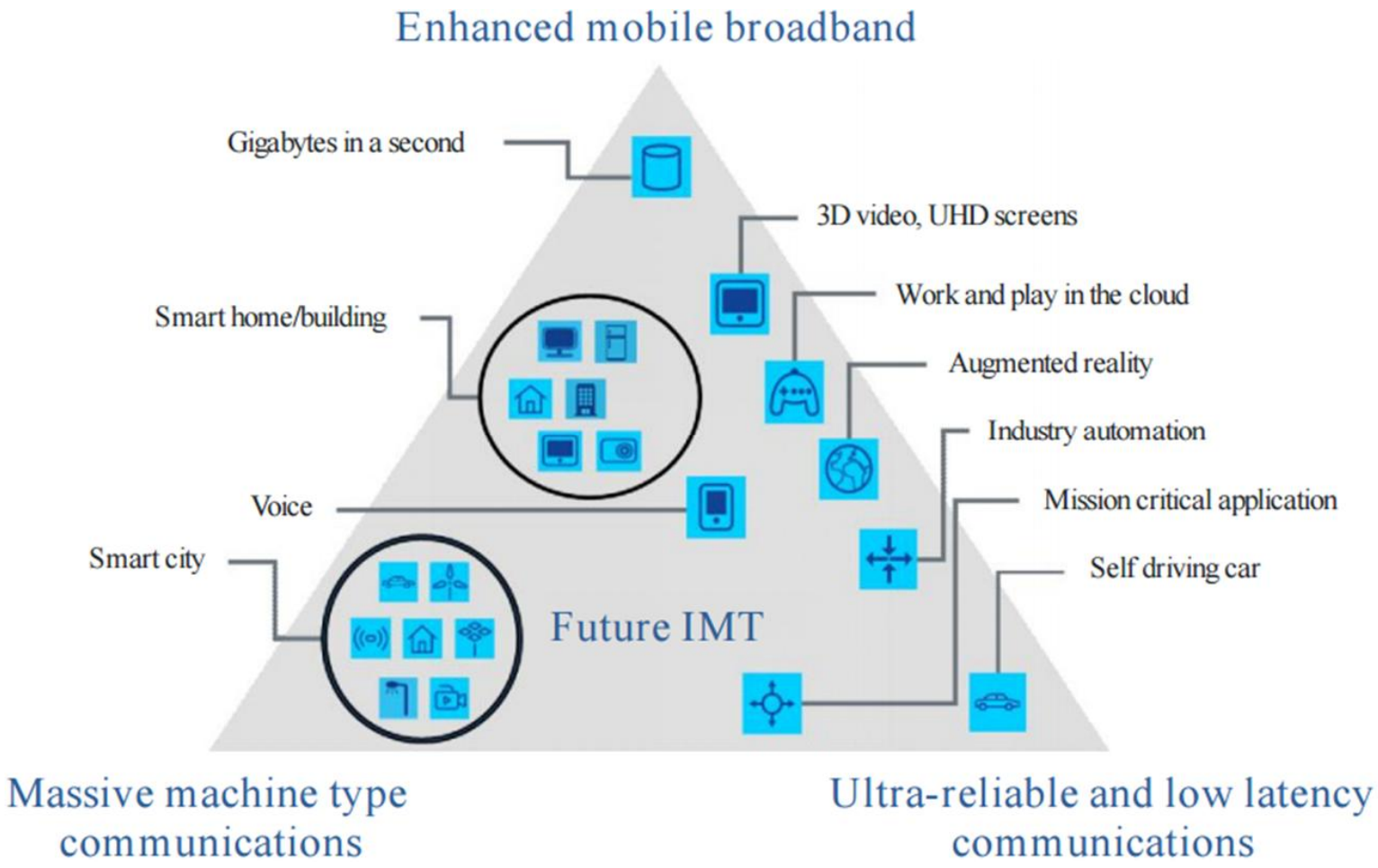
5G Test Network Finland (5GTNF) - Ecosystem for 5G and Beyond Technology and Vertical Solutions R&D

