

TOWARDS 5G-ENABLED GIGABIT SOCIETY

FUTURE NETWORKS FOR TRANSFORMING UTILITIES, TRANSPORTATION AND SMART CITY ECOSYSTEMS

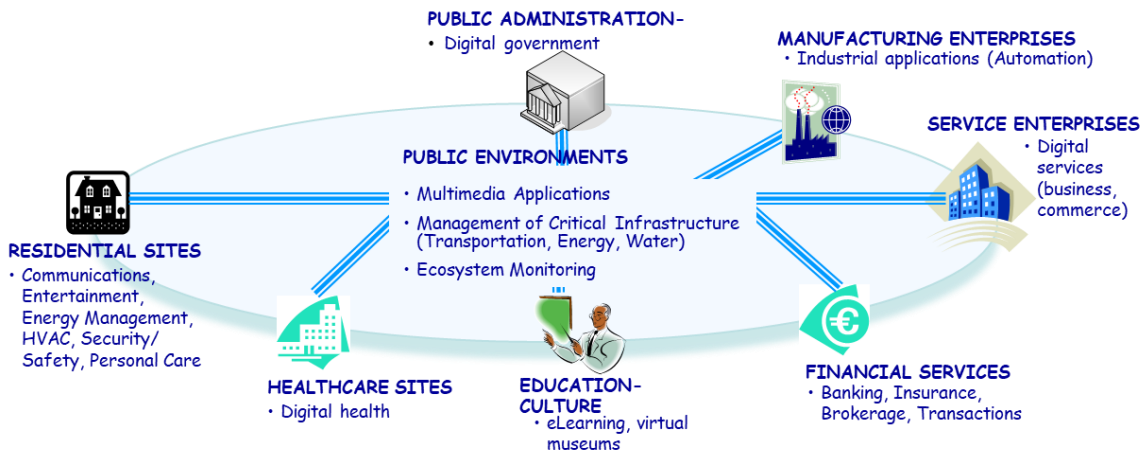
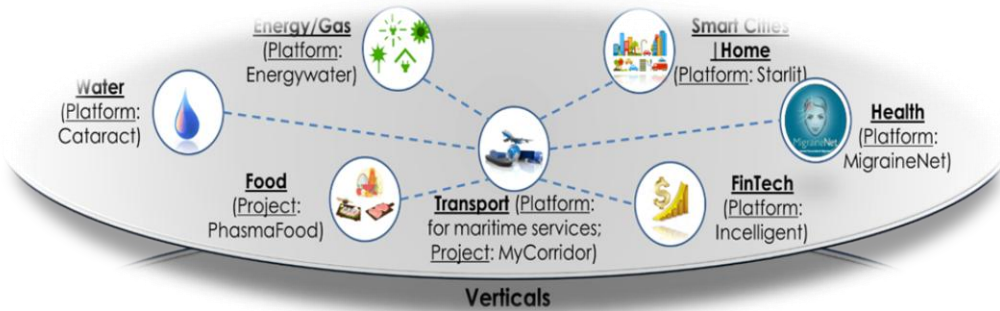
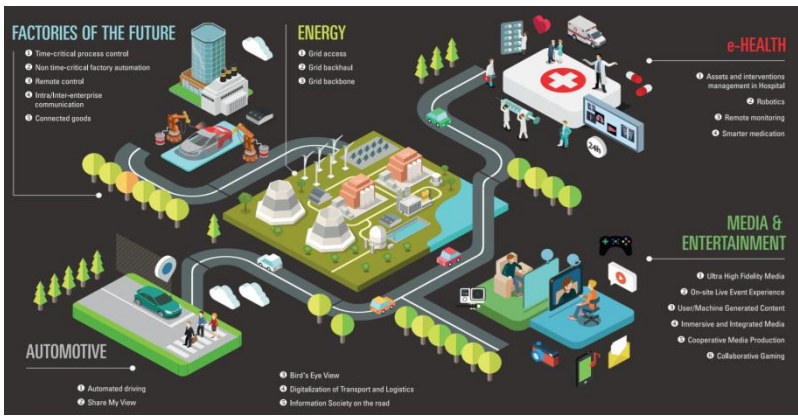
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University of Piraeus

