



# **5G Network Infrastructure for the Future Internet**

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## Future Internet in WP 2014-15

IoT

ICT 30: Internet of things and platforms  
for connected smart objects

### Net Innovation

- ICT 10: Collective awareness platforms for sustainability and social innovation
- ICT 13: Web entrepreneurship

### Software, services and cloud computing

- ICT 7: Advanced cloud infrastructures and services
- ICT 8: ECP: pre-commercial and joint procurement
- ICT 9: Tools and methods for software development

### Experimental Platforms

- ICT 11: FIRE+ (Future Internet Research & Experimentation)
- ICT 12: Integrating experiments and facilities in FIRE+

### Network technologies

- ICT 5: Smart networks & novel Internet architectures
- ICT 6: Smart optical & wireless network technologies

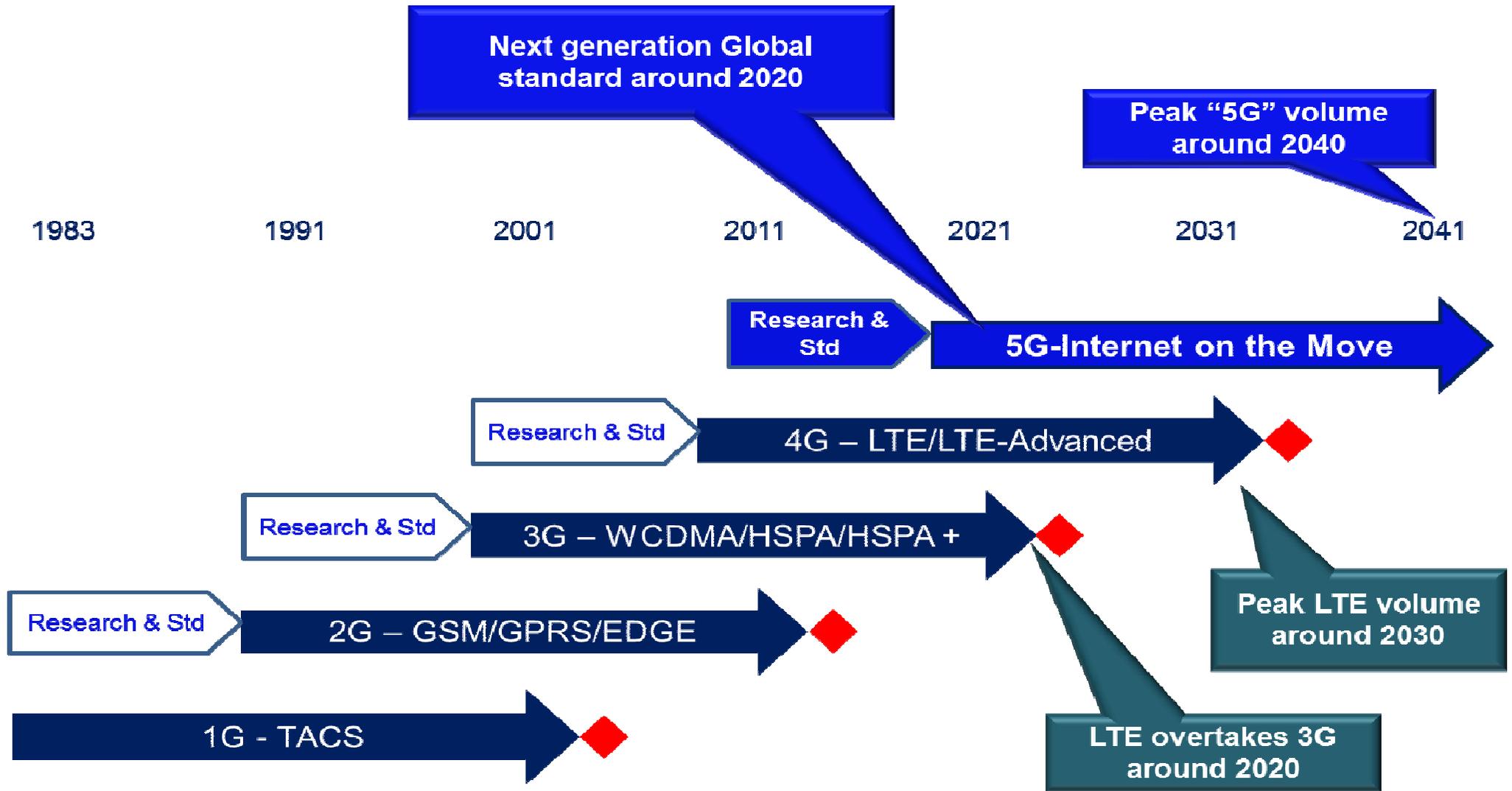
### Network technologies

- ICT 14: PPP on advanced 5G network infrastructure for the Future Internet

INCO

EU-Brazil R&D cooperation in advanced  
cyber infrastructure  
EU-Japan R&D cooperation in Net Futures

# The road to 5G



Average of 10 years research and standardisation, 20 years from introduction to peak volume

## 5G is more than NG Mobile Network

- ❑ Ubiquitous, faster, better, stronger
  - ⇒ 10Gbit/s, 1ms latency
