The 5G Infrastructure Association

Pre-Structuring Model (PSM) Phase 3.II

Version 1.1

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

H2020 5G Infrastructure PPP
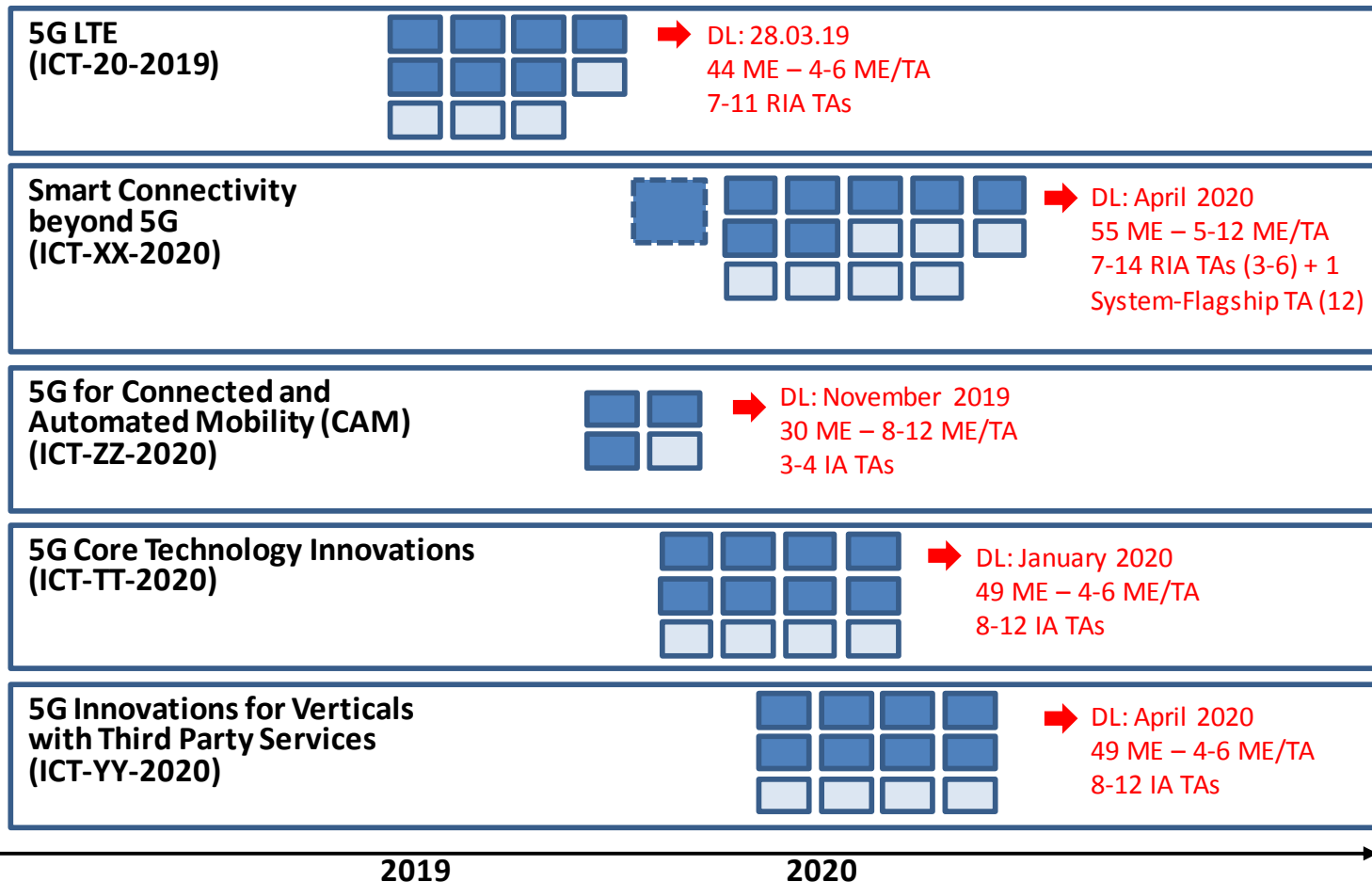# PSM Phase 3.II Approach

- 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
    - Phase 3.II PSM elaborated by 5G-IA Vision and Societal WG
  - Model taking as reference the EC Work Programme 2018-20 and (draft) EC Work Programme 2020 (see next slide 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 (1/2)

- 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 draft EC Work Programme 2020 (to be officially released in May-June 2019 – current draft SOs naming and definition)
    - ICT-XX-2020 – Smart Connectivity beyond 5G (RIA) – DL in April 2020
    - ICT-YY-2020 – 5G Innovations for Verticals with Third Party Services (IA) – DL in April 2020
    - ICT-TT-2020 – 5G Core Technology Innovations (IA) – DL in January 2020
    - ICT-ZZ-2020 – 5G for Connected and Automated Mobility (CAM) (IA) – DL in November 2019

- PSM Phase 3.II Version 1.0 released on 08.02.19 and open for interaction with Community. Focusing on ICT-20-2019 and ICT-XX-2020 Targeted Actions (TAs) and providing recommendations for ICT-XX-2020 TAs, including System flagship TA. Version 1.1 released on 28.02.19, including up-dates on ICT-20-2019 and ICT-XX-2020 recommendations and recommendations on ICT-ZZ-2020 (Corridors)

- PSM Phase 3.II Version 2.0 targeted in June/July 2019, following the release of the (official) final version of the EC Work Programme 2020. Covering the overall set of SOs

- 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

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PSM Phase 3.II Scope & Coverage (2/2)

- 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-XX-2020)**

DL: April 2020
55 ME – 5-12 ME/TA
7-14 RIA TAs (3-6) + 1
System-Flagship TA (12)

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

DL: November 2019
30 ME – 8-12 ME/TA
3-4 IA TAs

**5G Core Technology Innovations
(ICT-TT-2020)**

DL: January 2020
49 ME – 4-6 ME/TA
8-12 IA TAs

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

DL: April 2020
49 ME – 4-6 ME/TA
8-12 IA TAs

2019   **2020**

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PSM Phase 3.II Characteristics

- 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-XX-2020 focused on B5G. Some ICT-XX-2020 TAs to be targeted in the transitioning between H2020 and forthcoming Horizon Europe (HE)

  - ICT-ZZ-2020 (Corridors) recommendations included in/from the PSM Version 1.1 on 28.02.19

  - ICT-YY-2020 and ICT-TT-2020 TAs and recommendations to be included in/from the PSM Version 2.0

