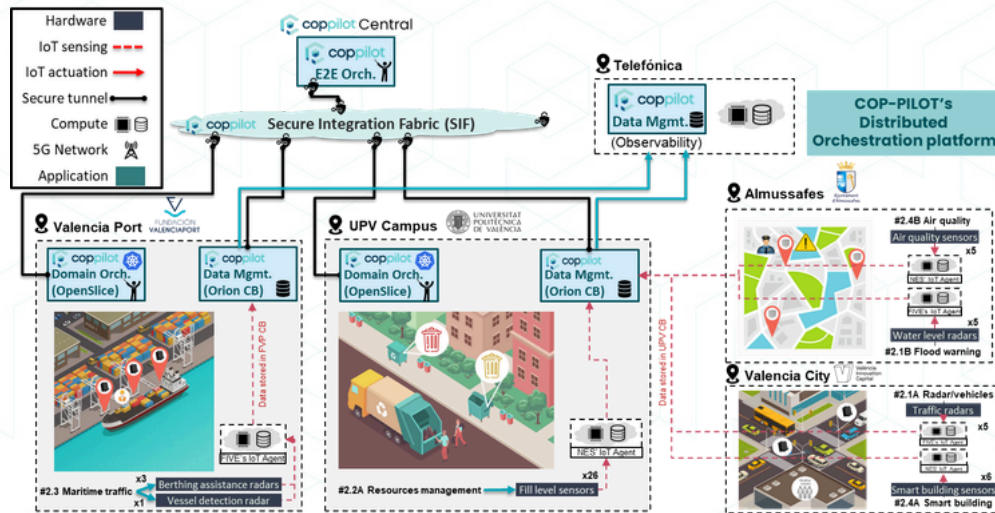


Cluster 2: Smart Sustainable IoT Solutions in Valencia

Use Case Overview Diagram



Ambition, Mission and Objectives

- Enable interoperable, secure IoT integration across urban, port, industrial, and campus environments to support real-time monitoring, analytics, and data-driven decision-making.
- Validate scalable smart city and smart building solutions through large-scale pilots addressing mobility, flooding, environmental quality, waste management, and infrastructure efficiency.
- Transition from fragmented, siloed urban systems to reusable, market-ready architectures that improve sustainability, operational efficiency, safety, and quality of life for citizens and stakeholders.

Description

Smart Buildings/Cities deploys and validates sustainable IoT solutions across urban, industrial, campus, and port environments in Valencia. Using real-life testbeds such as the City and Port of Valencia, Almussafes Industrial Park, and the UPV Smart Campus, the cluster integrates diverse IoT devices and platforms across an IoT-edge-cloud continuum. This enables real-time monitoring, AI-driven analytics, and interoperable data exchange to improve mobility, safety, resource efficiency, and environmental sustainability in complex operational settings.

Pathway to Execution

Execution requires close alignment between business priorities and technical delivery. Use cases are guided by measurable outcomes such as mobility, safety, sustainability, and cost efficiency, aligned with municipal strategies. Technically, interoperable platforms and distributed edge-cloud architectures enable scalable and secure deployment. Ongoing coordination between public authorities and technology providers ensures solutions are replicable and ready for wider adoption.

UC 2.1A



The site plan of the University of Coimbra campus is a complex diagram showing the layout of various buildings, green spaces, and infrastructure. The plan is color-coded and includes numerous labels for different areas and facilities. Key features include a large central green area, several parking lots, and various academic and administrative buildings. The plan is oriented with North at the top.

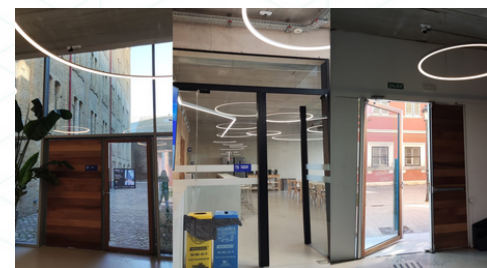
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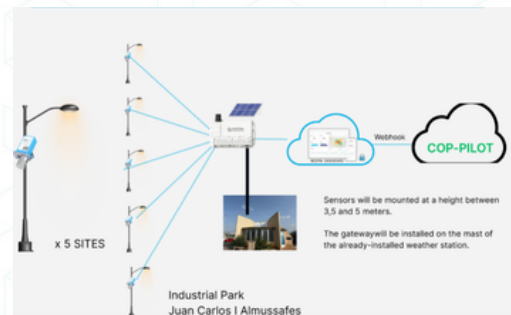
UC 2.3



