The 5G Infrastructure Association

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ITU-R Workshop on IMT-2020 terrestrial radio interfaces

Munich, October 4, 2017

Outline

- 5G PPP in Horizon 2020 of the European Union
- 5G roadmap and 5G PPP time plan
- 5G PPP research project portfolio
- IMT-Vision recommendation and time plan
- ITU-R evaluation approach
- Conclusions

5G PPP
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5G PPP in Horizon 2020 of the EU

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- 5G PPP is a research program in Horizon 2020 of the EU dedicated to 5G system research
  https://ec.europa.eu/programmes/horizon2020/en/h2020-section/future-internet
  https://5g-ppp.eu/
- 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 vertical use cases
- 5G Infrastructure Association vision paper
  http://5g-ppp.eu/wp-content/uploads/2015/02/5G-Vision-Brochure-v1.pdf
- 5G Infrastructure Association paper on vertical sectors
  https://5g-ppp.eu/wp-content/uploads/2016/02/BROCHURE_5PPP_BAT2_PL.pdf
- 5G Infrastructure Association paper on innovations
  https://5g-ppp.eu/wp-content/uploads/2017/01/5GPPP-brochure-MWC17.pdf
- Phase 1 projects started on July 1, 2015
- Phase 2 projects started on June 1, 2017

Source: 5G Infrastructure Association.

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

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Source: 5G Infrastructure Association.

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

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Pre-standards

Spectrum / **Evaluation ***

* Current structure

Vision and Societal Challenges

Activity 5G PPP Contractual Arrangement, KPIs

Activity 5G International cooperation

Trials

Activity Community building and Public Relations

SME support

Source: 5G Infrastructure Association.