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- PPP Programme – Phases, Strategic Objectives and Projects
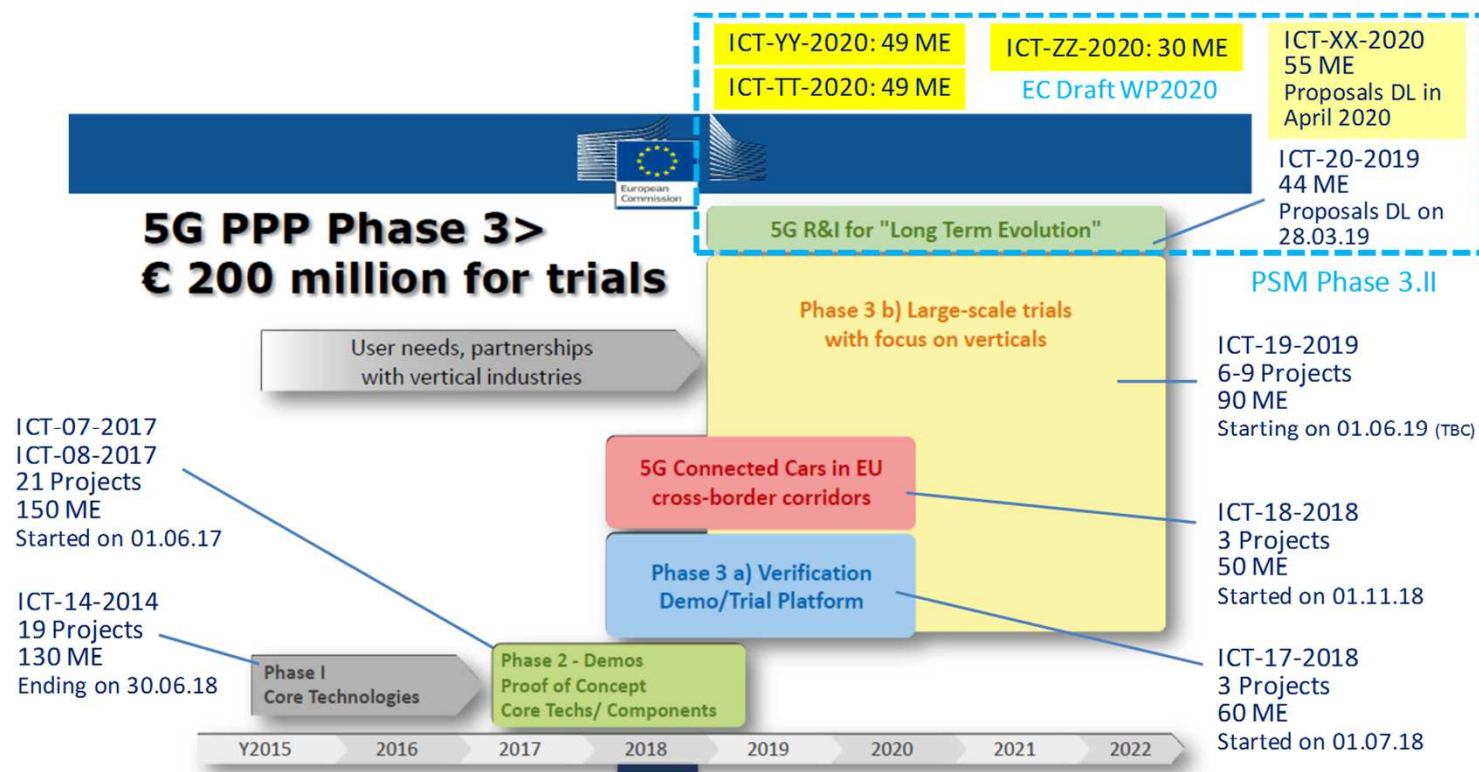
H2020 5G Infrastructure PPP
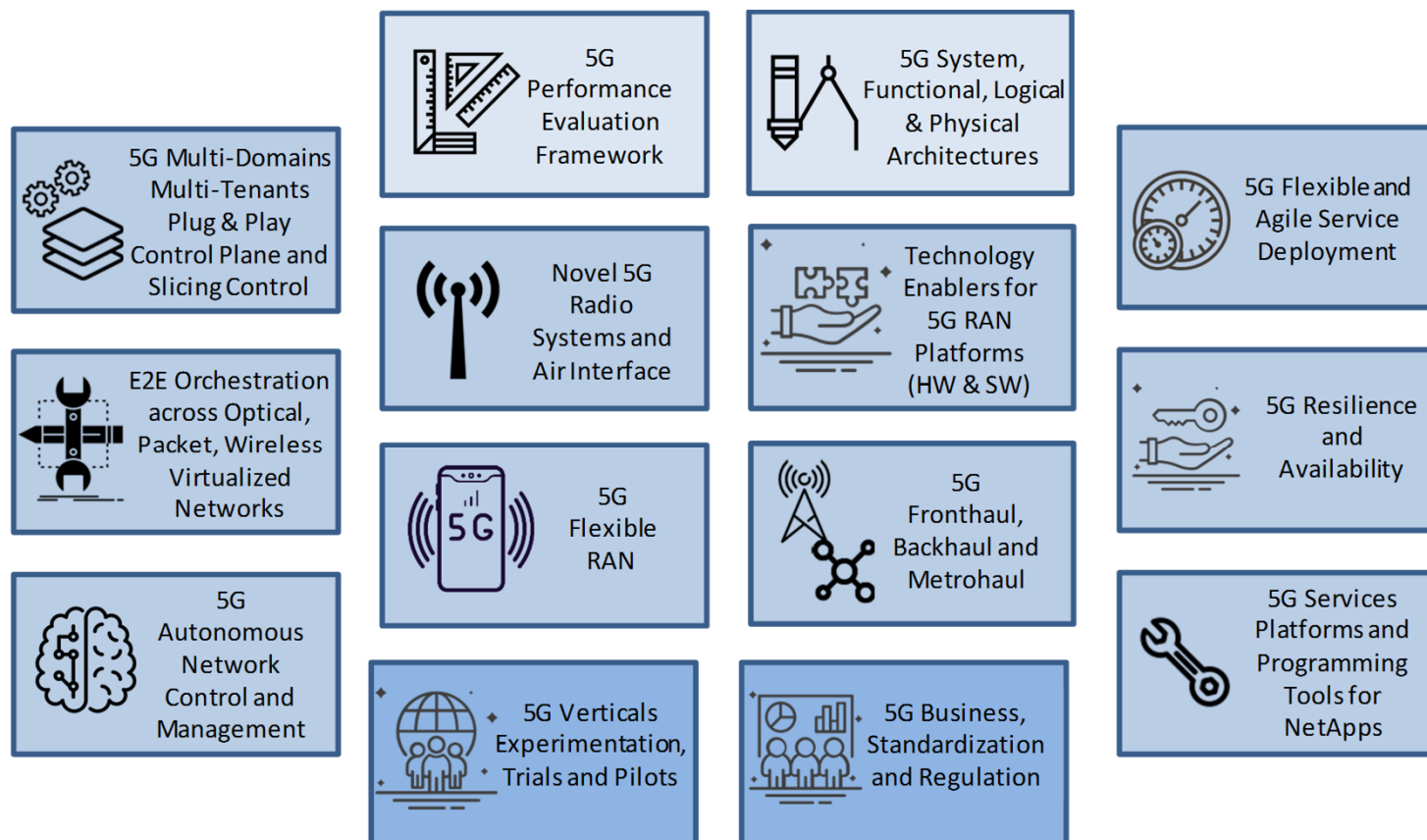## Phase 3.II and PPP Programmatic Perspectives (2/5)