Kyösti Rautiola
VTT TECHNICAL RESEARCH CENTRE OF FINLAND

email: kyosti.rautiola@vtt.fi

25.03.2019

5G Test Network Needs



5G features:

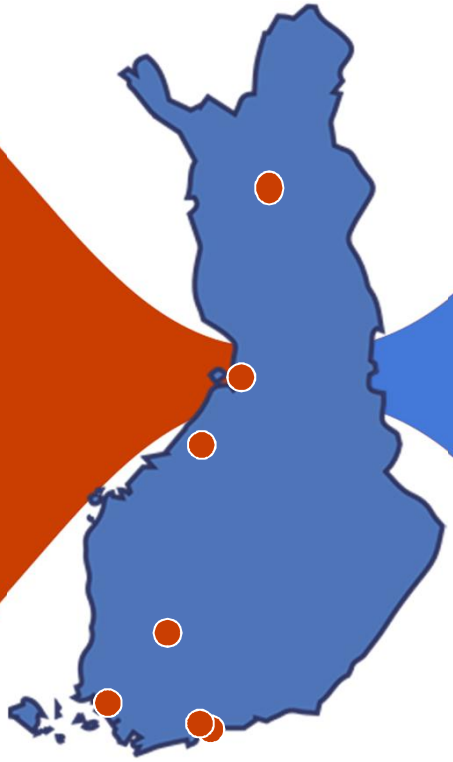
- Unlimited Broadband experience
- Instant Action
- Things Connected
- Ultra Reliability
- Slicing
- Virtualization
- Energy saving

Source: 5GPPP

Open innovation ecosystem for 5G technology and service development

CAPABILITIES

- Beyond state-of-the-art technologies
- Flexible service configurations
- Standardised and open interfaces
- Extensive access to monitoring and testing data



USE CASES

- Automotive
- eHealth
- Emergency & Public Safety
- Energy
- Factories of the Future
- Media & Entertainment
- Smart Cities

- Multi-site test network developed and maintained by R&D projects in Business Finland 5thGear programme
- Focus on pre-standard experimental technologies
- Support for technology validations and tailored service trials and demonstrations
- Main access sites in Espoo and Oulu
  - Additional site locations in Helsinki, Tampere, Turku, Ylivieska and Sodankylä

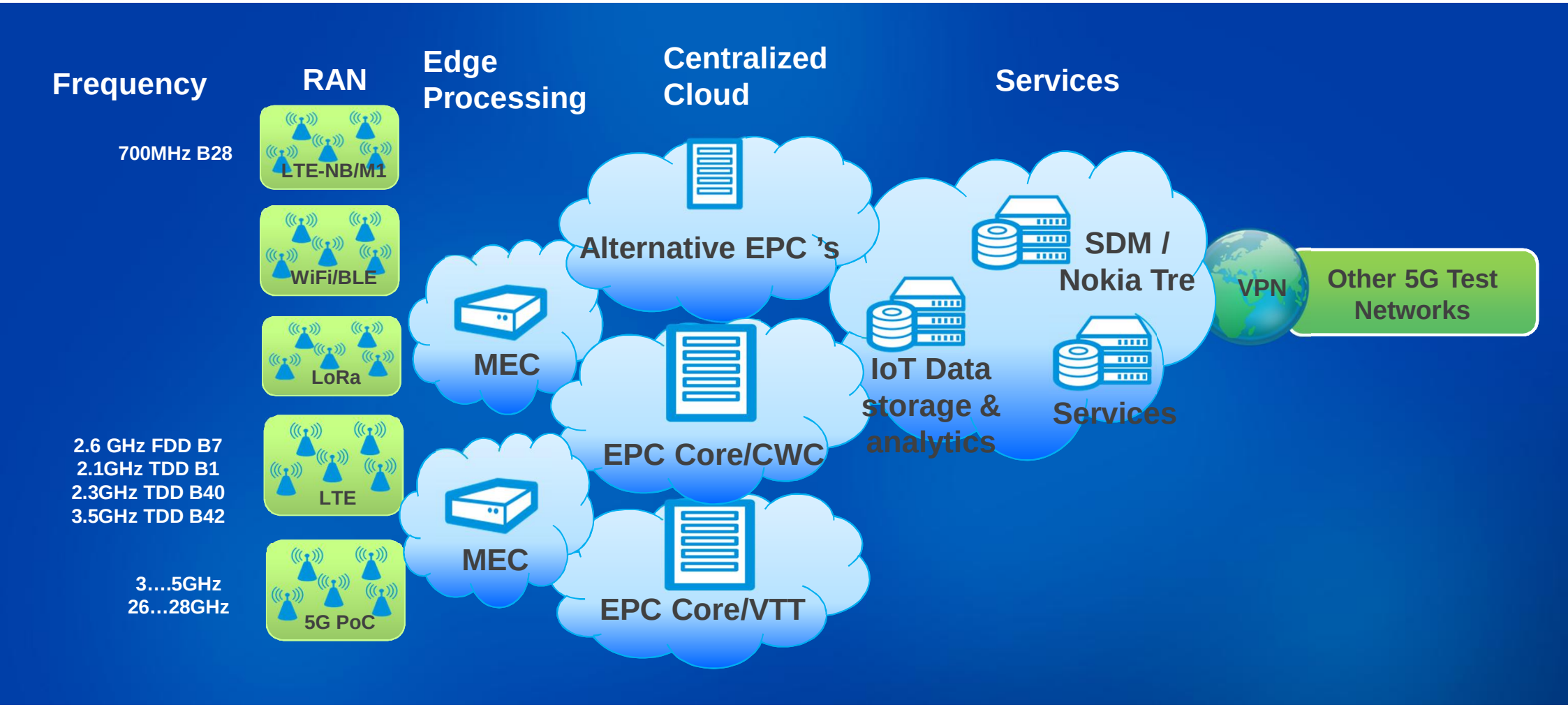
Current core test platform with state-of-the-art technologies

