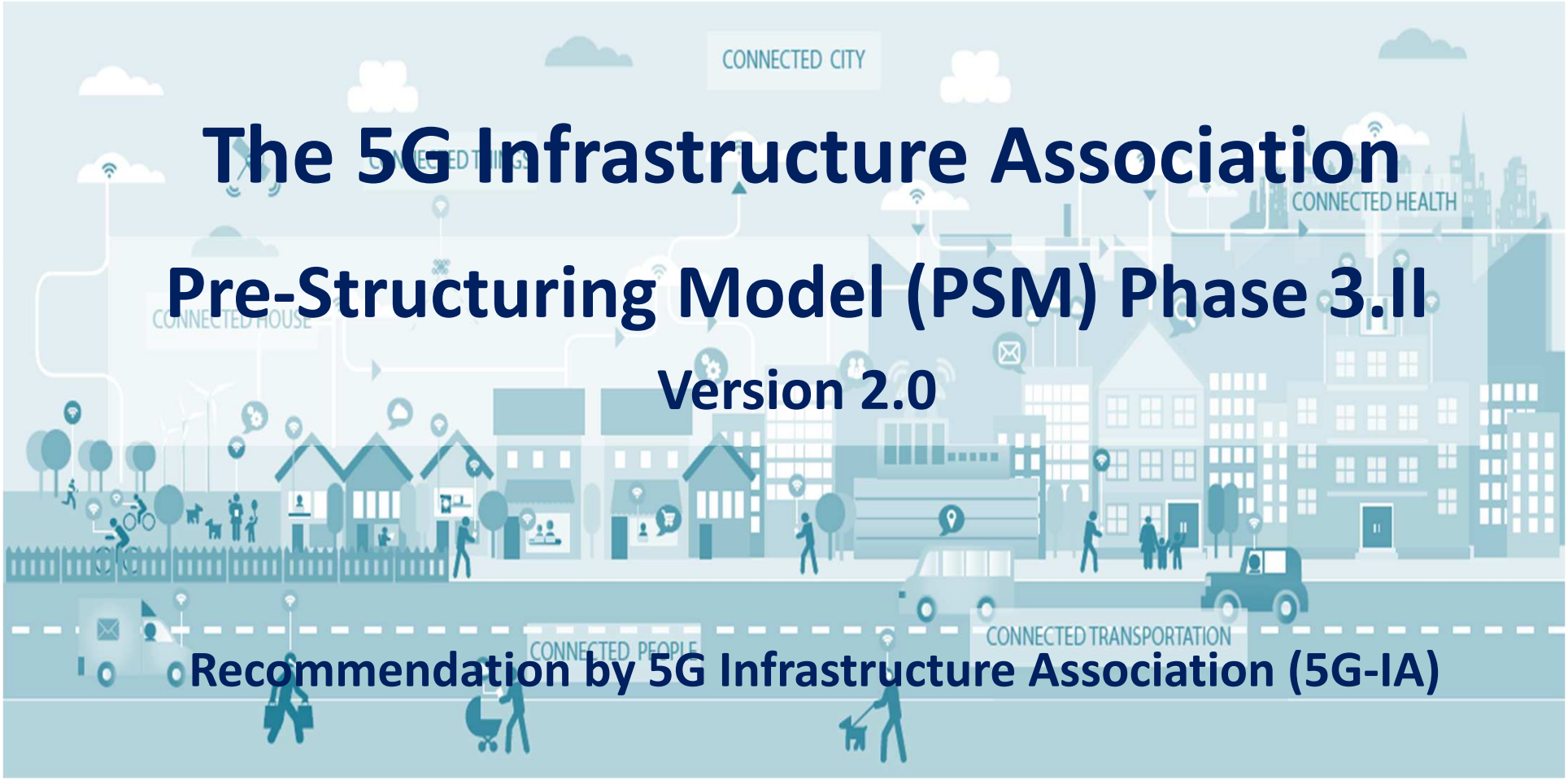
The 5G Infrastructure Association

Pre-Structuring Model (PSM) Phase 3.II

Version 2.0



Recommendation by 5G Infrastructure Association (5G-IA)

H2020 5G Infrastructure PPP
PSM Phase 3.II Approach

- 5G Infrastructure PPP is an ambitious programme (3 Phases) with ambitious KPIs
- 5G Infrastructure PPP is more than a group of standalone projects
- Pre-Structuring Model (PSM)
  - Ensuring that the right set of projects (portfolio) will work together
    - Intra-phase and through phases (90+ projects in the full programme)
    - Model presenting features and recommendations to guarantee smooth integration of new projects in existing coordinated programme
  - Model focused on PPP Phase 3.II projects portfolio and related projects, not on proposals. Model not prescriptive (including on technologies)
  - Model defining recommendations from 5G-IA perspective, enriched through interactions with the overall Community (incl. Open Consultation)
    - Phase 3.II PSM elaborated by 5G-IA Vision and Societal WG
  - Model taking as reference the EC Work Programme 2018-20 and (draft/final) EC Work Programme 2020 (see next slides detailing PSM Versions)
- Model to be widely accepted by the Community and to be recommended by 5G-IA and EC as « reference » platform and guidelines for the further development of proposals
- Evaluation of proposals to consider the Model as background information to the evaluation process
  - Avoiding duplication ("hype effect") and coverage gaps issues in the portfolio

H2020 5G Infrastructure PPP
PSM Phase 3.II Scope & Coverage (1/3)

- PSM Phase 3.II addressing the following 5G Infrastructure PPP Strategic Objective (SO) in the EC Work Programme 2018-2020
(http://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-leit-ict_en.pdf)
  - ICT-20-2019: 5G LTE (RIA) – DL on 28.03.19
- PSM Phase 3.II addressing the following 5G Infrastructure PPP SOs captured in the EC Work Programme 2020 officially released on 02.07.19
(http://ec.europa.eu/research/participants/data/ref/h2020/wp/2018-2020/main/h2020-wp1820-leit-ict_en.pdf)
  - ICT-52-2020 – Smart Connectivity beyond 5G (RIA) – DL on 22.04.20
  - ICT-41-2020 – 5G Innovations for Verticals with Third Party Services (IA) – DL on 22.04.20
  - ICT-42-2020 – 5G Core Technology Innovations (IA and CSA) – DL on 16.01.20
  - ICT-53-2020 – 5G for Connected and Automated Mobility (CAM) (IA) – DL on 13.11.19

H2020 5G Infrastructure PPP
PSM Phase 3.II Scope & Coverage (2/3)

5G PPP
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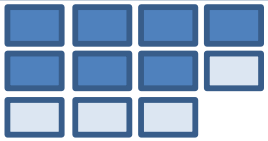
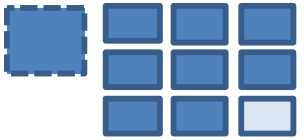
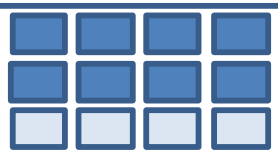
- EC H2020 5G Infrastructure PPP Phase 3.II – Strategic Objectives

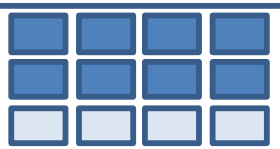
5G LTE (ICT-20-2019)

DL: 28.03.19
44 ME – 4-6 ME/TA
7-11 RIA TAs

Smart Connectivity beyond 5G (ICT-52-2020)

DL: 22.04.20
55 ME – 5-12 ME/TA
8-9 RIA TAs (5 ME) + 1 System/Flagship TA (12 ME)

5G for Connected and Automated Mobility (CAM) (ICT-53-2020)

DL: 13.11.19
30 ME – 7-10 ME/TA
3-4 IA TAs

5G Core Technology Innovations (ICT-42-2020)

DL: 16.01.20
48 ME – 4-6 ME/TA (+1 CSA – 1ME)
8-12 IA TAs

5G Innovations for Verticals with Third Party Services (ICT-41-2020)

DL: 22.04.20
49 ME – 4-6 ME/TA
8-12 IA TAs

2019 2020

H2020 5G Infrastructure PPP
PSM Phase 3.II Scope & Coverage (3/3)

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- PSM Phase 3.II Version 1.0 released on 08.02.19 and opened for interaction with Community. Focusing on ICT-20-2019 and ICT-52-2020 Targeted Actions (TAs) and providing recommendations for ICT-52-2020 TAs, including System flagship TA
- PSM Phase 3.II Version 1.1 released on 28.02.19, including up-dates on ICT-20-2019 and ICT-52-2020 recommendations and recommendations on ICT-53-2020 (Corridors). Open Consultation organized between 03.04.19 and 25.04.19, extended to 17.05.19 (https://5g-ppp.eu/consultation-on-the-psm-2019/). See details in slides 6 and 7
- PSM Phase 3.II Version 2.0 released on 12.07.19, following the release of the (official) final version of the EC Work Programme 2020 on 02.07.19. Covering the overall set of SOs and also considering the inputs to the Open Consultation. See the key take away points from the Open Consultation in Slide 7
- PSM Phase 3.II Version 3.0 targeted in November 2019, following the contractualization of the ICT-20-2019 projects. Will include the key topics addressed by the funded ICT-20-2019 projects, targeting an overall Portfolio-Structuring Model and providing important context for the rest of the PSM Phase 3.II TAs

