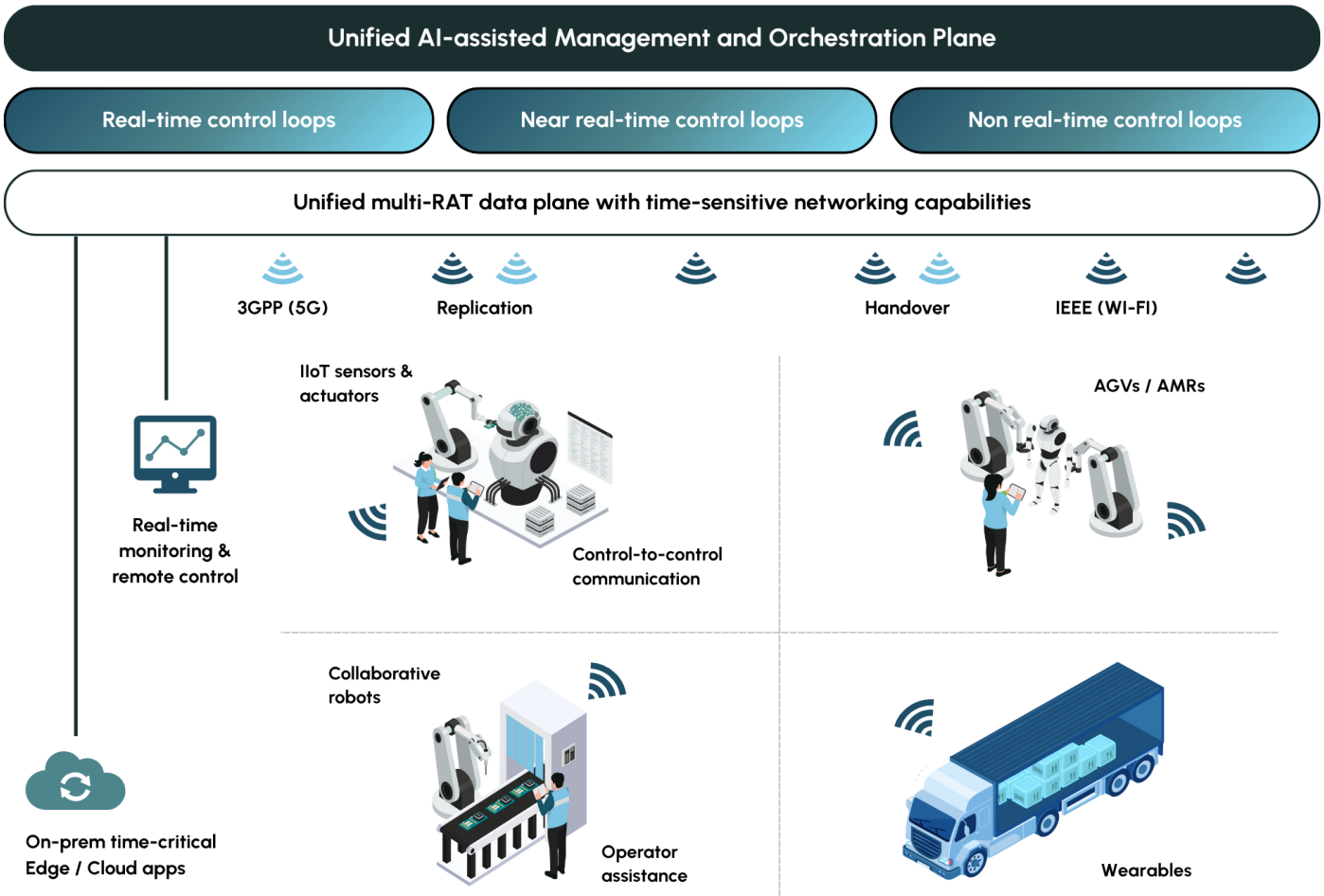
Multi-RAT O-RAN enabled NPN for supporting time sensitive application for Industry 4.0

Use Case 4



UNITY-6G's "Multi-RAT O-RAN enabled NPN for supporting time sensitive application for Industry 4.0" use case is designed addresses the critical need for deterministic, low-latency, and highly reliable communication in automated industrial environments. While current industrial applications often rely on wired Time-Sensitive Networking (TSN), this use case focuses on extending TSN capabilities wirelessly to enhance flexibility and support mobility.

The core of this use case involves deploying 6G Non-Public Networks (NPNs) that incorporate multi-Radio Access Technologies (multi-RAT), specifically combining cellular and Wi-Fi technologies. The novelty lies in establishing a unified AI-assisted management and orchestration plane that leverages the Open Radio Access Network (O-RAN) framework. This framework, already standardized for 5G, is extended to manage and control both cellular and Wi-Fi network domains seamlessly, providing a unified control plane. The architecture supports various control loops: real-time, near real-time, and non-real-time, enabling precise and dynamic optimization of the network. This unified multi-RAT data plane is designed with time-sensitive networking capabilities to meet the stringent requirements of Industry 4.0 applications. The NPN will support a diverse range of time-sensitive applications, including:

- Real-time monitoring and remote control of industrial machinery and processes.
- Control-to-control communication between various automated systems.
- Operator assistance and interactions with industrial equipment.
- Collaborative robots requiring precise synchronization and low-latency communication.
- Interactions with IIoT sensors and actuators for data collection and control.
- Management and coordination of Automated Guided Vehicles (AGVs) and Autonomous Mobile Robots (AMRs).
- Integration with wearables for worker safety and efficiency.
- On-premise time-critical Edge/Cloud applications.

Key objectives include developing novel TSN features in both wireless and wired domains, with TSN-based xHaul between O-RAN components and the core network. The system will expose a rich set of monitoring data and control knobs for both cellular and IEEE 802.11 domains to real-time (dApps), near real-time (xApps), and non-real-time (rApps) applications running on

respective Radio Intelligent Controllers (RICs). This allows for dynamic adjustments to network parameters, such as MCS index selection, EDCA parameters, time-aware scheduling, and time synchronization, based on real-time data input. This use case aims to demonstrate the first multi-RAT 6G NPN managed in a unified way through the O-RAN architecture, offering enhanced reliability, low latency, and deterministic communication essential for the evolving landscape of Industry 4.0.

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