

# ***Introduction to the Modern 5G World and Challenges***

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# Introductory Framework\_(1/3)

- **Internet and communication networks** are **“critical” tools** for most areas and sectors of our **modern societies & economies**.
- They are radically transforming our world and do constitute **fundamental “pillars”** for any evolutionary process supporting effort **for growth and development**.
- **The communication networks** and the wider modern services/facilities environment **of the year 2020** will be **“enormously richer and much more complex than those of today”**.
- The **underlying (usually heterogeneous) network infrastructure** **will be able of “connecting everything”** according to an **extended multiplicity** of **application-specific requirements** (*thus including users, equipment, things, goods, computing centres, content, knowledge, information and processes*), **in a purely flexible, mobile, and quite powerful way**.

## Introductory Framework\_(2/3)

- ➡ Modern innovative aspects not only necessitate but also imply for the **proper establishment** and the **effective operation** of a relevant **novel kind of infrastructure**, *able to provide network features and performance characteristics assuring progress and growth in all corresponding domains (i.e., technical, business, financial, regulatory, social, etc.).*
- ➡ The “**inclusion**” of modern features (such as of **virtualisation** and of **software-based network functionalities**) in network communications infrastructures **will support the actual transitional process, via further strengthening network flexibility and reactivity,**
  - *by providing a proper means for better network management*
  - *and for the offering of new services.*

## Introductory Framework\_(3/3)

- **Market “actors”** (*network operators and service providers, manufacturers, SMEs, end-users, etc.*) **are expected to be strongly involved in such processes.**
- This will “redefine” existing value chains and reform roles and/or relationships between market “players”, *whilst creating new and dynamic opportunities for novelty and investments.*

➡ These changes **will also take place within the forthcoming “fifth generation” -or 5G- of telecoms systems, that will be *the most critical building block of our “digital society” in the next decade.***

**5G will not only be an evolution of mobile broadband networks, but**

- ❖ will **bring** new unique network and service capabilities,
- ❖ will **create** a sustainable and scalable technology,
- ❖ will **establish** a proper ecosystem for technical/business innovation.



# Challenges for Infrastructures\_(1/3)

- The European economy has to “maintain” but also to “fortify” both its role and influence within the global international environment, *strongly influenced by the fast Internet penetration.*
- It is important to realize innovative actions and to expand knowledge so that *“to keep a strong position in a strategically important market such as the one of the ICT sector”.*

➡ *The diversity of new (personal and professional) usages, leads to new requirements on availability, latency, reliability, trustworthiness and security.*

- ✚ *Appearance of new trends, with the related features/functionalities much more closely “embedded” within the network applications.*
- ✚ *Users gradually become more and more “demanding” in terms of contents and service requirements.*
- ✚ *Privacy and sustainability issues become of prime importance, thus implying for resilient constraints on networks and service platforms.*

# Challenges for Infrastructures\_(2/3)

## ➡ Appearance of a variety of major challenges:

- **“Handling” of the increased network traffic** together with the **provision** of all necessary **capacity and/or spectrum availability**, so that to serve/fulfil all relevant requests coming from different services, devices and users.
- **Accommodation of novel classes of services/facilities** (e.g., covering attributes coming from the IoT, M2M communications or content-based applications, or by any other future “complex” environment that may potentially appear), **while preserving a “low” -or a kind of “reasonable”- CAPEX and OPEX features**, **supporting economies of scale** and **avoidance of unnecessary investments**.
- **Strengthening Internet’s penetration in all sectors of our lives and economies**, by making it an **“indispensable means”** for realizing an explicit, ubiquitous and dependable infrastructure in mobile, wireless and fixed communications.  
*Internet “drivers” are all kind of services/applications from low (sensor and IoT) to high throughput rates (e.g. high quality video streaming) and from low to high latency.*
- **Supporting of** all actions for providing a **guaranteed level of Quality of Service/Quality of Experience (QoS/QoE)** together with **enhancement of privacy and security over the Internet**, *especially for professional uses and with the aim of offering optimal performance.*
- **Making the communication critical infrastructures “as resilient as required”** by consumers of interconnected critical infrastructures (such as **smart grid**).
- Supporting measures for realizing **reduced energy consumption**.

***The forthcoming novel 5G infrastructure “faces” most of the identified challenges and will offer reliable solutions!***

**5G will be much more than the next step beyond 4G: it is expected to be the “core functional system of our modern digital society and economy”, thus generating a truly converged and tremendously “dense” communication infrastructure, integrating IT systems (e.g., processing and storage) with plentiful network resources.**

**5G is to become a sort of universal, highly flexible and ultra-low latency virtualized infrastructure,**

- ***capable of serving immense numbers of smart terminals, machines, things, sensors, cars, drones, etc.,***
- ***with significant processing and storage capabilities that may be exponentially increased, via relevant Cloud-based applications .***





**5G networks** will not only be based on transport and routing/switching technologies but **will be more “flexible and open”**.

