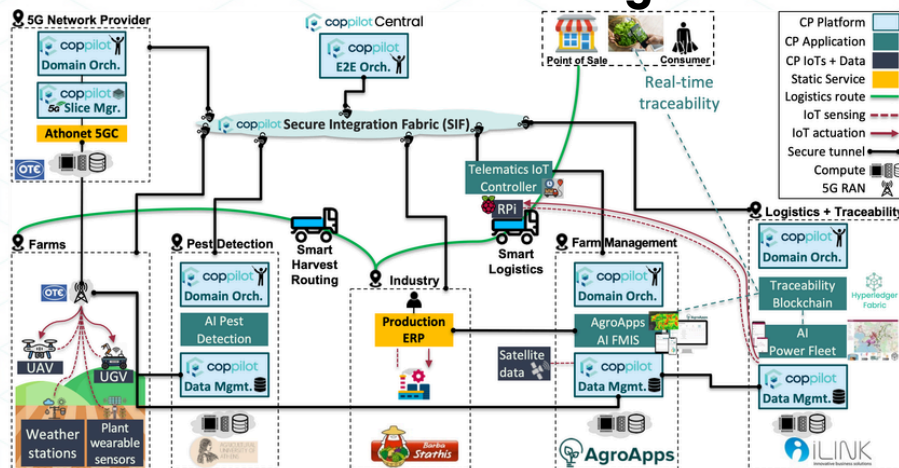


Use Case Overview Diagram



Ambition, Mission and Objectives

- Enable interoperable, data-driven open-field agriculture by integrating IoT sensing, robotic and aerial platforms, satellite Earth Observation, and digital farm management services over resilient connectivity.
- Enhance agricultural monitoring and decision-making through continuous field data collection, automated scouting, and AI-assisted analytics supporting precision operations.
- Advance sustainable and transparent farming practices by reducing resource inefficiencies and strengthening data traceability and compliance readiness across farm operations.

Description

AgriTech Transformation & Sustainability Initiative (ATSI) addresses the need to modernise European agriculture by integrating digital technologies that enhance productivity, sustainability, and resilience. Focused on leafy vegetable production, the cluster deploys interoperable IoT, edge computing, robotics, and data platforms to enable real-time crop monitoring, precision interventions, and traceable farm-to-fork logistics. Operating within EU Green Deal and CAP objectives, ATSI demonstrates how data-driven agriculture can reduce environmental impact, improve food quality, and strengthen competitiveness across the agri-food value chain.

Pathway to Execution

Execution relies on synchronising agronomic priorities, business value, and technical orchestration. Business alignment is achieved by anchoring use cases to measurable outcomes, input reduction, timely interventions yield and quality improvement, and traceability, aligned with EU sustainability and market expectations. Technically, execution depends on interoperable architectures that integrate IoT sensors, UAVs, UGVs, FMIS platforms, and blockchain through edge-native orchestration. Continuous coordination between farmers, agronomists, technology providers, and logistics actors ensures that real-time insights translate into timely interventions, scalable deployment, and replicable digital agriculture models across regions and crops.

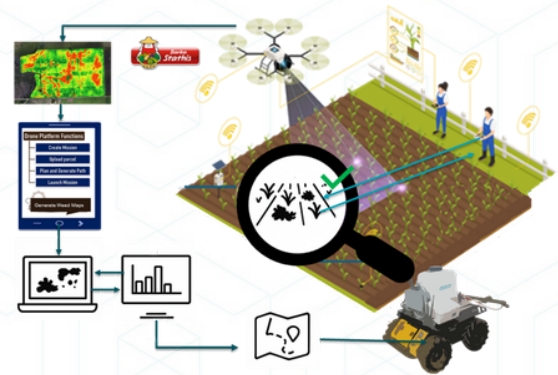
Cluster 3A Use Case Summary

UC 3A.1



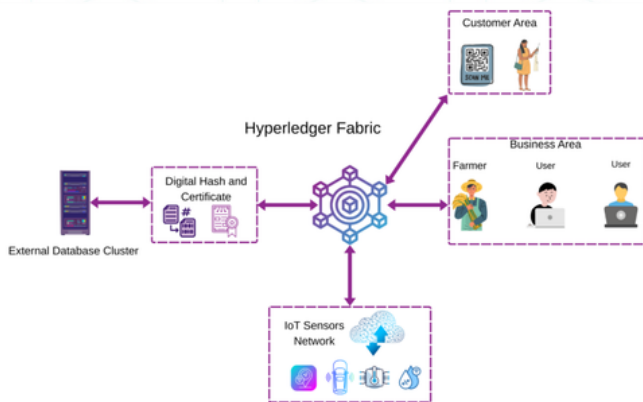
This use case supports precision spinach farming by integrating real-time IoT sensing, UAV imagery, and EO data to enable continuous crop and environmental monitoring, stress detection, and data-driven targeting of field operations, while improving data traceability across farm activities.

