

5G PPP Phase III

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5G Context and European policy



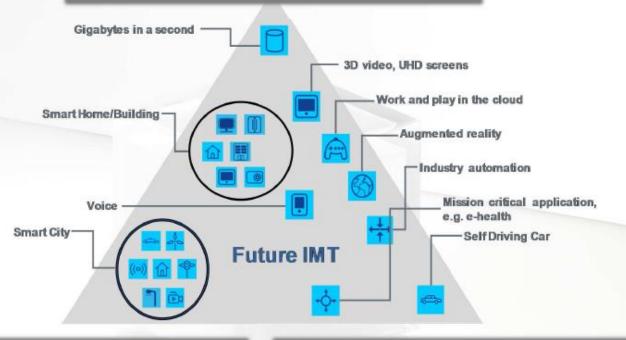
5G PPP - Addressing 5G as a strategic and global issue

- About 10 years to develop a new network generation, R&I started around 2012 in many countries, Europe at the forefront
- Today, huge efforts world-wide in the context of Public-Private partnerships
- Critical for Europe to lead in 5G, both as a supply centre of excellence and as an early adopter through lead markets
- Europe has developed its 5G path on which traction is now being created and needs to reach its objectives
- The 5G PPP is a fundamental building block of the EU 5G Policy strategy



5G Drivers

1.Enhanced Mobile Broadband

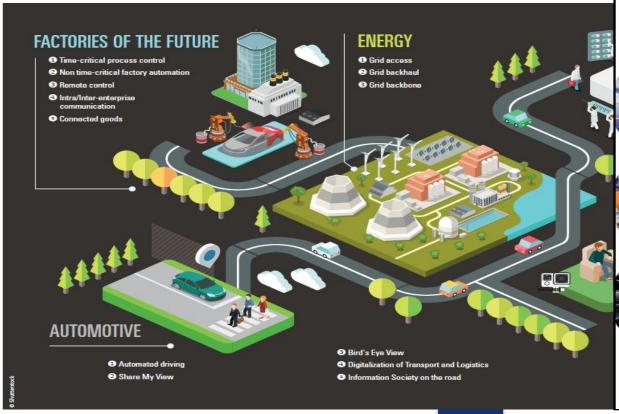


2.Massive-Machine Type Communication

3.Ultra-reliable and Low Latency Communication



European Vision



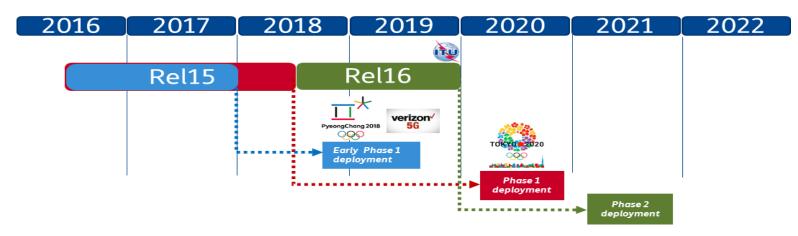


and verticals, 5G will open the field to new business value propositions.

Use-cases originating from verticals should be considered as drivers of 5G requirements from the onset with high priority and covered in the early phases of the standardisation process.



3GPP 5G overall Roadmap



- 5G features will be phased as it will be not possible to standardize all in time for Rel-15 completion and early deployments (2018-2020)
- Release 15 (aka phase 1, by June '18) will aim at a first phase of expected deployments in 2020 (Japan Olympic Games) new radio (NR) + new core (NC)
- Release 16 (aka phase 2, by Dec '19) will target the ITU IMT-2020 submission
- Additional "Early drop" milestone (Dec '17) recently added to meet early market needs