- PPP Governance

https://5g-ppp.eu/
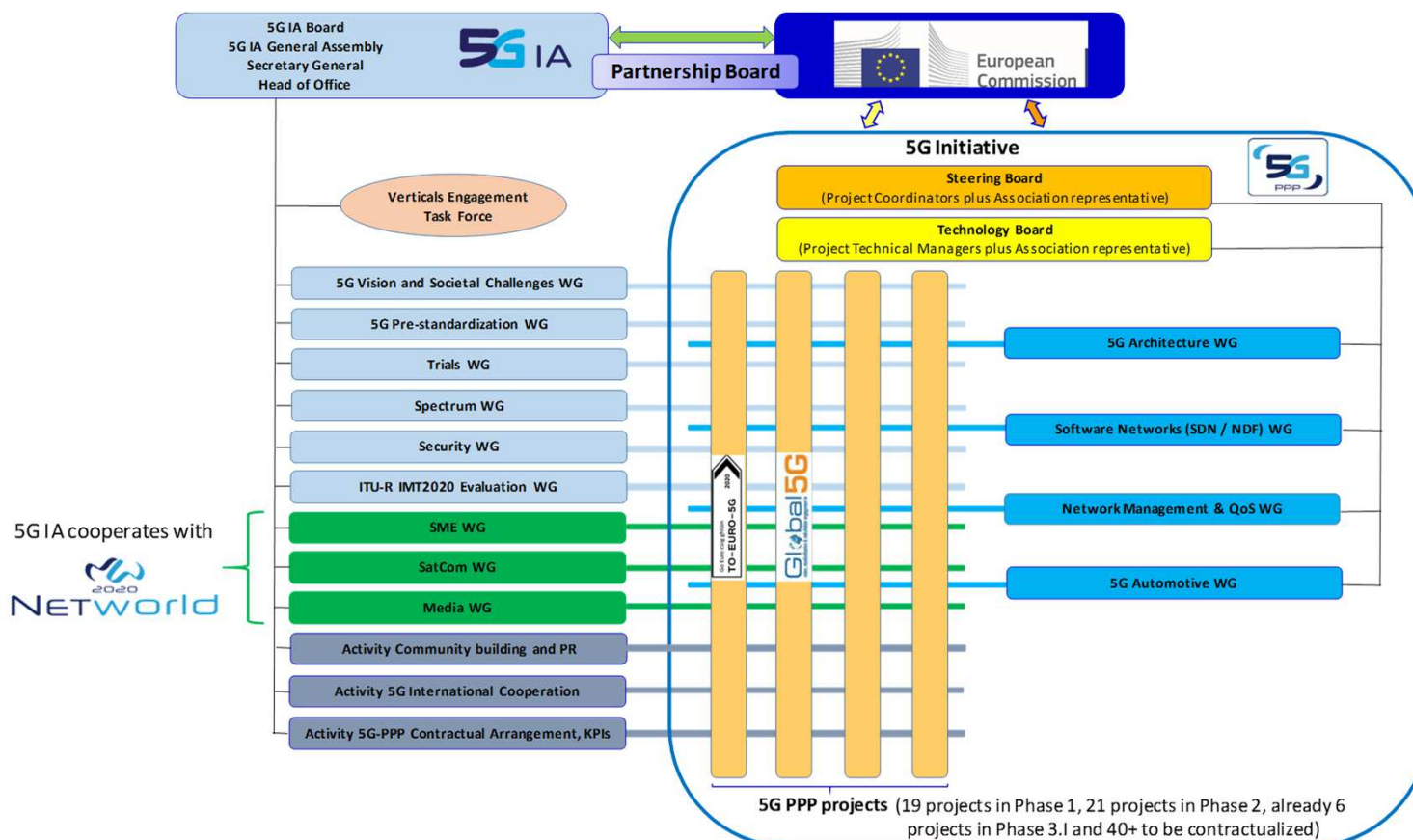
H2020 5G Infrastructure PPP
Phase 3.II and PPP Programmatic Perspectives (3/5)

- PPP Golden Nuggets Version 2.0

- 5G Multi-Domains Multi-Tenants Plug & Play Control Plane and Slicing Control
- E2E Orchestration across Optical, Packet, Wireless Virtualized Networks
- 5G Autonomous Network Control and Management
- 5G Performance Evaluation Framework
- Novel 5G Radio Systems and Air Interface
- 5G Flexible RAN
- 5G Verticals Experimentation, Trials and Pilots
- 5G System, Functional, Logical & Physical Architectures
- Technology Enablers for 5G RAN Platforms (HW & SW)
- 5G Fronthaul, Backhaul and Metrohaul
- 5G Business, Standardization and Regulation
- 5G Flexible and Agile Service Deployment
- 5G Resilience and Availability
- 5G Services Platforms and Programming Tools for NetApps

