



The 5G Infrastructure Public-Private Partnership

ITU GSC-19 Meeting, Geneva, July 15 and 16, 2015

Werner Mohr

Chair of the board of 5G Infrastructure Association

<http://5g-ppp.eu/>

Outline



- 5G PPP vision
- Time plan
- 5G PPP research project portfolio
- Exploitation of results
- Conclusions

5G Infrastructure PPP

The European path towards global next generation

communication networks

5G PPP in Horizon 2020 of the EU



- 5G PPP is a research program in Horizon 2020 of the EU dedicated to 5G system research
- Budget for 2014 – 2020 time frame
 - Up to 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 €
- Research program is addressing all building blocks of a future communication network and a huge number of huge cases from vertical sectors
- 5G Infrastructure Association vision paper published at Mobile World Congress 2015 in Barcelona
<http://5g-ppp.eu/wp-content/uploads/2015/02/5G-Vision-Brochure-v1.pdf>
- First set of projects started on July 1, 2015



5G PPP Vision and Requirements

5G new service capabilities



USER EXPERIENCE CONTINUITY

INTERNET OF THINGS

MISSION CRITICAL SERVICES



- 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

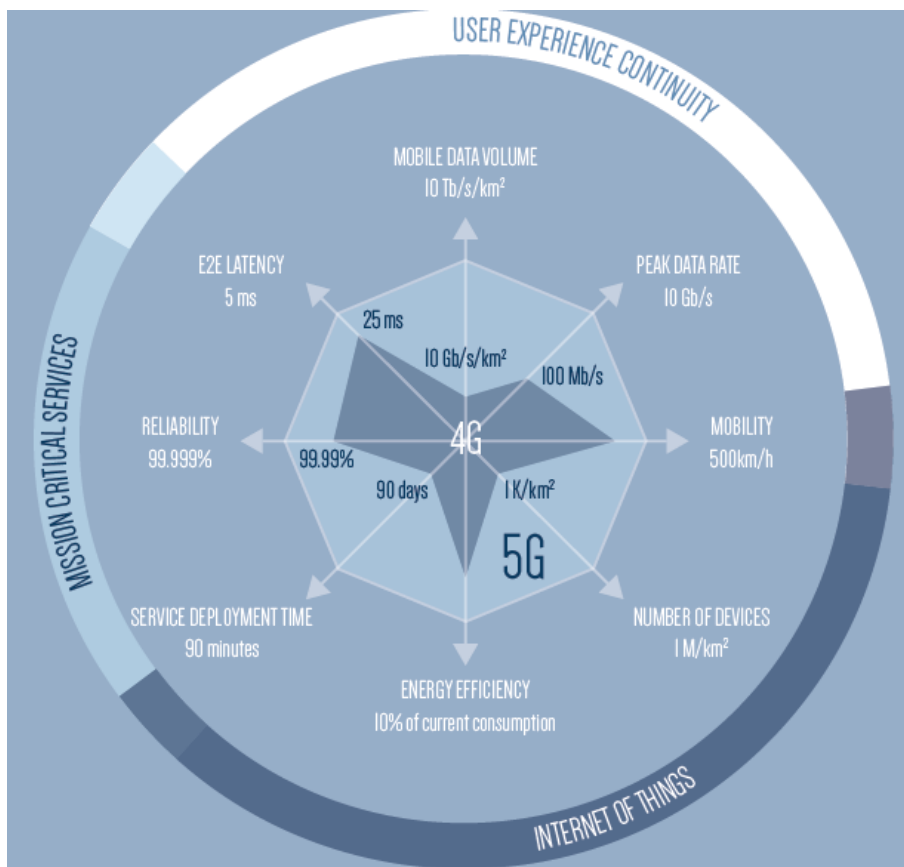
5G PPP Vision and Requirements

5G will have disruptive capabilities



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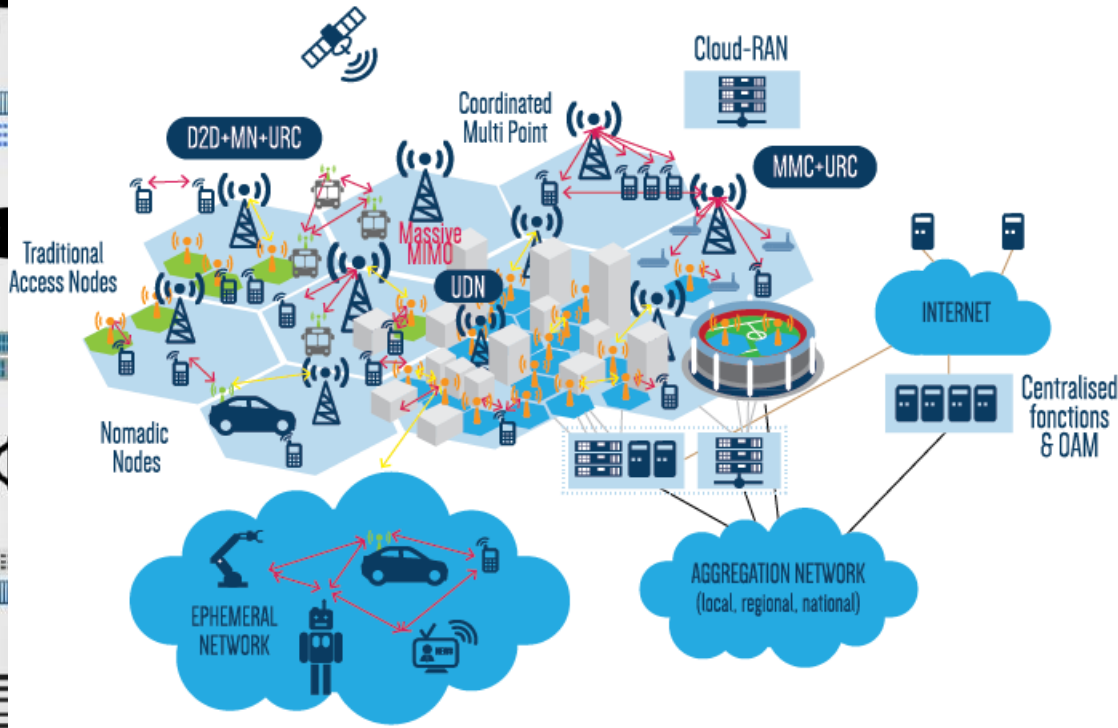
- 5G will provide an order of magnitude improvement in performance in the areas of more capacity, lower latency, more mobility, increased reliability and availability
- 5G infrastructures will be also much more efficient in terms of
 - energy consumption
 - service creation time
 - hardware flexibility



5G PPP Vision and Requirements

5G networks and services vision

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- ↔ Wireless access
- ↔ Wireless fronthaul
- Wired fronthaul
- Wired backhaul
- Macro radio node*
- Small cell radio node*, e.g. micro, (ultra-)pico, femto
- * Only Remote Radio Units (RRUs) assumed

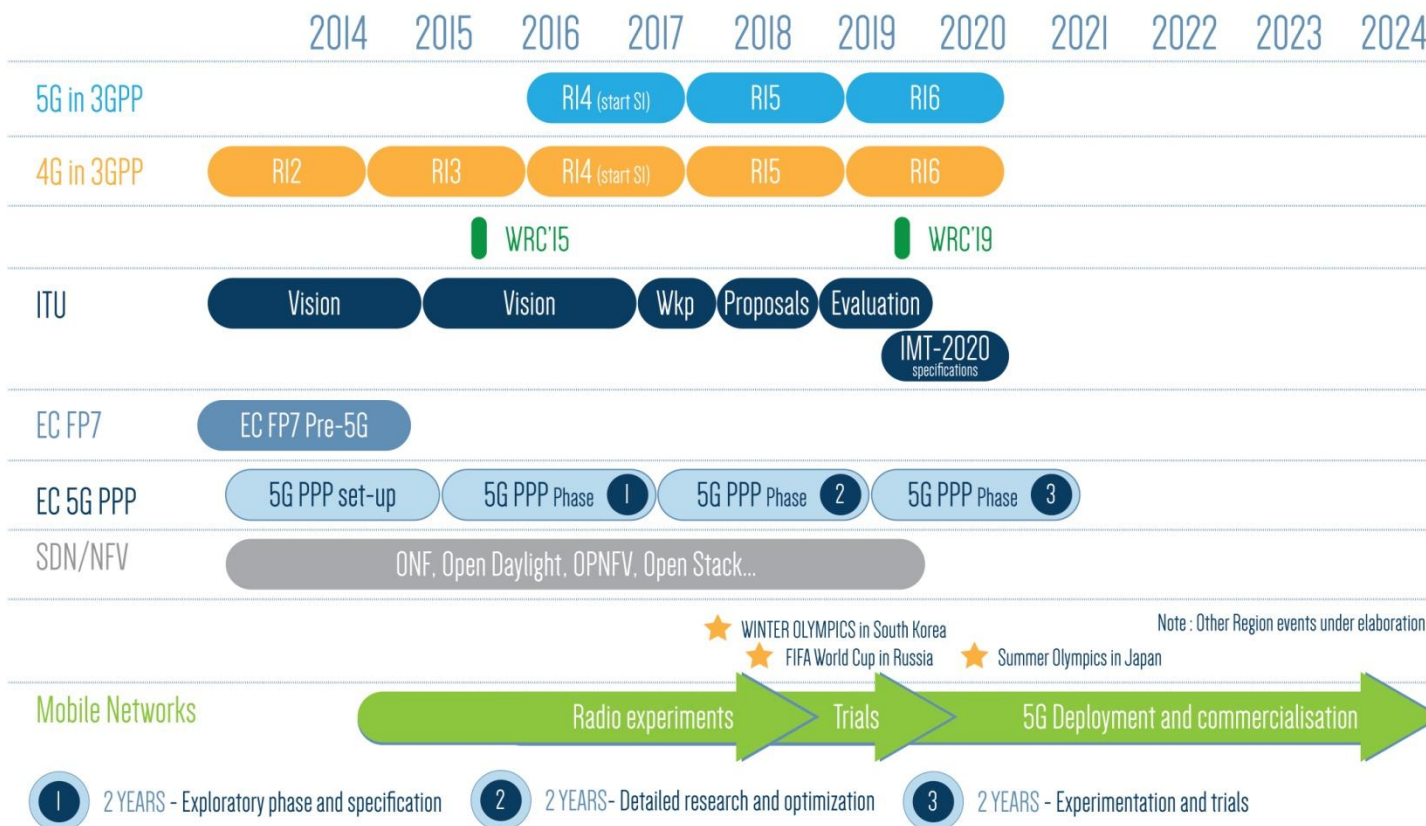
- D2D Device to Device
- MN Moving Networks
- URC Ultra Reliable Communication
- MMC Massive Machine Communication
- UDN Ultra Dense Networks

