



# Beyond 5G, a European Perspective

## Sixth ITU Workshop on Network 2030

**Lisbon, 13 January 2020**

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European Commission – DG CONNECT*



# New Commission, political agenda:

## A European Green Deal

Striving to be the first climate-neutral continent



## Promoting our European way of life

Building a Union of equality in which we all have the same access to opportunities.



## An economy that works for people

Working for social fairness and prosperity



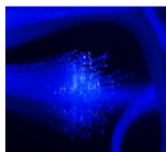
## A stronger Europe in the world

Europe to strive for more by strengthening our unique brand of responsible global leadership



## A Europe fit for the digital age

Empowering people with a new generation of technologies



## A new push for European democracy

Nurturing, protecting and strengthening our democracy



**Commissioner Thierry Breton, Hearings: “*significant investments in the digital technologies of the future, in the autonomous cars, and an evolution in the single market rules via the Digital Service Act. This means to invest in 6G, AI, cloud, post-cloud, edge computing, IoT, cybersecurity, blockchain and quantum technologies. Mastering those technologies from end-to-end and investing in them will allow Europe to grow as a global industrial power.*”**



# Starting point: 5G Public Private Partnership

Launched in 2013

Supporting EU technological leadership

€ 700 million IN H2020

User needs, cross industry partnerships  
with vertical industries

Completing phase 3: extra R&I focused on  
5G innovations, connected and automated  
mobility, and connectivity beyond 5G

5G R&I for "Long Term Evolution"

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 2 - Demos PoC\* -  
Core Techs  
Components

