
# Oulu 5G Test Network (5GTN) - 5G is Coming - What is missing?

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# The four seasons and Location

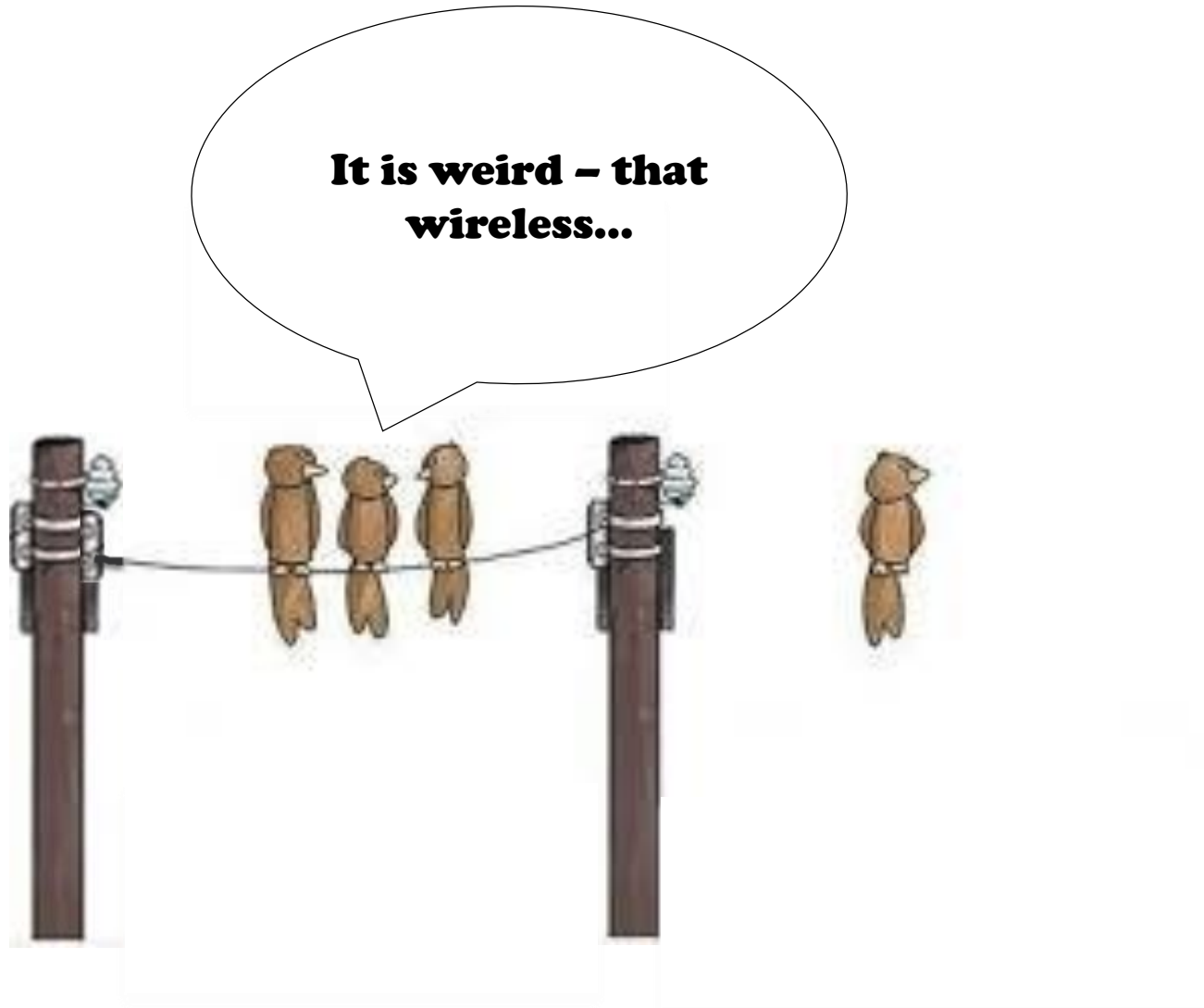
In spring nature awakens

Summers are green and mild

160 km south of arctic circle


Autumn colours

Crispy and snowy winters



5GTN

# 5G Test Network

## Innovation platform for next generation services

*www.5gtn.fi*

5GTN

# Partners involved


5GTN is part of 5thGear program by Tekes

# What do we have ?

- Future mobile network - live
- Accessible interfaces
- Test options from components to solutions
- Mobile Network Expertise
- Ecosystem co-operation

# 5GTN enablers

- Real mobile network with own SIM
- Access to all functions and interfaces
- Technology prototypes
  - NB-IoT and LTE-M
  - Pre-commercial 5G products
  - Pre-commercial devices
- Diverse environment and in-depth analytics
- Test equipment, telco expertise
- Co-operation opportunities with ICT ecosystem

# Status 08-2017

- Data Access with 2,6GHz and 3.5GHz LTE
- Out/in Coverage at univ &VTT. Several antenna types including DAS
- Remote access from OYS TestLab, OAMK and Nokia Tampere, ETRI Koren, Seoul - 5G Champion.  Further locations are being deployed (e.g. Caritas – Care on Demand, Nokia Factory – Industry 4.0)
- SIM subscription from 5GTN, compatible with current LTE terminals
- 5G radio PoC introduced (28 GHz), utilized e.g. in H2020 5GChampion, Sat5G, and ITEA APPSTACLE project
- Cloud infrastucture for virtualized core and service creation
- Test devices available from terminal partners
- LoRa introduced
- Mobile Edge computing (MEC) for service development and data analysis (ordered)
- NB-IOT Introduction (software upgrade to macros)
- Generic IoT Platform introduction (operational). IoT sensors (installed)