**5G networks** are expected **to evolve more easily** than today's networks and also **to embed sensing, computing and storage resources** in a converged and unified infrastructure, **able to “orchestrate” the delivery of services in a secure manner**.

**5G networks** **will provide a significantly higher system capacity than today** and solve any anticipated spectrum scarce.

**5G networks** **should also promote** -to the extent possible- **a common network management for mobile and wireless**, in terms of

- **constant performance optimisation,**
- **fast failure recovery,**
- **fast adaptations to changes** in network loads, architecture, infrastructure and technology.



➡ **Within the 5G-PPP framework, the following KPIs have been identified:**

- ❖ Possibility for the **provision of 1000 times higher wireless area capacity** and of **more varied service capabilities**, *if compared to those of 2010.*
- ❖ **Saving up to 90% of energy per service provided.** *(Here, the main focus should be in mobile communication networks, where the dominating energy consumption comes from the radio access network).*
- ❖ **Reduction of the average service creation time cycle** from 90 hours to 90 minutes.
- ❖ Creation of a **sufficiently secure, reliable and dependable Internet**, *with a “zero perceived” downtime for services provision.*
- ❖ Facilitating future **very “dense” deployments of wireless communication links to connect over 7 trillion wireless devices serving over 7 billion people**, thus realizing the option of *“connecting everything or everyone at any time at any place”.*
- ❖ **Enabling advanced user controlled privacy**, to guarantee a proper level of protection of the facilities offered.

*The development of the forthcoming 5G systems will be based on an ecosystem of close cooperation between industry, SMEs and the research community*

*with the aim of:*

- *developing innovative -but also applicable/viable- solutions;*
- *guaranteeing the exploitation of such in global standards & markets;*
- *ensuring interoperability and economies of scale, with affordable cost for system deployment and the end-users.*

# The European Policy Approach to 5G\_(4/6)



## The global environment



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# The European Policy Approach to 5G\_(5/6)

## Factories of the Future

- 1 Time-critical process control
- 2 Non time-critical factory automation
- 3 Remote control
- 4 Intra/inter-enterprise communication
- 5 Connected goods

## Energy

- 1 Grid access
- 2 Grid backhaul
- 3 Grid backbone

## e-HEALTH

- 1 Assets and interventions management in Hospital
- 2 Robotics
- 3 Remote monitoring
- 4 Smarter medication

## MEDIA & ENTERTAINMENT

- 1 Ultra High Fidelity Media
- 2 On-site Live Event Experience
- 3 User/Machine Generated Content
- 4 Immersive and Integrated Media
- 5 Cooperative Media Production
- 6 Collaborative Gaming

## AUTOMOTIVE

- 1 Automated driving
- 2 Share My View

- 1 Bird's Eye View
- 2 Digitalization of Transport and Logistics
- 3 Information Society on the road



5G empowering vertical industries



5G VERTICAL SECTORS

With 5G, networks will be transformed into intelligent orchestration platforms.

By converting strong relationships between vendors, operators and networks, 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.