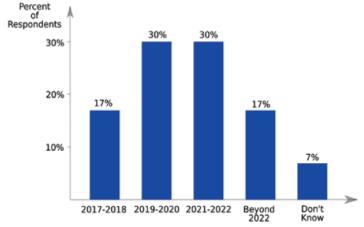


Towards Deployment

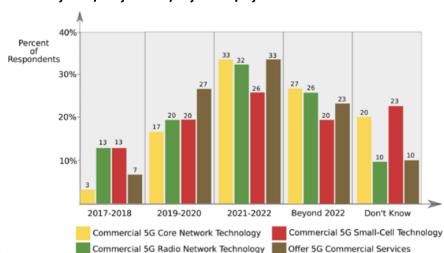
- EU Private trials, verticals, 2017-18
 - Deployment targets, 5G Action Plan

- US Verizon fixed wireless access trials, 2017
 - AT&T TV streaming trials, 2017
- South Korea, winter Olympic games, 2018
- Japan, Olympic games, 2020
- China, technology and system trials under National Key Projects

When do you expect to make 5G investments as part of your CAPEX budget



When do you expect your company will deploy?



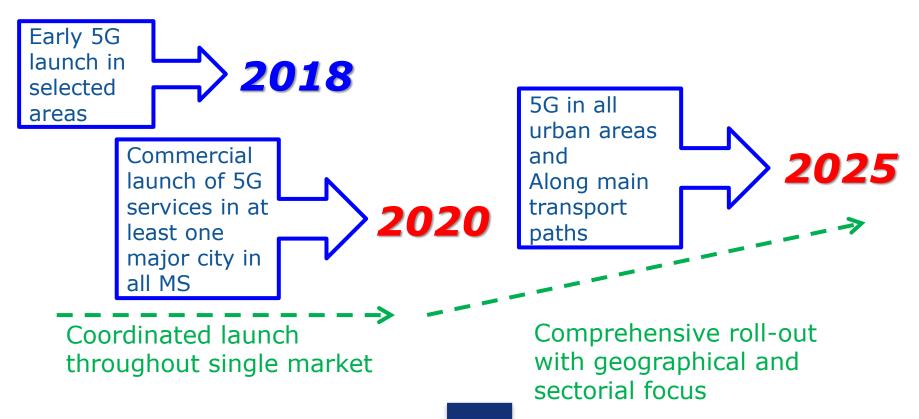


The European Commission 5G Action Plan

- EU policy measures for 5G deployment
- Part of the September 2016 "Connectivity Package"
- 2015 2025 deployment targets
- Pre-commercial trials to start 2018



5G Action Plan: European approach to 5G introduction





EU 5G "Pioneer Bands"

700 MHz (harmonised, ongoing assignment)

- ✓ European Commission Decision: technical harmonisation (April'16)
- ✓ UHF Decision: assignment deadline 2020 (April'17)

3.6 GHz (harmonised, available, partly used)

- ✓ Review of European Commission Decision by 2019 (ongoing)
- ✓ Re-farming/defragmentation for larger bandwidths (ongoing)

26 GHz (in preparation)

- ✓ Harmonised technical/sharing conditions (ongoing)
- ✓ European Commission Decision before WRC-19
- ✓ Services & authorisation models



European Trials Roadmap

5G Action Plan called for trials roadmap

- ✓ To help technology and business model validation.
- ✓ To prepare for early deployments
- ✓ To foster partnership with verticals and creation of ecosystem.

Roadmap announced in MWC in Barcelona (February '17)

- ✓ Support by key players of 5G in Europe
- ✓ Focussed on verticals and cities

5G Pan-European Trials Roadmap v1: 3rd 5G Global Event, Tokyo (May '17)

- ✓ Part of this implementation is supported by the 5G PPP
- ✓ Stakeholder commitment is key to implement the roadmap



5G Public Private Partnership (5G PPP)





Public Private Partnership (PPP) R&I Programme

- Industry driven initiative, including vertical industries
- Support EU positioning in global race to 5G
- Up to 700 million € public funding under H2020
 - To be matched by private funding of at least 3.5 billion €
- Support implementation of EU vision and policies (Pre-standardisation, Spectrum, International cooperation, trials and deployment)
- Implementation through 5G Infrastructure Association
- 3 Phases until 2020
- BUT NOT BUSINESS AS USUAL!