Athens, 11 October 2018

Outline

- On the Orientation towards Verticals
- Associated Requirements (5G, B5G)
 - ▣ Standardized and emerging ones
- Approach: Network Trends/ Evolution
 - ▣ Addressed in various generations and “newer” ones
- Approach: Program / Project Perspective
- Current Status: Components/ Verticals’ Systems
 - ▣ Megacities/Critical Infrastructure and Industry 4.0
- Further Targets: Evolved Applications/Networks
 - ▣ Utilities, Transport, Smart Cities

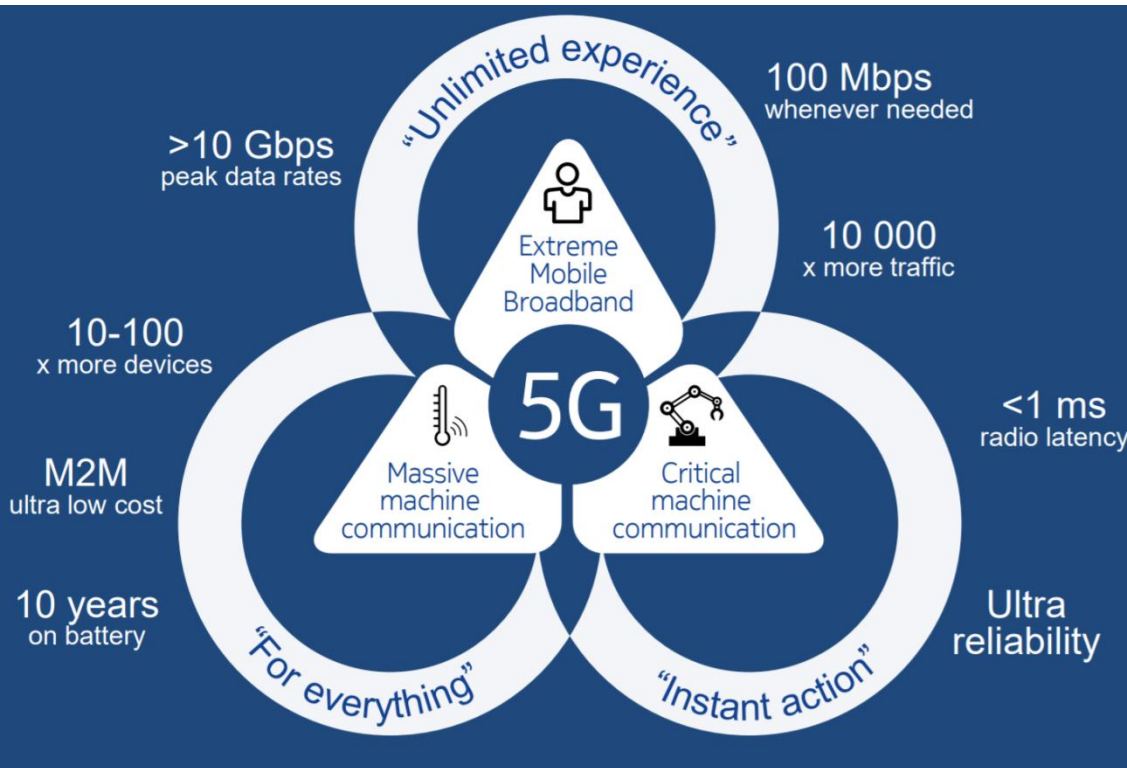
On the Orientation towards Verticals



P. Demestichas, "Introducing cognitive systems in the wireless B3G world: Motivations and basic engineering challenges", Telematics and Informatics, Vol. 27, No. 3, Aug. 2010, pp.256-268

Associated Requirements (5G, B5G): Standardized and Emerging

5G targets



Beyond 5G targets

- Network management efficiency
 - ▣ Virtualisation technologies, architectures, etc.
- Radio access network enhancements
- Enhanced network security, trust

Qualitative (for now)

Source: 5G-PPP (<https://5g-ppp.eu/>) and “Spectrum Aspects For Extreme MBB”, ETSI Summit, 2016