## European Approach within the 5G-PPP Framework

Source: 5G-PPP, <https://5g-ppp.eu/>

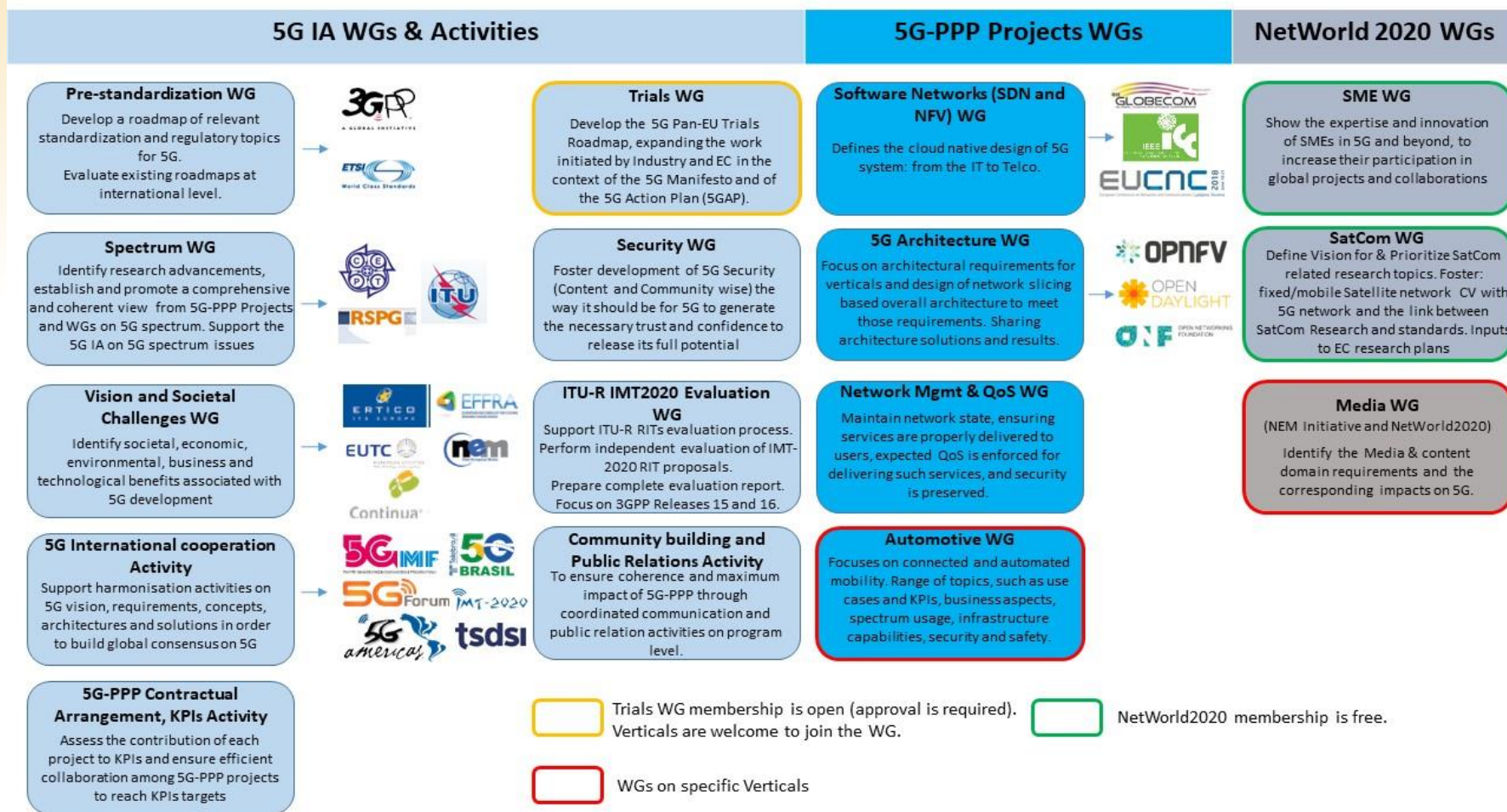


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# The European Policy Approach to 5G\_(6/6)