Focus on **programme** results and impact



Collaboration matters!

The projects are the engine of the 5GPPP:

- ✓ Support implementation of EU Vision and policies
- ✓ Populating the 5G association's working groups and collaboration structures
- ✓ Providing substantial inputs (ex: standardization, spectrum, KPIs)
- ✓ Integration to and contribution towards international developments and deployment

Collaboration agreement between projects through Complementary grants, Art 41.4 MGA (in the model of Phases 1 and 2)

- ✓ Joint definition of issues of common interests
- ✓ Sharing of results
- ✓ common approaches to standardization
- ✓ common dissemination and awareness raising activities

More than just projects — it's a PROGRAMME!



5G PPP Phase 1

5G Ensure Security

(Will be added later)

CogNet CogNet

Building an Intelligent System of Insights and Action for 5G Network Management

Selfnet SELFNET

Framework for SELF-organized network management in virtualized and software defined NETworks

Coherent

CHARISMA

CHARISMA

Converged Heterogeneous Advanced 5G Cloud-RAN Architecture for Intelligent and Secure Media Access

Radio-related cluster

Fronthaul/Backhaul

Hardware implementation

Network automation
SDN, NFV, Cloud and

Virtualisation

SUPERFLUIDITY

Superfluidity: a super-fluid, cloudnative, converged edge system

5GEx

5_{Gex}

5G Exchange

VirtuWind

Virtual and programmable industrial network prototype deployed in operational Wind park

sonata A S

SONATA

Service Programming and Orchestration for Virtualized Software Networks

Security

9

METIS-II

Mobile and wireless communications Enablers for Twenty-twenty (2020) Information Society-II

COHERENT

Coordinated control and spectrum management for 5G heterogeneous radio access networks

Speed≤ SPEED-5G

quality of Service Provision and capacity Expansion through Extended-DSA for 5G

5G norma

5G-Norma

5G NOvel Radio Multiservice adaptive network Architecture

SESAME SESAME

Small cEllS coordinAtion for Multi-tenancy and Edge services



FANTASTIC-5G

Flexible Air iNTerfAce for Scalable service delivery wiThin wheless Communication networks of the 5th Generation

Flex5Gware

Flexible and efficient hardware/softwar e platforms for 5G network elements and devices

5G-Xhaul

Dynamically Reconfigurable Optical-Wireless Backhaul/Fronthaul with Cognitive Control Plane for Small Cells and Cloud-RANs

5GXCrosshaul the integrated fronthaul/backhaul

5G-Crosshaul

The 5G Integrated fronthaul/backhaul



Euro-5G

5G PPP Coordination and Support Action

mm MAGIC

mmMAGIC

Millimetre-Wave Based Mobile Radio Access Networ for Fifth Generation Integrated Communications



5G PPP Phase 2

MATILDA

5GCity 5G CITY

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

SEXCAST 5G Xcast

Broadcast and Multicast

Communication Enablers for the

Fifth Generation of Wireless Systems

56 MEDIA 56 MEDIA

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

5Gtango № 5G TANGO

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

technology Network automation

Security, privacy, resilience, availability

Radio-related cluster

Fronthaul/Backhaul

SDN, NFV, Cloud and Virtualisation

Optical networks and

Platforms



SLICENET

MATII DA

A holistic, innovative framework for the design, development

and orchestration of 5G-ready applications and network

services over sliced programmable infrastructures

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



IoRL

Internet of Radio-Light in Buildings



METRO-HAUL

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

5G PHOS

NRG-5

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

Enabling Smart Energy as a Service

via5G Mobile Network advances

N&Daas aas

Next Generation Platform as a Service (PaaS)

