alive project during its lifetime:

- NetWorld2020/NEM Working Group discussing specific technical and research topics, which are of interest for both networking and media/content industry in establishing and considering requirements from both communities, helping that the corresponding Visions of the ETPs can be implemented in the future,
- Requirements on 5G from media industry, as one of the most promising sectors ready to utilize capabilities of the future 5G network infrastructure,
- Positioning of an initiative from NEM to establish a focused research and innovation programme on immersive and interactive content provision and delivery.

The NetWorld2020/NEM Working Group was set up in 2014 and involves 37 experts: 16 from NetWorld2020 and 21 from NEM ETP. The working group met 3 times during the last year, in order to identify the requirements from the content & media sector.

From the 19 research topics that NEM has identified in the Content Distribution chapter of the last version of the Strategic & Research Agenda, 4 of them has been identified as to be shared by the group:

1. Support better latency / real time (games):
  - A need to define an interface fitting the content application needs.
  - What the application should do to solve a bad latency?
2. Configuration according to the content requirements:
  - A need for content application to identify the parameters that has to be passed to the network

3. Support Quality of Experience placement of content in the network, graceful degradation, complexity hiding
4. Big data handling (network for big data)

The next step was to work on the interface between content and media applications and network in order to offer a network configurability function. From these 4 topics, the Joined NetWorld2020/NEM working group has identified 9 parameters that have to be shared by content providers and network service providers. For each of them, the group proposes a definition, a technical feasibility and a business value study.

These 9 parameters should fulfil the needs of NEM domains:

- Publishing (books): Security (DRM), end user context
- Film: Security (DRM), end user context
- Music: Security (DRM), end user context
- Audio/Video: Interactivity, Security, end user context
- Advertising: Location, Business model, Augmented reality, end user context
- Designers: Interactivity, virtual reality
- Cultural heritage: Storage, Security, Durability (never lost)
- Fashion: Augmented reality, virtual reality
- Game: Interactivity, end user context, virtual reality

The next objective is to influence the 5G PPP projects in order to achieve the objective to have networks able to deliver content & media in the most efficient way.

Furthermore, in order to discuss requirements on the future 5G network infrastructure from the media sector, the 5-Alive project supported preparation and organization of a related workshop at the in London, on 26 February 2015, where various topics of common interest related to 5G have been discussed with active participation of 97 participants, mainly from media and content sectors as well as creative industries. The discussion was focused on opportunities for the media industries given by the 5G developments and impact of the 5G PPP on the NEM plans for establishment of the focused programme (PPP) on immersive and interactive content. During all discussions with the NEM community, a particular attention was given to opportunities for the creative industries.

### 2.2.7 Expert Group

In accordance with the project plan, the NetWorld2020 Expert Group, including the NetWorld2020 SatCom Working Group, has been re-established and extended. It consists now of 198 members' organisations (see Annex A), where 369 individuals are involved. The 5-Alive project maintained communication within the Expert Group, provided necessary communication and collaboration tools, as well as facilitated various discussions within the group.

The Expert Group workshop, organised by the 5-Alive project, was held on 29 June 2015 in Paris, collocated with EUCNC'15, with the following three main topics:

1. “Looking Beyond 5G”, with the objective of identifying disruptive technologies and clean-slate approaches for new, very advanced communication systems.
2. Experimental facilities
3. 5G roadmap / TRL of 5G technologies

The workshop took place at Palais des Congrès of Issy les Moulineaux, Paris, France with participation of 110 Expert Group members (report from the workshop is available in Annex O). Results from the discussions within the Expert Group are provided in the 5-Alive deliverable D3.3.

### 2.2.8 SatCom Working Group

The Working Group contributed to the analysis of the 1<sup>st</sup> call of 5G PPP outcome versus the Pre structuring model defined for the first H2020 ICT 5G related call. Recognising that no project covering the integration of satellite technologies in H2020 ICT 5G PPP was selected although the added value of satellite in 5G was identified in the 5G IA's vision document, SatCom WG members contributed to the definition of the Pre-structuring model version 1.0 for 5G PPP Phase II based on the EU Commission Work Plan 2016/17 published on 3rd of November, in particular to the definition of

- TA6: Seamless Integration of Satellites Networks and Air Platforms into 5G
- TA26: EUK-01-2016: 5G – Next Generation Communication Networks
- This will help to prepare the upcoming H2020 ICT 5G related calls especially
- ICT-07-2017: 5G PPP Research and Validation of critical technologies and systems - Strand 1:
- EUK-01-2016: 5G – Next Generation Communication Networks

The key enablers, satellite technologies can bring to 5G are recalled here under:

- Address not only European markets but also emerging countries world-wide as well as serve passengers on board airplanes operating at worldwide level
- Provide a dependable global service especially to serve vertical market applications, including, but not limited to, freight, transport (road, air, maritime and rail), critical infrastructures as well as security/emergency management
- Ensure a cost effective and highly scalable delivery of high quality multimedia contents thanks to the satellite inherent broadcast/multicast capabilities

In addition, the WG prepared and sent a letter sent to Member States requesting inclusion of SatCom research in H2020 Space (starting in WP2016-17). This resulted in the inclusion of a specific objective in the space work programme dealing with Satcom technologies; « COMPET-2-2016: Maturing satellite communication technologies ».

Furthermore, numerous contributions were made to several Working Groups of the 5G Infrastructure association:

- WG Spectrum
  - Contribution –to the spectrum chapters of white paper and vision documents
  - Contribution to the presentation prepared for ICT2015
  - Concerns about the governance model adopted by the 5G IA Board for WG Spectrum
- WG Pre-stands
  - Contribution to the presentation prepared for 3GPP RAN Workshop on 5G (17-18 Sept 2015)
  - Contribution to the presentation prepared for ICT2015
- WG Vision
  - Review of the white papers e-health and factories
  - Contribution to the automotive paper (invitation of ERTICO)
  - Elaboration of a paper on entertainment and media, organisation of a dedicated workshop
  - Contribution to a white paper on Service Level Agreement led by Telenor
  - Ongoing editing of the 5G and Media & Entertainment paper

Finally, it should be noted that although no project addressing the integration of SatCom in 5G has been selected with the 1<sup>st</sup> call of H2020 ICT 5G, the satellite research community has started some standardisation activities

- At ETSI, a new work item is being created to develop a technical report expected to be finalised in Q2/Q3 2016. It will
  - Identify the 5G use case which would benefit from satellite technologies (communication and/or navigation)
  - Define the relevant integration scenarios of satellite technologies (communication and navigation) into 5G
  - Identify and plan the necessary standardisation activities in the appropriate standardisation bodies/groups
- At 3GPP SA1, a use case on 5G Connectivity using satellites was included in the TR 22.891 on 5G-SMARTER

## 3 REPORT ON ATTENDED EVENTS

### 3.1 Introduction

Contributing to workshops, giving presentations and networking at conferences is an important part of the 5G PPP (Private Public Partnership) Association. Therefore 5-ALIVE project partners show awareness and ensure that the mission and goals of the European 5G Association are well known. The Acronym 5-ALIVE stands for '5th Generation: A Leadership Vision for Europe' and is a support action project within the European frame research program Horizon 2020. The following chapter outlines which events members of 5-ALIVE have attended and represented the 5G PPP. The presentations mostly covered organizational and international topics and/or the European 5G vision. However this section does not cover every conference a 5G PPP Infrastructure Association member took part in. It focuses on the main events with strategic importance. A full list of events is attached in the next section.

### 3.2 Events Overview

The full list of events, providing an overview of the participation of 5G PPP Infrastructure Association members, demonstrating great effort spent to create public awareness and being recognized as Europe's voice on 5G can be found in Annex B. In the following chapter 3.3 the attendance to the most relevant events are described shortly.

### 3.3 Events Description, benefits and relevance

#### Future Internet Assembly 2014

Werner Mohr from NOKIA and Didier Bourse from Alcatel-Lucent played an active role during the Future Internet Assembly 2014. It is classified as an Organization Meeting of the EU Commission. Whereas Werner Mohr was presenting the 5G PPP, Didier Bourse's presentation was focusing on the pre-structuring model. The latest developments were presented from the association's point of view. The emphasis was on organizational issues since the group has started their work only a few weeks ago. Didier Bourse pointed out that according to the presented concept four strands are pulling together within the 5G PPP: Radio network Architecture and Technologies, Convergence beyond Last Mile, Network Management as well as Network Visualization and Software Networks. Those strands are partitioned into 16 projects, which are clustered in either Research and Innovation or Innovation activities.

#### BITKOM Academy

During a event from the German Federal Association for Information Technology, Telecommunications and New Media Werner Mohr gave a presentation on 5G in general and the 5G PPP. The seminar aimed at getting an overview of 5G and discussing views and impulses with business representatives.

### **FITCE (Fédération des Ingénieurs des Télécommunications de la Communauté Européenne)**

FITCE is the association of engineers in the field of telecommunications within the European Union. Their forums intend to discuss new technologies and developments in the field of ICT and media technologies. Marnix Botte from Alcatel-Lucent Bell Labs Belgium presented the 5G Infrastructure as a representative of 5-ALIVE to the ICT and Media professionals' community. He covered the topics purpose, current status and next steps, which perfectly support the topic of the forum. He talked about the cornerstone for establishing the PPP, the key challenges they are facing and what the research program will look like.

### **5G PPP Information Day**

In Paris 2014 the association met to prepare for the main parts of the 5G PPP Call. With Werner Mohr giving an overview and Didier Bourse presenting the pre-structuring model, the aim of the conference was met.

