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AMAZING-6G: Amazing Large-Scale Trials and Pilots for Verticals in 6G

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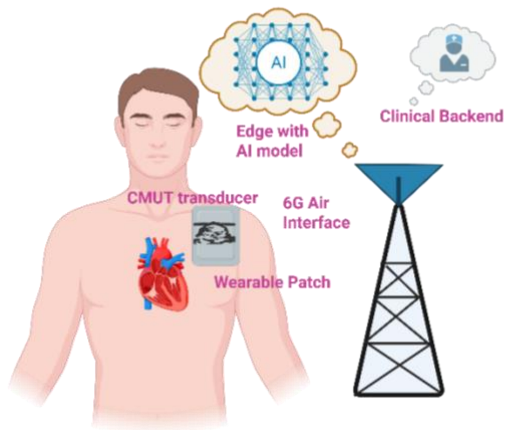
AMAZING-6G

AMAZING-6G proposes a novel set of 15 use cases in the domains of Healthcare, Public Safety, Energy and Transport which will be showcased in large-scale trials and pilots across Europe. As we move towards a world where the Internet of Things (IoT), augmented reality, and artificial intelligence play central roles in our daily lives, these use cases provide a unique opportunity to explore the potential of B5G/6G in fostering innovative solutions across various sectors, from healthcare and transportation to utilities and public/environment safety. Through large-scale trials, stakeholders can gain valuable insights into the transformative power of B5G/6G networks and strategically position themselves to harness the full spectrum of opportunities that this cutting-edge technology offers. This newsletter provides an overview of the different use cases developed in the framework of the AMAZING-6G project.

USE CASES IN THE HEALTH AND PUBLIC SAFETY DOMAIN

Wearable ultrasound patch for cardiac function monitoring

The use case focuses on novel ways to perform cardiac ultrasound assessment, an indispensable tool for the diagnosis, intervention and follow-up of heart patients. New adhesive-patch-based, ultrasound devices, leveraging Capacitive Micromachined Ultrasonic Transducer (CMUT) and similar transducer technologies, are appearing on the market. These patches can be semi-permanently attached to the patient's body enabling more frequent assessments and monitoring for longer time periods. Patch-based, cardiac ultrasound assessment can be automated by deploying AI-based, ultrasound image analysis algorithms on the edge. These algorithms will extract cardiac function parameters, such as ejection fraction. Furthermore, hemodynamic (e.g., blood pressure) and ECG data can be integrated into analyses for addressing different clinical situations. The cardiac assessment solution comprises a 6G-enabled, ultrasound patch (ECG and blood pressure sensing are optional) and the 6G system hosting AI-based image analysis on the edge. The AI-based assessments are communicated to the cardiologist via the Clinical backend which is connected to the 6G System via a Data Network such as the Internet.

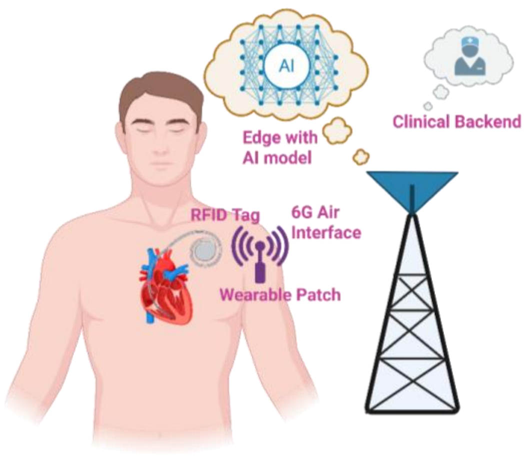


This solution may prove to be a new powerful tool for early detection of changes in cardiac function and for monitoring the effects of drug treatment more closely. This may also enable early discharge from the hospital. In short, cardiac ultrasound patches combined with edge-based AI analysis will improve patient outcomes and lower the cost of care, while improving patient and caregiver experience. Two clinical scenarios are of particular interest. The first scenario requires daily recording of short cardiac ultrasound clips (~1 minute) for monitoring at home or on the move, in particular during exercise with a battery-powered device. This scenario requires high-bandwidth (< 100 Mbps) upload, with minimal energy consumption (as the device will have a tiny battery), also under indoor coverage situations. The second scenario requires continuous, real-time recording just before (in ambulance), during (in CathLab), and directly after intervention (intensive care unit). This scenario involves continuous heart function monitoring with a mains-powered, 6G-enabled, ultrasound patch and real-time, AI-based, ultrasound analysis on the edge. This scenario requires high bandwidth (< 100 Mbps), high availability (99.9999%), while the total round-trip time (i.e., including AI-analysis on the edge) should be less than half a second.

Predictive remote reprogramming of implantable cardiac devices

Permanent pacemakers (PMs) and implantable cardioverter-defibrillators (ICDs) are critical medical devices used to manage abnormal heart rhythms. These devices need to be reprogrammed regularly to ensure they continue to meet the evolving clinical needs of the patient over time. Current reprogramming practice involves the patient visiting specialized centers, resulting in labor-intensive, infrequent reprogramming. This use case aims to demonstrate how B5G/6G connectivity, AI models running on the edge and wearable patches can support the real-time wireless reprograming of PM/ICD, based on the patient's daily activities in a closed-loop, remote and automated set-up. This requires continuous communication between the implanted device and the edge, currently a power-hungry limitation. To mitigate communication constraints, a wearable patch is proposed as a gateway between the PM/ICD and mobile networks.