5G PPP Vision and Requirements
5G roadmap

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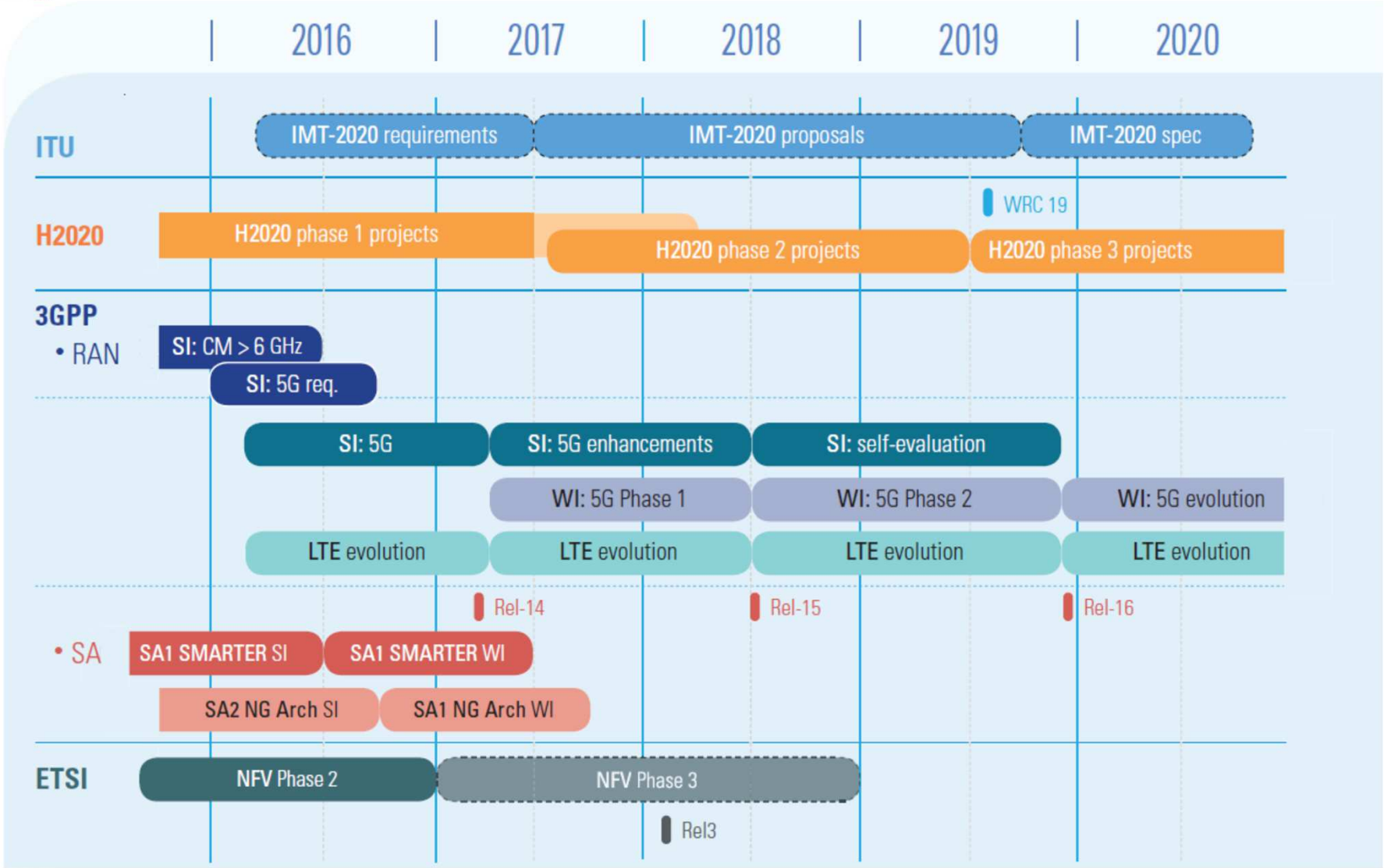
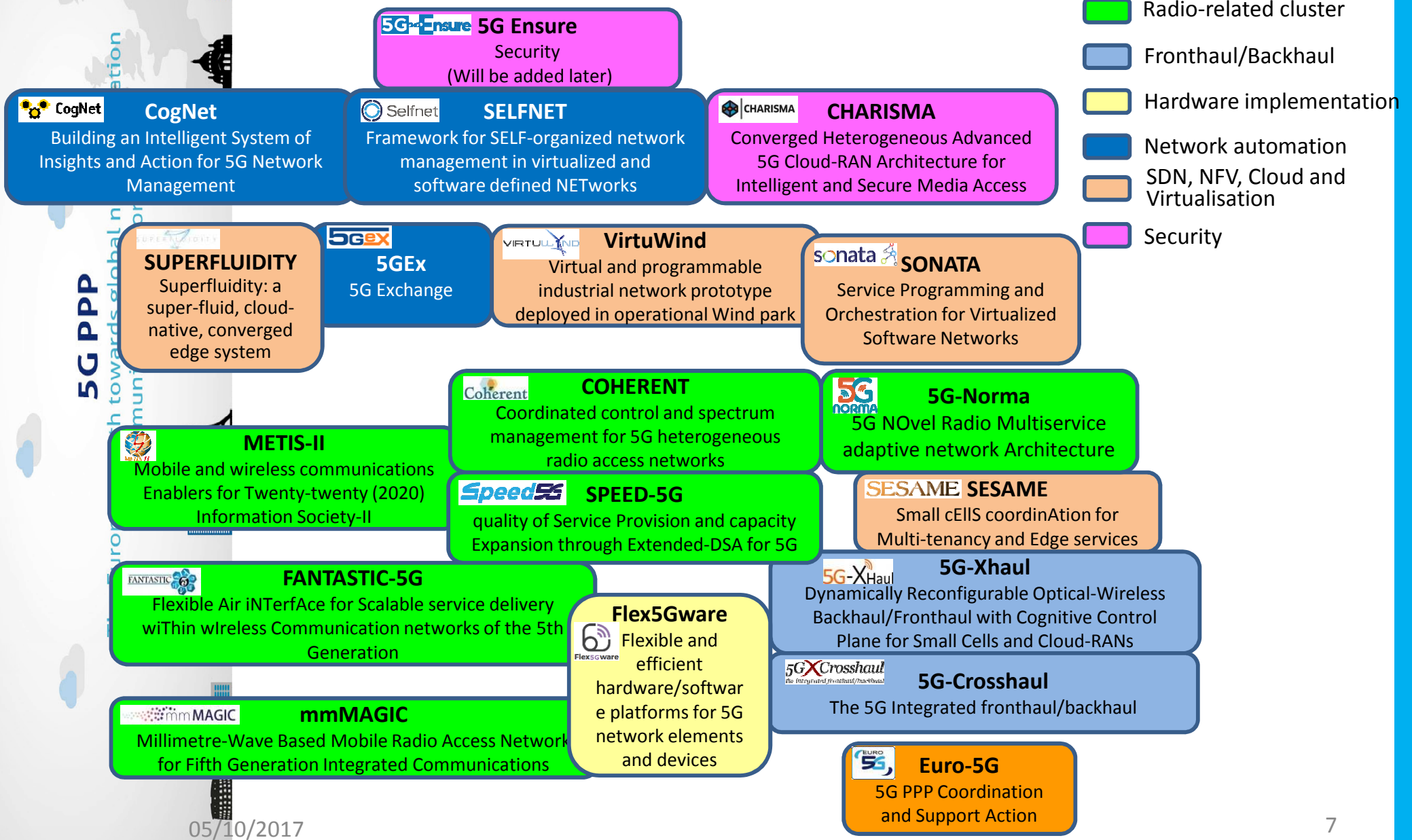