H2020 5G Infrastructure PPP
PSM Phase 3.II Characteristics

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- PSM Phase 3.II Characteristics
  - Model providing recommendations by Strategic Objectives and specific Targeted Actions (TAs) identified as key in the PPP Projects Portfolio
    - Leveraging approach from Phase 1 and Phase 2 Models that were proposing specific individual TAs (https://5g-ppp.eu/wp-content/uploads/2014/03/5G-Infra-PPP_Pre-structuring-Model_v2.0.pdf and https://5g-ppp.eu/wp-content/uploads/2015/11/160304_5G-Infra-PPP_Phase2-Pre-structuring-Model_v2.0.pdf)
    - Leveraging approach from Phase 3.I Model that was proposing recommendations, considering the specificities/focus of the Strategic Objectives (https://5g-ppp.eu/wp-content/uploads/2017/10/171107_5GInfraPPP_Phase3-Pre-StructuringModel_V2.0.pdf)
    - Targeting system recommendations to develop future efficient cross-projects cooperation, ensuring a comprehensive coverage of R&I topics, with no gaps or redundancies
  - ICT-20-2019 focused on 5G LTE and ICT-52-2020 focused on B5G. Some ICT-52-2020 TAs to be targeted in the transitioning between H2020 and forthcoming Horizon Europe (HE)
  - ICT-53-2020 (Corridors) recommendations included in/from the PSM Version 1.1 on 28.02.19
  - ICT-41-2020 and ICT-42-2020 TAs and recommendations included in/from the PSM Version 2.0
  - Final ICT-20-2019 TAs and recommendations included in Version 1.1 (https://5g-ppp.eu/wp-content/uploads/2019/02/190228_5GInfraPPP_PSM-Phase3.II_V1.1.pdf). Not included anymore in Version 2.0 (Call DL on 28.03.19)

H2020 5G Infrastructure PPP
PSM Phase 3.II – Open Consultation

- Key Take Away Points from the Open Consultation on PSM Version 1.1
  - Public Open Consultation on the PSM Version 1.1 launched on 03.04.19 with DL initially scheduled on 25.04.19, extended to 17.05.19 (https://5g-ppp.eu/consultation-on-the-psm-2019/)
  - 16 inputs received (including content on raised questions) from Academics (3), Research Centers (5), SMEs (5) and Large Industry (3)
  - 14/16 positive answers on the question if the PSM is helpful for the understanding of the PPP and its forthcoming Phase 3.II scope and potential priorities
  - Inputs on ICT-52, ICT-41 and ICT-42 considered for the further definition of the PSM Version 2.0 Recommendations and TAs slides, including (not exhaustive list)
    - Standard APIs for third parties experimentation (ICT-41)
    - Private network deployments (ICT-41)
    - Drone applications - Dynamic function split and placement (ICT-42)
    - Gaming + AR/VR - Memory and caching for opportunistic offloading of data on intermittently available wireless links (ICT-42)
    - Neutral host - Multi-tenant network functions security (ICT-42)

H2020 5G Infrastructure PPP
Phase 3.II and PPP Programmatic Perspectives (1/5)

5G PPP
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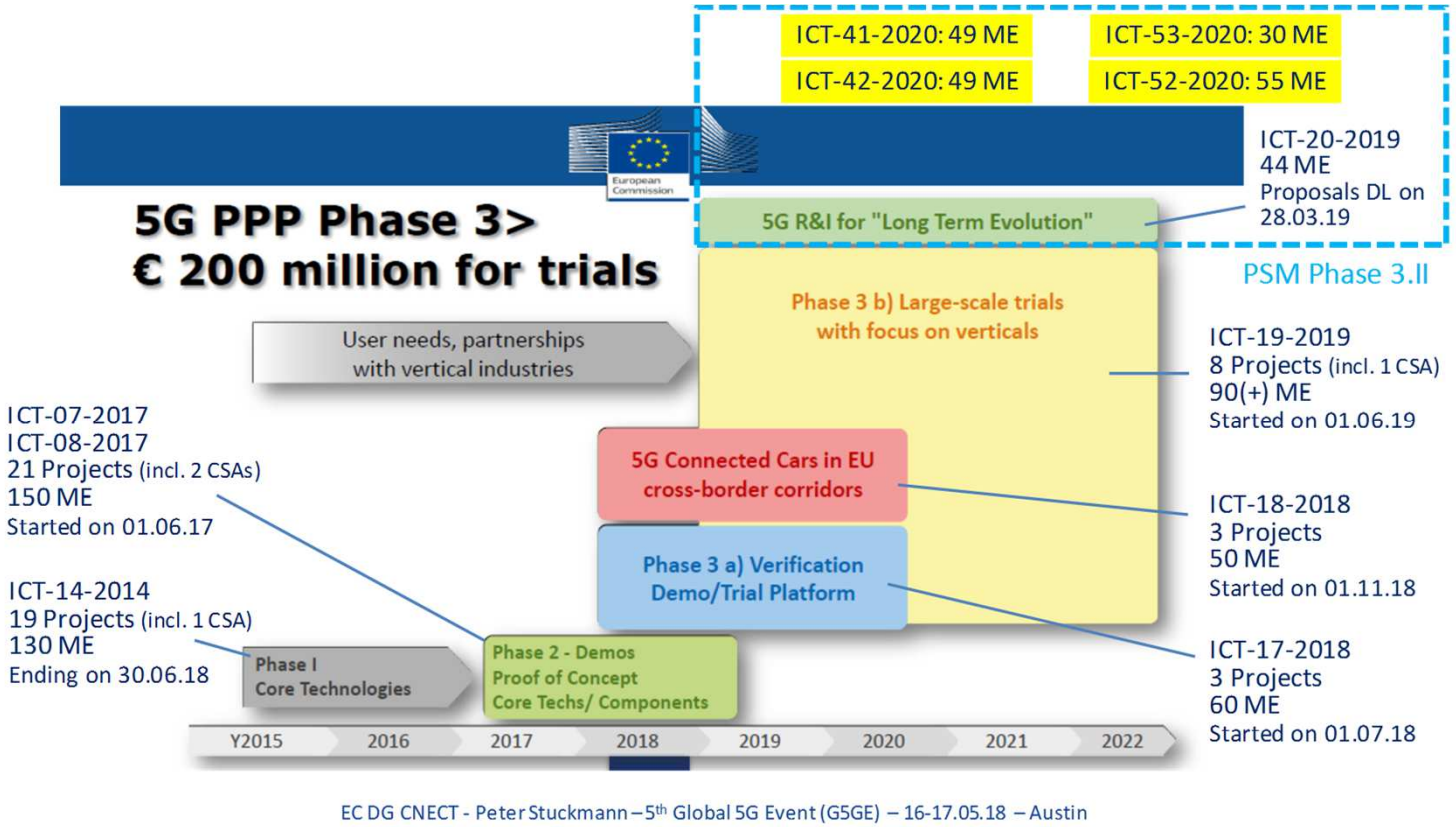
- PPP Programme – Phases, Strategic Objectives and Projects



EC DG CNECT - Peter Stuckmann – 5th Global 5G Event (G5GE) – 16-17.05.18 – Austin

H2020 5G Infrastructure PPP
Phase 3.II and PPP Programmatic Perspectives (2/5)