5G PPP Vision and Requirements

5G roadmap



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12/07/2015

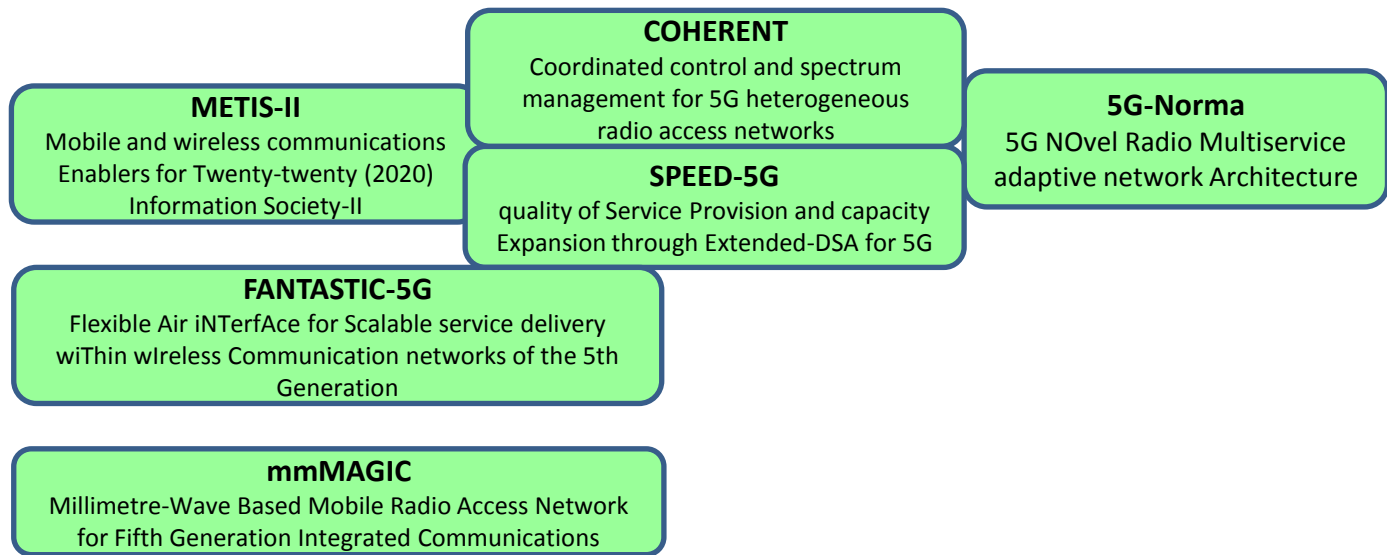
Source: 5G Infrastructure Association: Vision White Paper, February 2015.

Radio-related cluster



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- Research projects
- Innovation projects



Objectives

- Radio interface below 6 GHz
- Radio interface above 6 GHz
- Overall RAN design
- Heterogeneous radio access networks (RAN)
- Novel adaptive 5G mobile network architecture
- Spectrum access