Approach: Network Trends/ Evolution



Potential for sharing between operators (e.g., spectrum, network elements, network segments)

- Activation of functional components
- Functional components deployment to physical elements
- Physical element interconnection

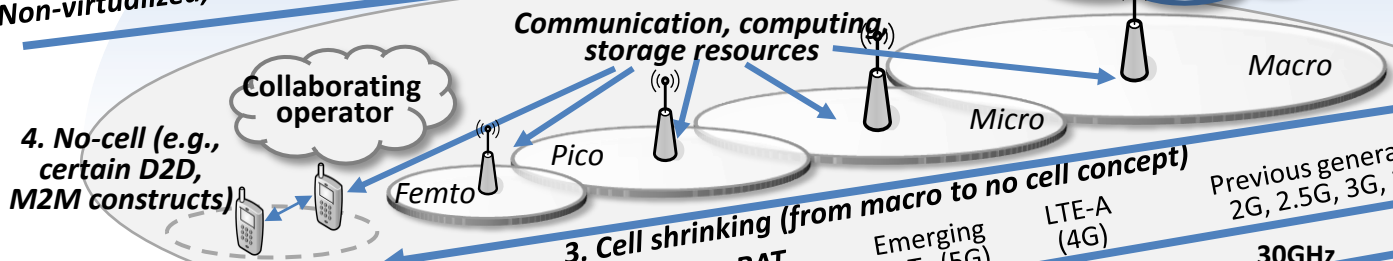
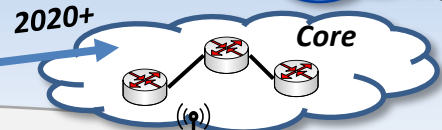
Repository of virtualized functions

6. 5G, WMB infrastructures: Cloud platforms offering services through abstractions, on demand, with elasticity, scalability, fairness



1. RAT evolution
2. Spectrum
- 3-4. Cell
5. Software Nets
6. Cloudification

5. Non-virtualized, Cloud-RANs, virtualization of core, SDN and/or NFV

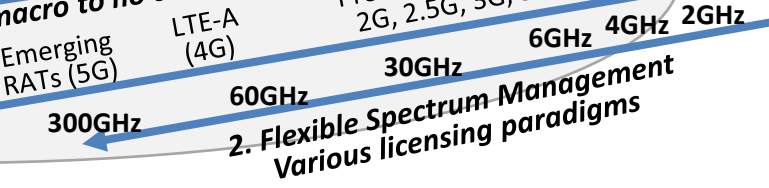


4. No-cell (e.g., certain D2D, M2M constructs)

3. Cell shrinking (from macro to no cell concept)

Previous generations 2G, 2.5G, 3G, 3.5G

Applications connecting everyone and everything, anywhere, anytime, involving all types of media

