



## **LEIT ICT WP 2018-20**

# **ICT-40-2019 Cloud Computing: towards a smart cloud computing continuum**

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## Cloud Computing – topic evolution

**FP7 Topics:** "software & services and cloud computing"

- Total EU contribution: €351.5 million
- Number of projects: 95 (s/w and cloud)
- Average per project: €3.7 million/project

**H2020 Topics:** "Advanced Cloud Infrastructures and Services"  
"Cloud Computing"  
"International collaboration with Japan, Korea and Brazil"

- Total EU contribution: € 195 million up to now
- Number of projects: 53 (cloud)
- Average per project: €3.8 million/project



H2020	Budget [MEUR]	EU contribution	RIA	PCP	IA	CSA	Total
<b>WP2014-(ICT7)</b>	<b>73.0</b>	<b>73.15</b>	<b>16</b>		<b>2</b>	<b>5</b>	<b>23</b>
<b>WP2015 (ICT8)</b>	<b>22.0</b>	<b>4.72</b>		<b>1</b>			<b>1</b>
<b>WP2016 (ICT-06)</b>	<b>45.5</b>	<b>49.7</b>	<b>8</b>		<b>3</b>		<b>11</b>
<b>WP2014-18 (Japan, Korea, Brazil)</b>	<b>17.20</b>	<b>17.20</b>	<b>10</b>			<b>1</b>	<b>11</b>
<b>WP2019 (ICT-15)</b>		<b>30</b>	<b>6</b>			<b>1</b>	<b>7</b>
<b>WP2020 (ICT-40)</b>		<b>20</b>					

- WP2014-ICT7: Advanced Cloud Infrastructures and Services
- WP2015-ICT8: Boosting Public Sector Productivity and Innovation through Cloud Computing Services
- WP2016-ICT-06: Cloud Computing

International Collaboration with Japan, Korea and Brazil (WP2014-18):

- EUJ 1 – 2014: Technologies combining big data, internet of things in the cloud
- EUB 1 – 2015: Cloud Computing, including security aspects
- EUJ-02-2016: IoT/Cloud/Big Data platforms in social application contexts
- EUK-03-2016: Federated Cloud resource brokerage for mobile cloud services
- EUB-01-2017: Cloud Computing
- EUK-01-2018: Cloud, IoT and AI technologies
- EUJ-01-2018: Advanced technologies (Security/Cloud/IoT/BigData) for a hyper-connected society in the context of Smart City

Total EU contribution: € 195 million  
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## Software Engineering for Services and Applications

### H2020 Projects

Aligned, ARCADIA, CloudTeams, DICE, ENTICE, HyVar, Supersede, SWITCH, TANGO, STAMP, Q-Rapids, MELODIC, COLA, Decide, DITAS, Elastest, MegaMart2(ECSEL), Radon, FASTEN, SODALITE, UNICORE

### Policy Areas

Open source, Artificial Intelligence/Algorithmic transparency

## Future Cloud

*(Merging of two former clusters:  
Inter-cloud Challenges, Expectations and Issues  
and Novel approaches and technologies for resource and  
service management)*

### H2020 Projects

CloudSocket, BEACON, SICLOPS, ENTICE  
CYCLONE, CLOUDLIGHTNING, SWITCH, BASMATI,  
ARCADIA, BEACON, CloudLigthning, CloudSpaces,  
ClouT, CloudWave, DICE, iKaaS, INPUT,  
IOStack, Mikelangelo, LIGHTKONE, CLOUDAPPLIANCE,  
PRESTOCLOUD, Mobile Cloud Networking,  
MUSA, RAPID, SWITCH, BIGCLOUT, MF2C, Fed4IoT,  
DECENTER, ATMOSHPERE, NECOS

### Policy Areas

Interoperability & Portability

## Data Protection, Security and Privacy in the Cloud

### H2020 Projects

CLARUS, CREDENTIAL, ESCUDO-CLOUD, MUSA,  
OPERANDO, PAASWORD, PRISMACLOUD, SERECA, SECURECLOUD,  
SLALOM, SLA-READY, STRATEGIC,  
SUNFISH, SWITCH, COEMS, RESTASSURED, TREDISEC, TRESCCA,  
WITDOM, MSEC

