



A 5G / IoT experimental test facility to support European Radio Spectrum Policy making

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SmartX – Living in a Smart Connected World

Smart Living



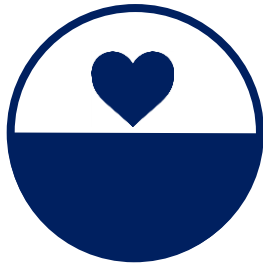
Smart Cities



Smart Mobility



Smart Homes

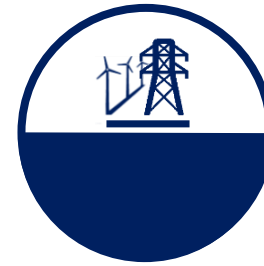


Smart Relationships



Smart Lifestyle

Smart Industry



Smart Grids



Smart Transport



Smart Finance



Smart Factory



Smart Services

SmartX and the European Commission

- Smart Mobility
 - Strategic Transport R&I Agenda (STRIA)
 - C-ITS (Cooperative Intelligent Transport System)
 - C-Roads Platform
 - European Automotive – Telecom Alliance (EATA)
 - Declaration on automated and connected driving
 - GEAR 2030 High Level Group
 - Declaration of Amsterdam
- Smart Cities
 - European Innovation Partnership (EIP) on Smart Cities and Communities
 - Sustainable Cities / Urban Agenda for the EU
- Smart Home
 - Energy conservation
 - Age-friendly living / eHealth
 - IoT in the Smart Home

Smart Spectrum Regulation in the Age of IoT

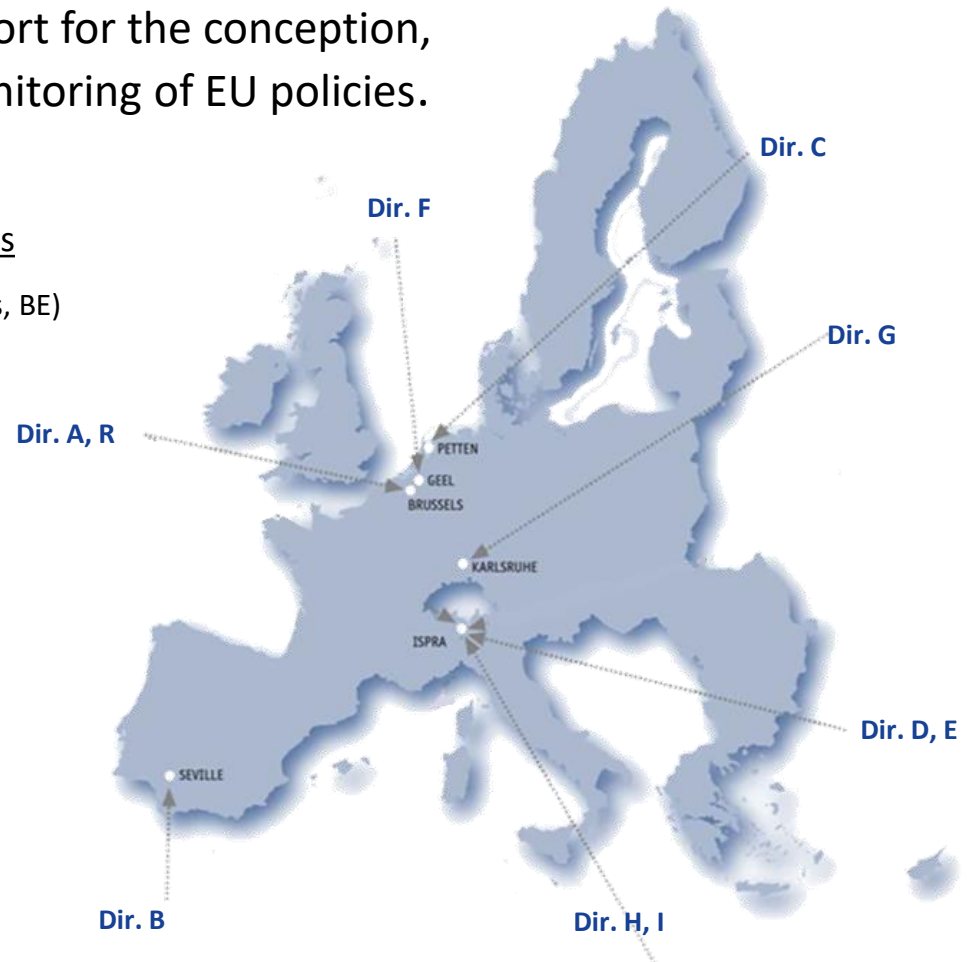
- A large number of IoT connections will be wireless
- RF environments are frequently unmanaged and [congested](#), even today
- IoT-related challenges to Spectrum Regulators
 - Fair access to, and efficient use of the radio spectrum
 - Development of fair and objective regulations
 - Protection of citizens' access to wireless services
- Prerequisite: Unbiased technical evaluations of
 - Technology options
 - Use cases
 - Deployment scenarios
 - Interference scenarios
 - Interference protection criteria