# 2017-2018 Plan

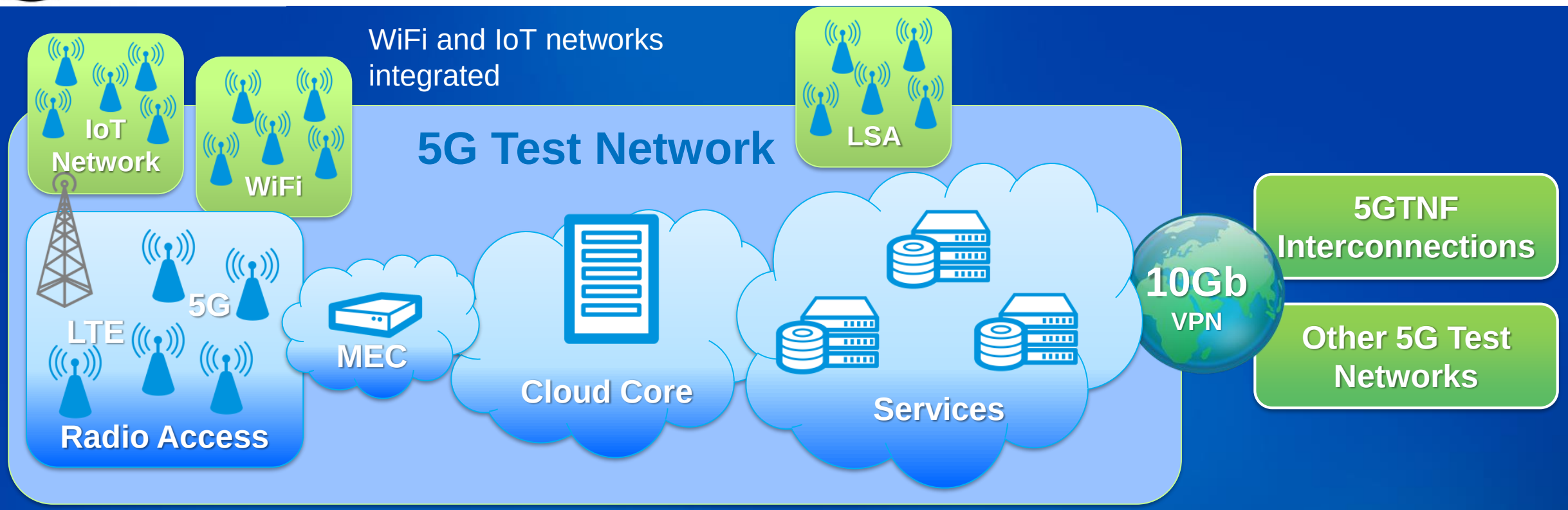
- Optimize for application driven development
- Continue technology research
- Bring first business verticals to trials
- Global use

# Focus moving to applications

- Tekes funding accepted for 5GTN+ and Cornet projects (’17/’18). ~3M€.
- Assumed vertical use cases for 2017-2018
  - Care/Fitness. Care on demand, wearables always connected
  - Media.  5G booster for TV production and distribution
  - eHealth.  Future hospital. Ambulance communication
  - Industry 4.0 - Factory of the Future
  - Automotive/Transport

# Ecosystem Cooperation

- 5G Hackathon 06/2017. Challenges from Teliasonera, Nokia and Oulu hospital
- 5G Demo preparations to euCNC conference 06/2017 was a success→ further developed to 02/2018 Korean PyeongChang Winter Olympics




From LTE evolution to 5G radio access

Mobile Edge Computing to bring services close to users access

Core network in a cloud environment

Cloud systems for applications available

Secure connection to other 5G test sites in Finland and worldwide

# How Does it Look ?

5G PoC

LTE Macros

LTE small cell

IoT sensors

# Key Take Away Messages on 5G@CWC

- University of Oulu and CWC in particular is a global power house on ICT research and the home of wolds´s first public 5G test network.
- Having established University of Oulu – Nokia Bell Labs research center on ICT, CWC contributes to the global understanding and standardisation on Future Wireless

