The owner of the space must have a role and incentive in building, operating and maintaining the network as well as creating context-related content and services. The role of local connectivity will increase dramatically.
How Operator Roles May Change?

• Spectrum **regulation** is going towards shared spectrum.
• **Wide coverage** area technically challenging for high datarates (>1Gbps).
• **Spectrum crunch** is efficiently tackled via densification.
• With **Small cell** technologies networks will be build mainly to indoor environments.
• Who has **incentive to invest** in NW infrastructure, operate and maintain the network as well as provide context related services?
• Emergence of new local **micro operators**?
Micro Operator - uO

- A virtual operator does not have own infrastructure but has own customer base.
- A micro operator (uO) has own infrastructure but not necessarily own customer base.
  - In public areas micro roaming is needed to grant access to all possible users.
  - In private areas, the owner of the space dictates who has access.
- Revenue models for uOs are not based on monthly fees of bytes.
  - Part of property offering – inclusion to rent
  - Part of customer service model
  - Improving the efficiency of public services
- Possible only via changes in regulation (both spectrum and telecom regulation in general).
A national project with Finnish industry, operators, Ministry of Transport and Telecommunications and Academia to study the bottlenecks and key enablers for uO business models.

**Technical building blocks:**
- Dense small cell networks
- Network virtualization
- Mobile edge computing
- Operation in higher carrier frequencies
- Spectrum sharing and management techniques

**uO concept:**
uOs build and operate indoor small cell networks and offer local context related services and content

**Regulatory building blocks:**
- Availability of 5G spectrum
- Local micro licenses
- Rights to build indoor networks
- Rules for collection and use of data
- Collaboration/competition rules with MNOs

**Business models**
STAKEHOLDERS

End user

Policy maker/Regulator

Facility owner and tenant

End user equipment manufacturer

Content provider

Local services and applications

Local connectivity for MNOs customers; collaborations to use MNO infra

Scalable small cell network and infrastructure on demand

Construction of small cell infrastructure

Permission to deploy networks; local services and content

Local spectrum licenses and rules for competition

STAKEHOLDERS

MNO

Network infrastructure vendor

Micro operator (uO)

Permission to deploy networks; local services and content

Local spectrum licenses and rules for competition

Construction of small cell infrastructure

Scalable small cell network and infrastructure on demand

Local services and applications

Local connectivity for MNOs customers; collaborations to use MNO infra

Content provider

End user

End user equipment manufacturer

Policy maker/Regulator

Facility owner and tenant

Network infrastructure constructor

Local services and applications

SCALABLE SMALL CELL NETWORK AND INFRASTRUCTURE ON DEMAND
Business environment change
General services for masses

Wholesale services
- Venues: Shopping malls, Campuses, Mass event arenas
- Offering: uO provides local connectivity to MNOs’ customers on-demand

Retail services
- Venues: Hotels, Offices
- Offering: uO provides on-demand connectivity and content locally to facility owners/tenants

Context-defined services
- Venues: Personalized consumer services, vehicular networks
- Offering: uO provides specific personalized content and context services to end-users on-demand

Vertically defined services
- Venues: Manufacturing sites, Smart grids, Hospitals
- Offering: uO provides tailored on-demand services to facility tenants’ end-users and systems

Micro operator (uO)

Special requirement services
Oulu 5G Network for uO Piloting

Nationally funded (Tekes 5th Gear) research trial project

Network operation by VTT and University of Oulu, Nokia radio and core network products

Campus area, includes private network (VTT) and public network (University)

State-of-art LTE 5G Proof of Concepts Step-by-step towards commercial 5G

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<td>LTE-M live network performance tests 5G vs. LTE air interface and e2e performance New 5G technologies, use cases, applications and business models</td>
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LTE-M live network performance tests

http://www.5gtn.fi/
Oulu 5G Test Network Offerings

• Real-life Lab for testing 5G portfolio, New Services, Applications and Business Models

• Current status
  – Outdoor & indoor coverage built @2.6GHz and 3.5GHz (outdoor coming soon).
  – Pre-commercial 5G radio with adaptive beamformer @28GHz by early 2017.
  – Commercial EPC for 100k users under installation.
  – Several Mobile Edge Computing servers already installed
  – IoT extension with ~1000 nodes completed during 2017.
  – 100 testphones currently; target to offer SIM for students and personnel to enable testing with 15-20000 users at the campus area

A real operator grade 5G test network
Oulu 5G Test Network used in

"The first 5G system PoC in conjunction with the PyeongChang winter Olympics"
http://www.5g-champion.eu/

LTE-A and 5G prototype radios

EPC with edge computing

On-board Multi-RAT RU  Wireless Backhaul  RAN controller

- Multi-RAT
- Synchronisation
- 5G positioning
- Traffic Aggregator
- HYBRID MIMO BF

- HYBRID MIMO BF
- BF CONTROL
- MOBILITY/MWN
- Synchronisation
- Sat-RAT convergence

2.5-20 Gbit/s
24-28 GHz
1-2 ms latency

Mobile Edge Computing

Centralized data center

Service location depending on latency criticality
The first live demos for uO concept are planned to given at:

**EUCNC 2017**

European Conference on Networks and Communications | Oulu, Finland

5G: European Roadmap, Global Impact

12 - 15 June 2017

www.eucnc.eu

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EuCNC 2017 is the 26th edition of a successful series of technical conferences in the field of telecommunications, sponsored by the European Commission. The event will be organised in Oulu, Finland. It targets to bring together researchers from all over the world to present the latest research results, being one of the main venues for showcasing, demonstrating and trialling the results...