INFRASTRUCTURE ASSOCIATION

The 5G Infrastructure Public-Private Partnership

5G PPP concept and structure, SRA & Collaboration established with 5G Americas

Werner Mohr

Chair of the board of 5G Infrastructure Association

http://5g-ppp.eu/

Outline

- 5G global momentum
- Launch of 5G PPP, structure and SRA
- 5G PPP vision
- First call for proposals and related projects
- International cooperation
- Time line

5G Infrastructure PPP
The European path towards global next generation communication networks

International activities on 5G getting momentum

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ITU-R Visions Group

EU
- Framework Program 7, e.g. METIS and 5GNow projects
- 5G PPP in Horizon 2020

Finland – 5G Test Network Finland (5G TNF)

Germany – 5G Lab Germany at TU Dresden

UK – 5G Innovation Centre (5GIC) at University of Surrey

Turkey – 5GTR Forum

US
- Intel Strategic Research Alliance (ISRA)
- NYU Wireless Research Center
- 5G Americas, MoU - signed

Brazil, Joint Declaration signed between the EU Commission and the Brazilian government

China
- 863 Research Program
- Future Forum
- IMT-2020 (5G) Promotion Group, MoU - signed

Indonesia – Indonesia 5G Forum i5Gf

Japan – The 5G Mobile Communications Promotion Forum, MoU - signed

Korea – 5G Forum, MoU - signed

Malaysia – Malaysian Technical Standards Forum Bhd

Taiwan – TAICS, Ministry of Science and Technology, Ministry of Economic Affairs

Russia – 5GRUS by Russia's Icom-Invest

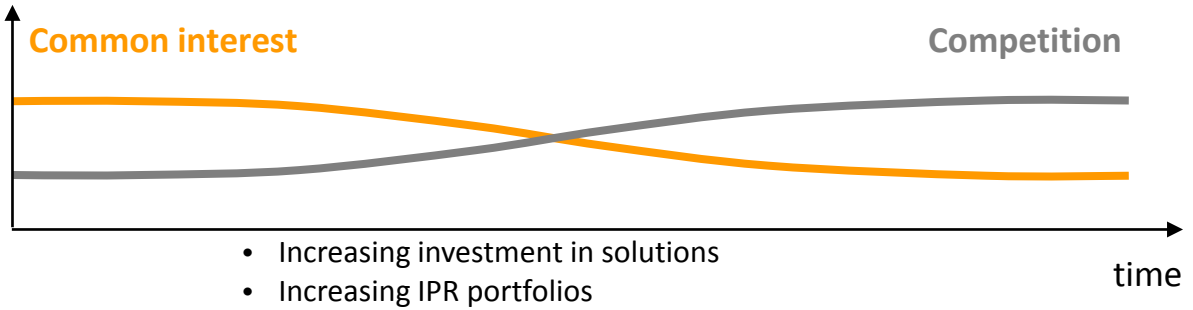
CJK White Paper

NGMN – White paper on future requirements
- Company internal research

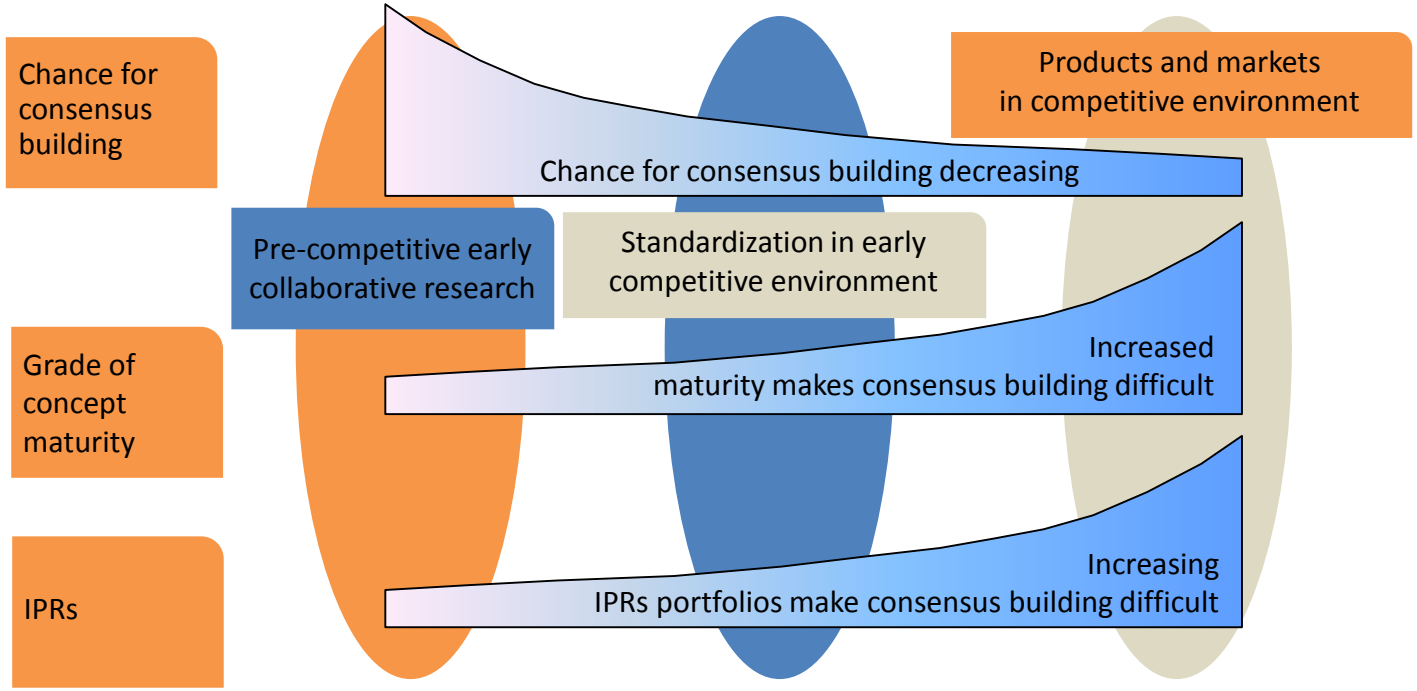
- Multilateral MoU on a series of Global 5G Event signed on October 20, 2015 in Lisbon
- Two events per year, rotation between continents

Source: 5G Infrastructure Association.

Why Collaborative research?
International consensus building at an early stage



- Increasing investment in solutions
- Increasing IPR portfolios



- Horizon 2020 is open for organizations from outside of Europe

Source: NetWorld2020.

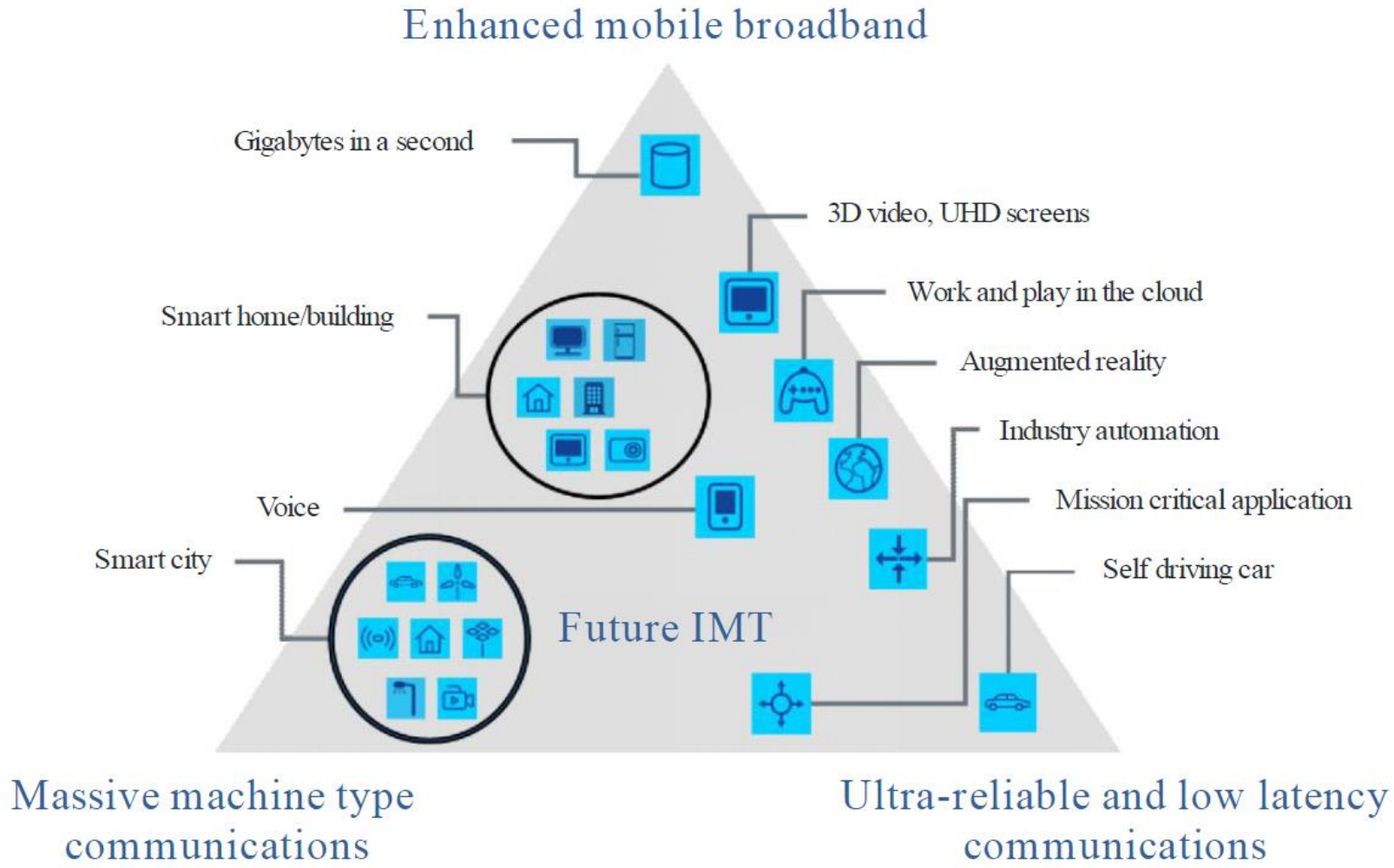
EU Commissioner Kroes called industry to join EU Commission in a PPP on 5G