### **IEEE VTC 2014 (Spring)**

IEEE VTC is the abbreviation for Institute of Electrical and Electronics Engineers - Vehicular Technology Society. On their flagship conference academia, government and industry meet to discuss ideals in technologies. At this event, Maziar Nekovee from Samsung gave a presentation of 5G PPP at the conference panel on 5G. He supplemented the presentation about 5G PPP with SAMSUNG's vision for 2020. Beside speeches, there were also tutorials and sessions.

### **Future Internet Summit 2014**

During the organization Meeting in Luxembourg, Werner Mohr talked about "How 5G will contribute to the future internet". This visionary presentation showed what our connected world could be like due to the developing technologies and which requirements occur.

### **5G PPP Workshop, 5G Special Interest Group, LTE World Summit 2014**

To give an overview, Didier Bourse, Terje Tjelta (Telenor) and Marnix Botte each presented Challenges and further related topics during the organization meetings in Paris, Kjeller and Amsterdam.

### **WPMC (Wireless Personal Mobile Communications) 2014**

Werner Mohr was invited for a keynote session on 5G and the 5G PPP. He expounded the European research activities during the conference in Sydney. The topics covered vision, requirements, international activities, milestones and key challenges of this undertaking.

### **The 5G Huddle - Towards a global 5G vision**

This conference was all about 5G. For this event industry as well as government leaders from North America, Europe and Asia met in London. In his speech Werner Mohr covered organizational topics on the 5G PPP: EU Projects, collaborative research, key challenges, proposed research program, funding, and time plan.

### **Next G-WiN 2014**

The abbreviation stands for Next Generation Green Wireless Networks and it's about state of the art in green wireless communications, as well as challenges and research trends. Didier Bourse gave a keynote on "The Energy Efficiency Challenge in the 5G Infrastructure PPP" covering 5G Alcatel-Lucent perspectives. One key point within the PPP program and KPIs is "saving up to 90% of energy provided" while the "main focus will be in mobile communication networks where the dominating energy consumption comes from the radio access network".

### **Future Forum International Workshop on 5G ICT Technologies 2014**

The workshop aimed for a global 5G platform with focusing on research and promoting globally. It took place in Beijing. China intends to be on top of the 5G mobile communication research and technologies. While Werner Mohr was holding a speech on the 5G PPP and 5G vision, David Soldani from Huawei gave a presentation on advanced 5G infrastructure. Topics covered were main challenges in the European Union, European Commissions priorities in Horizon 2020, Infrastructure Actions, Network and Services Vision, Enabling Technologies and 5G Architectures. Thus organizational as well as visionary topics were presented from a European perspective.

### **5G Special Interest Group, Norway**

In January 2015 Terje Tjelta from TELENOR presented European activities within the 5G Association, 5G Infrastructure PPP and NetWorld 2020. The organization meeting intended to support the Norwegian ICT Sector and its 5G innovations. Learning, reporting and networking were on the agenda. Terje's presentation, which covered also the topic "5G Key Challenges" fit well in this context.

### **ICIN (Innovations in Services, Networks and Clouds)**

This conference took place in Paris in February 2015. The conference brings together ICT experts, who are sharing knowledge and experiences. David Soldani gave a keynote, talking about 5G Vision, Mission, Examples, Enabling Technologies and a Technical Orientation.

### **19th International ITG Workshop on Smart Antennas**

This seminar, hosted by the German Technical University of Ilmenau, provided a forum for recent research experiences on smart antennas. Since 1996 ITG workshops took place and the momentum is intended to be extended. As similar to other presentations held during former conferences, Werner Mohr talked in his keynote about "5G Vision and Requirements in 5G PPP".

### **European Summit on Innovation for Active & Healthy Aging**

The attendance of the active and healthy aging conference turned out as very interesting. Experts and leaders from industry, government, academia and civil society talked about the demographic change and how to turn it into opportunities. David Soldani shared the vision

of how 5G can contribute to this topic. He presented “5G: the nervous system of the Silver Economy”.

### **Net Futures 2015**

Jean-Sebastien Bedo from Orange Labs presented the 5G Vision at this conference on March 2015. The presentation covered topics like Service Capabilities, Business Drivers, Disruptive Capabilities, Design Principles, Technological Components, Networks and Services Vision, Roadmap as well as Potential Topics. This aligned well with the conference’s objective to maximize European competitiveness in the technology industry while pushing innovation to market ready solutions.

### **Celtic-Plus Event 2015**

Also in April 2015 Jean-Sebastien Bedo presented the 5G Vision but with focus on economic impact. This presentation giving insight in current status and discussion to 5G PPP was well acknowledged by this partner organization. During this organization meeting results of Celtic-Plus projects were shown and new project ideas were displayed.

### **2015 IEEE 81st Vehicular Technology Conference: VTC 2015-Spring**

More organizational related topics were covered by Jean-Sebastien Bedo in May at the Glasgow conference. Whereas the conference was not focusing on 5G, he talked about “SDN towards the Digital Society: Transformations for Carrier, Concepts for 5G Architecture, Global Operating System, Point of Presence”. The topics presented on recent technology trends and achievements including required technologies were coherent with 5G related topics.

### **Wireless Russia Forum: 4G, 5G & Beyond and 5G Visions and Requirements. IMT-2020 Promotion Group General Meeting (Summit) 2015**

Werner Mohr was invited to give a presentation about the 5G PPP during the conferences named above. The presentations were similar to former ones, covering also Implementation of 5G PPP, Vision and Requirements. Noteworthy are the venues: Moscow and Beijing. This shows the international importance and recognition of the European initiative, while trying to push other economy regions forward.

### **IWPC workshop "The Path to 5G - Continuing the Pre-Standards Debate"**

Werner Mohr took part in this workshop, which showed trends and achievements within ICT including 5G related topics. He gave an update on 5G PPP and upcoming research while displaying 5G PPP research projects in addition to already known slides.

### **EuCNC 2015, June 30 to July 2, 2015, Paris**

At the launch event of 5G PPP Call 1 projects at EuCNC 2015 Werner Mohr gave a short overview presentation on the 5G Infrastructure Public-Private-Partnership in order to show the cooperation between the public and private side in the PPP.



### **ITU GSC workshop, 5G session on research activities**

This workshop from the International Telecommunication Union took place in Geneva in July 2015. GSC is the abbreviation for “an unincorporated voluntary organization dedicated to enhancing global cooperation and collaboration regarding communications standards and the related standards development environment”<sup>1</sup>. During the conference strategic topics were the Internet of Things, Spectrum and Network topics including 5G as well as Critical Communications and Public Safety. Werner Mohr shared the 5G PPP Vision and Requirements.

### **Small Cell Forum Champions Day, September 8, 2015, Rome, Italy**

The Small Cell Forum is mainly working on available systems like LTE deployment and in particular economic solutions. Therefore, the Forum invited 5G PPP for a presentation on ongoing research activities on 5G. Werner Mohr gave an 5G PPP overview presentation, which is similar like other presentations.

### **5G International Summit, September 21 and 22, 2015, Taipei, Taiwan**

The Taiwanese government is discussing a potential call with the EU Commission in the 5G domain. Therefore, Werner Mohr was invited for a presentation “5G PPP – Europe’s approach to 5G research” to explain 5G PPP and ongoing research activities.

### **International Workshop on the Fifth Generation Mobile Communications Systems (5G) – 2015, MIC – Ministry of Internal Affairs and Communications (Japan), Chiba, Japan, October 8, 2015**

As part of international cooperation activities the Japanese government in cooperation with ITU-R invited ITU-R WP5D, the 5G PPP counterparts IMT-2020 Promotion Group (China), 5GMF (Japan) 5G Forum (Korea), 4G Americas and 5G PPP for an international workshop. Werner Mohr gave an invited presentation 5G PPP – The European 5G Research Program and how research results are intended to be exploited.

### **RAN World 2nd Annual RAN World – 29-30 September 2015, Cologne, Germany**

The conference in general addresses RAN (Radio Access Network) related topics while bringing the engineering and strategic view together. Several working groups are focusing on a specific topic each. David Soldani held a presentation about “5G vision and priorities” within the 5G working group. He talked about how 5G activities could contribute to new service capabilities and what is required for those solutions. He pointed out the advantage for verticals and why LTE is not an option. Former EU Framework Program 7 projects as well as projects within Horizon 2020 with their impact and outcomes were presented. Furthermore David Soldani covered global 5G activities, highlighting the European-Chinese 5G international cooperation.