\*Proof of Concept

Phase I Core Technologies



Y2015

2016

2017

2018

2019

2020

2021

2022


# Supporting Vertical Pilots: 5G PPP E2E Infrastructure





5G EVE



5Genesis

 Main Facility that offers Services to ICT-19 with well defined SLAs

 Experimentation Facility for advanced Experimentation and Testing

 Moving Experimentation Facility Site

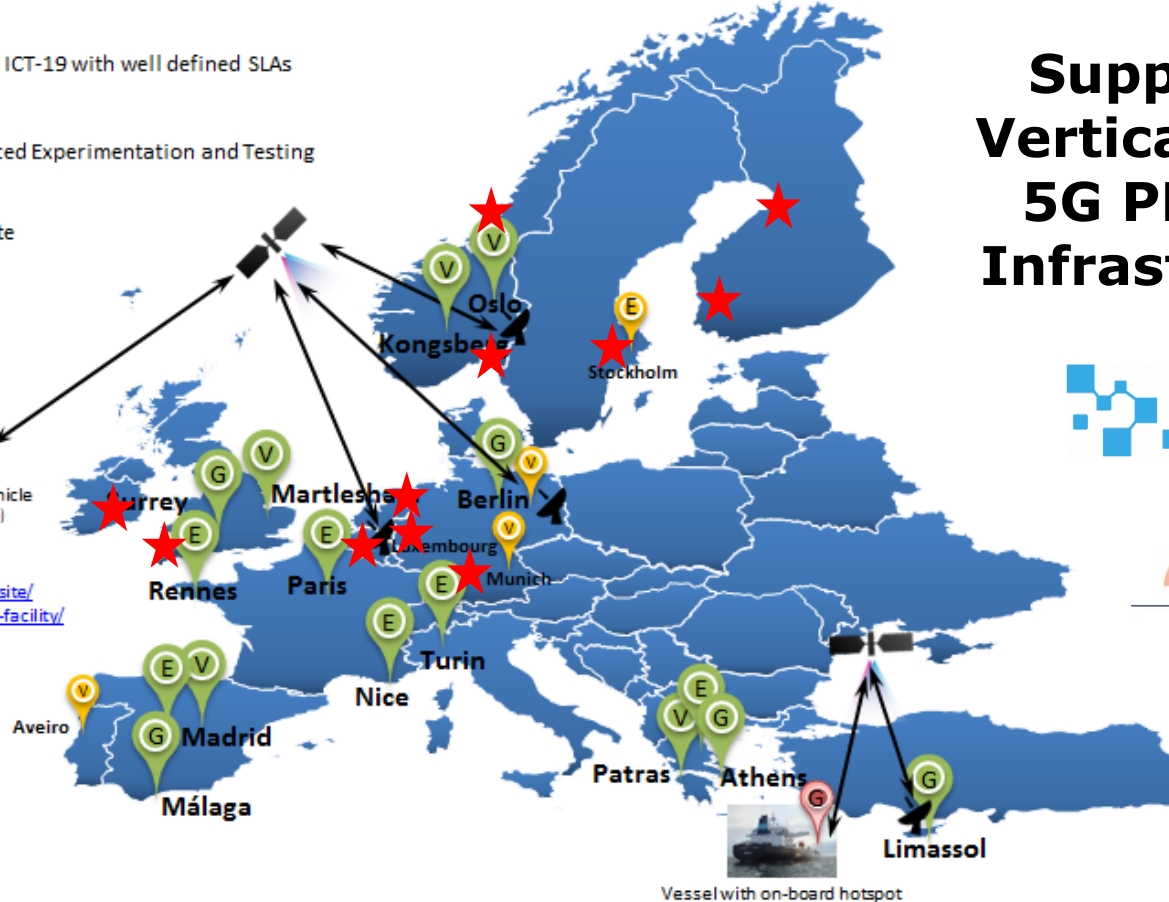
5G-Vinni  
5G-EVE  
5Genesis



Rapid response vehicle  
(any facility / location)

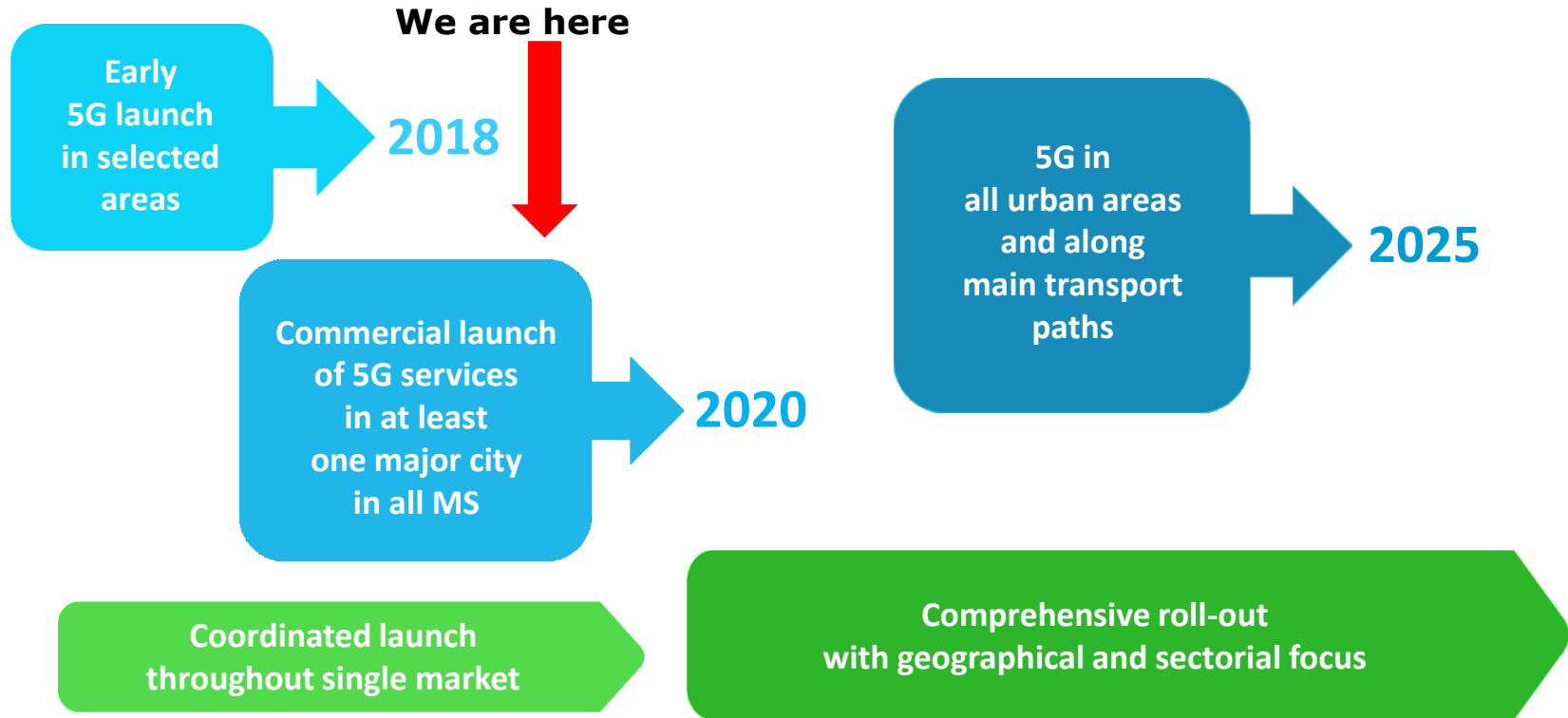
5G-VINNI : <https://www.5g-vinni.eu/facility-site/>  
5G-EVE : <https://www.5g-eve.eu/end-to-end-facility/>  
5GENESIS : [www.5genesis.eu](http://www.5genesis.eu)