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

https://5g-ppp.eu/phase-2-key-achievements/
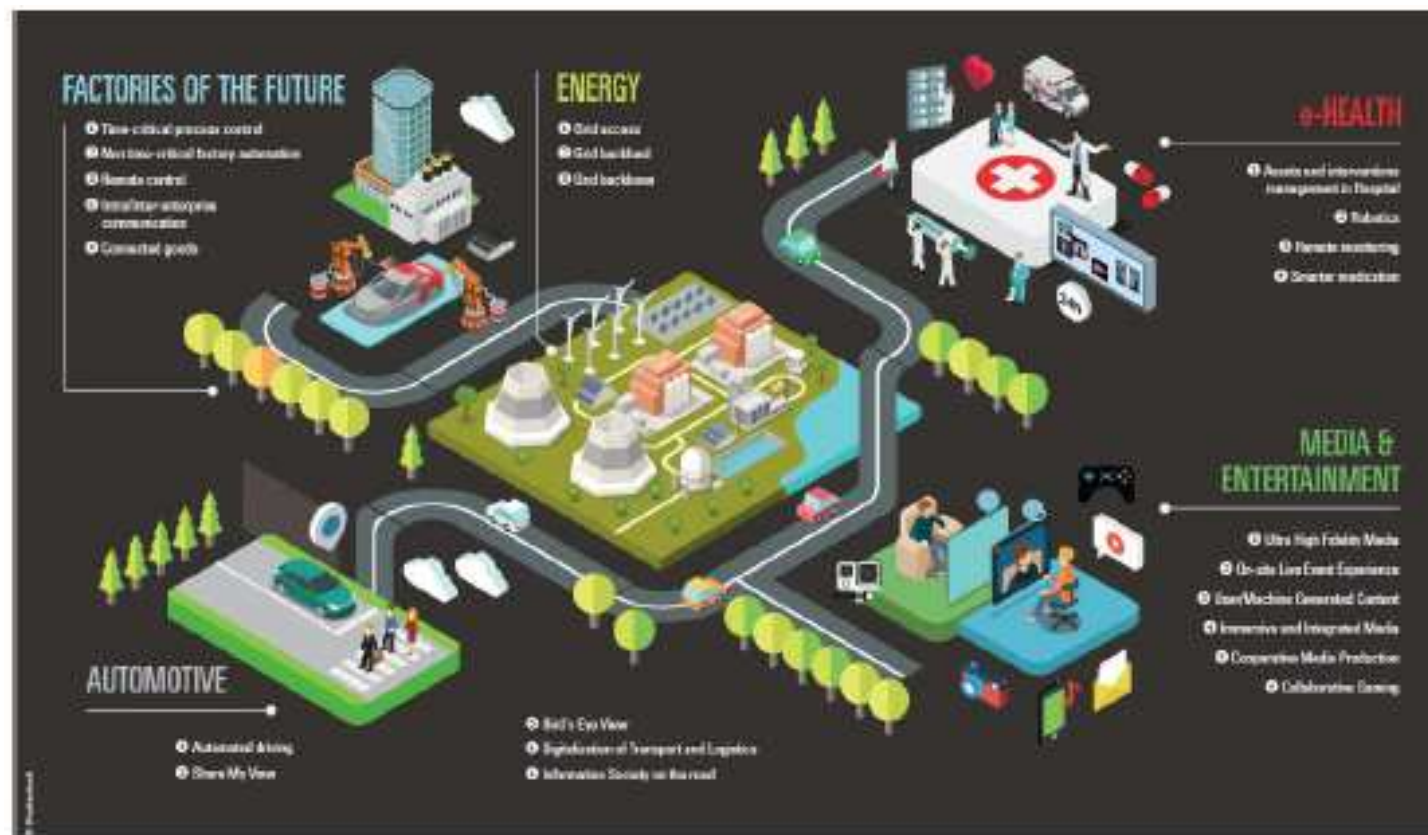
H2020 5G Infrastructure PPP
Phase 3.II and PPP Programmatic Perspectives (4/5)
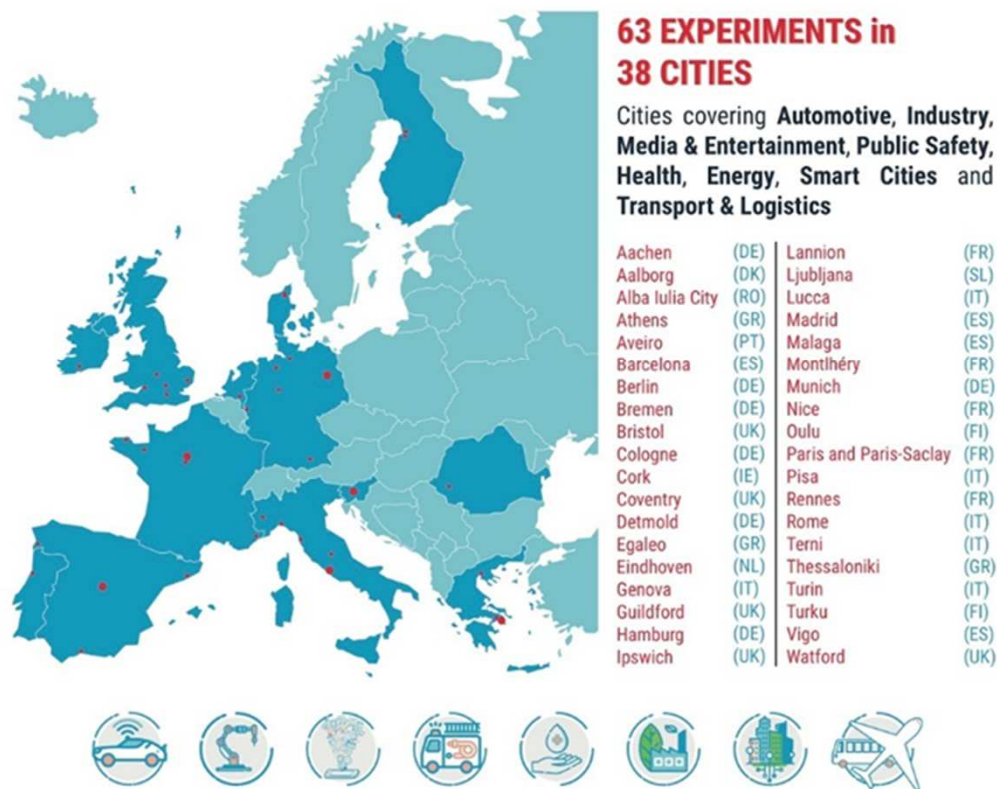
- PPP Verticals - White Paper – Highlights – MWC 2016

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

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

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

5G PPP **5G Infrastructure Public Private Partnership**

63 EXPERIMENTS in 38 CITIES

Cities covering **Automotive, Industry, Media & Entertainment, Public Safety, Health, Energy, Smart Cities** and **Transport & Logistics**

City		City	
Aachen	(DE)	Lannion	(FR)
Aalborg	(DK)	Ljubljana	(SL)
Alba Iulia City	(RO)	Lucca	(IT)
Athens	(GR)	Madrid	(ES)
Aveiro	(PT)	Malaga	(ES)
Barcelona	(ES)	Montlhéry	(FR)
Berlin	(DE)	Munich	(DE)
Bremen	(DE)	Nice	(FR)
Bristol	(UK)	Oulu	(FI)
Cologne	(DE)	Paris and Paris-Saclay	(FR)
Cork	(IE)	Pisa	(IT)
Coventry	(UK)	Rennes	(FR)
Detmold	(DE)	Rome	(IT)
Egaleo	(GR)	Terni	(IT)
Eindhoven	(NL)	Thessaloniki	(GR)
Genova	(IT)	Turin	(IT)
Guildford	(UK)	Turku	(FI)
Hamburg	(DE)	Vigo	(ES)
Ipswich	(UK)	Watford	(UK)

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

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PSM Phase 3.II – ICT-20-2019 Approach (1/5)

- ICT-20-2019 focusing on 5G LTE (https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/ict-20-2019-2020) and ICT-XX-2020 focusing on B5G (draft EC WP2020 not officially released)
- 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 definition of the targeted projects in the portfolio