- From LTE evolution to 5G radio access
- Provides access for the IoT network (NB-IoT, LTE-M, LoRa) to test your devices and applications
- New frequencies and spectrum sharing
- MEC's to bring services close to users access
- Network slicing
- C-RAN, SDN and NFV technologies
- eMBMS enables efficient broadcasting to mobile users
- Core network in a cloud environment
- Cloud systems for applications
- Connection between test sites in Finland and worldwide
- Monitoring of selected KPIs from network elements and interfaces for your use case

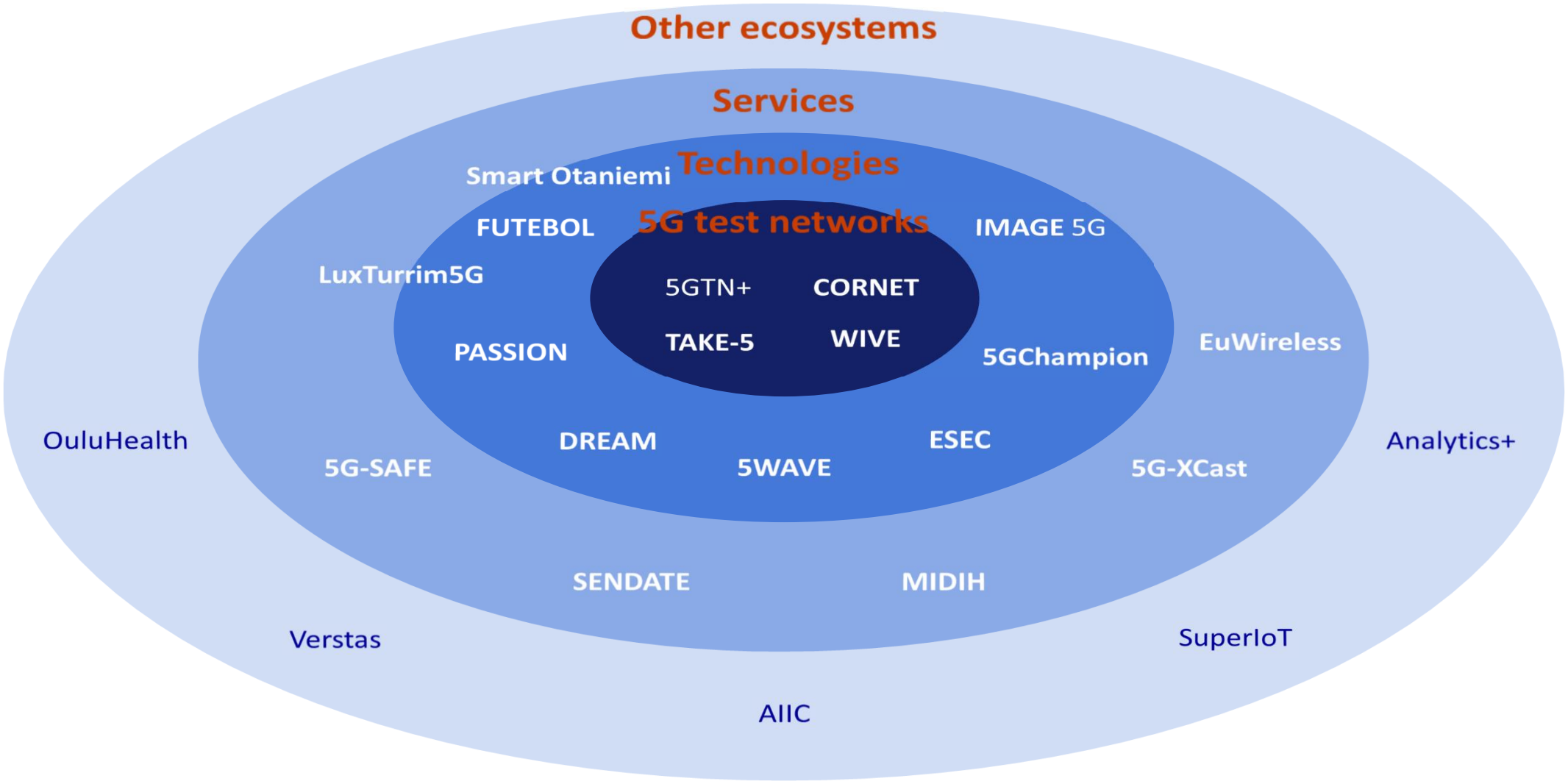
5G TNF

5GTN

Architecture in Oulu



5GTNF ecosystem portfolio 2016-2018



Latest result examples

- Infrastructure with MEC, network slicing and network virtualization, concepts and technologies for RAN cloudification, mobility, security and energy efficiency, TAKE5
- 5G light pole infrastructure with integrated / camouflaged 5G mmW radios, sensors, cameras, information displays and other devices, LUXTURRIM5G
- Concepts and technologies ensuring QoS for critical services in a commercial radio network and enabling temporary deployment in an area without mobile network coverage, CORNET
- Sensing care for long-term health and wellbeing (mMTC), real-time cellular IoT monitoring for sport wearables (mMTC) and 5G in media production and distribution (eMBB), 5GTN+
- 5G enabled solution for smart grid protection (uRLLC), automation in a harbour (uRLLC), maintenance and asset management environment (mMTC) and high capacity data transfer with 60 GHz link (eMBB), WIVE
- MEC based low delay connectivity solution for autonomous vehicles (uRLLC), 5G-SAFE

Ecosystem founding members

Network manufacturers

Operators

Technology and R&D service providers

Testing systems and tools manufactures

Verticals/ applications developers

Public organizations

Research organisations

Future needs

- ***Technology:***
  - Cost efficient and flexible implementation of critical use cases (uRLLC, mMTC, eMBB) requires B5G radio and network technology enablers
  - The roles of AI and novel cyber security concepts are increasing both in B5G networks and in the implementation of the different verticals
  - Competitive vertical services, products and systems requires integration of B5G networks and vertical area specific technologies.

