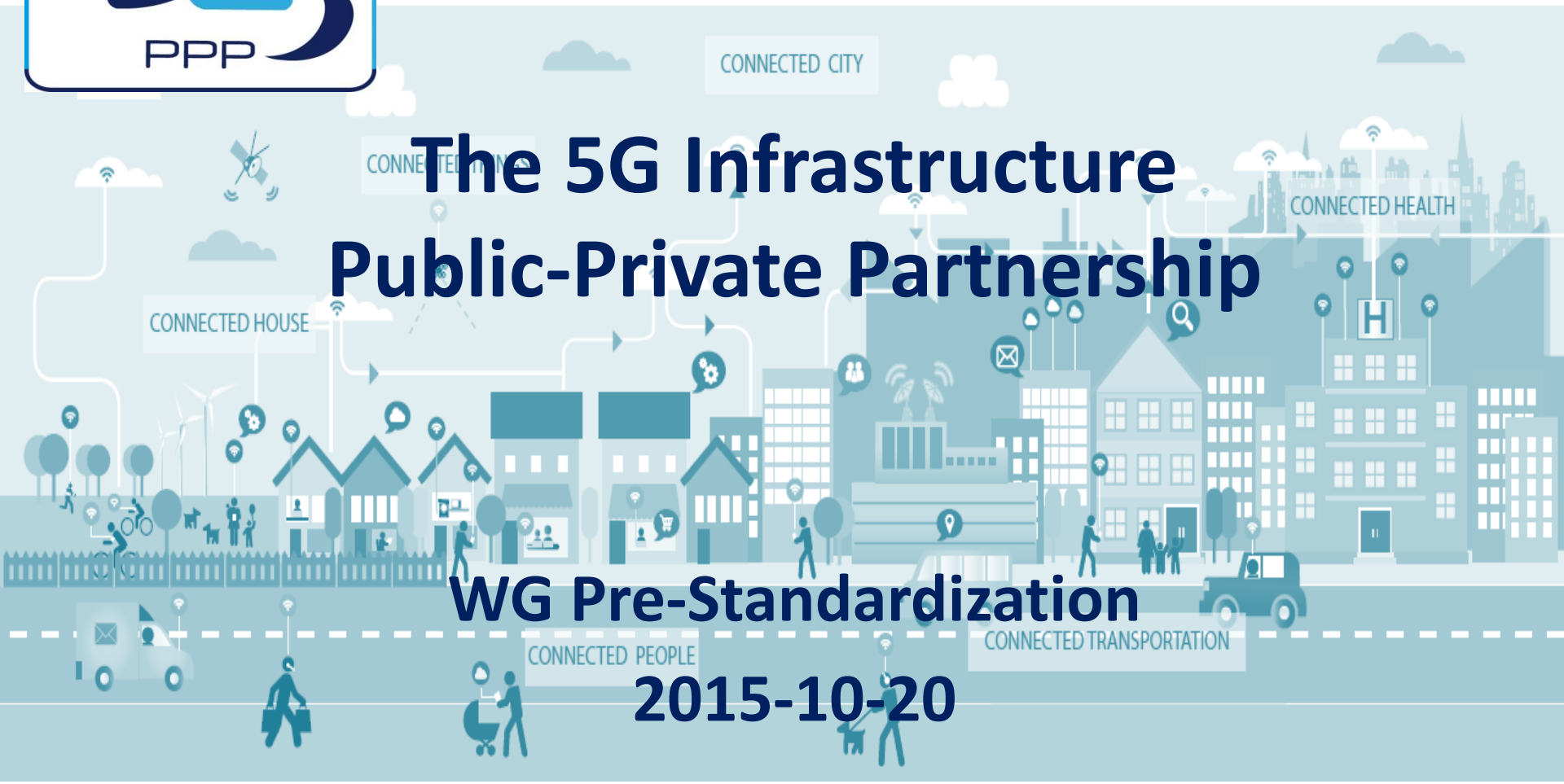


The 5G Infrastructure Public-Private Partnership

WG Pre-Standardization

2015-10-20

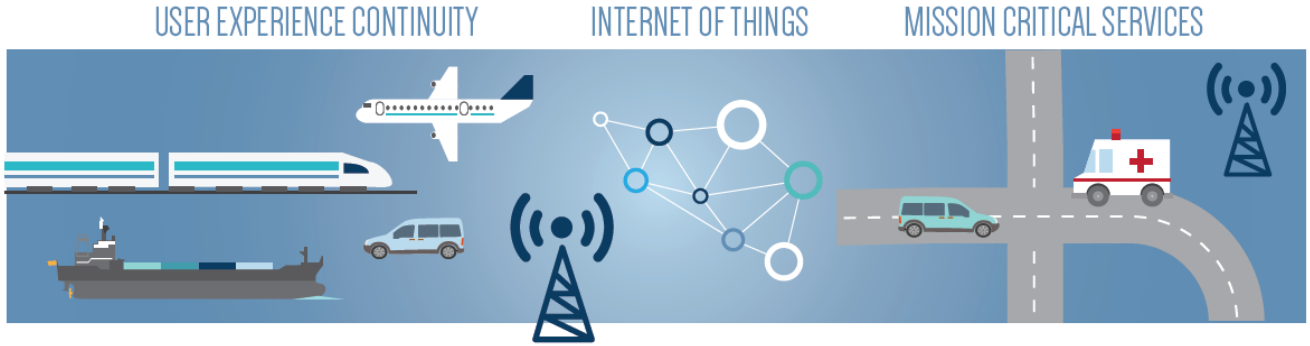
5G-PPP Key ambitions

- 5G-PPP Program aims at delivering technologies, architectures and solutions to future 5G communication infrastructures
- Support of 5G-PPP targeted outcomes in global standards is a priority.
- 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

5G-PPP believes this is largely aligned with other 5G Industry Forums

5G-PPP Vision and Requirements

5G new service capabilities



- 5G supports 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 e.g. 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
  - healthcare, government
- 5G scales to growing demand and different network layouts
  - anticipated dramatic growth in number of terminal devices and continuous growth of traffic
  - heterogeneous network layouts including satellite
  - power consumption less or equal to current networks and reduced network management complexity

5G-PPP believes there is a common view on 5G service capabilities

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5G-PPP Vision and Requirements
Key Requirements

These Key Requirements are not expected to be met all at the same time

- 1,000 X in mobile data volume per geographical area reaching a target ≥ 10 Tb/s/km^2
- 1,000 X in number of connected devices reaching a density ≥ 1M terminals/km^2
- 100 X in user data rate reaching a peak terminal data rate ≥ 10Gb/s
- Guaranteed user data rate >50Mb/s
- 1/10 X in energy consumption compared to 2010