The patch obtains EGM data from the PM/ICD via RFID and subsequently transmits it via the 6G network to the edge. The edge may send back reprogramming instructions via the same path. All of this has the occur – literally – within a heartbeat. Specifically, a data packet may be sent every heartbeat and it needs to arrive at the edge within 10 milliseconds to be in time for reprogramming the pacemaker before the next heartbeat. The use of RFID (backscatter) communication allows all reading and writing from/to the PM/ICD to be powered by the patch, rather than by the battery of the pacemaker, safeguarding its lifetime. The AI-based assessments are also communicated to the cardiologist via the Clinical backend which is connected to the 6G-System via a Data Network such as the Internet.



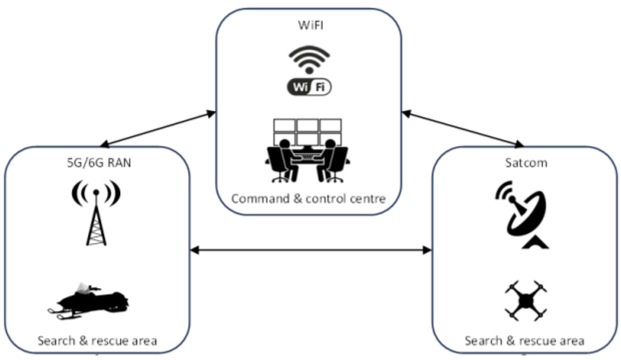
Ubiquitous B5G/6G communication and slice deployment across operators for PPDR AR/VR assisted Control Centers

For emergency service teams, reliable and secure data processing and communication are crucial. With mission critical broadband services and infrastructure at their disposal, first responders can communicate with the Local Control Center (LCC) and Central Control Centers (CCC) more efficiently. Also, they can be accurately assisted by high performance models and predictions and enhance their situational awareness. It is essential that robust and reliable communication is maintained in the area affected by an incident, even if the digital infrastructure is destroyed or underperforming. Therefore, this Use Case aims to deliver ubiquitous B5G/6G connectivity to a Public Protection and Disaster Relief (PPDR) campaign through interworking and convergence of multiple networks.

Assuming a wide-area emergency (wildfire/earthquake), with disruptions on the digital infrastructure, this use case will be designed for a high priority and increased quality PPDR service deployment, with a network slice over a private B5G/6G network, that can be interconnected to a public B5G/6G network. The PPDR service will maximize coverage and network performance within the affected area. This Use Case will demonstrate an end-to-end PPDR network slice over a private and a public Radio Access Network (RAN), the orchestration of network resources on-demand, the provision of Multi-Access Edge Computing (MEC) capabilities, and the interconnection of B5G/6G Core networks through their Application Functions, for fast provisioning and seamless operation.

Mission critical services interoperability with other systems

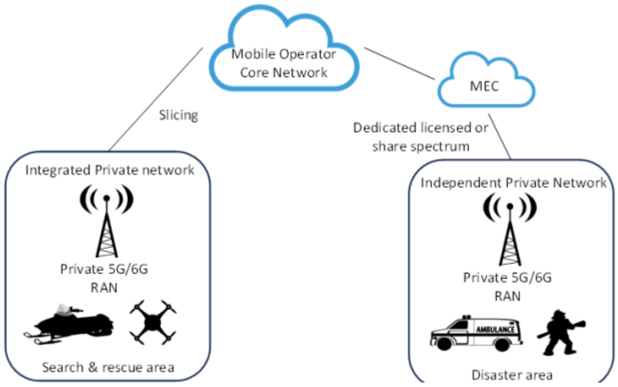
The use case focuses on achieving interoperability between Beyond 5G (B5G)/6G networks and non-3GPP technologies such as Wi-Fi and satellite systems. Its primary goal is to deliver seamless, reliable connectivity for mission-critical services, particularly for first responders operating across national networks. Testing is carried out in the



B5GTN test facility, where multiple connectivity options are combined to maximize coverage and resilience.

Key innovations include automated roaming and intelligent network selection to maintain continuous service, multi-network utilization for redundancy and performance optimization, and real-time monitoring supported by AI-driven decision-making. Service prioritization ensures that critical applications maintain high quality of service even under challenging and harsh conditions. The use case aligns with broader project objectives by addressing technical challenges in cross-network interoperability at both network and application levels. Real-world scenarios, such as handover between 5G and satellite connectivity in remote areas for the UE in responder vehicle, illustrate the practical benefits of these solutions. Use case aims to enable robust, uninterrupted communication for emergency services, which is challenging in remote low coverage areas.

Emergency private 5G/6G communication on-the-Move



The use case focuses on enabling independent private B5G/6G networks for Public Protection and Disaster Relief (PPDR) operations in areas where public networks are unavailable. The approach involves deploying essential RAN and core network components at the network edge, ensuring secure and reliable connectivity without Internet access. Two main configurations are considered: independent private network and integrated private network. Both setups include edge services such as video streaming, object detection, and LiDAR processing.

Key communication enablers include network slicing and network exposure APIs, while innovations focus on tailored deployments, customized services for mission areas, and an analytics framework for the traffic monitoring. Challenges include integrating private networks with slicing, optimizing resource allocation between public and private networks, and managing architectural complexity. Field trials will validate these concepts through real-world scenarios, such as rescue operations in remote regions, where mobile private networks maintain high QoS and operational efficiency.