EC ICT-20-2019 Strand / Objectives	Relevant Sections in NetWorld2020 SRIA
Strand 1: Extension of virtualization technologies and architectures for Network Management to support	
Recursive deployments of functional components for multi-tenancy	2.1, 2.2, 2.3, 2.4
High device heterogeneity through virtualization of resource-constrained devices with load reduction approaches and new network control solutions to effectively handle the authentication, naming, addressing, routing and related functions for massive number of terminals	2.1, 2.4, 2.5, 2.6, 5.3.2
End to end resource self-configuration and management according to service, traffic, channel or mobility conditions	2.1, 2.3, 2.4, 4.5, 8.5
SDN intelligent network interface selection	2.1, 2.4
Ultra-dense network deployment with massive user generated traffic	2.5, 2.6, 5.3.2
Unified management of compute, storage and connectivity resources	2, 2.1, 5.3.3, 2.2, 2.3

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H2020 5G Infrastructure PPP
PSM Phase 3.II – ICT-20-2019 Approach (2/5)

5G IA

- ICT-20-2019 Strand 2 and Strand 3

EC ICT-20-2019 Strand / Objectives	Relevant Sections in NetWorld2020 SRIA
Strand 2 - Security	
Security: hardware, software technologies and architectures, level of abstraction for information sharing enabling tenants workloads to trust the host systems	6.1, 6.2, 6.3, 6.4, 7.6.3, 2.1
It enables trusted deployment of critical workloads across infrastructure and for infrastructure owners, differentiated services offers to tenants, whilst also improving their own control of their systems, vulnerabilities and compromises.	6.5
It covers Trusted Execution Environments (TEEs) secure provisioning and their remote management, with categorization of sensitive operations supporting trust domain definition and set up, with real -time identification of possible compromises or security breaches.	6.5

EC ICT-20-2019 Strand / Objectives	Relevant Sections in NetWorld2020 SRIA
Strand 3: Radio network enabling technologies, architectures and advanced signal processing targeting:	
Differentiated service requirements, including broadcast/multicast and strategies for spectrum sharing and usage optimization in licensed and unlicensed bands	3.1, 7.2, 7.6.1, 7.6.2
Terminals as moving nodes for coverage or service extension	3.5, 3.8, 3.10, 2.5
Network assisted self-driving objects with optimized information fusion/processing from maps, sensors, and events communication	3.8, 3.10, 5.3.3, 2.5, 2.7
Simplified access points through distributed computing and optimized function placement	3.10, 5.3.3, 2.5, 2.1
Ultra low latency services	3.6, 3.7, 3.10
Applicability of mmWave frequency bands to use cases beyond eMBB	3.2, 3.5, 3.9
Usability of novel spectrum at Terahertz frequencies (incl. visible light communications)	3.3, 3.4, 3.5

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PSM Phase 3.II – ICT-20-2019 Approach (3/5)

- PSM recommendation to have ICT-20-2019 TAs targeting further impact in 3GPP Standardization. The following 3GPP Working Groups may be of interest for projects in ICT-20-2019
    - 3GPP SA1 – Services: e.g. new services and or vertical application requirements
    - 3GPP SA2 – Architecture: Core network architecture e.g. cloud based / service based
    - 3GPP SA3 – Security: Mobile network security
    - 3GPP SA5 – Telecom Management: e.g. slicing / orchestration
    - 3GPP SA6 – Applications: e.g. UAV applications
    - 3GPP RAN: e.g. 5G broadcast support, mobile multi-hop / ad-hoc networking / V2X, 5G satellite integration, new frequency bands, 5G positioning, factory networks, UAVs
        - 3GPP RAN1 – Radio Layer 1
        - 3GPP RAN2 – Radio Layer 2 and Radio Layer 3
        - 3GPP RAN3 – Radio access network architecture
- The timing of ICT-20-2019 implies that input to 3GPP will largely fall within Release 17 time frame
- Focus areas for Release 17 will be decided in December 2019, but agenda setting starts earlier. Inspiration for features may be obtained from SA1 studies on next slide or items that are still on the to-do-list

H2020 5G Infrastructure PPP
PSM Phase 3.II – ICT-20-2019 Approach (4/5)

- PSM recommendation to have ICT-20-2019 TAs targeting further impact in 3GPP Standardization and considering 3GPP SA1 Rel-17+ Study Items

  - FS_NCIS - Network Controlled Interactive Service in 5GS
  - FS_AVPROD – Feasibility Study on Audio-Visual Service Production
  - FS_MPS2 – Feasibility Study on Multimedia Priority Service (MPS) Phase 2
  - FS_CMED – Feasibility Study on Communication Services for Critical Medical Applications
  - FS_5G_ATRAC – Study on Asset Tracking Use Cases
  - FS_REFEC – Study on enhanced Relays for Energy efficiency and Extensive Coverage
  - FS_EAV – Study on enhancements for UAVs

  - Common ground
    - High requirements on some or all of: Number of devices, bit rates/QoS, and latency
    - Communication between devices (either direct or via network)
    - High requirements mean high frequency bands to provide required capacity
    - High frequency bands are subject to blocking, this implies a highly dynamic environment if things move around. Seamless handover with high requirements is a challenge
    - Reduction of general level of radio transmitted power

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- Recommendation to target in the ICT-20-2019 Projects Portfolio a set of Targeted Actions (TAs) focused on each Strand (1 / 2 / 3) and specific Cross-Strands TAs

- Considering (1) the current PPP Phase 1, Phase 2 and Phase 3.I projects portfolio, (2) the targeted priorities in Phase 3.II and (3) the ICT-20-2019 EC funded budget (55 ME), a possible portfolio could include

  - Ideal number of TAs: 10 TAs

  - Strand 1: 2 TAs

  - Strand 2: 1 TA

  - Strand 3: 2 TAs

  - Cross-Strands 1-3: 1 TA

  - Cross-Strand 3-1: 1 TA

  - Cross-Strands 1-2: 2 TAs

  - Blue TA: 1 TA
    - PSM considering dedicated open "Blue" TA that would clearly reinforce the Model, as identified from Evaluators / EC Officers perspectives. Either outstanding / disruptive TA not identified in the Model or second instance of a defined TA (or another combination of Strand topics into a new TA) in the Model. Blue TA not to create a side gap in the portfolio

28/02/2019

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TA1 (Strand 1): Extension of Virtualization Technologies and Architectures

Rationale

5G Long Term Evolution will rely on an homogeneous physical infrastructure and dynamic resource allocation to be realized by graphs of adaptable NFs deployed and managed by technologies based on current NFV and SDN. To guarantee service quality in these conditions, tenants will have to be able to control the service execution environment, i.e. how user flows are handled by NFs. However, given the foreseen high number and diversity of such NFs and their connecting graphs, as well as the requirements on service flexibility and multi-tenancy, the OAM (Operation And Management) control system must dynamically follow and adapt to the network service requirements, dealing with NF and graph deployment, supporting their extension, shrinking, migration and change