- ***Testing environment:***
  - Vertical industry need leading edge environment to develop B5G, AI and cyber security based solutions, services, systems and products
  - Telecom industry need realistic test environments based on real vertical system and service needs and requirements
  - Research organizations need multisite test environments supporting B5G technologies and service research and large-scale field trial

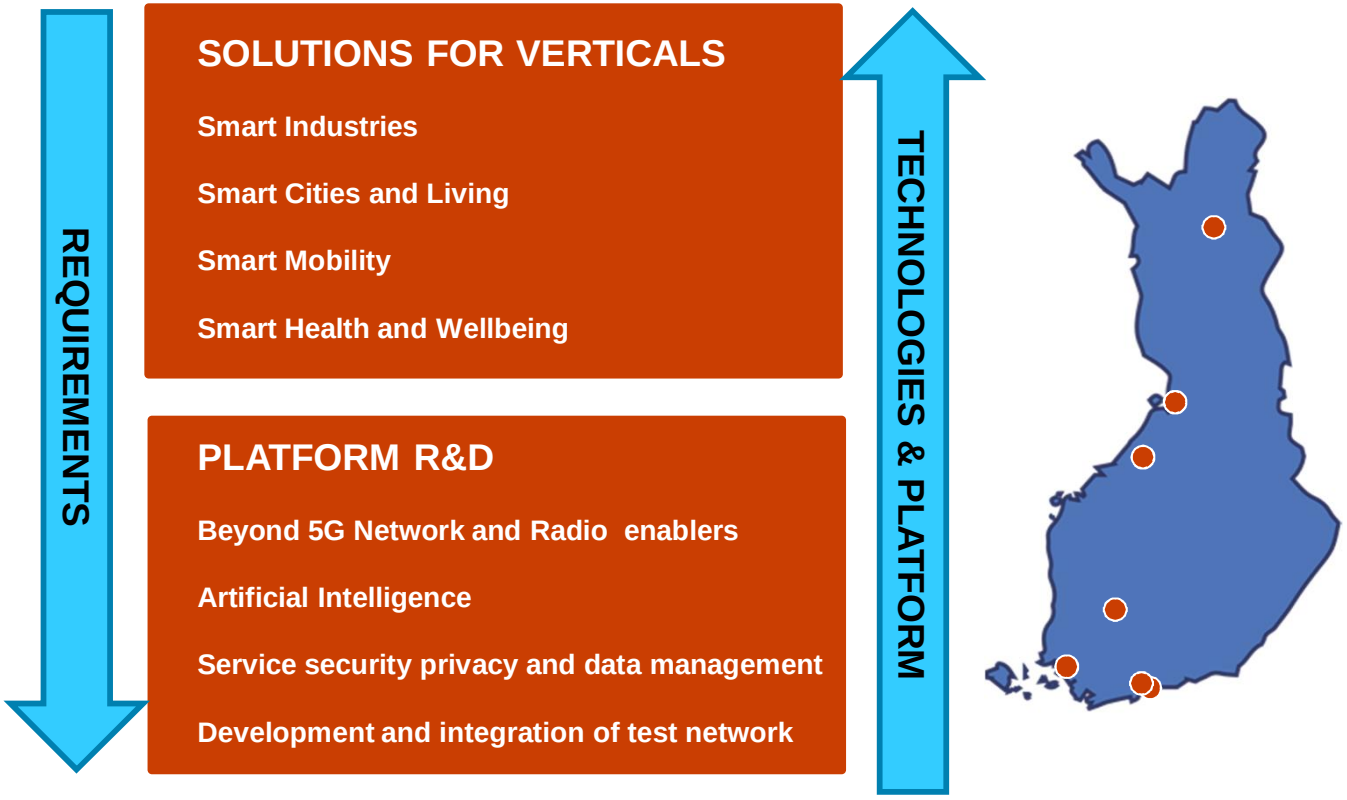
5G Test Network Finland 2019 ->

MISSION

5G Test Network Finland is open and evolving innovation ecosystem supporting 5G evolution **and Beyond 5G technology research and validation**, **vertical industry product developmen**t and pioneer company experiments.