- Commissioner Kroes called industry at Mobile World Congress 2013 in Barcelona, Spain

  "… And today I call on EU industry and other partners to join us in a Public-Private partnership in this area. An open platform that helps us reach our common goal more coherently, directly, and quickly. European 5G is an unmissable opportunity to recapture the global technological lead. And I hope you will be able to support and join us. …"

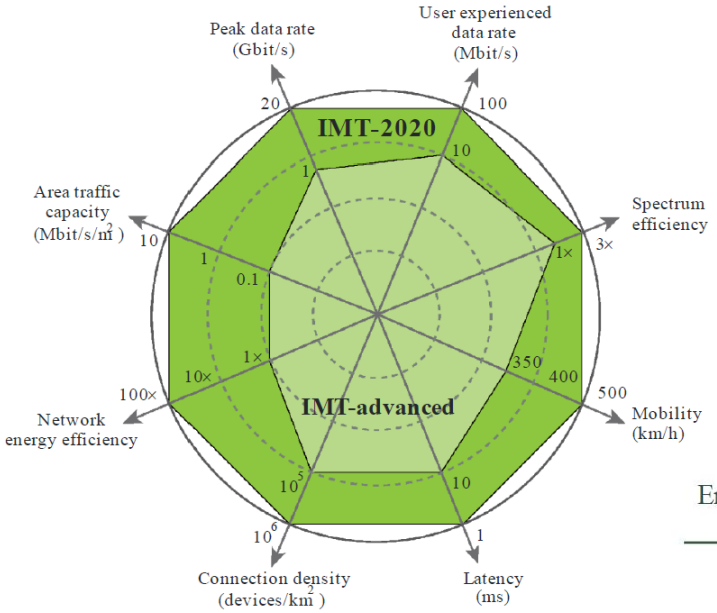
Source: Commissioner Neelie Kroes, Smashing barriers and thinking big. Address at Mobile World Congress, 26 February 2013, Barcelona, Spain, http://europa.eu/rapid/press-release_SPEECH-13-159_en.htm?locale=en.

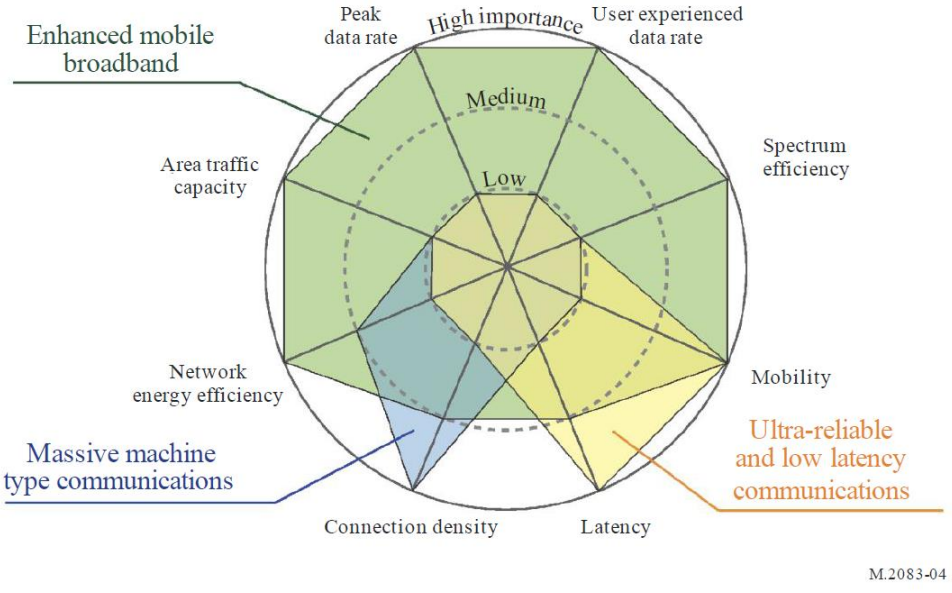
Usage scenarios for IMT-2020 and beyond (ITU-R)



Source: ITU-R: IMT Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond. Recommendation ITU-R M.2083-0 (09/2015), https://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.2083-0-201509-I!!PDF-E.pdf.

Enhancement of key capabilities from IMT-Advanced to IMT-2020 (ITU-R)





Source: ITU-R: IMT Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond. Recommendation ITU-R M.2083-0 (09/2015), https://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.2083-0-201509-I!!PDF-E.pdf.

Regulation on PPPs

Article 25

Public-private partnerships

1. Horizon 2020 may be implemented through public-private partnerships where all the partners concerned commit to supporting the development and implementation of precompetitive research and of innovation activities of strategic importance to the Union's competitiveness and industrial leadership or to addressing specific societal challenges. Public-private partnerships shall be implemented in such a way that full participation of the best European players is not impeded.

2. The involvement of the Union in public-private partnerships shall make use of the preexisting and lean governance structures and may take one of the following forms:

   a) financial contributions from the Union to joint undertakings established pursuant to Article 187 TFEU under the Seventh Framework Programme, subject to the amendment of their basic acts; to new public-private partnerships established pursuant to Article 187 TFEU; and to other funding bodies referred to in points (iv) and (vii) of point (c) of Article 58(1) of Regulation (EU, Euratom) No 966/2012. This form of partnerships shall only be implemented where the scope of the objectives pursued and the scale of the resources required justify it taking full account of the relevant impact assessments, and where other forms of partnerships would not fulfil the objectives or would not generate the necessary leverage;

   b) contractual arrangements between the partners referred to in paragraph 1, which specify the objectives of the partnership, respective commitments of the partners, key performance indicators, and outputs to be delivered, including the identification of research and innovation activities that require support from Horizon 2020.

With a view to involving interested partners, including, as appropriate, end-users, universities, SMEs and research institutions, public-private partnerships shall make public funds accessible through transparent processes and mainly through competitive calls, governed by rules for participation in compliance with those of Horizon 2020. Exceptions to the use of competitive calls should be duly justified.

Source: EU Commission: REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing Horizon 2020 - The Framework Programme for Research and Innovation (2014-2020) and repealing Decision o 1982/2006/EC.

Regulation on PPPs

Article 25

Public-private partnerships

3. Public-private partnerships shall be identified and **implemented in an open, transparent and efficient way**. Their identification shall be based on all of the following criteria:
   a) the demonstration of the added value of the action at Union level and of the choice of the instrument to be used;
   b) the scale of impact on industrial competitiveness, job creation, sustainable growth and socio-economic issues, including societal challenges, assessed against clearly specified and measurable objectives;
   c) the long-term commitment, including a balanced contribution from all partners based on a shared vision and clearly defined objectives;
   d) the scale of the resources involved and the ability to leverage additional investments in research and innovation;
   e) a clear definition of roles for each of the partners and agreed key performance indicators over the period chosen.
   f) complementarity with other parts of Horizon 2020 and alignment with the Union research and innovation strategic priorities, in particular those of the Europe 2020 strategy.