- 1/5 X in end-to-end latency reaching 5 ms for e.g. tactile Internet and radio link latency reaching a target ≤ 1 ms for e.g. Vehicle to Vehicle communication
- 1/5 X in network management OPEX
- 1/1,000 X in service deployment time reaching a complete deployment in ≤ 90 minutes
- Mobility support at speed up to 500km/h for ground transportation
- Accuracy of outdoor terminal location ≤ 1m

5G requirements identified by other Industry Forums appear to be similar

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5G-PPP and the Vertical sectors
Setting the requirements

- Requirements from vertical sectors for 5G are very important
- 5G-PPP is writing a series of whitepapers on automotive, health, nedia, energy, and manufacturing requirements involving players from these verticals.
- Challenges that will be difficult, even impossible, to meet with current LTE include:
  - Very low latency of 5ms is required (e.g. for autonomous driving)
  - Coverage needs to be improved (e.g. deep indoor, rural areas and roads)
  - Service continuity between different access technologies is needed (e.g. for automotive, manufacturing and media & entertainment)
  - High throughput of at least 50 Mbps is needed for immersive user experience everywhere (e.g. virtual reality and 4K videos)
  - High reliability / QoS control (and potentially low latency) of 99.999% is required for low throughput applications (~Mbps) for health, energy and manufacturing
  - Localization accuracy of 10cm is required for bicycles road safety applications
  - Low cost and energy efficiency is a must for energy and manufacturing applications
  - Lots of verticals require a high level of security