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<sup>1</sup> ITU 2015, URL: <http://www.itu.int/en/ITU-T/gsc/Pages/default.aspx>

## 4 MAJOR EVENTS ORGANIZED BY 5-ALIVE

### 4.1 NetWorld2020 Event 2014

The NetWorld2020 event was organised in Brussels on 3 December 2014, 118 participants. The event included three plenary and four parallel sessions, as is presented below:

| Opening session – plenary I |   |
|-----------------------------|---|
| 9:00 - 10:45                | <ul style="list-style-type: none"> <li>• <b>Welcome and Opening</b>, Werner Mohr, Nokia, NetWorld2020 Chairman</li> <li>• <b>Towards 5G – Building the EU Community Capacity and Stimulating Innovation</b>, Thibaut Kleiner, EC</li> <li>• <b>Towards the User-Centric Network</b>, Markus Hofmann, SVP Bell Labs US, former chair of IEEE Internet TC</li> <li>• <b>What we should expect with 5G</b>, Alan Hadden, President, Global mobile Suppliers Association</li> <li>• <b>Requirements on 5G systems - a perspective from Korea</b>, Prof. Han Youngnam, 5G Forum Korea</li> </ul> |

| Plenary session II |   |
|--------------------|---|
| 11:15 - 12:30      | <ul style="list-style-type: none"> <li>• <b>The Future of Satellite Technologies and Networks</b>, Dr Emmanuel Rammos, Senior Advisor of Telecommunications and Integrated Applications at ESA</li> <li>• <b>NetWorld2020 ETP activity report</b>, Werner Mohr, Nokia, Chairman of NetWorld2020 ETP</li> <li>• <b>Our long-term vision: 5G systems in the society of the future</b>, Giovanni Corazza, Univ. of Bologna</li> <li>• <b>Priorities for the WP 2016-17 – recommendations from the 5G PPP Association</b>, Jean-Sébastien Bedo, ORANGE, Leader of 5G PPP Vision WG</li> </ul> |

|               | Track 1   | Track 2  |
|---------------|---|--|
| 13:45 – 14:45 | Session 1a:<br>Requirements from vertical sectors on 5G systems - experiences gained from | Session 2a:<br>Testbeds, experiments, demonstrations in 5G PPP |

|               |  |  |
|---------------|--|--|
|               | experimentation in the FI-PPP  |  |
| 14:45 – 15:45 | Session 1b:<br>From “Signal Strength” and unpredictable QoE to “Service Level” and customer choice | Session 2b:<br>Challenges towards trusting the network and the Cloud |

|                                      |  |
|--------------------------------------|--|
| <b>Closing session – plenary III</b> |  |
| 16:15 - 16:45                        | <ul style="list-style-type: none"> <li>• <b>Opportunities for NetWorld2020 SMEs: how can you be involved?</b>, Jacques Magen, InterInnov</li> <li>• <b>Future plans for NetWorld2020, participation of members and closing</b>, Werner Mohr, Nokia, NetWorld2020 Chairman</li> </ul> |

## 4.2 Mobile World Congress 2015

At the MWC event 2015, in Barcelona, the 5-Alive project coordinated activities on the EU 5G Research booth, where five projects selected by EC presented their results through demonstrations. The project was responsible for completing the set-up of the booth, which includes organisation of necessary power and internet connections, selection of needed furniture, graphical design of the booth walls, organisation of needed audio-visual equipment, negotiations and contracts with the local organisers, ensuring presence and guidance at the booths during the event, etc. Of course, in order to meet all requirements from different demonstrations presented, series of meetings and audio calls have been organised during the preparations as well.

### 4.2.1 Summary of supported activities at the MWC 2015

The 5-Alive project supported overall presence of the EU 5G Research at the MWC 2015 event, which consisted of the following particular activities:

- Presentation of EU Vision for 5G, including participation of high-level representatives from EC and 5G Infrastructure Association,
- Press event on European 5G Vision,
- Signing memorandum of understanding with partners from America, and
- Demonstration of ongoing European research on 5G.

Before the event, the 5G-Infrastructure PPP has prepared its vision of the next generation of communication networks and services, which was communicated in its full and short (executive summary) versions as well as presented at the 5G workshop with involvement of their members and supported by the 5-Alive project. Moreover, the 5G Vision was also presented within a keynote given by Günther H. Oettinger, the European Commissioner for Digital Economy and Society.

At a dedicated press event, the European Commission and the 5G Infrastructure Association, on behalf of the 5G-PPP, have launched the 5G-PPP 5G Vision at Mobile World Congress 2015 and issued an official press release (see Annex 0). During the event Günther H. Oettinger, European Commissioner, Digital Economy & Society, and the executives of the global top technology companies discussed the goals, market expectations and further developments of 5G. Speakers at the press event (in order of company name) were:

- Opening Address – 5G for the Digital Economy, Mr Günther H. Oettinger, Commissioner for Digital Economy and Society
- 5G key drivers and key enabling technologies including the role virtualization will play in 5G, Mr Marcus Weldon, Chief Technology Officer and Bell Labs President, Alcatel-Lucent
- 5G requirements, capabilities and key technologies, Mr Seizo Onoe, Executive Vice President, Chief Technical Officer, and Member of the Board of Directors, Docomo
- 5G: The road to Digitize & Mobilize Industries, Mr Ulf Ewaldsson, Chief Technology Officer, Ericsson
- 5G enabling technologies, business aspects, role of public sector, and Huawei contribution to 5GPPP, Mr Li Yingtao, President of 2012 Laboratories, Huawei
- How do you see Shannon’s law and Moore’s law coming together in 5G?, Dr. Hermann Eul, Corporate Vice President, General Manager Mobile Technology Leadership, Intel
- 5G use cases and expectations from industry to meet 5G targets, Mr Hossein Moiin, Executive Vice President, Chief Technology Officer, Nokia Networks
- Customer experience towards a digital and energy aware economy, Mrs Mari-Noëlle Jégo-Laveissière, Senior Executive Vice President of Innovation, Marketing and Technologies, Orange
- 5G for a connected world, Mr Kyungwhoon Cheun, Executive Vice President, Samsung Electronics
- Role of satellites in 5G and cooperation of terrestrial and satellite communities, Mr Didier Le BOULC’H, Chief Technology Officer – Telecom, Thales Alenia Space

The 5G Infrastructure Association – Public Private Partnership (5G PPP) an international non-profit association for collaboration on 5G communications systems and networks with international bodies, and 4G Americas, a wireless industry trade association representing LTE mobile broadband technologies including LTE-Advanced and beyond to 5G signed Memorandum of Understanding at the MWC 2015. The memorandum of understanding signed by 4G Americas President, Chris Pearson and Chair of the Board of 5GPP, Werner Mohr, outlines the basis for ongoing cooperation and collaboration between the two organizations. It specifically sets forth the agreement to share information on basic system concepts for 5G, spectrum frequencies to support the global regulatory process and preparation of future global 5G standards by identification of common interest and consensus building.

### 4.2.2 EU 5G Research demonstrations

Five demonstrations were presented at the joint EU 5G Research Stand from ongoing European research projects in the 5G arena:

- MIWEBA: Millimetre-wave small cell backhaul link.
- 5GNOW: Fragmented spectrum and asynchronous multiuser for 5G systems – filter bank multi-carrier physical layer.
- CREW/EVARILOS: Remote evaluation of RF-based indoor localization.
- IJOIN: Novel system architecture thanks to mobile network intelligence centralization.
- METIS: Nomadic nodes for capacity increase and Flexible FBMC air interface for 5G.



Several more 5G demonstrations, coming from EC projects were also presented at other locations, where corresponding organisations had booths:

- ERICSSON: Device-to-device communication with interference cancellation, METIS Project
- HUAWEI: New Waveform Supporting Spectrum Flexibility, and Low Air Interface Latency, METIS Project
- ALCATEL LUCENT BELL LABS: Blended traffic demo: 5G for broadband and M2M communication, 5GNOW Project
- NOKIA: Real time bidirectional mmWave system for 5G, MiWaveS Project
- NATIONAL INSTRUMENTS: 5G New Waveform Prototyping with LabVIEW Communications on NI's SDR platform, 5GNOW Project
- i2CAT: Showcases of the Network Functions Virtualization (NFV) marketplace and the interaction with the user, T-NOVA Project

### 4.2.3 Promotion around MWC 2015

In the scope of its promotional activities (communication and promotion material, reported in details in 5-Alive deliverable D1.1), the 5-Alive project kept on promoting the EU 5G presence at the event before, during, and after the event by providing and updating the related information on the 5G PPP website as well as through further social media channels and mailing lists. The 5G Vision documents were also designed and printed in a professional form as well as the stand brochures, with all necessary information about demonstrations at the EU 5G stand and other locations at the event, and a journalistic description of the 5G vision and challenges.

### 4.3 5G Launch Event

On 1/2 July 2015 in Paris, at the EUCNC 2015 conference, the 5-Alive project organised a special session; Introducing The 5G-INFRASTRUCTURE-PPP – Launching the European 5G Initiative, chaired by David Kennedy from Eurescom. In a full conference room, the attendees had an opportunity to listen to introduction into the 5G-PPP from both EC and 5G Infrastructure Association perspectives, followed by presentation of 12 out of 19 projects accepted for funding in the first phase of the 5G PPP and started on 1 July 2015. The session agenda is presented below:

#### Wednesday, 1 July, 2015

- 5G-PPP Introduction from the European Commission, Bernard Barani, EC
- 5G-PPP Introduction from 5G Infrastructure Association, Werner Mohr, 5G-Infrastructure Association
- 5G Exchange (5GEx) – Multi-domain Orchestration for Software Defined Infrastructures, Róbert Szabó, Ericsson
- CHARISMA – Converged Heterogeneous Advanced 5G Cloud-RAN Architecture for Intelligent and Secure Media Access, Eduard Escalona, I2CAT
- SELFNET – Framework for Self-Organized Network Management in Virtualised and Software Defined Networks, Jose M. Alcaraz Calero, University of the West of Scotland
- SUPERFLUIDITY, Felipe Huici, NEC
- CogNet, Robert Mullens, TSSG

#### Thursday, 2 July, 2015

- Euro 5G, David Kennedy, Eurescom
- 5G Radio Access Network Design – A Brief Overview on the 5G-PPP Project METIS-II, Patrick Marsch, Nokia
- 5G NORMA – 5G NOvel Radio Multiservice adaptive network Architecture, Simone Redana, Nokia
- 5G-Xhaul – Dynamically Reconfigurable Optical-Wireless Backhaul/Fronthaul for Small Cells and C-RAN, Eckhard Grass, IHP
- Xhaul – The 5G Integrated Fronthaul/Backhaul, Antonio de la Oliva, UC3M
- mmMAGIC – Millimetre-Wave Based Mobile Radio Access Network for Fifth Generation Integrated Communications, Peter von Wrycza, Ericsson
- FANTASTIC5G, Frank Schaich, Alcatel-Lucent

### 4.4 6<sup>th</sup> Usage Areas Workshop

In the scope of the 5-Alive project activities to support a substantial dialogue among main 5G stakeholders and the so-called “vertical industries”, encouraging them to consider recent and future 5G developments in their areas, the 6<sup>th</sup> Usage Areas Workshop was organised on 1 July 2015 in Paris (at EUCNC 2015 conference) and chaired by Jean-Sebastien Bedo,

Orange. Indeed, EUCNC 2015 represented an opportunity to initiate a dialogue with the vertical sectors in order to embark their requirements in 5G design and to leverage on their challenging use cases for future experiments within 5G-PPP work programme.