UC 3A.2



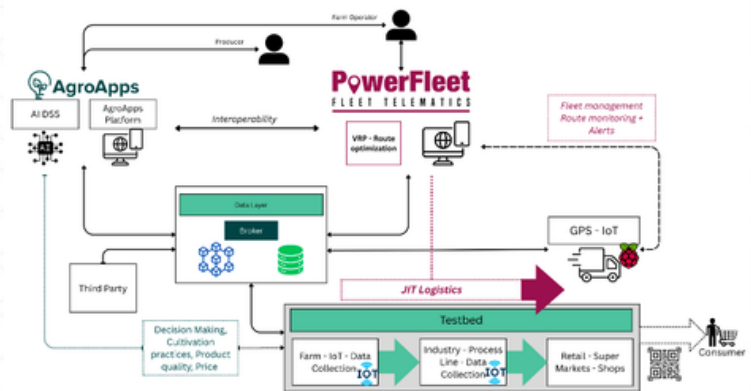
The use case enables autonomous precision weed control by combining UAV monitoring, AI weed detection, and UGV-led spot spraying, reducing chemical inputs while improving field-level sustainability and efficiency.

UC 3A.3



This use case enables secure and interoperable data integration and traceability across the agri-food supply chain, from primary production through processing, logistics, and distribution, by combining federated multi-cloud infrastructures and blockchain-based mechanisms to ensure data integrity, controlled access, and trusted data sharing among stakeholders.

UC 3A.4



This use case enables Just-In-Time logistics for perishable agri-food products by integrating vehicle telematics and AI-based analytics to optimize scheduling and routing, reducing delays, spoilage and operational inefficiencies.

Integrated Precision Agriculture and Crop Monitoring



Description

This use case enables precision spinach cultivation through continuous crop and environmental monitoring by integrating IoT weather stations, plant-wearable sensors, UAV imagery, and satellite Earth Observation, with UGV support for field scouting. The system detects weed patches, monitors crop stress and antinutrient-related indicators, and delivers data-driven recommendations for field operations through a digital Farm Management Information System (FMIS). Data generated at field level are structured to support traceability and downstream coordination across the agri-food value chain.