Source: 5G Infrastructure Association: 5G Empowering vertical industries White Paper, February 2016.

Horizon 2020 5G PPP

Call 1 selected projects – 07.2015 – 06.2017 (06.2018)



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

Horizon 2020 5G PPP

Call 2 selected projects – 06.2017 – 11.2019 (08.2020)

5G CITY
Distributed multi-tenant cloud and radio platform for municipalities and infrastructure owners acting as 5G neutral hosts

5G MEDIA
Programmable edge-to-cloud virtualization fabric for the 5G Media industry

MATILDA
A holistic, innovative framework for the design, development and orchestration of 5G-ready applications and network services over sliced programmable infrastructures

5G Xcast
Broadcast and Multicast Communication Enablers for the Fifth Generation of Wireless Systems

5G TANGO
5G Development and Validation Platform for global Industry-specific Network Services and Apps

SLICENET
End-to-End Cognitive Network Slicing and Slice Management Framework in Virtualised Multi-Domain, Multi-Tenant 5G Networks

NRG-5
Enabling Smart Energy as a Service via5G Mobile Network advances

IoRL
Internet of Radio-Light in Buildings

METRO-HAUL
METRO High bandwidth, 5G Application aware optical network, with edge storage, compUte and low Latency

5G PHOS
5G integrated Fiber-Wireless networks exploiting existing photonic technologies for high-density SDN-programmable network architectures

PaaS
Next Generation Platform as a Service (PaaS)

Bluespace
Building on the Use of Spatial Multiplexing 5G Networks Infrastructures and Showcasing Advanced technologies and Networking Capabilities

5G CAR
Fifth Generation Communication Automotive Research and Innovation for e2e V2X connectivity and multi-RAT interworking

5G Transformer
5G Mobile Transport Platform for Verticals

5G PICTURE
5G Programmable Infrastructure Converging disaggregated network and compUte Resources

CLEAR5G
Converged wireless access for reliable 5G MTC for factories of the future (Machine type communications)

5G MoNArch
5G Mobile Network Architecture for diverse services, use cases, and applications in 5G and beyond

ONE5G
E2E-aware Optimizations and advancements for the Network Edge of 5G New Radio

SaT 5G
Satellite and Terrestrial network for 5G for integration of satellite and terrestrial systems