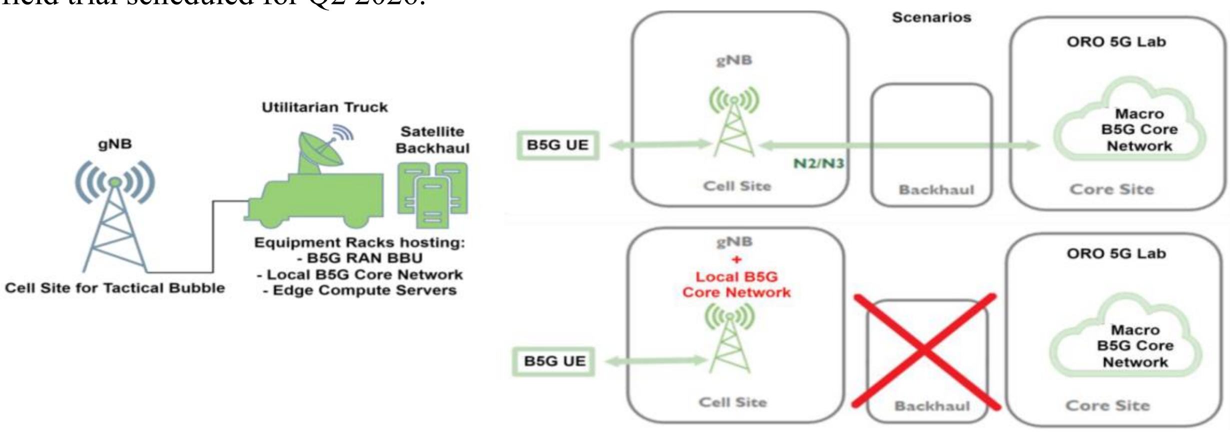
Arctic Area Search and Rescue Operation

This use case provides effective ways of using B5G and alternative connectivity to communicate between first responder team in the snow avalanche site and Command-and-Control Center (CCC) coordinating remotely the rescue operation preparation to achieve fast situational awareness. The first responder search and rescue team is equipped with electric snowmobile eSled, packed with on-board instrumentation to detect the number and locations of avalanche victims and estimate the severity of the avalanche. Instrumentation consists of LiDAR 3D-monitoring device, GPS tracker, heat camera and spectrum analyzer, along with driver helmet camera and mobile phone voice link, everything shared with CCC in real-time, enabling avalanche site detection to be completely coordinated by CCC.

Multitude of sensor systems doing parallel continuous measurements in rural area, all data delivered to remote CCC location, sounds a bit of a challenge to the communication network! It is indeed an ultimate challenge. We need to be able to send huge amounts of continuous measurement data and adequatequality video-feed for real-time remote monitoring purposes, relying on B5G networking capabilities in rural location and harsh weather conditions, with likely risks of poor connectivity. We must prepare for employing hybrid communication systems (WiFi, satellite), exploit eSled power systems for enhancing communication and prioritization of delivered data sources, to ensure operability in all circumstances.

Emergency private 5G/6G communication on-the-move

This use case demonstrates a portable communication system designed to provide mission-critical voice, video and data services for emergency teams in areas where commercial networks are unavailable or damaged. The tactical bubble includes a portable gNB, a local B5G standalone core network, MCX servers and an edge-compute platform that can run with satellite backhaul or operate in fully isolated mode. The system supports group calls, video streaming from bodycams and drones, file transfer, SOS alerts and location tracking. It is designed for fire brigades, medical teams, gendarmes and other responders who depend on reliable communication and near-real-time situational awareness. KPIs such as latency, service availability, call setup time and reliability have been defined to measure performance during trials. In the first year, the architecture, scenarios and trial plan were completed, including the two validation modes: satellite-connected and standalone. The ORO 5G Lab was prepared as the main integration site and the core network and MCX platform were installed. Equipment acquisition has started, including rugged terminals, bodycams, UAVs, IoT sensors, the portable gNB and the satellite terminal. Preparation meetings with STS and ORO aligned expectations for the first field tests, and operational requirements such as priority handling and emergency call flows were defined. Monitoring and automation tools in the ORO 5G Lab are ready to support controlled end-to-end testing of MCX services. Next steps include completing system integration in the lab and preparing the first preliminary field trial scheduled for Q2 2026.