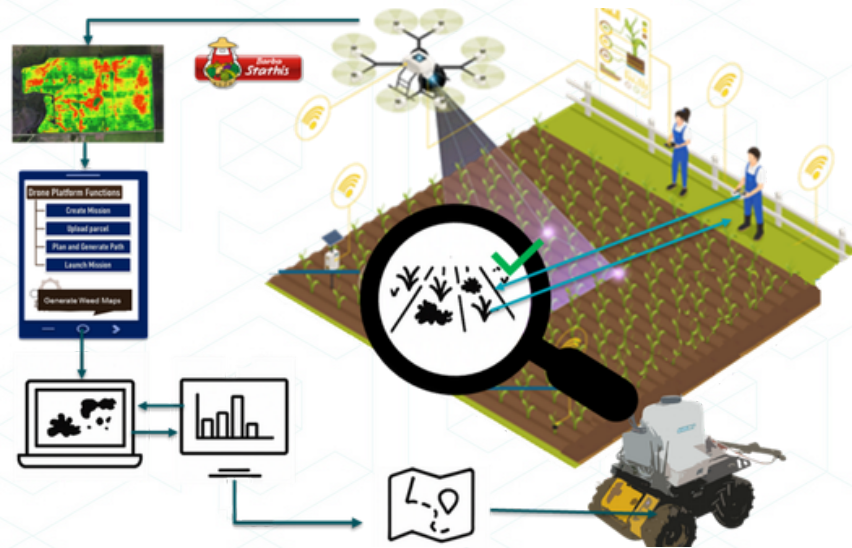
Functional Requirements

The system shall register crop parcels and continuously acquire multi-source field data, including weather station measurements, soil and plant-wearable sensor data, UAV imagery, and satellite Earth Observation. It shall process aerial and satellite imagery to generate vegetation indices, detect anomalies and weed zones, and fuse heterogeneous observations into a unified field-level view. The platform shall deliver AI-assisted alerts and operational recommendations within defined response times through a Farm Management Information System (FMIS). It shall support hybrid edge and cloud processing, secure data transmission, role-based access control, and immutable logging of field observations and interventions, including integration with blockchain-based traceability mechanisms. The system shall enable tasking and coordination of UGV field scouting activities and provide interfaces for downstream integration with logistics and Just-In-Time (JIT) transport coordination services.

Market Business Requirements

The business requirements focus on reducing production and operational costs while improving yield consistency, product quality, and stakeholder trust. Early detection, timely and precision field interventions reduce input use and labour effort, limit crop losses, and shorten decision-to-action cycles. Enhanced data traceability, supported by blockchain-backed records, increases buyer confidence and enables access to higher-value markets. Integration with smart and Just-In-Time logistics improves freshness, reduces spoilage and fuel consumption, and delivers measurable return on investment through a scalable model for sustainable leafy-vegetable production.

Advanced Agri-robotics For Autonomous Intervention



Description

This use case enables autonomous precision weed control in spinach cultivation by combining UAV-based field monitoring with AI-driven analysis and UGV-led spot spraying. Multispectral UAV imagery is processed to detect and map weed pressure. When thresholds are exceeded, autonomous UGVs validate infestations on site and execute targeted spraying, with results logged in the FMIS to reduce chemical use and improve sustainability.

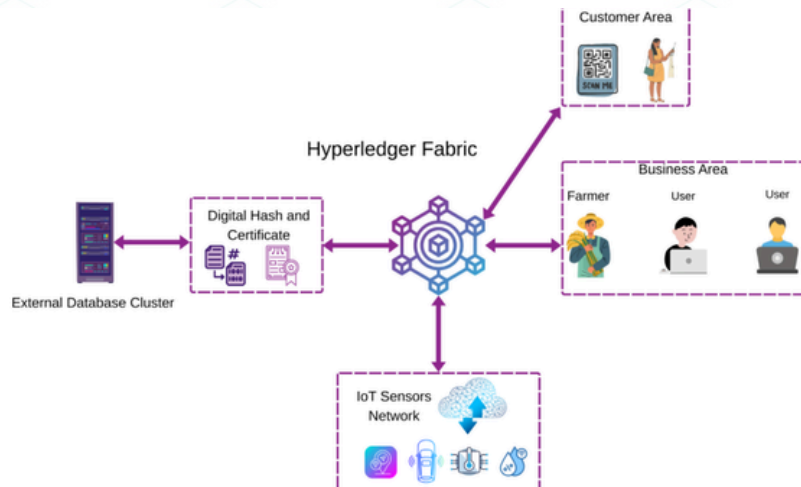
Functional Requirements

The functional requirements for this use case are that the system must register the crop parcel in the FMIS, execute scheduled UAV missions, process UAV imagery into orthomosaics and classified weed maps. It must quantify weed cover percentage and apply threshold logic to determine when intervention is required, then transmit mission commands and geo-referenced treatment zones to the UGV via the orchestration layer. The UGV must autonomously navigate to target areas, capture and locally process visual data at the edge to validate and refine recommendations, and support a human confirmation step before execution. After spot spraying, the system must record action logs (treatment type, location, timestamp, operator identity, and dose) and upload mission results to the FMIS for traceability, reporting, and future optimisation.

Market Business Requirements

The market and business requirements focus on faster weed detection and action, reduced herbicide use, and lower labour costs through automation. The solution should enable rapid detection-to-intervention cycles, support precise spot spraying per weed patch, and replace manual scouting with UAV–UGV operations. It must be scalable and interoperable, with edge processing to minimise latency and auditable records to support compliance and commercial adoption.

Secure Data Management and Interoperability



Description

UC3A.3 enables secure, trusted, and interoperable data sharing across the agri-food value chain using a federated multi-cloud architecture and blockchain-based traceability. By immutably recording cultivation, packaging, transport, and storage events, this use case ensures end-to-end visibility, regulatory compliance, and verifiable provenance from farm to consumer. The solution transforms traceability from a static compliance tool into a real-time, trusted digital service that supports automation, transparency, and collaboration across stakeholders.