   Where appropriate, complementarity between priorities and activities and the involvement of Member States shall be ensured in public-private partnerships.

4. The research priorities covered by public-private partnerships may, where appropriate, be included in regular calls in Horizon 2020 work programmes, in order to develop new synergies with research and innovation activities of strategic importance.

Source: EU Commission: REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing Horizon 2020 - The Framework Programme for Research and Innovation (2014-2020) and repealing Decision o 1982/2006/EC.

Key challenges

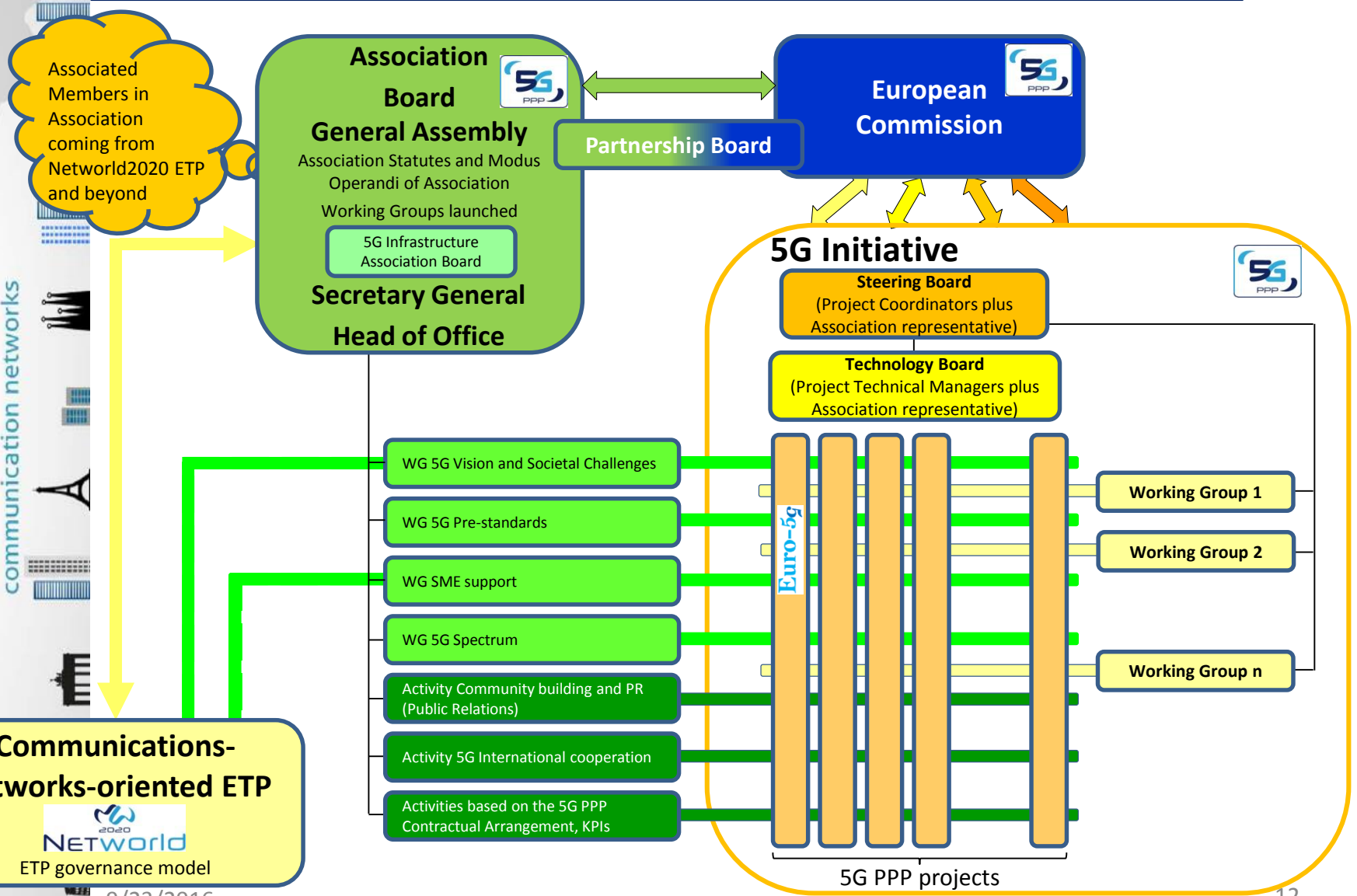
- PPP Program that will deliver solutions, architectures, technologies and standards for the ubiquitous 5G communication infrastructures of the next decade
- Program Ambitions: Key Challenges / High level KPIs
  - Providing 1000 times higher wireless area capacity and more varied service capabilities compared to 2010
  - Saving up to 90% of energy per service provided. The main focus will be in mobile communication networks where the dominating energy consumption comes from the radio access network
  - Reducing the average service creation time cycle from 90 hours to 90 minutes
  - Creating a secure, reliable and dependable Internet with a “zero perceived” downtime for services provision
  - Facilitating very dense deployments of wireless communication links to connect over 7 trillion wireless devices serving over 7 billion people
  - Enabling advanced User controlled privacy

Research program

- Faster, More Powerful and More Energy Efficient Solutions for integrated High Capacity Access and Core Networks for a Wider Range of Services
  - Wireless Networks
  - Optical Networks
  - Automated Network Organisation - Network Management and Automation
  - Implementing Convergence Beyond the Access Last Mile
- Re-Designing the Network
  - Information Centric Networks
  - Network Function Virtualisation
  - Software Defined Networking
  - Networks of Clouds
- Ensuring availability, robustness and security
- Ensuring efficient hardware implementations

5G Infrastructure PPP
The European path towards global next generation communication networks

Overall Governance discussion



Source: NetWorld2020 ETP and Annex to 5G PPP Contractual Arrangement.

Members of 5G Infrastructure Association including international dimension

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Industry

- ADVA Optical Networking SE
- Alcatel-Lucent
- Airbus
- Atos
- Deutsche Telekom
- DOCOMO Communications Laboratories Europe GmbH
- Ericsson
- Huawei Technologies Düsseldorf GmbH
- **IBM Research**
- **Intel Mobile Communications**
- NEC Europe Ltd., NEC Laboratories Europe
- Nokia
- Orange Labs
- Samsung Electronics Research Institute Ltd.
- SES
- Telecom Italia
- Telefónica I+D
- Telenor ASA
- Telespazio
- Thales Alenia Space
- Turk Telekomünikasyon A.Ş.