 **New Sites/nodes as of 1<sup>st</sup> of June 2019**

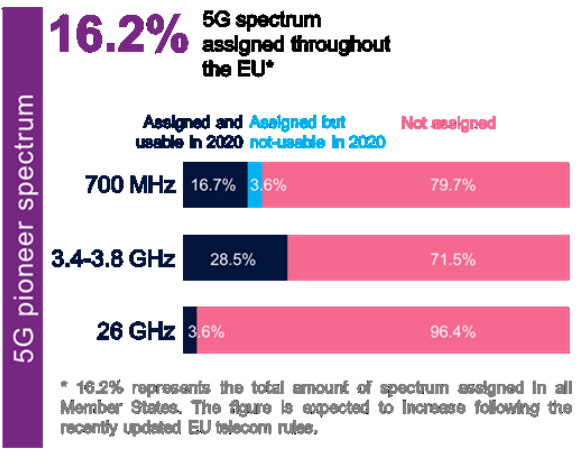
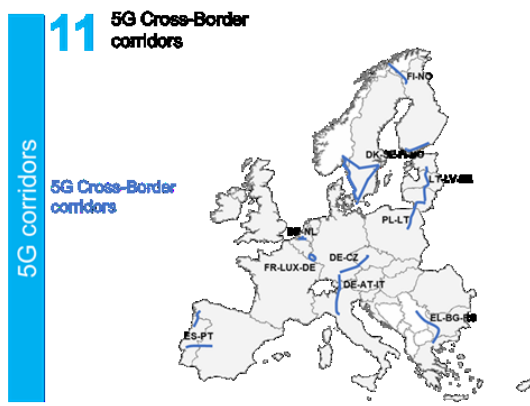
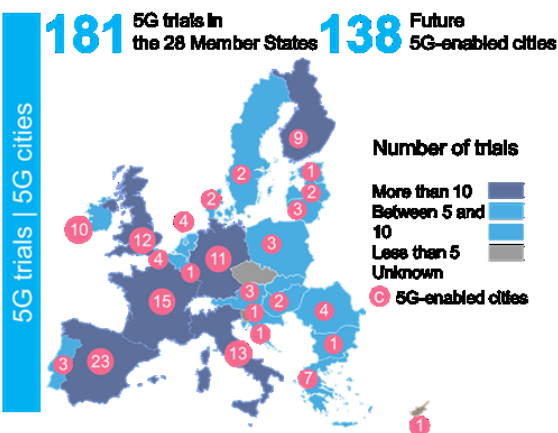


Vessel with on-board hotspot

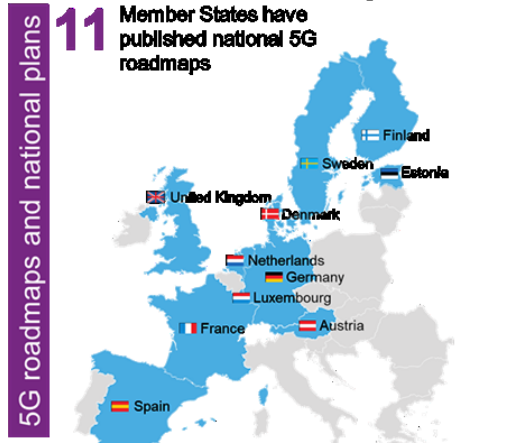
# 5G Action Plan: European targets for 5G introduction

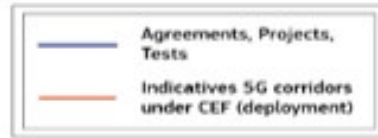


# 5G Scoreboard



## 5G scoreboard – EU-28 (December 2019)





Target corridors under CEF2 programme

« Strategic Deployment Agenda » under development





## Opportunities for the next decade

	« Digital Industries »	« Physical Industries »
Share of GDP	30%	70%
Digital Investment	70%	30%
Annual Productivity Growth (15 Years avg)	3%	0,7 %

Source, Nokia quote from: The coming productivity boom, Michael Mandel, Brett Swanson

Automation and Industry: by 2025, 11% of economy (Mc Kinsey)

Network share prospects, 10%? Doubling current broadband revenues?