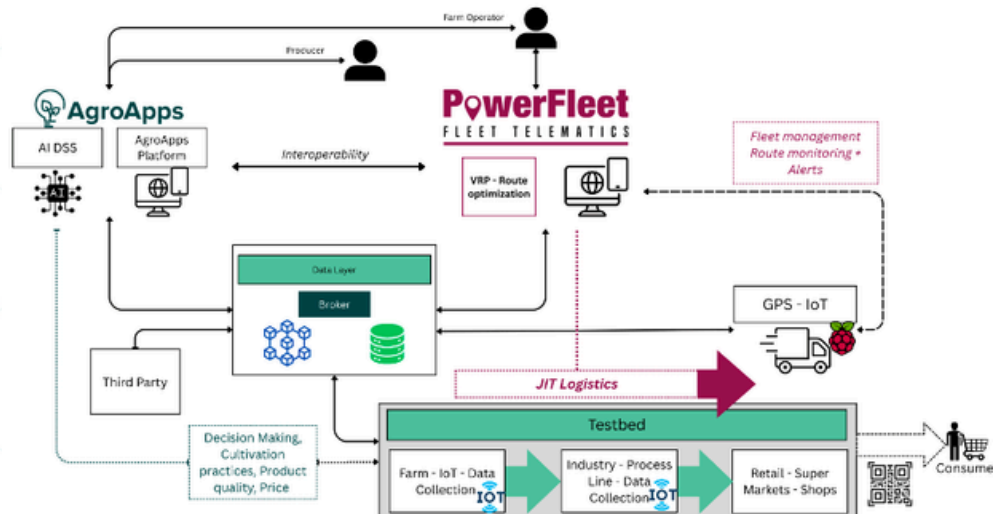
Functional Requirements

The functional requirements focus on securely capturing, signing, and storing agri-food lifecycle events on a permissioned blockchain. The system must register harvested batches, log packaging and certification data, ingest telemetry from IoT sensors, and expose traceability information via QR codes. It shall support role-based access control, low-latency data exchange, and orchestration triggers for SLA deviations, ensuring integrity, auditability, and interoperability across platforms.

Market Business Requirements

The market requirements emphasize cost-effective compliance, scalability, and value creation through verifiable provenance. The solution must reduce certification and auditing costs, simplify onboarding for new partners via standard APIs, and support expansion into ESG-driven and premium markets. By delivering trusted, tamper-proof traceability with low operational overhead, this use case enhances brand value, consumer confidence, and competitiveness across agri-food supply chains.

Smart Logistics and Supply Chain Optimisation



Description

This use case enables real-time, freshness-aware logistics for perishable produce using telematics from refrigerated vehicles (GNSS, temperature, humidity, cargo status). An AI-driven orchestration layer continuously estimates freshness and dynamically adjusts routing, priorities, and dispatch plans when risks (delays, temperature excursions, SLA breaches) are detected. The outcome is improved JIT delivery, reduced spoilage, and better transport resource utilisation across the agri-food supply chain.

Functional Requirements

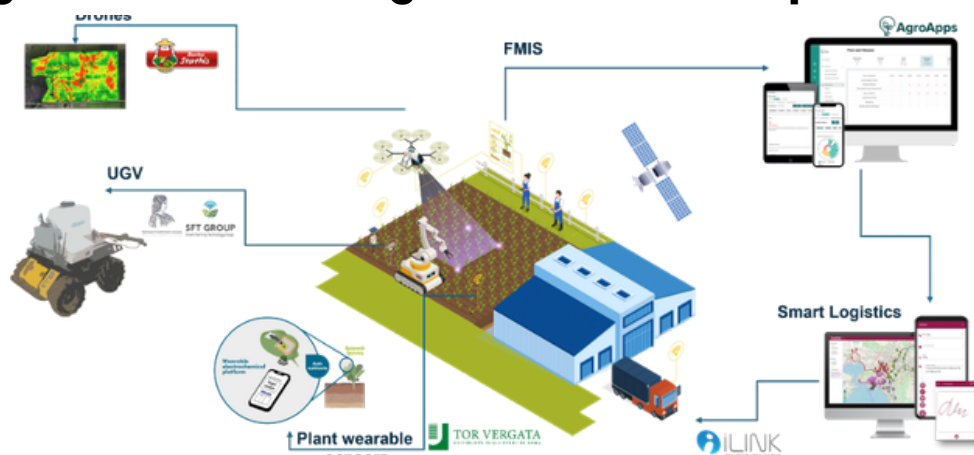
The system must collect and transmit real-time telemetry from field and vehicle sensors, trigger route optimisation and vehicle dispatch via PowerFleet, and integrate with the COP-PILOT orchestration layer through secure APIs. It must log key harvesting/transport/packaging events (and related metadata) on the blockchain, and provide consumer-facing traceability via QR codes. The platform must support event-driven re-routing when freshness thresholds/SLA conditions are violated, with secure authentication and encrypted communications.