Research

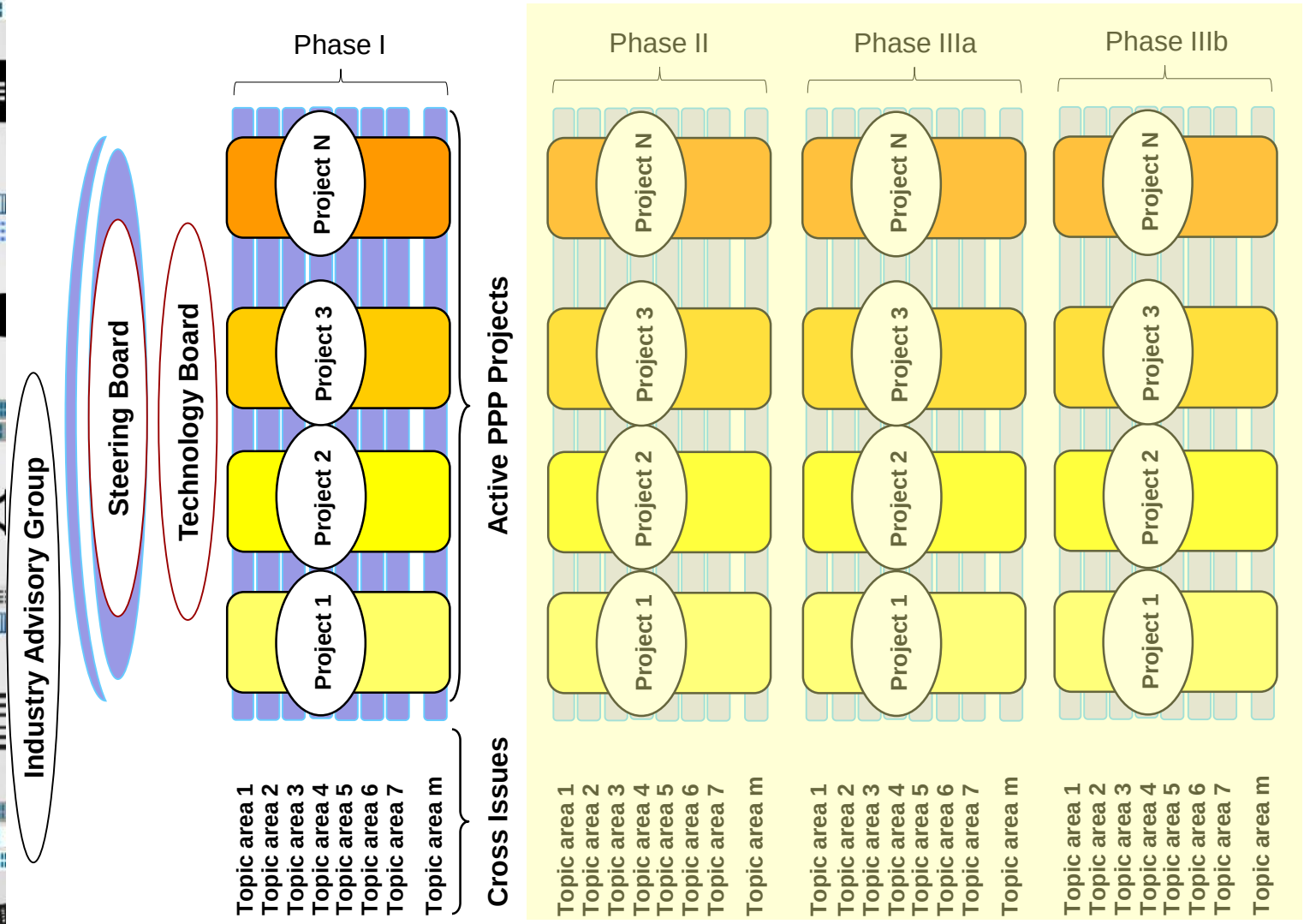
- CEA-LETI
- Centre Tecnologic de Telecomunicacions de Catalunya (CTTC)
- Consorzio Nazionale Interuniversitario per le Telecomunicazioni (CNIT)
- Fundacion IMDEA Networks
- Instituto de Telecomunicacoes
- TNO
- University of Bologna – DEI

SMEs

- Integrasys SA
- INTERINNOV
- M.B.I. S.R.L.
- Nextworks s.r.l.
- Quobis
- Sequans Communications

Source: 5G Infrastructure Association.

Governance model – Basic approach
Project Implementation



- Consortium Agreement per project signed by all project partners
- 5G Infrastructure Collaboration Agreement across all projects in all Phases and signed by all partners

Source: 5G PPP Annex to contractual arrangement.

Policy-oriented Working Groups under the umbrella of 5G Infrastructure Association

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Pre-standards

Spectrum

Vision and Societal Challenges

Activity 5G PPP Contractual Arrangement, KPIs

Activity 5G International cooperation

Activity Community building and Public Relations

SME support

Technology-oriented Working Groups under the umbrella of 5G Initiative (5G PPP projects)

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Architecture

Use cases and performance evaluation models

Software Networks
(SDN and NFV)

Network Management, QoS

Security

Major milestones towards the 5G PPP implementation

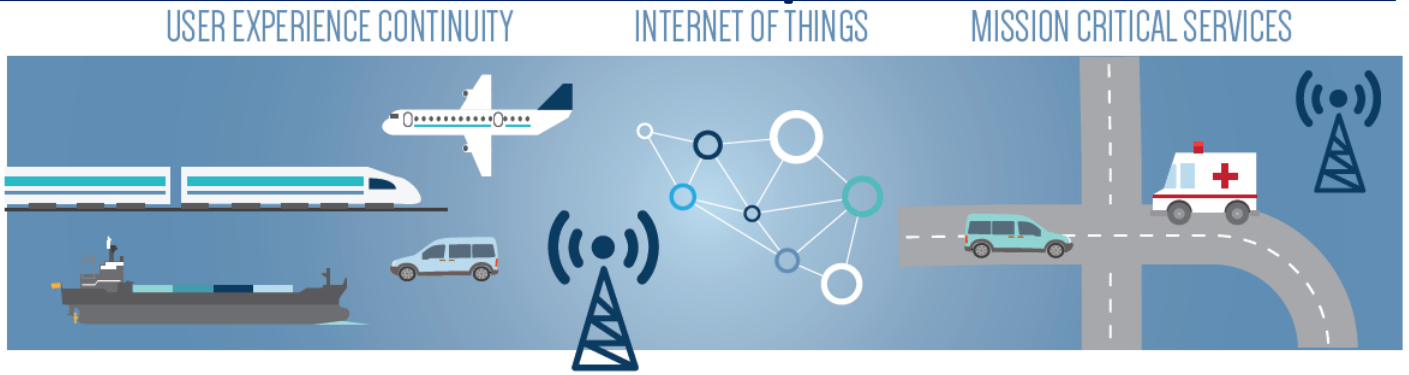
- 5G PPP is a new instrument in Horizon 2020
- First Call for Proposals published on December 11, 2013
- Contractual Arrangement on 5G PPP signed between EU Commission and private side on December 17, 2013
- Budget for 2014 – 2020 time frame
  - 700 million € public funding
  - Matched by private side including leveraging factor 5 of additional private investment results in private value of about 3.5 billion €
- 5G PPP industry launch at Mobile World Congress on February 24, 2014
- Submission deadline of proposals on November 25, 2014
- Project start on July 1, 2015
- 5G Vision EU – CTO Press Event at Mobile World Congress on March 3, 2015
- 5G Infrastructure Association vision paper published

http://5g-ppp.eu/wp-content/uploads/2015/02/5G-Vision-Brochure-v1.pdf

From left to right:
- Marcus Weldon, Chief Technology Officer and President Bell Labs, Alcatel-Lucent
- Li Yingtao, President of 2012 Laboratories, Huawei
- Kyungwhoon Cheun, Executive Vice President, Samsung Electronics
- Hermann Eul, Corporate Vice President General Manager, Mobile and Communications Group, Intel
- Mari-Noëlle Jego-Laveissière , Senior Executive Vice President of Innovation, Marketing and Technologies, Orange
- Günther H. Oettinger, Commissioner for Digital Economy and Society
- Hossein Moiin, Executive Vice President, Chief Technology Officer, Nokia Networks
- Didier le Boulc'h, Chief Technology Officer, Thales Alenia Space
- Mr Seizo Onoe, Executive Vice President, Chief Technical Officer, and Member of the Board of Directors, Docomo
- Ulf Ewaldsson, Chief Technology Officer, Ericsson

Source: 5G Infrastructure Association.