  - ⇒ More secure, lower energy consumption, lower operating costs
- ❑ M2M, Internet of Things
  - ⇒ 100B connected objects
- ❑ new services and applications
  - ⇒ SDN, integration with cloud
  - ⇒ innovations yet to be invented

*5G will affect the whole infrastructure even though Radio Access is key*

## Motivations for a "FI" 5G PPP Initiative

- High Economic importance
- Addressing growing markets
  - Internet access*
  - Mobile data services*
  - Business data services*
- Solving perceived limitations of network infrastructures
- 5G Programmes now starting globally
- Reinforcing the 7 million European jobs in the sector and the >3% GDP contribution



*Call for action, Commissioner N. Kroes, MWC 2013*

## EU can make a difference

- ❑ Competitive telecom sector
- ❑ Capacity to reshape industry
- ❑ Commitment: 5G PPP launched with 700M€ leveraged by industry
- ❑ Building early consensus with many industry players
- ❑ Fostering standardisation and international cooperation, including spectrum planning

## 5G PPP and Horizon 2020 programme

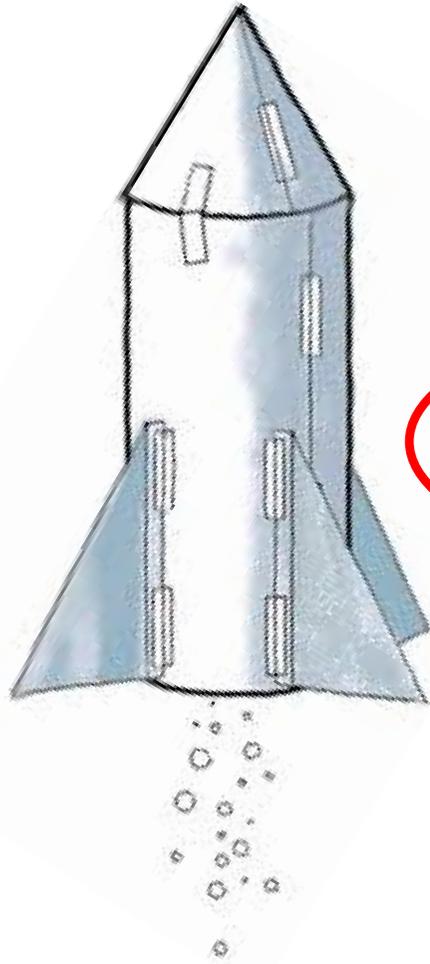
- ❑ A strong and visible community : more than 1000 organisations - Open to new stakeholders
- ❑ Aim at operational 5G deployment from 2020 to 2030
- ❑ First call of 125M€ in 2014
- ❑ Projects starting early 2015