Market Business Requirements

UC3A.4 must deliver measurable cost and performance gains: lower cost per delivery through dynamic routing and higher fleet utilization, faster onboarding and integration via modular APIs/connectors, and high operational resilience through failover and continuity mechanisms. It should enable service differentiation (freshness-aware delivery orchestration as a service), support scalability to new actors/regions, and protect commercial value by reducing spoilage, delays, and SLA penalties.

Use Case 3A.1

Integrated Precision Agriculture and Crop Monitoring



Description

This use case enables precision spinach cultivation through continuous crop and environmental monitoring by integrating IoT weather stations, plant-wearable sensors, UAV imagery, and satellite Earth Observation, with UGV support for field scouting. The system detects weed patches, monitors crop stress and antinutrient-related indicators, and delivers data-driven recommendations for field operations through a digital Farm Management Information System (FMIS). Data generated at field level are structured to support traceability and downstream coordination across the agri-food value chain.

Functional Requirements

The system shall register crop parcels and continuously acquire multi-source field data, including weather station measurements, soil and plant-wearable sensor data, UAV imagery, and satellite Earth Observation. It shall process aerial and satellite imagery to generate vegetation indices, detect anomalies and weed zones, and fuse heterogeneous observations into a unified field-level view. The platform shall deliver AI-assisted alerts and operational recommendations within defined response times through a Farm Management Information System (FMIS). It shall support hybrid edge and cloud processing, secure data transmission, role-based access control, and immutable logging of field observations and interventions, including integration with blockchain-based traceability mechanisms. The system shall enable tasking and coordination of UGV field scouting activities and provide interfaces for downstream integration with logistics and Just-In-Time (JIT) transport coordination services.

Market Business Requirements

The business requirements focus on reducing production and operational costs while improving yield consistency, product quality, and stakeholder trust. Early detection, timely and precision field interventions reduce input use and labour effort, limit crop losses, and shorten decision-to-action cycles. Enhanced data traceability, supported by blockchain-backed records, increases buyer confidence and enables access to higher-value markets. Integration with smart and Just-In-Time logistics improves freshness, reduces spoilage and fuel consumption, and delivers measurable return on investment through a scalable model for sustainable leafy-vegetable production.

Instantiation of Use Case

UC3A.1 enables real-time crop and environmental monitoring through IoT sensors, wearable plant sensors, UAV imaging, and satellite data. Within COP-PILOT, heterogeneous data streams are securely ingested via the SIF and processed in the DDOL, where EO, IoT, and UAV inputs are fused into unified crop intelligence services, enabling parcel-level analytics and continuous situational awareness.

The real benefit in the use case

By leveraging COP-PILOT's data fusion and orchestration capabilities, the use case delivers near real-time insights and early warning mechanisms that would not be achievable with fragmented systems. This results in faster, more accurate decision-making, reduced input use, and improved yield performance through coordinated, data-driven interventions.



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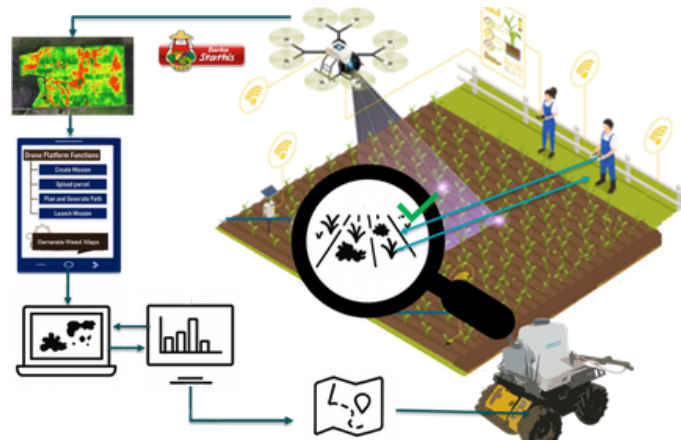
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Use Case 3A.2

Advanced Agri-robotics For Autonomous Intervention



Description

This use case enables autonomous precision weed control in spinach cultivation by combining UAV-based field monitoring with AI-driven analysis and UGV-led spot spraying. Multispectral UAV imagery is processed to detect and map weed pressure. When thresholds are exceeded, autonomous UGVs validate infestations on site and execute targeted spraying, with results logged in the FMIS to reduce chemical use and improve sustainability.