The workshop included presentations and discussions on three different vertical sectors and a presentation on opportunities for vertical markets given by the 5G developments. The session was organized around 4 talks:

- Alain Servel from Peugeot Citroen, representing the automotive industry
- Yanis Nahal from Orange Healthcare, representing the healthcare industry
- Alan Murphy from the BBC, representing the media industry
- Jean-Sebastien Bedo from 5G Infrastructure Association, summarizing the workshop on 5G and verticals which was organized in Brussels a few weeks before

4 short abstracts were published in EUCNC proceedings.

Content of the presentations and discussions are considered in WP3, Task 3.1 and deliverable D3.1, related to activities on an informed dialogue among 5G and vertical sectors. Four short abstracts on these talks have been written and published in EUCNC proceedings.

### 4.5 ICT event 2015

At the ICT event 2015 in Lisbon, on 20-22 October 2015, the European 5G Initiative and PPP were presented by a number of activities supported by Euro-5g project (Support action for the first 5G PPP phase), where the 5-Alive project was responsible for provision of promotion material for the 5G booth at the event, as reported in the deliverable D1.1.

## 5 CONCLUSIONS

The 5-Alive project contributed heavily into initiating and supporting many activities related to the NetWorld2020 European Technology Platform and the 5G Public-Private Partnership, and more generally to assemble and strengthen the European 5G community and beyond.

Some of the main activities that have been performed in relation with the 5G community building are related to events and working groups. The first relates more to building the 5G community as a whole around the 5G PPP constituencies and achievements, while the latter relates more to community building within the 5G PPP and NetWorld2020.

Those activities are completed by the definition and monitoring of the 5G PPP KPIs (cf. deliverable 2.1 “Evaluation of the 5G PPP KPIs”) and also by promotion and communication activities (cf. deliverable 1.1 “Communication Report”).

At the time when 5-Alive is ending, we can say on the one hand that the 5G PPP community is set up and is working together towards a strong European contribution to many important issues, as demonstrated by the intense contribution to the Working Groups and the various documents and white papers; and on the other hand that the 5G PPP is being recognized as “the” European voice on 5G all around the world.

5-Alive has also worked on handing over those important tasks to the Euro-5G follow-up Coordination and Support Action, thanks to an overlap in time of a few months.



## **ANNEX A      NETWORK2020 EXPERT GROUP**

### **A.1      Organisations represented in the Expert Group**

Aalto University

Acreo

ADVA

Airbus DS

Alcatel-Lucent

Arctos Labs Scandinavia AB

Ariadna

Aristotle University of Thessaloniki

ASTRI

Ateknea Solutions

Athens University of Economics and Business

ATOS

Austrian Institute of Technology - AIT

Autonomous University of Barcelona

Bassi Consulting

BEACONTECH

Berner Fachhochschule

Brunel Univeristy London

CEA

Chalmers University of Technology

CIT Development

City University London

CNES

COPELABS / University Lusofona

Core Network Dynamics

Coriant GmbH

CSIR

CTIF Global - Aalborg University

CTTC

Delektre Ltd.

Deutsche Telekom

DFKI/Univ. Kaiserslautern

Digital Catapult

DITEN-University of Genoa / CNIT - University of Genoa Research Unit

DLR  
Ecole Supérieur d'Electricité -Supélec  
Edinburgh University  
Engineering Ingegneria  
Ericsson  
ESADE  
ETHZ  
Eurescom  
Fondazione Ugo Bordonni  
Fraunhofer FOKUS  
Fraunhofer SIT  
Gdansk University of Technology  
Gilat Satellite Networks Ltd  
Gradiant  
Hamburg University of Technology - ComNets  
Hendrik Berndt Consulting  
HIT – Holon Institute of Technology  
Hochschule Osnabrueck  
HOLISTIC INNOVATION INSTITUTE  
Huawei  
HW Communications  
i2CAT  
IBM World Trade Corporation  
IMDEA Networks  
IMEC  
INCITES CONSULTING SARL  
Indra  
Inesc-ID  
Institut für Rundfunktechnik GmbH  
Institut Mines-Télécom  
Instituto de Telecomunicações - Aveiro  
Istituto Superiore Mario Boella  
Instituto Técnico de Informática  
Intel  
InterDigital Europe LTD  
INTRACOM S. A. TELECOM SOLUTIONS

IRT (Institut fuer Rundfunktechnik)

ISMB

IS-Wireless

IT Aveiro

ITRI

itrust consulting

ITTI

Karlstad University

KINGS COLLEGE LONDON

Kingston University

Koc University

Luleå University of Technology

Management IP SARL

Mavigex

MBI

MeadowCom

MEF University

Mobintec Ltd

NCSR Demokritos

NEC Europe Ltd.

Nextworks

Nile University and Cairo University

NOKIA

Okan University

Optare Solutions, S.L.

Orange

Peregrine Semiconductor UK Ltd

Politecnico di Bari

Politecnico di Torino

Quobis

Rechtsanwalt

RF DSP Inc.

ROSE

Sagemcom

Samsung

Santander Municipality

SAP  
Scientific Consultant  
Sequans  
SETEC-Bucharest  
Siberian State University of Telecommunications and Information Sciences  
Sigma-Orionis  
Simula Research Laboratory  
SINTEF  
Southwest Jiaotong University  
Spectrum Insight Ltd  
Swisscom  
SWR Südwestrundfunk  
Tampere University of Technology  
TAMUM Consulting  
TE Connectivity  
Technical University Braunschweig  
Technical University Cluj-Napoca  
Technical University of Berlin  
Technicolor  
Technische Universität Chemnitz  
Technological Educational Institute of Epirus  
Tecnalia  
Telcaria Ideas S.L.  
Telecom Bretagne  
Telecom Italia  
Telefonica  
Telenor  
Telespazio  
Thales Alenia Space  
Thales Communications & Security  
TNO  
Triganosys (Zodiac Aerospace)  
TU Darmstadt  
Tudor  
UbiTech Ltd.  
Ubiwhere

Univeristy of the Aegean  
Universidad de Málaga  
Universitat Autònoma de Barcelona  
Universität Bremen (TZI)  
Universitat Politècnica de Catalunya  
University Carlos III  
University College London  
University degli Studi del Sannio di Benevento  
University Lusofona Campus Lisboa  
University Mediterranea of Reggio Calabria  
University of Athens  
University of Bologna  
University of Bremen  
University of Bristol  
University of Calabria  
University of Cantabria  
University of Duisburg-Essen  
University of Edinburgh  
University of Florence  
University of Geneva  
University of Hertfordshire  
University of Kassel  
University of Kent  
University of La Laguna  
University of Leeds  
University of Lisbon (IST)  
University of Liverpool  
University of Luxembourg (SnT)  
University of Malaga  
University of Murcia  
University of Oulu  
University of Padova  
University of Patras  
University of Pavia  
University of Peloponnese  
University of Piraeus

University of Rome - La Sapienza  
University of Rome - Tor Vergata  
University of Sheffield  
University of Siena  
University of Stockholm  
University of Surrey  
University of Twente  
University of Vigo  
University of York  
University Paderborn  
University Politecnica of Madrid  
University Politecnica of Valencia  
University Publica de Navarra  
University Würzburg  
Virtualware Group  
Vodafone  
Waterford Institute of Technology, TSSG  
Wifiactiva  
Wroclaw University of Technology  
ZTE Wistron Telecom AB

## A.2 Report from the Expert Group workshop

*Rapporteurs: Rui L. Aguiar, Barry Evans*

### Summary

The **Expert Group together with the Vision Group of the NetWorld 2020 European Technology Platform for communication networks** and services held a joint workshop collocated with the European Conference on Networks and Communications (EuCNC 2015), held in Paris last June. A total of eight workshops were celebrated on the first day of this renowned international conference. In spite of this competitive offer, the Joint Expert Group and Vision Group Workshop was a great success, attracting a mixed audience of 110 participants amidst researchers and specialised professionals interested on technologies “beyond-5G”.

The workshop brought together 16 technical presentations on diverse topics on the field of 5G communications and what lies ahead. The high number of attendees, considering that several other workshops were also scheduled in parallel, clearly shows the interest of the international ICT community on the future of 5G technologies, and how the Expert and the Vision Group are succeeding on gathering the points of view of their different tenants.

