ROBOTICS & AI
at Luleå University of Technology

AMBITI◉US
Digital solutions for the 5G era

LULEÅ
UNIVERSITY
OF TECHNOLOGY

Aerial Internet of Things (A-IoT): concepts, integration and use cases

Dr. Emanuele Pagliari

Postdoctoral researcher at Robotics and AI group

emanuele.pagliari@ltu.se

12/11/2024

Internet of Things (IoT): use cases and constraints

- **IoT used in industrial, rural and urban environments for monitoring purposes**

- IoT focus on data collection and energy efficiency (e.g., battery-powered field deployed nodes)

- Current IoT constraints: **network coverage, data-rates and battery life**

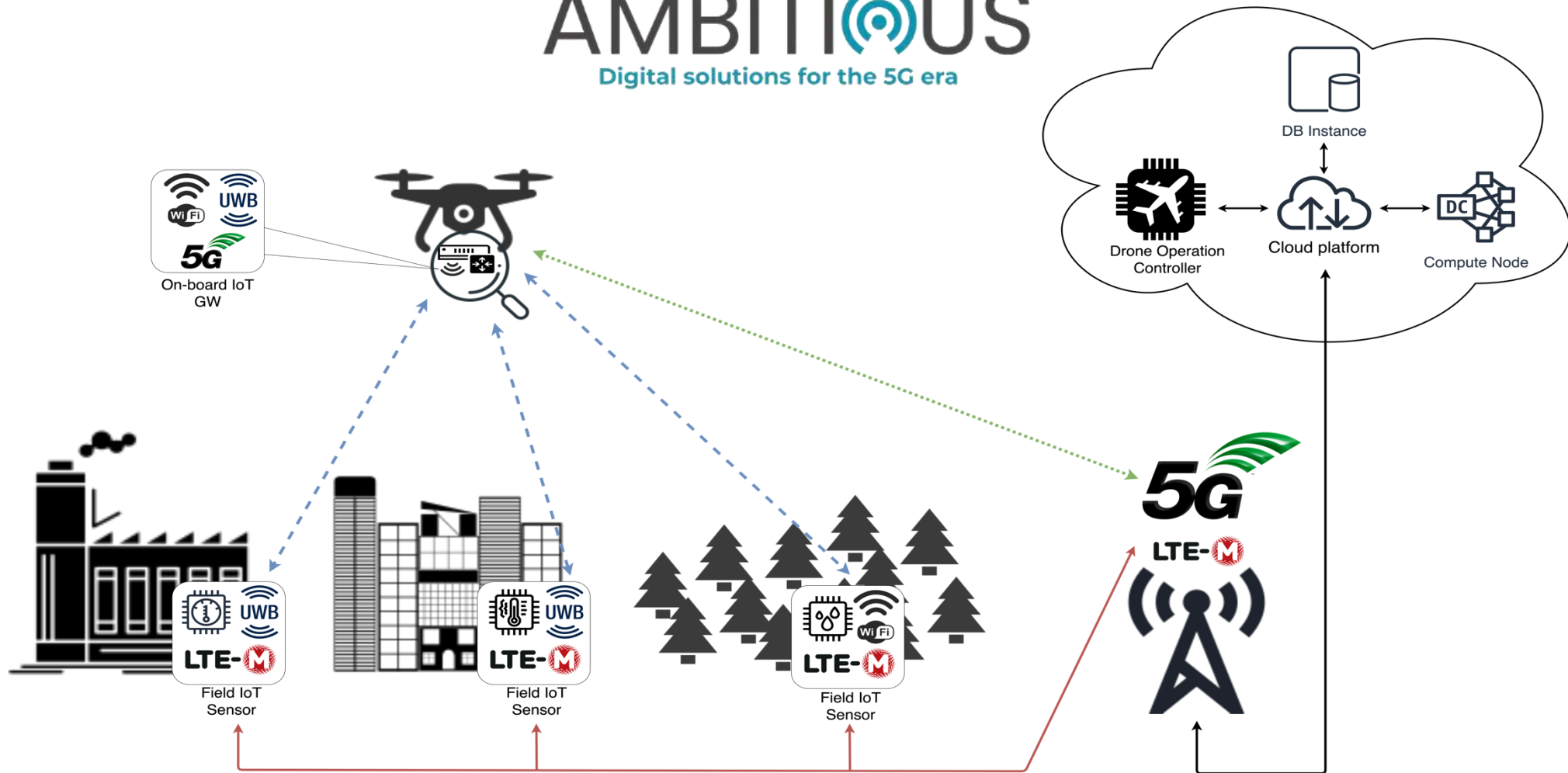- How can we solve this limitations in specific IoT applications?