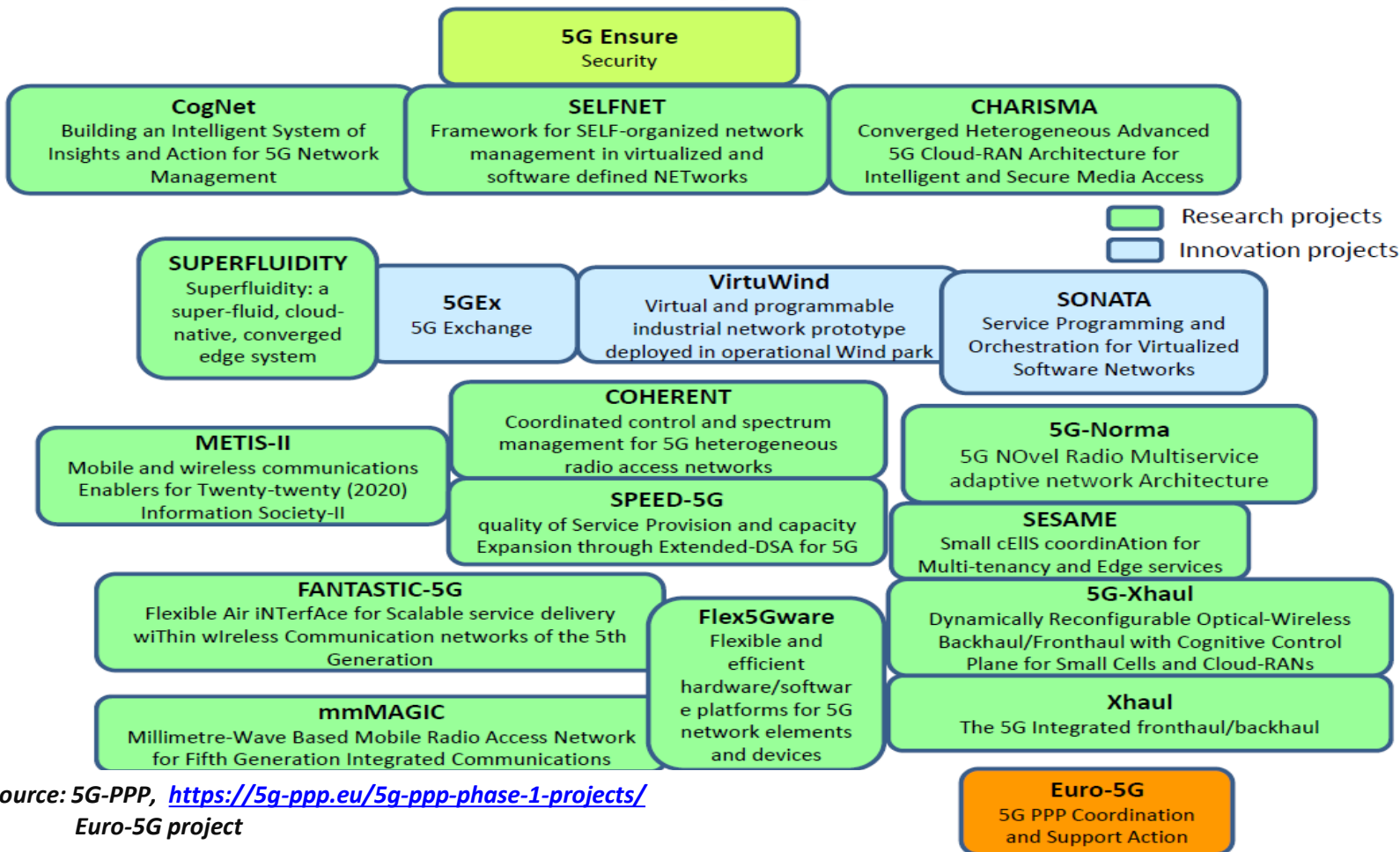
## 5G IA and 5G-PPP Working Groups



# 5G-PPP Phase-1 Projects \_(1/2)

**19 projects**

## Horizon 2020 5G-PPP Call 1 selected projects

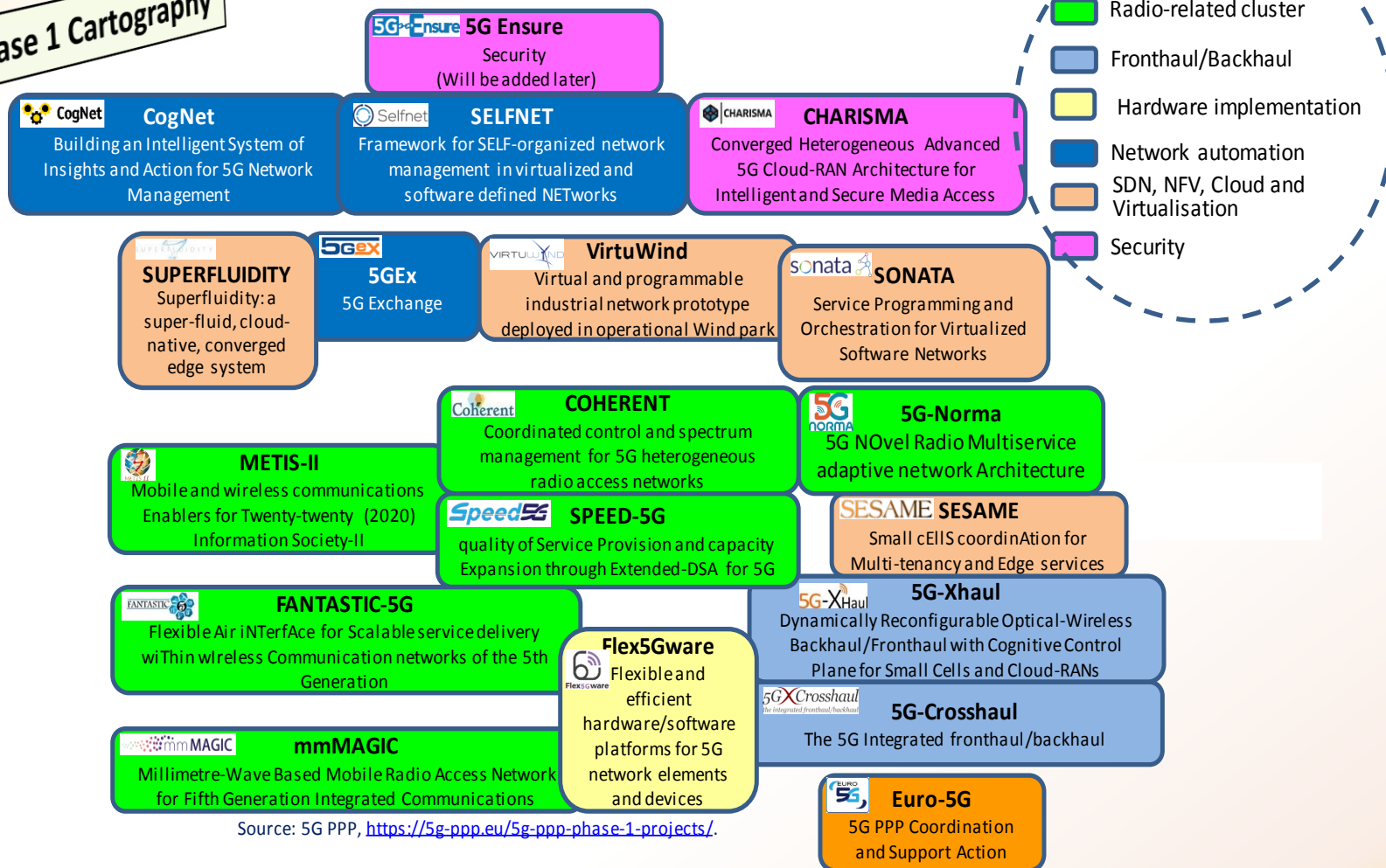


