Automated microhubs for collaborative urban logistics in Bologna

Physical Internet-led innovation on urban freight
POLIS – ALICE Joint Webinar
27 March 2024

Project Overview

What?

1. Innovative framework: Transition to PI and collaboration models through real life testing

2. Measurable impact: 20% CO_2 emissions reduction

3. Scalability: Facilitate replication of LL' exemplars to avoid working in silos

How?

- ✓ Innovative interventions & models
- ✓ Innovation Transferability Platform
- ✓ KPIs & Impact Assessment Radar
- ✓ Scaling up through feasibility studies

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> 4 **Lighthouse Living Labs** (WAVE 1)

> 2 **Twinning Living Labs** (WAVE 2)

Human Centric
Digital Twinning Tools

2024   Twinning LLs

Helsinki

TL2
Karlsruhe

Valladolid   TL1
Barcelona   Bologna

Thessaloniki

Lighthouse LLs

LL1
Helsinki

2022

Reference Assets

LL3
Valladolid

LL2
Bologna

LL4
Thessaloniki
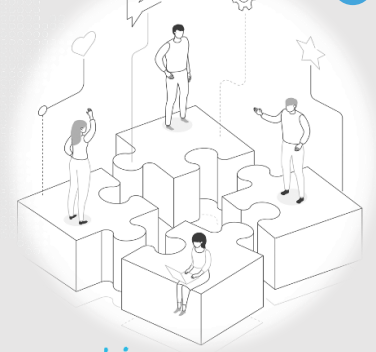
URBANE Innovation
Transferability Platform

Co-development of innovative operational models
- Hub&Spoke delivery
- Hyperlocal on-demand delivery
- Collaborative delivery
- Containerisation delivery
- Digital-as-a-service delivery

Innovations
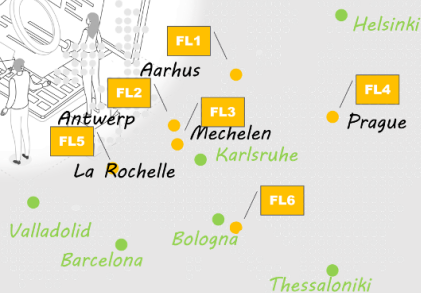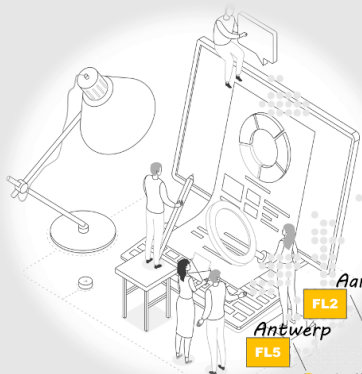- Physical
- Digital
- Business & Governance
- Social

Enabling Technologies
Digital Twins
AI
Blockchain

This project
Union's Hor
programme under grant agreement No. 101069782

> Feasibility studies in 6 cities (WAVE 3)

PI - Zero Emissions Vision

2028
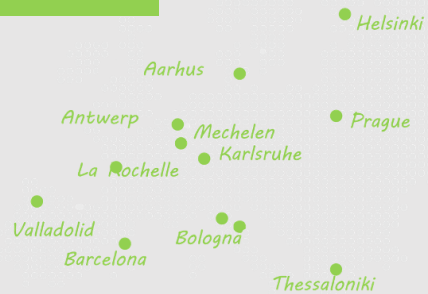
2026

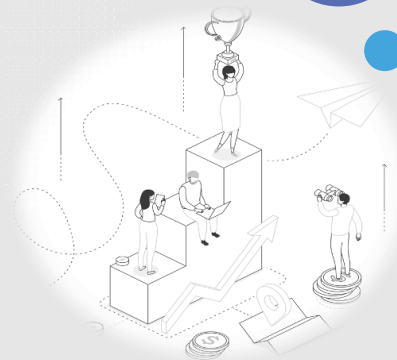Helsinki
Aarhus
Antwerp
Mechelen
Karlsruhe
La Rochelle
Valladolid
Bologna
Barcelona
Thessaloniki

Successfully established PPPs

> Policy package & Adoption Roadmap
> Data-driven Impact Assessment Radar

FL1
FL2
FL3
FL4
FL5
FL6

Helsinki
Aarhus
Antwerp
Mechelen
Prague
Karlsruhe
La Rochelle
Valladolid
Bologna
Barcelona
Thessaloniki

Follower Cities
Adoption Feasibility Studies

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Involved partners in each lighthouse LL

ITALY – Bologna Lighthouse Living Lab (WAVE 1)

FINLAND – Helsinki Lighthouse Living Lab (WAVE 1)

SPAIN – Valladolid Lighthouse Living Lab (WAVE 1)

GREECE – Thessaloniki Lighthouse Living Lab (WAVE 1)