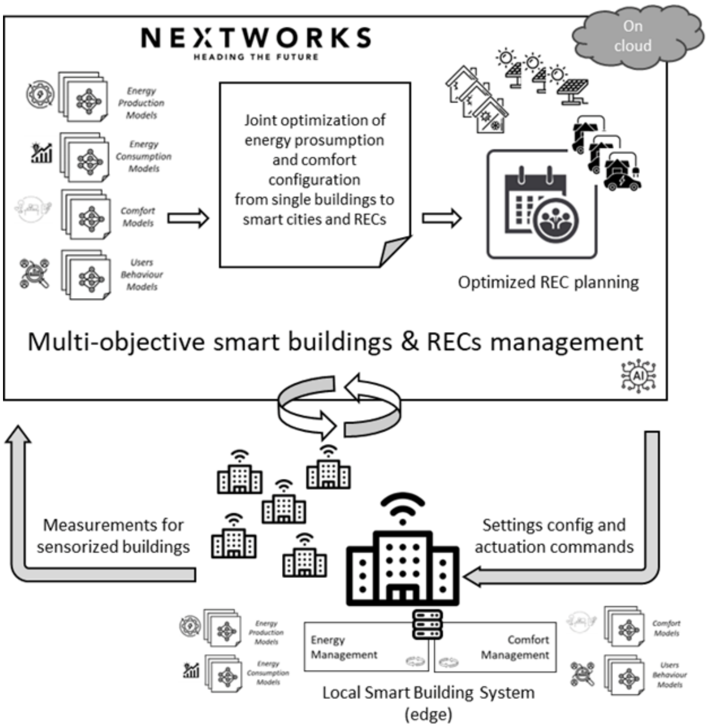
USE CASES IN THE ENERGY DOMAIN

Renewable Energy Communities

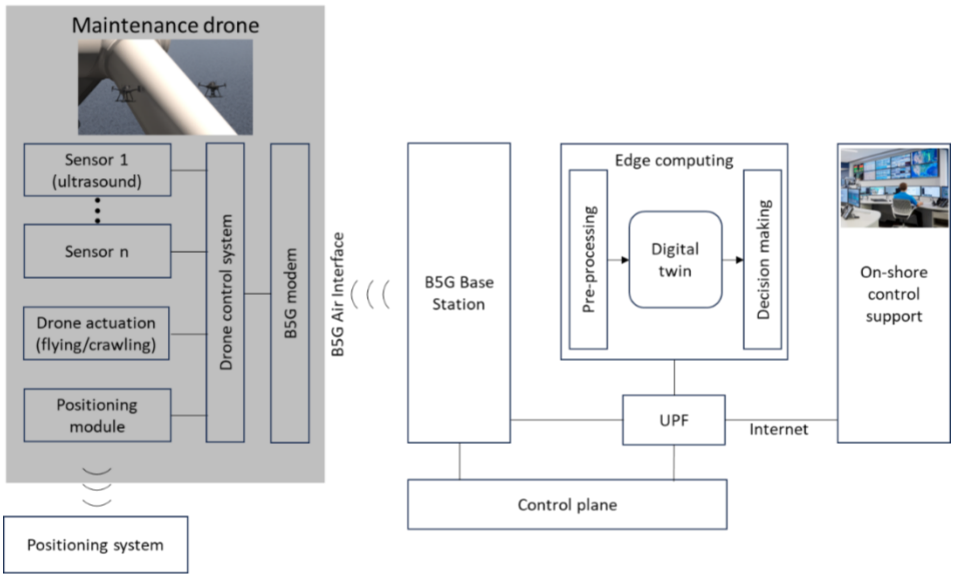
This use case focuses on improving the way energy is managed in smart buildings and renewable energy communities by using B5G/6G connectivity, IoT devices and AI models running at the edge or cloud. The system collects data from sensors measuring temperature, presence and energy consumption and combines it with user preferences to jointly optimize comfort and energy use. The aim is to control heating, cooling, ventilation, and lighting automatically across single buildings and, later, across groups of collaborative buildings. The communication layer relies on low-latency B5G/6G connectivity to ensure that data from sensors and actuators is received and processed quickly, while the application layer uses prediction models to estimate energy demand and adjust control strategies in real time.

During the first year of the project execution, the main software components of the Smart Building Energy Management System were designed and implemented, including the IoT data platform, the orchestration tools, the monitoring system, and the MLOps framework. These modules have been tested in the Nextworks laboratory and initial integration activities have started in the 5G ORO lab.

The IoT platform has been validated with environmental and power-consumption sensors, while the AI models for energy consumption prediction have been trained using public datasets and prepared for deployment through the MLOps platform. The current implementation supports a full single-building setup, which will be extended to Renewable Energy Community scenarios in the next phase. Next steps include deploying the system in the 5G ORO lab for preliminary testing in 2026 and preparing the extensions needed for multi-building REC optimization. In parallel, an Intent-Based GenAI framework for network slicing optimization and resource automation will be introduced by CAPG (Capgemini Engineering), enabling high-level intent translation, slice configuration, and QoS adaptation within the B5G infrastructure.

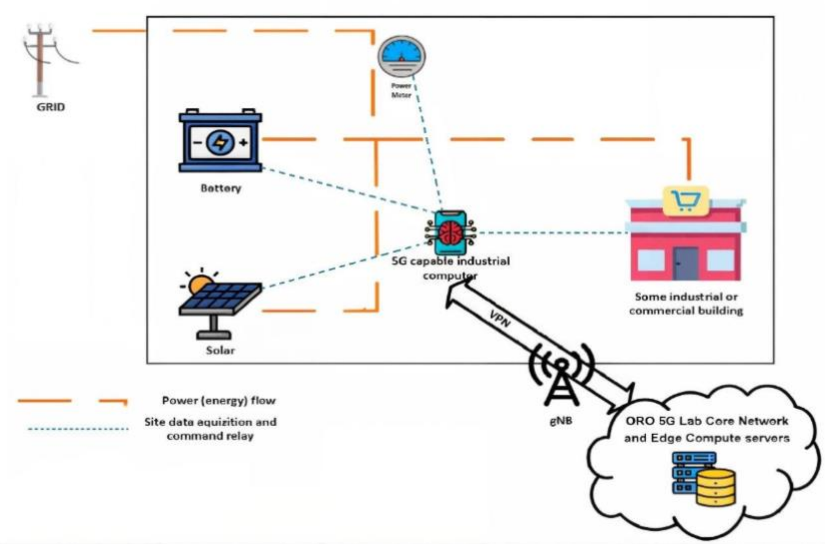


Robotized offshore wind turbine blade inspection and maintenance
This use case aims to demonstrate how B5G connectivity and edge computing can support automated inspection of offshore wind turbine blades using drones equipped with cameras, ultrasound and positioning sensors. The objective is to reduce the need for physical access to the turbine, lower operational risks and provide faster insight into blade condition. Data captured during drone flights is sent over the B5G network to an onshore digital-twin system, where it is processed in real time to detect structural issues. The scope includes a full B5G testbed, UAV integration, an edge-processing layer and network slicing features to ensure stable uplink transmission and low latency. In the first project year, the Zephyros Lab in Vlissingen has been prepared as the main integration site and equipped with a real turbine blade for testing. The Amarisoft small cell and spectrum license were secured, enabling deployment of the local B5G network. Initial tests have verified basic connectivity using the Quectel 5G module and early sensor evaluations have begun on the AIRTuB-ROMI drone. High-precision GNSS-RTK equipment has been prepared for hybrid localization, and the design of the network slicing configuration was completed. Preliminary trial plans were validated and KPIs covering uplink throughput, latency, service availability and localization accuracy were confirmed. Next steps include completing the network deployment, integrating the drones with the B5G radio link and preparing the system for preliminary trials in Q1–Q2 2026.