SPACE Bluespace

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



5G CAR

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

GOTRANSFORMER 5G Transformer

5G Mobile Transport Platform for Verticals

56 PICTURE 5G PICTURE

5G Programmable Infrastructure Converging disaggregated network and compUte Resources

CLEAR5G

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



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



ONE5G

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



SaT 5G

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

5G ESSENCE 5G ESSENCE

Embedded Network Services for 5G Experiences

***5GCOTOL 5G-CORAL

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

TO-EURO-5G 2020 TO-Euro-5G

Supporting the 5G-PPP especially 5G Initiative governance

Gløbel5G Global5G.org

Global vision, standardisation and stakeholder engagement in 5G



5G PPP Phase 3 WP18-20, pre-published

User needs, partnerships with vertical industries

5G R&I for "Long Term Evolution"

Early 5G introduction Lower frequency bands Later 5G introduction Higher frequency bands

Phase 3 b) Integrated Verification Trial

- radio+network+applications -

Kick off at EUCNC Conference 12-15 June, Oulu, Fin

5G Connected Cars in EU X border corridors

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

Phase I Core Techologies

Phase 2 - Demos PoC*- Core Techs Components

*Proof of Concept

Y2015 | 2016 | 2017 | 2018 <u>20</u>19 | 2020 | 2021 | 2022



International cooperation, moving forward

| | R&D, 2018-20 Work Programme | Policy |
|----------------------|---|---|
| JAPAN | Applications and trials with 5G networksBeyond 5G, applicability of spectrum >275 GHz | - Spectrum, interoperability at different bands |
| REPUBLIC OF KOREA | Application trials at mmwave bandsInterworking across multiple radios | - Standards, validation of specs |
| CHINA | - eMBB Trials at 3,5 GHz and in the V2X context | Spectrum co-operationStandards, preparing 5G phase 2through trial results |
| TAIWAN | - 5G trials addressing end-to-end testbeds for specific applications | |
| USA | - Coordination of EU-NSF projects relevant to the Advanced Wireless Platform programme | |
| BRAZIL | - Trials | Spectrum co-operationStandardsTrials |



5G PPP Phase 3, Calls Specifics



5G PPP Phase 3 topics closing in 2018

| | Title | Closing Dates | |
|-------------|---|------------------|--|
| ICT-17-2018 | 5G End to End Facility | | |
| ICT-22-2018 | EU-China 5G Collaboration | 31 January 2018 | |
| EUJ-02-2018 | EU-Japan Joint Call - 5G and beyond | | |
| EUK-02-2018 | EU-Korea Joint Call - 5G | | |
| ICT-18-2018 | 5G for cooperative, connected and automated mobility (CCAM) | 17 April 2019 | |
| ICT-21-2018 | EU-US Collaboration for advanced wireless platforms | 17 April 2018 | |
| ICT-19-2019 | Advanced 5G validation trials across multiple vertical industries | 14 November 2018 | |





ICT-17-2018: 5G end-to-end facility - general context

- Availability of Pan European platforms that can be used to validate in end to end manner the 5G KPI's, from the 5G PPP and beyond
- Critical to go beyond capabilities that can be demonstrated with running pre commercial trials of industry
- Novel features in relation to vertical, notably end-to-end slicing are of particular importance
- Platforms are to be reused by ICT 19 projects, in support of trials
- Open to support implementation of 5G AP trial roadmap
- Impact critical
- Open to support different stakeholders constellations





ICT-17-2018: 5G end-to-end facility - scope

- The target 5G end-to-end network facility covers fixed/multi radio access, backhaul, core network, service technologies and architectures targeted for 5G including end to end virtualisation and slicing as key component
- The objective is
 - to validate the 5G network KPIs through representative network trials,
 as defined by the 5G PPP
 - to prepare an extensive validation platform for verticals use cases





