Leveraging Heterogeneous Connectivity in Converged 5G-IoT Ecosystem*

Dr. Sergey Andreev
W.I.N.T.E.R. Group,
Tampere University of Technology (TUT), Finland

http://winter-group.net/ [sergey.andreev@tut.fi]

*These slides are intended for educational purposes and include material published by W.I.N.T.E.R. Group as well as available openly on the Internet.
Internet of Things (IoT) is All Around Us
Consumer vs. Industrial IoT Domains
Today, there exists a “zoo” of IoT-ready wireless access technologies.
Other Radio Access Technologies for IoT

**Historical** solutions (Bluetooth, IEEE 802.15.4, IETF stacks,...) are evolving to *maintain competitiveness* in growing IoT market.

Novel **IEEE 802.11ah** technology is being developed to empower *low-cost* and *large-scale* connectivity across massive deployments.

**Unlicensed** Low-Power Wide Area (LPWA) networks rapidly emerge to support the *early stages* of the IoT development, until *standardized* cellular M2M solutions enter the market.
Fifth-generation (5G) wireless technology is targeting to offer support for numerous IoT applications.
Given **IMT-2020** requirements, the next-generation 5G technology is taking shape rapidly.
Support for a Diversity of IoT Applications

The world is developing toward a **networked society**, where *all kinds* of devices interact and share information.

**Cellular IoT** has the potential to serve a *wide range* of prospective IoT applications and services.
Tactile Internet: Our Final Destination?

**Bi-Directional Haptic Control**

- **response (e.g. force)**
- **command (e.g. velocity)**

**Master Domain**
- Operator(s) with tactile human-system interface (possibly distributed)

**Network Domain**
- Internet, transmitting audio-visual and tactile information.

**Controlled Domain**
- Tactile edge composed of e.g. remotely controlled robots.

**Latency Goals:**
- 0.3 ms Air Interface
- 0.5 ms BS & Control/Steering Server
- 1 ms Terminal

**Small, efficient workshops**
- Collaborative robots
- Wearables
- Increasing efficiency, safety and worker satisfaction
Cellular 3GPP standards are constantly evolving to meet IoT requirements and characteristics towards future 5G-grade systems.