➔ Assumption 1: Industrial/Vertical applications will remain a strong innovation driver over next decade





**Assumption 2:** 5G design parameters pushed towards new frontiers will remain valid towards wider industrial applicability

**Disruptions** may be expected, for example:

- Innovative spectrum use towards sensing and environment augmentation → Thz coms + sensing
- Generalised use of AI and Machine Learning in multiple aspects, Intelligence and semantic
- Multiple network architectural issues (extreme agility, energy, blurring device/network/cloud, security)
- Untested technologies at scale, e.g. blockchain



## What we observe today:

- Social issues, coverage
  - 3,5 Billion people without wireless Internet
- Energy, sustainability in hyperconnected society
  - « Energy skyrocketing at the edge ».
- EMF raising concerns
  - What impact of untested spectrum usages? How to decrease exposure?
- Human centricity and trust, data control and governance
- Security and Autonomy
  - Coping with embedded critical infrastructures

**→ Assumption 3: Societal issues to gain accrued importance**



**Assumption 4:** Significant advances compared to foreseeable 5G will come from the combinatorial effect of a multiplicity of technologies, use cases, societal requirements, and business models.

→ A modified approach may be required from the start.



# Proposal: Partnership on Smart Networks and Services





# Horizon Europe 2021-2027

Support the creation and diffusion of high-quality knowledge

Strengthen the impact of R&I in supporting EU policies

Foster all forms of innovation and strengthen market deployment

Optimise the Programme's delivery for impact in a strengthened ERA



Pillar 1  
Excellent Science

European Research Council

Marie Skłodowska-Curie Actions

Research Infrastructures



Pillar 2  
Global Challenges and European Industrial Competitiveness

Clusters

- Health
- Culture, Creativity and Inclusive Society
- Civil Security for Society
- **Digital, Industry and Space**
- Climate, Energy and Mobility
- Food, Bioeconomy, Natural Resources, Agriculture and Environment

Joint Research Centre



Pillar 3  
Innovative Europe

European Innovation Council

European innovation ecosystems

European Institute of Innovation and Technology

Strengthening the European Research Area

Widening participation and spreading excellence

Reforming and Enhancing the European R&I system

# Beyond 5G, 6G: Is it too early to start R&I?

**China initiates 6G research, technology to be made available for commercial use by 2030**

CKN  November 12, 2018  2,547



China operational 6G Working group launched early November 2019

## LG sets up 6G research centre at KAIST

LG Electronics and Korea Advanced Institute of Science and Technology (KAIST) have opened a 6G research centre to cooperate in the development of the next-generation wireless network.

## University of Oulu to begin groundbreaking 6G research as part of Academy of Finland's flagship programme

“It is the right time to be researching on 6G but not the right time to be productizing anything related to 6G,” Nokia’s Suri said.

## Taiwan moving to develop B5G, 6G tech

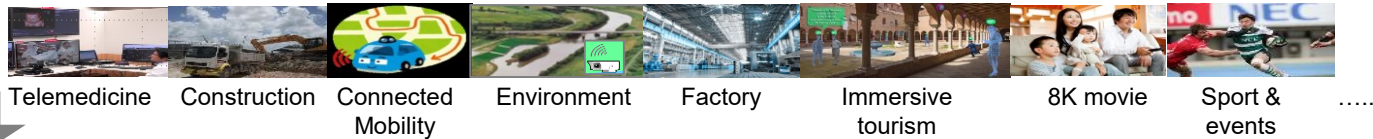
Bryan Chuan, Taipei; Willis Ke, DIGITIMES  Monday 29 April 2019  0  

Despite 5G applications still at a budding stage, Taiwan’s Ministry of Science and Technology (MOST) is actively seeking B5G (beyond 5G) and 6G academic research projects aiming to meet tech demand by 2030, according to ministry sources.

