



SMART CITIES AND SMART LOGISTICS

CollMi: Technology for a more trustable and sustainable logistics value chain

With the contribution of



FIWARE - OPEN APIs FOR OPEN MINDS

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Background

Since September 2020, FIWARE Foundation¹ has been leading the successful [i4Trust project](#)² around Data Spaces, which has been receiving funding by the European Commission under the Grant Agreement of 951975. Thanks to the extraordinary collaboration of partners such as iShare³ and FundingBox, 32 selected solutions on Data Spaces have been awarded and funded. With the first impacting results available, FIWARE has decided to publish a fine selection of Impact Stories showcasing FIWARE-based solutions created by an awarded and funded consortium of DIHs (Digital Innovation Hubs) and SMEs. The [CollMi](#) experiment addresses two common issues in logistics operations: The **absence of a unified digital communication mechanism** between different entities and the **lack of trust between** logistics companies. These issues have been causing many errors and have been hindering the implementation of efficient and sustainable practices.

¹ FIWARE Foundation is the legal independent body providing shared resources to help achieve the FIWARE mission by promoting, augmenting, protecting, and validating the FIWARE technologies as well as the activities of the FIWARE community, empowering its members including end-users, developers and rest of stakeholders in the entire ecosystem. FIWARE Foundation is open: anybody can join contributing to the transparent governance of FIWARE activities and rising through the ranks based on merit. FIWARE Foundation is a non-profit organization that drives the definition and encourages the adoption of open standards (implemented using Open Source technologies) that ease the development of smart solutions across domains such as Smart Cities, Smart Energy, Smart AgriFood, Smart Industry, or Smart Water, based on FIWARE technology.

² The EU-funded i4Trust project is contributing to the breaking of 'data silos' that isolate interoperability between information systems and stimulate the sharing, reusing and trading of data assets. It launched an incubator of trusted B2B data sharing ecosystems of collaborating SMEs connected to digital innovation hubs (DIHs), allowing them to share data and encouraging them to adopt proven successful tools such as iSHARE, CEF building blocks and FIWARE Smart Data Models. The project supports 32 bottom-up experiments that will engage at least 150 SMEs and 32 DIHs, helping them to understand the demand for data and establishing data-sharing associations.

³ iSHARE is a trust framework that allows APIs to seamlessly integrate with each other and communicate in a trusted way and only share data when authorized. For developers, it's key to understand the basic principles of iSHARE prior to starting the development of connectors.

Challenge & Context

The rise of e-commerce and the increasing consumer demand for rapid delivery has placed considerable pressure on the logistics industry to improve their efficiency in both urban and rural areas. Municipalities are also concerned about the negative impact of increased parcel deliveries on traffic, congestion, and pollution in urban centers, and are seeking sustainable solutions⁴.

Collaborative Micro-Hubs (CMHs) represent a new logistical concept that utilizes advanced game theory methodologies. In this model, a group of logistics companies, including express and freight forwarders, collaborate by sharing resources to deliver parcels from a network of common logistics centers located in strategic areas of urban centers. The primary incentives for logistics companies to operate within a CMH include **cost reduction, improved service quality**, and wider geographical coverage **without large initial investments and risks**.

The [CollMi](#) experiment addresses two common issues in logistics operations that cause many errors and hinder the implementation of efficient and sustainable practices, such as those utilized by CMHs.

These problems are:

- The **absence of a unified digital communication mechanism** between different entities involved in the **logistics value chain, such as senders**, recipients, forwarders, shippers, consignees, and **receivers**. Typically, unstructured email messages are used to exchange information about the parcel's whereabouts and to agree on important details of shipping, such as pickup locations and times, customs clearance procedures, and delivery dates and locations. There is an urgent need for an easy-to-use platform that provides intelligent EDI processes, which take into account the needs of smaller companies that cannot afford the typically large investment of

⁴ Magdalena Mucowska, Trends of Environmentally Sustainable Solutions of Urban Last-Mile Deliveries on the E-Commerce Market—A Literature Review, Department of Strategic Management and Logistics, Wrocław University of Economics and Business, 53-345 Wrocław, Poland, 2021.

custom logistics management systems. The main challenge is to develop a common data model with integrated authentication and authorization that meets the data needs of each entity and respects different privacy requirements and data-sharing processes.

- The [lack of trust between logistics companies](#)⁵, that hinders the implementation of collaborative operations that could benefit both companies and the entire logistics process. **The main obstacle is** that logistics companies find it **difficult to trust a third-party entity** that manages data-sharing platforms because of the potential damage that such an entity could inflict in the case of a malicious action. A possible solution to this problem is to use distributed ledger technology with appropriate consensus mechanisms that ensure all parties validate the exchanged data and prevent future changes.