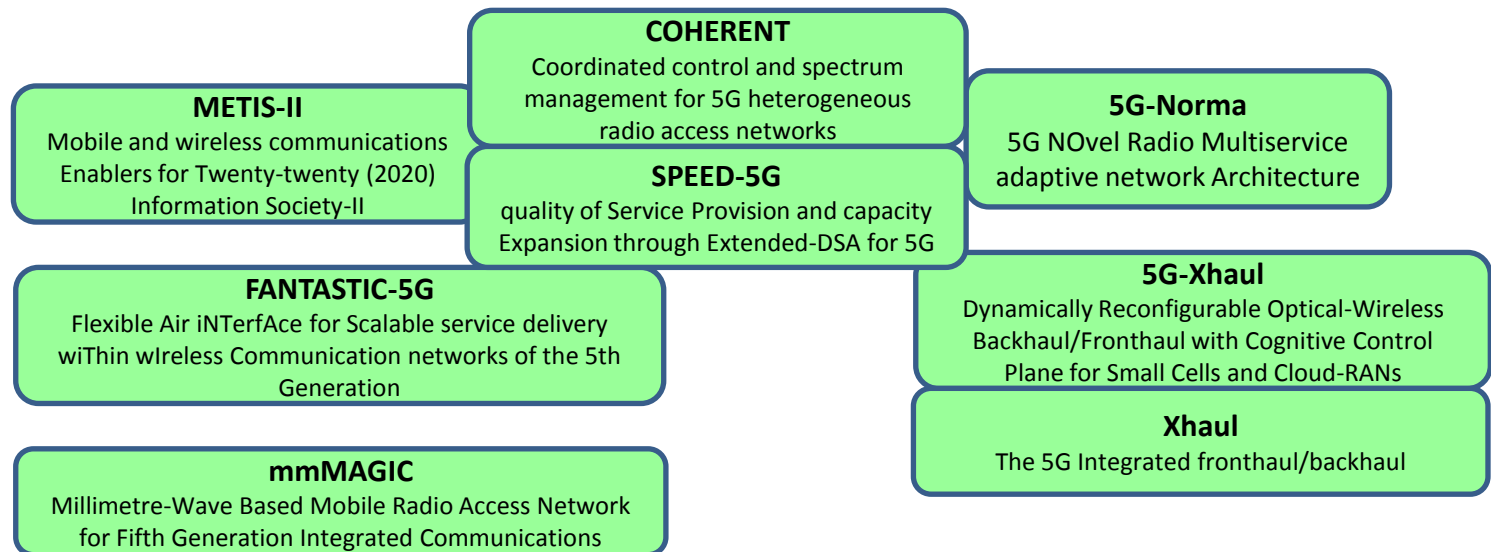
Fronthaul/backhaul



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- Research projects
- Innovation projects



Fronthaul/backhaul



Objectives

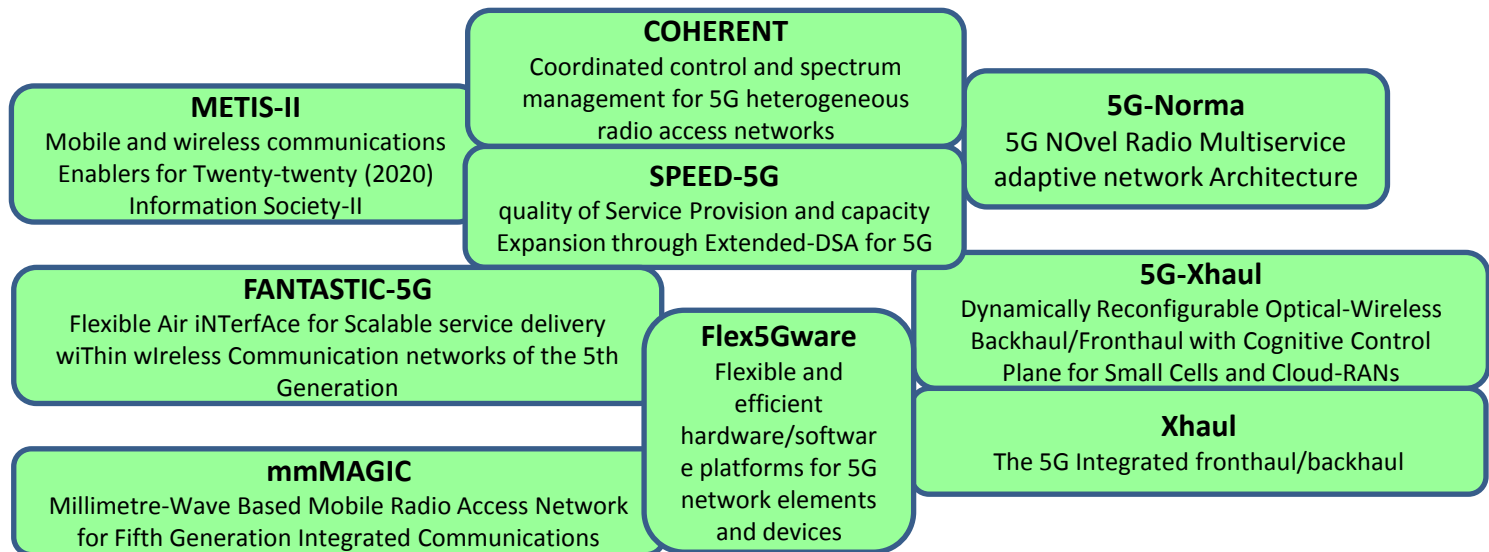
- **5G integrated backhaul and fronthaul transport network**
- Fronthaul and backhaul solutions between RAN and packet core
- Demonstration and validation of xHaul technology components will be integrated into a software-defined flexible and reconfigurable 5G Test-bed
- **Flexible backhaul/fronthaul network** for serving current and future RAN deployments in a dynamic, service oriented, and cost-effective way
- **Seamless integration of future-proof technologies** in the optical and wireless (Sub-6 GHz, mm-Wave) metro/access domains, through a converged software-based control plane

