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Machine-type Wireless Communications Enablers for the 6G-era: A look into Secure and Sustainable Wireless Networks

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The **sixth generation (6G)** of cellular networks envision a **society that is data-driven**, enabled by **near-instant, unlimited wireless connectivity**, as envisioned by the **6G Flagship.**

Such vision is shared by the **Internet of Things (IoT)**:

- Wireless connectivity to anything: sensors to heavy machinery.
- Revolutionizing the way we live and the complete value chain of several industries (Industrial IoT - IIOT).
- Generating new business with huge potential economic impact.

Machine-type wireless communication (MTC):

- Massive MTC (mMTC) and critical MTC (cMTC).
- Challenging requirements: latency and reliability that are not attended by current technologies.
- New technological paradigm on the design of wireless networks.

MTC is one of the key enablers of the IoT and fundamental for developing the 6G.

To meet such a vision at the **Machine-type Wireless Communications Group** we seek elegant mathematical and algorithmic solutions for MTC within its diverse and heterogeneous requirements and applications.

Lead by **Assist. Prof Hirley Alves** the **MTC Group** is formed by

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Four illustrative use-cases of mMTC and cMTC and some key performance indicators (KPIs) of MTC presented in Fig. 1.

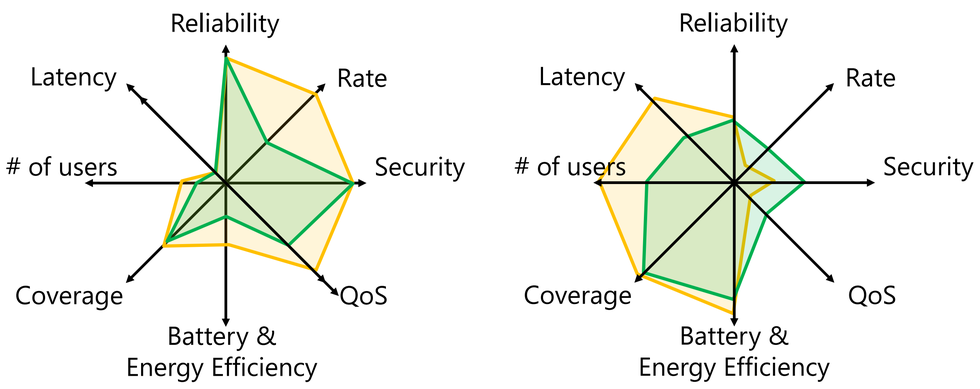

Fig. 1 Illustrative KPIs of mMTC and cMTC use-cases. cMTC on the right: critical (real-time) networked control in IIoT (green) and AR/VR assisted control (yellow). mMTC on the left: non-critical networked control in IIoT (green) and telemetry services (yellow).

Energy-Efficient Massive Wireless Energy Transfer

Wireless Energy Transfer (WET) appears naturally combined with Wireless Information Transfer (WIT), and is intrinsically a fundamental and sensitive building block because:

- WET duration could be significantly larger than WIT.
- WET operates almost permanently while WIT happens sporadically - event-driven traffic.
- Challenges on charging massive MTC – sustainable networks.

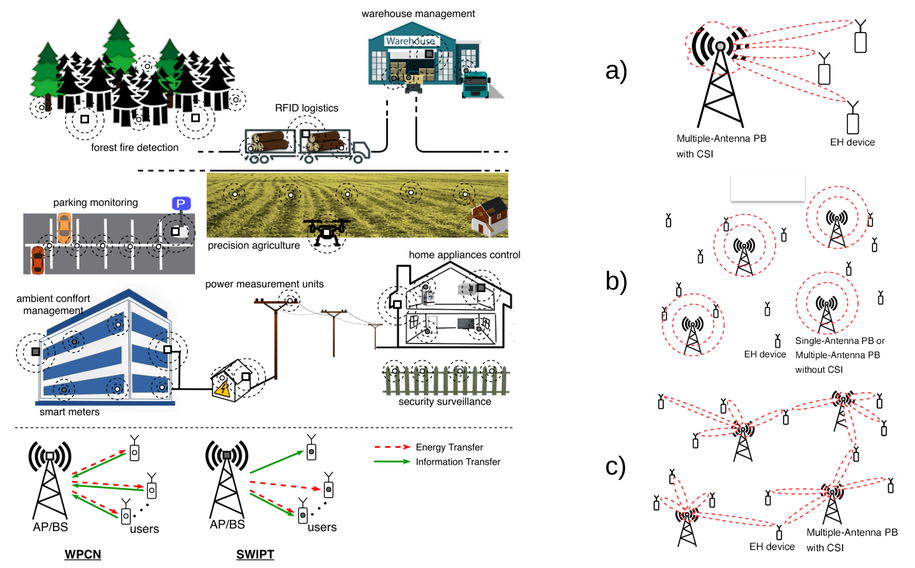

Fig. 2 mMTC use cases in different industrial verticals on the left. On the right, 3 alternatives for wireless energy transfer: a) energy beamforming; b) distributed antenna system; and c) hybrid distributed energy beamforming, which are exploited for massive wireless energy transfer.

Safeguarding MTC for 6G at the Physical Layer

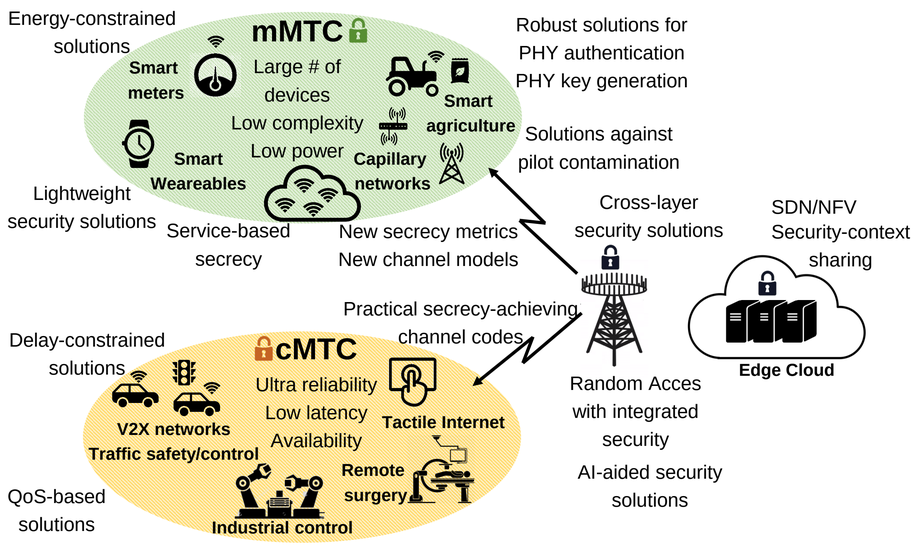

Fig. 3 mMTC and cMTC security uses cases for the 6G era.

- **Practical Channel Models:** needed for design and performance evaluation of secrecy, security, privacy and authentication metrics at mmWave and THz bands.
- **Cross Layer Techniques:** gracious security guarantees across layers. Reduced cost and overheads.
- **AI-based PHY Security:** robust multi-attribute authentication, and in highly dynamic environments.

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