Solution

Despite the recognized commercial and environmental advantages of collaborative micro-hubs, implementing them is a complex challenge in terms of business technology. Success depends on the ability to provide credible solutions for different transport operators to exchange information and execute operations shared with each other. **Smart contracts, based on blockchain technology, are chosen as essential elements to support the adherence of operators to the platform.**

This project aims to develop a practical solution to this problem, by using **blockchain technology**, specifically distributed **ledger technology**. The goal is to implement a robust digital solution that solves the collaboration and trust issues that limit the implementation of collaborative micro-hubs. Blockchain technology has the potential to record all transactions of the micro-hub, last-mile carriers, freight

⁵ Sunil Tiwari, Pankaj Sharma, Tsan-Ming Choi, Andrew Lim, Blockchain and third-party logistics for global supply chain operations: Stakeholders' perspectives and decision roadmap, Transportation Research Part E: Logistics and Transportation Review Volume 170, February 2023.

forwarders, and sellers, in a verifiable, permanent, and transparent way for all interested parties.

The role of the [i4Trust initiative](#)⁶ in this project is to provide a reliable data-sharing framework with trustworthy access control. The framework ensures that each retailer only has access to package information for their own orders or their clients' orders. Each logistics operator can access package information relevant to their operation, whether it is their own orders or those they were subcontracted to deliver.

The CollMi experiment introduces collaborative logistics micro-hubs that foster co-opetition among traditional market competitors, representing a significant conceptual innovation. The benefits of this project extend beyond the entities directly involved in the operations, with **spill-over effects including reduced traffic and air pollution**, benefitting the wider community. The main technological contribution of the project is the integration of distributed ledger technologies, [iShare](#), and [FIWARE components](#)⁷ to implement smart data models and operational trusted data sharing processes.

The retail industry has long awaited a reliable source of information to track the whereabouts of incoming and outgoing goods, irrespective of the specific freight forwarders, last-mile carriers, subcontracted companies, and government agencies involved in the process. **The proposed solution offers** important efficiency gains, such as **eliminating the need to make multiple phone calls or manually access the digital platforms of each entity involved in the supply chain to track parcel status.**

⁶ i4Trust has been building a sustainable ecosystem where companies are able to create innovative services by means of breaking 'data silos' through sharing, re-using and trading of data assets. As part of its scope, 32 bottom-up experiments involving at least 150 SMEs and 32 Digital Innovation Hubs are contributing to the digital transformation of industrial value chains across multiple domains, such as Smart Cities, Smart Mobility, Smart Manufacturing, Smart AgriFood, Smart Energy, Smart Water, Smart Health and Smart Logistics.

⁷ FIWARE brings a curated framework of Open Source software platform components which can be assembled together and with other third-party components to build platforms that support the development of Smart Solutions faster, easier and less costly.

The solution provides more reliable information to customers about their **purchases and future availability of out-of-stock goods**. It also allows them to compare the performance of logistics operators and make strategic business decisions.

How it works

The experiment architecture categorizes logistics operators into two types:

- Last-Mile Delivery (LMD) and operators ([Logimade](#)⁸, [Logislink](#)⁹, [Trans Bag](#)¹⁰);
- Freight Forwarder (FF) and operators (Logislink).

The LMD operator is contracted by the retailer to deliver goods directly to the final client, while the FF is a subcontracted third party for a portion of the route. Logislink assumes both roles and will implement the components for the LMD since they include everything needed by the FF. Each LMD operator will run its own instance of a [FIWARE Context Broker \(Orion LD\)](#)¹¹ and a [MongoDB](#)¹² database containing relevant context data for packages they were contracted to deliver.

⁸ Logimade LDA started its activity in 2016 and is today one of the main players in the markets where it operates. Logimade started its journey in the commercialisation of paper, through the exclusive representation of The Navigator Company. This achievement allowed them to dominate the competitive office paper market, which opened up opportunities in many other business areas.

⁹ Logislink provides regular transport services, container consolidation and deconsolidation, storage of dry, frozen and chilled goods, stock management and collection.

¹⁰ Tans Bag is a cargo transport company from Portugal.

¹¹ FIWARE Context Broker allows to manage the entire lifecycle of context information including updates, queries, registrations and subscriptions. It is an NGSIv2 server implementation to manage context information and its availability. Using the Orion Context Broker, one is able to create context elements and manage them through updates and queries. In addition, one can subscribe to context information so when a specific condition occurs (e.g. the context elements have changed) the user receives a notification. These usage scenarios and the FIWARE Context Broker features are described in this documentation.

¹² MongoDB is a source-available cross-platform document-oriented database program. Classified as a NoSQL database program, MongoDB uses JSON-like documents with optional schemas.