Hardware implementation



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- Research projects
- Innovation projects



Hardware implementation



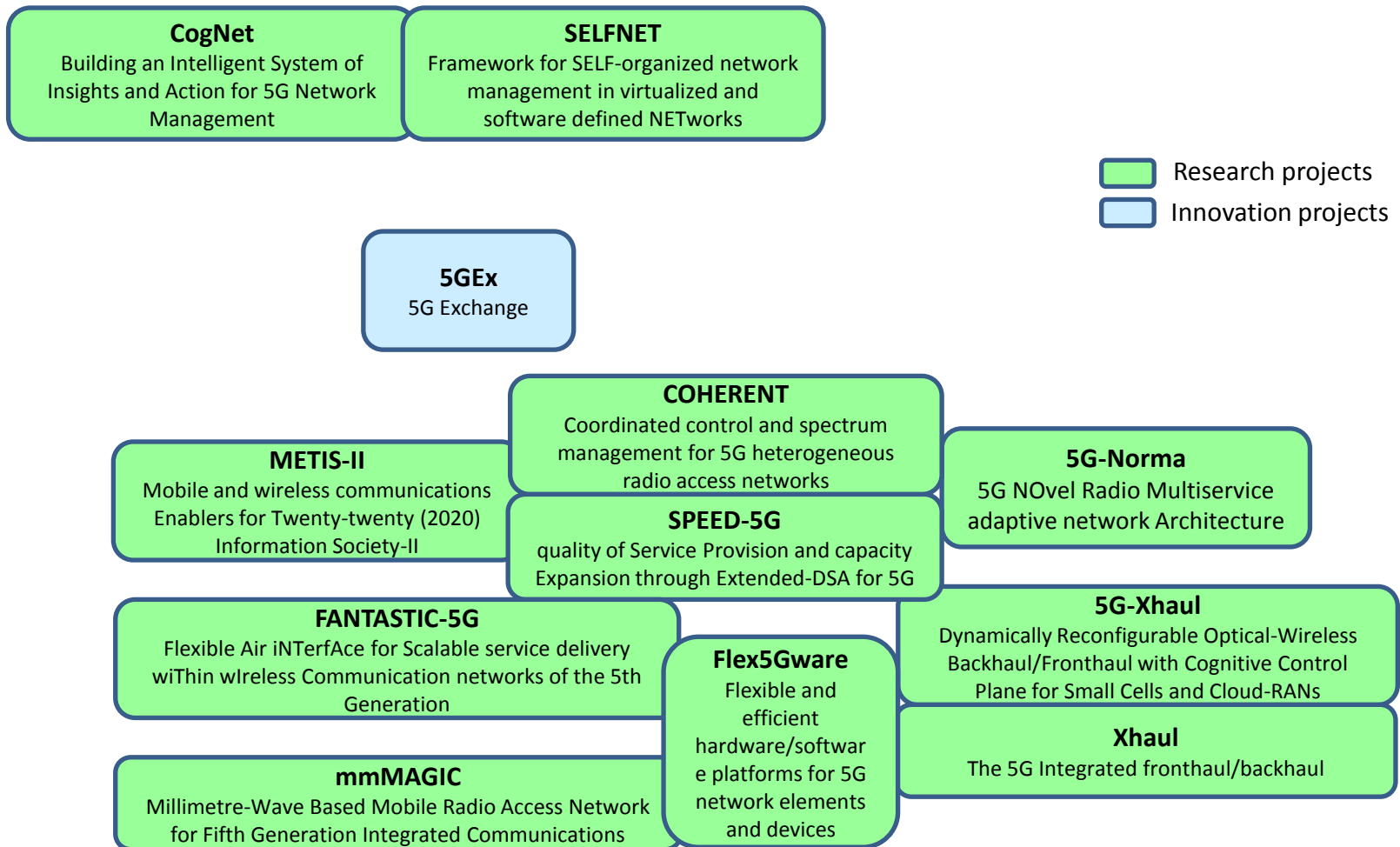
Objectives

- Increasing the HW versatility and reconfigurability
- Providing HW-agnostic, flexible and cost-effective SW platforms
- Increasing the overall capacity of 5G communication platforms
- Decreasing the energy consumed by 5G communication platforms
- Identifying and prototyping key building blocks

Areas to be addressed

- RF front-ends and antennas (versatility, TRX > 6 GHz, antennas, ...)
- Mixed-signal technology (broadband DAC/ADC, full duplex, ...)
- Digital front-end + HW/SW split (HW for new waveforms, MIMO ...)
- SW modules and functions (SW re-configurability, energy savings)