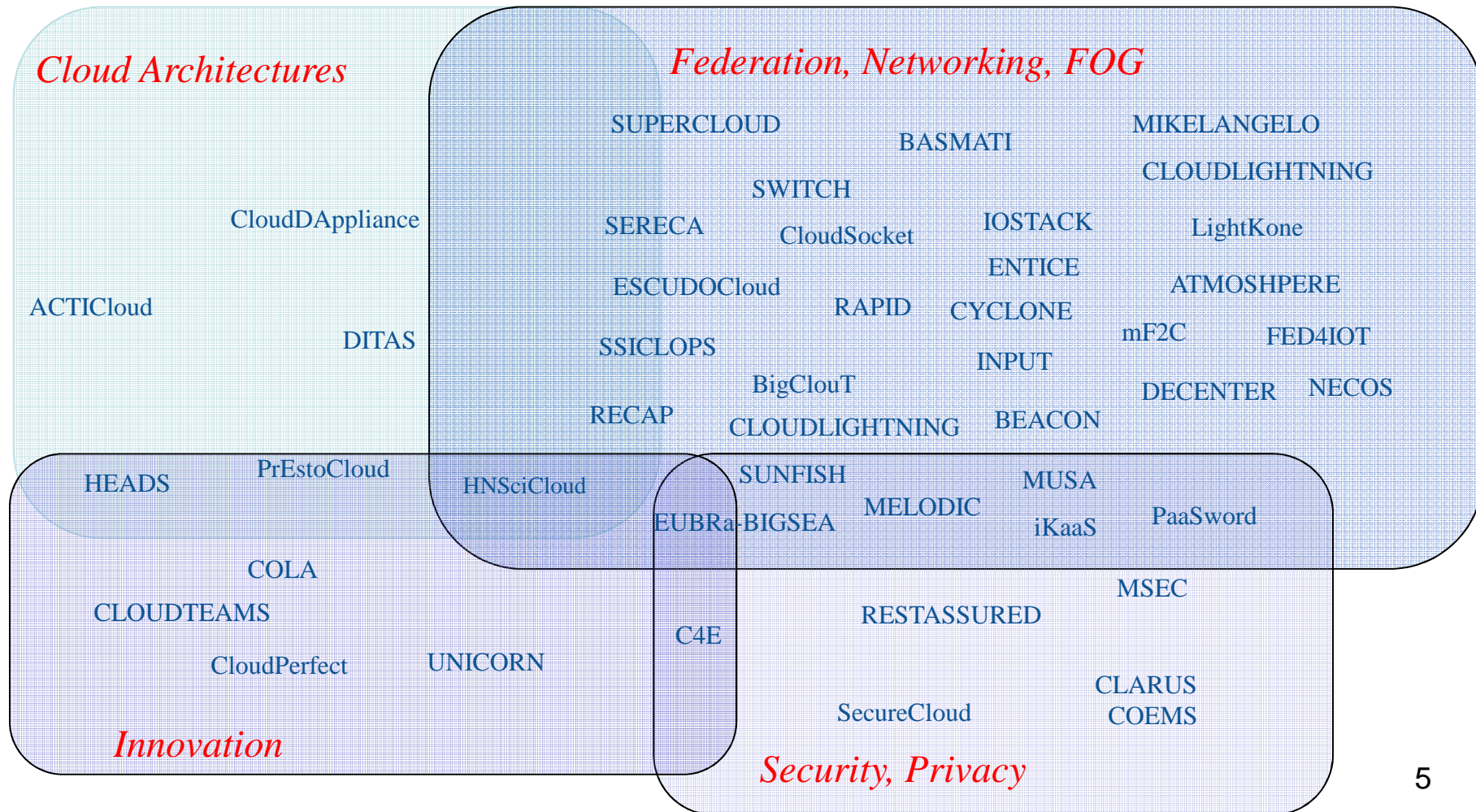
### Policy Areas

Free Flow of Data, Cloud Security Certification

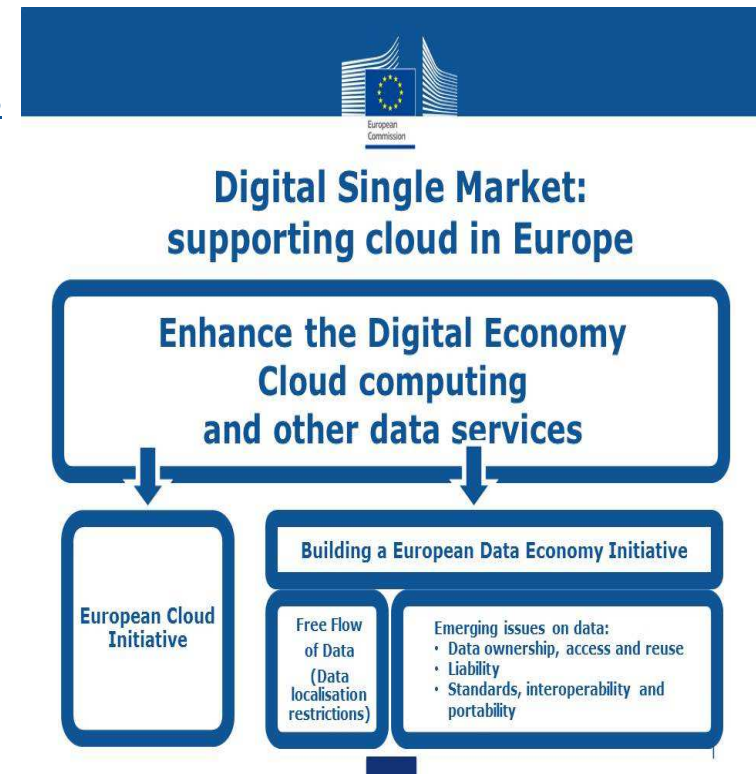
## Crosscutting Co-ordination & Support Actions

REACHOUT, AppHub, CloudWatch 2, EUBrasilCloudForum

## Horizon 2020 project portfolio in Cloud



- ❖ **European Cloud initiative** - tackle fragmentation and raise the trust and confidence of users in cross-border cloud services through EU-wide specifications and certification
- ❖ **Building a European data economy** - enable the best possible use of the potential of digital data to benefit the economy and society. Unlock the re-use potential of different types of data and its free flow across borders to achieve a European digital single market
- ❖ **Free flow of data** - address key obstacles to the freedom of movement of data within the EU
  - ❖ DSM Cloud Stakeholders Group (SWIPO/CSCPRT groups)
- ❖ **Interoperability and standardisation**—increase interoperability of products and services key aspects of EC's Digitising European Industry Initiative



- Internal consultation
- Position papers from Industry consultation, Experts, NESSI, CloudWatch, HolaCloud, Cloud Project Clusters, etc.
- Open web consultation
- Workshop → Final report: <https://ec.europa.eu/digital-single-market/en/news/consultation-cloud-computing-research-innovation-challenges-wp-2018-2020>

## The specific Challenge

*Cloud computing is changing from a pure elastic provisioning of virtual resources (or platforms) to a transparent and adaptive hosting environment that fully realizes the “everything as a service” provisioning concept, from centralized cloud to the edge, and from network and computing infrastructure up to the application layers.*

The challenge is to develop comprehensive cloud solutions and testbeds combining various execution platforms for ubiquitous and seamless execution computing environments as a foundation for a complete computing continuum.

- This requires novel solutions for **federating infrastructures, programming applications and services, and composing dynamic workflows**, which are capable of reacting in **real-time** to unpredictable data sizes, availability, locations, and rates. This will provide application developers with greater control over network, computing and data infrastructures and services, and the end-user will benefit from seamless access to continuous service environments.
- Such solutions should also address **security, semantic interoperability, heterogeneous data integration, organisation and linking, data protection, performance, resilience and energy-efficiency requirements** to respond to the future digitisation needs of industry and the public sector.

Addressing these challenges will also be part of and contribute to the technological ambitions of the Next Generation Internet (NGI).