5G PPP Vision and Requirements
5G new service capabilities

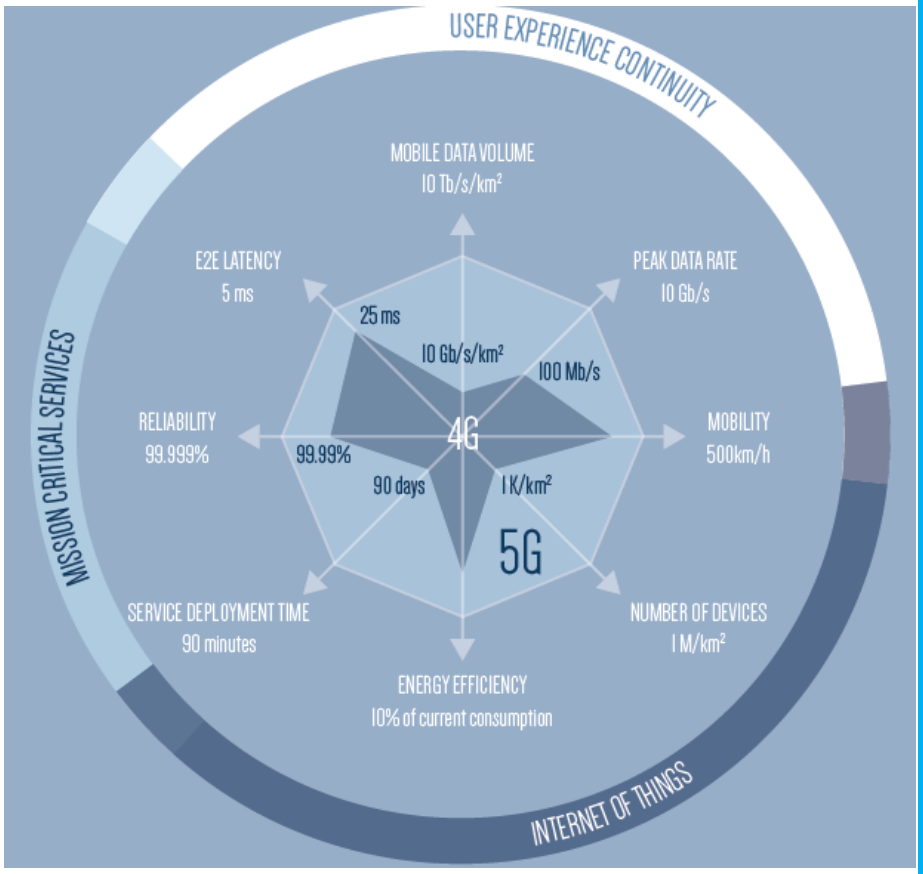


- 5G needs to support efficiently three different types of traffic profiles
  - high throughput for e.g. video services
  - low energy for e.g. long–living sensors
  - low latency for mission critical services
- 5G covers network needs and contributes to digitalization of vertical markets
  - automotive, transportation, manufacturing, banking, finance, insurance, food and agriculture
  - education, media
  - city management, energy, utilities, real estate, retail
  - government
  - healthcare
- Sustainable and scalable technology to handle
  - anticipated dramatic growth in number of terminal devices
  - continuous growth of traffic (at a 50-60% CAGR)
  - heterogeneous network layouts
  - without causing dramatic increase of power consumption and management complexity within networks

Source: 5G Infrastructure Association: Vision White Paper, February 2015.

5G PPP Vision and Requirements
5G will have disruptive capabilities

- **5G will provide an order of magnitude improvement in performance** in the areas of more capacity, lower latency, more mobility, increased reliability and availability
- **5G infrastructures will be also much more efficient** in terms of
  - energy consumption
  - service creation time
  - hardware flexibility



Source: 5G Infrastructure Association: Vision White Paper, February 2015.

Vertical sectors

- White papers on
  - 5G and Factories of the Future (5G-PPP White Paper on Factor
  - 5G and Healthcare (5G-PPP White Paper on eHealth Vertical Sector –
  - 5G and Energy (5G-PPP White Paper on Energy Vertical Sector – Octobe
  - 5G and Media (5G-PPP White Paper on Media & Entertainment Vertical
  - 5G and Automotive (5G-PPP White Paper on Automotive Vertical Se

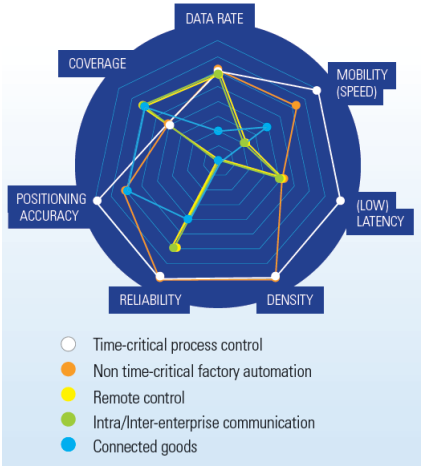
- Identification of
  - main use cases
  - requirements and
  - areas for research and innovation

- Vertical workshops
  - June 18, 2015
  - November 9, 2015
- White Paper published at Mobile World Congress 2016
  https://5g-ppp.eu/wp-content/uploads/2016/02/BROCHURE_5PPP_BAT2_PL.pdf

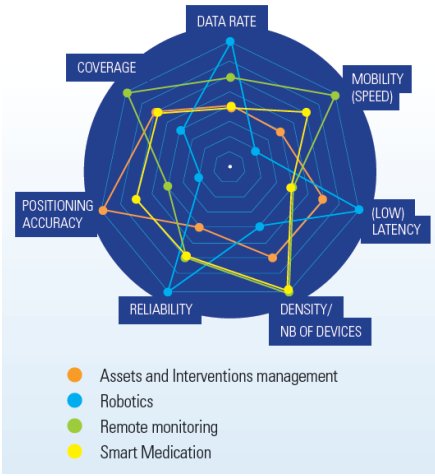
Source: 5G Infrastructure Association.