**Join Us –**

**You Can Make a Difference**

**We Provide Results that Make a Difference**

# What is missing in 5G…



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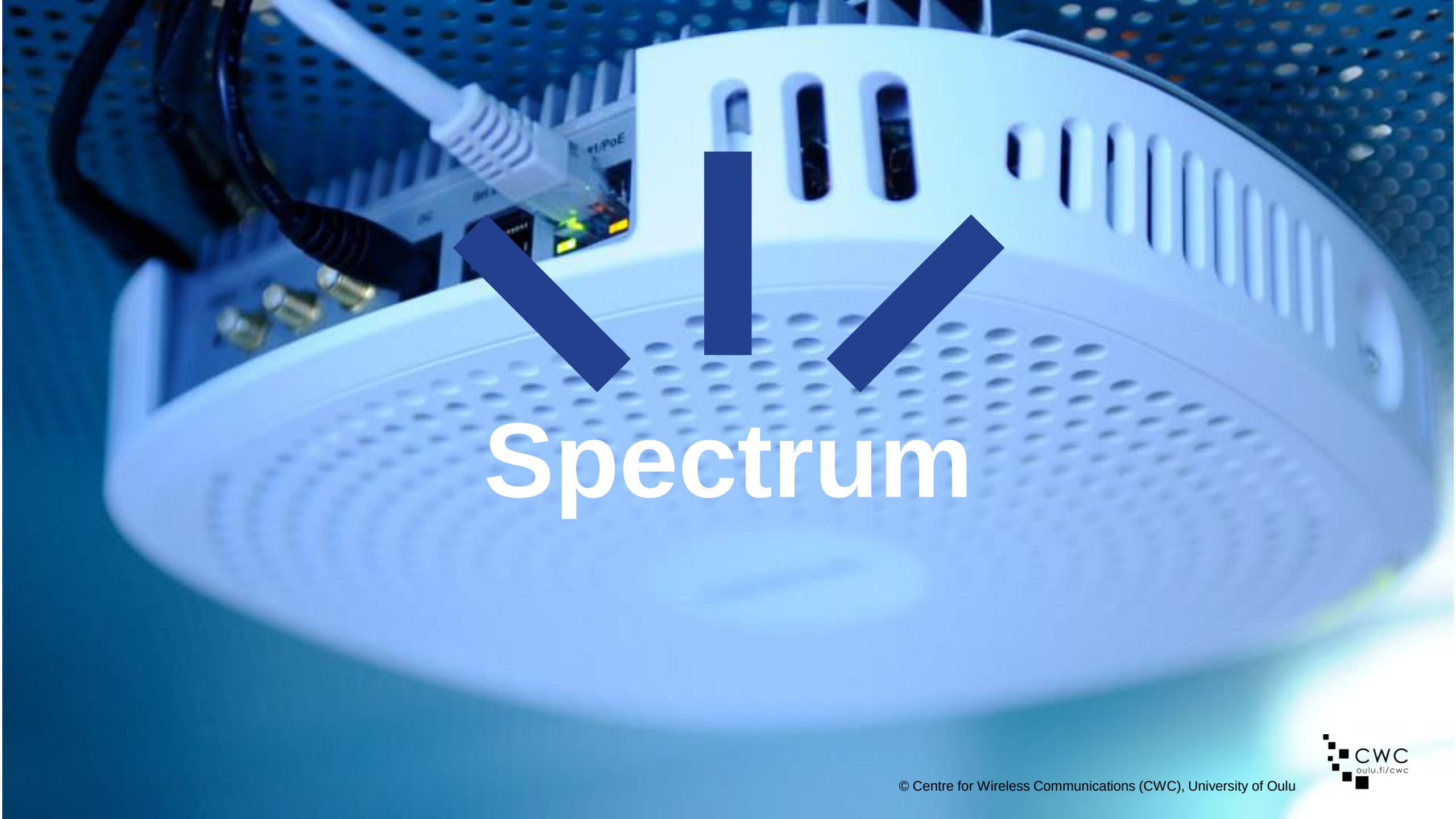

# Spectrum



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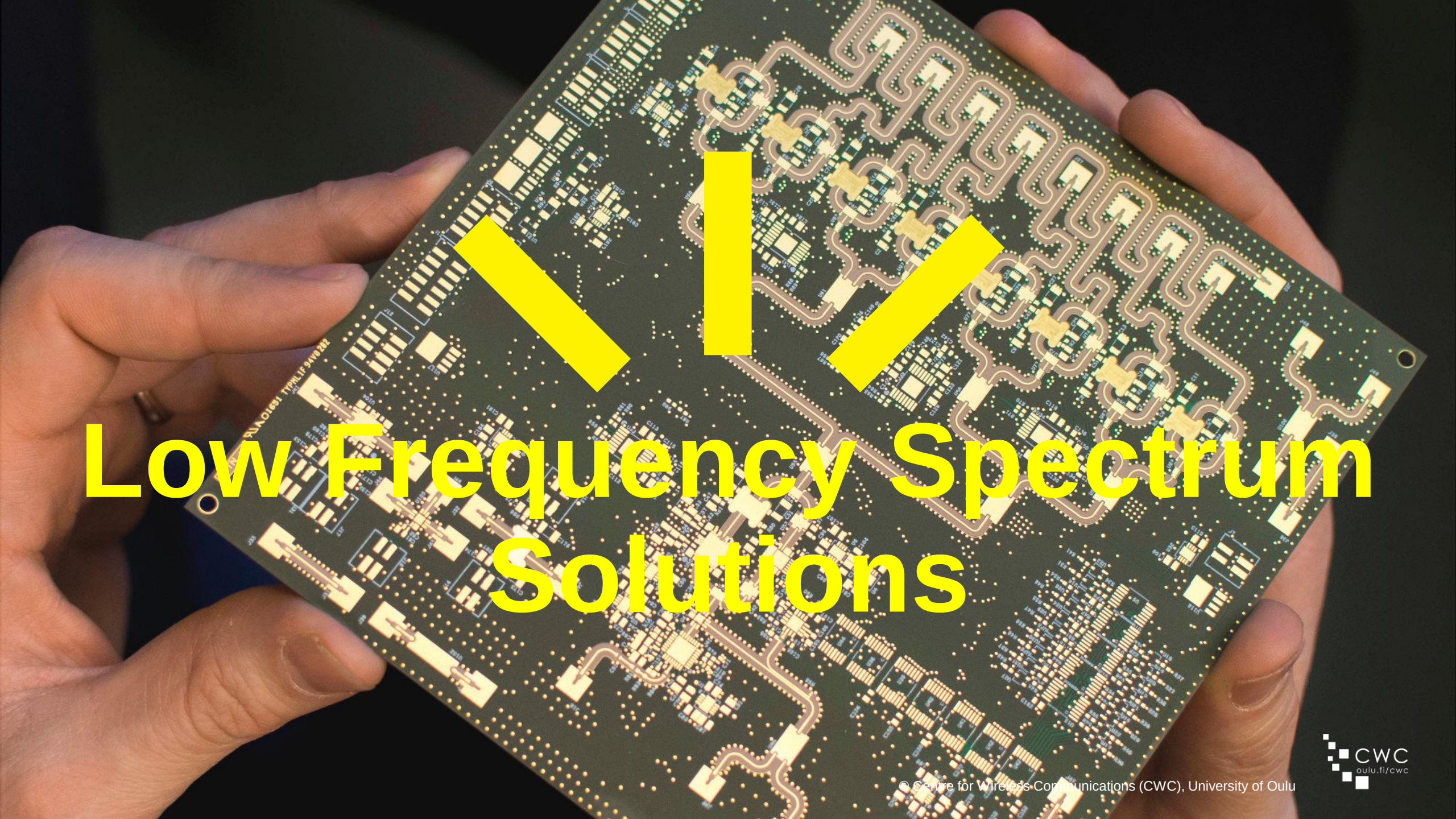
# The near-term spectrum for 5G as proposed by industry: pioneering 5G bands

