European Conference on Networks and Communications (EuCNC) 2019

European and Taiwanese Cooperation on 5G

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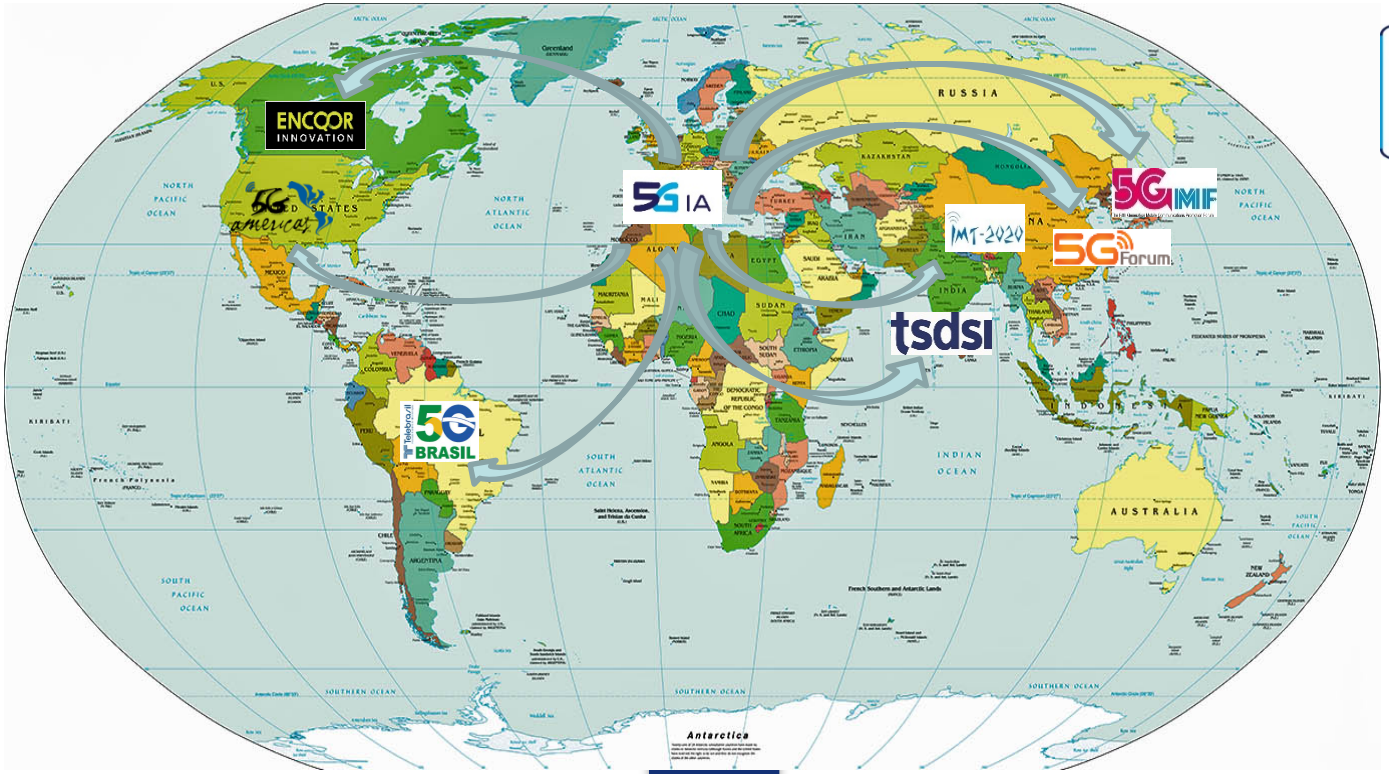
Motivation for International Cooperation in Network R&I

- Industry Drive, competitiveness across value chains;
- Pre competitive opportunities, towards
  - Global consensus and standards;
  - Interoperability, spectrum
  - Use case best practices
  - Addressing global societal challenges
  - Specific policy issues, fn(partner country), e.g. reciprocity