UC 2.4A



UC 2.4B



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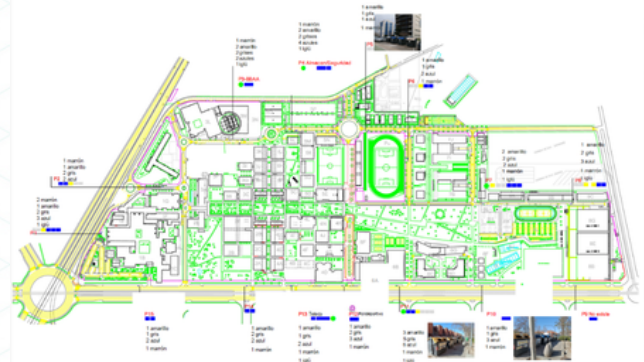
Cluster 2 Use Case Summary

UC 2.1A



UC 2.1A uses radar-based vehicle classification with real-time AI analytics to improve traffic management, road safety, and urban mobility efficiency.

UC 2.2



The use case establishes a smart, data-driven waste management system at UPV using fill-level sensors and IoT platforms to enable real-time monitoring, improve environmental assessment, and support informed.

UC 2.3



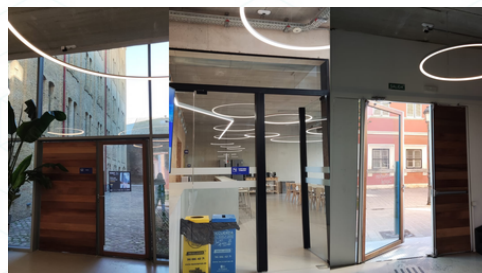
Use case 2.3 uses radar-based tracking to deliver precise, real-time vessel positioning and orientation, improving port safety and efficiency.

UC 2.1B



This use case monitors water-level through NB-IoT connected radars for flood monitoring

UC 2.4A



This use case turns La Harinera into a smart building using IoT sensors for real-time monitoring of occupancy, comfort, and energy use.

UC 2.4B



Through this use case a LoRaWAN network is used to monitor formaldehyde levels in real time, enabling alerts, emergency response, and improved industrial safety.

5G – Connected Radars For Traffic Classification and Vehicle Counting



Description

This use case addresses current limitations in traffic monitoring by introducing radar-based vehicle classification to identify cars, two-wheelers, and trucks entering Valencia. Integrated into the VLCi platform and connected via 5G, the solution enables real-time data collection, AI-driven analytics, and continuous optimisation. It supports data-driven traffic management, urban planning, emergency response, and sustainability goals, while reducing congestion, improving road safety, and enhancing overall urban mobility efficiency.

Functional Requirements

The functional requirements focus on enabling real-time, radar-based vehicle detection and classification across key entry points in Valencia. The system must support secure 5G data transmission, processing for vehicle type, speed, and direction, and seamless integration with the VLCi and COP-PILOT platforms. It should enable scalable deployment, continuous monitoring, automated reporting, and adaptive optimisation to support traffic management, emergency response, and cross-domain urban analytics.

Market Business Requirements

The market requirements emphasise improved urban mobility outcomes through data-driven decision-making. By providing accurate vehicle classification and real-time traffic insights, the solution reduces congestion, enhances road safety, improves public transport efficiency, and supports environmental sustainability. It enables authorities to optimise infrastructure planning and policies, lowers operational inefficiencies, and delivers long-term economic, social, and environmental value for the city.

Flood warning and mitigation system through radar sensing



Description

This use case intends to implement a flood warning system throughout the deployment of connected radar units WIOTRAD at vulnerable locations of Almussafes and the Industrial Park. The radars will constantly monitor the water level at the sensed locations and report when it surpasses the pre-defined thresholds. By mapping the water levels at the different locations, the evolution of the flood can be tracked, and decisions can be made in real time, for example, regarding evacuation of personnel.