- The 5G Industry Association (and others) are proposing as pioneering 5G bands (at least in EU)
  - 700 MHz, wide area and indoor coverage
  - 3.4-3.8 GHz, suitable for urban areas
  - 24.25-27.5 GHz, useful for hot spots
- The 700 MHz band lends itself to large coverage but is the band sufficient for the services foreseen for 5G and for the current regulatory framework with licensing.
- Can remote areas be offered to micro-operators? Local co-operatives? Municipalities?



# Low Frequency Spectrum Solutions



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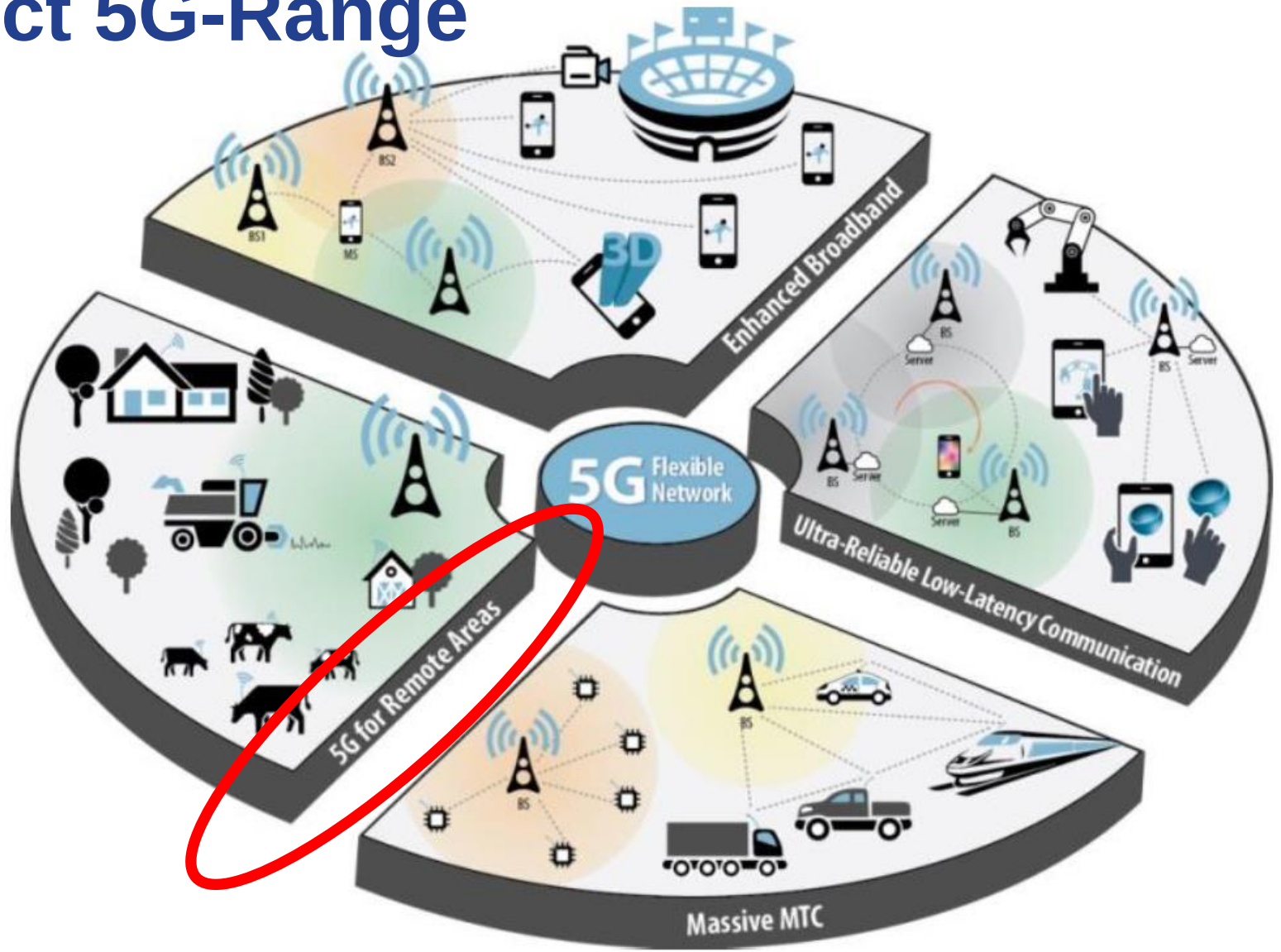
# The near-term spectrum for 5G as proposed by industry: pioneering 5G bands

- The 700 MHz band lends itself to large coverage but is the band sufficient for the services foreseen for 5G and for the current regulatory framework with licensing?
  - Split between operators
  - Bandwidth requirements
  - Range requirements
- Co-existence in other low frequency bands may be the solution

# A network slice towards 5G for Remote Areas EU-Brazil project 5G-Range

- Let’s design a high capacity waveform and protocol stack for a new network slice offering 5G for remote or sparsely populated areas