ROBOTICS & AI
at Luleå University of Technology

IoT meets Autonomous Drones

- **Autonomous drones with on-board sensor and IoT connectivity gateway**

- 5G-enabled drones to connect rural area IoT sensors (e.g., forest)

- Disaster response applications where the network infrastructure is not available

- Enhance battery life and efficiency of constrained IoT sensors

- Sensor-to-Drone data flow: **Aerial IoT**

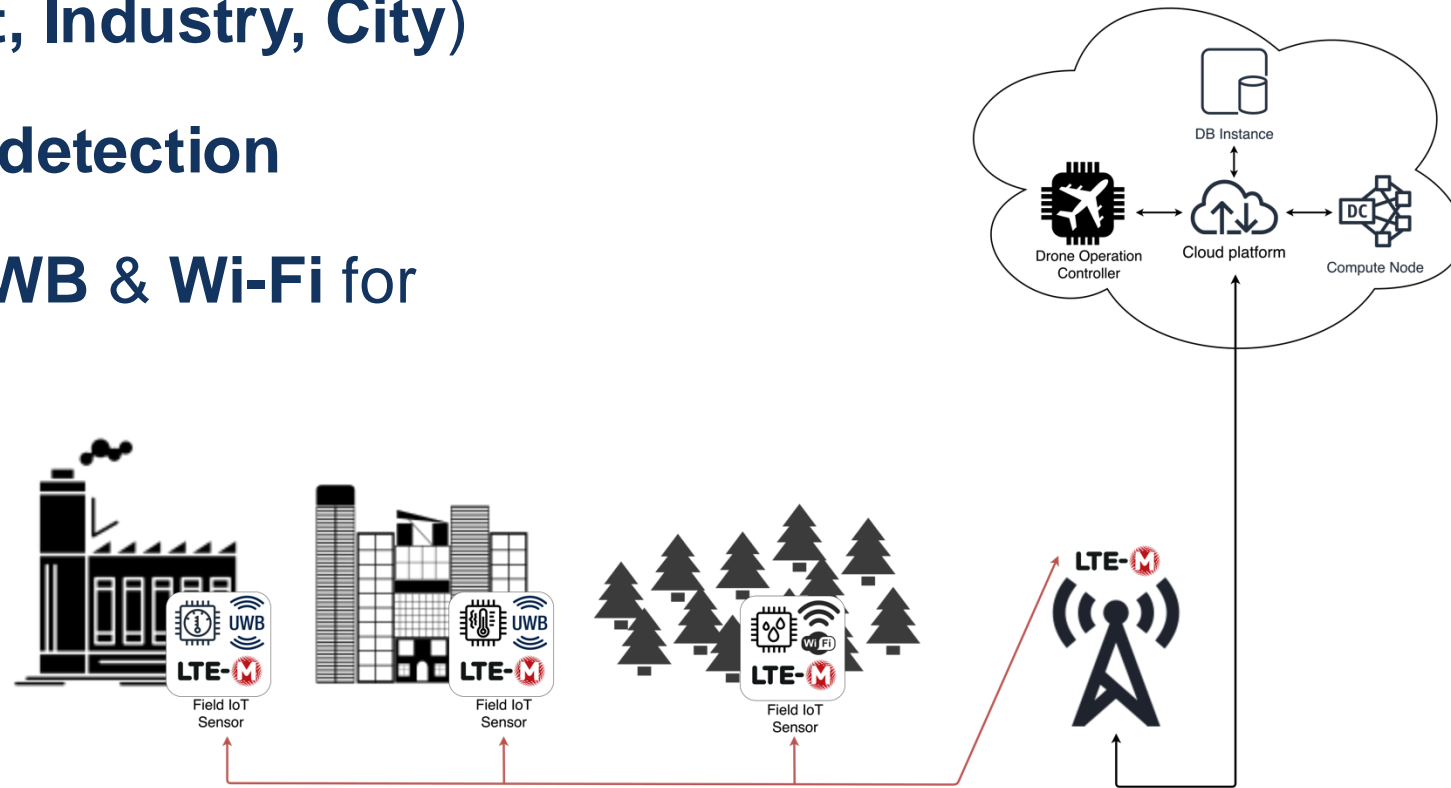**ROBOTICS & AI**
at Luleå University of Technology