The Joint Research Centre of the European Commission

Mission: To provide and technical support for the conception, development, implementation and monitoring of EU policies.

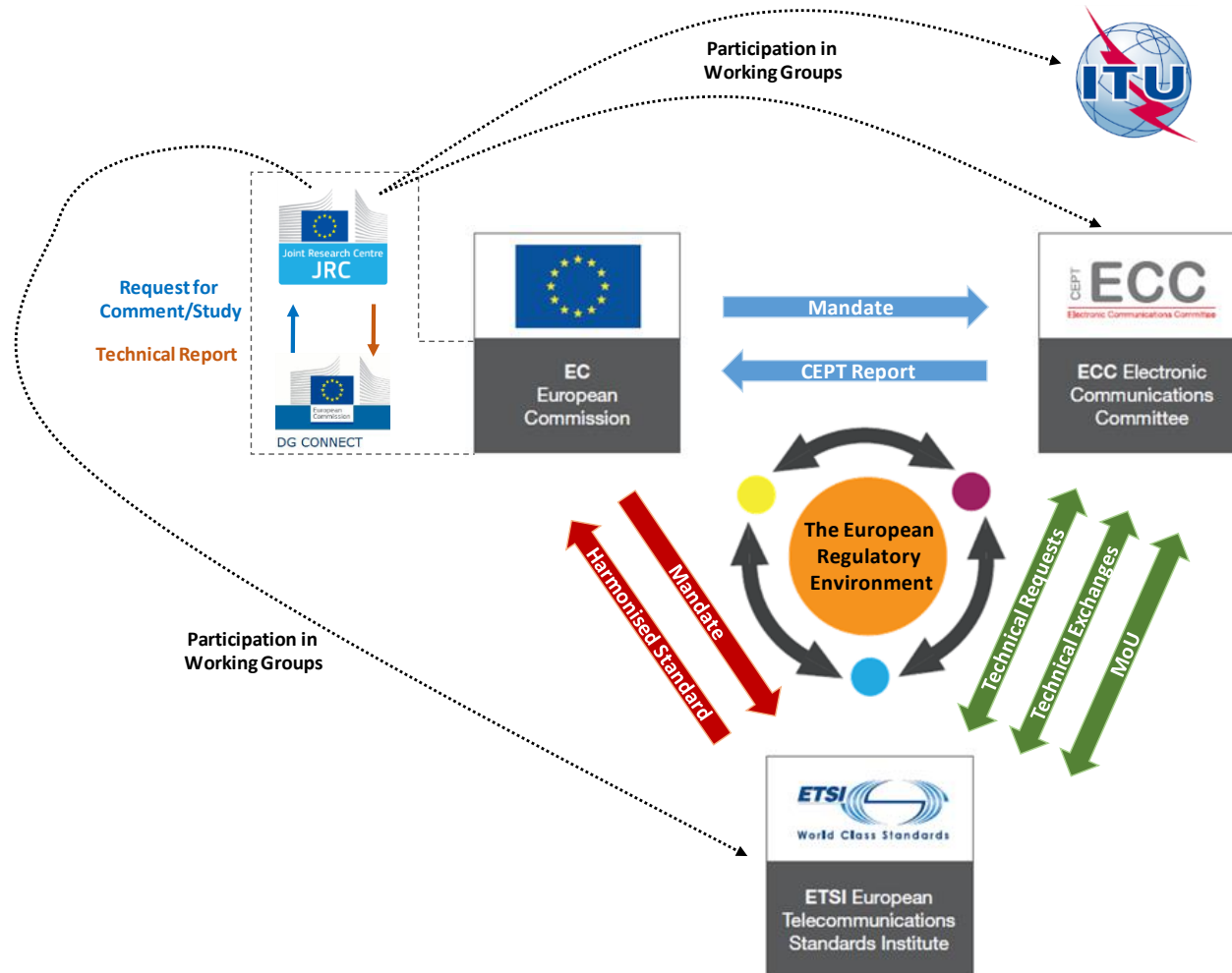
3500 staff in ten Directorates in five Member States