# Satellite ?

## One more network slice for 5G



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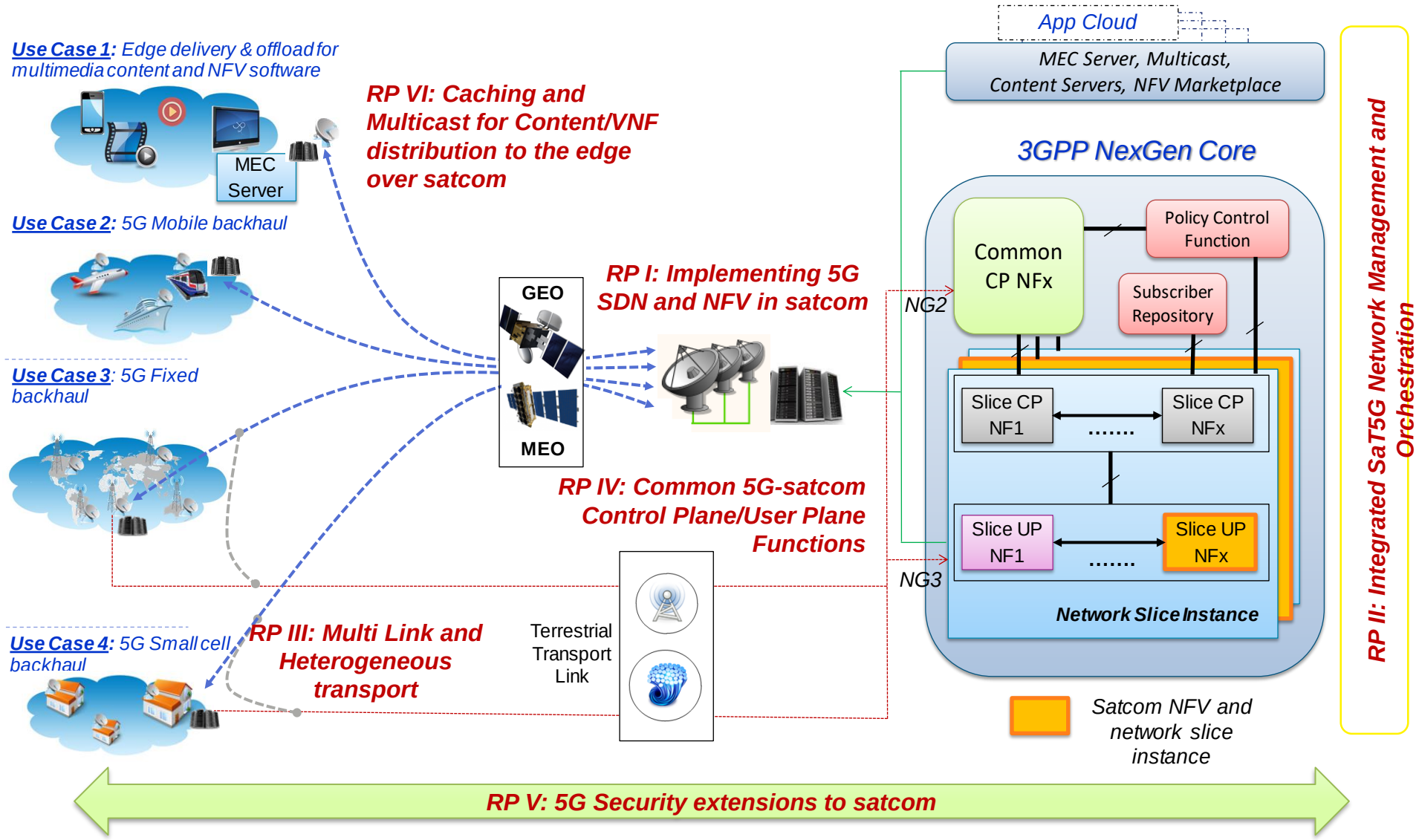
# Project Objectives