Vertical sectors
Main technical requirements

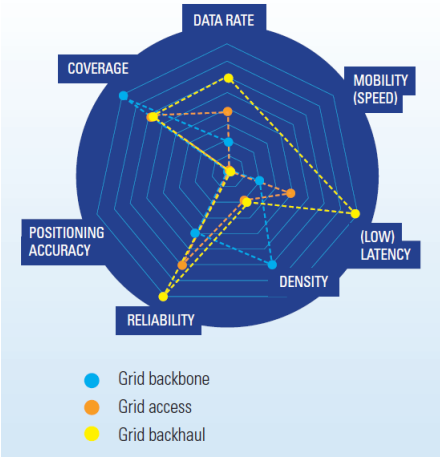
FACTORIES



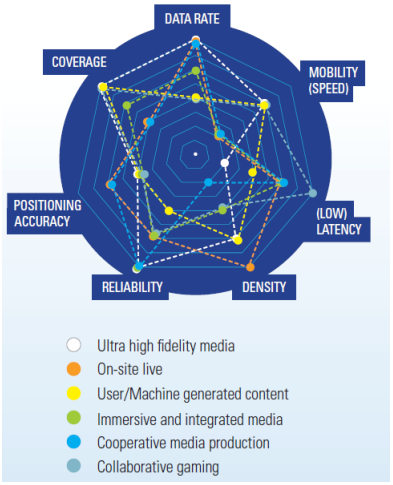
EHEALTH



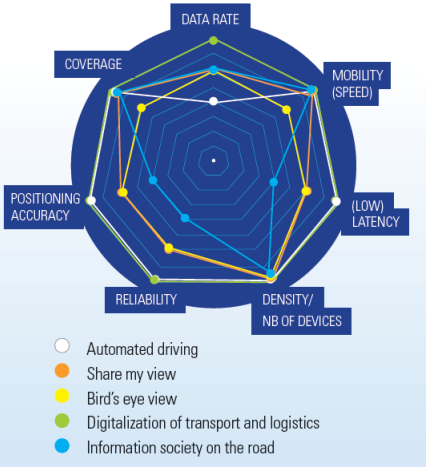
ENERGY



MEDIA & ENTERTAINMENT

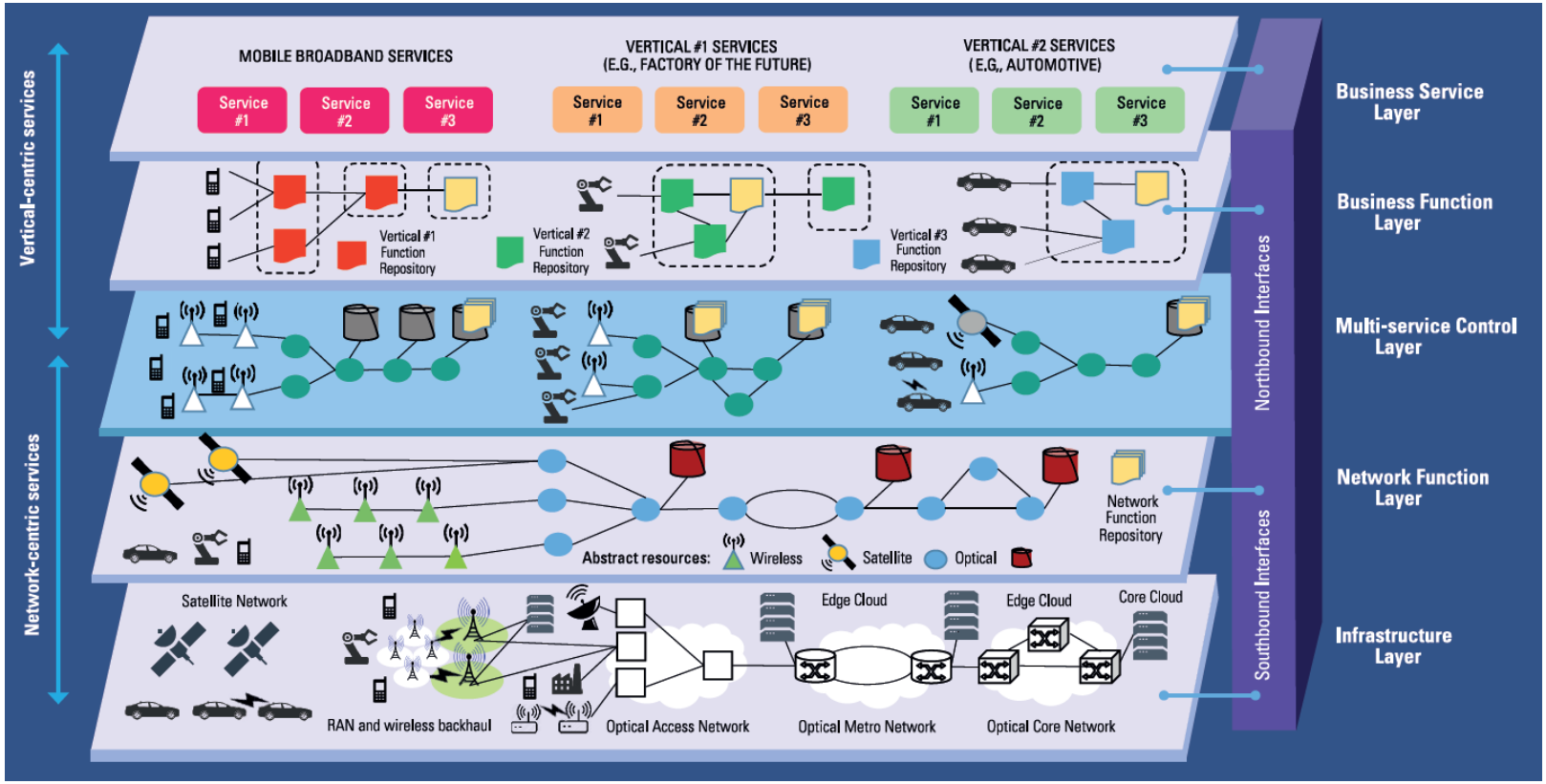


AUTOMOTIVE



Source: 5G Infrastructure Association: 5G Empowering vertical industries. White Paper, 2016, https://5g-ppp.eu/wp-content/uploads/2016/02/BROCHURE_5PPP_BAT2_PL.pdf.

Integrated 5G architecture for mobile broadband and vertical services (5G PPP)



Source: 5G Infrastructure Association: 5G Empowering vertical industries. White Paper, 2016.

Horizon 2020 5G PPP Call 1 objectives
125 million € Funding

Radio network architecture and technologies

Support anticipated 1000 fold mobile traffic increase and very different classes of traffic/services

- Network architecture, protocols and radio technologies capable of at least a ten times increase in frequency reuse and new frequency ranges above 3,6 GHz
- Versatile low cost ubiquitous radio access infrastructure equally supporting low rate IoT and very high rate (>> 1 Gbit/s) access
- Flexible and efficient radio, optical or copper based backhaul/fronthaul with low latency
- Innovative architectures for 5G transceivers and micro-servers
- Experiment based research preparing for large scale demonstrator and test-beds

Convergence beyond last mile

Support integration of a ubiquitous access continuum composed of cooperative, cognitive fixed and heterogeneous wireless resources, with fixed optical access reaching at least the 10 Gb/s range

- Solving the management heterogeneity of different fixed and heterogeneous wireless networks
- Architectures to optimize reuse and sharing of functionality across heterogeneous access technologies and networks

Network management

Challenge to radically decrease network management Opex through automation whilst increasing user perceived quality of service, of experience and security

- Novel simplified (low Opex) approaches to overall management of the network (e.g. Self-organizing networks –SON) and service level management
- Combination of software defined network implementations with autonomic management of resources
- Network security across multiple virtualized or SDN domains

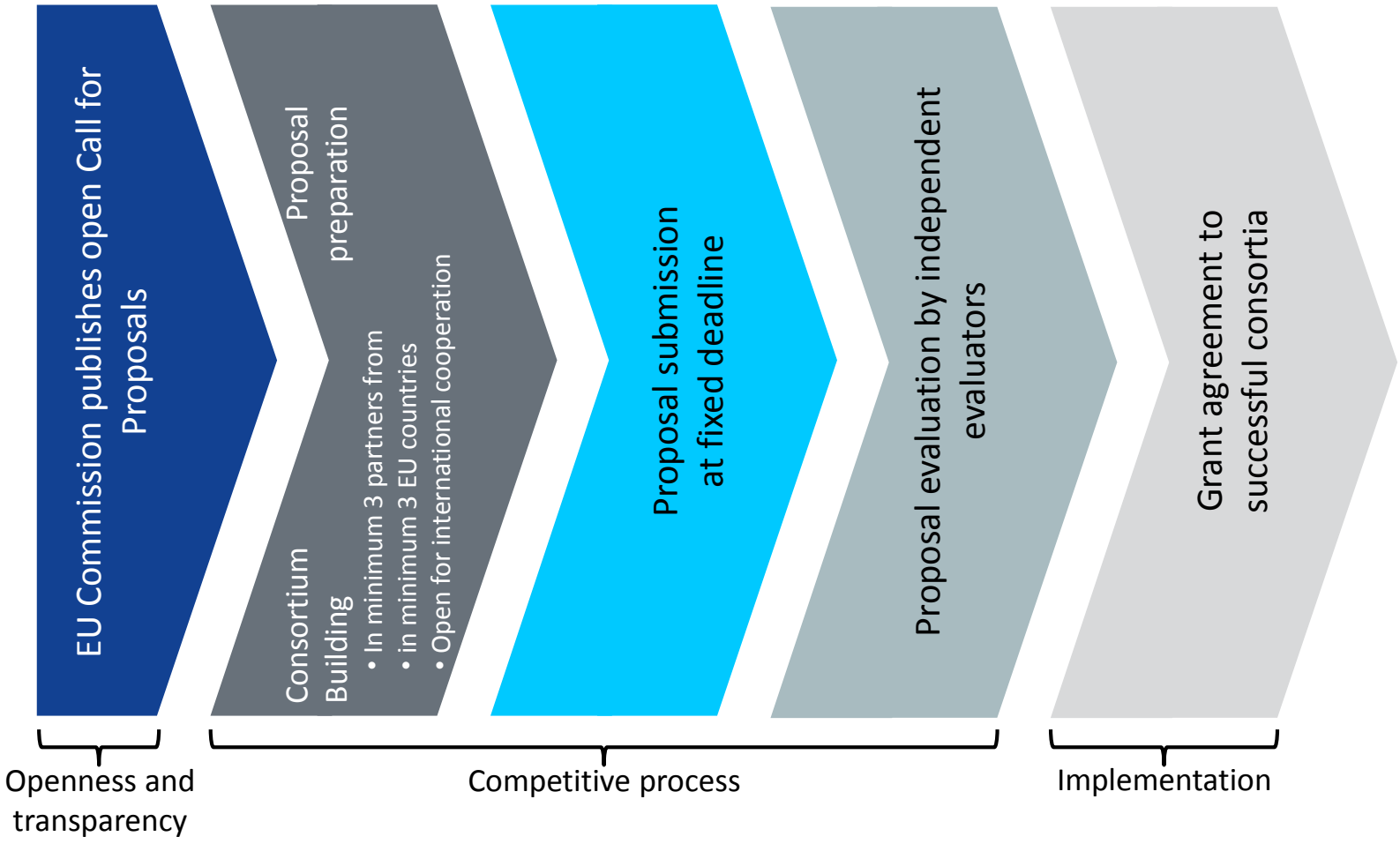
Network virtualization and Software Networks

Highly flexible, manufacturer-independent model of controlling reconfigurable resources supporting changing/emerging application requirements

- Virtualization of network functionalities at infrastructure level and implementation of network services
- Orchestration logic (SDN), enabling network programmability, automation of cross domain network configuration, simplification and programmability of devices
- Tighter integration between application/service layers and networking layers
- Support of open network functionalities for dynamic integration with third party and OTT cloud environments