Proposals will address at **least one** of the following:

- I. **Advanced cloud technologies and testbeds combining aspects of network, computing and data/information resources** (i.e., next generation networks, novel datacenter architectures, fog/edge computing and sensor networks, large-scale analytics and simulation, public, hybrid, multi-cloud computing, etc.) to provide complete solutions encompassing network, computing and data services. The key aspect of these advanced cloud technologies is to **seamlessly combine computation resources all along the data path and support the complete service lifecycle** (i.e. from the end-user request/context to creation of workflows, monitoring of execution platforms, application deployment and adaptation while optimising the execution).
- II. **Advanced Cloud Data Privacy and Security techniques** taking into account issues such as integrating data protection principles, unifying security policies across cloud services and applications, defining personal data semantics, managing data locality, migration and latency.

III. Novel programming models and semantically interoperable services to support dynamic environments that respond intelligently to changes in application behaviour or data variability; automatic deployment and continuous dynamic composition of semantically annotated services; adaptability of services to different resources & usage contexts; automatic reasoning, scheduling and deployment of workflows on top of the resulting infrastructure.

The proposals should demonstrate the applicability and viability of the proposed solution across multiple application domains.

The Commission considers that proposals requesting a contribution from the EU of between EUR 3 and 5 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Proposals in this action will address the following:

- Coordinate stakeholders in Cloud Computing and act as support to R&D programmes/activities by disseminating project results and organising scientific and policy events, developing research and innovation roadmaps, and addressing pre-standardisation initiatives.

The Commission considers that proposals requesting a contribution from the EU between EUR 400.000 to 600.000 would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

## Research & Innovation Actions (RIA)

- Contribute to the development of an ecosystem and testbeds that will respond to the future digitisation needs of industry and the public sector;
- Assist the development of new cloud-based services and infrastructures in Europe and foster an industrial capability in the cloud computing sector;
- Create new opportunities to encourage European-based providers, in particular SMEs, to develop and offer cloud-based services based on the most advanced technologies;
- Leverage research and innovation projects to support the development and deployment of innovative cloud-based services and next generation applications, for the public and private sectors (including standardisation and applications for AI, Big-Data and other sector-specific applications).

## Coordination & Support Actions (CSA)

- Creation of a sustainable European forum of stakeholders representing the Cloud Computing research, industry and users.

*Provide appropriate metrics for claimed impacts*



## Hints to Proposers

### What are we looking for?

- ✓ Development of **generic and advanced cloud technologies, mechanisms, techniques, etc.**
- ✓ The proposals should **demonstrate the applicability and viability of the proposed technological solutions** across multiple application domains.

### What do we NOT want?

Any User Application development using existing cloud technologies





ICT-15-2019 Cloud

## Upcoming events / information days

ICT Proposers' Days 2019 in Helsinki  
September 19-20, 2019



*ICT-40-2020: "Cloud Computing: towards a smart cloud computing continuum"* will be presented in session:

*"Cloud and software challenges beyond 2020"*  
→ September 20<sup>th</sup>, from 15:00 - 16:15

**(call opens 19/11/19 - closes 22/04/20)**



## Further Information

H2020 Work Programme 2018-2020

Tbc

Digital Agenda – Cloud Computing

<https://ec.europa.eu/digital-single-market/en/cloud>

European Cloud Computing Strategy - DSM

<https://ec.europa.eu/digital-agenda/en/european-cloud-computing-strategy>

Report from the Public consultation :

<https://ec.europa.eu/digital-single-market/en/news/consultation-cloud-computing-research-innovation-challenges-wp-2018-2020>

Cloud Projects:

- <https://ec.europa.eu/digital-single-market/en/projects/75981/3494>
- [http://www.cloudwatchhub.eu/sites/default/files/BookletA4\\_June2017\\_inner\\_v04\\_web.pdf](http://www.cloudwatchhub.eu/sites/default/files/BookletA4_June2017_inner_v04_web.pdf)



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# ICT-52-2020

## Smart Connectivity Beyond 5G

*Rémy Bayou – Programme Officer*

*Future Connectivity Systems  
European Commission – DG CONNECT*







# 5G Public Private Partnership

## Phase 3 in Work Programme 2020: Forward looking R&I

WP 2020, R&I opportunities  
- Beyond 5G



5G R&I for "Long Term Evolution"