Network automation



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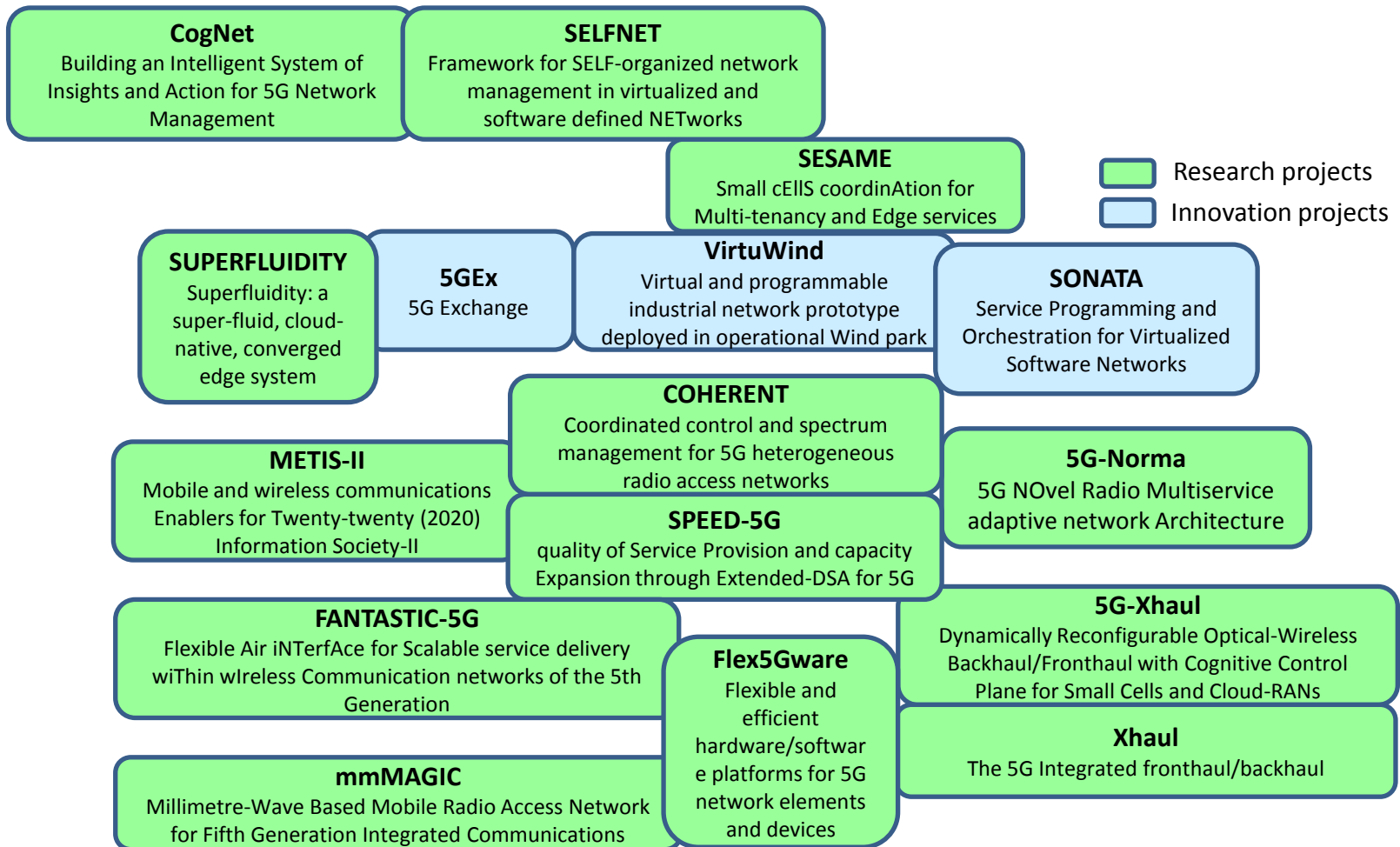
Objectives

- **Automated and fast provisioning** of infrastructure services in a multi-domain/multi-operator 5G environment
- Innovative framework for the **automated management** and rapid deployment **of self-configuring next-generation networks and services**
- Extending the state-of-the-art network management within the Software-Defined Networking and Network Function Virtualization (SDN/NFV) arena
- Network Management at the **5G/IOT** scale