5G Public Private Partnership
Industrial R&I cooperation cartography



	R&I , 2018-20 Work Programme	Number of Projects	Total N° of projects *	Partner
	- Applications and trials with 5G networks - Beyond 5G, applicability of spectrum >275 GHz ➔spectrum, interop, use cases, Beyond 5G	**2**	**6**	**5GMF**
	- Application trials at mmwave bands - Interworking across multiple radios ➔ Standards validations, use cases	**2**	**4**	**5G Forum**
	- eMBB Trials at 3,5 GHz and in the V2X context ➔ standards, 5G V2X	**1**	**1**	**IMT 2020 (5G) Promotion Group**
	- 5G trials addressing end-to-end testbeds for specific applications ➔ 5G verticals,	**2**	**4**	**DoIT-MoEA**
	- ***Coordination of EU-NSF projects relevant to the Advanced Wireless Platform programme*** ***➔ Longer term beyond 5G***	**1**	**1**	**NSF**

***5G/Network related only, under H2020 programme**

EU-Taiwan: Horizon 2020 and 5G as catalyser

5G PPP Phase 1: Classical cooperation

5GXCrosshaul
the integrated fronthaul/backhaul

METIS II

5G PPP extension: Two dedicated call for Taiwanese partners

Clear5G

Two EU-TW call 1 projects
started in September 2017

5G coral

EU-TW call 2 results:

5GPPP Phase 3: E2E Infrastructure and Vertical Trials

Main Facility that offers 5G pan European Services (e.g. to ICT-19) with well defined SLAs