User needs, cross industry partnerships with vertical industries

We are HERE

Phase 3 b) Integrated Verification Trial  
- radio+network+applications -

5G Connected Cars in EU:  
Cross border corridors

Phase 3 a) Verification Demo/Trial Platform  
- Integration radio+ network

Phase I Core Technologies

Phase 2 - Demos PoC\*- Core Techs Components

\*Proof of Concept





## 5G PPP Phase 3 relevant focus:

*...this Work Programme aims at leveraging 5G technologies towards downstream innovation both at service and product levels, at maintaining a significant long term commitment to prepare for 5G "Long Term Evolution" and to bridge into smart connectivity platforms, which are expected to emerge during the next multi-annual financial framework (MFF)....*

*The work also supports the needed transformation of the telecom industry with a growing part of the activities moving from hardware to software in the context of an increased virtualisation of networks.*



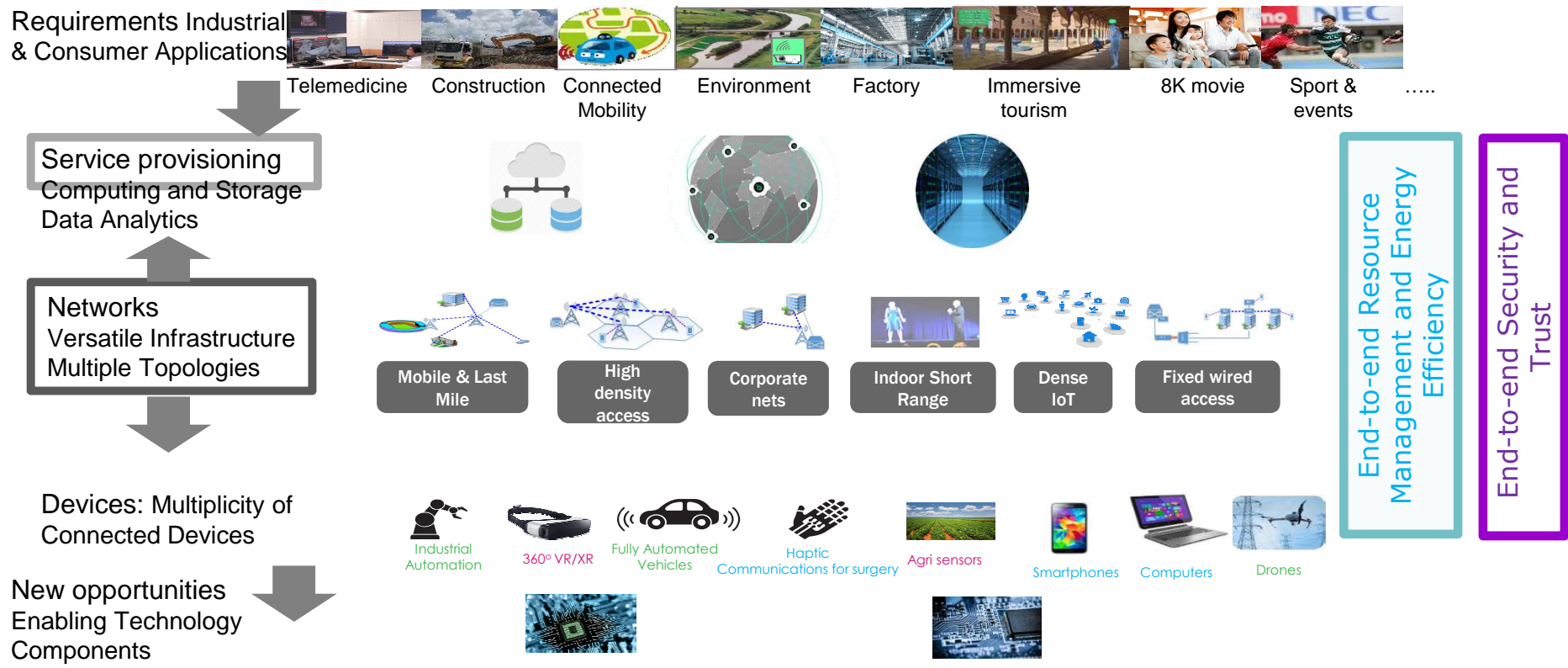


## Context and challenge

*The challenge is to go well beyond the 5G capabilities available in 2020. It also looks Beyond 5G to prepare Smart Connectivity systems as a platform for a Next-Generation Internet, supporting a highly flexible connectivity infrastructure that can dynamically adapt to innovative applications whilst facilitating user data control and innovation friendly implementation of relevant legislation. This requires a full value-chain approach towards seamless and secure end-to-end interworking with computing resources and with a range of innovative devices.*