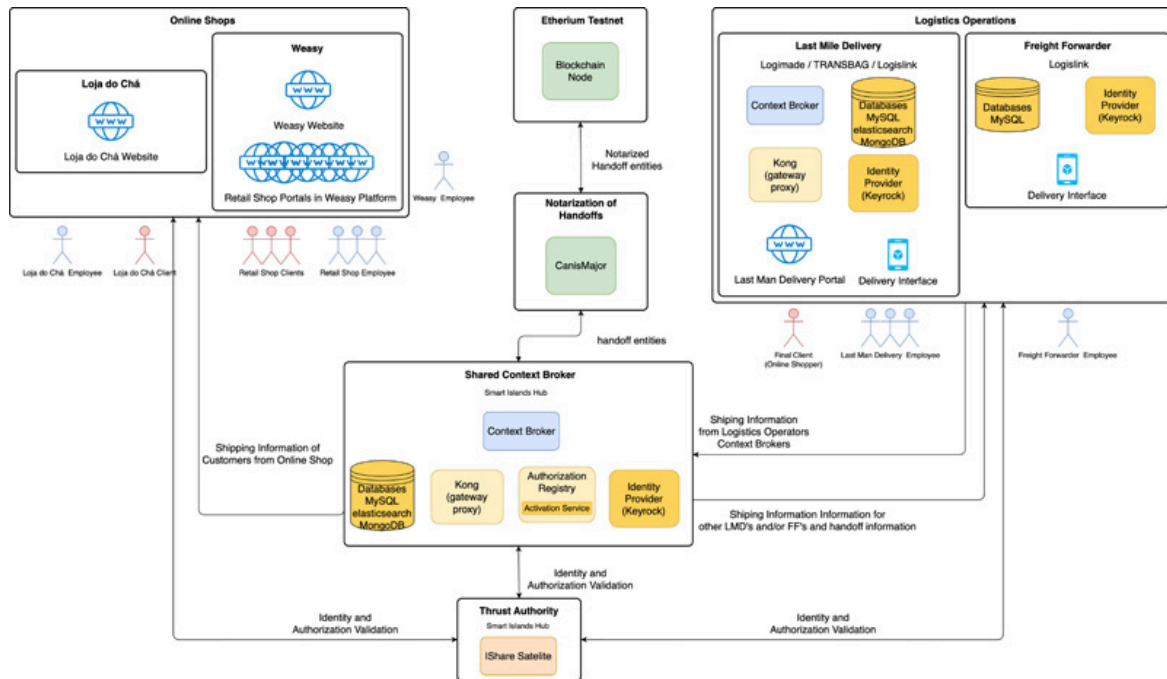


Figure 1 - Architecture

Similarly, the [Smart Islands Hub \(SIH\)](#)¹³ will also run an instance of a FIWARE Context Broker, referred to as shared Context Broker. Context Broker will subscribe to waybills related to the collaborative microhub present in the context brokers implemented by the LMDs and serve as the primary context information provider for all participants, retaining information regarding handoff operations. Access to these context brokers will be protected by instances of [Kong](#), a gateway proxy, in each logistics operator and the SIH.

¹³ The Smart Islands Hub (SIH) is a Digital Innovation Hub (DIH) that aims to promote the empowerment and digital inclusion of the Madeiran population and encourage the adoption of advanced digital technologies by SMEs, Mid Caps and Public Sector organisations based in this region. SIH can introduce added value in National and European Digital Innovation ecosystems, promoting the Smart Islands strategy to cooperate with technological, business and strategic partners in order to develop solutions that can help local organisations in their digital transformation.

Once all participants are registered as iShare parties, package context information (waybill) is then provided via the shared context broker to retailers and contracted LMDs, using iShare compliant access policies for identification, authentication, and authorization. The experiment's retailers are [Loja do Chá](#), an online shop, and Weasy, which acts as a proxy for all online shops under their umbrella and offers them a plugin to access their respective client package information. The FF and other LMD's contracted to deliver within the micro hub will also obtain package context information assigned to them via the shared context broker to obtain the necessary information for their legal transport document.

The retailers, LMDs, and FFs, will subscribe to waybill entities of the LMDs they work with via the shared context broker and have access only to those entries where they are listed as the trader or transporter for that leg of the delivery. Any changes to those entries will trigger notifications. The final customer can track their delivery status on both the online shop's website (in their authenticated area) and the LMD's website (unauthenticated) using a unique identifier provided by the LMD and passed on by the retailer.

All LMDs and the SIH will implement [FIWARE's Identity Manager Keyrock¹⁴](#), and retailers will use the identity provider at the shared context broker (SIH) for authentication.