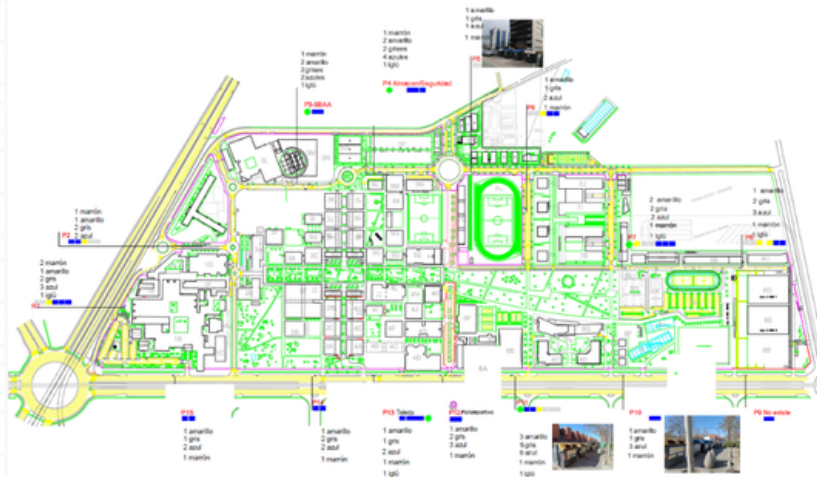
Functional Requirements

The use case's functional requirements revolve around measurement accuracy and solution reliability due to the extremely important safety implications that the sensors' measurements have. Moreover, the solution must implement an effective strategy to decide sensing and transmission frequency balancing reporting granularity and battery life. Additionally, an adequate alert system must be set in place.

Market Business Requirements

The business requirements focus on providing a solution to improve effectiveness when dealing with a flood event. While the solution must be accompanied with other measurements such as adequate prevention, having a real-time monitoring tool for the water level at key locations allows to better coordinate a response and distribute efforts to prevent human and material losses.

Smart Resources Management in The UPV Campus



Description

This use case aims to establish a smart, data-driven waste management system at the Universitat Politècnica de València (UPV). By deploying fill-level sensors across general waste containers and integrating data into centralized IoT and COP-PILOT platforms, UPV can move from estimated to real-time, accurate monitoring of waste generation. The solution enables continuous visibility, improved environmental impact assessment, and informed decision-making across campus operations.

Functional Requirements

The system must support real-time fill-level sensing, secure data transmission, and integration with Nespra's IoT platform, Thinking Cities, and COP-PILOT. It should enable centralized monitoring, data validation, analytics, visualization dashboards, and reporting. The platform must support scalable deployment, carbon footprint assessment, and data-driven optimisation of container distribution, collection frequency, and routes across a multi-year implementation roadmap.

Market Business Requirements

The business requirements focus on improving operational efficiency and sustainability in campus waste management. Accurate data reduces reliance on external estimates, optimises collection logistics, lowers operational costs, and decreases environmental impact. The solution supports regulatory reporting, sustainability targets, and long-term planning, delivering measurable economic and environmental value while positioning UPV as a leader in smart, sustainable campus management.

Maritime Traffic Monitoring and Berthing Assistance



Description

This use case addresses the growing complexity of vessel traffic management in the Port of Valencia, driven by the arrival of larger container ships. Existing GPS and AIS systems lack the precision needed to determine vessel orientation and occupied space during critical maneuvers. By deploying radars at port entrances and docks and integrating them with existing platforms, the solution enables accurate, real-time tracking of vessel position, direction, and proximity to port infrastructure, improving safety and operational efficiency.