- A. Strategy and Work Programme Coordination (Brussels, BE)
- B. Growth & Innovation (Seville, ES)
- C. Energy, Transport & Climate (Petten, NL)
- D. Sustainable Resources (Ispra, I)
- E. Space, Security & Migration (Ispra, I)**
- F. Health, Consumers & Reference Materials (Geel, BE)
- G. Nuclear Safety & Security (Karlsruhe, D)
- H. Knowledge Management (Ispra, I)
- I. Competences (Ispra, I)
- R. Resources (Brussels, BE)



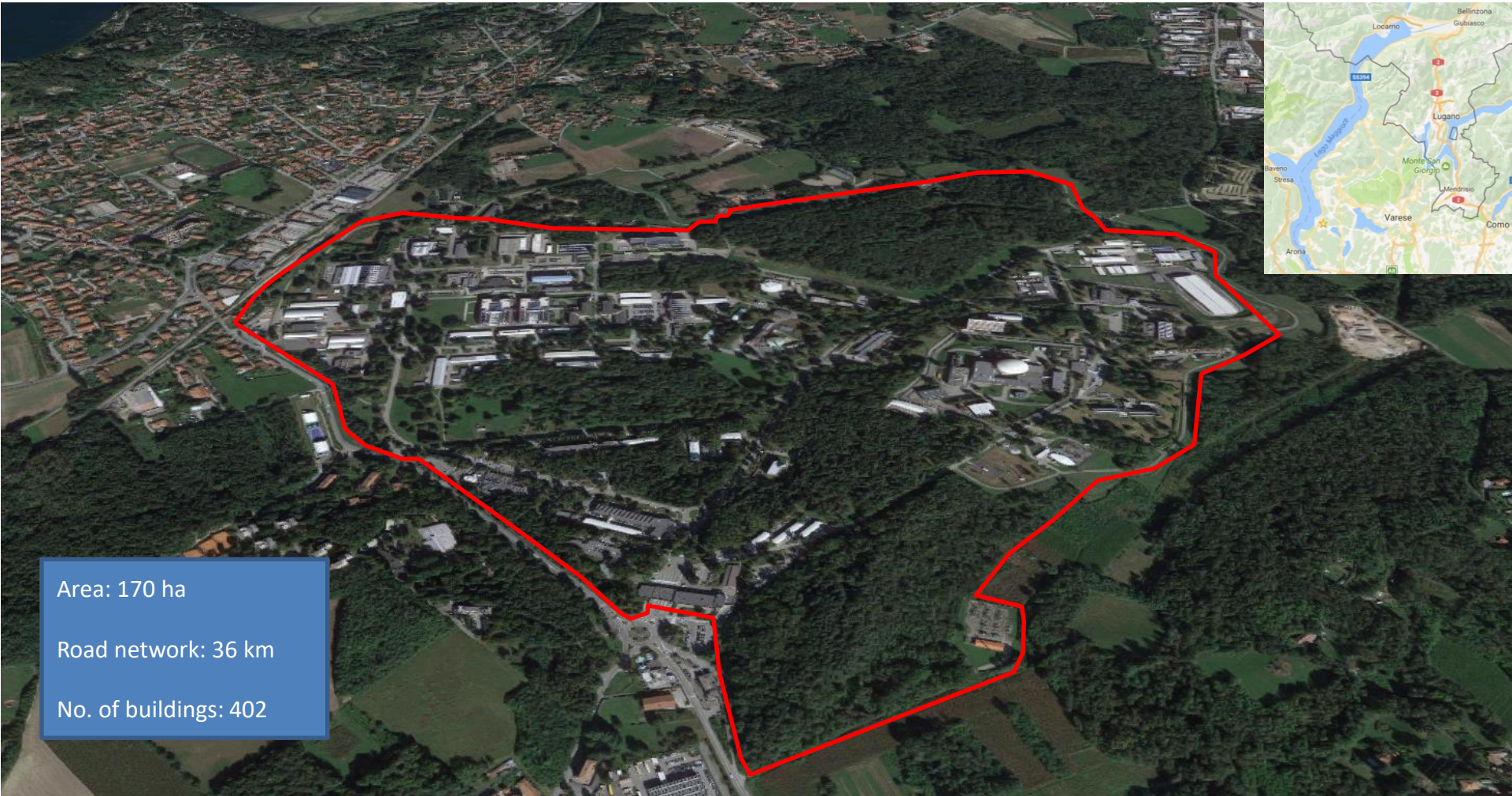
The JRC's Radio Spectrum Laboratory (RSL)