The Aerial IoT concept in AMBITIOUS AIDA UC5

Regular Data Flow (traditional IoT architecture)

- Field deployed IoT nodes **periodically send sensor data to the cloud** (LTE-M & 5G Red Cap)

- **Battery powered** nodes with different sensors based on the environment (**Forest, Industry, City**)

- **Cloud processing and anomaly detection**

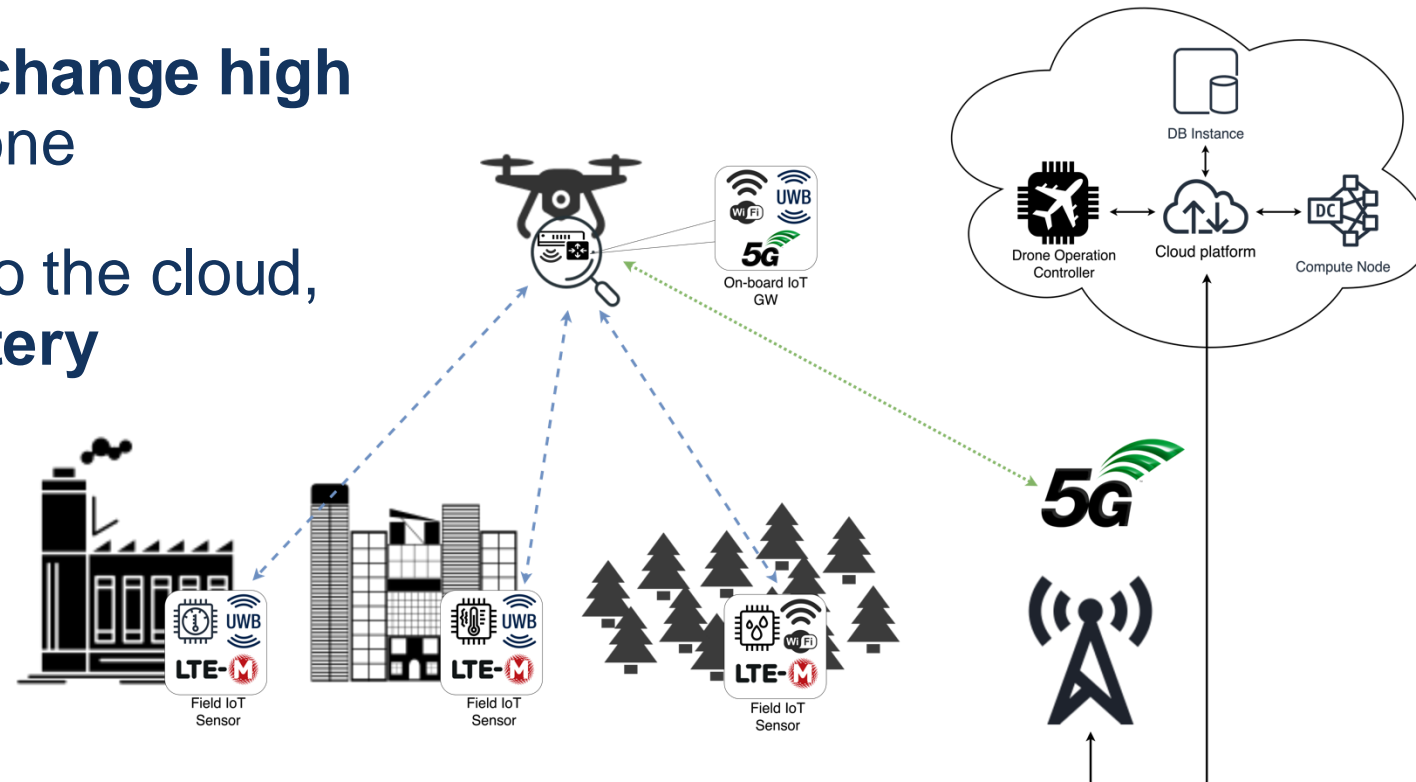- Field IoT nodes **equipped with UWB** & **Wi-Fi** for short range communication