Solar energy monitoring, control and predictions using B5G/6G communications and edge-cloud
In this use case, we focus on creating a unified platform for real-time monitoring, control and forecasting of solar energy production using B5G/6G communication and edge–cloud technologies. The system connects photovoltaic inverters through an IoT gateway that reads field data over Modbus and forwards it securely to the cloud using MQTT. The cloud layer provides device management, visualization,

forecasting models and control features. This architecture supports the full chain of data collection, processing and optimization, enabling more accurate production forecasts, remote control of inverters and fast reaction to grid-related events. KPIs for latency, reliability and end-to-end data delivery have been defined to evaluate how well the system performs over 5G/6G networks. During the first year, the IoT edge gateway was developed and tested in the SIMTEL laboratory, successfully reading inverter data and executing remote control commands. A basic cloud backend was deployed to validate communication flows and supports continuous data ingestion. Integration work with RedCap-based 5G modules is ongoing, preparing the system for operation over the ORO 5G Lab testbed. A hardware version of the custom gateway is under development, and cloud features for storage, dashboards and analytics are being extended. ML components for solar forecasting are being prepared by CAPG, using data collected from the SIMTEL solar park. The technical enablers for intent-based operation, AI-as-a-Service and MLOps integration have been aligned with use case needs. Next steps include completing cloud features, finalizing 5G/RedCap integration and preparing the system for preliminary testing in the ORO 5G Lab in Q1–Q2 2026.



USE CASES IN THE TRANSPORT DOMAIN

Protection of Vulnerable Road Users

This use case aims to assist individuals with disabilities, such as visually impaired persons, during their urban journeys. The UC investigates how B5G/6G networks can support advanced applications for this scope, and which advanced B5G/6G network features can be exploited by application developers. It includes the experimentation of roadside infrastructure that is battery-powered and sourced with renewable energy.

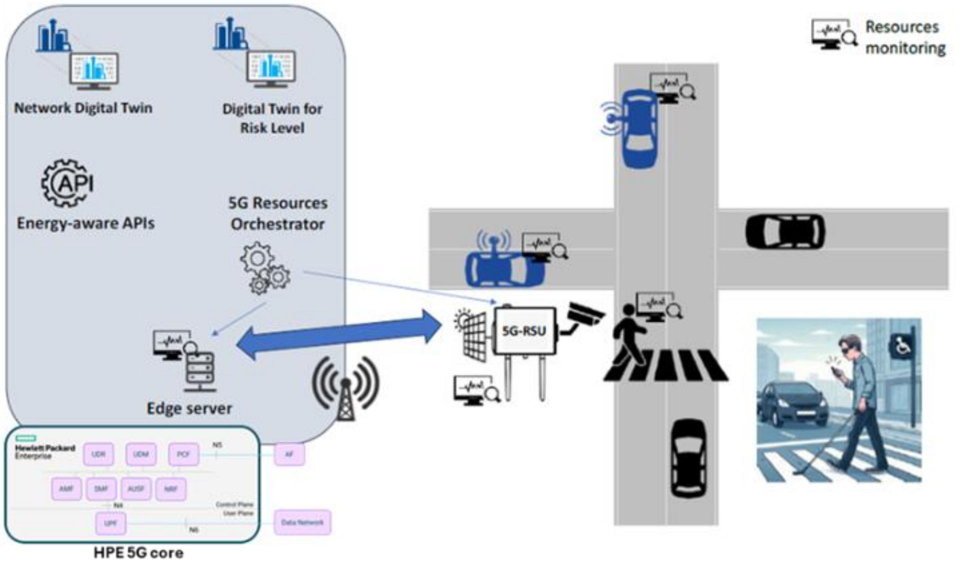
The focus of the experimentation is on a road intersection where a Road Side Unit (RSU) equipped with perception sensors, such as cameras and LiDARs, and B5G/6G connectivity is installed. The RSU monitors the intersection using its sensors, and the information from the sensors is used to detect vehicles, pedestrians, and other road users and to track their movements.

The perception information is complemented by data shared by connected vehicles and pedestrians. In particular, some vehicles can be equipped with an OnBoard Unit (OBU) and they can share their position, and potentially other available data, over the B5G/6G network. Pedestrians may also share their position through their smartphones using standard C-ITS messages via an app.

The information gathered from the road intersection is provided to a Digital Twin that resides on the edge server. The Digital Twin is responsible for estimating the risk level by leveraging all the collected data. The computed risk level is used to provide feedback to the visually impaired people to enhance their safety in dangerous situations, such as when crossing the road. A risk notification is sent via B5G/6G network to the smartphone, which alerts the user using vibrations or sounds.

