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
It is weird – that wireless...
5G Test Network
Innovation platform for next generation services
www.5gtn.fi
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 infrastructure 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

WiFi and IoT networks integrated
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 powerhouse on ICT research and the home of world’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...
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?
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
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

**Use Case 1:** Edge delivery & offload for multimedia content and NFV software

**Use Case 2:** 5G Mobile backhaul

**Use Case 3:** 5G Fixed backhaul

**Use Case 4:** 5G Small cell backhaul

**RP I:** Implementing 5G SDN and NFV in satcom

**RP II:** Integrated SaT5G Network Management and Orchestration

**RP III:** Multi Link and Heterogeneous transport

**RP IV:** Common 5G-satcom Control Plane/User Plane Functions

**RP V:** 5G Security extensions to satcom

**RP VI:** Caching and Multicast for Content/VNF distribution to the edge over satcom

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**App Cloud**

- MEC Server, Multicast, Content Servers, NFV Marketplace
- Policy Control Function
- Subscriber Repository

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**3GPP NexGen Core**

- Common CP NFx
- Slice CP NF1
- Slice CP NFx
- Slice UP NF1
- Slice UP NFx

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**Network Slice Instance**

- Satcom NFV and network slice instance
One more network slice for 5G?
Micro operators or sharing economy?
Is there 5G spectrum – or just spectrum?
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)
Trends of change in mobile connectivity

- From outdoor macro cell deployments to indoor small cell networks
- From exclusivity in spectrum access rights to operation in shared spectrum bands
- From sharing between an operator and an incumbent to inter-operator spectrum sharing
- From small number of dominant MNOs to emergence of a large number of local network operators
- From owning infrastructure to leasing network slices on-demand
- From a small number of nation-wide spectrum licenses to a large number of local spectrum licenses

What is needed for uO?

• 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

Figure. uO driven business ecosystem
Regulatory 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 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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