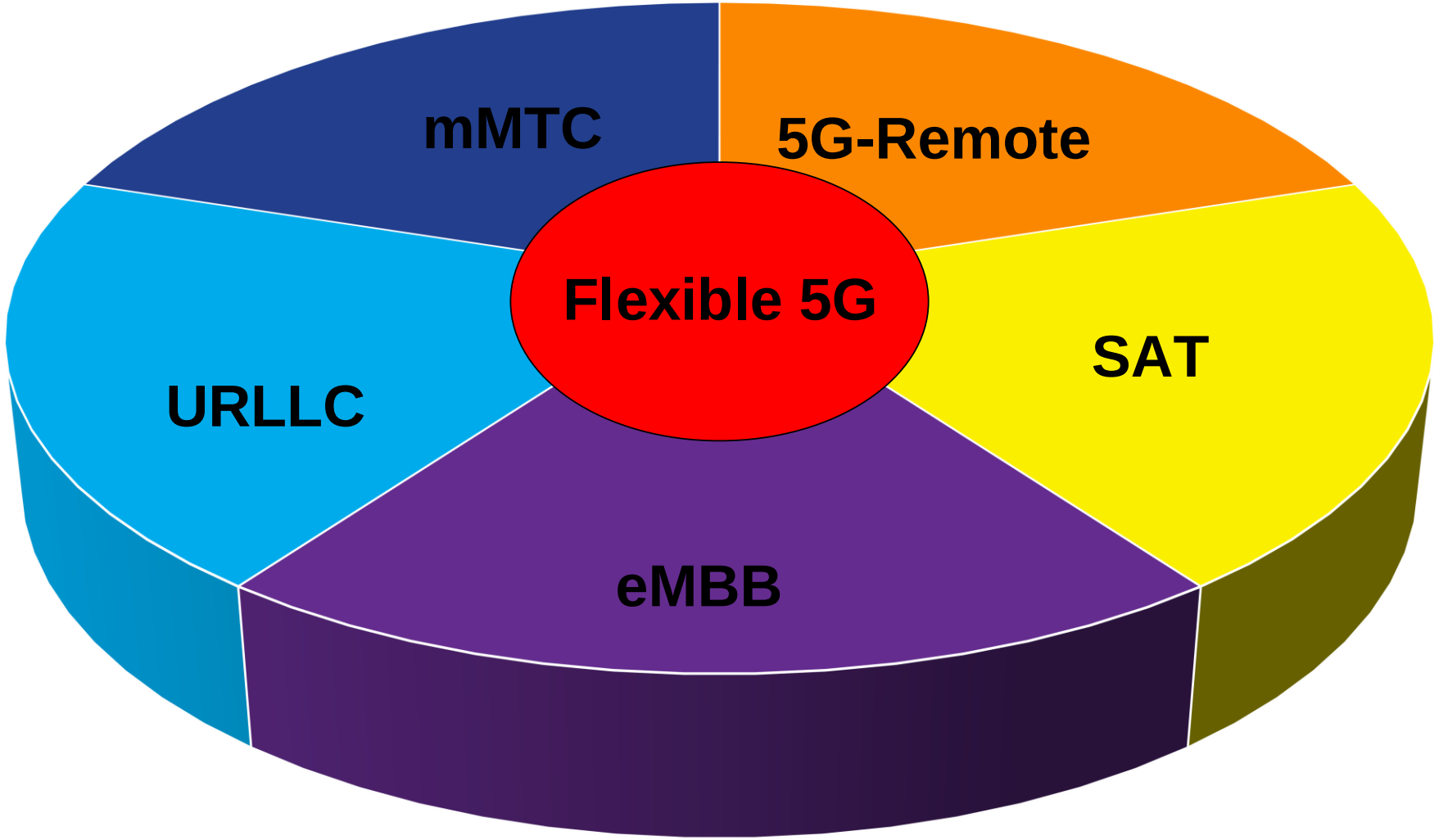
## Sat5G

- **Overall objectives**
  - Contributing to the 5GPPP use case "**Broadband access everywhere**", SaT5G will foster the implementation of solutions enabling the "plug and play" integration of satcom components into 5G networks.
  - To this aim, SaT5G will **research and validate the key technology enablers through validation and demonstration in live 5G testbeds**.
  - SaT5G impact is for the satellite industry to join the European initiative in the deployment of a competitive and ubiquitous 5G network globally.
- **Schedule**
  - 30 months duration
- **Consortium**
  - AVA project coordination, TAS technical coordination
  - 16 partners (satellite/terrestrial operators, vendors, universities and research centres)

# Use Cases & Research Pillars



# One more network slice for 5G ?



# Micro operators

## or sharing economy?

## Is there 5G spectrum – or just spectrum?



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# Micro operator concept to boost service delivery in 5G

- Growing digitalization requires that versatile location and case specific requirements with high traffic densities are met (particularly in indoors).
- uO5G challenges the traditional wireless connectivity MNO market to speed up digitalization across verticals for service delivery.

➢ **Concept of micro operators (uO)**

Tekes




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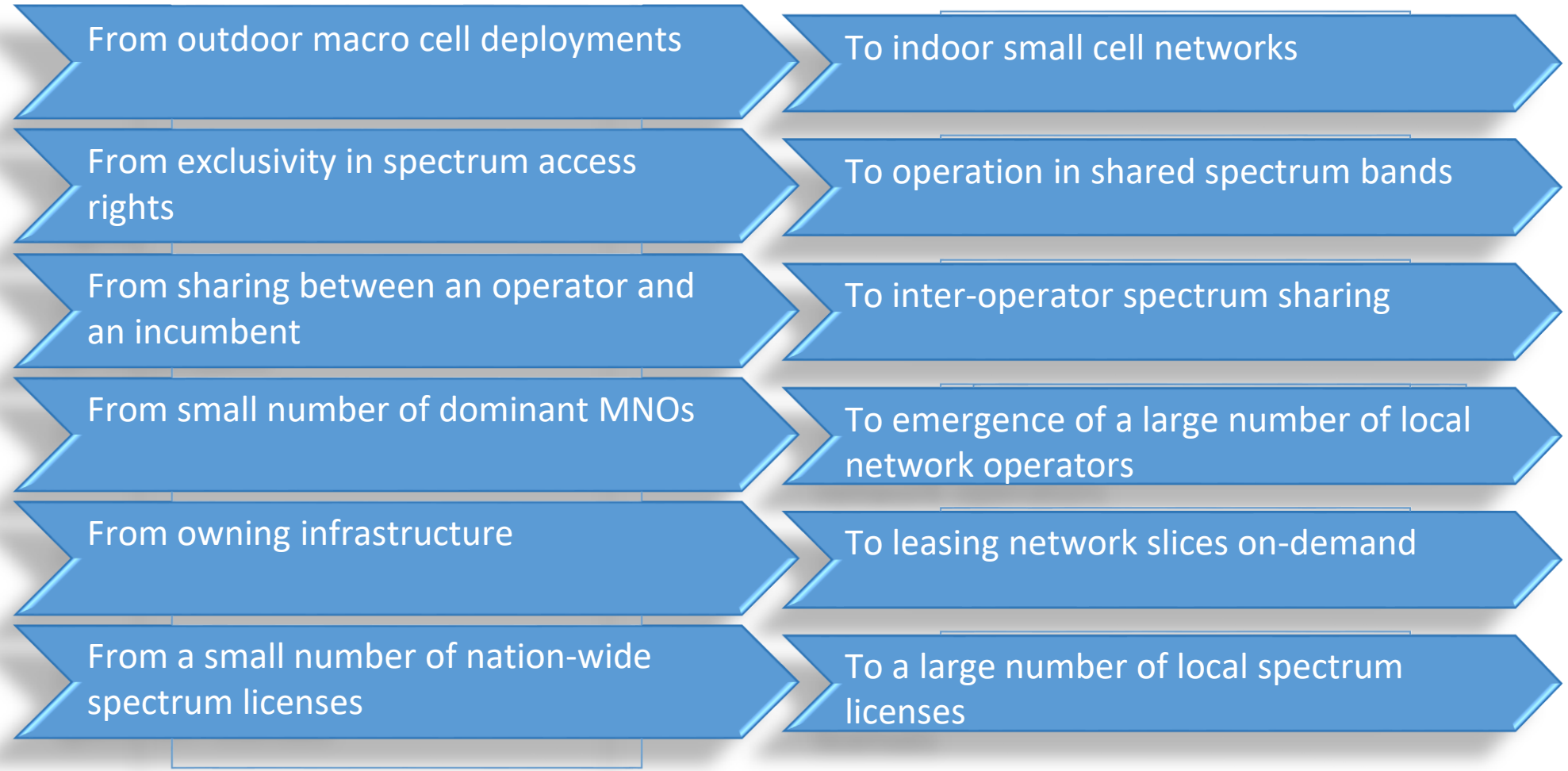
# Trends of change in mobile connectivity