Instantiation of Use Case

UC3A.2 deploys AI-enabled UGVs to perform targeted interventions such as precision spraying, based on real-time inputs from sensors and UAVs. Within COP-PILOT, the DDOL orchestrates decision triggering and coordination between sensing and actuation layers, ensuring seamless integration and real-time communication across components.

Functional Requirements

The functional requirements for this use case are that the system must register the crop parcel in the FMIS, execute scheduled UAV missions, process UAV imagery into orthomosaics and classified weed maps. It must quantify weed cover percentage and apply threshold logic to determine when intervention is required, then transmit mission commands and geo-referenced treatment zones to the UGV via the orchestration layer. The UGV must autonomously navigate to target areas, capture and locally process visual data at the edge to validate and refine recommendations, and support a human confirmation step before execution. After spot spraying, the system must record action logs (treatment type, location, timestamp, operator identity, and dose) and upload mission results to the FMIS for traceability, reporting, and future optimisation.

The real benefit in the use case

Through COP-PILOT's real-time orchestration and edge-to-cloud integration, the use case enables fully automated and synchronised interventions (UAV & UGV informed), significantly improving responsiveness and accuracy. This leads to reduced chemical inputs, optimised resource use, and increased operational efficiency compared to traditional mechanical solutions and uniform applications.

Market Business Requirements

The market and business requirements focus on faster weed detection and action, reduced herbicide use, and lower labour costs through automation. The solution should enable rapid detection-to-intervention cycles, support precise spot spraying per weed patch, and replace manual scouting with UAV-UGV operations. It must be scalable and interoperable, with edge processing to minimise latency and auditable records to support compliance and commercial adoption.



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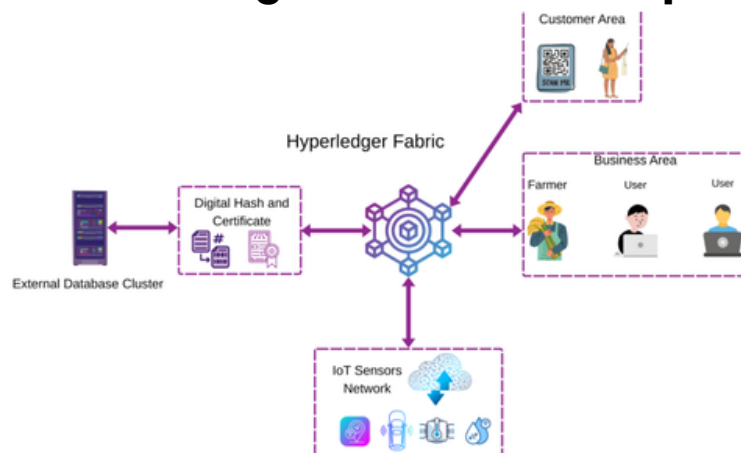
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Use Case 3A.3

Secure Data Management and Interoperability



Description

UC3A.3 enables secure, trusted, and interoperable data sharing across the agri-food value chain using a federated multi-cloud architecture and blockchain-based traceability. By immutably recording cultivation, packaging, transport, and storage events, this use case ensures end-to-end visibility, regulatory compliance, and verifiable provenance from farm to consumer. The solution transforms traceability from a static compliance tool into a real-time, trusted digital service that supports automation, transparency, and collaboration across stakeholders.

Functional Requirements

The functional requirements focus on securely capturing, signing, and storing agri-food lifecycle events on a permissioned blockchain. The system must register harvested batches, log packaging and certification data, ingest telemetry from IoT sensors, and expose traceability information via QR codes. It shall support role-based access control, low-latency data exchange, and orchestration triggers for SLA deviations, ensuring integrity, auditability, and interoperability across platforms.