Source: 5G-PPP, <https://5g-ppp.eu/5g-ppp-phase-1-projects/>  
Euro-5G project



# 5G-PPP Phase-1 Projects \_(2/2)

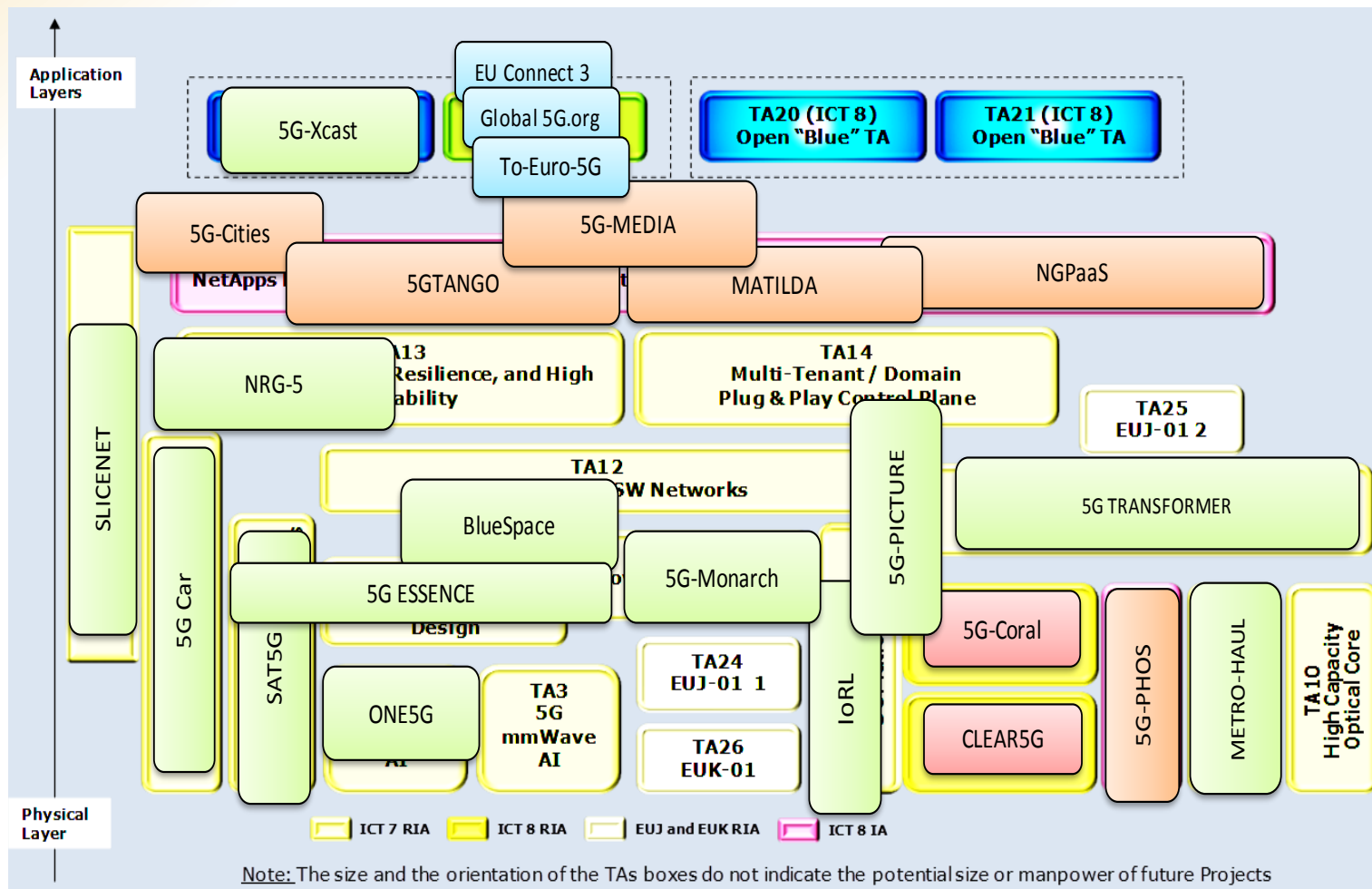
## Phase 1 Cartography



Source: 5G PPP, <https://5g-ppp.eu/5g-ppp-phase-1-projects/>.