5G-PPP believes addressing the vertical sectors distinguish 5G from 4G

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5G-PPP approach to research and standardization

- Develop a common view on use-cases and verticals
- Develop concepts addressing the scenarios
- Research projects investigate technology component candidates
  - First evaluations based on scenarios and use-cases
- Industry partners select relevant topics to drive in standardization
- Method to contribute
  - Partners inputs to 3GPP (and other standardization bodies)
  - Understanding the verticals (interaction with relevant standardization organs to understand key requirements)
- Next steps in research projects

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5G-PPP View on Relevant Standardization bodies for 5G

- Telecom
  - 3GPP
    - Access, fronthaul, system architecture,...
  - ITU-R (SG3/SG5, WP5D), ITU-T (SG13/SG15)
  - IEEE
    - Access, fronthaul
  - ETSI (NFV/MEC), IETF/IRTF (SDNRG/NFVRG/SFC …), IEEE (802.1CF), ONF, BBF, Open source projects (Open Daylight, OPNFV, Open Stack)
    - System architecture, softwarization and virtualization, control and orchestration
  - OneM2M
    - IoT, Machine-Type Communication
  - ETSI TC SES
    - Satellite subsystems

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5G-PPP View on Relevant Standardization bodies for 5G

- Vertical-specific
  - Reason for verticals to use these solutions is to benefit from
    - Ease of integration
    - economy-of-scale
  - Trade-off between specific requirements and unified, standardized solutions
  - Focus on requirements from vertical SDOs
- Examples of SDOs for the Automotive industry
  - C-ITS, ETSI, CEN and ISO.
  - E.g., joint work between ISO TC204 WG18 and CEN TC278 WG16

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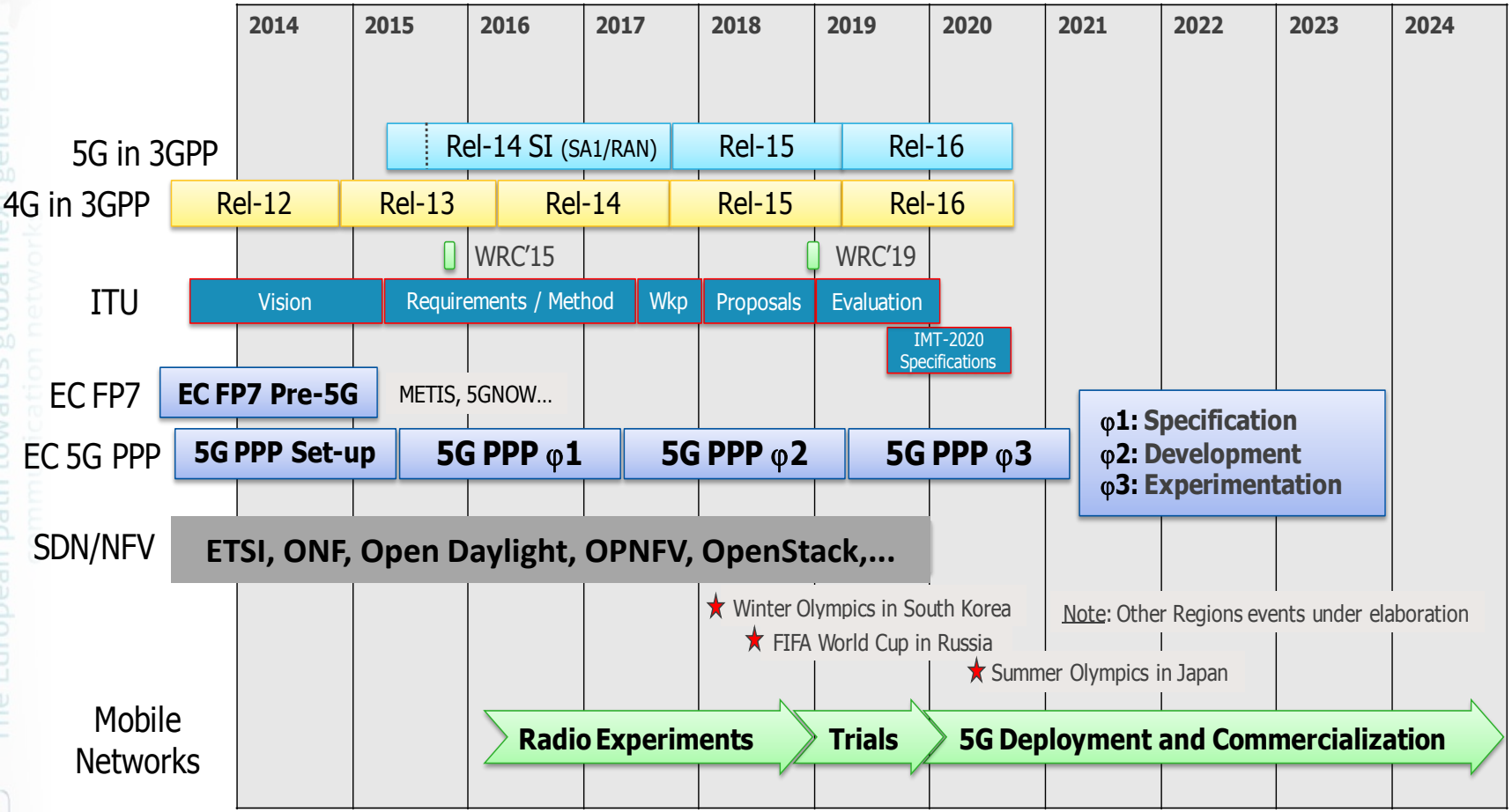
5G Time-Line
Mapping to 3GPP projected schedule