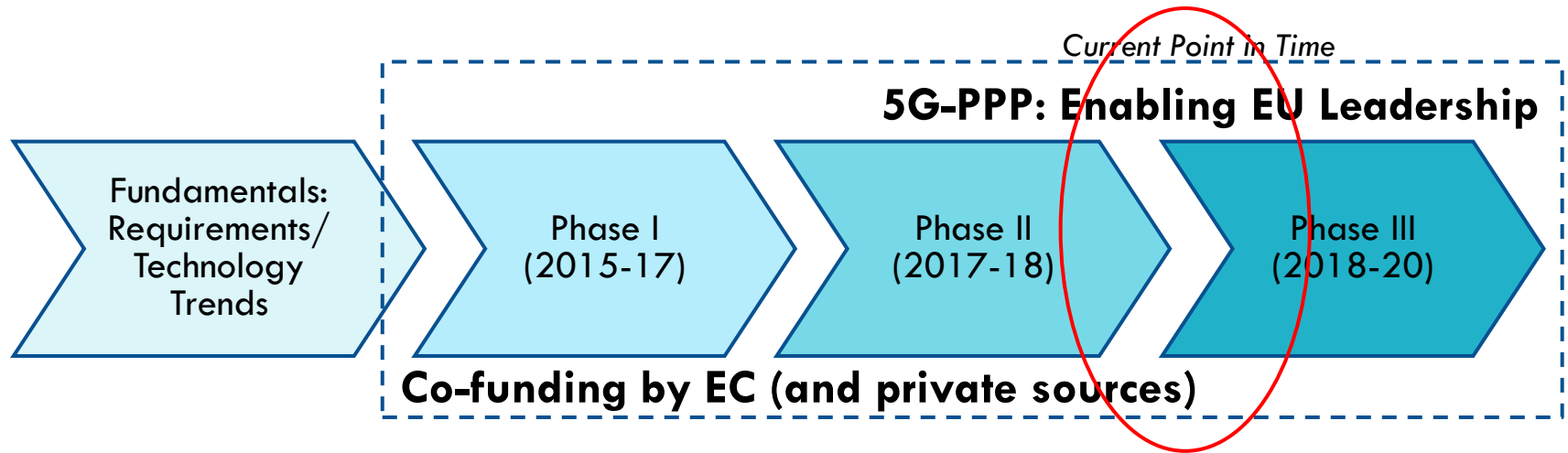


2. Flexible Spectrum Management Various licensing paradigms

Reference: P. Demestichas, A. Georgakopoulos, K. Tsagkaris, S. Kotrotsos, "Intelligent 5G Networks: Managing 5G Wireless/Mobile Broadband," IEEE Vehicular Technology Magazine, vol.10, no.3, pp.41-50, Sept. 2015

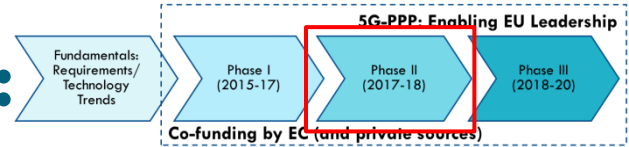
Approach: Program / Projects

Perspectives



- **A. Fundamentals**
 - ▣ Requirements
 - ▣ Technology Trends
- **B. Concepts and technology enablers, e.g.,**
 - ▣ FANTASTIC-5G (PHY-MAC-System level simulation)
 - ▣ SPEED-5G (Distributed RRM/Slicing)
- **C. Technology components/ Systems for verticals**
 - ▣ Megacities (One5G)
 - ▣ Robotics in I4.0 (Clear5G)
- **D. Evolved applications/ components**
 - ▣ Technology fine-tuning/ Evolved components

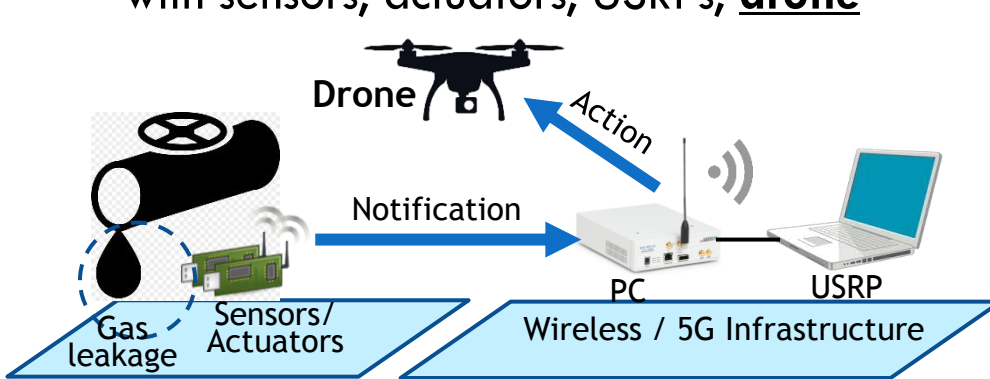
Current Achievements (sample):



Megacities/Critical Infrastructure and Industry 4.0

Megacities & Critical infrastructure (One5G)