VISION

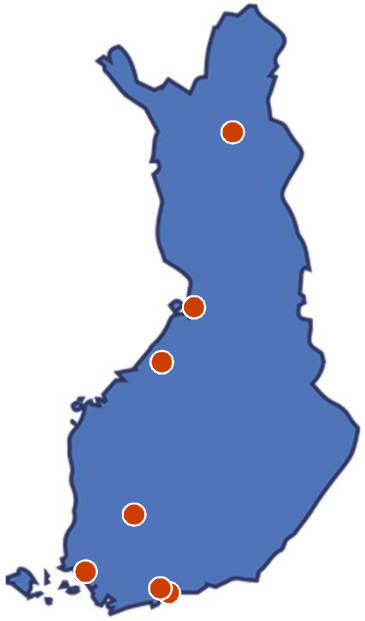
Beyond 5G R&D and **utilization of AI and novel cyber security** concepts are ramping up and offer excellent business opportunities to both telecom and vertical industries



Future (2019 ->) targets

- regeneration
  - 3GPP **Rel16->, 5G and beyond** communication concepts, towards 6G
  - **utilization of AI** in radio resource and network management and vertical use case implementation, novel **cyber security** concepts
  - **vertical use cases** utilizing 5G and beyond, AI and cyber security concepts
- interdisciplinary approach
  - co-operation between **telecom and vertical** (automation, energy, health, safety, media, automotive, buildings, …) area technology and **business model** experts
- differences compared to existing research;
  - Strong support to **verticals**
  - **Integration** of Beyond 5G research, vertical use case design, utilization of AI, cyber security concepts and large area research infrastructure integration
- differences compared to pre-commercial test environments;
  - more **future looking**, non-commercial (still under standardization and research, utilization of AI, novel cyber security) technologies, flexibility, wide set of tools and co-operation possibilities with wide eco-system

Future goals; Platform R&D



- Scope:
  - B5G, cyber security and AI research
  - Development of common network modules/parts
  - Development and integration of test network
  - Platform experiments manager and cross platform orchestrator

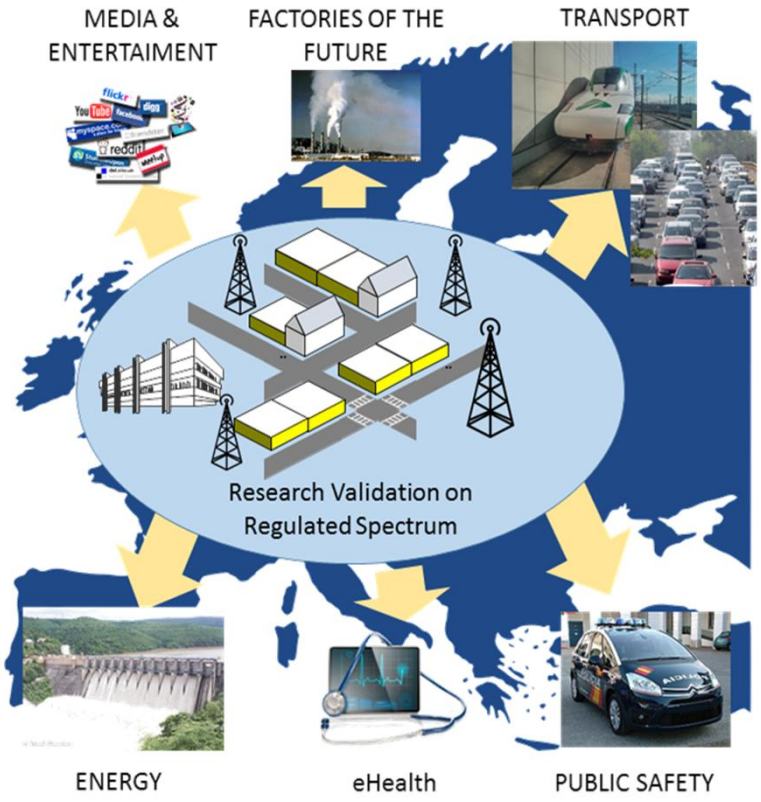
- Technology focus:
  - ***Network Technology enablers:*** Edge computing, Network slicing, Industrial Internet, Massive scale autonomous IoT network
  - ***Radio Technology enablers****:* positioning and tracking, RAN support fo UAV's, multi-RAT mobility and connectivity, mmw massive MIMO, uRLLC platform, radio enablers for dense 5G networks
  - ***Artificial Intelligence:*** network management and self healing, mobility and radio beam management, uRLLC and E2E reliability, Media & Entertainment, AI integration to verticals
  - ***Service security privacy and data management:*** AI applications in Security, Trust and blockchain, DoS vulnerabilities and defencies, Roaming security, Cyber-Security interface for verticals