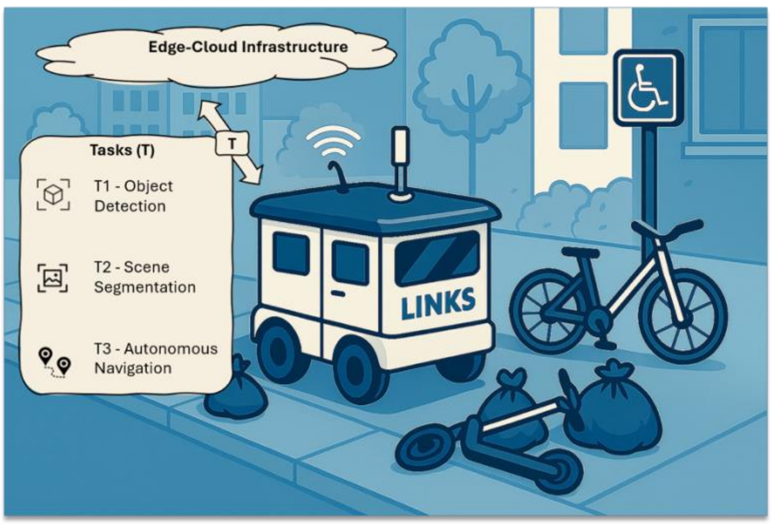
The RSU is powered by a solar panel, and it is equipped with a battery to prolong operating time. Some of the processing done by the RSU (e.g. detection and tracking) is based on AI algorithms that are computationally intensive. It is likely that the RSU will run out of power if intensive computation runs 24/7.

For this reason, orchestration solutions are implemented. To save energy at the RSU and keep it active, sensor data processing can be offloaded from the RSU to the edge server when needed. The orchestration automatically switches applications between the RSU and the edge server based on policies that take into account network, computing, and energy metrics that are continuously monitored. The orchestration preserves the application context when moving them in order to avoid information gaps. Moreover, the energy-aware information will be exposed through open and standard APIs, enabling optimal integration within the B5G/6G network.
The high-level architecture of the use case is shown in the figure below. On the right, there is depicted the road intersection with the relevant actors (i.e., RSU with sensors, vehicles, connected vehicles, pedestrians, visually impaired people). On the left, the core and the edge segments are shown. At the edge server, the main components of the UC are deployed: i) the orchestrator for network and computing resources, ii) the energy-aware APIs for collecting energy metrics, iii) the Network Digital Twin to provide the current status of network resources, iv) the Digital Twin for risk level estimation.



The coverage of the junction will be ensured by a dedicated private mmW network operating alongside the standard public 5G infrastructure. The experimentation will evaluate how to best combine the two networks, assessing their ability to work together seamlessly and identifying the respective strengths and limitations of each solution

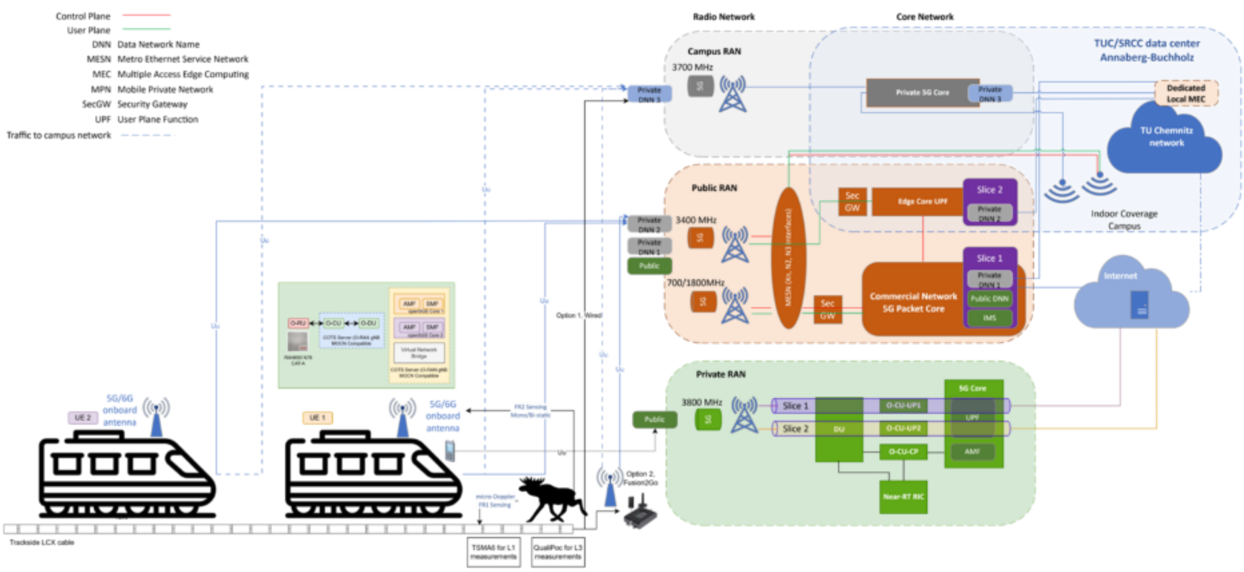
Enhancing Urban Safety with UGV Monitoring
The second use case of the transport domain targets urban areas where additional safety support is required, such as urban parks. The main actor of this UC is an Unmanned Ground Vehicle (UGV) that monitors the surrounding area and intervenes upon request of citizens. The UGV intervention can be requested using a dedicated app or by directly interacting with the UGV through a button.
The UGV includes perception sensors (e.g., cameras) to analyse the environment and to identify potentially illegal/suspicious activities. Scene recognition is used to verify the incident and to notify the responsible authorities.
The image detection and recognition are computationally intensive tasks, and they can significantly drain the UGV battery. To extend the operating time of the UGV, the TUC considers offloading tasks from the AGV to the edge server when feasible. Task migration is performed seamlessly by an orchestrator that considers energy and network metrics. The orchestrator needs also to manage network resource utilization as tasks related to sensor



processing are moved to the edge server. Therefore, additional uplink bandwidth for sensor data may be required to the UGV.
Moreover, the use case considers the need for a low-latency communication channel for teleoperation for cases in which the UGV must be tele-operated, for example, if the UGV is stuck in a position and manual guidance is needed.
The following figure depicts the high-level architecture of the use case. The UGV, with its sensors, monitors the target area. Applications are migrated between the AGV and the edge server to offload AGV workloads and extend battery life.