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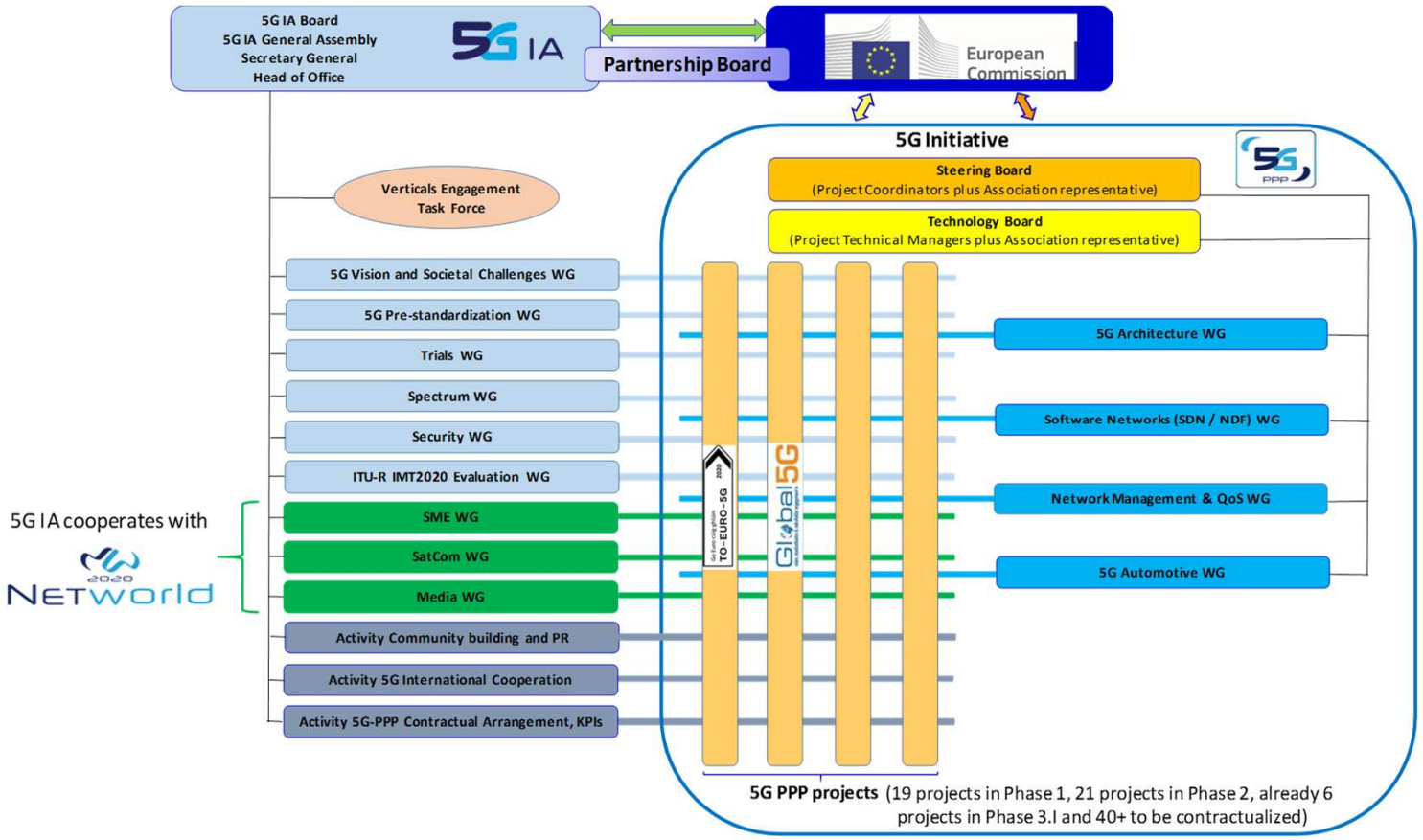
- PPP Governance



https://5g-ppp.eu/

H2020 5G Infrastructure PPP
Phase 3.II and PPP Programmatic Perspectives (3/5)

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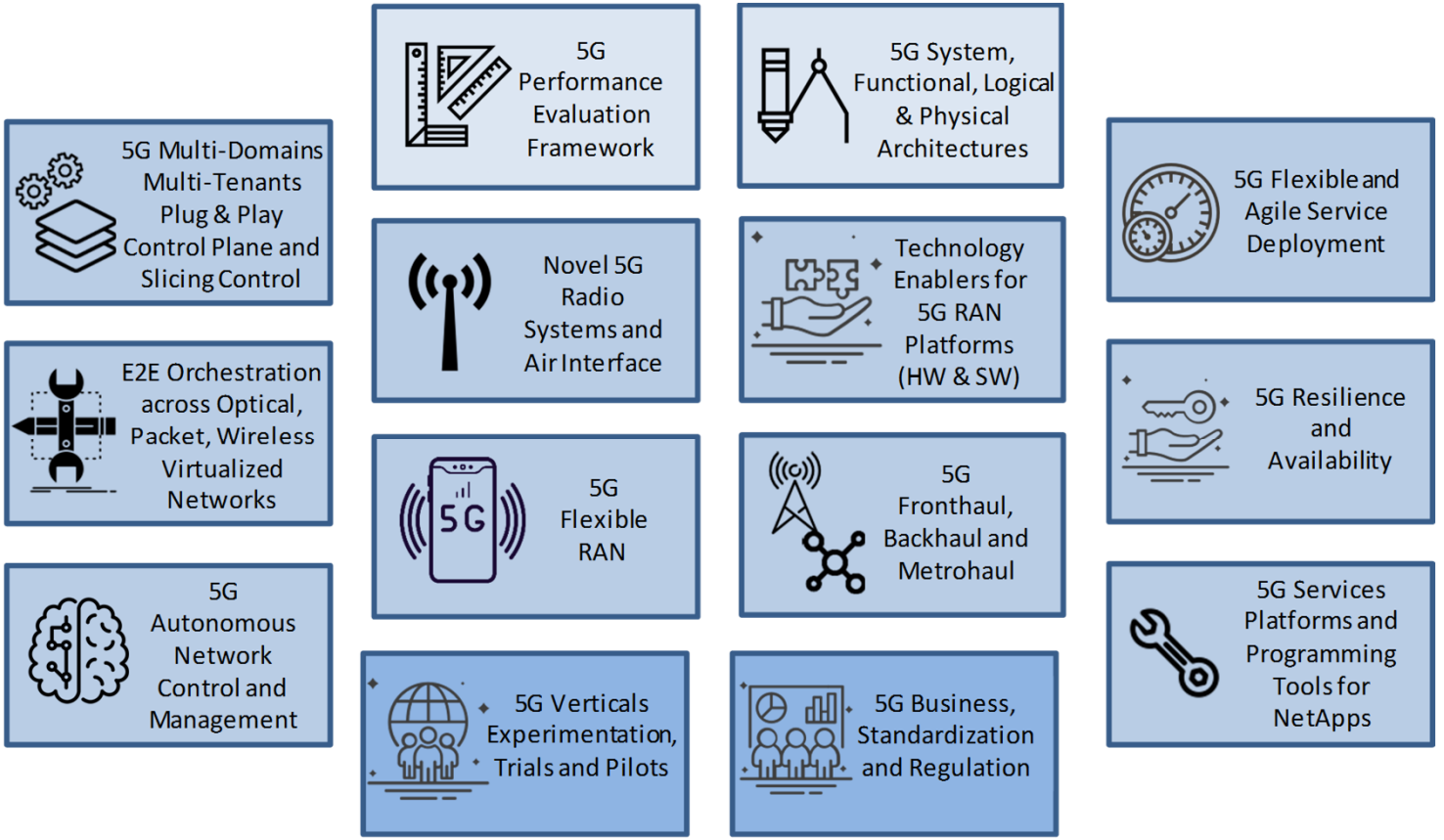
- PPP Golden Nuggets Version 2.0



Icons sources: https://www.iconfinder.com and https://www.flaticon.com

https://5g-ppp.eu/phase-2-key-achievements/

H2020 5G Infrastructure PPP
Phase 3.II and PPP Programmatic Perspectives (4/5)

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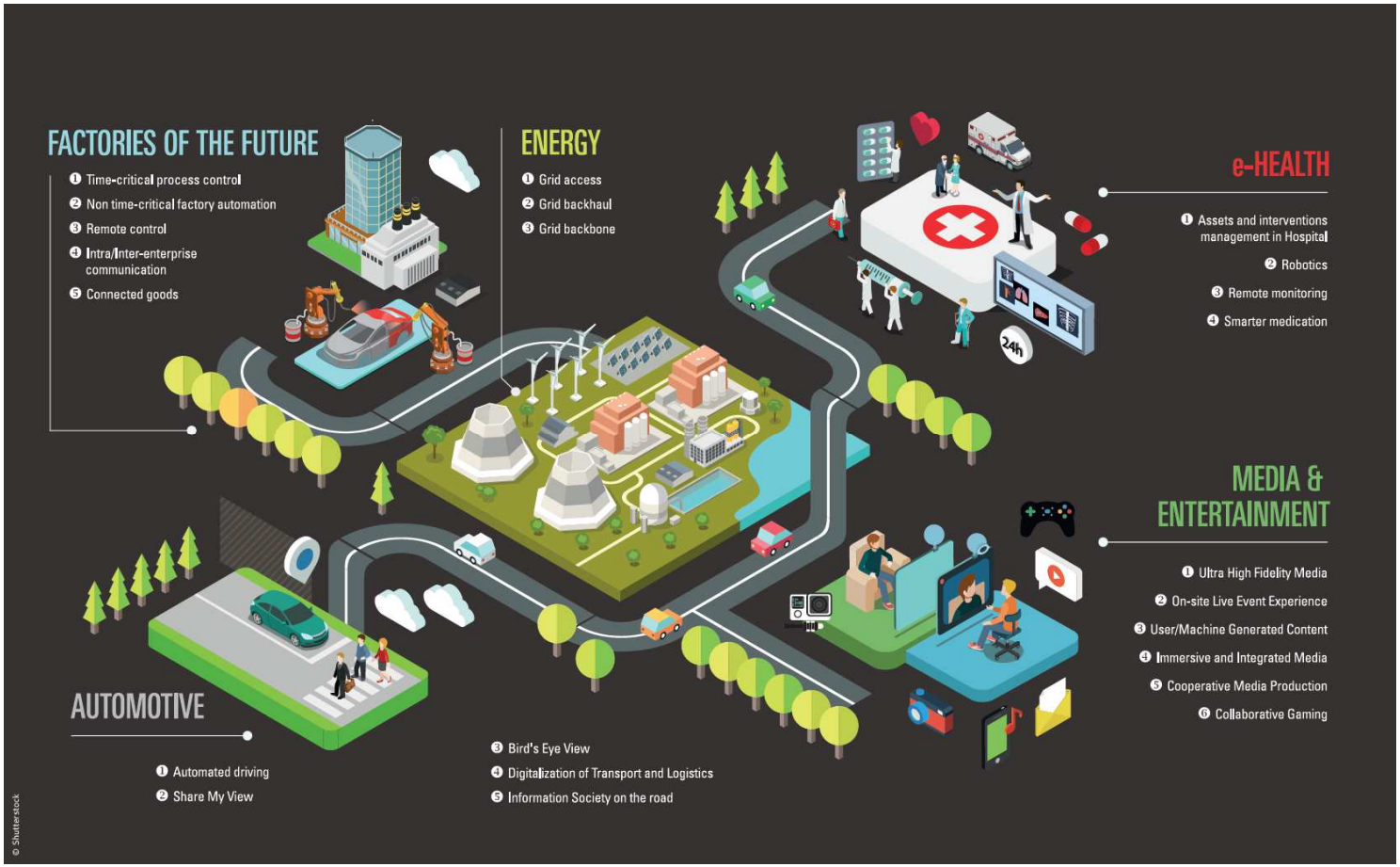
- PPP Verticals - White Paper – Highlights – MWC 2016



https://5g-ppp.eu/wp-content/uploads/2016/02/BROCHURE_5PPP_BAT2_PL.pdf

H2020 5G Infrastructure PPP
Phase 3.II and PPP Programmatic Perspectives (5/5)