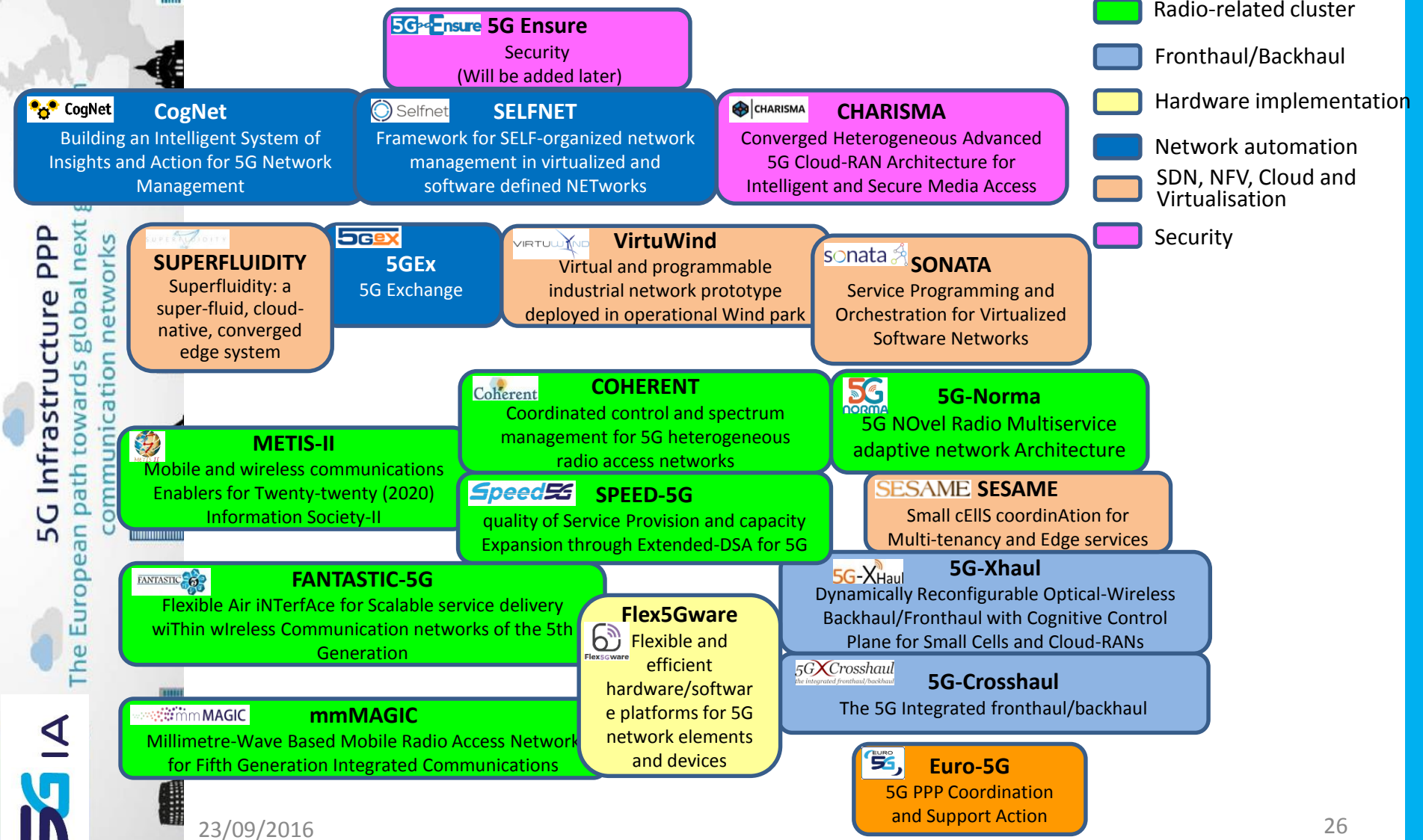
Source: EU Commission Work Program 2014-2015 / 5G Infrastructure Association.

How to start a project?
Major steps



Source: 5G Infrastructure Association.

Horizon 2020 5G PPP
Call 1 selected projects



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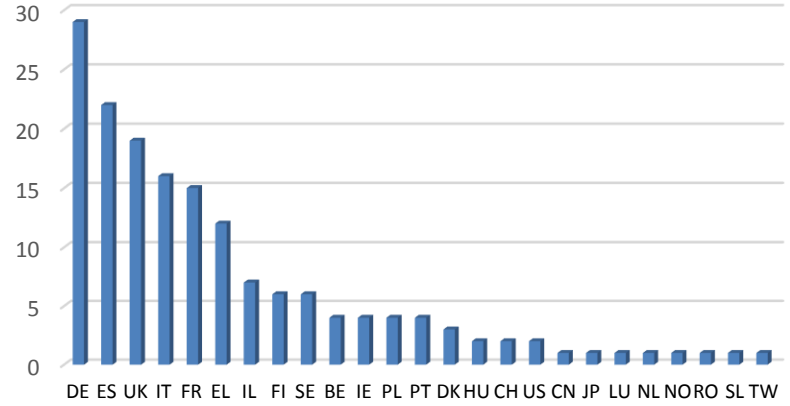
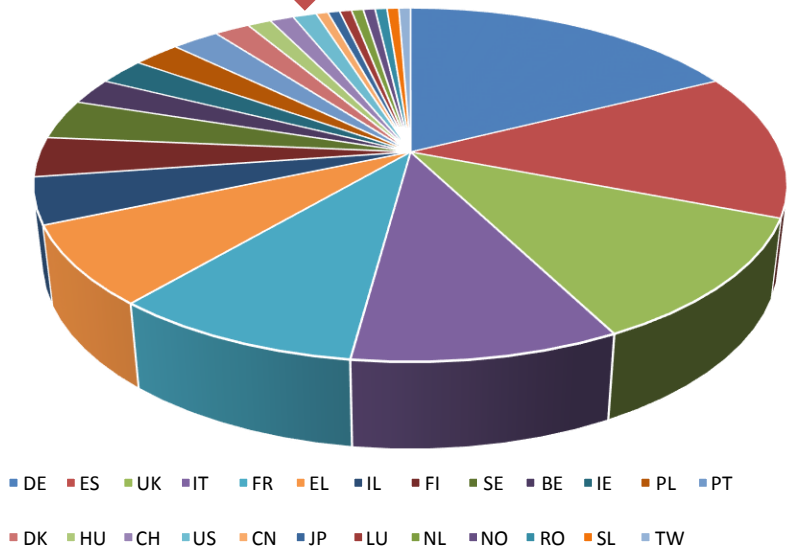
23/09/2016

Source: 5G PPP, https://5g-ppp.eu/5g-ppp-phase-1-projects/.

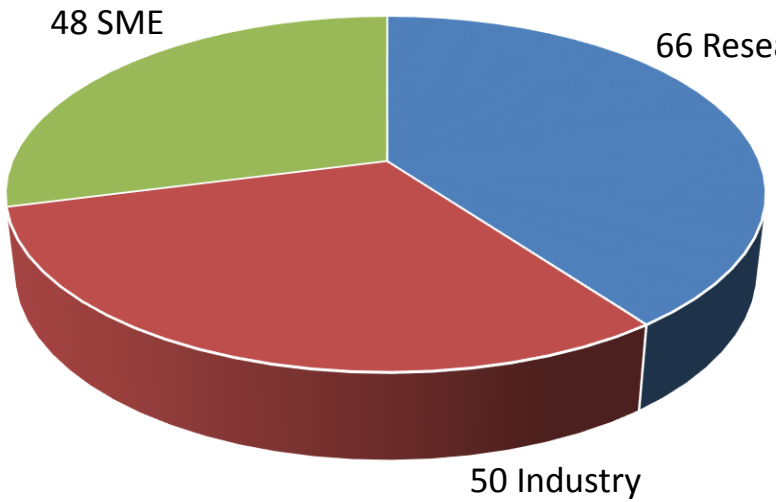
Participation in Call 1 projects
Based on available information

Number of organisations





Number of organisations



- BE Belgium
- CH Switzerland
- CN Canada
- DE Germany
- DK Denmark
- EL Greece
- ES Spain
- FI Finland
- FR France
- HU Hungary
- IE Ireland
- IL Israel
- IT Italy
- JP Japan
- LU Luxembourg
- NL Netherlands
- NO Norway
- PL Poland
- PT Portugal
- RO Romania
- SE Sweden
- SL Slovenia
- TW Taiwan
- UK United Kingdom
- US USA

Source: 5G Infrastructure Association.