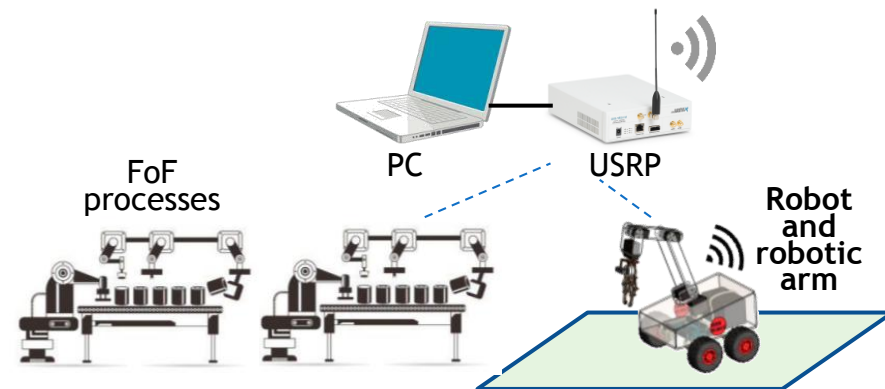
- E2E-aware optimizations
- Advanced technologies and enhancements
- Slicing negotiation
- Service chaining
- Hardware and software demonstrations with sensors, actuators, USRPs, **drone**



- Demo in MWC 2018
- Best Booth Award in EuCNC'18

Robotics for Industry 4.0 (Clear5G)

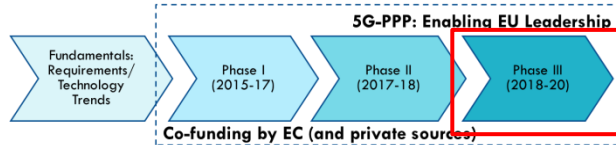
- Towards “zero” latency
- Ultra-reliable services and mMTC
- Network slicing
- Service chaining