As a result of the technical presentations, the workshop originated a very vivid discussion on which technologies and paradigms should be considered for beyond-5G scenarios, discussion that extended until the end of the workshop.

As a tangible outcome of this event, several topics have been identified as of potential interest in beyond-5G systems and a white paper will be written materialising the initial discussion described above.

### Agenda

10:00 Welcome and Introduction

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*Welcome by Expert Group Chair and Vision Group Chair, Arturo Azcorra, IMDEA Networks and Univ. Carlos III, Expert Group Chair, and Jean-Sebastiën Bedo, Orange, Vision Group Chair*

10:30 Session One, Chair: Paul Müller

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*Software Defined Testbed, Paul Müller, University of Kaiserslautern*

*Applying RINA as a Clean-Slate Approach to Software Networks, Diego R.Lopez, Telefonica*

*Towards Software Networks beyond 5G, C.J. Bernardos,*

*H2020 5GEx Project: “Gluing technologies” as drivers of future communication systems, Elisa Rojas, Telcaria Ideas*

11:30 Session Two, Chair: Ralf Steinmetz

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*Location Aware Information -Opening new Frontiers for Technology beyond 5G, Ralf Steinmetz, Technische Universität Darmstadt*

*Information-Centric Networking: Cisco vision on 5G and beyond, Giovanna Carofiglio, CISCO*

*5G Converged Networks: System Design and Evolution Path*, Rui Aguiar, Instituto de Telecomunicações/DETI, Universidade de Aveiro

*Measuring QoS/QoE in 5G/Beyond-5G environments*, Rui A. Costa, Ubiwhere

14:00 Session Three, Chair: David Larrabeiti

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*Elastic optical networks in a converged backhaul-metro beyond-5G scenario*, David Larrabeiti, H2020 Xhaul Project

*Energy Efficient Backhaul for Highly Dense Urban Areas*, David Grace and Alister Burr, University of York

*Non coherent massive MIMO for 5G and beyond*, Ana García Armada, University Carlos III of Madrid

*The 2019 spectrum shared jungle*, Julián Seseña, A-CING

15:45 Session Four, Chair: Holger Karl

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*Predictive/Anticipatory Systems*, Holger Karl, Universität Paderborn

*Zero-Delay Communication*, Paul Müller, University of Kaiserslautern

*Network and Device Management in NG Mobile Environments*, Andreas Mauthe, Lancaster University

*Machine-to-Machine Communications: Beyond 5G*, Sinem Coleri Ergen, Koc University

17:00 Discussion and Wrap-up, Chair: Arturo Azcorra/Jean-Sebastiën Bedo

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*Organization of future Workshops and Workshop Wrap-up*

*Expert Group Workplan and related actions*

*Workshop closure*

### Workshop Objective

The workshop is the first European community event associated with the future of research on the mobile communications after the 5G network becomes a reality. The idea is to start discussing ideas on technologies that are currently out of-radar and clean-slate approaches for new, advanced communication systems that may become relevant after 2020.

### Workshop Operation

The workshop is organized by the 5GPPP, jointly by the vision and expert groups, aiming to be the first European community event associated with the future of research on the mobile communications after the 5G network becomes a reality. The idea is to start a discussion on what should be interesting areas for “beyond-5G” (B5G) networks.

An early call for contributions was made to the EC community, through the 5GPP expert group lists, which led to the creation of the workprogramme. The end of the workshop was dedicated to conclusions and assessment of this first exercise.

### Workshop Lessons

The programme considered four key technical sessions, organized along four main ideas: “the software network”, “architecture issues”, “optical and radio”, and “ultra-fast networks”. The following sections discuss the key ideas of each session. Although with a variable number of participants, all sessions had more than 100 persons on the room.



### **Session 1 – The software network.**

The first presentation, by Paul Muller, made a strong case for on-demand test-beds, software based and reconfigurable. The G-Lab ToMaTo was suggested as a potential guiding line for developments. These must be sustainable and interconnectable, and specific research incentives should be planned for funding. Software defined testbeds can overcome the problems of sustainability and offers the domain researchers a flexible tool for experimentation, which can be fitted to the demands of the experiment and the demands for experiments beyond 5G.

Diego Lopez then presented RINA, as a formal approach for a new network architecture. Going beyond 5G will demand an underlying networking infrastructure able to support the dynamic allocation of resources, flexible function composition, elastic component placement and migration, and implicit security. While current approaches consider the adaptation of present mechanisms, such as overlays, clean-slate proposals can provide a rather better substrate. RINA may have the potential to support fast network creation times, through the exploration of design patterns. Research is however needed on the question if this model fits the 5G small cells architectures.

The following presentation was on software defined networks beyond 5G, by Carlos Bernardos. It is to be expected that software-oriented-networks will still be on a roll-out stage after 5G, and it is clear that several questions will exist on what should be softwarized. True and secure self-configuration & self-organization will be essential. There are still issues about composing services with both physical and soft implementation which should be driven by the service requirements.

The final presentation, from Elisa Rojas, discussed the ideas of ultra-flexible and composable networks, and the pressure to instantiate services on the fly in heterogeneous environments. The key idea is the reduction of complexity by slicing into blocks and then gluing them together (in what can be seen an evolution of SDN and NFV concepts). Current results are much more dependent on technology than on the gluing issues, but there is a need for a single point of entry for SDN that controls the complete cycle.

### **Session 2 – Architectural Issues.**

Ralf Steinmetz made the case for building location awareness on packet information. Context-aware mobile multimedia applications experienced a tremendously increased popularity, that enable users (i) to interact with their vicinity in the context of location-based services and (ii) to interact with other users in the context of social applications. Location awareness would open many new services, and would increase the richness of information extractable from the packet transversal of the network. Questions on how to include this, and how to trade the concepts of circuit and packet switching (or other communication techniques) are still open.

ICN was again argued by Giovanna Carofiglio, as a potential network architecture, in particular as it can provide mobility and security through context awareness. The question of it is reasonable and worthwhile to run the Internet over ICN is however still unknown, and the evolutions of ICN routers will have an impact on it.

Rui Aguiar made the case for a continuum of evolution(s). Not all the features being discussed will be in 5G early standards, and Beyond 5G research will need to be based on the network at the time. Regulation aspects, including radio spectrum, will become a nightmare, as regulators and business will change much less than technology may allow. Designing for energy will be a key issue, and questions on how to design an intelligent control plane requiring low energy, and how to design an efficient data plane, will still be pending (and increasingly important).

Finally, Rui Costa raised issues on data gathering and on QoE evaluation and measuring, on a per application basis, raising the need of a network of probes. Learning from the 5G evolution will influence the upcoming applications and the future of B5G. For instance, it is not clear what to measure for M2M communications, and what will be the import QoE aspects for many applications.

### **Session 3 – Radio and Optical**

The third session started with David Larrabeiti bringing the discussion on elastic optical networks for converged backhaul-metro scenarios. Optical research will need to move to hybrid IP/OTM approaches, with a unified data data plane, in order to support more than 100Gpbs with simple modulations, targeting ~375GHz channels.

David Grace and Alister Burr took a completely different approach to a similar problem, but relying on dense urban areas. For backhaul, and easy ability to a dense connected car networks, street lamps can be used, with a mm-wave front and back-haul. Using line-of-sight MIMO, low-energy mesh networks can support very large bit-rate networks through the exploration of intelligent digital signal processing.

Massive MIMO, with non-coherent systems, was tackled by Ana-Garcia Armanda, which claimed for simpler systems. To obtain all the advantages of MIMO, the knowledge of channel state information (CSI) at the transmitter and receiver is required: the problem of pilot contamination, that is, uplink pilot sequences from different cells interfering with each other, make obtaining even imperfect CSI very challenging for massive MIMO where the number of channels that need to be estimated is very large. As scale increases, complexity and the number of antennas become an issue, and this should be tackled at design stage as soon as possible: removing (e.g.) CSI estimation may provide on the long run much more reliable and realizable systems. Non-coherent communications and their application to massive MIMO may be the key to really implementing these systems with their advantageous energy efficiency (required power decrease in proportion to the number of antennas).

Julian Sesena brought the regulation into play, and the need for a paradigm shift in the flexible allocation of spectrum. Spectrum is needed across bands and needs to be used flexibly, and statistical spectrum allocation approaches need to be considered for the future. Technology can certainly contribute enormously to enhance the efficiency of the use of the spectrum. Future allocations of spectrum, or identification of spectrum for certain applications, will not need to follow the traditional schemes known today. Technological trends for the Beyond 5G era should target new spectrum access schemes, towards more efficiency, more flexibility, less costs, faster access, etc., exploiting advances like the

cognition of the network and the terminals, miniaturization of electronics, high processing capabilities, new software solutions, etc.

### Session 4 - Ultra-fast networks

The final technical session started with Holgar Karl discussing the concept of networks anticipating and predicting what applications need, making systems aware of what is happening. Architectural questions like proper APIs for participating applications, the need and right to know which types of anticipatory data, or the suitability of different application classes have yet to be answered.

Paul Muller continued with these concerns, and the need for zero delay communications. His point was bringing the operating system into discussion: to achieve low latencies we need an holistic approach E2E, and this implies all delays both at the network and the operating system, need to be consider. How to map application requirements (timewise) into the network and on current protocols is an issue to be considered.

The device was also an issue on Andreas Mauthe presentation. In heterogeneous networking the devices will need to select and connect do diverse networks, as they move through them, so they will need to be integrated in the network monitoring process. What Ultimately this vision argues for the integration of independent mobile network technologies and communication channels by using edge devices as part of the network management infrastructure in an extensible and future proof manner, without the need for global or central coordination instances. Coordination between all system and network aspects will be ensured through aneasily extensible policy infrastructure.