Objectives/Scope

Design and implement integrated OAM architectures and mechanisms suitable for management and control of distributed virtual/physical infrastructures

- Unified control of the converged infrastructure, i.e. capability to organically grow the control system within the infrastructure depending on control needs supporting high device heterogeneity and different realizations of NFs and the graphs composing them (distributed NFs, single-point NFs, physical and virtual NFs…)
- Scalable conflict resolution or avoidance mechanisms, providing required guarantees on completeness of operations in presence of concurrent, independent decision-making modules (e.g. multi-tenancy, e.g. SDNC and VIM, e.g. autonomous control loops…)
- Hyper local services, where different devices and/or compute/storage resources communicate with each other within e.g. an office, home, or factory, and with the rest of the network as required, adapting to traffic and usage patterns. Seamless services in a highly dynamic environment with changing traffic, channel and mobility conditions

Expected Impact

- Evolution of networks towards integrated service platforms combining connectivity, storage and computing resources, opening for new service models to telecom/ISP providers - (Strand 1)
- Network scalability towards high number of resource constrained devices, multiplicity of service requirements, highly dynamic environments, and new connectivity paradigms (user controlled) – (Strand 1)

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PSM Phase 3.II – ICT-20-2019 TAs (2/11)

TA2 (Strand 1): Energy Efficient Cognitive Resource Self-Management

Rationale

5G LTE is expecting a reduction in the energy consumption that would be implying as a fundamental element the self–management of resources in a dynamic environment

Objectives/Scope

- Design and implement enhanced intelligent mechanisms for an unified self-management and re-configuration of compute, storage and network resources under changing conditions of traffic, mobility…
- Close-loop intelligence in autonomic network controlling (SDN) based on Artificial Intelligence (AI) - data-driven closed control loops that can enable cognitive network behavior
- Energy reduction extensions in current NFV MANO solutions, e.g. optimized placement based on green objectives
- Service enablers and dynamic SLA features to incentivize reduction of energy consumption by smart and dynamic service use

Expected Impact

- Evolution of networks towards OTT like platforms integrating connectivity, storage and computing resources opening for new service models to telecom/ISP providers - (Strand 1)
- Network Energy consumption reduction, a factor of at least 10 (Strand 1)

5G IA

TA3 (Strand 2): Safe, Secure & Trustable 5G Multi-Party/Tenant/Techno Ecosystems

Rationale

5G long term evolution is facing an unpreceded threat landscape which will expose the automation of future critical ecosystems (multi-party / tenant / technologies) even if their applications/services they will serve have been delivered to be Safe, Secure and Trustable by design and by operations. If work has been engaged, it is far from being complete and calls to be fostered to adapt to the new (anticipated) changes (e.g. paradigm changes) while embracing a multi-disciplinary approach to cover all relevant aspects (not limited to purely technical ones) necessary for 5G systems successive to be widely adopted and so deliver their promises

Objectives/Scope

- Fully embrace and release potential of "Smart" 5G (and successive) security (i.e. AI fueled, Integrative, Trustworthy, Responsible, Automated …), enabling as well new service features
- Advance security paradigms (i.e. Software defined Security,/SD-SEC Security as a Service/SECaaS) leveraging on SDN/NFV/MEC/FOG …) to cover the whole spectrum (e.g. Cybersecurity: Identify, Protect, Detect, Respond, Recover)
- Further develop Trust and promote Liability (Dynamic, contextual Liability, Imputability and Verifiability/Proofability in support of Trust and confidence between parties)
- Achieve measurable (i.e. security level) and provable Security in conformance to what's apply (i.e. legislation/regulation/sovereignty, (domains/verticals) specific demands , new labeling or certification schemes)
- Investigate novel approaches for safety, security and trustability between parties (e.g. new electronic components, data-centric security, software and operating system security, IoT security, supply chain security mastering, Zero Touch Security & Trust...) and/or techniques (e.g. deception techniques)
- Promote multi-disciplinary approach to cover all relevant aspects and so ease adoption & (individual but also collective) as well as trustworthy usage of the enabling tools/techniques developed

Expected Impact

- 5G systems which can be trusted by design and by operations in measurable way. This with the potential to be extended to support also liability models

TA4 (Strand 3): Terahertz Access, Fronthaul and Backhaul for 5G Mobile Networks

Rationale

The ever increasing demand of new bands for mobile communications has spurred interest in the potential use of mmWave and THz frequencies including optical wireless communications. In the early stage, it is necessary to study architectures, enabling technologies and signal processing that can make the mmWave and THz (including optical) bands an integral part of 5G LTE for access, fronthaul and backhaul. In a later stage, specific exploitation of these frequencies can lead to novel service paradigms, involving new verticals and application spaces in the 5G ecosystem

Objectives/Scope

- Analysis of spectrum in the THz region for 5G LTE systems, investigations of sharing coexistence mechanisms
- Measurement, characterization and modelling of channels in the THz region considering a wide range of scenarios
- Research and development of multi antenna technologies to enable coverage and multiuser support in THz frequencies
- Design of integrated and dynamic THz-based access, fronthaul and backhaul solutions for 5G RANs
- Support of verticals other than eMBB in the mmWave and THz (including optical) frequency regions
- Research and development of novel 5G localization techniques for ubiquitous (indoor) positioning, exploiting the frequencies in the mmWave/THz spectrum

Expected Impact

- Improvement of radio spectrum usage, novel strategies for coverage/service extension, support of novel use cases, usability of today unexplored spectrum
- Demonstrate the use of mmWave/THz frequencies for active and passive localization coupled with AI-assisted data processing in virtualized fog/edge nodes
- Proofs of concept for validation of THz,- mmWave, and visible light technology as well as verticals other than eMBB.
- Recommendations related to the use of THz bands in standardization and regulatory bodies and industry consensus building

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H2020 5G Infrastructure PPP
PSM Phase 3.II – ICT-20-2019 TAs (5/11)

TA5 (Strand 3): Unlicensed Spectrum and Point to Multipoint

Rationale

Unlicensed spectrum represents a very flexible and affordable way to set up local private networks. Furthermore, other spectrum efficient techniques yet to be standardized in mixed mode point to multipoint transmissions (PTM). A 5G unlicensed spectrum solution enabling concurrent use of unlicensed spectrum with other systems such as LTE-U and WiFi is needed. This is required to demonstrate 5G unlicensed spectrum/PTM applications to Private networks such as industrial IoT, malls, stadiums for verticals such as automation, V2X, media delivery and emergency