Experimentation Facility for advanced Experimentation and Testing

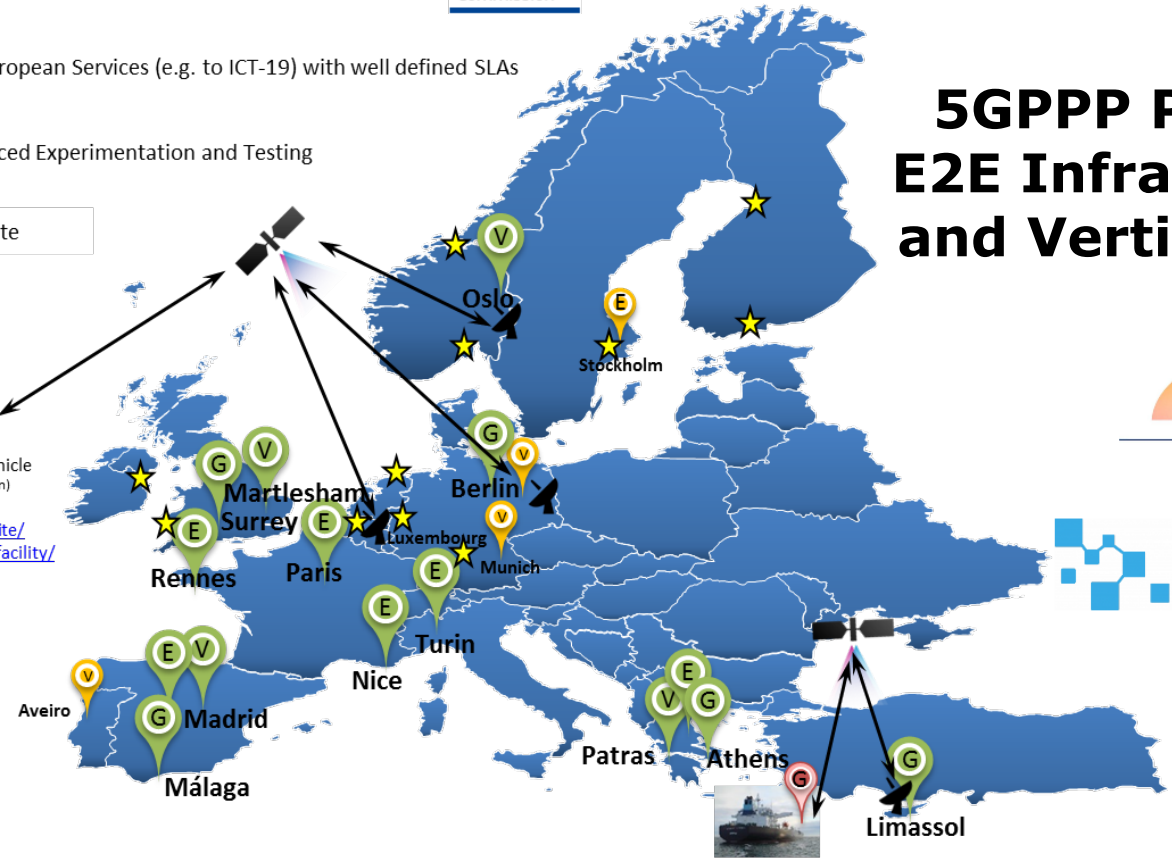
Moving Experimentation Facility Site

5G-**V**inni
5G-**E**VE
5**G**enesis

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

Additional ICT-19 Projects Platforms & Nodes: Aachen, Aalto, Bristol, Brussels, Dublin, Groningen, Heroya, Kista, Oulu, Reutlingen and Trondheim



Vessel with on-board hotspot

5G EVE

5G-VINNI

5Genesis

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

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.

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

CKN November 12, 2018 2,547

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.

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: 3,5 to 10 Trillion € by 2025, 11% of economy (Mc Kinsey)

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

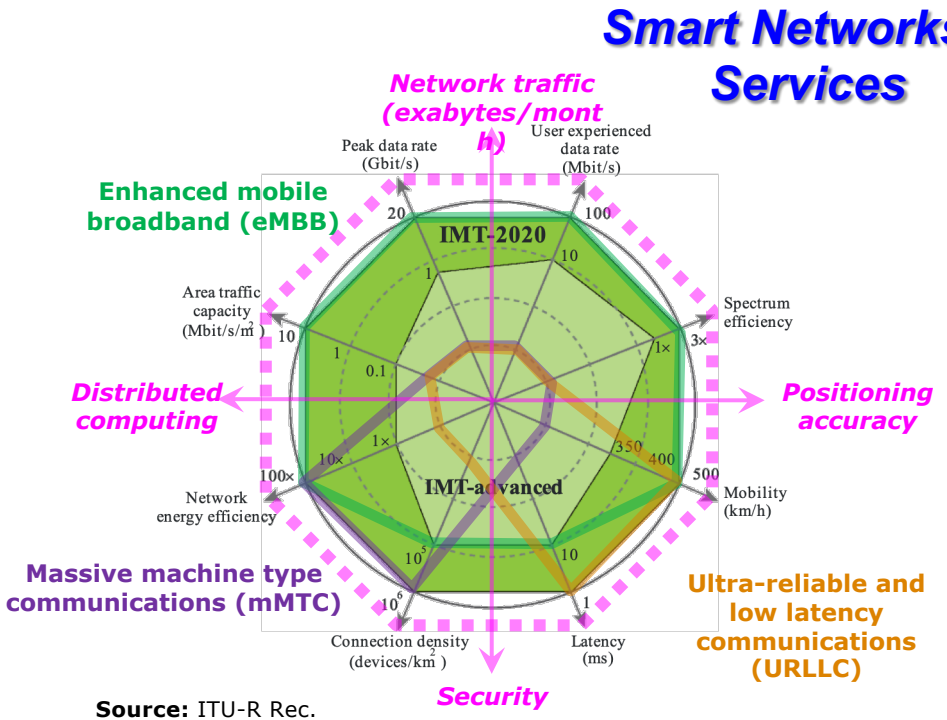
➔ Assumption 1: Industrial/Vertical applications will remain a strong innovation driver over next decade

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 infrastructres

➔ Assumption 2: Societal issues to gain accrued importance

5G Vision and focus Parameters: will they remain valid?