The final presentation, by Sinem Coleri-Ergen addressed M2M communications. It highlighted that 67% of current M2M communication still uses 2G, and for low-power wide area, the sensing cost in 4G is too high (energy wise). For Low-cost wide-area and low-latency ultra-reliable M2M communications, we will need to explore novel waveforms with low delay and low . Furthermore, controlling the elements in our environment based on the data provided from machines in this class of M2M applications requires a paradigm shift for control and communication systems with novel strategies for their joint design in beyond 5G networks.

### Discussion and conclusions

The final session led to a discussion across all participants of what has been presented.

It was clear that several of the topics presented are evolutions of research areas that will be present in 5G networks. In that sense, it is not easy to foresee at this stage in what degree these concepts will be already realized in 5G networks. Clearly, B5G will also be an evolution of 5G concepts, but larger experience on 4G networks, and final standards for 5G will be required to design research questions for that time.

Another two global concerns were related with the lack of discussions on visions from standard and/or industry for a (lack NGNM or 3GPP), which could suggest a reference view against which to consider further research challenges; and about the rarity of discussions

from an application and intelligent terminal point of view, as the “app-world” is now starting to dominate our interface with the information society.

A global conclusion was that we will need vision documents to consolidate what challenges will expect us after 2020, and to start laying the ground work for this. Given the current difficulty in separating long-term 5G research from B5G research, this vision paper should provide a structure that relies on very clear and structured technical lines, resilient to the variable technological pace of 5G networks.

## A.3 5G Press Release

### 5G CAN DELIVER A 'TRULY NETWORKED' SOCIETY WITH EUROPE IN THE DRIVING SEAT

**Much more than an evolution of mobile broadband, 5G PPP launches vision of a ubiquitous 5G network that can create a single digital economy and connect people, things and services like never before**

BARCELONA – Today at the Mobile World Congress 2015 in Barcelona, 5G PPP, the 5G Public-Private Partnership between the European Commission and European industry and research community, launched its inaugural vision paper, which outlines how 5G will create a single digital economy, and put Europe back in the driving seat with a ubiquitous network that will connect people, things and services based on a plethora of innovation unseen before at such scale.

European society and economic performance will strongly rely on 5G infrastructure in the years beyond 2020. 5G is more than an evolution of mobile broadband technology. It is an enabler for a truly digital society with ubiquitous, ultra-high-speed communications infrastructure that will support all economic sectors as well as ever-growing consumer demand for new services. 5G is also an opportunity for the European ICT sector, which is already well positioned in the global R&D race and contributes about 5% to Europe's GDP, to expand its leadership position globally.

To coincide with today's announcement, 5G PPP industry stakeholders launched its 5G Vision white paper, [which can be viewed here](#) and defines the following:

- The 5G PPP vision for next generation communication networks and services
- A comprehensive roadmap towards 5G deployment in 2020+
- How 5G will enable and support new businesses and services
- The key use case scenarios that 5G will need to support
- Consensus among 5G PPP members on the role that a wide range of existing and future technologies will play in 5G as well as initial design principles for the system
- Topics related to 5G spectrum that need further research

In addition to the 5G vision announcement, EU-funded 5G research will be showcased at Mobile World Congress 2015. Five ongoing European research projects will demonstrate 5G technological progress in areas such as new waveforms, cell densification, usage of spectrum above 6GHz and spectrum optimization in Hall 8, Booth 0B17. Additional 5G demonstrations from European research projects will be held in other locations, including the stands of 5G PPP members Alcatel-Lucent, Ericsson, Huawei and Nokia.

At a press conference today, Günther H. Oettinger, European Commissioner for the Digital Economy and Society, and the CTOs from Alcatel-Lucent, DoCoMo, Ericsson, Huawei, Intel,

Nokia, Orange, Samsung and Thales Alenia Space shared their perspectives on the goals, market expectations and further developments of 5G.

5G PPP is a collaborative research initiative within the European Commission's Horizon 2020 program, which is the biggest EU Framework Program for Research and Innovation to date. The goal of 5G PPP is to foster industry-led research that is guided by a number of business-related, network performance and societal objectives. The 5G PPP runs from 2014 to 2020 and is open for international cooperation and participation. The European Commission, with the approval of the European Parliament, has committed €700 million of public funds to support 5G PPP activities from 2014 to 2020. Complementary private investment in the order of five times this amount is expected to be provided by industry, small and medium enterprises, and research institutes to realize the 5G PPP vision. Participation by private sector members within 5G PPP is represented by the 5G Infrastructure Association.

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### About the 5G Public-Private Partnership (5G PPP)

5G PPP is a collaborative research program that is organized as part of the European Commission's Horizon 2020 program – The European Union Program for Research and Innovation. It is aimed at fostering industry-driven research, which is controlled by business-related, performance and societal KPIs. The 5G PPP has a lifetime from 2014 to 2020 and is open for international cooperation and participation. Within this research and innovation framework, the European Commission, with the approval of the European Parliament, has committed 700M€ of public funds to supporting 5G PPP activities. Complementary private investment in the order of five times this amount is expected to be provided by Industry, SME, and Research Institutes to realize the 5G-PPP vision. The private side in 5G PPP is represented by the 5G Infrastructure Association.

More information is available at <http://5g-ppp.eu/>.

Twitter: @5GPPP, #5GPPPMWC

## ANNEX B LIST OF EVENTS

| Date               | Event/ Meeting   | Location   | 5G Association participants/ presenters  | Classification       | Year |
|--------------------|--|------------|--|----------------------|------|
|                    | <b>Previous Events</b>   |            |  |                      |      |
| 05. - 06. 02. 2014 | ETP Expert Group meeting   | Stuttgart  | Werner Mohr (giving a presentation on the 5G PPP)  | NetWorld2020         | 2014 |
| 26.02.2014         | Mobile World Congress 2014, GSMA Seminar on future spectrum<br><a href="http://www.mobileworldcongress.com/about/start-here/">http://www.mobileworldcongress.com/about/start-here/</a>   | Barcelona  | Werner Mohr (giving a presentation on 5G and the 5G PPP)   | Seminar              | 2014 |
| 20.03.2014         | Future Internet Assembly 2014 <a href="http://www.fi-athens.eu/program/sessions/5g-ppp-event">http://www.fi-athens.eu/program/sessions/5g-ppp-event</a>  | Athens     | Werner Mohr (giving a presentation on the 5G PPP), <b>Didier Bourse</b> (presenting the pre-structuring model) | Organization Meeting | 2014 |
| 27.03.2014         | Bitkom Akademie: "5G: Mehr Speed oder mehr Qualität – oder beides? Was wann und wie nach LTE und LTE Advanced kommt"<br><a href="https://www.bitkom-akademie.de/seminare/tech-trends/5g-das-wettrennen-jenseits-lte">https://www.bitkom-akademie.de/seminare/tech-trends/5g-das-wettrennen-jenseits-lte</a>  | Berlin     | Werner Mohr (giving a presentation on 5G and the 5G PPP)   | Seminar              | 2014 |
| 28.03.2014         | Photonics21 Annual Meeting 2014<br><a href="http://www.photonics21.org/index.php">http://www.photonics21.org/index.php</a>   | Brussels   | Werner Mohr (giving a presentation on the 5G PPP)  | Organization Meeting | 2014 |
| 02.04.2014         | IWPC workshop 5G: "Rethinking Wireless Infrastructure"<br><a href="http://www.iwpc.org/workshops/2014-vodafone-5g/agenda.html#faqs">http://www.iwpc.org/workshops/2014-vodafone-5g/agenda.html#faqs</a>  | Oxford     | Werner Mohr (giving a presentation on the 5G PPP)  | Seminar              | 2014 |
| 09.04.2014         | IEEEWCNC 2014: Panel organised on "Global research activities on 5G communication networks" <a href="http://wnc2014.ieee-wcnc.org/program/panels#ep8">http://wnc2014.ieee-wcnc.org/program/panels#ep8</a>  | Istanbul   | Werner Mohr (giving a presentation on 5G and the 5G PPP)   | Seminar              | 2014 |
| 23/04/14           | FITCE<br><a href="http://www.fitce.org/">http://www.fitce.org/</a>   | Brussels   | <b>Marnix Botte</b> (giving a presentation on the 5G PPP)  | Forum                | 2014 |
| 28.04.2014         | 5G PPP Information Day<br><a href="http://5g-ppp.eu/5g-ppp-information-day-paris/">http://5g-ppp.eu/5g-ppp-information-day-paris/</a>  | Paris      | Werner Mohr (giving a presentation on the 5G PPP), <b>Didier Bourse</b> (presenting the pre-structuring model) | Information Day      | 2014 |
| 05.05.2014         | ICT (International Conference on Telecommunications) 2014<br><a href="http://www.ict-2014.org/">http://www.ict-2014.org/</a>   | Lisbon     | Werner Mohr (giving an invited keynote presentation on 5G and the 5G PPP)                                      | Conference           | 2014 |
| 19.05.2014         | IEEE VTC 2014 (Spring)<br><a href="http://www.ieeevtc.org/vtc2014spring/">http://www.ieeevtc.org/vtc2014spring/</a>  | Seoul      | <b>Maziar Nekovee</b> (giving an presentation of 5G PPP at conference panel on 5G)                             | Conference           | 2014 |
| 21.05.2014         | WWRF meeting   | Marrakesch | Werner Mohr (giving a presentation on the 5G PPP)  | Organization Meeting | 2014 |
| 03.06.2014         | NGMN Partner Forum<br><a href="http://www.ngmn.org/nc/events/eventsearch/eventssingle/article/ngmn-forum-meeting-june-2014-1120.html">http://www.ngmn.org/nc/events/eventsearch/eventssingle/article/ngmn-forum-meeting-june-2014-1120.html</a>  | Bonn       | Werner Mohr (giving a presentation on the 5G PPP)  | Forum                | 2014 |
| 12.06.2014         | Future Internet Summit 2014<br><a href="http://www.fis2014.uni.lu/index.php/programme">http://www.fis2014.uni.lu/index.php/programme</a>   | Luxembourg | Werner Mohr (giving a panel presentation on 5G and the 5G PPP)   | Organization Meeting | 2014 |
| 17.06.2014         | 5G PPP Workshop - French actors mobilisation organised by Systematics, Cap Digital, Images&Réseaux, SCS and Minealagic clusters<br><a href="http://www.images-et-reseaux.com/sites/default/files/medias/blog/2014/24/0.5ginfrappp_workshop_paris.pptx_.pdf">http://www.images-et-reseaux.com/sites/default/files/medias/blog/2014/24/0.5ginfrappp_workshop_paris.pptx_.pdf</a> | Paris      | <b>Didier Bourse</b> (giving a presentation on the pre-structuring model)                                      | Organization Meeting | 2014 |
| 17.06.2014         | 5G Special Interest Group, Norway<br><a href="http://5gsig.no/events/">http://5gsig.no/events/</a>   | Kjeller    | <b>Terje Tjelta</b> to present European activities in 5G Association and NetWorld2020                          | Organization Meeting | 2014 |