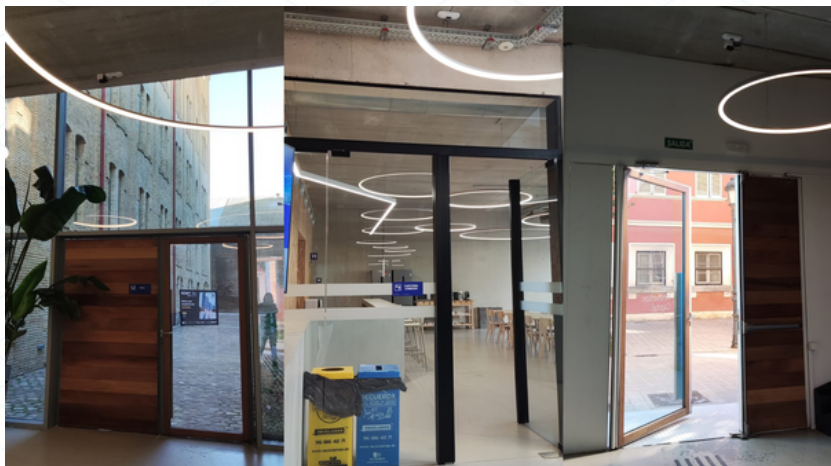
Functional Requirements

The system must support radar-based real-time vessel detection, correlation with AIS data, and precise tracking of vessel position, orientation, and dock proximity. It should integrate with port data sources, TID's platform, and terminal operating systems (TOS), providing visualization, alerts, and KPI monitoring. The solution must ensure low latency, high accuracy, continuous availability, and interoperability across multiple stakeholders and port systems.

Market Business Requirements

The business requirements focus on enhancing port safety, efficiency, and profitability. Improved tracking reduces accident risk, optimizes docking and turnaround times, and supports better resource coordination among port operators, terminals, and shipping companies. By lowering operational delays and infrastructure damage, the solution reduces costs, increases throughput, and strengthens the Port of Valencia's competitiveness as a high-capacity, smart maritime hub.

IoT-Driven Smart Building Management



Description

This use case focuses on transforming La Harinera, a multipurpose public building managed by the City Council of València, into a smart, data-driven facility. By integrating existing BMS-connected IoT nodes with a cloud platform and deploying new sensors where needed, the solution enables real-time visibility into occupancy, comfort, and energy usage. It replaces estimation-based management with objective data to improve operational efficiency, user comfort, and sustainability.

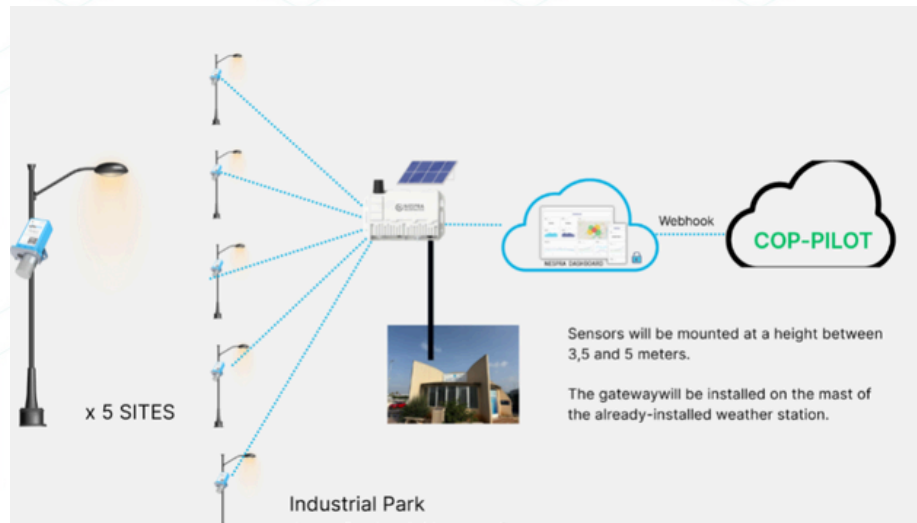
Functional Requirements

The system must support hybrid IoT integration, combining legacy BMS data with newly deployed sensors using LoRaWAN and NB-IoT connectivity. It should enable real-time data collection, edge and cloud processing, secure data transmission, centralized dashboards, and interoperability with COP-PILOT and other urban platforms. The solution must support monitoring, automation, remote control, analytics, and scalability across multiple municipal buildings.