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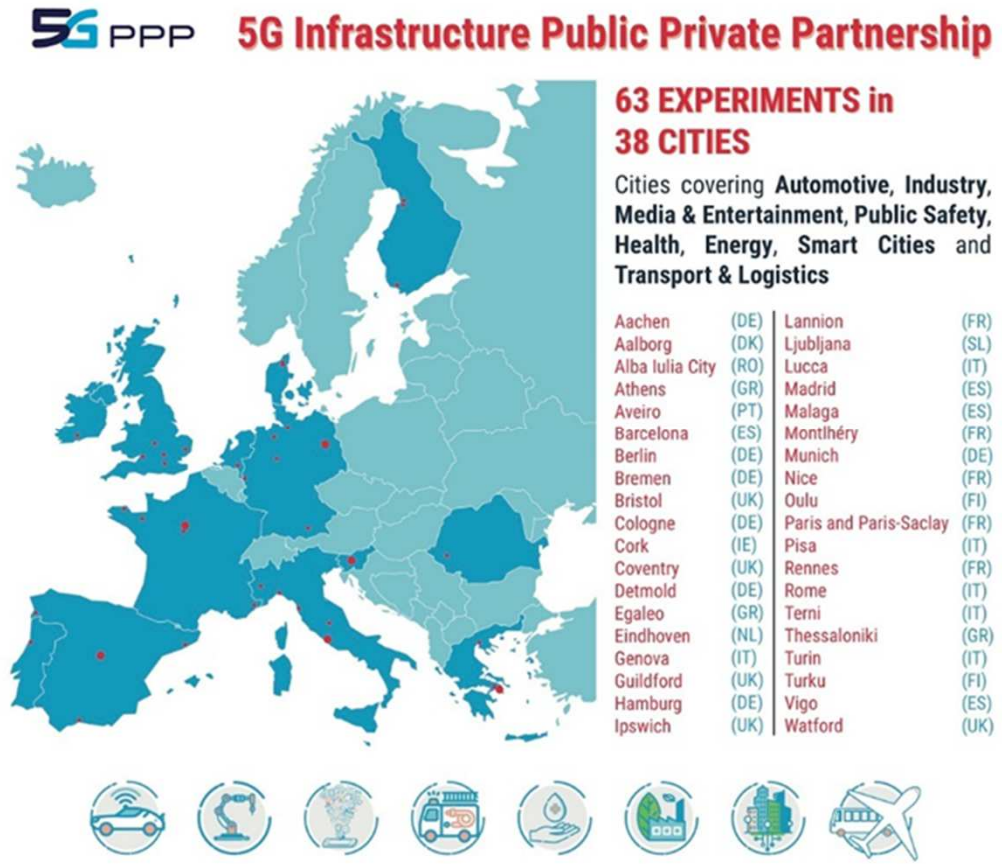
- PPP Phase 2 Projects Verticals Pilots & Trials – 38 Cities (Highlights – May 2018)



https://5g-ppp.eu/5g-trials-roadmap/

H2020 5G Infrastructure PPP
PSM Phase 3.II – ICT-52-2020 TAs (1/8)

- ICT-52-2020 focusing on B5G
- PSM Phase 3.II considering the NetWorld2020 Strategic Research & Innovation Agenda (SRIA) – 2021-2027 (https://www.networld2020.eu/wp-content/uploads/2018/11/networld2020-5gia-sria-version-2.0.pdf) for the R&D directions to orientate the projects in the portfolio
- Some ICT-52-2020 TAs to be targeted in the transitioning between H2020 and forthcoming Horizon Europe (HE) (targeted Smart Networks & Services (SN&S) Partnership)
- PSM recommendation to target
  - System flagship project (top-down) (around 12 ME)
  - Complementary smaller and more focused projects (5 ME) according to the Call topics, proposed bottom-up. PSM Version 2.0 identifying key Thematics to be considered and proposing specific grouping of these Thematics inside TAs. Proposed grouping inside TAs corresponds to one recommendation towards the Community. Alternative Thematics and grouping are clearly possible. There is no inclusion of detailed individual ICT-52 TAs slides in the PSM Version 2.0 as the ICT-52 B5G target is widely open and the PSM intention is to provide value to the Community avoiding any potential prescriptive perspective

H2020 5G Infrastructure PPP
PSM Phase 3.II – ICT-52-2020 TAs (2/8)

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System Flagship TA

Rationale

The challenge is to go well beyond the 5G capabilities developed under 3GPP release 16 that will become available early 2020. The NetWorld2020 Strategic Research & Innovation Agenda (SRIA) v1.0 provides a technical vision for key R&I directions in smart communication networks in the upcoming period 2021-2027. Proposals in this Topic should start addressing some of these R&I threads, to advance the current knowledge and prototypes, and prepare the ground for research initiatives in the next Framework Programme and beyond. This TA would also thus have structuring effects across key industry stakeholders and linking them with academia. This TA could also support transition from Horizon 2020 to Horizon Europe via impact on future calls. The pre-standardization type of work done in the TA would maintain momentum of European contributions to international standardization

Objectives/Scope

- Provision of seemingly infinite network capacity for demanding applications considering for instance connectivity between distributed storage and computing resources and more generally between required endpoints
- Support for imperceptible latencies, as well as flexible configuration of uplink vs. downlink radio resources
- High accuracy positioning and radar imaging
- Provision for connection of massive amounts of things and systems in a scalable and cost-efficient way
- Support for adaptive networks, allowing alignment of application intent with network services, considering requirements from different applications and verticals
- Provide personalized, multi-tenant and perpetual protection based on security, privacy and trust mechanisms

Expected Impact

- Smart connectivity platforms integrating connectivity, storage, and computing resources opening for new service and business models
- Smart connectivity platforms integrating novel radio schemes and technologies towards perceived zero latency
- Network scalability towards a high number of resource-constrained devices, multiplicity of service requirements, and new user-controlled connectivity paradigms
- Characterization and availability of secure and trusted environments for software based virtualized networks, including underlying hardware limitations and enabling trusted multi-tenancy
- Dynamic scalability of network capabilities through availability of managed and enhanced optical resources.
- Characterization of distributed trust technologies (such as DLTs, commonly known as "blockchains") to enhance network/service management and security
- Application of AI and data-enabled mechanisms for network/service management, anomaly detection and mitigation, and security response
- Significant reduction of total cost of ownership through improved operational and capital expenditure efficiency, and energy consumption
- Reduction of general level of radio transmitted power

H2020 5G Infrastructure PPP
PSM Phase 3.II – ICT-52-2020 TAs (3/8)

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Thematics to be considered for ICT-52-2020 TAs in Version 2.0

- The PSM Phase 3.II Version 2.0 includes TAs based on the inputs developed by the 5G-IA Vision & Societal WG - PSM Sub-Group in tight connection/interactions with the Community (incl. NetWorld2020 and Open Consultation). Some examples (highlights) of key technical and technological challenges/domains are detailed below
  - **T1**: **Superbandwidth Air Interface for ultra-high rate data transmission**
    - Surpassing the IMT-2020 (3GPP Rel-15/16) requirements and potentially going beyond current 5G NR that uses OFDM waveforms, for both terrestrial and satellite networks
    - Identifying additional KPIs that should be taken into account for future IMT-2030 evaluation framework
    - Taking into account capabilities and limitations of RF and baseband subsystems
    - Design as a part of multi-connectivity framework including non-3GPP technologies (e.g. Wi-Fi, Li-Fi and satellite) and potential use for joint access/backhaul
    - Responding to "seemingly infinite network capacity" requirement of ICT-52-2020, while dynamically optimizing resource utilization across the variety of concurrent application requirements
  - **T2:** Radio technologies toward **cell free networks**
    - Distributed antenna system and relay network design for enhancing capability of eMBB, URLLC and mMTC.
    - Including, (1) user clustering in large-scale distributed antenna systems for joint processing at physical layer. (2) beam/precoding designs in Massive MIMO, mmWave, as well as potentially jointly orchestrated terrestrial and satellite communication systems
    - ML Based designs, taking into account physical layer conditions and instantaneous traffic
    - Responding to "radio technologies towards cell free networks including scalable cell-free Massive MIMO"