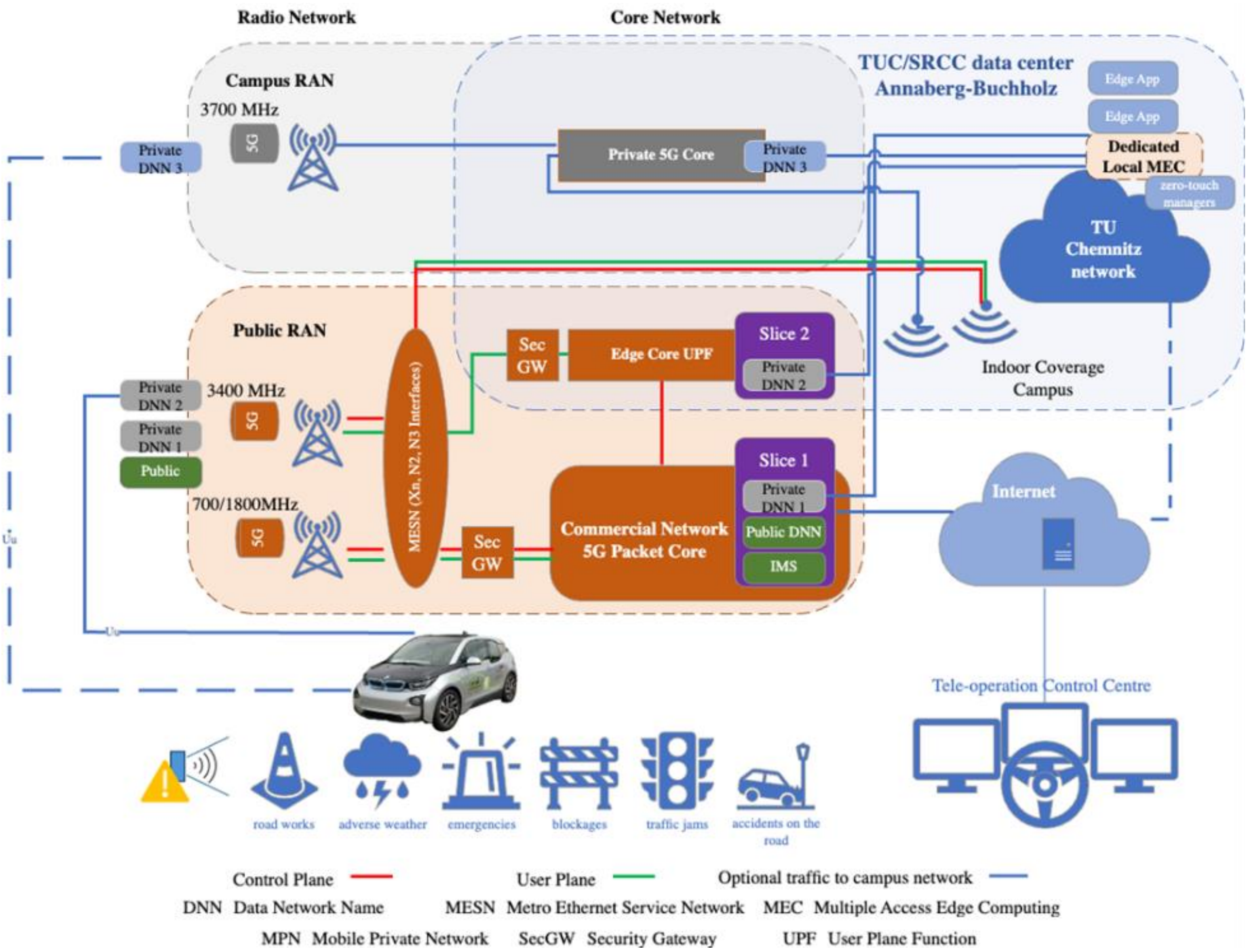
Also in this case, both a public and a private network will be used. While in the previous use case the focus was on their combined operation, here a comparative assessment will be carried out to evaluate the possibilities and limitations of each network individually, with the analysis tailored to the specific requirements of the use case.

Wireless signaling on rail tracks
This use case demonstrates how B5G/6G technologies can enhance railway signaling by complementing the operation of traditional hardwired infrastructure with advanced wireless communication and sensing capabilities. The objective is to ensure safe, reliable, and resilient train operations through real-time signaling and obstacle detection. The platform integrates multiple technological enablers, including Integrated Sensing and Communication (ISAC), network slicing, and point-to-point communication between trains, deployed within the TUC testbed infrastructure.
The system comprises two trains travelling one behind another on the same track. The front train is equipped with ISAC modules, enabling continuous monitoring of its own position, speed, and integrity. The train on the back maintains safe separation through redundant communication links, receiving signaling data via both the terrestrial B5G/6G network and a direct connection to the preceding train.
Track-side LCX cables support both communication and sensing functions by transmitting 5G signals and analyzing their reflections to detect train presence and track occupancy. The O-RAN units deployed along the line act as redundant access points, ensuring reliable connectivity in case of coverage variations.
The figure below depicts the high-level architectural view of the railway use case. The TUC network supports the railway communication and sensing functions, enhancing their operation with advanced capabilities.



Teleoperation as a backup to autonomous driving
The “teleoperation as a backup to autonomous driving” use case demonstrates how tele-operation can serve as a reliable backup when an autonomous vehicle encounters conditions where self-driving is no longer safe or effective (e.g. adverse weather, construction zones, or complex traffic). The concept relies on a B5G/6G-enabled communication platform that ensures seamless switching between autonomous and tele-operated modes, supported by real-time video streaming, V2X situational awareness, and distributed AI-based decision logic.