Emergency Data Flow (Aerial IoT architecture)

- **Anomaly detected → Autonomous drone flight**

- Autonomous drone equipped with **5G-IoT gateway** flies nearby IoT sensors

- IoT nodes use **Wi-Fi or UWB to exchange high throughput** information with the drone

- Drone 5G IoT gateway relays data to the cloud, **without draining the sensors' battery**

- **Higher throughput & battery saving**

Aerial IoT for dense forest monitoring

- Drone-mounted **IoT GW and droppable sensors** for forest monitoring in **remote area**

- **Radio coverage cannot penetrate** trough the forest → drones have **LOS with towers**

- Drone records the GNSS positions of the dropped sensors and **periodically flies over the area to harvest their data**

- **Narrow band-**enabled **sensing IoT nodes** (LoRa & BLE)

- **Multi-interface** drone-mounted **IoT GW**

AMBITIOUS
Digital solutions for the 5G era

Cloud platform
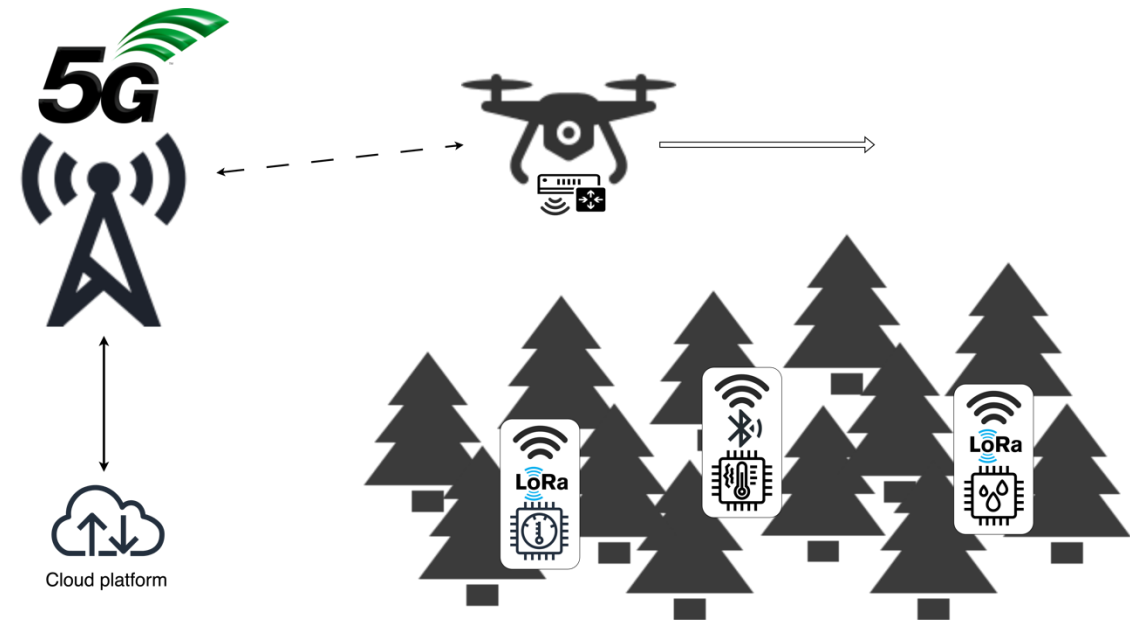
Further Aerial IoT scenarios

Disaster Response and Emergency Management (e.g., **autonomous drones to enable connectivity after disasters**)

Sensing nodes mounted on swarm of drones for **hazardous environment monitoring** (e.g., after an environmental disaster or in harsh industrial area)

Exploit IoT field deployed infrastructure for indoor autonomous drone navigation

Dr. Emanuele Pagliari
Postdoctoral researcher at Robotics and AI group
emanuele.pagliari@ltu.se

LULEÅ
UNIVERSITY
OF TECHNOLOGY