M. Matinmikko, M. Latva-aho, P. Ahokangas, V. Seppänen. Reshaping regulations for 5G: Micro licensing for locally operated networks. Submitted to Telecommunications Policy.

# What is needed for uO?

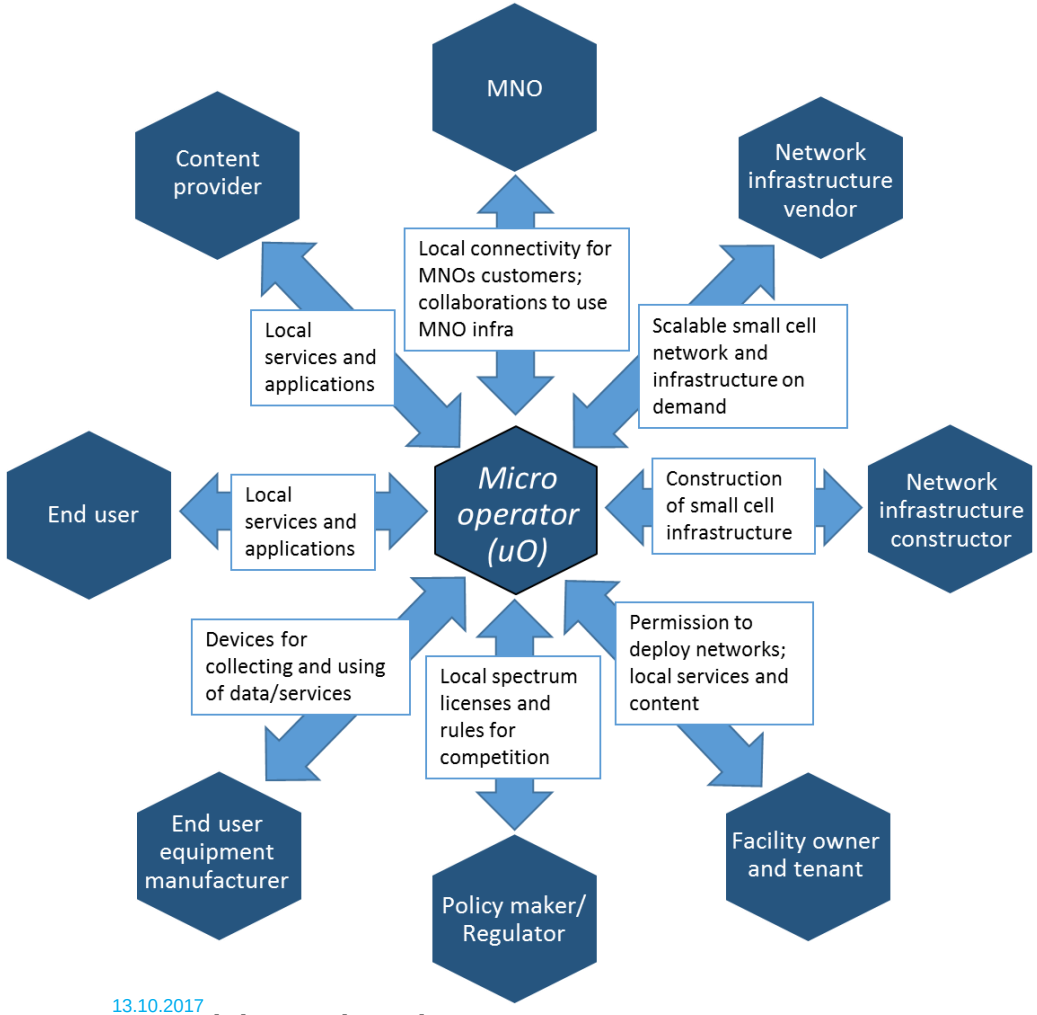
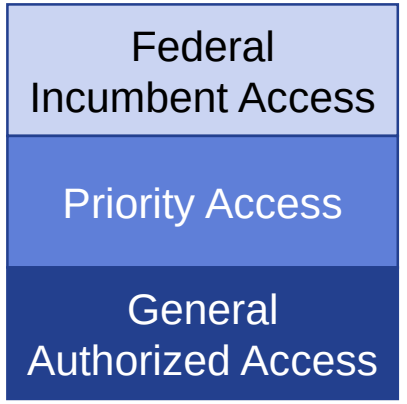