Market Business Requirements

The market requirements emphasize cost-effective compliance, scalability, and value creation through verifiable provenance. The solution must reduce certification and auditing costs, simplify onboarding for new partners via standard APIs, and support expansion into ESG-driven and premium markets. By delivering trusted, tamper-proof traceability with low operational overhead, this use case enhances brand value, consumer confidence, and competitiveness across agri-food supply chains.

Instantiation of Use Case

UC3A.3 enables secure and interoperable data exchange across the agri-food value chain through encryption, Hyperledger Fabric blockchain infrastructure, and standardized data models. Within COP-PILOT, the SIF supports trusted data integration and exchange, while the DDOL manages orchestration, access control, and interoperability across distributed systems.

The real benefit in the use case

By building on top of COP-PILOT's Secure Integration Fabric and orchestration layer, the use case ensures trusted, end-to-end data flows across stakeholders and systems. This enhances data reliability, enables verifiable, tamper-proof traceability, and supports the deployment of cross-domain services that depend on secure and interoperable data sharing.



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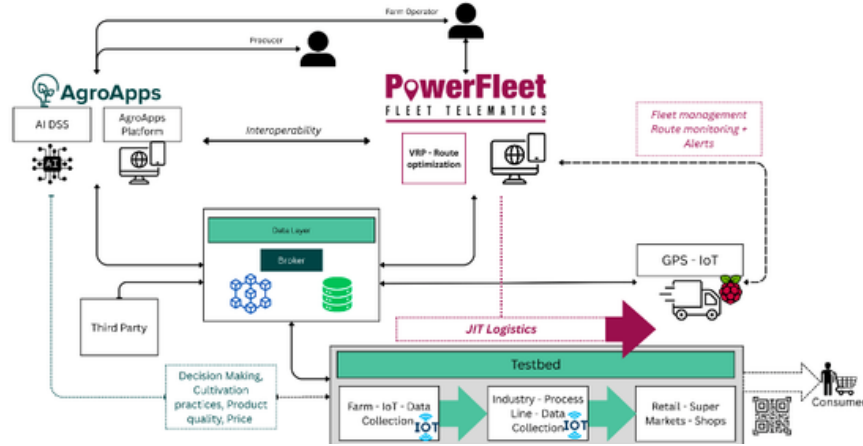
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Use Case 3A.4

Smart Logistics and Supply Chain Optimisation



Description

This use case enables real-time, freshness-aware logistics for perishable produce using telematics from refrigerated vehicles (GNSS, temperature, humidity, cargo status). An AI-driven orchestration layer continuously estimates freshness and dynamically adjusts routing, priorities, and dispatch plans when risks (delays, temperature excursions, SLA breaches) are detected. The outcome is improved JIT delivery, reduced spoilage, and better transport resource utilisation across the agri-food supply chain.

Functional Requirements

The system must collect and transmit real-time telemetry from field and vehicle sensors, trigger route optimisation and vehicle dispatch via PowerFleet, and integrate with the COP-PILOT orchestration layer through secure APIs. It must log key harvesting/transport/packaging events (and related metadata) on the blockchain, and provide consumer-facing traceability via QR codes. The platform must support event-driven re-routing when freshness thresholds/SLA conditions are violated, with secure authentication and encrypted communications.

Market Business Requirements

TextUC3A.4 must deliver measurable cost and performance gains: lower cost per delivery through dynamic routing and higher fleet utilization, faster onboarding and integration via modular APIs/connectors, and high operational resilience through failover and continuity mechanisms. It should enable service differentiation (freshness-aware delivery orchestration as a service), support scalability to new actors/regions, and protect commercial value by reducing spoilage, delays, and SLA penalties.

Instantiation of Use Case

UC3A.4 optimizes harvesting and logistics operations through Just-In-Time coordination, leveraging real-time field data, predictive analytics, and the Power Fleet telematics platform. Within COP-PILOT, the DDOL orchestrates data flows between field intelligence, Agro Apps 360 (FMIS), and refrigerated transport fleets, while the SIF ensures secure interoperability across all actors involved.

The real benefit in the use case

Leveraging COP-PILOT's end-to-end integration and real-time data exchange, the use case enables synchronized decision-making between primary production, AgriFood processing and logistics activities. This results in improved planning accuracy, reduced delays and losses, and more efficient, responsive supply chain operations compared to conventional, disconnected systems.



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