H2020 5G Infrastructure PPP
PSM Phase 3.II – ICT-52-2020 TAs (4/8)

5G PPP
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Thematics to be considered for ICT-52-2020 TAs in Version 2.0

- **T3: Resilient networking** for supporting improved and **elastic reliability**
  - Smart anomaly detection, predicting and resisting negative effects before they happen and/or rapidly recovering if negative effects can not be avoided
  - Developing novel elastic network technologies, e.g., support for changing network topologies at runtime
  - Taking into account vulnerability of both network infrastructures and individual devices (e.g., IoT devices) in the network and support application-level resilience
  - Relating to "novel architectures and protocols for adaptive networks" requirement of ICT-52-2020
- **T4**: **AI/ML**-powered **adaptative network operations**
  - Intent-based networking, monitoring and reacting in real time to changing network conditions, and consequently adapting to different network topologies
  - Closed-loop AI/ML mechanisms based on context-aware and metadata-driven policies to make automatically actionable decisions
  - Proactive resource allocation decisions based on heuristics (rather than reactive approaches)
  - Decision modules as software control elements realizing an adaptive control over the network resources and terminals in an end-to-end approach
  - Taking into account both network and individual terminal perspectives in the design, enabling cognitive functionalities at an application level
  - Relating to "novel architectures and protocols for adaptive networks" requirement of ICT-52-2020
- **T5:** Application level E2E Latency for providing **true low latency user experiences**
  - Providing ultra-low latency hardware/software/network solutions that also meet security and privacy requirements
  - Evolution of URLLC
  - Flexible connectivity-compute technologies for optimized resource distribution
  - Integration of application layer and network services for zero-perceive latency services in the Tactile Internet, using new protocol architectures and potentially AI techniques. Examples: remote teleoperation and control of connected cyber-physical systems
  - Multicast/Broadcast enabler i.e. terrestrial and/or satellite overlay and smart video caching/processing at the edge
  - Responding to "perceived zero latency" as well as "security, privacy and trust" requirements of ICT-52-2020

H2020 5G Infrastructure PPP
PSM Phase 3.II – ICT-52-2020 TAs (5/8)

5G PPP
The European path towards global next generation communication network

Thematics to be considered for ICT-52-2020 TAs in Version 2.0

- **T6:** Application level **E2E energy efficiency** for supporting sustainable ICT development
  - Providing holistic energy efficient solutions including network infrastructure, increased number of edge nodes, end-user equipment and computing
  - Providing smart network management of massive amounts of things/systems in a scalable way from connectivity to computing (MEC)
  - Highly distributed computing and cloud-native orchestration, where network applications are dynamically created/, moved/removed
  - Fully exploiting capabilities of jointly orchestrated terrestrial and satellite networks offering ubiquitous multicast/broadcast coverage (broadcast to the edge)
  - Efficient resources management (optimum functionalities split, background bearers, dynamic control plane for mobile edge nodes
  - Relating to "connection of massive amounts of things and systems in a scalable and cost-efficient way" requirement of ICT-52-2020

- **T7: E2E security** for B5G applications
  - Deployment (and possible adaptation) of technologies that have gained momentum (e.g. AI/ML/DL/RL; Blockchain, placement optimization…) in the connectivity and computing domain for them to deliver and provide measurable improvements (KPIs) on a number of topics with overall objective to achieve E2E security the way expected (trustable and responsible)
  - Optimized security placement and network operations (effective in security coverage / energy)
  - Security tooling to ease system of systems and complex systems security and assurance certification (certification and composition schemes, formal proofs)
  - Considering both hardware and software security capabilities
  - Responding to "security, privacy and trust" requirements of ICT-52-2020

H2020 5G Infrastructure PPP
PSM Phase 3.II – ICT-52-2020 TAs (6/8)

5G PPP
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Thematics to be considered for ICT-52-2020 TAs in Version 2.0

- **T8: Secure and trustworthy** multi-tenant environment
  - Supporting the next generation multi-tenant and multi-cloud environment, with very high degree of virtualization and softwarization
  - Privacy management in full ([semi-]automated) compliance with what applies (legislation, regulation, …)
  - Geo-scale data management across heterogeneous networks
  - Effective & objective (evidence-based) Trust and liability management (including associated mechanisms)
  - Deliver effective way to (dynamically) compose and orchestrate security to fit needs at hands this together with the offering (services, standards, labels) to make it happen in a trustworthy manner
  - Vertical specific 5G security & privacy enhancements (e.g. security/privacy for CAM)
  - Responding to "security, privacy and trust" requirements of ICT-52-2020

- **T9:** Network design for enabling/improving **connectivity in currently underserved areas**
  - Providing commercially viable and scalable mobile broadband solutions from both radio access and network architecture (e.g. terrestrial and/or satellite communications) points of view as well as business/operation/ maintenance models
  - Supporting low-cost, energy efficient and environment friendly connectivity-computing solutions for enabling smart farming and mission critical applications (e.g. wildfire alarm/rescue) in remote/rural areas
  - Relating to rural broadband connectivity requirement of EC strategic connectivity objectives for 2025 (5G Action Plan), whose estimated investment costs can be lighten by making use of terrestrial and/or satellite communications

- **T10: Next-generation optical access & x-haul** for B5G applications
  - Enabling massive cost-efficient 5G small cell deployment
  - Following up on the respective PPP Phase 2 Golden Nugget
  - Capturing the new B5G challenges in terms of bandwidth, connectivity and flexibility
  - Responding to "perceived zero latency" requirement of ICT-52-2020

H2020 5G Infrastructure PPP
PSM Phase 3.II – ICT-52-2020 TAs (7/8)

5G PPP
The European path towards global next generation communication network

Thematics to be considered for ICT-52-2020 TAs in Version 2.0

- **T11:** Flexible and sustainable **optical fiber capacity scaling**
  - Addressing the scaling disparities in the various optical network segments (access, metro, core and data center interconnect)
  - Prevent bottlenecks in B5G mobile generations
  - Relating to the "enhanced optical capabilities" called for in WP2020
- **T12: Next-generation private networks** for vertical applications
  - Addressing flexible and high-bandwidth integrated scenarios (wireless+optical, cellular+satellite, connect+compute).
  - Integration of WiFi and LiFi into the private network
  - Integration of non-wireless communications technologies, e.g., sensing, radar, Lidar, charging and imaging, enriching functions of the network
  - Smart spectrum share and management for supporting multiple services and various radio technologies
  - Secure and efficient interaction and handover to and from public operators
  - Considering network, compute and storage sharing with public networks
  - Support of smart manufacturing features, e.g. augmented reality, virtual reality, 3D machine vision, collaborative robotics
- **T13:** Integration of **terrestrial and aerial communication networks**
  - Full integration of satellite and aerial UEs with terrestrial networks for extended coverage, not limited to network level
  - Dynamic network infrastructures powered by unmanned autonomous vehicles (e.g., satellite, HAPs, UAVs).
  - Design of flexible aerial-terrestrial hybrid communication-computing systems
  - Taking sustainability aspect (e.g., cost and business) into account
  - Understanding of the impact on the satellite and aerial communication platforms and hence the hosted payloads when operating in different orbiting planes (i.e., environmental effects, deployment and orbital maintenance)
  - Developing PoC for demonstrating the feasibility and sustainability of integrated terrestrial and aerial communications systems

H2020 5G Infrastructure PPP
PSM Phase 3.II – ICT-52-2020 TAs (8/8)

5G PPP
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Recommendations for ICT-52-2020 TAs in Version 2.0

The PSM Phase 3.II Version 2.0 proposes the following 6 TAs (+2 TAs Blue Open) that cover all the 13 identified key technological domains/thematics. However, considering the grand challenge(s) some domain(s) may face, the PSM recommendation does not rule out the possibility to combine and cross-leverage domains and enabling thematics "beyond sum of the parts"

- **TA-1: Enabling radio technologies for achieving ultra-high network capacity**
  - Superbandwidth Air Interface for ultra-high rate data transmission (T1)
  - Radio technologies toward cell free networks (T2)
- **TA-2: URLLC Evolution towards the Tactile Internet**
  - Application level E2E Latency for providing true low latency user experiences (T5)
  - Next generation private networks for vertical applications (T12)
  - Resilient networking for supporting improved and elastic reliability (T3)
- **TA-3: Sustainable and scalable networks for massive connectivity and/or coverage extension**
  - Application level E2E energy efficiency for supporting sustainable ICT development (T6)
  - Network design for enabling/improving connectivity in currently underserved areas (T9)
  - Integration of terrestrial and aerial communication networks (T13)
- **TA-4: Secure, personalized and multi-tenant networks**
  - E2E security for B5G applications (T7)
  - Secure and trustworthy multi-tenant environment (T8)
- **TA-5: Novel architectures and protocols for adaptive networks and AI powered operations**
  - AI/ML-powered adaptative network operations (T4)
  - Resilient networking for supporting improved and elastic reliability (T3)
- **TA-6: Next-generation optical network infrastructure**
  - Next-generation optical access & x-haul for B5G applications (T10)
  - Flexible and sustainable optical fiber capacity scaling (T11)
- **TA-7 and 8 – Blue Open**