Source: ITU-R Rec. M.2083 (modified)

Use cases and drivers

- Capacity, still 50% traffic increase/ year
- local applications, sub-ms latency
- Gbps availability, e.g XR applications
- Extreme reliability beyond 5x9;
- mMTC “everywhere “
- Extreme energy efficiency
- Further enhanced high security/trust
- Very high mobility
- cm-level localization

Assumption 3: 5G design parameters pushed towards new frontiers will remain valid towards wide industrial applicability

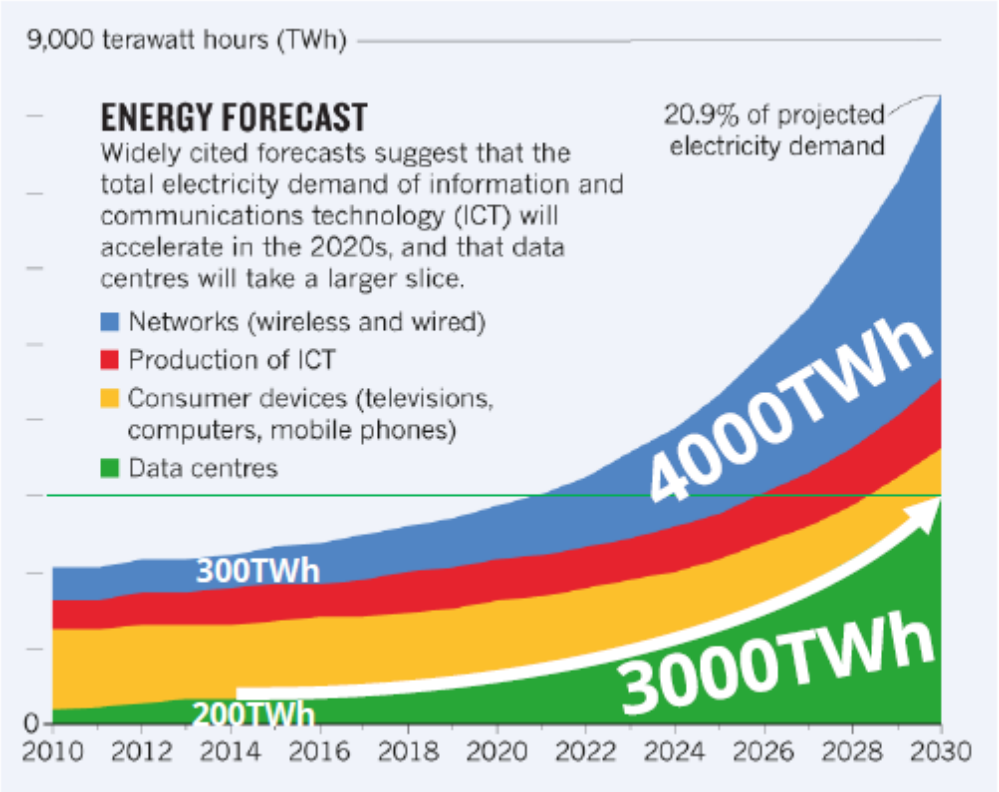
Disruptions may be expected, for example:

- Innovative spectrum use towards sensing and environment augmentation
- 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

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?

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

"Journal of ICT Standardization" *OpenAccess by River Publishers* Special issues on "5G non-standard aspects" and "3GPP 5G specifications"

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.

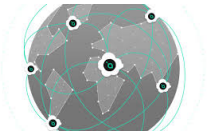
Proposal: Partnership on Smart Networks and Services

Smart Networks and Services - Value Chain Approach

Requirements
Industrial & Consumer Applications

Telemedicine | Construction | Connected Mobility | Environment | Factory | Immersive tourism | 8K movie | Sport & events | .....