# 5G-PPP Phase-2 Projects \_(1/2)

## 5G-PPP Phase 2 programme

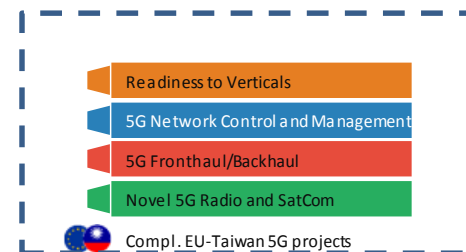


Source: 5G-PPP, <https://5g-ppp.eu/5g-ppp-phase-2-projects/>

# 5G-PPP Phase-2 Projects \_(2/2)

**21 projects**

Source: 5G-PPP, <https://5g-ppp.eu/5g-ppp-phase-2-projects/>



**CLEAR5G**

Converged wireless access for reliable 5G MTC in Factories

**5GCity**

Distributed multi-tenant cloud and radio platform for 5G neutral hosts

**5G MEDIA**

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

**5G ESSENCE**

Embedded Network Services for 5G experiences

**5Gtango**

DevOps Platform for 5G Network Services and Apps

**5G TRANSFORMER**

5G Mobile Transport Platform for Verticals

**MATILDA**

Framework for devel. & orchest. of 5G apps & services

**5G-MONARCH**

Mobile Network Architecture for 5G and beyond

**SLICE NET**

E2E Cognitive Network Slicing and Slice Mgmt in 5G Networks

**NGpaas**

Next Generation Platform as a Service (PaaS)