ICT-17-2018: 5G end-to-end facility - scope

The targeted facility

- allows to validate early versions of the standards and to prepare for later "forward compatible" versions
- may be based on the interworking of several experimental platforms existing in Europe
- requires availability of an openness framework (both legal and technical,
 e.g. open APIs) enabling "vertical" projects to access and use it
- requires a methodology to consistently compare technologies where appropriate





ICT-17-2018: 5G end-to-end facility - expected impact

- Demonstrated feasibility of **5G PPP KPIs beyond 4G evolution**. It requires clear analysis of the state of the art and how 5G goes beyond
- Demonstration of **innovative radio spectrum use** and sharing applicable to 5G spectrum: (un)-licensed, licensed-shared access
- Validation of a representative end to end 5G architecture including end to end service provisioning with slicing capabilities
- Impactful contribution to standards. Participation of key European industrial partners with high standardisation impact is desired
- Availability of 5G facility that may be further used for validation through specific vertical use cases and/or for large scale showcasing events





ICT-17-2018: 5G end-to-end facility

- Opening 31/10/2017
- Closing 31/01/2018
- Target is 3 to 4 projects
- Type of action: Research and Innovation action
- Special conditions!
 - The limit for a full proposal is 100 pages
 - Complementary grant agreements (through special clause 41.4):
 One collaboration agreement to be signed by the 5G PPP projects aiming at, for example, → Joint definition of issues, → shared results, → common approach to standardisation and disseminations, ...

up to 60 M€





ICT-18-2018: 5G for cooperative, connected and automated mobility (CCAM) - general context

- Connected and Cooperative Assisted Mobility (CCAM) identified as a strategic industrial opportunity in the EU
- 5G considered as the connectivity platform of choice (long term) for CCAM use cases
- Member State support with Letter of Intent, signed at ministerial level in March 2017
- European Automotive and Telecom Alliance (EATA) launched in September
 2016
- 5G Automotive Association (5GAA) launched in September 2016
- → ICT 18 aims at validating 5G for CCAM in this wider techno-policy context





ICT-18-2018: 5G for cooperative, connected and automated mobility (CCAM) - scope

- Validation of 5G in a broad CCAM context is realised through cross border trials along 5G corridors
- Core technological innovation expected from 5G, such as (but not limited to):
 - New Radio, new frequency bands
 - C-RAN
 - Mobile Edge Computing
 - network virtualisation
 - new network architecture
 - cross domains data flows





ICT-18-2018: 5G for cooperative, connected and automated mobility (CCAM) - scope

- Define options for deployment, taking into account the evolution from earlier cellular technology (e.g. LTE-V2X), and possible co-existence with other technologies (e.g IEEE 802.11p)
- Includes cost/complexity assessment of the various technology deployment options. Identifies who has to invest and who will benefit commercially





ICT-18-2018: 5G for cooperative, connected and automated mobility (CCAM) - expected impact

- Validation of 5G technologies and architecture in an "extended CCAM" context
- Validated cost/benefit analysis of cross border 5G deployment enabling CCAM along 5G corridors potentially including several operator's domains
- Availability of deployment scenarios and strategies with broad base industry and administration consensus
- Identification of spectrum and standardisation gaps. Participation of key European industrial partners of both the ICT and the automotive sectors and with high standardisation impact is desired





ICT-18-2018: 5G for cooperative, connected and automated mobility (CCAM)

- Opening 31/10/2017
- Closing 17/04/2018
- Target is 2 to 4 projects
- Type of action: Innovation action
- Special conditions!
 - The limit for a full proposal is 100 pages
 - Complementary grant agreements (through special clause 41.4):
 One collaboration agreement to be signed by the 5G PPP projects aiming at, for example, → Joint definition of issues, → shared results, → common approach to standardisation and disseminations, ...

up to 50 M€





ICT-19-2019: Advanced 5G validation trials across multiple vertical industries - general context