5G ESSENCE
Embedded Network Services for 5G Experiences

5G-CORAL
A 5G Convergent Virtualized Radio Access Network Living at the Edge

To-Euro-5G
Supporting the 5G-PPP especially 5G Initiative governance

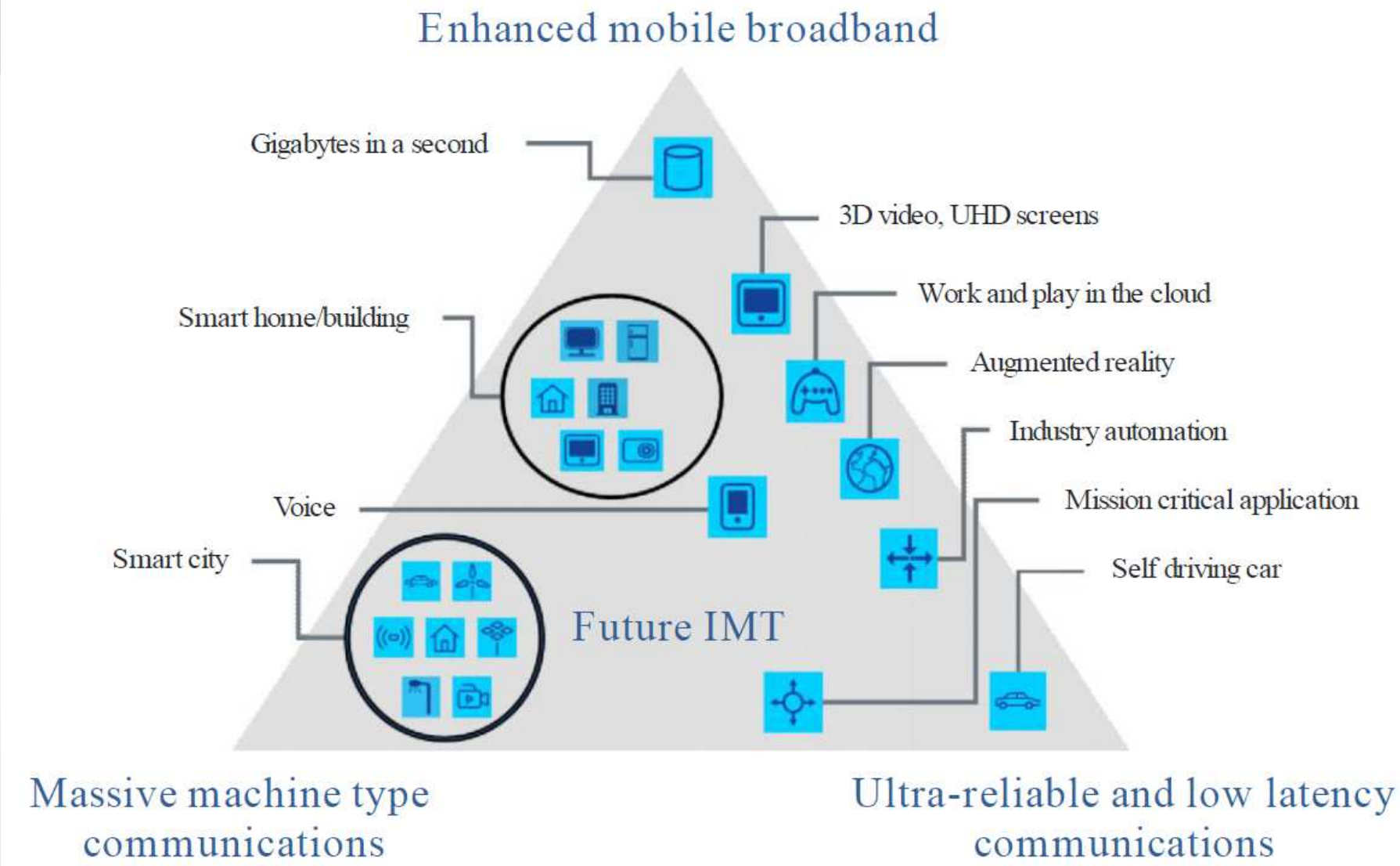
Global5G.org
Global vision, standardisation and stakeholder engagement in 5G

- Radio-related cluster
- Fronthaul/Backhaul
- SDN, NFV, Cloud and Virtualisation
- Optical networks and technology
- Network automation
- Security, privacy, resilience, availability
- Platforms

Most projects are cooperating with vertical use cases

Source: 5G PPP, https://5g-ppp.eu/5g-ppp-phase-2-projects/.