**NRG5**

Smart Energy as a Service via 5G Mobile Network advances

**5G CAR**

5G Comms for e2e V2X and multi-RAT interworking

**5G Xcast**

Broadcast and Multicast Comms for 5G Wireless Systems

**METRO-HAUL**

5G App-aware metro optical network

**5G-PICTURE**

Programm. Infrastr. for disaggr. net & comp resources

**SaT 5G**

Integration of Satellite and Terrestrial network for 5G

**ONE5G**

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

**5G phox**

5G integrated Fiber-Wireless for high-density SDN networks

**Global 5G**

Global vision, standardisation & stakeholder engagement in 5G

**5G coral**

5G Convergent Virtualized Radio Access Network at the Edge

**5G blueSPACE**

Spatial Multiplexing 5G Networks for Adv. Networking

**IoRL**

Internet of Radio-Light in Buildings

**TO-EURO-5G 2020**

Supporting the 5G-PPP especially 5G Initiative governance



# 5G-PPP Phase-3 Projects

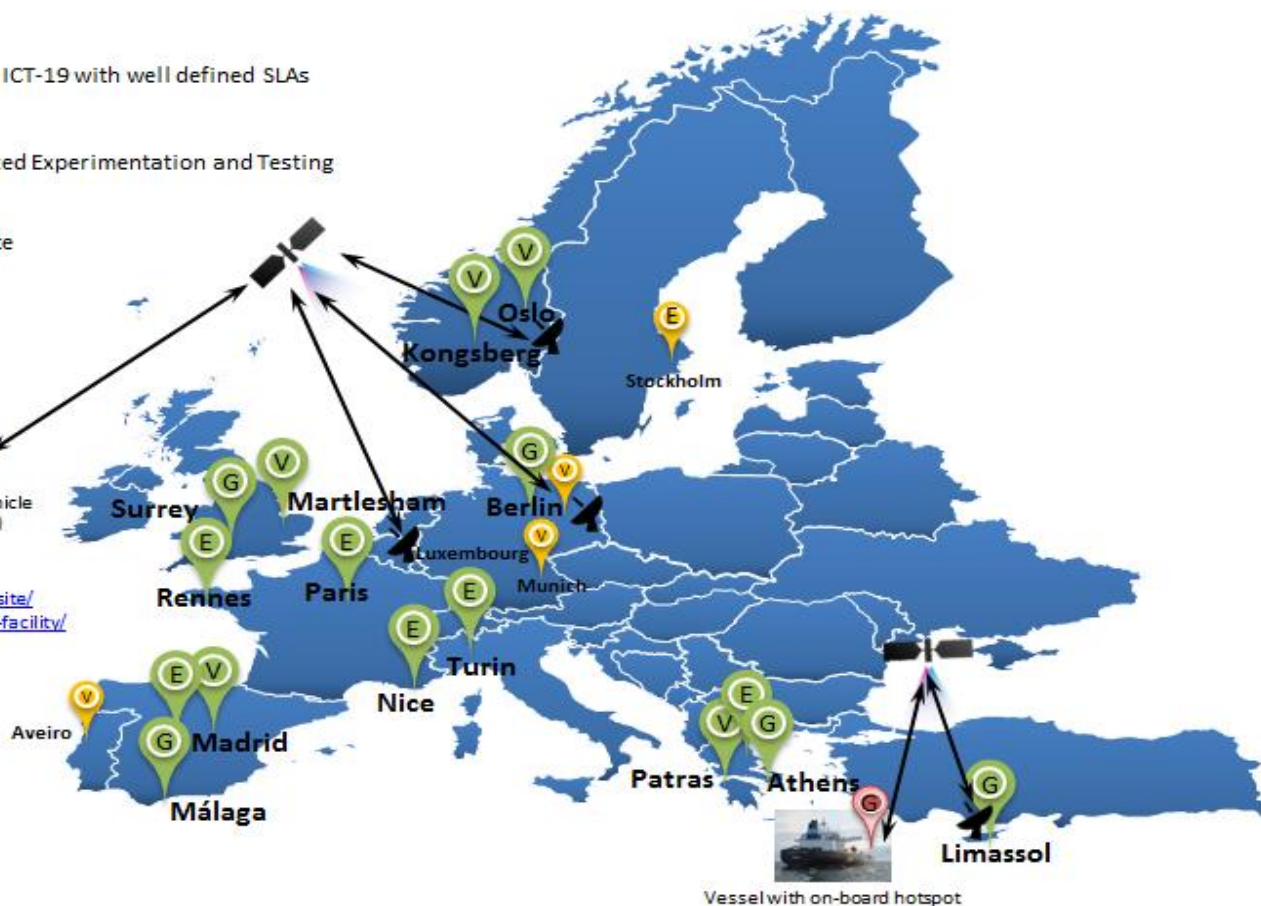
## 3 projects

- 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  
5GGenesis



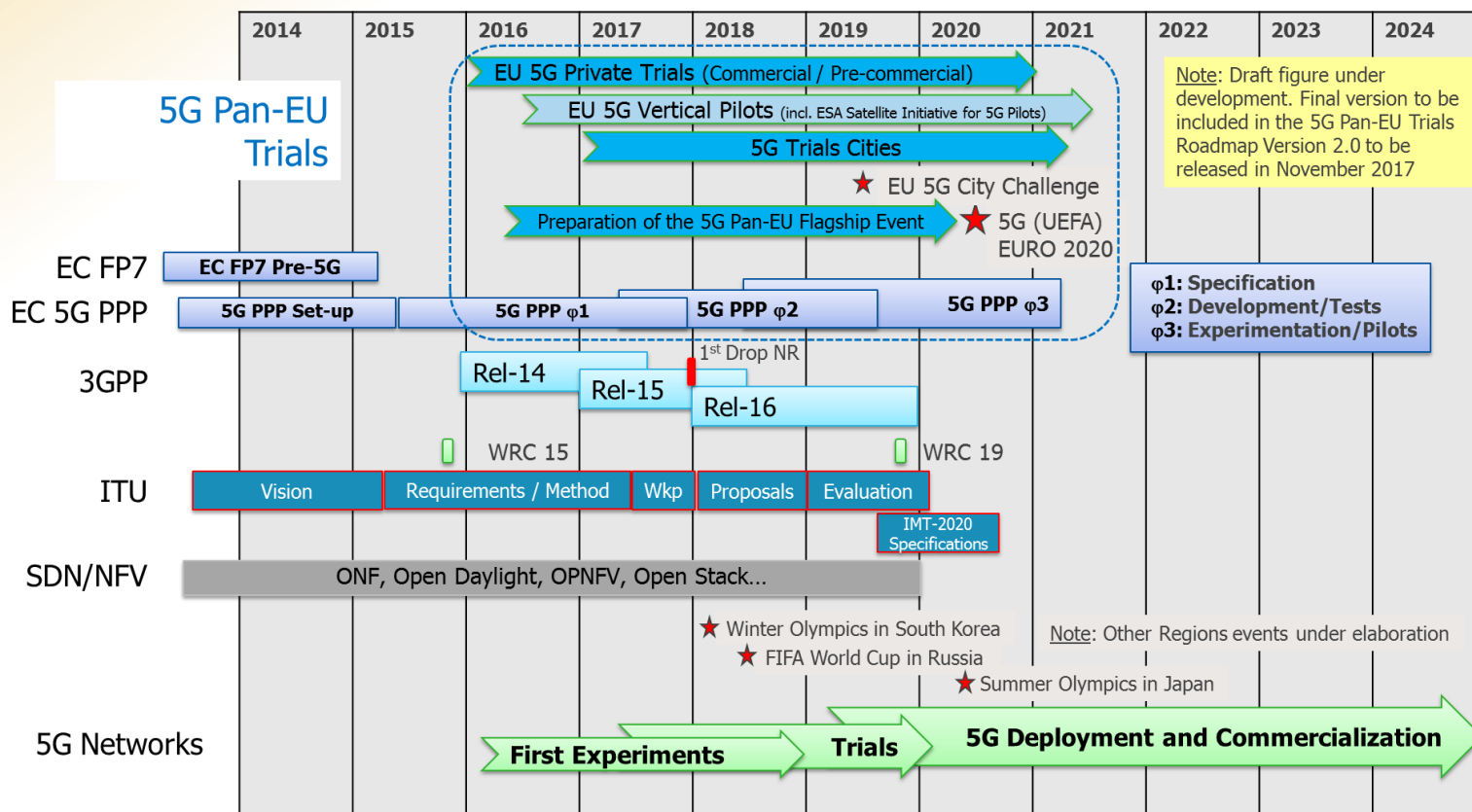
5G-VINNI : <https://www.5g-vinni.eu/facility-site/>  
5G-EVE: <https://www.5g-eve.eu/end-to-end-facility/>  
5GENESIS: [www.5genesis.eu](http://www.5genesis.eu)