- Trials and demonstrations are key to demonstrate 5G applicability to vertical industries and to prepare for mature cross sector business cases
- Trials may also be considered in support of the 5G AP Trial Roadmap developed under the 5G PPP
- 5G technology can only be validated in its fullest extent if used by several applications at the same time with different requirements (cloud like behaviour and isolation)
- Multi domain management of resources is important in such shared technology environments, including strong isolation and security aspects
- Trials expected to support later releases of 3G PP standards enabling full coverage of vertical requirements





ICT-19-2019: Advanced 5G validation trials across multiple vertical industries - scope

Research and innovation action:

- Trials of various scales, depending on the target technology, demonstrating that performance conforming to 5G PPP KPIs requirements are met in the context of specific vertical use cases
- Technology/architecture trials targeting concurrent usage of resource by multiple verticals, addressing eMBB, mMTC, URLLC use cases
- To demonstrate that 5G architecture and technologies enabling multi domain management of resources are in line with concurrent vertical performance requirements
- Preferably implemented over the 5G end to end platforms developed under ICT-17-2018 and contribute to 5G demonstration in the context of large showcasing events





ICT-19-2019: Advanced 5G validation trials across multiple vertical industries - scope

Coordination and support action:

- Cooperation of the implemented 5G Research and Innovation Actions (RIA) and Innovation Actions (IA) towards joint leveraging of results:
 - Management and orchestration of 5G PPP project cooperation for horizontal issues of common interests (e.g. KPIs, security, energy efficiency, spectrum, standardisation, societal impact of 5G)
 - Portfolio analysis, coverage, mapping and gap analysis, roadmaps
 - Support to key international co-operation activities (standards, spectrum)
 - Organisation of stakeholder events
 - Monitoring of the openness, fairness and transparency of the PPP process
 - Maintenance of the "5G web site"





ICT-19-2019: Advanced 5G validation trials across multiple vertical industries - expected impact

Research and innovation action:

- Validated core 5G technologies and architectures in the context of specific vertical use cases and deployment scenarios and for differentiated performance requirements
- Viable business models for innovative digital use cases
- Impactful contributions towards standardisation bodies, involving vertical actors
- Validation of relevant KPIs linked to specific vertical sectors
- Europe 5G know how showcasing





ICT-19-2019: Advanced 5G validation trials across multiple vertical industries - expected impact

Coordination and support action:

- Organisation of the 5G PPP as a programme
- Maximised output and exploitation of 5G PPP project results in key domains (standardisation, spectrum)
- Constituency building, stakeholder support, support to key international cooperation events and activities; dissemination, support to relevant stakeholder events; definition of future R&I actions





up to 92 M€

ICT-19-2019: Advanced 5G validation trials across multiple vertical industries

- Opening Early September 2018
- Closing 14/11/2018
- Target is 6 to 9 projects
- Type of action: Research and Innovation action (90 M€), Coordination and support action (2 M€)
- Special conditions
 - The limit for a full proposal is 100 pages
 - Complementary grant agreements (through special clause 41.4):
 One collaboration agreement to be signed by the 5G PPP projects aiming at, for example, → Joint definition of issues, → shared results, → common approach to standardisation and disseminations, ...

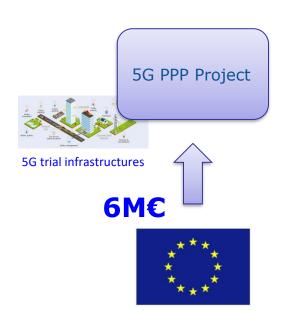


ICT-21-2018: EU-US collaboration for advanced wireless platforms (closing 17 April 2018)

- To establish EU US collaboration on advanced wireless research beyond 5G
- To develop notably research roadmaps, workshops, scientific exchanges, tools for experimentation, cross atlantic trials
- Proposals to foresee projects entities twinning, including NSF PAWR projects
- Expected impact: reinforced cooperation with the US in Wireless research towards beyond 5G connectivity systems and services
- Target: 1 CSA project (EU) with total funding up to 2 M€