Market Business Requirements

The business requirements emphasize improved energy efficiency, reduced operational costs, and enhanced user experience in public buildings. Real-time insights enable proactive facility management, better space utilization, and evidence-based sustainability strategies. The solution delivers long-term value by reducing manual interventions, supporting climate objectives, and establishing a scalable smart-building model that can be replicated across Valencia's municipal infrastructure.

IoT-Based Environmental Quality Monitoring System



Description

This use case deploys a LoRaWAN-based environmental monitoring network in the Juan Carlos I Industrial Park (Almussafes) to track formaldehyde (HCHO) levels in real time. Five outdoor sensors and a solar-powered gateway feed measurements into Nespra's IoT platform, which integrates with CO-PILOT to support transparent monitoring, rapid alerts, and coordinated emergency response. The solution strengthens industrial safety, reduces health risks, and improves trust across operators, companies, and public authorities.

Functional Requirements

The system must continuously measure and transmit formaldehyde concentrations via LoRaWAN, using a reliable outdoor gateway and secure connectivity to Nespra's IoT platform and CO-PILOT. It should provide configurable alerting (email/SMS) for threshold breaches, low battery, and device disconnections, alongside dashboards, logging, and data storage for analysis. The architecture must ensure high uptime, low latency for critical alerts, secure authentication and encryption, and scalability to add sensors or expand coverage.

Market Business Requirements

The business requirements focus on improving industrial risk management and compliance through continuous, auditable air-quality surveillance. Real-time detection and alerting reduce incident response time, support evacuation and operational continuity, and lower the likelihood and cost of safety events. Transparent reporting strengthens stakeholder confidence, enables proactive environmental governance, and creates a scalable monitoring model that can be replicated across industrial zones to meet safety and sustainability objectives.

Use Case 2.1A

5G – Connected Radars For Traffic Classification and Vehicle Counting



Description

This use case addresses current limitations in traffic monitoring by introducing radar-based vehicle classification to identify cars, two-wheelers, and trucks entering Valencia. Integrated into the VLCi platform and connected via 5G, the solution enables real-time data collection, AI-driven analytics, and continuous optimisation. It supports data-driven traffic management, urban planning, emergency response, and sustainability goals, while reducing congestion, improving road safety, and enhancing overall urban mobility efficiency.

Instantiation of Use Case

Use Case 2.1A provides an insight into real-time traffic status within the city of Valencia through deployed 5G-capable radars in conjunction with open data coming for 3rd-party sensors. The radars can collect statistics on detected vehicles and monitor the fluency of the analyzed street. The usage of additional input sources allows to increase the reliability of the measurements and complete a clearer picture of the traffic. The information collected by the radars is transmitted to the COP-PILOT platform where sensor aggregation is managed to obtain the final assessment of the traffic status.

Functional Requirements

The use case's functional requirements revolve around measurement accuracy and solution reliability due to the extremely important safety implications that the sensors' measurements have. Moreover, the solution must implement an effective strategy to decide sensing and transmission frequency balancing reporting granularity and battery life. Additionally, an adequate alert system must be set in place.

The real benefit in the use case

COP-PILOT gives an opportunity to move from a pure visualization system to be able to easily automate the execution of actions based on the available information. It additionally simplifies the unification of multiple inputs in a scalable manner, providing a unifying management platform. The platform allows us to combine sensors for improved accuracy. Upon detection of events such as traffic jams, re-routing applications can be launched. Additionally, traffic statistics can be made readily available to decision personnel to improve urban planning.

Market Business Requirements

The market requirements emphasise improved urban mobility outcomes through data-driven decision-making. By providing accurate vehicle classification and real-time traffic insights, the solution reduces congestion, enhances road safety, improves public transport efficiency, and supports environmental sustainability. It enables authorities to optimise infrastructure planning and policies, lowers operational inefficiencies, and delivers long-term economic, social, and environmental value for the city.



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Use Case 2.1B

Flood warning and mitigation system through radar sensing



Description

This use case intends to implement a flood warning system throughout the deployment of connected radar units WIOTRAD at vulnerable locations of Almussafes and the Industrial Park. The radars will constantly monitor the water level at the sensed locations and report when it surpasses the pre-defined thresholds. By mapping the water levels at the different locations, the evolution of the flood can be tracked, and decisions can be made in real time, for example, regarding evacuation of personnel.