- History
 - Assessment of technology for security-related applications
 - Advanced Radar and Telecommunication Techniques for Security
- Current areas of engagement
 - Radio Communications
 - GNSS / Galileo
- Objectives and Tasks
 - Providing impartial technical and scientific support for the definition of EU Radio Spectrum Policies
 - Conducting studies, field trials, measurement campaigns, expert workshops, equipment compliance tests, and others
 - Contributing to the work of CEPT, ITU-R, and ETSI



Smart Environment - 5G / IoT Experimental Test Facility

The JRC Ispra site



Area: 170 ha

Road network: 36 km

No. of buildings: 402

JRC Ispra 5G / IoT Wide-area test facility

Main elements

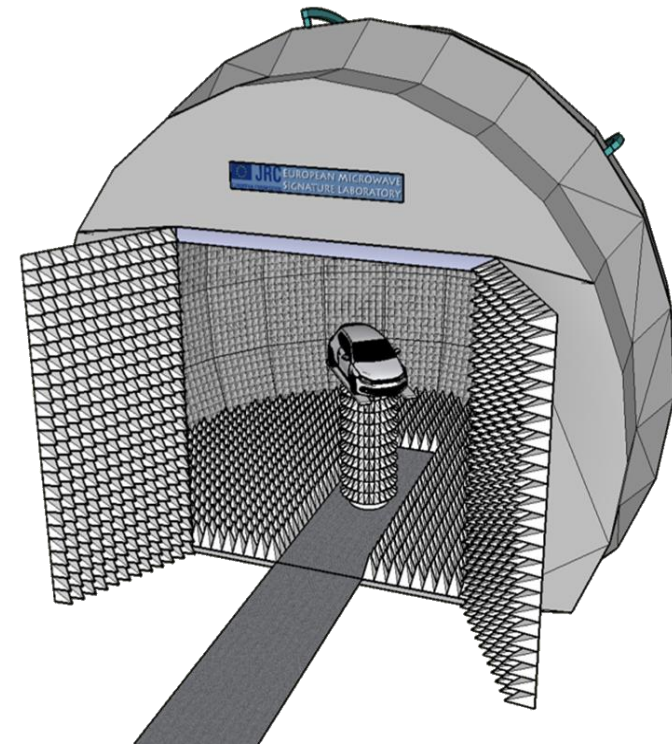
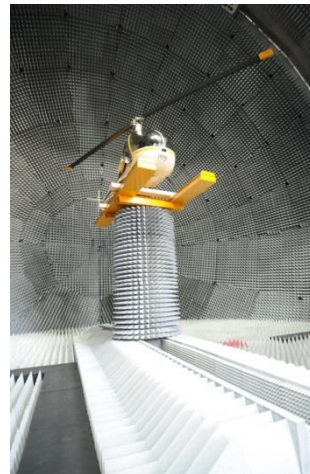
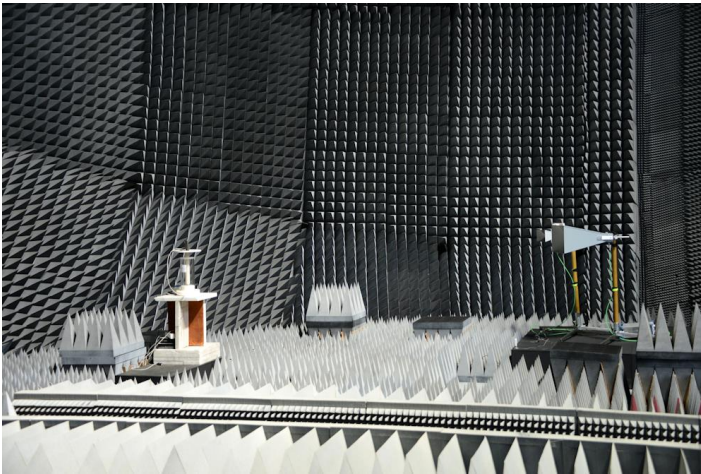
- RF anechoic chamber (one of the largest in Europe)
- Network of fixed and mobile indoor and outdoor transmitters, transceivers, and base stations (4G/5G)
- Network of fixed and mobile indoor and outdoor/roadside sensors
- Drive test range for cooperative, connected and automated vehicles and other transportation-related applications
- DomusLab IoT 'test house'
- UAV-based airborne spectrum measurement and monitoring
- Data collection and analysis centre