H2020 5G Infrastructure PPP
PSM Phase 3.II – ICT-53-2020 TAs (1/4)

5G PPP
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5G IA

Recommendations for ICT-53-2020: 5G for Connected and Automated Mobility (CAM) (IA)

- Project validation through cross border trials along 5G Corridors
- Projects shall consider the EC policy on CCAM (https://ec.europa.eu/digital-single-market/en/cooperative-connected-and-automated-mobility-Europe)

https://5g-ppp.eu/tag/automotive/

EU Corridors

- Metz-Merzig-Luxembourg (FR-DE-LU)
- Rotterdam-Antwerpen-Eindhoven (NL-BE-NL)
- Porto-Vigo and Evora-Merida (PT-ES)
- Tromso-Kolari - E8 "Aurora Borealis": (NO-FI)
- Helsinki-Turku-Stockholm-Gothenburg-Oslo-Copenhagen Nordic Way2 (FI-SE-NO-DK)
- Munich-Bologna - Brenner Corridor (DE-AT-IT)
- Thessaloniki-Sofia-Belgrade (EL-BG-RS)
- Tallinn-Riga-Kaunas - Via Baltica (E67)– Lithuanian/Polish border (EE-LV-LT)
- Kaunas-Warsaw - Via Baltica (LT-PL)

https://5g-ppp.eu/5g-trials-roadmap/

New Corridors not included in the map may be eligible if a MoU between the participating MSs is developed/available (https://ec.europa.eu/digital-single-market/en/news/eu-and-eea-member-states-sign-cross-border-experiments-cooperative-connected-and-automated and https://eur-lex.europa.eu/resource.html?uri=cellar:da5da09e-6a5a-11e8-9483-01aa75ed71a1.0003.03/DOC_2&format=PDF)

H2020 5G Infrastructure PPP
PSM Phase 3.II – ICT-53-2020 TAs (2/4)

5G PPP
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Current Projects: 5G for Connected and Automated Mobility (CAM) (IA)

ICT-18-2018 projects already address trans-national cross-borders Corridors

- 5GCroCo
  - Metz, Merzig and Luxembourg corridor, crossing the borders of France, Germany and Luxembourg
  - Use-cases: Tele-operated driving, high definition maps for autonomous vehicles and Anticipated Cooperative Collision Avoidance (ACCA)
- 5G CARMEN
  - North-south corridor from Bologna-Munich via the Brenner Pass, connecting three European regions, Bavaria (Germany), Tirol (Austria) and Trentino/South-Tyrol (Italy)
  - Use-cases: Vehicle manoeuvre negotiation, infotainment, timely distribution of environmental info and events and green driving control in sensitive areas
- 5G-MOBIX
  - Two Spain-Portugal corridors + a Greece-Turkey corridor + six national urban sites in Versailles (France), Berlin and Stuttgart (Germany), Eindhoven-Helmond (Netherlands) and Espoo (Finland)
  - Cost-benefit analysis, new services, deployment options and business models for CCAM

Some additional projects dedicated to CAM services

- 5GCAR (ICT-07-2017)
  - 5 Use-cases: Lane merge, See-through, Vulnerable Road User (VRU) protection, High Definition (HD) map, Remote driving for automated parking
  - Demonstration in confined test site for 3 use-cases: Lane merge, See-through, Vulnerable Road User (VRU) protection
- 5G-Drive (ICT-22-2018)
  - EU-China collaboration project with trials at three locations: Surrey (UK), Espoo (Finland), JRC Ispra (Italy)
  - Use cases: Demonstration of the latest 5G technologies in eMBB and V2X scenarios in pre-commercial 5G networks

H2020 5G Infrastructure PPP
PSM Phase 3.II – ICT-53-2020 TAs (3/4)

5G PPP
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Recommendations for ICT-53-2020: 5G for Connected and Automated Mobility (CAM) (IA)

- 3-4 projects (IA) to validate 5G specifications in innovative CAM applications under realistic conditions and seamlessly functioning across borders
  - Long-term roadmap is the realization of the Connecting Europe Facility proposal (CEF Digital): All major transport paths covered with 5G by 2025 through cross-border corridors
- Expected contribution in project trials
  - 5G innovation at any network level in the service infrastructure for CAM especially in a cross-border/cross-operator context (seamless and harmonized collaboration/operation). Definition of relevant KPIs for automotive use cases
  - Adoption of 5G vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), vehicle-to-pedestrian (V2P), and vehicle-to-network (V2N) technologies, able to interwork with the infrastructure
  - Application of Artificial Intelligence (AI) and Distributed Ledger Technology (DLT) to enable advanced CAM use cases managing a broad range of relevant data sets based on connectivity and sensors, including localization and third party applications for new verticals
  - Viable business models driven by a European cloud multi-tenant business architecture supporting Europe-wide roaming and orchestration of CAM services
  - Increased safety, security, public acceptance and serviceability, mitigating potential regulatory concerns while expanding use cases and adoption
  - May include advanced services on board of international trains covering passenger and logistic services, train traffic management systems, as well as other operational services in preparation for the advent of the FRMCS, including migration from previous generation issues (GSM-R) and spectrum sharing aspects
  - Sea / Maritime / Ferries could be considered in the context of a multimodal Corridor including first automotive or railways and if demonstrated support from Member States. Possible experimentation in cross-border ferries (highways of the sea), to test advanced services for passengers and goods, including interworking with port authorities

H2020 5G Infrastructure PPP
PSM Phase 3.II – ICT-53-2020 TAs (4/4)

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Recommendations for ICT-53-2020: 5G for Connected and Automated Mobility (CAM) (IA)

- Expected Impact
  - Validation of latest versions of 5G standards (Release 16 and beyond) in a CAM context, including also innovative technology and business models
  - Validation of sustainable models combining 5G and AI and DLT to support advanced CAM use-cases
  - Cost/benefit analysis of both 5G deployment in corridors and pan-European cloud infrastructure supporting CAM services at European scale
  - Integration and clear definition of roles, relations and responsibilities of market players (also beyond the automotive sector) and public authorities within the CAM ecosystem
  - Technological validation of 5G introduction for train/railways use cases including FRMCS aspects, migration, spectrum, and co-existence issues with the automotive case
  - Sea / Maritime / Ferries could be considered in the context of a multimodal Corridor including first automotive or railways and if demonstrated support from Member States. Technological validation of 5G service continuity over ferries in cross-border scenarios, including migration, spectrum, and co-existence issues, especially with the radio coverage of port authorities

H2020 5G Infrastructure PPP
PSM Phase 3.II – ICT-41-2020 TAs (1/7)

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Recommendations for ICT-41-2020 TAs

- ICT-41-2020: 5G Innovations for Verticals with Third Party Services
- 49 ME – 4-6 ME/TA - 8-12 IA TAs
- The PSM Phase 3.II Version 2.0 includes TAs based on the inputs developed by the 5G-IA Vision & Societal WG - PSM Sub-Group in tight connection/interactions with the Community (incl. NetWorld2020)
- PSM recommandation to target
  - 4 TAs focused on cross-Verticals challenges
  - 6 TAs focused on facilities per Vertical
  - 2 Blue TAs open to other ideas
- The TAs are not building the 5G aspects of the facilities from scratch, focusing on the NetApps methods for validation, deployment, benchmarking, monitoring and showcasing. Reusing and enhancing existing experimental platforms is expected for the cross-vertical TAs
- All TAs will cooperate to define a process for SMEs to use their results during the project, including the creation of a repository of Open source tools to be re-usable by the Community

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PSM Phase 3.II – ICT-41-2020 TAs (2/7)

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Recommendations for ICT-41-2020 cross-Verticals TAs

- The key technical and technological cross-Vertical challenges/domains to be addressed by specific TAs are the following
  - TA1: Experimental facility for advance performance validation of NetApps during development
    - Automatic Lab and field pre validation to map network slices to QoE (including energy)
    - Benchmarking procedures to qualify NetApps
    - Combination of ML/IA with other methods to learn on automatic configuration/decomposition/mapping of legacy and new NetApps for optimal performance
    - Detection of underperformance configurations/behaviours
  - TA2: Experimental facility for increasing Security aspects of NetApps and to guarantee third parties secure access to 5G infrastructure
    - Secured and standard APIs for third parties experimentation
    - Legal procedures support (IPR, liability…)
    - Confidentiality and sensible data management issues
    - Private network implications

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PSM Phase 3.II – ICT-41-2020 TAs (3/7)

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Recommendations for ICT-41-2020 cross-Verticals TAs

- TA3: Experimental facility to validate experiments observability & control
  - Advanced monitoring mechanisms at 5G infrastructure and virtualization levels
  - Usability tools to enable automation of the whole experimentation lifecycle and up to different entry points and experiments results analysis, dashboard, programmatic APIs…
  - Traceability of NetApps in execution
  - Methodology and a workbench for facilitating KPIs validation
- TA4: Experimental facility to address interoperability at large scale
  - Interoperability and multidomain, including aspects like Life cycle of NetApps for different MANOS and VIMs to run NetApps on multiple administrative domains
  - Transformation and adaptation tools for NetApps provided by different vendors for interoperability
  - Enabling adjustment of existing NetApps
  - Methods to access to spectrum for large scale trials, like spectrum sharing with MNOs