Functional Requirements

The use case's functional requirements revolve around measurement accuracy and solution reliability due to the extremely important safety implications that the sensors' measurements have. Moreover, the solution must implement an effective strategy to decide sensing and transmission frequency balancing reporting granularity and battery life. Additionally, an adequate alert system must be set in place.

Market Business Requirements

The business requirements focus on providing a solution to improve effectiveness when dealing with a flood event. While the solution must be accompanied with other measurements such as adequate prevention, having a real-time monitoring tool for the water level at key locations allows to better coordinate a response and distribute efforts to prevent human and material losses.

Instantiation of Use Case

Use Case 2.1B deals with flood warning and mitigation based on radar sensing. The deployed water level radars periodically measure their floor level and send the information to the platform, where through processing it must be determined if a flood event is occurring and trigger actions in consequence, by discriminating detected levels and possible false positive measurements due to environmental conditions. Additional sources of information will complement the measurements, such as weather reports or meteorological stations' available inputs.

The real benefit in the use case

For critical applications such as the one solved by this use case, a platform that allows to unify multiple inputs and manage the devices in an automated way can lead to reducing decision times and more efficient response to emergencies. The deployment of water level radars in such a dynamic environment as an industrial park benefits from joining multiple sources of information for increased accuracy as well as optimizing report times without compromising battery life of the devices.



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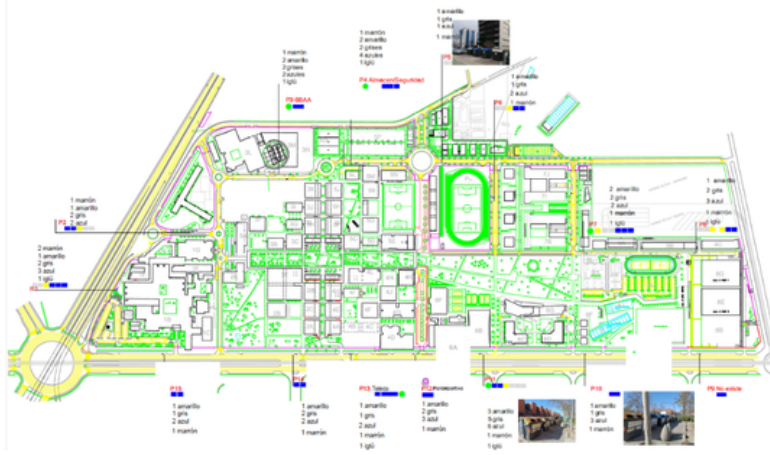
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Use Case 2.2

Smart Resources Management in The UPV Campus



Description

This use case aims to establish a smart, data-driven waste management system at the Universitat Politècnica de València (UPV). By deploying fill-level sensors across general waste containers and integrating data into centralized IoT and COP-PILOT platforms, UPV can move from estimated to real-time, accurate monitoring of waste generation. The solution enables continuous visibility, improved environmental impact assessment, and informed decision-making across campus operations.

Functional Requirements

The system must support real-time fill-level sensing, secure data transmission, and integration with Nespra's IoT platform, Thinking Cities, and COP-PILOT. It should enable centralized monitoring, data validation, analytics, visualization dashboards, and reporting. The platform must support scalable deployment, carbon footprint assessment, and data-driven optimisation of container distribution, collection frequency, and routes across a multi-year implementation roadmap.

Market Business Requirements

The business requirements focus on improving operational efficiency and sustainability in campus waste management. Accurate data reduces reliance on external estimates, optimises collection logistics, lowers operational costs, and decreases environmental impact. The solution supports regulatory reporting, sustainability targets, and long-term planning, delivering measurable economic and environmental value while positioning UPV as a leader in smart, sustainable campus management.

Instantiation of Use Case

Use Case 2.2 focuses on resource management within the UPV Campus, utilizing twenty-six NB-IoT-enabled fill-level sensors. These devices transmit real-time telemetry through the NES IoT Agent to the COP-PILOT Orion Data Management component. Overseen by the domain orchestrator, the system manages local data storage and software deployments. The main goal is to monitor and control waste collection and container filling levels, ensuring efficient campus-wide operations through secure, automated IoT sensing pathways and centralized supervision.