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.

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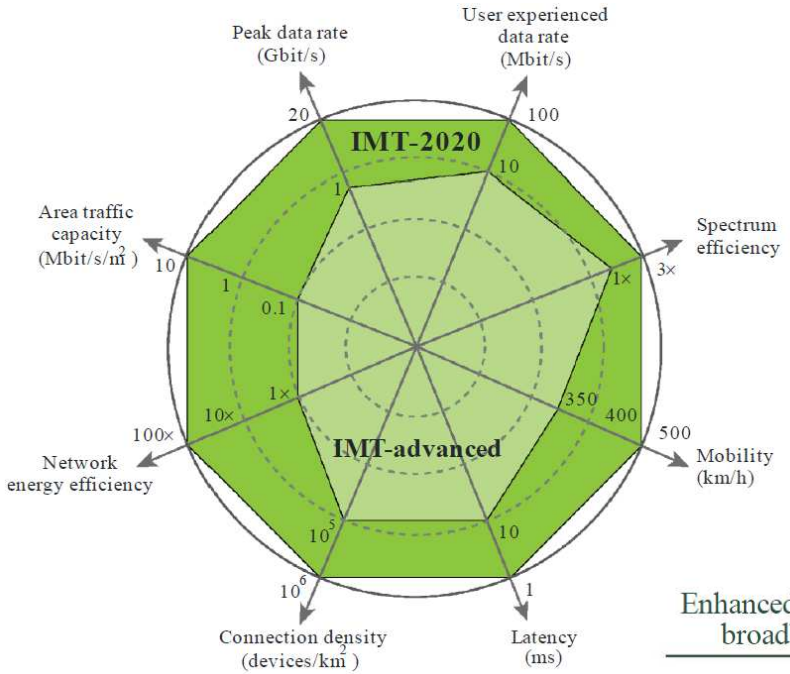
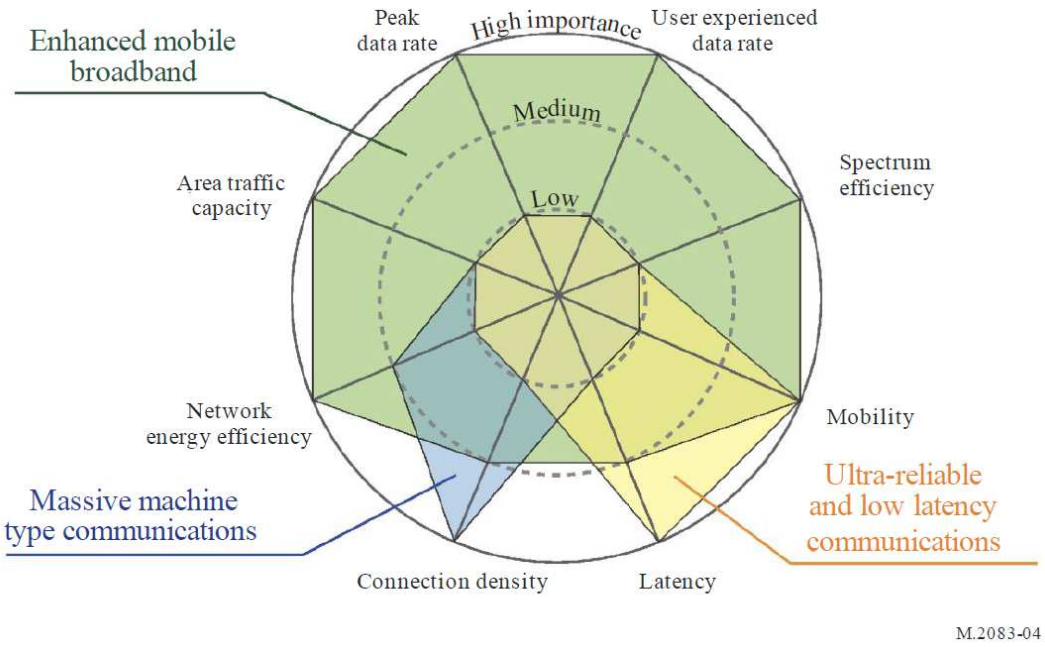
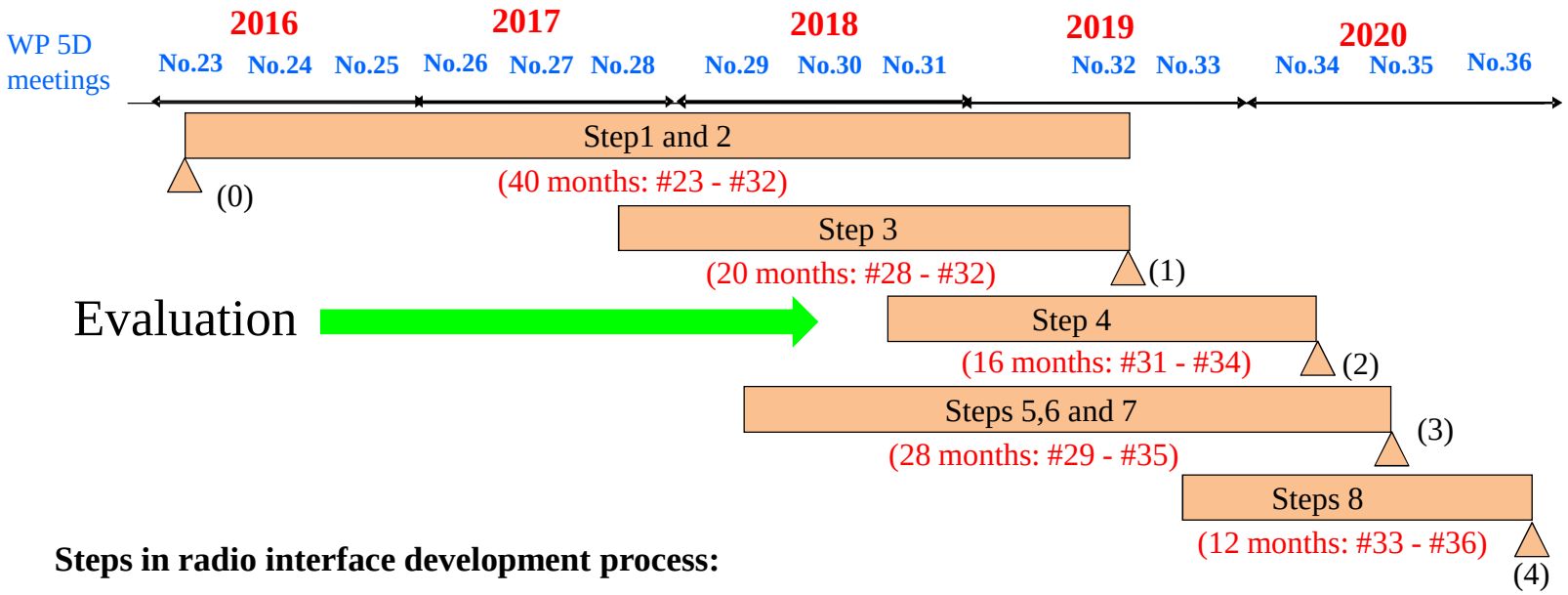
Enhancement of key capabilities from IMT-Advanced to IMT-2020 (ITU-R)