*See you at FIA Athens conference 17-20 March: many 5G workshops !*

# Expected Impacts

- At **macro level**, strong EU industrial base % of markets
- At **societal level**, a wider spectrum of applications and services at lower cost, with increased resilience and continuity, with higher efficiency of resources usage
- At **operational level**,
  - ✓ 1000 times higher mobile data volume per geographical area.
  - ✓ 10 times to 100 times higher number of connected devices.
  - ✓ 10 times to 100 times higher typical user data rate.
  - ✓ 10 times lower energy consumption for low power Machine type communication.
  - ✓ 5 times reduced End-to-End latency (5ms for 4G-LTE).
  - ✓ Ubiquitous 5G access including in low density areas .
  - ✓ European industry driving the development of 5G standards, of 5G SEP Availability of a scalable management framework reduction of network management opex by at least 20%. Availability of security/authentication metrics across multi domain virtualised networks.

# 5G PPP - Three phases in EU

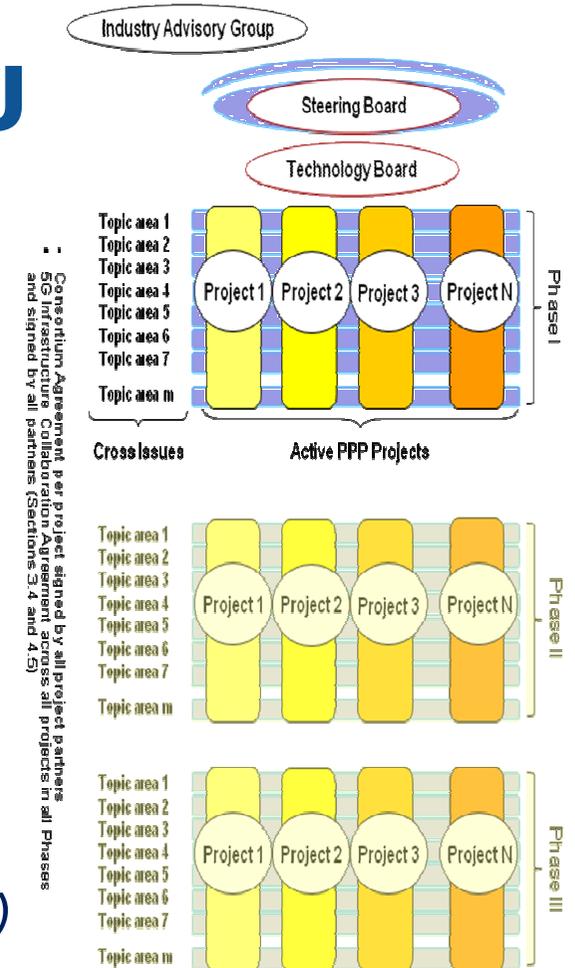


**Phase III (2017-2018)**  
Large-scale trials

**Phase II (2016-2017)**  
System optimisation

**Phase I (2014-2015)**  
Research (I) work

**Ignition phase (2012-2013)**  
**Project METIS 5GNOW, iJOIN, TROPIC, Mobile Cloud Networking, COMBO, MOTO, PHYLAWS..**



# Networks Infrastructure Calls in 2014



## ***Deadline 23<sup>th</sup> April 2014:***

- ICT 5: smart networks & novel Internet architectures (24 M€)
- ICT 6: smart optical & wireless network technologies (30 M€)
- ICT 7: advanced cloud infrastructures and services (73 M€)
- ICT 9: tools and methods for software development (25 M€)
- ICT 11: FIRE+ (31.5 M€)
- ICT 13: Web entrepreneurship (10 M€)

## ***Deadline 25<sup>th</sup> November 2014:***

- **ICT 14: 5G PPP (125 M€)**

## ***Deadline 10<sup>th</sup> April 2014:***

- EU-Japan R&D cooperation on Net Futures (6 M€)

## ICT 5. Smart Networks and novel Internet Architectures

*Novel architectural and networking approaches to information delivery and access*

Evolution from a 'host centric' to a more efficient internet architecture able to support a growing number of services, processes and business models.