The real benefit in the use case

The COP-PILOT system provides a scalable foundation for automating UC2.2, significantly reducing manual oversight. By utilizing the domain orchestrator, it allows for the seamless, automated deployment of software components and the easy integration of diverse information sources. Whether using NB-IoT devices or other hardware types, the system simplifies adding new sensors. All data is unified through a centralized management system using the NGSI-LD protocol, ensuring interoperability. This modularity allows for expansion to other campus areas, different container types, or even city-wide applications.



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Use Case 2.3

Maritime Traffic Monitoring and Berthing Assistance



Description

This use case addresses the growing complexity of vessel traffic management in the Port of Valencia, driven by the arrival of larger container ships. Existing GPS and AIS systems lack the precision needed to determine vessel orientation and occupied space during critical maneuvers. By deploying radars at port entrances and docks and integrating them with existing platforms, the solution enables accurate, real-time tracking of vessel position, direction, and proximity to port infrastructure, improving safety and operational efficiency.

Functional Requirements

The system must support radar-based real-time vessel detection, correlation with AIS data, and precise tracking of vessel position, orientation, and dock proximity. It should integrate with port data sources, TID's platform, and terminal operating systems (TOS), providing visualization, alerts, and KPI monitoring. The solution must ensure low latency, high accuracy, continuous availability, and interoperability across multiple stakeholders and port systems.

Market Business Requirements

The business requirements focus on enhancing port safety, efficiency, and profitability. Improved tracking reduces accident risk, optimizes docking and turnaround times, and supports better resource coordination among port operators, terminals, and shipping companies. By lowering operational delays and infrastructure damage, the solution reduces costs, increases throughput, and strengthens the Port of Valencia's competitiveness as a high-capacity, smart maritime hub.

Instantiation of Use Case

Use Case 2.3 aims to manage the monitoring of maritime traffic in the port of Valencia through the installation of multiple radars which will detect incoming ships and provide berthing assistance in the targeted dock. Triggered by the detection of a ship entering the interest area, a slice will be activated providing docking assistance radars with the required connectivity to report continuous measurements. The radars will report to the platform, where the information provided by other monitoring sources will be integrated.

The real benefit in the use case

COP-PILOT will provide the use case with a platform where actions triggered by the detection of an incoming ship can be easily automated, and multiple sources of information can be combined to improve the day-to-day operations of the port. Moreover, the possibilities of integration with other use cases to evaluate the impact of maritime traffic on the city's mobility and occupancy offer exciting opportunities.



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Use Case 2.4A

IoT-Driven Smart Building Management



Description

This use case focuses on transforming La Harinera, a multipurpose public building managed by the City Council of València, into a smart, data-driven facility. By integrating existing BMS-connected IoT nodes with a cloud platform and deploying new sensors where needed, the solution enables real-time visibility into occupancy, comfort, and energy usage. It replaces estimation-based management with objective data to improve operational efficiency, user comfort, and sustainability.

Functional Requirements

The system must continuously measure and transmit formaldehyde concentrations via LoRaWAN, using a reliable outdoor gateway and secure connectivity to Nespra's IoT platform and CO-PILOT. It should provide configurable alerting (email/SMS) for threshold breaches, low battery, and device disconnections, alongside dashboards, logging, and data storage for analysis. The architecture must ensure high uptime, low latency for critical alerts, secure authentication and encryption, and scalability to add sensors or expand coverage.

Market Business Requirements

The business requirements emphasize improved energy efficiency, reduced operational costs, and enhanced user experience in public buildings. Real-time insights enable proactive facility management, better space utilization, and evidence-based sustainability strategies. The solution delivers long-term value by reducing manual interventions, supporting climate objectives, and establishing a scalable smart-building model that can be replicated across Valencia's municipal infrastructure.

Instantiation of Use Case

Use Case 2.4A implements automated capacity tracking across city facilities by deploying advanced people-counting sensors. These units capture and stream occupancy data through specialized IoT agents directly into the COP-PILOT Orion Context Broker. Orchestrated by the domain layer, the architecture facilitates localized data processing and software updates. This setup ensures precise monitoring of building density and room usage, providing a centralized framework for managing campus-wide space allocation through secure and automated digital workflows.