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3GPP Time-line

- Study Phase in 3GPP TSG RAN to start in December 2015
  - Requirements and scope of new radio will be established by RAN in the SI (Study Item) starting in December 2015
  - The study should assume no phasing, nor aim to conclude on any phasing. Requirements should be defined for all identified use-cases.
  - WGs will then proceed with the evaluation of technology solutions in another SI starting in March 2016
- Study Item in 3GPP TSG SA WG1 ongoing
  - Looking for inputs on use-cases
- Study Item in 3GPP TSG SA WG2 expected to start December 2015
  - Will look for inputs on 5G architecture
- Channel modeling
  - Contributions generally welcome
  - Closing date not determined, likely within 6-12 months

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3GPP Time-line

- Phase 1 until H2 2018
  - Phase 1 to be completed by H2 2018 to address a more urgent subset of the commercial needs
  - There is no consensus yet what is the “urgent subset of the commercial needs”
  - This maps to 3GPP Rel-15
- Phase 2 until December 2019
  - Phase 2 to be completed by December 2019 for the IMT 2020 submission and to address all identified use-cases and requirements
  - This maps to 3GPP Rel-16

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5G-PPP research project impact

- Scenarios and use-cases need to be disseminated from the H2020 projects urgently to impact the 3GPP RAN and SA work.
- Channel model results need to be disseminated from the H2020 projects urgently to impact the 3GPP RAN work.
- The H2020 projects need to be agile to adapt to the contents of the 3GPP normative phases and timely disseminate appropriate technical results.
- Next, architecture results may be disseminated from the H2020 projects to impact 3GPP SA2

Technology areas frequently mentioned at 3GPP RAN 5G Workshop

- New Carrier
- New waveform/Numerology
- Massive MIMO enhancements
- Latency reduction techniques
- mmWave communications
- Non-Orthogonal Multiple Access
- Adaptive frame structure, Flexible frame structure
- Cell virtualization
- User-centric (NFV/Slicing, RAN virtualization)
- Ultra Dense Network
- Advanced MIMO/beamforming
- Focus on TDD
- Less network broadcast, reduced or no periodic transmission
- Flexible Duplex
- Symmetric UL/DL PHY (e.g. MC-OFDM)
- eD2D
- Small cells
- Dynamic TDD
- Wireless Mesh (D2D)

Thank you for your attention!

http://5g-ppp.eu