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PSM Phase 3.II – ICT-41-2020 TAs (4/7)

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5G IA

Recommendations for ICT-41-2020 Verticals TAs

- The Vertical sectors will consider specific challenges in the following TAs
  - TA5: Media and Entertainment
  - TA6: Industry 4.0
  - TA7: Automotive
  - TA8: PPDR
  - TA9: Healthcare
  - TA10: Energy
- All Vertical TAs will consider these common challenges
  - Deployment and testing techniques to reduce service creation time in the specific domain
  - Standardization of functionalities, APIs, testing procedures and any other aspect not already covered by 3GPP or other relevant standardization bodies
  - Showcasing several NetApps per vertical in a realistic full 5G network during the project in connection with the potential customers
  - Implementation of technical/administrative mechanisms to attract SMEs to the facility to validate their solutions (and the facility)
  - TAs may consider business and ecosystem implications and opportunities, including multi-actor ecosystems
  - TAs may consider standardization and community building (e.g. to foster progressing existing or developing new APIs and SW), not only in Telco fields but also focusing on Verticals and general enablement

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PSM Phase 3.II – ICT-41-2020 TAs (5/7)

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Specific challenges and scope to be considered for Verticals ICT-41-2020 TAs

- On top of the common challenges, each Vertical TA will address specific challenges
- TA5: Media and Entertainment
  - VR/AR entertainment services which offload a significant part of the processing to the network (edge computing) and thus require a high bandwidth and low latency communication in the mobile link
  - Use 5G networks for remote and distributed content creation for broadcasting
  - Contribution of private handhelds (mobiles) to different kind of TV programs, i.e. magazines, news and others
- TA6: Industry 4.0
  - Agile, dynamic and flexible deployments to be able to cope with variable production needs on demand and ensure fast service level KPIs
  - Virtual Reality as a platform in Factory of the Future (FoF) enabling system operations non-attached to a fixed physical infrastructure and allowing distributed geographical location
  - Multi-level security framework where the frontline system operation center level-one security analyst role can be performed with the appropriately scoped visual cues, without requiring a seasoned security professional depth of knowledge
  - Evolved investment cycles based on the identification of areas under the utilization of immersive VR space ecosystem

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PSM Phase 3.II – ICT-41-2020 TAs (6/7)

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Specific challenges and scope to be considered for Verticals ICT-41-2020 TAs

- TA7: Automotive
  - Interoperability with DSRC and previous LTE and 5G NR releases
  - Cross-border and cross-operator issues, including agreement for spectrum
  - Enhance the end-to-end performance with edge computing
  - Improve Localization Accuracy
  - NetApps for ultra-low latency, mission critical applications
  - NetApps and lightweight on-board unit virtualization techniques for building a moving, app-based fog environment targeting a cooperative vehicular AI framework
- TA8: PPDR
  - Agile, dynamic and flexible deployments to be able to cope with public safety needs on demand and ensure fast service level KPIs
  - PPDR as an umbrella of technologies over 5G with a clear focus on facilitating first-responders job in terms of available services, stronger and faster communications…
  - Incorporate enabling solutions that could serve as technology gateways between the advanced standard communication solutions and the legacy ones
  - Deploy solutions for first-responders hosting the operations through different 5G mobile operator with close-to-seamless switch/handover

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PSM Phase 3.II – ICT-41-2020 TAs (7/7)

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Specific challenges and scope to be considered for Verticals ICT-41-2020 TAs

- TA9: Healthcare
  - Expose 5G resources that may be reserved through the 5G Core in order to provide a specific Quality of Service (QoS)
  - Support different data flows which can have different priorities and QoS to map several data streams, such as sensors data, alerts and video streaming
  - Security of the NetApps endpoints as well as their data streams to preserve sensitive and confidential data
- TA10: Energy
  - Eliminate outages through the dynamic engagement of new energy sources to serve the demand
  - Maximize the use of renewables through the dynamic reallocation of demands to renewable energy sources
  - Dynamic reallocation of demands based on multi-objective decision making and machine-learning based approaches
  - Smart monitoring solutions for decision support systems

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PSM Phase 3.II – ICT-42-2020 (IA) TAs (1/7)

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5G IA

Recommendations for ICT-42-2020 Thematics and TAs

- Focused projects (4-6 ME / TA) according to the Call topics, proposed bottom-up. PSM Version 2.0 identifying key Thematics to be considered and proposing grouping possibilities of these Thematics inside TAs. There is no inclusion of detailed individual ICT-42 TAs slides in the PSM Version 2.0 as the ICT-42 target is widely open and the PSM intention is to provide value to the Community avoiding any potential prescriptive perspective
- The Thematics proposal below is based on the different requirements put on access points and terminals depending on the Vertical application (e.g. SWaP-C). Each Thematic scope can be very different depending on the type of terminals and network elements being addressed
  - Vehicular
    - T1: Autonomous driving (car, bus, truck, ship) – URLLC traffic type
    - T2: Drone applications – URLLC, mMTC traffic types
  - Multimedia
    - T3: Gaming + AR/VR (glasses, headset, helmet) – eMBB, URLLC aspects
    - T4: 360, 4K/8K video streaming (360º camera, high-end smartphone) – eMBB, URLLC
  - Health
    - T5: Remote surgery (surgical robot, bio sensors, remote imaging diagnostics) – eMBB,URLLC, mMTC
    - T6: Remote healthcare (remote monitoring devices) – mMTC
  - Industry 4.0
    - T7: Remote robotics (robotic arms, 3D printer) – URLLC, mMTC
    - T8: Sensors for monitoring (low-power devices, surveillance camera) - mMTC
  - B2B
    - T9: FWA (router, CPEs) – eMBB
    - T10: Neutral host (focus mostly on network elements) – eMBB, URLLC, mMTC

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PSM Phase 3.II – ICT-42-2020 (IA) TAs (2/7)

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Recommendations for ICT-42-2020 Thematics - Vehicular

- T1: Autonomous and remote driving (car, bus, truck, ship) – URLLC, eMBB
  - Loose size and power constraints
  - Restrictive cost constraints (especially for cars, less important in bus, truck and ship)
  - Specific elements that can be targeted
    - Low profile antennas and mmWave antenna arrays
    - Hybrid beamforming schemes
    - Security features
    - Integration of communication and sensing (e.g. radar) into the same component
- T2: Drone applications – URLLC, mMTC
  - Drones can be considered as terminals or as part of the network infrastructure (e.g., coverage extension) so both aspects should be targeted
  - Very strict size, weight and power consumption constraints
  - Cost constraints can be very variable depending on exact application
  - Targeted elements
    - Low profile antennas and antenna arrays
    - Compact analog front-end, mixed signal stages and baseband processing platform
    - Specialized network stack including dynamic function split and placement
    - Sensor fusing on chip for improved performance (e.g. reliability and location precision)

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PSM Phase 3.II – ICT-42-2020 (IA) TAs (3/7)

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Recommendations for ICT-42-2020 Thematics - Multimedia

- T3: Gaming + AR/VR (glasses, headset, helmet) – eMBB, URLLC
  - Strict size and power constraints (especially for glasses and headset, less relevant for helmet)
  - Very strict cost constraints
  - Specific elements that can be targeted
    - Low profile mmWave antenna arrays
    - Edge computing
    - Architectures for relaying among gaming gadgets and laptop/desktop PC, including memory and caching for opportunistic offloading of data on intermittently available wireless links
- T4: 360, 4K/8K video and audio streaming (e.g., for tele-education) – eMBB, URLLC
  - Loose size and power constraints
  - From low cost consumer, to high cost professional equipment for media production
  - Specific elements that can be targeted
    - Uplink and downlink
    - Compressed (low cost) and uncompressed (professional quality, low latency)
    - Powerful baseband processing platform
    - Low profile antennas and mmWave antenna arrays
    - Hybrid beamforming schemes

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PSM Phase 3.II – ICT-42-2020 (IA) TAs (4/7)

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Recommendations for ICT-42-2020 Thematics - Health

- T5: Remote surgery (surgical robot, bio sensors, remote imaging diagnostics) – eMBB, URLLC, mMTC
  - Loose power and cost constraints for the surgical robot
  - Strict power and size constraints for the bio sensors
  - Slicing capabilities at the NW side to serve both traffic types
  - Specific elements that can be targeted
    - Low profile antennas (including mmWave operation)
    - Communication between bio sensors and surgical robot (e.g. 5G relaying)
    - Security features
- T6: Remote healthcare (remote monitoring devices) – mMTC
  - Very strict size, weight and power consumption constraints
  - Strict cost constraints
  - Targeted elements
    - Inclusion of a "gateway" terminal to gather all the information from the monitoring devices vs. each monitoring device is acting as a terminal
    - Very compact analog front-end, mixed signal stages and baseband processing platform

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PSM Phase 3.II – ICT-42-2020 (IA) TAs (5/7)

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Recommendations for ICT-42-2020 Thematics – Industry 4.0