# General Context- Example value Chain Approach







## ICT-52-2020 Smart Connectivity Beyond 5G

Opening 19/11/2019 - Closing 22/04/2020

**up to 55 M€**

### ➤ Research & Innovation Actions (RIA)

€ 5 to 12million/project (indicative). In particular, initiatives *with strong structuring effects* across a large set of key industry stakeholders and programmatic impact for future European actions in the domain of Smart Network and Services *may target the higher budget range*.

A complementary grant agreement will be implemented across **all** projects in 5G-PPP Phase 3





## ICT-52-2020 Smart Connectivity Beyond 5G Scope

- Infinite network capacity, innovative spectrum use and management, usability of new bands and radio technologies and architectures including optical capabilities
- Imperceptible latencies through flexible connect-compute technologies
- Smart connectivity of massive amounts of things and systems, impact of Mobile edge computing and energy efficiency
- Novel architectures protocols and technologies (e.g. AI) for adaptive networks
- Personalised, multi-tenant and perpetual protection based on security, privacy and trust mechanisms with innovative technologies (e.g. DLT)

*Proposals may address one or several of above topics.*





# ICT-52-2020 Smart Connectivity Beyond 5G

## Expected Impact

- Smart connectivity technologies for platforms integrating ubiquitous connectivity, storage, and computing resources opening for new service and business models.
- Smart connectivity platforms towards perceived zero latency.
- Network scalability towards a high number of resource-constrained (IoT) devices
- Characterisation and availability of secure and trusted environments for software based virtualised networks, including underlying hardware limitations and enabling trusted multi-tenancy.
- Innovative radio spectrum use, novel strategies for coverage/service extension, support of novel wireless technologies and use cases through platforms, usability of today unexplored spectrum.
- Heterogeneous networks with dynamic topologies for advanced mobility solutions.
- Dynamic scalability of network capabilities with managed and enhanced optical resources.
- Characterisation of AI 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.







# ICT-52-2020 Smart Connectivity Beyond 5G

## What we do NOT want

### Innovation Action

- Short term R&I without ambitious perspective
- One off proposals with no follow up potential under next MFF
- Technologies locked to a specific business model

In any case actions which do not clearly focus  
on European opportunities and actors





## ICT-52-2020 Smart Connectivity Beyond 5G Topic evolution

### New topic

- May however piggyback on previous topics in the 5G PPP notably topic ICT 09 2017 "Networking research beyond 5G" or EUJ-02-2018 "5G and beyond" and ICT-20-2019-2020 5G Long Term Evolution

No specific instructions for evaluators

Project Portfolio : see 5G PPP websites





## ICT-52-2020 Smart Connectivity Beyond 5G Topic evolution

### ➤ Leading players

- ICT vendors, network service providers, verticals, SMEs
- Academics & R&I centers are expected to have a “visionary” role compared to the previous 5G PPP phases
- Large scale framing initiatives should be strongly industry driven

### ➤ Key group of actors – participants to projects from

- 5G PPP
- NetWorld2020 ETP





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## Stakeholders Information Opportunities

19-20 SEPTEMBER - HELSINKI

DIGITAL EXCELLENCE FORUM  
@  
ICT  
PROPOSERS' DAY 2019

@DSMeu | #ICTpropday  
<http://bit.ly/ICTPropDay2019>

<https://ec.europa.eu/digital-single-market/en/news/digital-excellence-forum-ict-proposers-day-2019>





## Find out more

5G Action Plan for Europe

<https://ec.europa.eu/digital-single-market/en/5g-europe-action-plan>

ICT Work Programme

<https://ec.europa.eu/programmes/horizon2020/en/what-work-programme>

Funding & tender portal

<https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/programmes/h2020>

European 5G Observatory

<http://5gobservatory.eu>

5G PPP

<http://www.5G-PPP.eu>





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# 5G PPP Phase III

## ICT-52-2020

**Thank you for your attention!**





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# ICT-41-2020 5G PPP – 5G innovations for verticals with third party services