### **Scope** (*Small Research and Innovation Projects*)

- novel architecture approaches (naming, routing, caching..)
- built-in security and privacy (content vs channel)
- generalised mobility and integration with IT
- Beyond content, IoT
- scalability and migration strategies
- experimental pilots

24 M€

## **ICT 6 – Smart optical and wireless network technologies**

### ***Research and Innovation; small projects***

Innovative network technologies addressing the increasing traffic and the multiplicity of usages

#### Optical networks:

Flexible management; very high speed transmission and access; efficient data center architectures

#### Wireless networks:

New paradigms for wireless connectivity; flexible use of spectrum; addressing usage diversity; hybrid (terrestrial / satellite) infrastructure for extensive coverage/resilience

*Support actions; CSA; 1 M€;*

Support to dissemination, standardisation, international cooperation, industrial roadmapping, etc.

**29 M€**

## **ICT 14 – Advanced 5G Network Infrastructure 5G-PPP High Level KPIs**

- **1000 times higher wireless area capacity and more varied service capabilities** 10
- **Saving up to 90% of energy per service**  
(focus mobile access networks)
- Reducing the average **service creation** time cycle  
**from 90 hours to 90 minutes**
- **“zero perceived” downtime** for services provision
- **Very dense deployments of wireless communication**
- Enabling advanced **User controlled privacy**

# ICT 14 – Advanced 5G Network Infrastructure

## Introduction to the proposed "pre-structuring"

- **Objectives:**

- ✓ Achieve more than a group of standalone or loosely coordinated projects
- ✓ Avoiding gaps, "hype" issues,...
- > **Optimising overall project portfolio but leaving space for flexibility**

- **Principles:**

- Ensuring an optimum set of projects, working together, no discrimination!
- Model focused on outcome / projects, not proposals as such.
- Ideally, broad agreement on of project scopes, their interfaces and the possible cross-issues between projects + gap analysis
- Example of Energy Efficiency to be seen as "by design"

- **Open issue:** How to take advantage of pre-structuring in the selection process (challenging, still under consideration)

Source: 5G-PPP

2/21/2014

# ICT 14 – Advanced 5G Network Infrastructure

## *a. Research & Innovation*

### a.1. Strand Radio network architecture & technologies

- **Network architecture:** focus on access speed, low latency, spectrum efficiency, usage of higher frequency bands, traffic prioritisation / QoS / QoE, address new cloud networking requirements, low energy
- **Versatile ubiquitous radio access infrastructure:** support low rate IoT, fixed/mobile seamless access continuum (wireless, fixed, satellite)
- **Flexible backhaul solutions** + backhaul/fronthall integration
- Architecture for 5G "transceivers" and micro-servers, HW building blocks
- **Preparing for large scale demonstrators and test-beds**  
(possibly leveraging existing experimental facilities)

## **ICT 14 – Advanced 5G Network Infrastructure**

### ***a. Research & Innovation***

#### **a.2. Strand Convergence beyond last mile**

- **Integration wireless/optical** to support the ubiquitous access continuum (obj.: reach 10 Gb/s access speeds)
- **Addressing management complexity/heterogeneity**
- **Architectures:** optimise functionality reuse (via virtualisation)

#### **a.3. Strand Network Management**

- **Approaches to reduce Opex** (simplify, SON, "feed" big data, SDN + autonomic resource management, net security across virtualised domains)
- **Increase user perceived QoS / QoE / trust**

**98 M€**

# ICT 14 – Advanced 5G Network Infrastructure

## *b. Innovation*

## *c. Support Actions*

**b. Strand Network Virtualisation & Software Networks**  
(centre of gravity on innovative solutions, additional research must be secondary)

- Network Functions Virtualisation
- Orchestration & management of heterogeneity
- Architectures: optimise functionality reuse (via virtualisation)

25 M€

### **c. Support Actions**

- Programme integration
- Monitoring
- International activities
- (Pre) Standardisation

2 M€



Thank you

Network Technologies web  
[http://ec.europa.eu/digital-  
agenda/en/network-technologies](http://ec.europa.eu/digital-agenda/en/network-technologies)