## 5G Infrastructure PPP Phase 3 Platforms Projects – Geographic Cartography

Source: 5G-PPP, <https://5g-ppp.eu/5g-ppp-phase-3-projects/>

# Challenges for Growth\_(1/5)



## Pan-European Trials Roadmap

Source: 5G-PPP, <https://5g-ppp.eu/>

# Challenges for Growth\_(2/5)



## The Vision for the 5G-oriented future

Source: 5G-PPP, <https://5g-ppp.eu/>



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# Challenges for Growth\_(3/5)



## The Vision for the 5G-oriented future

Source: 5G-PPP, <https://5g-ppp.eu/>



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# Challenges for Growth\_(4/5)



*Strong Interactions with the 5G Stakeholders*

Source: 5G-PPP, <https://5g-ppp.eu/>



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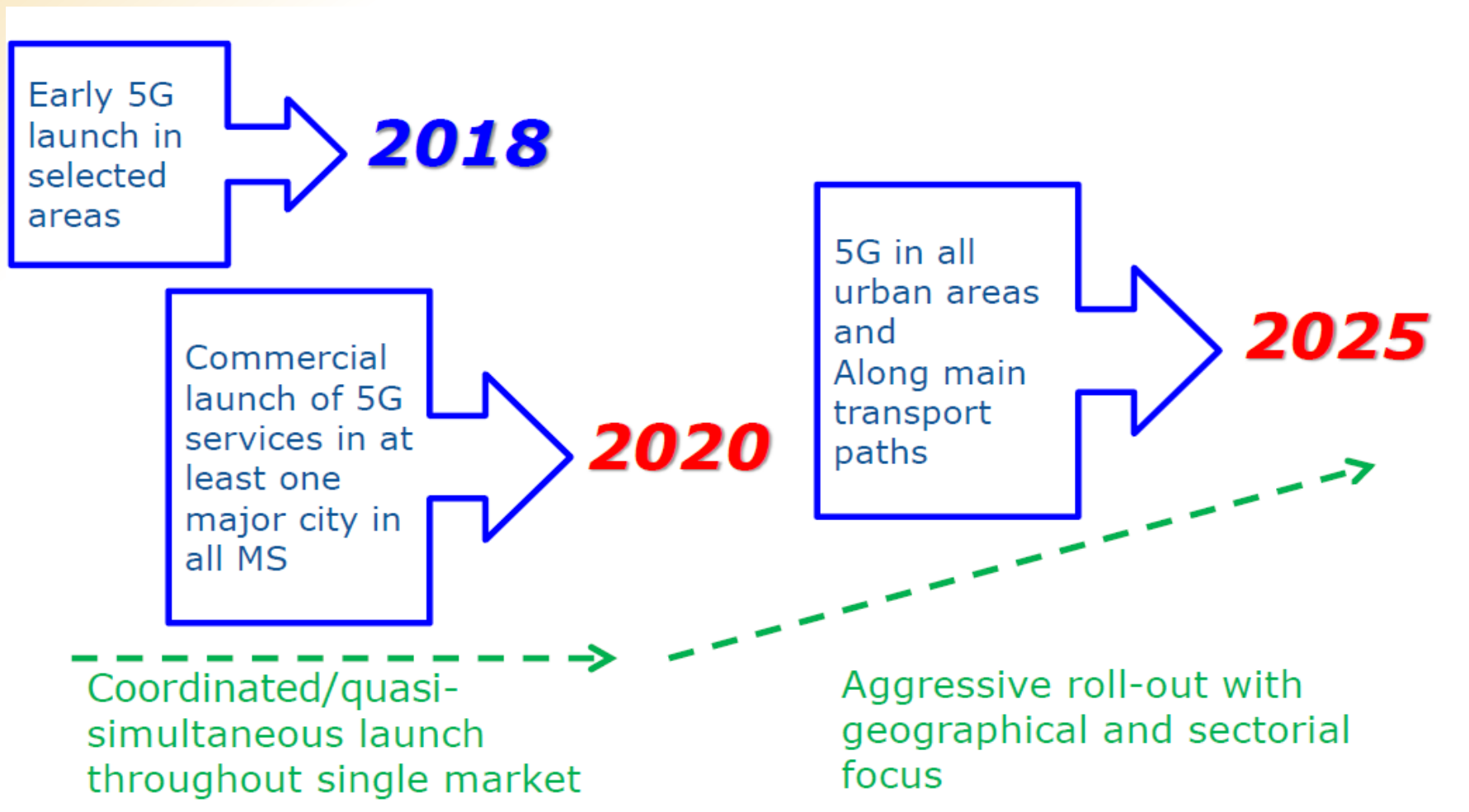


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# Challenges for Growth\_(5/5)



Source: 5G-PPP, <https://5g-ppp.eu/>



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