*Manuel Carvalhosa – Programme Officer*

*Future Connectivity Systems  
European Commission – DG CONNECT*



# 5G Public Private Partnership

## Phase 3 in Work Programme 2020: accelerating take up and industrial readiness

WP 2020, extra R&I  
- 5G innovations for verticals with third party services

5G R&I for "Long Term Evolution"

User needs, cross industry partnerships with vertical industries

We are HERE

Phase 3 b) Integrated Verification Trial  
- radio+network+applications -

5G Connected Cars in EU:  
Cross border corridors

Phase 3 a) Verification Demo/Trial Platform  
- Integration radio+ network

Phase I Core Technologies

Phase 2 - Demos PoC\*- Core Techs Components

\*Proof of Concept







## 5G PPP Phase 3 relevant focus:

*....this Work Programme which also aims at leveraging 5G technologies towards downstream innovation both at service and product levels...*

*Activities under this heading .....should significantly contribute to building a first class European industrial supply side for core 5G technologies with global market footprints and notably for network technologies and systems. They will support the emergence of new innovative market players taking advantage of the growing adoption of distributed cloud computing technologies in 5G networks and making possible open innovation at service level*





## ICT-41 - General context

### Challenge

- Software networks provide high flexibility through implementation of virtual network functions (VNFs). VNF's may be chained across several domains to create Network Applications (NetApps) tailored to the requirements of specific tenants.
- This requires open platforms that provide access to networks resources which can then be used to develop NetApps supporting requirements and developments from specific vertical sectors.





# ICT-41-2020 - 5G PPP – 5G innovations for verticals with third party services

Opening 19/11/2019 - Closing 22/04/2020

➤ Innovation Actions (IA)

€ 4 to 6 million/project (indicative)

**up to 49 M€**

A complementary grant agreement will be implemented across **all** projects in 5G-PPP Phase 3





## ICT-41-2020 - 5G PPP – 5G innovations for verticals with third party services - **Scope**

- Experimentation facilities able to provide enhanced experimentation infrastructures on top of which third party experimenters (e.g. SMEs) will have the opportunity to test their applications tailored to specific vertical use cases.
- To create 5G open source repositories for wide use and towards standards development
- Typical vertical use cases: automated mobility, smart factories and industry 4.0





## ICT-41-2020 - 5G PPP – 5G innovations for verticals with third party services– Expected Impact

- Testing and validation of NetApp solutions on top of a 5G virtualised experimental environment
- NetApps secure interoperability beyond vendor-specific implementation across multiple domains, availability of standards or reference implementations.
- Open-source repository of network applications that can be further leveraged by other developers.
- Creation of third party markets for start-ups and SMEs. 50% of SMEs are targeted for this action.
- Relevant 5G PPP KPI: Service creation time in minutes.
- Results that may be appropriate for transfer towards an incubator or a start up, either within the project or outside of the projects in follow up actions.





## ICT-41-2020 - 5G PPP – 5G innovations for verticals with third party services - What we do NOT want

### Innovation Action

- Experimentation facilities that are not sufficiently open, or rich in terms of VNFs, to attract third parties to test NetApps for specific vertical sectors.
- Solutions that clearly will not be taken up by SMEs or start-ups.





## ICT-41-2020 - 5G PPP – 5G innovations for verticals with third party services

### New topic

- Leveraging on 5G enabling technologies and systems developed within or out of the 5G PPP Phases 1, 2 and 3
- Extending the innovation to software innovations with low market entry barriers that can be leveraged by SME's and new actors

No specific instructions for evaluators

Project Portfolio : see 5G PPP websites





## ICT-41-2020 - 5G PPP – 5G innovations for verticals with third party services

- Leading players
  - SW development companies, SMEs and research centers (public or private)
  - Communication research department in universities, industries and research centers
- Key group of actors – participants to projects from
  - 5G PPP







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## Stakeholders Information Opportunities

19-20 SEPTEMBER - HELSINKI

DIGITAL EXCELLENCE FORUM  
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## Find out more

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# 5G PPP Phase III

## ICT-41-2020

**Thank you for your attention!**