Advantages

- Controlled environment
- Realistic conditions (low to medium density environment)

Radio Spectrum Lab Facilities

- European Microwave Signature Laboratory (EMSL)
 - Originally conceived for remote sensing and test & measurement of automotive systems
 - Diameter of the sphere: 20 m, Height: 15 m
 - Frequency Range: 0.2 – 26.5 GHz



5G Test Infrastructure – Main Elements

- mmWave Communications
 - Implementation of Base Station/Home Broadband Backhaul over mmWave Radio Links
- Massive MIMO
 - Implementation of an SDR-based massive MIMO testbed
- Enhanced Mobile Broadband
 - Carrier Aggregation for High-Definition Multimedia Traffic Delivery over Wi-Fi™ (802.11ac) and cellular (LTE) links in licensed and unlicensed bands
- Virtualised Core Network
 - Implementation of a Fully-Virtualised LTE Evolved Packet Core with Network Slicing

Smart Mobility Test Range

- Cooperative, connected and automated vehicle test site
- Target areas/Objectives
 - Autonomous Road Transport (ART)
 - Cyber-security and privacy aspects of cooperative and connected vehicles
 - Analysis of existing IMT-2020 use cases and future 3GPP study/work items
 - Assessment of EMC/EMI
 - Data collection/fusion/analysis
 - Experimental performance evaluation for use case validation and fact-based conclusions drawing

Vehicle Emissions Laboratory (VELA)

- State-of-the-art test laboratories for characterising vehicle electro-magnetic compatibility and immunity, emissions, and performance.
 - 2 test-cells to measure the electromagnetic compatibility of vehicles with the fields generated by external sources and by the vehicles themselves (VELA 9 and IMSL).
 - VELA 9 allows to measure the fields generated by a vehicle running at a speed of up to 160 km/h. Thus, it could be used to verify the compatibility of communication technologies with the fields generated by the most powerful electric engines.
 - 4 test cells to measure emissions, fuel and energy consumption of all types of vehicles (light and heavy duty, internal combustion engines, hybrids and plug-in hybrid vehicles) (VELA 1-8).
 - 4 PEMS systems to measure emissions and fuel consumption from vehicle driven on the road under real conditions of use.



5G / IoT Smart Home Experimentation facility

- Experimental facility for radiocompatibility, spectrum sharing, RF propagation, and resilience studies.
- Fully furnished and equipped, with variable layout.
- Sensors and RF transmitters, receivers, transceivers can be placed anywhere in the residential area of the building, as well as outside.
- Wired communication systems (DSL, cable, PLC, etc.) can be fitted, as well.
- On-site 4G/5G/Wi-Fi network allows studying outdoor-to-indoor and indoor-to-outdoor signal propagation and coexistence conditions.
- Generation of arbitrary traffic between all nodes and recording of signals handled locally by data centre in the basement.

DomusLab
DomusLab



Image source: <http://img.friv5games.me/2016/11/09/3d-building-cross-section-l-e83cc17bae01f89a.jpg>