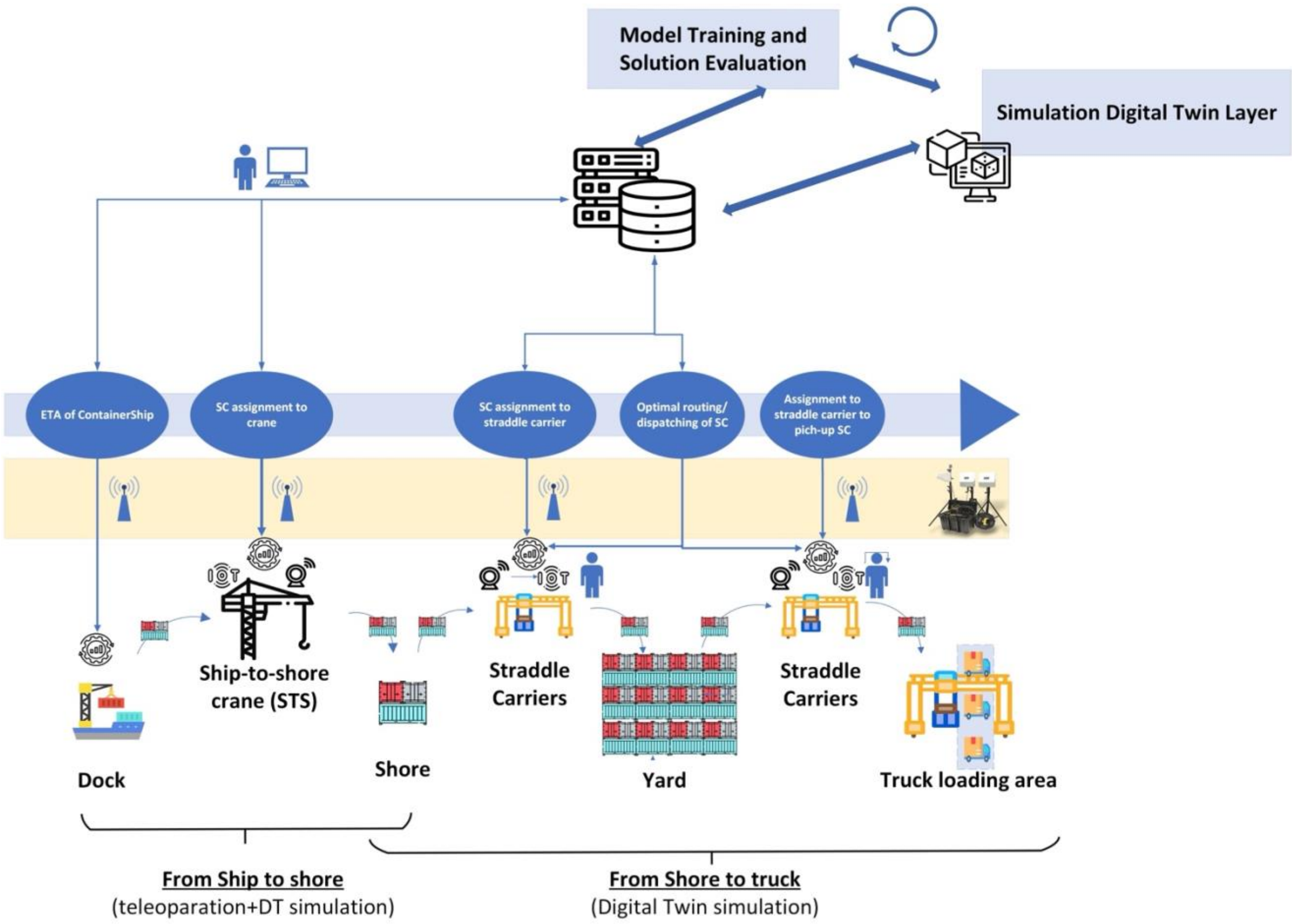
The tele-operation system integrates vehicle sensors, edge/cloud computing resources, and a remote-control center where a human operator can safely take control when needed. Communication between the vehicle and the operator is maintained via a low-latency 6G link supported by the TUC testbed, while additional context awareness is provided through V2X data fusion and AI-based event detection. The figure below depicts an architectural view of the use case:



Port logistics and transport operations optimization and safety

The use case of the Port of Thessaloniki in AMAZING-6G is focused on the operations occurring in its Container Terminal (ship-to-shore and shore-to-truck operations). Containers in ThPA S.A. are being handled 24 hours a day, 361 days a year at the designated area of the Container Terminal in the western part of Pier 6 (quay 26). It is part of the Free Zone and it extends in a 550m long and 340m wide area (352.000 m^2) with a storage capacity of 5,200 TEU in ground locations while it can serve vessels with a draught of up to 12 meters. The Container Terminal is fully equipped with modern container handling equipment while it features technical facilities and an experienced technical support team.

This use case aims to foster operational efficiency, safety, and human-machine interaction, by reducing potential disruption of operations and the environmental footprint of port logistics and transport operations. This is achieved by enabling real-time, massive twinning, by extending a Digital Twin platform developed for process monitoring and tele-operation. The platform will be tested in a pilot that covers an end-to-end port process, i.e., from vessel unloading to loading trucks.



PROJECT INFORMATION

For comprehensive information on the project's structure, consortium members, use cases, latest news, and contact details, please refer to the official project website. Additionally, deliverables, scientific publications, and other dissemination and communication materials can be accessed through the designated section of the website.

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