International cooperation
General status of MoUs

- China
  - MoU signed with IMT-2020 (5G) Promotion Group on Beijing
- Japan
  - MoU signed with The 5G Mobile Communications Pro March 25, 2015 at NGMN Industry Conference in Fran
- Korea
  - MoU signed with 5G Forum on June 17, 2014 after sig between EU Commission and Korean government in S
- USA
  - MoU signed with 5G Americas on March 2, 2015 at M in Barcelona, Spain
- Multilateral MoU on a series of Global 5G Even
  - Two events per year
  - Rotation between continents
  - MoU signed between IMT-2020 (5G) Promotion Grou Americas and 5G Infrastructure Association on Octobe

5G Infrastructure PPP
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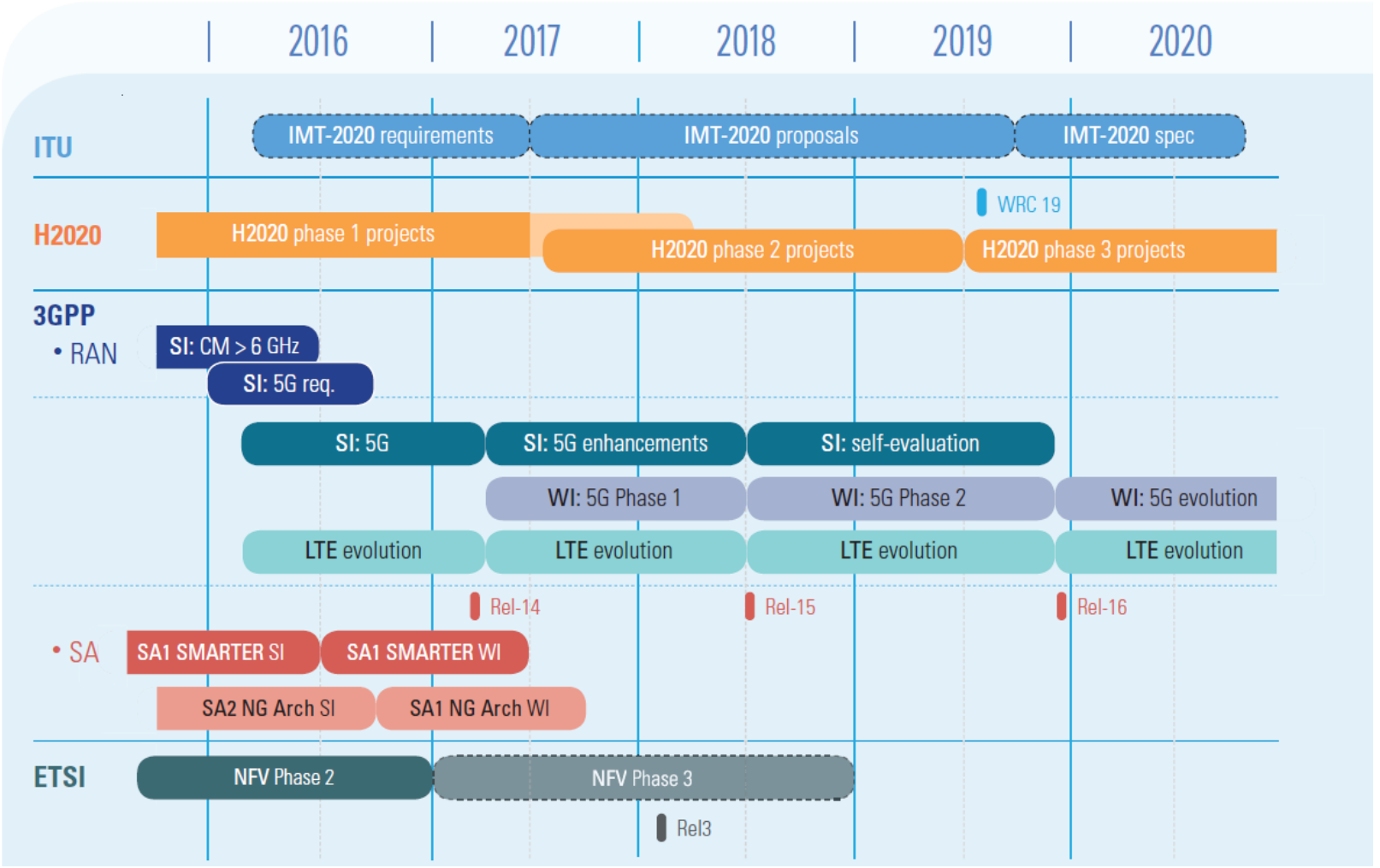
Source: 5G Infrastructure Association.

5G PPP is inviting you to the
5G Global event in Rome, Italy
on November 9 and 10, 2016

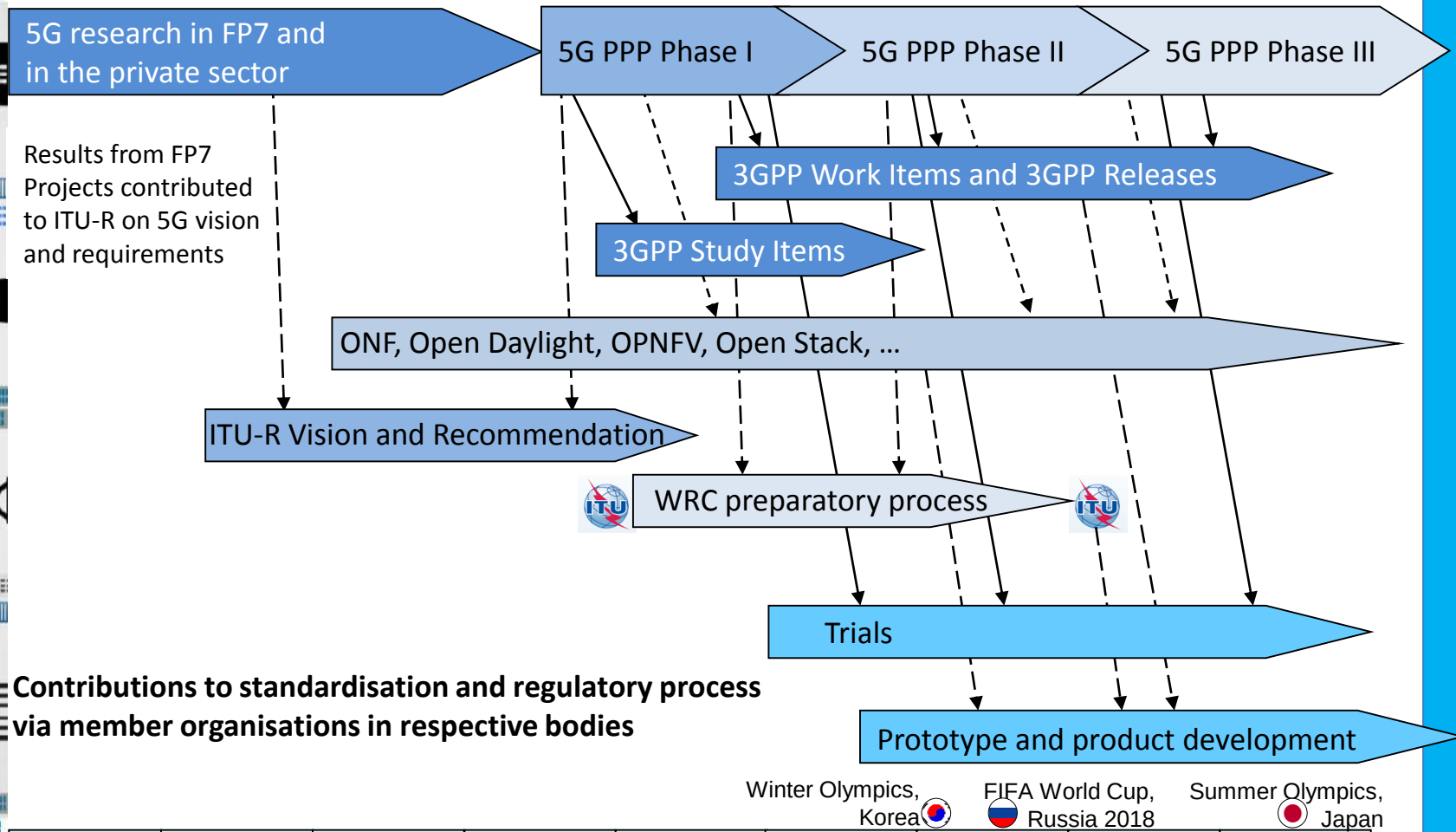
IMT-2020 5G PPP 5G Forum 5GIMF The Fifth Generation Mobile Communications Promotion Forum 5G americas

5G PPP Vision and Requirements
5G roadmap



Source: 5G Infrastructure Association: 5G Empowering vertical industries White Paper, February 2016.

Exploitation of results



Source: 5G Infrastructure Association.

Networking opportunities

- Networld2020 website: http://www.networld2020.org/
- 5G PPP website: https://5g-ppp.eu/
- Participation in Networld2020 and 5G PPP activities like working groups
- Preparation of a Pre-Structuring Model
  - as recommendation to the community
  - as a mapping of the Call for Proposals
  - to Target Research Areas
- Information days are planned in 2016
  - first meeting on January 21, 2015 in Brussels
  - second meeting on March 17, 2016 in Bologna
  - third meeting on May 18, 2016 in Warsaw
  - fourth meeting on June 30, 2016 in Athens after EuCNC 2016
  - fifth meeting on September 26, 2016 in Bratislava in the afternoon
- Brokerage Platform on 5G PPP website: https://5g-ppp.eu/brokerage-platform-new/

Source: 5G Infrastructure Association.

INFRASTRUCTURE ASSOCIATION

http://5g-ppp.eu

Thank you for your attention!