# Smart Networks and Services - Value Chain Approach

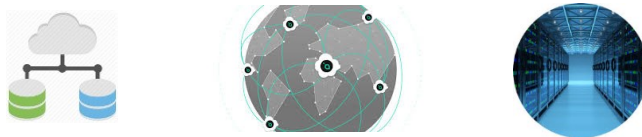
## Requirements

Industrial & Consumer Applications



## Service provisioning

Computing and Storage  
Data Analytics



## Networks

Versatile Infrastructure  
Multiple Topologies



**Devices:** Multiplicity of Connected Devices



## New opportunities

Enabling Technology Components



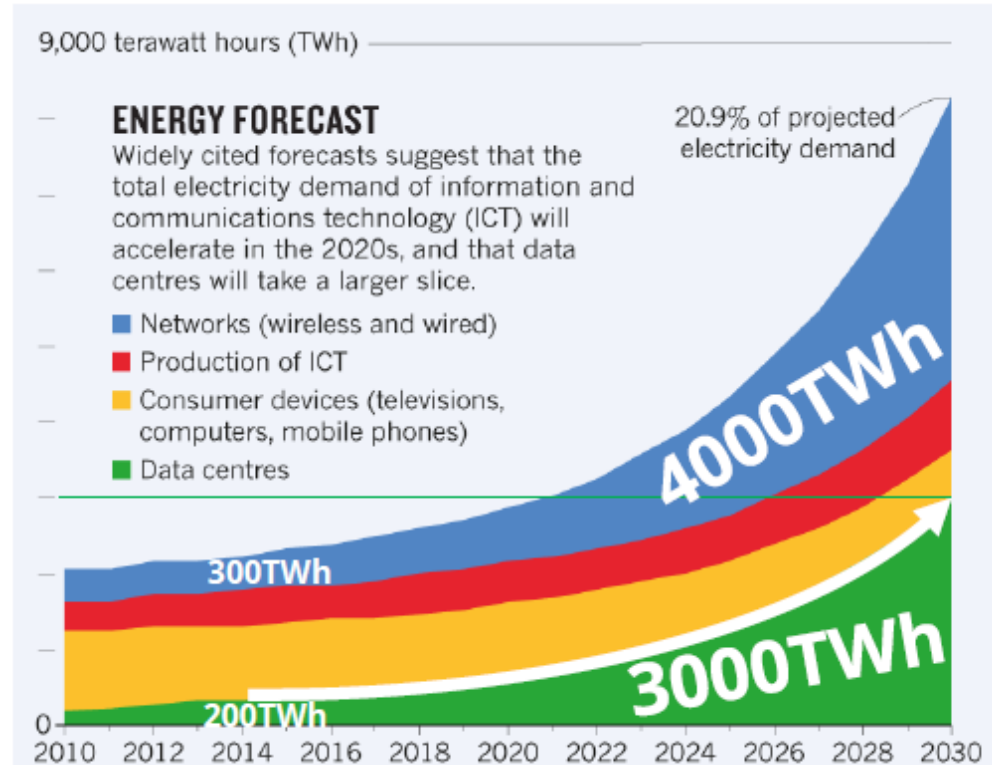
End-to-end Resource Management and Energy Efficiency

End-to-end Security and Trust

# Horizontal issue: Energy Efficiency

- Energy needs, significant increase since 2014, expected to accelerate;
  - by 2030, 10 M edge clouds , 9 M robo-cars/yr → new architectures.
  - Optical, virtualisation, densification: parts of the solution
  - Other techniques, energy harvesting and ambient energy use
- Towards EE as part of the network management, « EFCAPS » + E2E integration

Source: Anders Andrae « best case », Nature News Feed, Sept 2018.







# Horizontal issue: Security

## 5G Phase I

Unified & Access-agnostic Authentication	Increased Home Control	RAN Security – DU-CU Split	5GS – EPS Interworking Security
Primary Authentication	Initial NAS Security & Privacy	Service Based Architecture	LTE-NR Dual Connect. (Option-3)
Secondary Authentication	Visibility and Configurability	Steering of Roaming	PLMN Interconnect Security - SEPP

## 5G Phase II

- Network Slice Security
- Long Term Key Update
- 256-bit Algorithms for 5G
- KDF Negotiation
- Vertical services and LAN
- Single Radio Voice Continuity from 5G to UTRAN
- Wireless and Wireline Convergence Security
- Cellular IoT Security for 5G

## Beyond 5G?

- Beyond SaaS
- Interoperability, E2E
- Quantum
- AI based malware detection
- GDPR
- (Multiple) Identities
- Cross domains blockchains
- .....



# Timeline and process

<b>May-November</b>	Structured consultation of <b>Member States</b>
<b>May</b>	Publication of draft Inception Impact Assessments
<b>4 July</b>	<b>Stakeholder Workshop (extended scope for Smart Networks)</b>
<b>Sept-6 Nov</b>	Open Public Consultation on future European Partnerships
<b>11 Sept</b>	Information session to Member States and Associated Countries
<b>24-26 Sept</b>	European R&I Days (policy discussion and validation with stakeholders, covers all European Partnerships)
<b>Oct-Nov</b>	<b>Stakeholder Workshops (SRIA and SDA for SNS)</b>
<b>28 Nov</b>	Digital Partnerships meeting with <b>Shadow Programme Committee</b>
<b>Early 2020</b>	Submission of draft Impact Assessment to Regulatory Scrutiny Board
<b>Mid 2020</b>	Adoption of Commission proposals for Article 185/187 initiatives
<b>Q1-Q2 2020</b>	<b>Finalisation of SRIA, SDA, and Roadmap for SNS</b>
<b>Early 2021</b>	Launch of first European Partnerships under Horizon Europe