Service provisioning
Computing and Storage
Data Analytics



Networks
Versatile Infrastructure
Multiple Topologies

Mobile & Last Mile

High density access

Corporate nets

Indoor Short Range

Dense IoT

Fixed wired access

Devices: Multiplicity of Connected Devices

Industrial Automation

360° VR/XR

Fully Automated Vehicles

Haptic Communications for surgery

Agri sensors

Smartphones

Computers

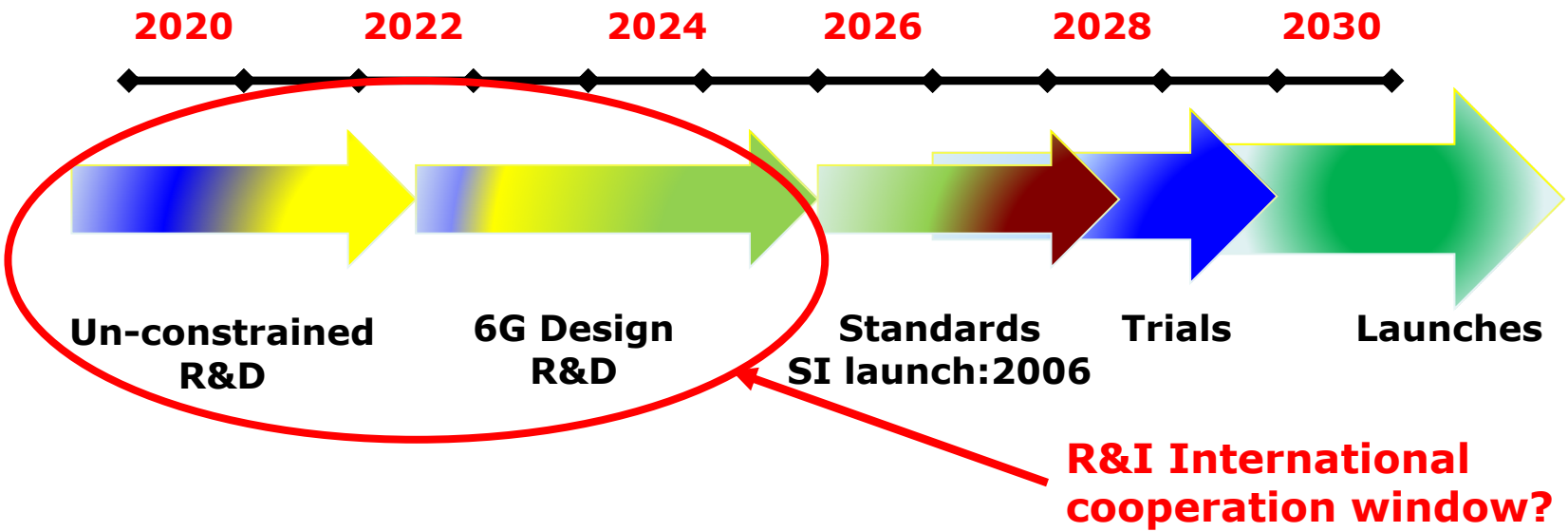
Drones

New opportunities
Enabling Technology Components

End-to-end Resource Management and Energy Efficiency

End-to-end Security and Trust

Beyond 5G: A Possible Roadmap



~ Based on modified 5G Model

Need agility in case of accelerated commercial pressure

Derived from Orange

Indicative timeline European Partnerships

3 May – 27 June:	Structured consultation of Member States (as part of strategic coordinating process)
May-June:	Publication of draft Inception Impact Assessments and start of the Impact Assessment work
Mid-June until September:	Open Public Consultation on future European Partnerships based on Article 185/187
July	SNS Stakeholders Workshop (extended, tentative)
24-26 September:	European R&I Days (policy discussion and validation with stakeholders, covers all European Partnerships)
October	SNS Stakeholders Workshop
End of 2019:	Submission of Impact Assessment drafts to Regulatory Scrutiny Board
Early 2020:	Adoption of Commission proposals for Article 185/187 initiatives
Early 2020	Finalisation of SNS SRIA and Roadmap (TBC)
Early 2021:	Launch of first European Partnerships under Horizon Europe

By Way of Conclusion

The B5G-6G journey has started. At this early stage, flexibility is key. We can today identify as potential drivers:

- Networks in industrial environments, pushing the 5G envelope limits
- Societal issues to get enhanced focus
- 5G design drivers duly complemented remain valid
- New innovation/disruptions to be integrated (AI/ML, DLT, mEC..)
- New system/stakeholders approach targeted
- Europe committed to support EU excellence in this critical domain.

Thank you for your attention !