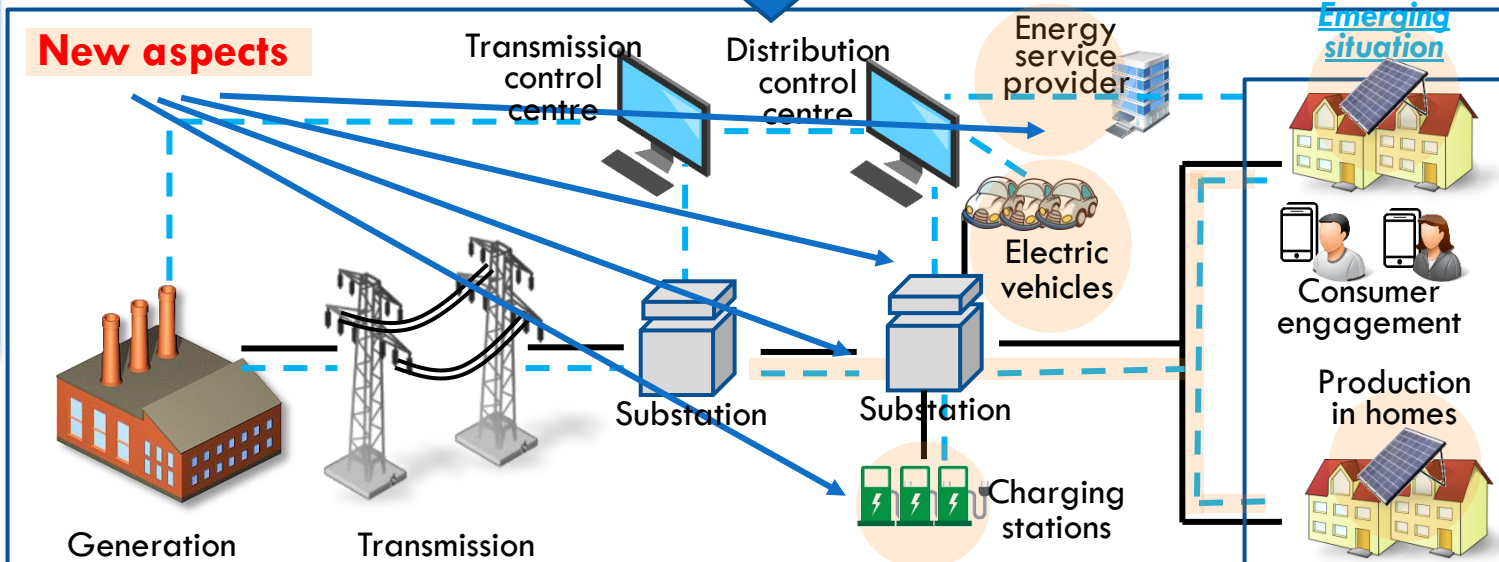
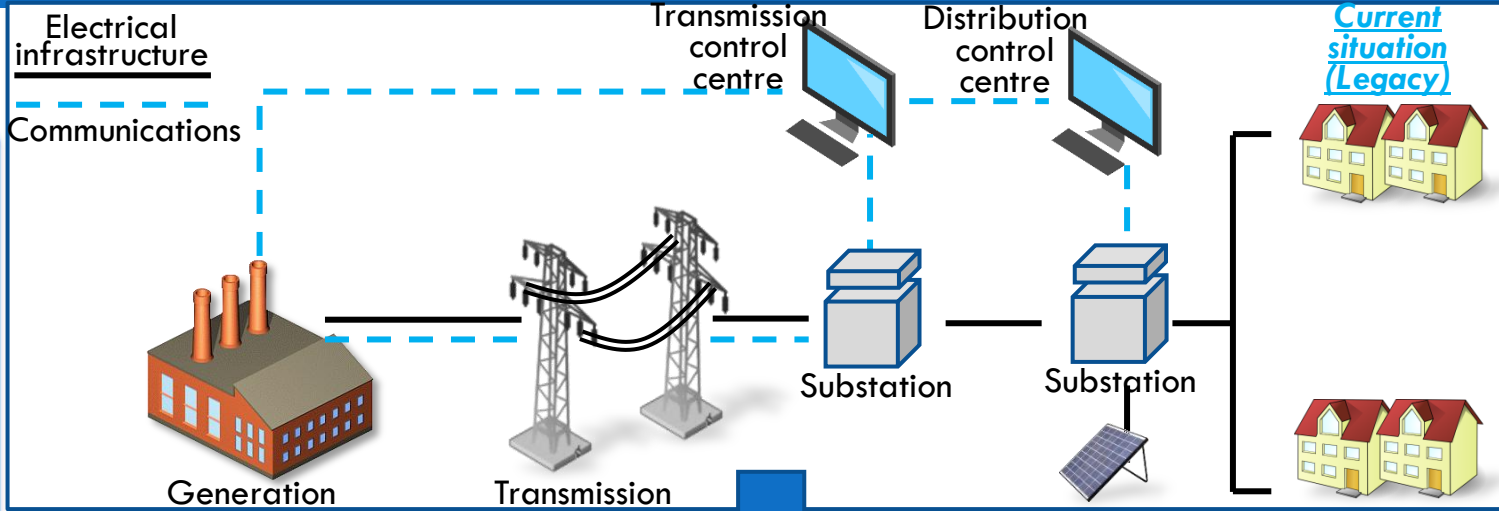
- Hardware and software demonstrations with sensors, actuators, USRPs, **robot and robotic arm**

Further Targets: Evolved Systems:

Utilities

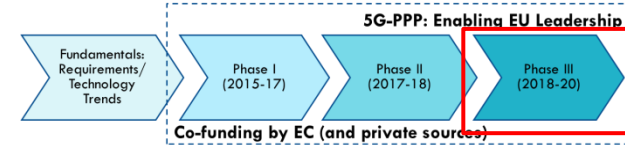


- Virtualization of devices
- Integration of communication technologies
- Distributed/Centralized optimizations
- Solutions for optimized charging/discharging, energy storage, demand response
- Dashboards and apps