Benefits & Impact

CollMi is a B2B digital platform that enables logistics companies to share deliveries with one another.

¹⁴ Keyrock is the FIWARE component responsible for Identity Management. Using Keyrock (in conjunction with other security components such as PEP Proxy and Authzforce) enables the addition of OAuth2-based authentication and authorization security to services and applications.

The platform has two typical use cases. Firstly, **companies without the necessary resources or interest in making a delivery** can offer it to another logistics company on the platform. Secondly, **a logistics company experiencing a period of low activity** can use the platform **as a source of deliveries**. These situations are common among logistics companies, especially smaller ones. However, **ColliMi** transforms these problems into business opportunities, **increasing the productivity of logistics companies**. Currently, no other platform on the market provides such a service, making the opportunity quite unique.

ColliMi's proposed experiment involves collecting data on the costs, time, and participant feedback from the new processes enabled by the data sharing platform. The results will demonstrate significant benefits for all stakeholders. These benefits include **lower delivery costs, shorter delivery times, wider geographical coverage, more detailed and accurate information** for end customers, **reduced traffic, and decreased carbon emissions**¹⁵.

The experiment will also create qualified jobs in the logistics sector by opening a number of new positions to manage and monitor micro-hub operations, while reducing the number of unqualified and lower-paying jobs, such as delivery couriers and drivers. ColliMi anticipates a significant increase in this effect in the near future as companies and end-customers become more aware of the need to reduce carbon emissions and adopt responsible consumption behaviors, leading to a greater demand for collaborative micro-hubs.

The **cooperative relationship between companies within the micro-hub opens up new opportunities for smaller logistics companies** to operate and **compete**

¹⁵ [A Deloitte study](#) titled "Last Mile Logistics - Challenges and Solutions in Spain" reports that LMDs account for 40% of the total cost of logistics operations and 25% of air pollution. A collaborative logistics micro-hub can directly reduce the carbon emissions of LMD vehicles in three ways. First, forwarders can reduce deliveries and cover less distance by concentrating packages from different LMDs in strategically positioned micro-hubs. Second, collaboration between LMD companies within the micro-hub can increase the efficiency of delivery routes, by delivering more packages per kilometer traveled. Third, optimized routes will have more stops and shorter distances, creating optimal conditions for the introduction of alternative vehicles, such as electric bikes, for deliveries in urban areas.

with larger market owners. This should help cultivate a more equitable economic landscape where wealth is shared among a greater number of companies and their associates.

All SMEs involved in this experiment can leverage these benefits to increase their sales. However, SMEs in the logistics and software development sectors stand to gain the most, with sales expected to increase by over 30%, according to the author's opinion. Logistics companies will be able to accept more deliveries and relay them to partners via the micro-hub, receiving a fee in the process. They can also accept deliveries from other operators within the micro-hub's market. Software development SMEs can meet their sales objectives by developing and maintaining logistics software management projects integrated with the micro-hub platform.

Added value through FIWARE

FIWARE technology brings significant value to the development of digital platforms like CollMi, which allows logistics companies to share deliveries and reduce delivery costs. The following are the main **value-adds of FIWARE** in this experiment:

- **interoperability:** FIWARE provides a set of standard APIs that enable logistics companies to easily connect different systems and share delivery information;
- **reusability:** FIWARE's modular architecture and reusable components significantly reduced the time and effort required to develop and deploy CollMi's digital platform;
- **scalability:** FIWARE can scale horizontally and vertically, making it ideal for large-scale deployment and usage by multiple logistics companies;
- **Open Source:** As an open-source platform, FIWARE provides access to a large and growing community of developers, solution providers, and end-users, facilitating collaboration and the sharing of best practices and solutions.
- **robust security:** FIWARE incorporates robust security features, such as role-based access control, encryption, and authentication, ensuring the protection of sensitive delivery information and the secure exchange of data among logistics companies.

- **cost-effectiveness:** The platform's Open Source and modular architecture reduces licensing and implementation costs, making it an attractive and cost-effective framework to support the entire collaboration platform.

In conclusion, the combination of FIWARE's interoperability, reusability, scalability, Open Source, robust security, and cost-effectiveness makes it an ideal solution for the development of digital platforms like CollMi, which enable logistics companies to reduce costs and CO2 emissions and share deliveries.

Next steps

CollMi's consortium recognized that, possibly through third party software, data generated by the platform could be supplemented with data from individual logistics operators. This could then be used to create a recommendation engine that advises companies in advance on which deliveries they should outsource to other companies, and which deliveries they should bid on, at what amount, and quantity. This would not only automate the interaction of logistics companies with the marketplace, it would also provide companies with a mechanism to increase the automation level of their entire logistics operation.

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