Objectives/Scope

- Unlicensed spectrum techniques both anchored in licensed (such as LAA) and fully unlicensed solutions (Multefire) both for below 6GHZ (such as 5 GHz and 2.4 GHz unlicensed bands) as well as millimeter wave unlicensed bands
- Mixed mode broadcast/multicast (5G-eMBMS) for use in below and above 6 GHz
- Define how the efficient use of Satcom to distribute point to multipoint close to the network edge best fits

Expected Impact

- Enable unlicensed operation in frequencies beyond 6 GHz including different techniques required to support Listen-Before-Talk transmission in mmWave where beamforming is used
- Unlock the high throughput possibilities provided by a large amount of spectrum in the unlicensed bands to be used in local/remote areas, private networks
- Demonstrate the use of unlicensed spectrum and multicast for applications such as Industrial IoT, local media distribution, autonomous vehicles, including the optimum role for satcom

TA6 (Cross-Strands 1-3): Unified E2E Autonomic Management (of Compute, Storage and Network Resources) in Runtime

Rationale

5G long term evolution poses new, challenging requirements on dense & ultra-fast connectivity and extreme service flexibility. Under the cost pressure of low TCO, these make network automation and self–management crucial elements of 5G-LTE, calling for real-time network service management and dynamic resource provision (including in runtime), e.g. through zero-touch orchestration and intelligent E2E network management. Both must be addressed in a unified way for network and compute resources alike, as the overall service time is to be guaranteed

Objectives/Scope

Design and implement enhanced intelligent mechanisms for an end to end, unified self-management of compute, storage and network resources

- Define abstractions and autonomic unified interfaces for E2E system management, i.e. of compute, storage and network, remote/local and virtual/physical Device/Access/Edge/Backhaul/Metro/Core modules and functions
- Further automation towards real time and zero-touch beyond MANO mechanisms. Dynamic resource scalability, self-configuration and self-management
- Close-loop intelligence in autonomic network control (SDN) based on Artificial Intelligence (AI) - data-driven closed control loops that can enable cognitive network behavior, and intelligent SDN selection interface for the different network segments
- Advancements into intelligent service & traffic aware routing and processing system/solutions

Expected Impact

- Evolution of networks towards OTT like platforms integrating connectivity, storage and computing resources opening for new service models to telecom/ISP providers - (Strand 1)
- Dynamic scalability of network capabilities through availability of managed and enhanced resources - (Strands 1 and 3)
- Increased flexibility under the same TCO through better load distribution (transforming network to low-energy distributed computer)

TA7 (Cross-Strands 3-1): Distributed Moving Networks for Coverage and Service Extension in Use-Cases beyond eMBB

Rationale

5G long term evolution pursues providing services to all types of connected devices. In order to provide coverage to all these devices, coverage extension strategies like moving network elements or terminals acting as relay nodes appear to be one of the most cost-effective approaches. Moreover, the type of communication services that these nodes are requiring are usually not related to eMBB (e.g., ultra low latency services), which requires that the network is flexible enough to tailor its service capabilities according to the terminals needs, noting many moving networks may rely on satcom "backhauls"

Objectives/Scope
- Radio technologies and architectures to enable
  - Terminals as moving nodes for coverage or service extension and relaying for new applications including V2X
  - Optimized and dynamic function placement across edge nodes (including terminals and simplified access points) Network assisted self-driving objects (in particular, to be applied to the moving network nodes)
- Management of moving network nodes to improve coverage/service extension plus ultra low latency and / or reliable capabilities
  - Design communication protocols with moving terminals/vehicles (D2D for safety, URLLC services, HD maps download)
- New network MANO extensions to increase network resiliency to have zero-perceived-downtime

Expected Impact
- Network scalability towards high number of resource constrained devices, multiplicity of service requirements
- Dynamic scalability of network capabilities through availability of managed and enhanced resources
- Novel strategies for coverage/service extension including vehicles and UAVs, support of novel use cases and mobile edge cloud applications
- Network energy consumption reduction and improved cost-effectiveness

TA8 (Cross-Strands 1-2): SDN/NFV and Security

Rationale

Current security solutions are generally based at protecting connections between two physical devices (e.g. a mobile device and a network server). In a cloud based infrastructure, however, the end-point of communication is a network function which can be implemented anywhere in the cloud. Furthermore, in a multi-tenancy environment, network functions may be hosted on equipment from different parties. Since, network slicing is one of the enabler of multi-tenancy in 5G networks, the cross layer (vertically) and cross domain (horizontally) security mechanisms, not only have to be developed/adapted to support secure and trusted execution of network functions but have to be aligned to ensure required isolation among different networks slices and comply with EC and National regulation in each location. In 5G, network services and slices are to be customized according to the requirements of the application (related KPIs) to be run on the top (as long as it comply with local regulation constraint), similarly, the slice isolation requirement can also be tuned, i.e., the slice isolation level could be adapted according to application requirements. This will also have economic impact on the slice since hard slice isolation can be complex and expensive (in terms of resources) as compared to soft slice isolation (which could not been accepted as solution in some countries)

Objectives/Scope

- New paradigms for multitenant security definition and policies taking into account that network functions (of any scale) are to be possibly hosted partially in third parties infrastructures, where the hosting/infrastructure/NFVaaS provider may be different from the network function owner in some or all of the distributed components that constitute the function
- To enhance slice management mechanisms in existing 5G platforms to enable flexible (tunable) slice isolation based on vertical use case requirements (taken into account regulation constraint of each hosting infrastructure)

Expected Impact

- Security solutions and standards that fully enable a multi-tenancy / distributed liability cloud environment

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TA9 (Cross-Strands 1-2): Application Layer Networking

Rationale

The continued growth in the video space and the push for increased quality, interactivity and personalization of media content, coupled with the widespread introduction of augmented and virtual reality, and increasingly heterogeneous and mobile platforms, challenge network performance and will require new approaches and solutions. In this landscape, the application layer networking concept foresees both transport protocols and web infrastructure evolution, as well as integration of accurate and ubiquitous location information as a network-native service,. changing the delivery, security and liability models between all tenants

Objectives/Scope

- Applications (components) in the network: One of the key developments in the network architecture is the deep integration of application and service functionality pervasively within the network
- Applications making specific demands to the network need a more agile interface with the network itself. The traditional Berkeley Socket API does not expose the dynamic, changing nature of the network, nor the high-level services and features needed to support modern applications
- Derivation of features and behavioral patterns out of locations/events, exposing them to applications via simple APIs
- New security solutions to ensure liability, integrity and source of data, through multiple layers of caching, processing, and distribution, while maintaining privacy, facing new potential breaches brought by virtualization

Expected Impact

- New delivery models having a disruptive impact on media industry, able to change the way in which contents are not only consumed but also generated
- The dawn of a new era for networked applications, where the usage of Berkeley socket is no more a dogma, and specific applications can use novel and more dynamic APIs
- Localization and analytics "as a service", to expand the range of offered applications in the 5G ecosystem