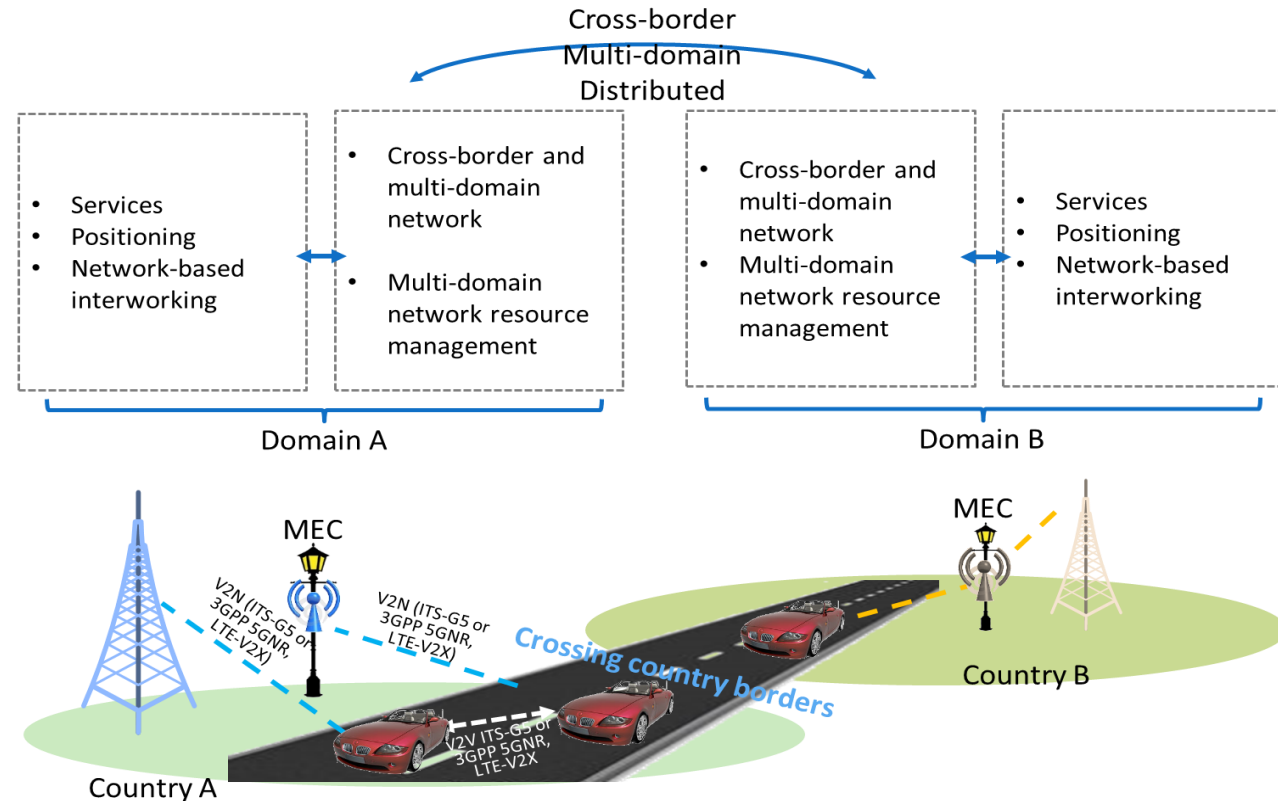
Further Targets: Evolved Systems:

Transport



Use cases:

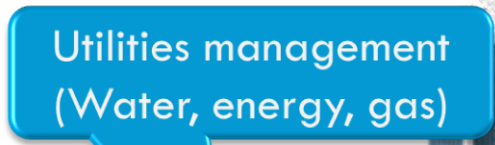
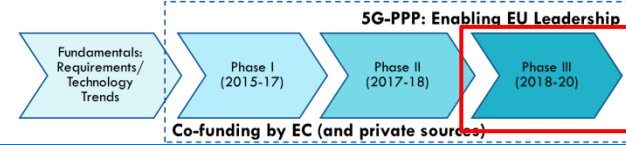
- ❑ Critical manoeuvres cooperative overtake – highway lane merging or leaving
- ❑ Truck platooning
- ❑ Automated valet parking
- ❑ Dense urban environment driving with vulnerable road user detection
- ❑ Remote control for driverless vehicles
- ❑ See through capability
- ❑ HD map update
- ❑ Information society on the road



Acknowledgment:

ICT-18-2018 **MOBIX** project (5G for cooperative & connected automated MOBility on X-border corridors)
ICT-18-2018 **CARMEN** project (5G for Connected and Automated Road Mobility in the European Union)

Further Targets: Evolved Systems: Overall Smart Cities Vision



Summary

- Verticals, Associated Requirements, Several Achievements, Many Opportunities
- **Interdisciplinary** approaches are key
- Synergies between **business, research** and **solutions/products** development

Thank You!