- T7: Remote robotics (robotic arms, 3D printer) – URLLC, mMTC
  - Loose power and cost constraints
  - Slicing capabilities at the NW side to serve both traffic types
  - Specific elements that can be targeted
    - Low profile antennas (including mmWave operation)
    - Security features
- T8: Sensors for monitoring (low-power devices, surveillance camera) – mMTC
  - Very strict size, weight and power consumption constraints
  - Strict cost constraints
  - Targeted elements
    - Very compact analog front-end, mixed signal stages and baseband processing platform
    - Security features

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PSM Phase 3.II – ICT-42-2020 (IA) TAs (6/7)

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Recommendations for ICT-42-2020 Thematics – B2B

- T9: FWA (router, CPEs) – eMBB
  - Loose power constraints
  - Strict size constraints and very strict cost constraints
  - Specific elements that can be targeted
    - Compact analog front-end and mixed signal stages
    - Powerful baseband processing platform
    - Security features
- T10: Neutral host – eMBB, URLLC, mMTC
  - TA focus on network elements, including radio, transport and compute
  - Reduced power consumption and efficiency considerations
  - Targeted elements
    - Powerful baseband processing platform including hardware processing/acceleration to deploy real time virtualized functionalities
    - Network slicing support for very diverse traffic types with variable security capabilities
    - Multi-tenant network functions security
    - mmWave antenna arrays with hybrid beamforming capabilities
    - Edge computing capabilities on constrained devices
    - Multi-technology/Multi-service integrated hardware platforms
    - Business model between MNOs and verticals regarding SLAs

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PSM Phase 3.II – ICT-42-2020 (IA) TAs (7/7)

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Recommendations for ICT-42-2020 Thematics and TAs

- Potential approach for TAs
  - A TA may focus on a single Thematic to be validated in an overall architecture
  - A TA may target two (or more) Thematics to be validated in a common overall architecture
    - The recommendation regarding this case is that the developed individual technology components be shared by more than one Thematic. For example, Thematics T6 and T8
  - TAs may consider horizontal functional capabilities (e.g. middleware) in support/enablement of components and devices, to effectively utilize advanced 5G and B5G capabilities
  - TAs may cover device side as well as network side components for proper integration and validation of technologies as part of an overall architecture representing a subset of 5G network functions
- The PSM recommends that TAs tackle the defined challenges and scopes in ICT-42-2020 with a value chain approach, i.e. targeting the necessary individual components within a specific system/subsystem
  - TAs may align the development of all the involved components as well as take the system/sub-system integration into account. In the end, performance of the developed system/sub-system solution will be evaluated instead of that of individual components
  - TAs may consider business and ecosystem implications and opportunities, both on supplier side and service provider side, including multi-actor ecosystems
  - TAs may consider standardization and community building (e.g. to foster progressing existing or developing new APIs and SW), not only in Telco fields but also focusing on verticals and general enablement

H2020 5G Infrastructure PPP
PSM Phase 3.II – ICT-42-2020 CSA TA

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- The main goal of the CSA is to provide a roadmap of European-led hardware enabling technologies of future connectivity platforms with special focus on
  - Building blocks at terminal/device level
  - Hardware processing/acceleration at edge level
- The scope of the CSA includes
  - Identification of needed core hardware components to enable future connectivity systems
  - Liaison with the IA actions and other European technology providers to exploit synergies in the implementation of the activities. E.g., multiple vertical domains may share the use of some of the technological blocks, which might not be apparent if there was no coordination at CSA level
  - Portfolio analysis, coverage, mapping and gap analysis for the key core hardware components and technologies and expertise in Europe
  - Market and economic impact analysis of the availability of European-led hardware enabling technologies of future connectivity platforms
  - Organization of stakeholder events and workshops, reaching out to technology providers, verticals, users and other stakeholders
  - Support of a joint communication strategy of the implemented IAs
  - Identify the future connectivity KPIs related to hardware enabling technologies

H2020 5G Infrastructure PPP
PPP Collaboration Planning

PPP Collaboration Planning – Source David Kennedy (/To-Euro-5G CSA)

Role	Resources per annum	Comment
Steering Board Participation	1 PM + travel	Part of the Management WP
Technology Board Participation	1 PM + travel	Will require technical inputs from the project WPs
Working Group Participation	1-2 PM per WG + travel	Should be included in the relevant WPs resource planning
Joint Dissemination / Demonstration Activities	2 PM + 30K Euro	Should be a visible dissemination role in the project (2x Global 5G events and 1 major EU conference per year)
Programme Representation	1 PM + travel	Speaking at conferences, global discussions, advisory boards, etc.,
TOTAL	Approx 1 – 1.5 Person Year + costs (may vary depending on number of WG participations foreseen)	Approx 2% to 4% of project budget

https://5g-ppp.eu/

H2020 5G Infrastructure PPP
PSM Phase 3.II – Next Steps

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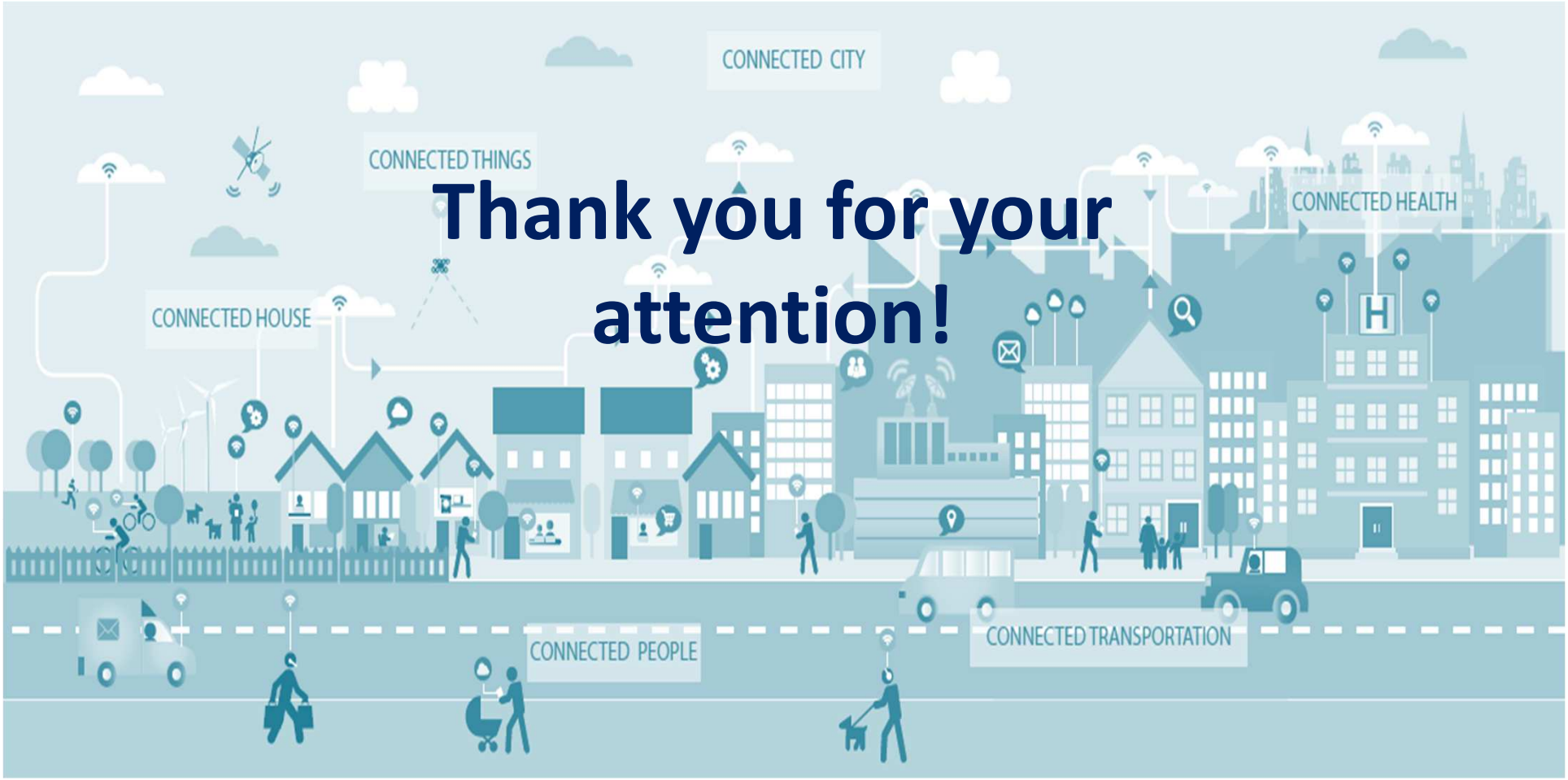
- PPP Phase 3.II Session during EC Proposers Days to be organized on 19-20.09.19 in Helsinki (https://www.ideal-ist.eu/news/ict-proposers-day-2019)
- PSM Phase 3.II Version 3.0 to be released in November 2019
- PPP meetings, awareness events and Info Days incl. specific discussions on the Model
- Model to be widely accepted by the Community and to be recommended by Association and EC as « reference » platform and guidelines for the further development of Proposals
- Model to be provided as input to the Evaluation
- Phase 3.II Brokerage Platform under current discussion
- Solid FAQ webpage to be developed and up-dated until the Calls deadline so that all Community members have access to the latest information

➡ Stay tuned and join us in implementing a very successful PPP Phase 3.II with impact!

http://5g-ppp.eu



Thank you for your attention!