Future goals; Verticals related R&D

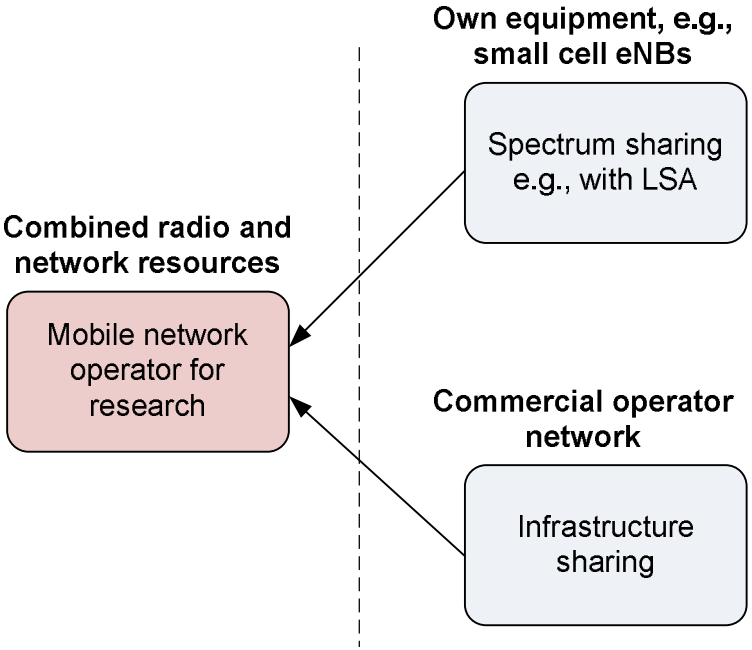
- Scope:
  - vertical specific technology R&D
  - Development of vertical specific technology components and solutions
  - Implementation of vertical trials

- Trial plans:
  - Harbors, digital factories and smart grids monitoring and control (5GVIIMA)
  - Critical communication use cases; search and capture, support to smart rural business and emergency response (CRANE)
  - Media production and distribution, video and sensor analysis from a sport match, live virtual reality streaming, athlete positioning technologies for sport wearables (5GEXPERIENCE)
  - Air quality monitoring for smart cities (MEGASENSE)
  - Monitoring and control of building heating and energy consumption, smart charging and remote inspection with drones (SMART OTANIEMI)
  - Solutions for healthcare, aquaculture and transport (5G-HEART)

5GTNF long term goal – towards more flexible technology and solution validation on regulated spectrum