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PSM Phase 3.II – ICT-20-2019 TAs (10/11)

TA10: Blue TA - Open

- Model considering dedicated open "Blue" TA that would clearly reinforce the Model, as identified from Evaluators / EC Officers perspectives
  - Inclusion of outstanding / disruptive TA not identified in the Model
  - Inclusion of a second instance of a defined TA in the Model or another combination of Strand topics into a new TA
  - Not creating gap(s) in the Portfolio

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Input to PSM 3.II – Table – ICT-20-2019 TAs Matching of Expected Impact

Expected Impact	Strands (and Scope topics)	Primary Focus	Complementary Focus
Evolution of networks towards OTT like platforms integrating connectivity, storage and computing resources opening for new service models to telecom/ISP providers	Str 1.	TA1, TA2, TA9	TA6, TA8
Network scalability towards high number of resource constrained devices, multiplicity of service requirements, and new connectivity paradigms (user controlled)	Str 1.	TA1, TA9	
Characterisation and availability of secure and trusted environments for software based virtualised networks, enabling trusted multi-tenancy	Str 2.	TA3, TA8	
Improvements of radio spectrum usage, novel strategies for coverage/service extension, support of novel use cases and mobile edge cloud applications, usability of today unexplored spectrum	Str 3.	TA4, TA5, TA7	
Dynamic scalability of network capabilities through availability of managed and enhanced resources	Str 1 and 3	TA6, TA7	TA8, TA9
Network energy consumption reduction, a factor of at least 10 is targeted	Str 1 and 3	TA2	TA6, TA7

Notes
- Primary focus: Refers to TAs whose main impact is fully aligned with the listed ICT-20-2019 expected impacts
- Complementary focus: Refers to TAs whose impact is related to the listed ICT-20-2019 expected impact

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PSM Phase 3.II – ICT-XX-2020 Approach (1/4)

- ICT-XX-2020 focusing on B5G (draft EC WP2020 not officially released)

- 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-XX-2020 TAs to be targeted in the transitioning between H2020 and forthcoming Horizon Europe (HE). Further on-going discussions/orientations on EC draft WP2020 / ICT-XX-2020 (e.g. targeted projects scales) to be reflected in the forthcoming PSM Versions 2.0 and 3.0

- PSM recommendation to target

  - System flagship project (top-down) (around 12 ME)

  - Complementary smaller and more focused projects (5 ME - 3-6 ME) according to the Call topics, proposed bottom-up. The PSM Phase 3.II Version 2.0 and Version 3.0 will include the detailed definition of the ICT-XX-2020 TAs developed by the 5G-IA Vision & Societal WG - PSM Sub-Group and by the Community, in tight interactions with the NetWorld2020 Experts involved in the SRIA developments

System Flagship TA

Rationale

The challenge is to go well beyond the 5G capabilities developed under 3G PPP 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 between distributed storage and computing resources
- Support for imperceptible latencies
- Provision for connection of massive amounts of things and systems in a scalable and cost-efficient way
- Support for novel architectures and protocols for adaptive networks, allowing alignment of application intent with network services
- 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 IA and blockchain technologies in the connectivity domain, notably for network/service management and security
- 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

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PSM Phase 3.II – ICT-XX-2020 Approach (3/4)

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

- The PSM Phase 3.II Version 2.0 will include 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). Some examples (highlights) of key technical and technological challenges/domains are already included below

  - Superbandwidth Air Interface for ultra-high rate data transmission
    - Going beyond current 5G NR that uses OFDM waveforms
    - Taking into account capabilities and limitations of RF and baseband subsystems
    - Responding to "seemingly infinite network capacity" requirement of ICT-XX-2020

  - Resilient networking for supporting improved and elastic reliability
    - Enabling active environment and cognitive learning, resisting negative effects before they happen and/or rapidly recovering if negative effects can not be avoided. Evolution of URLLC
    - Relating to "novel architectures and protocols for adaptive networks" requirement of ICT-XX-2020

  - Application level E2E Latency for providing true low latency user experiences
    - Providing ultra-low latency hardware/software/network solutions for meeting security and privacy requirements
    - Responding to "perceived zero latency" as well as "security, privacy and trust" requirements of ICT-XX-2020

  - Application level E2E energy efficiency for supporting sustainable ICT development
    - Providing energy efficient solutions including not only network but also end-user equipment
    - Relating to "connection of massive amounts of things and systems in a scalable and cost-efficient way" requirement of ICT-XX-2020

  - …

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PSM Phase 3.II – ICT-XX-2020 Approach (4/4)

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

- …
- Networks with extended range for enabling mobile broadband in currently underserved areas
  - Providing commercially viable and scalable technical solutions as well as business/operation/maintenance models
  - Relating to rural broadband connectivity requirement of EC strategic connectivity objectives for 2025 (5G Action Plan)
- Next-gen optical access & x-haul for B5G applications
  - 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-XX-2020
- 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
- Secure multi-cloud environments for mission-critical enterprise applications
  - Responding to the security and reliability requirement, focusing on the European enterprise sector
- Time-sensitive private networks for industrial control applications
  - Addressing flexible and high-bandwidth integrated scenarios (wireless+optical, connect+compute)
  - Support of smart manufacturing features, e.g. augmented reality, 3D machine vision, collaborative robotics

- The detailed definition of the ICT-XX-2020 TAs will be progressed in the period March-June 2019

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PSM Phase 3.II – ICT-ZZ-2020 Approach (1/3)

Recommendations for ICT-ZZ-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)

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/

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

H2020 5G Infrastructure PPP
PSM Phase 3.II – ICT-ZZ-2020 Approach (2/3)

Recommendations for ICT-ZZ-2020: 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, and emissions 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)
  - Demonstration in confined test site for three use-cases: Lane merge, See-through, Vulnerable Road User (VRU) protection
  - Use-cases: Lane merge, See-through, Vulnerable Road User (VRU) protection, High Definition (HD) map, Remote driving for automated parking

- 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-ZZ-2020 Approach (3/3)

Recommendations for ICT-ZZ-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
  - 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) 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
  - Optimization of a multi-tenant business architecture towards a European cloud supporting Europe-wide roaming of CAM services
  - Increased safety, public acceptance and serviceability, mitigating potential regulatory concerns while expanding use cases and adoption

- Expected Impact
  - Validation of latest versions of 5G standards (Release 16 and beyond) in a CAM context, including also innovative business models
  - Validation of sustainable models combining 5G and AI 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
  - Clear definition of roles, relations and responsibilities of market players and public authorities within the CAM ecosystem

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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

- PSM Phase 3.II Version 2.0 to be released in June/July 2019 and Version 3.0 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!

Thank you for your attention!