SDN, NFV, Cloud and Virtualisation



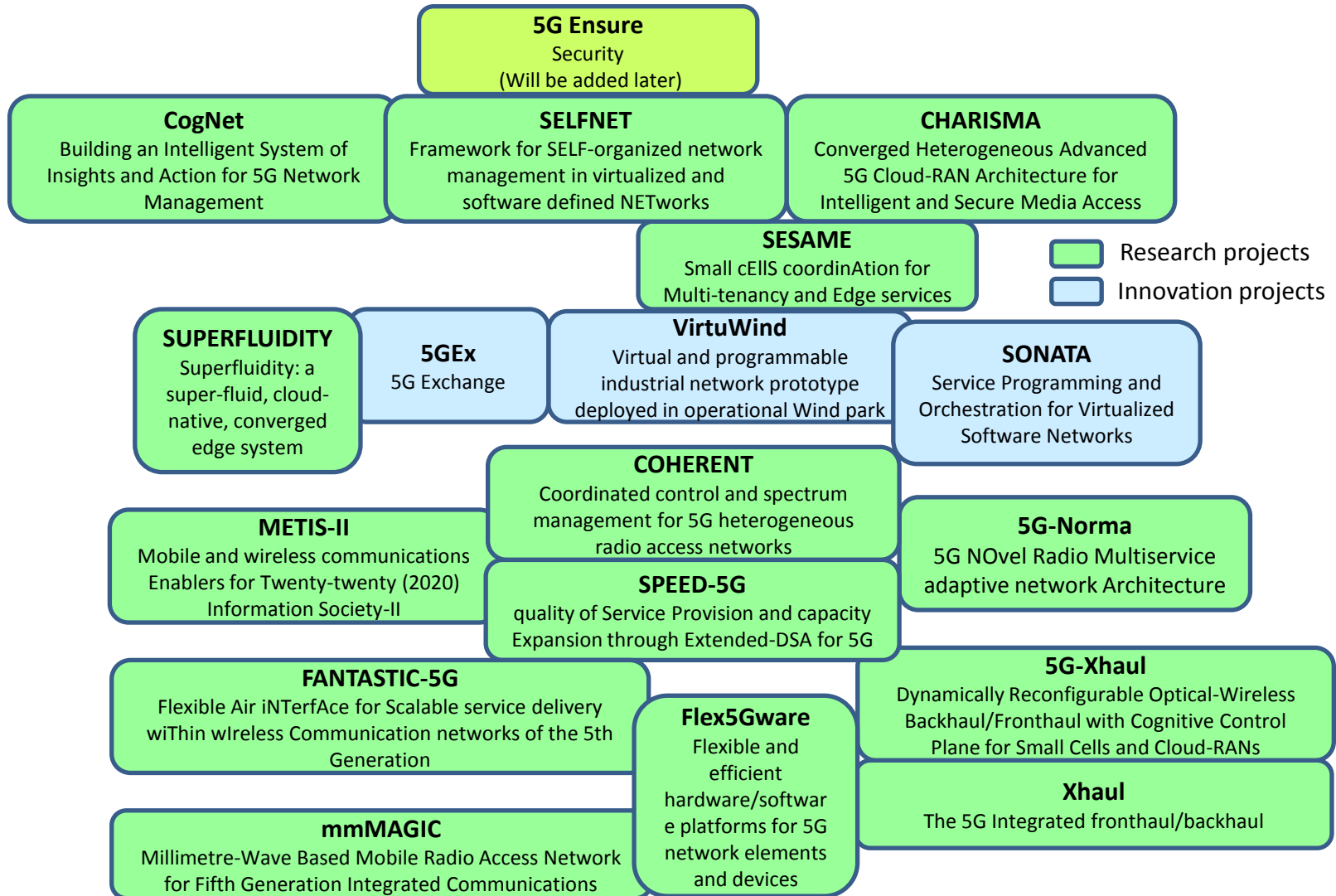
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Objectives

- **Network Functions Virtualisation (NFV)** and **Edge Cloud Computing**;
- Substantial evolution of the Small Cell concept
- Consolidation of **multi-tenancy** in communications infrastructures, allowing several operators/service providers to engage in new sharing models of both access capacity and edge computing capabilities.
- **Reduce time to market for networked services** by shortening service development (Programming model and SDK)
- Optimizing resource utilization and reduce cost of service deployment and operation
- Converged cloud-based 5G concept that will enable innovative use cases in the mobile edge, empower new business models, and reduce investment and operational costs
- To develop a **SDN & NFV ecosystem for industrial domains**, based on open, modular, and secure communication framework, leading to a prototype demonstration for intra-domain and inter-domain scenarios in real wind parks as a representative use case of industrial networks, and quantify the economic benefits of the solution