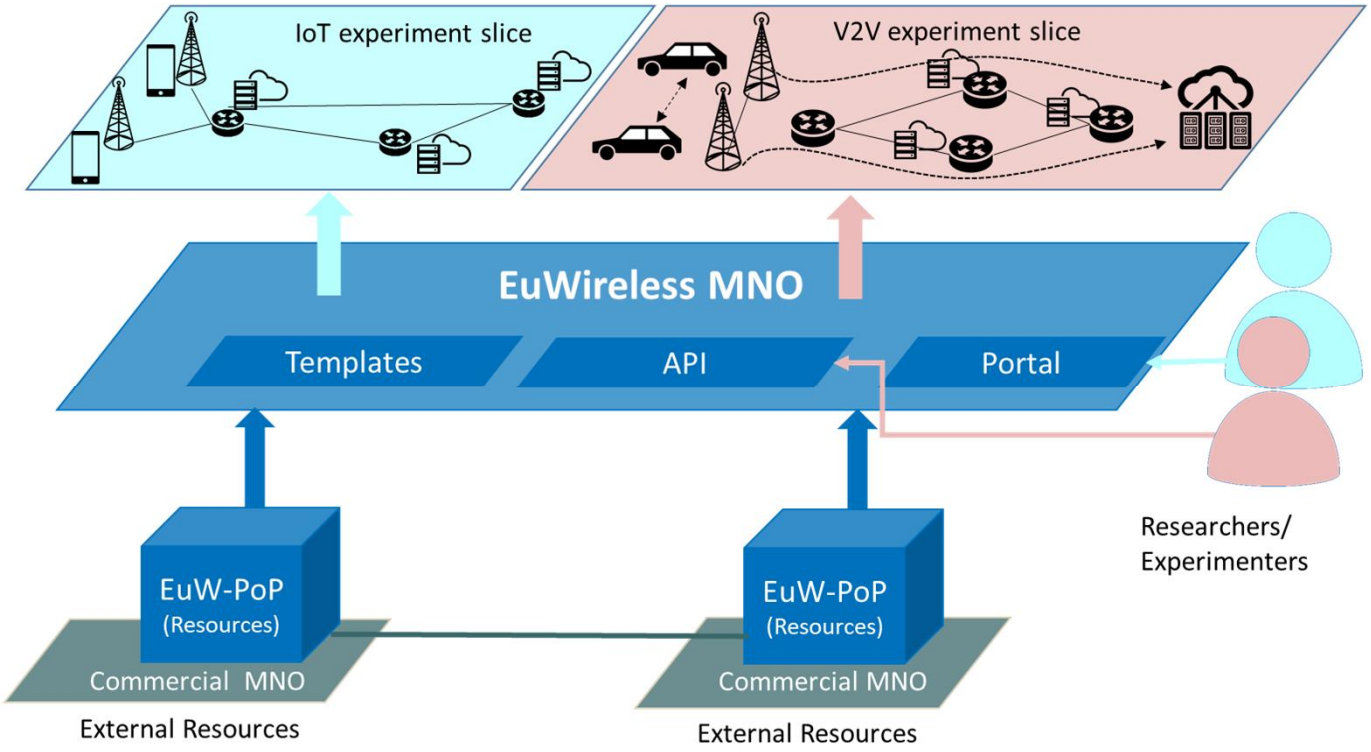


EuWireless research operator concept [https://euwireless.eu/]



- Need: virtual operator for European-wide research to act as the broker between the commercial operators and the research community
- Goal: technical, legal and economic solutions that encourage mobile network providers to share their infrastructures with universities, research centres and other businesses

… towards research infrastructure operator



EuWireless high-level architecture [https://euwireless.eu/].

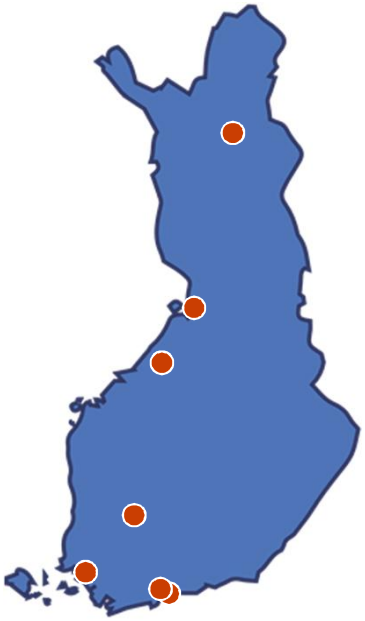
PoP = Point of Presence.

On going activities:

- Concepts to share the spectrum, the access nodes, the transport network and the core network
- Identify possible regulatory barriers so as to propose workable solutions for each country
- Business models which will ensure that commercial operators directly benefit from the controlled transfer of their resources for research purposes

Summary

- Status
  - The 5G Test Network Finland first phases (->2018) focused on the first 5G releases (up to Rel-15) technologies, development of separate test beds and some vertical use case proof-of-concepts
  - Commercialization of the first 5G network generation has started. At the same time, B5G R&D and utilization of AI are ramping up and offering excellent business opportunities to both telecom and vertical industries.



- Current R&D activities:
  - Technologies and innovations related to B5G network and radio enablers, cyber security, utilization of AI and business models
  - Integrated multi-site B5G flexible research test network, flexible sharing of spectrum and infrastructure with MNO's
  - 5G and beyond technologies and solutions for vertical industries; smart industries, cities, living, mobility, health and wellbeing and critical communications