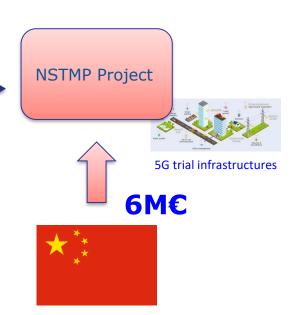


ICT-22-2018: EU-China 5G collaboration



Twinning of projects

unified trial specifications
unified trial frequency bands
Sharing of data
Joint deliverables, tests reports,
white papers, publications and
standard contributions



The National Science and Technology Major Project (NSTMP) is a main 5G research program in China



ICT-22-2018: EU-China 5G collaboration (closing 31 January 2018)

- Conduct 5G trials addressing two specific scenarios: enhanced Mobile Broadband (eMBB) and Internet of Vehicles (IoV)
- Both scenarios shall be implemented in both regions (EU and China)
- Not restricted to 5G radio access, also for network slicing, virtualisation, crossdomain orchestration
- In EU, trials are preferably implemented over the 5G end-to-end platforms developed under ICT-17-2018.
- Expected Impact: Global interoperability demonstrations for 5G networks,
 Joint contributions to global 5G standards specifications, ...
- Target: 1 Research and Innovation action (EU) with total funding up to 6 M€



EUJ-02-2018: 5G and beyond (closing 31 January 2018)

- Part of the 4th EU-Japan Joint Call between EC, MIC and NICT
- Area 1: Large-scale demonstrations and trials towards 5G applications
 - Focus on trials and demonstrations of 5G applications in eMBB and Broadband Access in Dense Areas
- Area 2: Joint research on enabling technologies for beyond 5G
 - Focus on the enormous capacities foreseen to be needed in the backhaul and fronthaul networks
- Target: 2 Research and Innovation actions (1/area) with total funding up to 3 M€ (EU)
- Check the special conditions



EUK-02-2018: 5G (closing 31 January 2018)

- Part of the 2nd EU-Korea Joint Call between EC and MSIP/IITP
- Area 1: mmwave and super broadband services
 - should include demonstration of 5G technologies for Access networks,
 Core networks
- Area 2: interoperability and integration of 5G vertical testbeds on heterogeneous environments
- Target: 2 Research and Innovation actions (1/area) with total funding up to 4 M€ (EU)
- Check the special conditions!



Future Foreseen Topics after 2018



ICT-20-2019-2020: 5G long term evolution (closing March 2019)

- The longer term vision targets the realisation of pervasive mobile virtual services
- 3 strands:
 - Extension of virtualisation technologies and architectures for Network
 Management
 - Security
 - Radio network enabling technologies, architectures and advanced signal processing
- Research and Innovation actions



ICT-23-2019: EU-Taiwan 5G collaboration (closing 15 January 2019)

- Conduct 5G trials addressing technology and business validation of 5G end-to-end connectivity and associated management from applications in Taiwan
- Expected Impact
 - Validation of core 5G technologies and architectures in the context of specific vertical use cases
 - Leverage cooperation towards industrial consensus between EU and Taiwan
 - Accelerate the pre-commercialization trials of the use cases introduced by IMT-2020 (eMBB, mMTC, URLLC)
- Research and Innovation actions with total funding up to 4 M€



Stakeholders Information Opportunities



https://ec.europa.eu/digital-single-market/en/events/ict-proposers-day-2017



https://www.4th-g5ge.org/





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

5G PPP

Horizon2020 web site

Participants portal

H2020 Helpdesk, including FAQ

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

http://ec.europa.eu/programmes/horizon2020

http://ec.europa.eu/research/participants/portal

http://ec.europa.eu/research/index.cfm?pg=enquiries



5G PPP Phase III

Thank you for your attention!