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.

Schedule for development of IMT-2020 radio interface recommendation



Steps in radio interface development process:

Step 1: Issuance of the circular letter
Step 2: Development of candidate RITs and SRITs
Step 3: Submission/Reception of the RIT and SRIT proposals and acknowledgement of receipt
Step 4: Evaluation of candidate RITs and SRITs by Independent Evaluation Groups
Step 5: Review and coordination of outside evaluation activities
Step 6: Review to assess compliance with minimum requirements
Step 7: Consideration of evaluation results, consensus building and decision
Step 8: Development of radio interface Recommendation(s)

Critical milestones in radio interface development process:

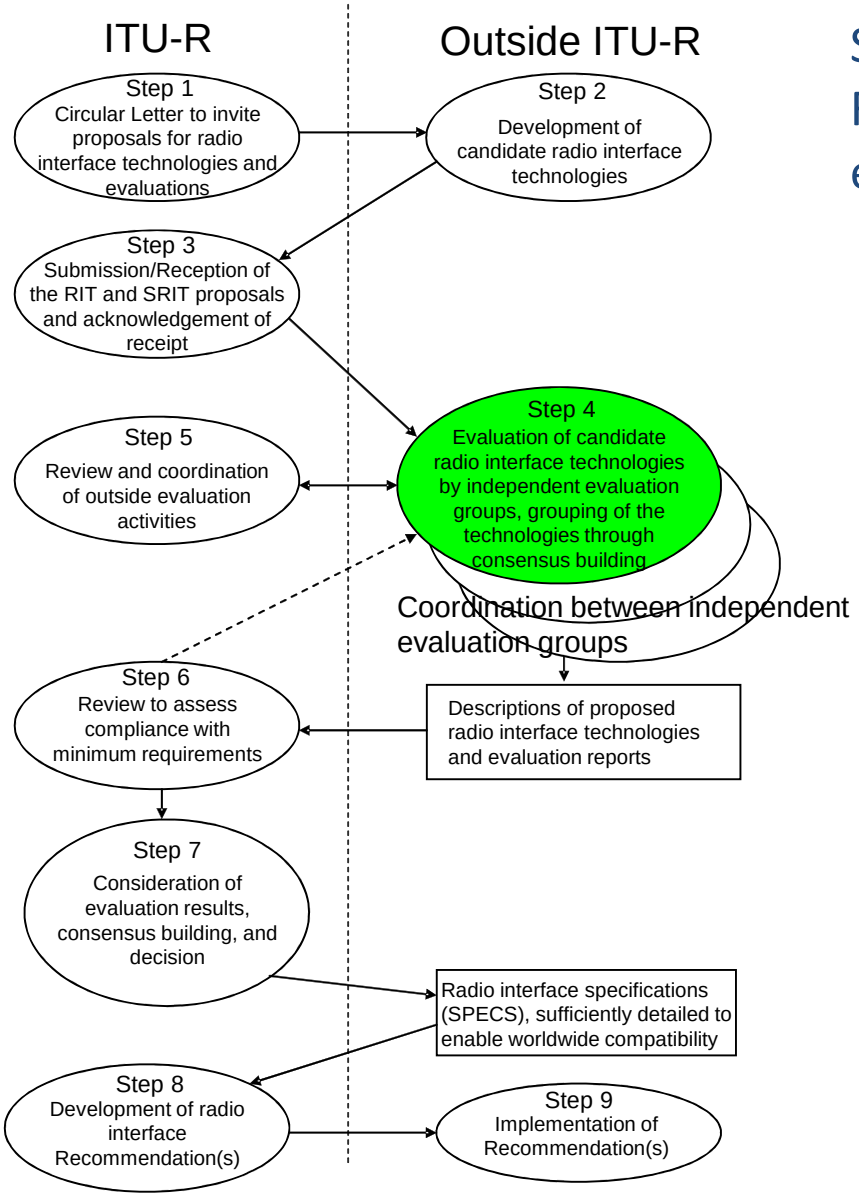
(0): Issue an invitation to propose RITs March 2016
(1): ITU proposed cut off for submission of candidate RIT and SRIT proposals July 2019
(2): Cut off for evaluation report to ITU February 2020
(3): WP 5D decides framework and key characteristics of IMT-2020 RIT and SRIT June 2020
(4): WP 5D completes development of radio interface specification Recommendations October 2020

IMT-2020 2-01

RIT - Radio Interface Technology
SRIT - Set of Radio Interface Technologies

Source: ITU-R WP 5D: Submission, Evaluation Process and Consensus Building for IMT-2020. 2017.

IMT-2020 terrestrial component radio interface development process



Step 4 – Evaluation of candidate RITs or SRITs by independent evaluation groups

- 5G Infrastructure Association registered as Evaluation Group at ITU-R
- Evaluation guidelines to follow in ITU-R M.[IMT-2020.Submission]
- Additional evaluation methods by Evaluation Groups may be used and shared between Evaluation Groups
- Coordination between Evaluation Groups for comparison and consistency of results
- Evaluation reports to be sent to ITU-R Study Group 5 as input for WP5D and publication

Source: ITU-R WP 5D: Submission, Evaluation Process and Consensus Building for IMT-2020. 2017.