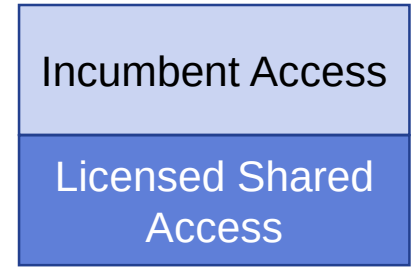

Figure. uO driven business ecosystem

- Regulation that assigns local licenses for micro operation and makes building of indoor connectivity feasible
- Business models that are scalable across different verticals
- Technology for local small cell deployments and leasing the required infrastructure without high up-front investments

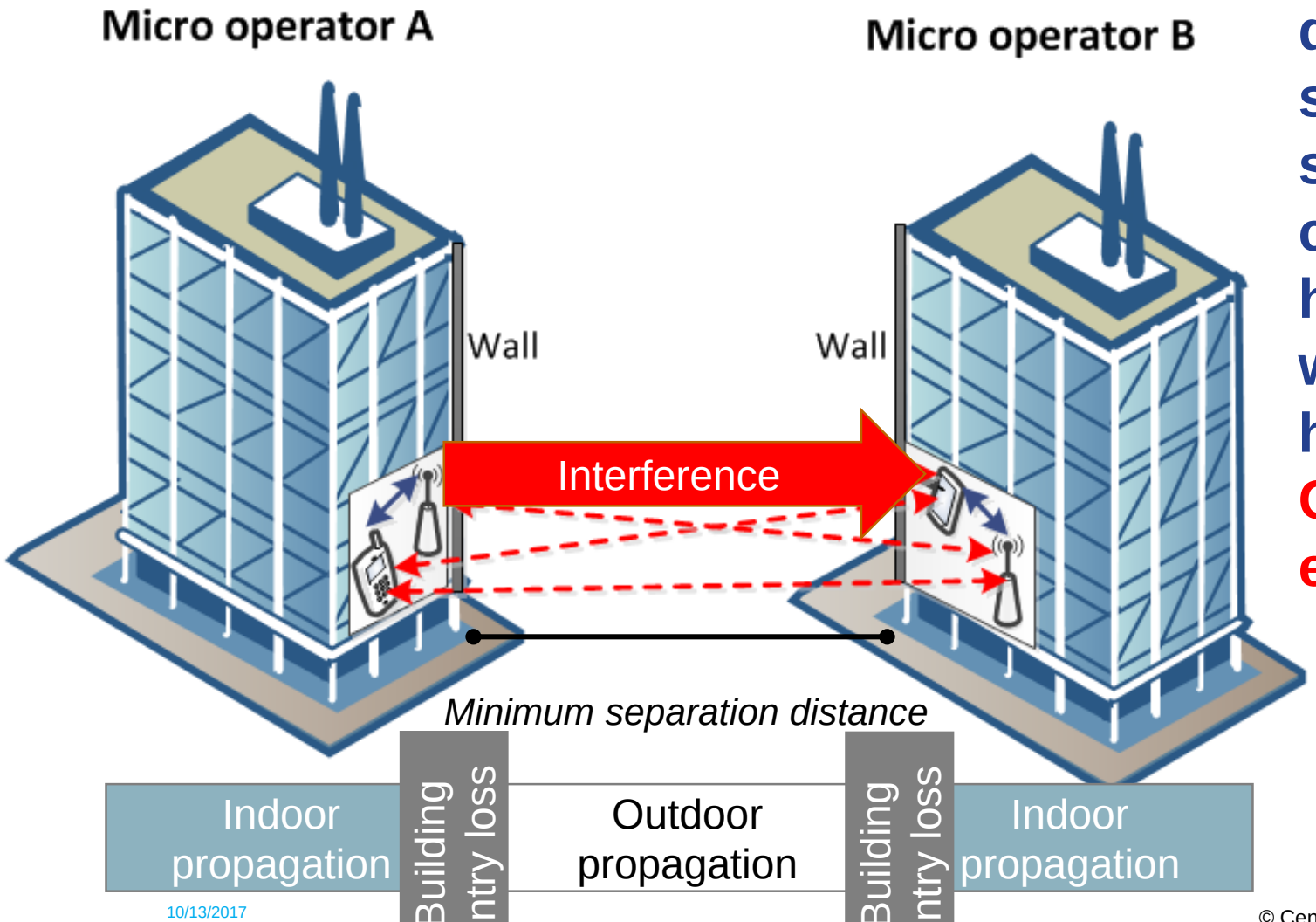
# Regutory developments globally enable local networks

- The US regulator FCC:n has introduced a three-tier model in 3.55-3.70 GHz that enables market entry for new players with local access rights
- In Europe the Licensed Shared Access (LSA) – concept in 2.3-2.4 GHz and 3.4-4.2 GHz bands enables local deployments of mobile communications while protecting incumbents
- Other regulatory developments towards the new sharing economy (use of big data, pricing, privacy, competition, roaming, building of indoor networks)
- Can remote areas be offered to micro-operators? Local co-operatives? Municipalities?



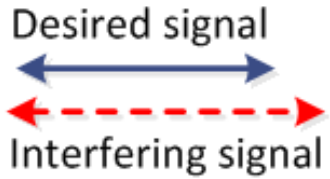



# Micro license model




**"Micro licensing" opens the market for new entrants to deploy and operate local small cell networks in a specific location such as campus, sports arena, hospital, mall or factory with protection from harmful interference.**

**Can this uO model be extended to remote areas?**

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