## 5-Alive Deliverable D2.2

| Date                   | Event/ Meeting   | Location           | 5G Association participants/ presenters   | Classification       | Year |
|------------------------|--|--------------------|---|----------------------|------|
| <b>Previous Events</b> |  |                    |   |                      |      |
| 17.06.2014             | 5G Special Interest Group, Norway<br><a href="http://5gsig.no/events/">http://5gsig.no/events/</a>   | Kjeller            | <b>Terje Tjelta</b> to present European activities in 5G Association and NetWorld2020   | Organization Meeting | 2014 |
| 24.06.2014             | EuCNC 2014<br><a href="http://www.eucnc.eu/2014/www.eucnc.eu/index1bef.html?q=node/107">http://www.eucnc.eu/2014/www.eucnc.eu/index1bef.html?q=node/107</a>  | Bologna            | Werner Mohr (giving a panel presentation on 5G and the 5G PPP) Giovanni Corazza organizing Workshop, 5G PPP Assembly, NetWorld2020 Assembly                           | Conference           | 2014 |
| 25/06/14               | LTE World Summit 2014<br>( <a href="http://ws.lteconference.com/">http://ws.lteconference.com/</a> )   | Amsterdam          | <b>Marnix Botte</b> (giving a presentation on the 5G PPP)   | Organization Meeting | 2014 |
| 02.07.2014             | totaltelecom NETWORK management Show 2014<br><a href="http://www.terrapinn.com/conference/total-telecom-network-management-show/index.stm">http://www.terrapinn.com/conference/total-telecom-network-management-show/index.stm</a> | London             | Werner Mohr <b>invited</b> to chair the session "The road to 5g: The impact of 5G on network planning" => no participation!?  | Organization Meeting | 2014 |
| 02.09.2014             | IEEE ICUWB 2014<br><a href="http://www.icuwb2014.org/Default.aspx?Id=1467&amp;Id=78&amp;Id=78">http://www.icuwb2014.org/Default.aspx?Id=1467&amp;Id=78&amp;Id=78</a>   | Paris              | <b>Maziar Nekovee</b> (giving a keynote on "Technologies for unlocking new spectrum above 6 GHz for 5G")  | Conference           | 2014 |
| 08.09.2014             | WPMC (Wireless Personal Mobile Communications) 2014<br><a href="https://wpmc2014.org/">https://wpmc2014.org/</a>   | Sidney             | Werner Mohr (giving an invited keynote presentation on 5G and the 5G PPP)   | Conference           | 2014 |
| 08. - 10. 09. 2014     | ASMS/SPSC2014<br><a href="http://www.asms2014.org/">http://www.asms2014.org/</a>   | Livorno            | invitation for a panelist of the roundtable "The 5G perspective for satellite and terrestrial telecommunication industry: stronger cooperation for new opportunities" | Conference           | 2014 |
| 22. - 23. 09. 2014     | The 5G Huddle - Towards a global 5G vision<br><a href="https://eu-ems.com/summary.asp?event_id=219&amp;page_id=1884">https://eu-ems.com/summary.asp?event_id=219&amp;page_id=1884</a>  | London             | <b>Werner Mohr</b> (giving a presentation on the 5G PPP)  | Conference           | 2014 |
| 29. - 30.09. 2014      | EC E1 Consultation Workshop on EC WP2016-17  | Brussels           | <b>Unit E1: Network Technologies</b>  | Seminar              | 2014 |
| 01/10/14               | Next G-WiN 2014<br><a href="http://www.next-gwin.org/">http://www.next-gwin.org/</a>   | Rennes             | <b>Didier Bourse</b> (giving a keynote on The Energy Efficiency Challenge in the 5G Infrastructure PPP)   | Seminar              | 2014 |
| 08/10/14               | Workshop "5G Vision towards 2020"<br><a href="http://www.ceatec.com/en/">http://www.ceatec.com/en/</a>   | Chiba, Japan       | <b>Werner Mohr</b> (giving an invited keynote presentation on 5G and the 5G PPP)  | Seminar              | 2014 |
| 21. - 23.10. 2014      | 14th Annual Broadband Worldforum 2014<br><a href="http://broadbandworldforum.com/">http://broadbandworldforum.com/</a>   | Amsterdam          | Marnix Botte (invited to be a panellist on this think tank debate on LTE Advancements)  | Forum                | 2014 |
| 20. - 21.10. 2014      | 5G Global Summit 2014<br><a href="http://5ggs.org/index_e.html">http://5ggs.org/index_e.html</a>   | Busan, South Korea | Werner Mohr (invited speaker)   | Forum                | 2014 |
| 06. - 07.11. 2014      | Future Forum International Workshop on 5G ICT Technologies 2014<br><a href="http://www.future-forum.org/zhuanti/141106/en/index.html">http://www.future-forum.org/zhuanti/141106/en/index.html</a>                                 | Beijing            | Werner Mohr (gave a vision on 5G, session chair, panelist), <b>David Soldani</b> (gave a vision on advanced 5G infrastructure, panelist)                              | Seminar              | 2014 |
| 12. - 13.11. 2014      | BB Traffic Management Congress<br><a href="http://broadbandtrafficevent.com/2014-speakers/">http://broadbandtrafficevent.com/2014-speakers/</a>  | Barcelona          | invitation to participate in a panel session  | Forum                | 2014 |
| 12. - 14.11. 2014      | 5G North American Workshop   | Monterey (CA), USA | co-hosted by Qualcomm + Ericsson  | Seminar              | 2014 |