Detailed ITU-R report of evaluation guidelines

Characteristic for evaluation	High-level assessment method	Evaluation methodology in this report	Related section of Reports ITU-R M.[IMT-2020.TECH PERF REQ] and ITU-R M.[IMT-2020.SUBMISSION]
Peak data rate	Analytical	§ 7.2.2	Report ITU-R M.[IMT-2020.TECH PERF REQ], § 4.1
Peak spectral efficiency	Analytical	§ 7.2.1	Report ITU-R M.[IMT-2020.TECH PERF REQ], § 4.2
User experienced data rate	Analytical for single band and single layer; Simulation for multi-layer	§ 7.2.3	Report ITU-R M.[IMT-2020.TECH PERF REQ], § 4.3
5th percentile user spectral efficiency	Simulation	§ 7.1.2	Report ITU-R M.[IMT-2020.TECH PERF REQ], § 4.4
Average spectral efficiency	Simulation	§ 7.1.1	Report ITU-R M.[IMT-2020.TECH PERF REQ], § 4.5
Area traffic capacity	Analytical	§ 7.2.4	Report ITU-R M.[IMT-2020.TECH PERF REQ], § 4.6
User plane latency	Analytical	§ 7.2.6	Report ITU-R M.[IMT-2020.TECH PERF REQ], § 4.7.1
Control plane latency	Analytical	§ 7.2.5	Report ITU-R M.[IMT-2020.TECH PERF REQ], § 4.7.2
Connection density	Simulation	§ 7.1.3	Report ITU-R M.[IMT-2020.TECH PERF REQ], § 4.8
Energy efficiency	Inspection	§ 7.3.2	Report ITU-R M.[IMT-2020.TECH PERF REQ], § 4.9
Reliability	Simulation	§ 7.1.5	Report ITU-R M.[IMT-2020.TECH PERF REQ], § 4.10
Mobility	Simulation	§ 7.1.4	Report ITU-R M.[IMT-2020.TECH PERF REQ], § 4.11
Mobility interruption time	Analytical	§ 7.2.7	Report ITU-R M.[IMT-2020.TECH PERF REQ], § 4.12
Bandwidth	Inspection	§ 7.3.1	Report ITU-R M.[IMT-2020.TECH PERF REQ], § 4.13
Support of wide range of services	Inspection	§ 7.3.3	Report ITU-R M.[IMT-2020.SUBMISSION], § 3.1
Supported spectrum band(s)/range(s)	Inspection	§ 7.3.4	Report ITU-R M.[IMT-2020.SUBMISSION], § 3.2

- ITU-R report provides detailed guidelines on evaluation methodology and procedures
  - System simulation procedures
  - Analytical approach
  - Inspection approach
  - Usage scenarios
  - Test environments
  - Network layout
  - Evaluation configurations including detailed parameter settings
  - Antenna characteristics
  - Channel models for IMT-2020 for system and link level simulations

Source: ITU-R WP 5D: Guidelines for evaluation of radio interface technologies for IMT-2020. [Preliminary] Draft New Report ITU-R M.[IMT-2020.EVAL], 2017.

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Conclusions

- In Europe 5G PPP is major 5G research program in Horizon 2020
- 5G Infrastructure Association is representing private side in 5G PPP and EU Commission is representing the public side
- Cooperation with international counterparts
- 5G Infrastructure Association registered as ITU-R Evaluation Group
- Ongoing research projects on most 5G building blocks and cooperation with vertical sectors
- 5G Infrastructure Association in discussion with 5G PPP projects for technical contributions to IMT-2020 evaluation
- Ambition: Complete evaluation report with main focus on expected 3GPP submission
- Horizon 2020 is open for international participation

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

Source: 5G Infrastructure Association.

http://5g-ppp.eu

Thank you for your attention!