The real benefit in the use case

Leveraging the COP-PILOT platform transforms raw occupancy metrics into actionable insights, removing the reliance on manual headcounts. The system's domain orchestrator simplifies the integration of new sensing hardware and the deployment of analytical tools. By standardizing data via the NGSI-LD protocol, the solution ensures full interoperability with smart building management systems. This modular approach allows for seamless scaling to larger venues, enhancing both operational efficiency and safety protocols across the entire city infrastructure.



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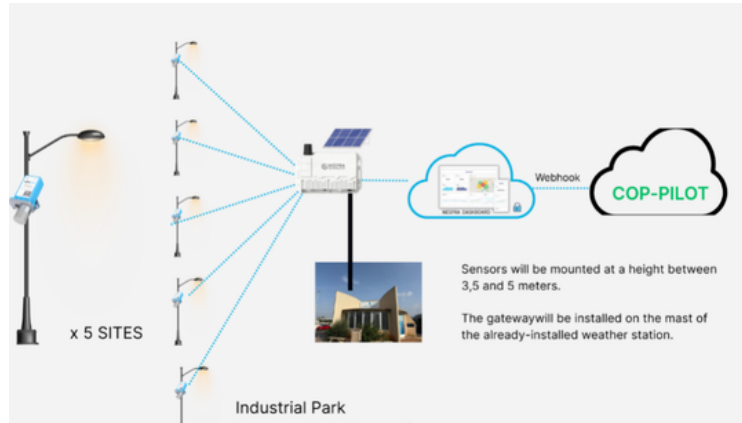
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Use Case 2.4B

IoT-Based Environmental Quality Monitoring System



Description

This use case deploys a LoRaWAN-based environmental monitoring network in the Juan Carlos I Industrial Park (Almussafes) to track formaldehyde (HCHO) levels in real time. Five outdoor sensors and a solar-powered gateway feed measurements into Nespra's IoT platform, which integrates with CO-PILOT to support transparent monitoring, rapid alerts, and coordinated emergency response. The solution strengthens industrial safety, reduces health risks, and improves trust across operators, companies, and public authorities.

Instantiation of Use Case

Within the Almussafes Industrial Park, Use Case 2.4b deploys a network of five LoRaWAN sensors designed for real-time formaldehyde detection. These environmental monitors push concentration data through a dedicated IoT gateway into the COP-PILOT Orion management component. Under the supervision of the domain orchestrator, the infrastructure handles complex data streams and automated software triggers. This deployment focuses on safeguarding industrial environments by establishing a robust, automated pipeline for chemical monitoring and high-level oversight through centralized data management.

Functional Requirements

The system must continuously measure and transmit formaldehyde concentrations via LoRaWAN, using a reliable outdoor gateway and secure connectivity to Nespra's IoT platform and CO-PILOT. It should provide configurable alerting (email/SMS) for threshold breaches, low battery, and device disconnections, alongside dashboards, logging, and data storage for analysis. The architecture must ensure high uptime, low latency for critical alerts, secure authentication and encryption, and scalability to add sensors or expand coverage.

The real benefit in the use case

The COP-PILOT framework enhances industrial safety in Almussafes by providing a highly responsive system for air quality control. Its domain orchestrator facilitates the rapid deployment of monitoring modules, making it easier to incorporate diverse chemical probes. By unifying all environmental telemetry through the NGSI-LD standard, the platform ensures that data remains accessible and consistent. This architecture not only streamlines current monitoring tasks but also offers a future-proof model for expanding pollutant detection across broader industrial clusters.

Market Business Requirements

The business requirements focus on improving industrial risk management and compliance through continuous, auditable air-quality surveillance. Real-time detection and alerting reduce incident response time, support evacuation and operational continuity, and lower the likelihood and cost of safety events. Transparent reporting strengthens stakeholder confidence, enables proactive environmental governance, and creates a scalable monitoring model that can be replicated across industrial zones to meet safety and sustainability objectives.



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