Radio Access Networking Challenges Towards 2030

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Challenge #1: Verticals Driving Development
Wireless Connectivity Offers Unlimited Opportunities

• Wireless connectivity is driving major societal changes:

  1G - 2G
  1980s – 2000s
  Millions of voice users

  3G - 4G
  – 2020s
  Billions of Mobile
  Broadband users

  5G and beyond
  – 2040s
  Trillions of
  connected objects

• Application range explodes and new value chains emerge:

  Logistics
  Shopping
  Agriculture
  Industry 4.0
  Health
  Sustainable energy
  Automotive & transportation

EC estimates of 5G in Europe by 2025: €113.1B revenue per year and 2.3M new jobs.
Network infrastructure is spreading massively to other locations besides operator base station sites.

Requirements for security and reliability become much more stringent.
Challenge #2: Network Architectures Change
1) Higher frequencies needed => the physics of radio signals propagation mean shorter link ranges ⇒ More basestations needed => the role of short range connectivity is drastically increasing.

2) Higher frequencies do not propagate through walls => base stations must be installed indoors ⇒ who does that and pays the bill?? => new value chains / business models needed.

3) Spectrum regulation has to enable local frequency licencing for the benefit of different verticals ⇒ Radio Spectrum Policy Group (RSPG) in European Commission is pushing this.
More Variety in Networks Deployment
Cloud Distribution Across Network...

- Smart society calls for distributed AI.
- AI solutions are driven by different verticals.
- Whole system architecture is changing: base station densification, mobile edge computing, fog computing at devices...

What AI/ML brings to wireless systems and what wireless connectivity offers to AI/ML based apps.
...All the Way to Mobile Devices
Challenge #3: New Value Chains Appear
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.
Micro Operator (uO)

- **Virtual operator** does not have own infrastructure but has own customer base.
- **Micro operator** (uO) has own infrastructure but not necessarily own customer base.
- 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 service => savings for society
- Possible only via changes in regulation.

http://www.oulu.fi/uo5g/
uO concept:

uOs build and operate indoor small cell networks and offer local context related services and content.

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

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

HUGE ECONOMIC GROWTH VIA FAST DIGITALIZATION OF SOCIETY ENABLED BY AGILE NEW PLAYERS IN THE ECOSYSTEM
5G Test Network Driving uO Concept Trials

- Open test network for co-creation (https://5gtn.fi).
- Was used in EU-Korea demos at 2018 Winter Olympic Games (http://www.oulu.fi/cwc/node/50700).
- Operator grade live network with plugged in 5G prototype radios.
- Near future targets: become the first operational local micro-operator at University of Oulu Digital Campus.

800 MHz @26/28 GHz 10 Gbps Hybrid beamformer
5G PoC IoT sensors LTE Macros with NB IoT LTE small cell @3.5GHz 5GTN SIM
Challenge #4: Connecting The Last 4 Billion People
Wireless Solutions Are Critical for Sustainable Development

Sustainability targets set by UN for 2030
Grand Challenges That Have Been Overlooked

- How to solve backhauling in remote areas?
- How remote area networks are financed?
- How about emerging economies and developing countries?
- Spectrum regulation in remote areas should be handled differently.

NGMN Alliance launches new projects to boost 5G success

Updates on first 5G deployment experiences, further technology development and new business models to be shared at the NGMN Industry Conference in Vancouver, November 6-8, 2018

Frankfurt, GERMANY, June 18, 2018 – Next Generation Mobile Networks (NGMN) has confirmed the launch of four new key projects to support the development and deployment of 5G networks.

The projects – “Spectrum and deployment efficiencies”, “Ultra Reliable Low Latency Communication (URLLC) requirements for vertical industries”, “RAN convergence” and “Extreme long-range communications for deep rural coverage” – have been highlighted as crucial development areas to further optimise and guide the telecoms industry towards the successful deployment of 5G beyond 2018.
Challenge #5: Major Technology Leap Required for 6G
Finnish Flagship on Wireless Communications

6G Enabled Smart Society and Ecosystem

www.oulu.fi/
www.6genesis.org
6G will emerge around 2030 to satisfy the expectations not met with 5G, as well as, the new ones fusing AI inspired applications in every field of society with ubiquitous wireless connectivity.

Vision for 2030
Our society is data-driven, enabled by near-instant, unlimited wireless connectivity.

6G will emerge around 2030 to satisfy the expectations not met with 5G, as well as, the new ones fusing AI inspired applications in every field of society with ubiquitous wireless connectivity.
Trends in Mobile Technology Development

Fully automated society
National Flagship on Wireless Communications

- National Flagship for 2018-2026
- Volume 251M€
- Operated by University of Oulu
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- More info: www.6genesis.org

RESEARCH AREAS:

**Wireless Connectivity**
Ultra-reliable low-latency communications

Unmanned processes

**Devices & Circuit Technology**
THz communications materials & circuits

Unlimited connectivity

**Distributed Computing**
Mobile edge intelligence

Time critical & trusted applications

**Services and Applications**
Multidisciplinary research accross verticals

Disruptive value networks

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