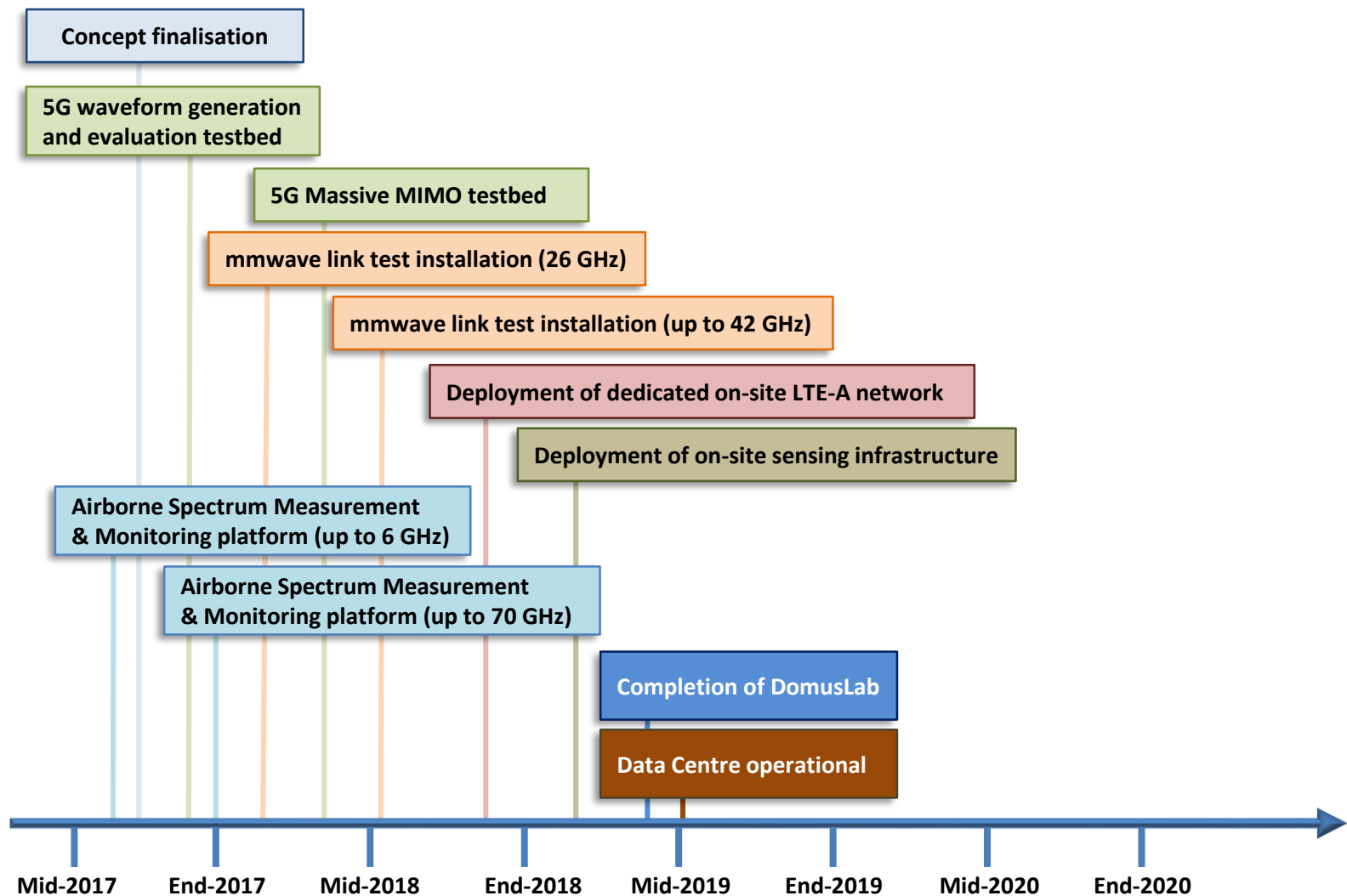
Airborne Spectrum Measurement and Monitoring

- Applications

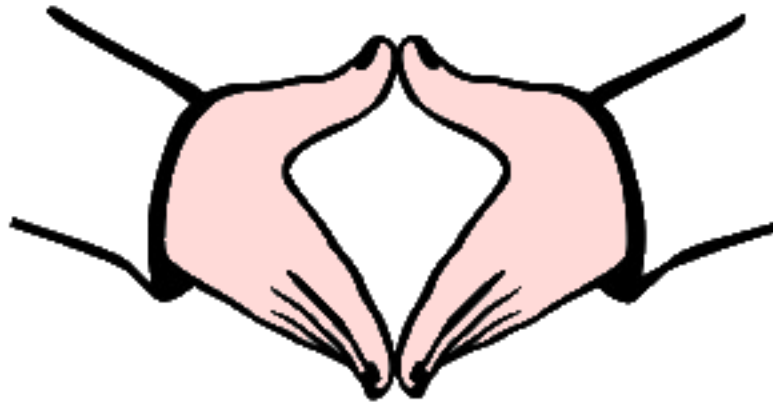
- Measurement of RF emissions in a wide frequency range
 - 9 kHz to 6 GHz now, up to 70 GHz end of 2017
- Characterization of RF emissions and signal propagation
- RF interference assessment
- Evaluation of communication systems' and technologies' resilience to attacks (jamming, eavesdropping, spoofing, etc.)
- Measurement of spectrum utilisation



Timeline (tentative)



Experimental verification is without alternative



Thank you