## 5-Alive Deliverable D2.2

| Date                   | Event/ Meeting  | Location              | 5G Association participants/ presenters   | Classification       | Year |
|------------------------|---|-----------------------|---|----------------------|------|
| <b>Previous Events</b> |   |                       |   |                      |      |
| 18. - 20.11. 2014      | 36th DIGIWORLD summit 2014  | Montpellier           | Terje Tjelta did participate on the panel   | Forum                | 2014 |
| 26. - 28.11. 2014      | 1st International Conference on 5G for Ubiquitous Connectivity<br><a href="http://www.digiworldsummit.com/speakers-2014/?lang=en">http://www.digiworldsummit.com/speakers-2014/?lang=en</a>   | Levi, Finland         | David Soldani (role?), Terje Tjelta (presenting Telenor's 5G research mentioning the alignment with 5G PPP)   | Conference           | 2014 |
| 08/12/14               | IEEE GLOBECOM 2014<br><a href="http://globecom2014.ieee-globecom.org/hotel.html#.VNN4GS4RTOA">http://globecom2014.ieee-globecom.org/hotel.html#.VNN4GS4RTOA</a>   | Austin (TX), USA      | Hans-Peter Mayer (ALU) + Charlie Zhang (Samsung) + David Soldani (Huawei) + Takehira Nakamura (NTT Docomo) + Erik Dahlmann (Ericsson) panelists                     | Conference           | 2014 |
| 27.01.2015             | 5G Special Interest Group, Norway<br><a href="http://5gsig.no/">http://5gsig.no/</a>  | Lysaker               | <b>Terje Tjelta</b> (to present European activities in 5G Association and NetWorld2020)   | Organization Meeting | 2015 |
| 17. - 19.02. 2015      | ICIN (Innovations in Services, Networks and Clouds)<br><a href="http://www.icin.co.uk/">http://www.icin.co.uk/</a>  | Paris                 | David Soldani (keynote on 5G)   | Conference           | 2015 |
| 26. - 27.02. 2015      | EPS innovation day  | Brussels              | David Soldani (keynote on 5G)   | Seminar              | 2015 |
| 02. - 05. 03. 2015     | Mobile world Congress 2015<br><a href="http://www.mobileworldcongress.com/">http://www.mobileworldcongress.com/</a>   | Barcelona             | supporting EC showcasing 5G projects results, EC 5G press event with invited CTOs from Alcatel-Lucent, DoCoMo, Ericsson, Huawei, Intel, Nokia, Orange, Samsung, SES | Conference           | 2015 |
| 03 - 05.03.2015        | 19th International ITG Workshop on Smart Antennas<br><a href="http://www.tu-ilmenau.de/wsa2015/">http://www.tu-ilmenau.de/wsa2015/</a>  | Ilmenau, Germany      | Werner Mohr<br>Invited keynote "5G Vision and Requirements in 5G PPP"   | Seminar              | 2015 |
| 09. - 10. 03. 2015     | European Summit on Innovation for Active & Healthy Aging<br><a href="http://ec.europa.eu/research/innovation-union/index_en.cfm?section=active-healthy-ageing&amp;pg=2015-summit">http://ec.europa.eu/research/innovation-union/index_en.cfm?section=active-healthy-ageing&amp;pg=2015-summit</a> | Brussels              | David Soldani volunteered to represent either Networld2020 or 5G PPP  | Conference           | 2015 |
| 09. - 12.03. 2015      | IEEE WCNC 2015<br><a href="http://wcnc2015.ieee-wcnc.org/">http://wcnc2015.ieee-wcnc.org/</a>   | New Orleans           | Werner Mohr (invited panel session on 5G vision and requirements), David Soldani (Panelist 5G)  | Conference           | 2015 |
| 24. -25.03. 2015       | NGMN Industry Conference<br><a href="http://ice2015.ngmn.org/home.html">http://ice2015.ngmn.org/home.html</a>   | Frankfurt             | Werner Mohr (invited 5G PPP presentation on vision and requirements based on working group paper)   | Conference           | 2015 |
| 25. - 26. 03. 2015     | Net Futures 2015<br><a href="http://netfutures2015.eu/">http://netfutures2015.eu/</a>   | Brussels              | <b>Jean-Sebastien Bedo</b> (workshop organized by FIRE, presenting the 5G Vision)   | Conference           | 2015 |
| 14/04/14               | Building America's 5G Ecosystem<br><a href="http://events.lightreading.com/m-events/Info/Agenda?e=029638bd-5efb-4df6-99cb-dd48df3235b9">http://events.lightreading.com/m-events/Info/Agenda?e=029638bd-5efb-4df6-99cb-dd48df3235b9</a>  | New York              | Werner Mohr (invited to give a vision on 5G) "A European-Global View on 5G R&D"   | Conference           | 2015 |
| 21. - 23.04.2015       | WWRF meeting #34<br><a href="http://www.wwrf34.ch/">http://www.wwrf34.ch/</a>   | Santa Clara (CA), USA | Werner Mohr (invited presentation on 5G PPP vision)   | Organization Meeting | 2015 |
| 27. - 28. 04. 2015     | CELTIC-Plus Event 2015<br><a href="http://celticplus.eu/Events/Event2015-Vienna/Vienna2015.asp">http://celticplus.eu/Events/Event2015-Vienna/Vienna2015.asp</a>   | Vienna                | <b>Jean-Sebastien Bedo</b> , presenting the 5G Vision (tbc)   | Organization Meeting | 2015 |
| 11. - 14. 05. 2015     | 2015 IEEE 81st Vehicular Technology Conference: VTC2015-Spring<br><a href="http://www.ieeevtc.org/vtc2015spring/plenary.php">http://www.ieeevtc.org/vtc2015spring/plenary.php</a>   | Glasgow               | <b>Jean-Sebastien Bedo</b> (panelist on 5G & SDN)   | Conference           | 2015 |
| 20. - 21.05.2015       | Wireless Russia Forum: 4G, 5G & Beyond<br><a href="http://saas.ru/events/view/~wireless-russia-forum-4g-5g-beyond">http://saas.ru/events/view/~wireless-russia-forum-4g-5g-beyond</a>   | Moscow                | <b>Werner Mohr</b> , invited 5G PPP presentation  | Conference           | 2015 |
| 28. - 29.05.2015       | 5G Visions and Requirements. IMT-2020 Promotion Group General Meeting (Summit) 2015<br><a href="http://www.imt-2020.cn/en/introduction">http://www.imt-2020.cn/en/introduction</a>  | Beijing               | <b>Werner Mohr</b> , invited 5G PPP presentation  | Conference           | 2015 |
| 08. - 12.06. 2015      | ICC 2015<br><a href="http://icc2015.ieee-icc.org/">http://icc2015.ieee-icc.org/</a>   | London                | David Soldani, coordinated a panel on 5G test & trials together with EC   | Conference           | 2015 |
| 15. - 17.06. 2015      | IWPC workshop "The Path to 5G - Continuing the Pre-Standards Debate"<br><a href="http://www.iwpc.org/workshops/2015/2015-06-DT/agenda.html">http://www.iwpc.org/workshops/2015/2015-06-DT/agenda.html</a>   | Bonn                  | <b>Werner Mohr</b> (invited to give an update on 5G PPP and the upcoming research)  | Workshop             | 2015 |

| Date                   | Event/ Meeting   | Location        | 5G Association participants/ presenters  | Classification | Year |
|------------------------|--|-----------------|--|----------------|------|
| <b>Previous Events</b> |  |                 |  |                |      |
| 21. - 26.06. 2015      | Symposium on Future Mobile Networks: 5G and Beyond<br><a href="http://www.iaria.org/conferences2015/5G.html">http://www.iaria.org/conferences2015/5G.html</a>                    | Brussels        | so far not in the radar  | Conference     | 2015 |
| 29.06. - 02.07. 2015   | EUCNC 2015<br><a href="http://www.eucnc.eu/">http://www.eucnc.eu/</a>  | Paris           | Henrik Abramowicz, Didier Bourse, Werner Mohr (Steering Committee), David Soldani (Steering Committee, 5G panel & keynote, tbc) Jean-Sebastien Bedo session chair on "5G for vertical industries - 6th Usage Areas Workshop"                             | Conference     | 2015 |
| 15. - 16.07.2015       | ITU GSC workshop, 5G session on research activities<br><a href="http://www.itu.int/en/ITU-T/gsc/19/Pages/default.aspx">http://www.itu.int/en/ITU-T/gsc/19/Pages/default.aspx</a> | Geneva          | Werner Mohr, invited 5G PPP presentation   | Workshop       | 2015 |
| 08/09/15               | Small Cell Forum<br><a href="http://www.smallcellforum.org/events/next-plenary/">http://www.smallcellforum.org/events/next-plenary/</a>  | Rome            | Werner Mohr, invited for a keynote presentation from 5G PPP on pre-standardisation activities  | Forum          | 2015 |
| 22/09/15               | 5G EU-Taiwan workshop  | Taipei          | Werner Mohr, invited for a 5G PPP presentation   | Workshop       | 2015 |
| 21. and 22.09.2015     | 5G International Summit<br><a href="http://www.5g.org.tw/#home">http://www.5g.org.tw/#home</a>   | Taipei          | Werner Mohr, invited by EC for 5G Workshop, combined with signature of MoU   | Conference     | 2015 |
| 29. - 30.09. 2015      | RAN World<br><a href="http://www.ranworldevent.com/Content/Welcome">http://www.ranworldevent.com/Content/Welcome</a>   | Düsseldorf      | David Soldani (5G PPP Infrastructure Association speaker)  | Conference     | 2015 |
| 08/10/15               | The Fifth Generation Mobile Communications Promotion Forum<br><a href="http://5gmf.jp/en/">http://5gmf.jp/en/</a>  | Chiba/Japan     | Werner Mohr, invited for 5G Workshop   | Forum          | 2015 |
| <b>Future Events</b>   |  |                 |  |                |      |
| 20. - 22.10. 2015      | ICT 2015 Innovate, Connect, Transform<br><a href="http://ec.europa.eu/digital-agenda/ICT2015">http://ec.europa.eu/digital-agenda/ICT2015</a>                                     | Lisbon          | 5-Alive/ proposed networking session "5G-PPP: Establishing European Leadership in 5G - how to participate in phase two of the 5G-PPP", 5G internat. Workshop on pre-standards & spectrum on invitation of EC, IDEALIST brokerage event organized by NCPs | Conference     | 2015 |
| 02.11. - 04.11.2015    | Capacity Europe<br><a href="http://www.capacityconferences.com/Capacity-Europe.html">http://www.capacityconferences.com/Capacity-Europe.html</a>                                 | Paris           | 5G PPP logo will be provided   | Forum          | 2015 |
| 03.11. - 04.11.2015    | Connected America 2015   | Washington D.C. | tbc  |                | 2015 |
| 05. - 06.11.2015       | Future (Mobile Communication) Forum 2015   | Beijing         | 5G PPP not yet contacted   |                | 2015 |
| 25. - 27.11. 2015      | 2nd International Conference on 5G for Ubiquitous Connectivity<br><a href="http://5gconference.org/2015/show/home">http://5gconference.org/2015/show/home</a>                    | Guildford, UK   | Werner Mohr, member TPC  | Conference     | 2015 |
| 06. - 10.12. 2015      | GLOBECOM 2015<br><a href="http://globecom2015.ieee-globecom.org/">http://globecom2015.ieee-globecom.org/</a>   | San Diego       | David Soldani (role tbd)   | Conference     | 2015 |
| 04. 07.09. 2016        | PIMRC 2016<br><a href="http://www.ieee-pimrc.org/">http://www.ieee-pimrc.org/</a>  | Valencia        | Association role tbd   | Conference     | 2016 |