Security



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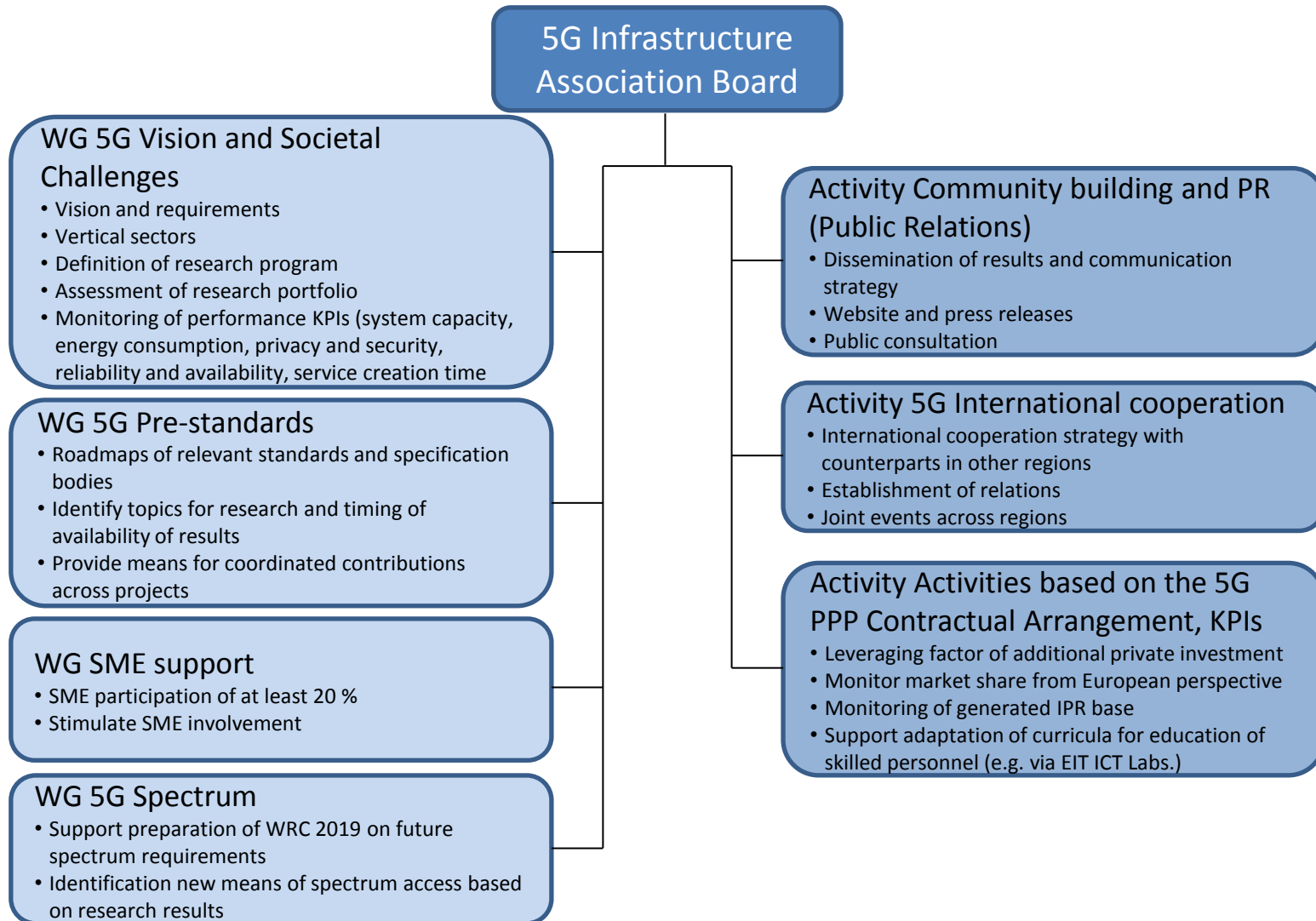
Security



Objectives

- End-to-end security across all layers of the converged and virtualised open access network
- Physical layer low-latency security for both wireless and optical, in open, dynamic, multi-user, highly connected and decentralized 5G networks
- Build two secure end-to-end pilot demonstrators

5G Infrastructure Association Working Groups and Activities



Exploitation of results



5G research in FP7 and in the private sector

5G PPP Phase I

5G PPP Phase II

5G PPP Phase III

Results from FP7 Projects contributed to ITU-R on 5G vision and requirements

3GPP Work Items and 3GPP Releases

3GPP Study Items

ONF, Open Daylight, OPNFV, Open Stack, ...

ITU-R Vision and Recommendation



WRC preparatory process



Trials

Contributions to standardisation and regulatory process via member organisations in respective bodies

Prototype and product development

Winter Olympics, Korea

FIFA World Cup, Russia 2018

Summer Olympics, Japan

2012	2013	2014	2015	2016	2017	2018	2019	2020
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12/07/2015

Release 12

Release 13

Release 14

Release 15

FIFA World Cup, Qatar 2022

Source: 5G Infrastructure Association.

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Conclusions



- 5G PPP is a research program in Horizon 2020 of EU Commission dedicated to 5G system research and development
- Collaborative research as means for consensus building to prepare future standards
- 5G PPP vision and requirements similar to views in other regions and international bodies and associations
- Large project portfolio or cooperating projects, which are addressing major elements and building blocks of a future communication network
- 5G PPP Working Groups and Activities support project cooperation and contributions to international standardisation and the regulatory process
- Research results are expected to be contributed by project participants to the international standardisation and regulatory process

Acknowledgement: The author would like to thank his colleagues for their contributions.





<http://5g-ppp.eu>

**Thank you for your
attention!**