Ambition

	Operational models
Helsinki	**Hyperlocal on-demand delivery** (customer-centric, the service provider acquires/delivers in the same geographical area, ADVs).
Bologna & Valladolid	**Collaborative delivery** (smart consolidation, sharing resources, infrastructure, and transportation, alliances) (Micro-hubs networks and light EDVs) (Fleet of fully electric vehicles with solar panels and CCAM capabilities)
Helsinki & Karlsruhe	**Containerisation delivery** (feeder vehicle to the last mile delivery one, mixing goods from several carriers in the same feeder vehicle, ADVs)
Thessaloniki	**Hub&Spoke delivery** (Micro-consolidation lockers, distribution hub & satellite stores)
Barcelona	**Digital-as-a-service delivery** (platforms, AI-enabled route optimization)

Bologna LL set up

LL's Area: **City Centre of Bologna** (4 kmq)

Limited Traffic Zone: 3,2 kmq – monitored by 22 cameras (7am-8pm / 24h)
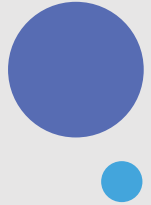
Main data (31/12/2021):

- Inhabitants: 53.737 (14% of the total population)

- Active commercial activities:
- 2.656 in City Centre
  - 2.312 (88%) in LTZ

Legend
- Piazza Maggiore
- Business activities
- Ring road
- Limited Traffic Zone

Bologna LL set up

In late 2019 the Metropolitan city of Bologna approved the Sustainable Urban Mobility Plan (SUMP) and the Sustainable Urban Logistic Plan (SULP).

At city level it is foreseen the implementation of these measures:
- Logistics system at zero emissions
- Integration and harmonization of city logistics rules in all the cities of the metropolitan area
- **Implementation of the Nearby Delivery Area (NDA)**
- Night deliveries
- Use of intermodal (passenger) nodes to maximize the impact of freight deliveries (e.g. with lockers in bus station)

Bologna has been chosen by the European Commission among the **100 climate-neutral and smart cities by 2030 (Cities Mission)**
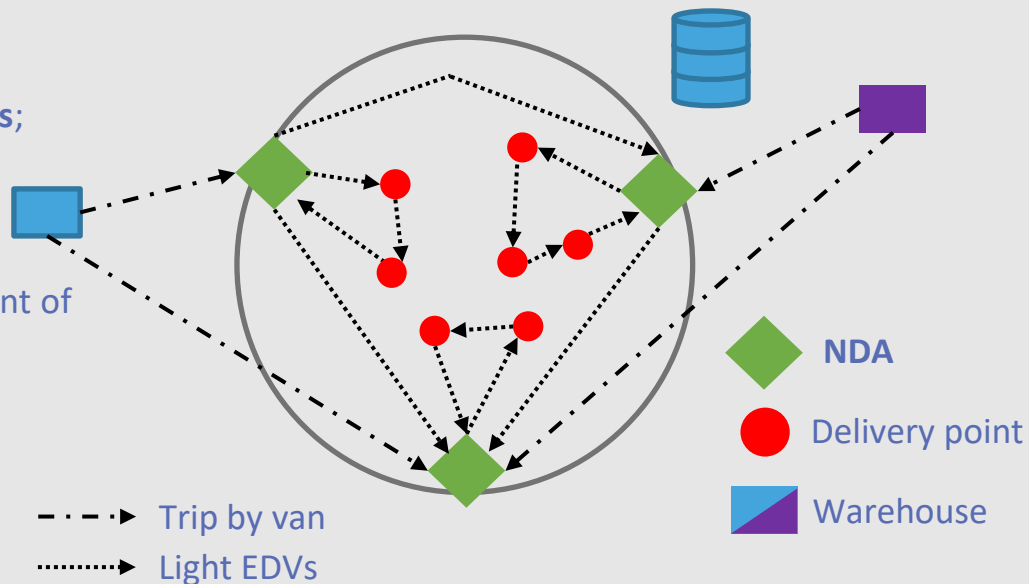
Vision and challenges to be addressed in URBANE

The Bologna Living Lab aims to realize a measure listed in the SUMP, namely the **implementation of the Nearby Delivery Area (NDA)**, combined with a:

- **collaborative approach between logistics operators**;
- utilisation of **zero emission vehicles**
- **High degree** of **automation**

NDA -> **micro consolidation centres** for the transhipment of parcels from conventional vans to cargo bikes and/or Electric Delivery Vehicles

◆ **NDA**

● Delivery point

▧ Warehouse

—·—▶ Trip by van

······▶ Light EDVs

# Vision and challenges to be addressed in URBANE

- **Develop and set up a business model** for an innovative delivery method in urban areas

- Promote the **collaboration** between logistics operator

- Ambition to introduce **Physical internet** delivery methods

- Support and test digital **Urbane digital Twin**

- **Reduction distance travelled** by conventional vans in Bologna City Centre

- **Reduction of the related negative externalites** produced (**noise, pollution**)

- **Increasing of safety roads condition**

- **Improving of urbane space quality**

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Use case:

Micro-hubs networks and light EDVs - PI last mile deliveries
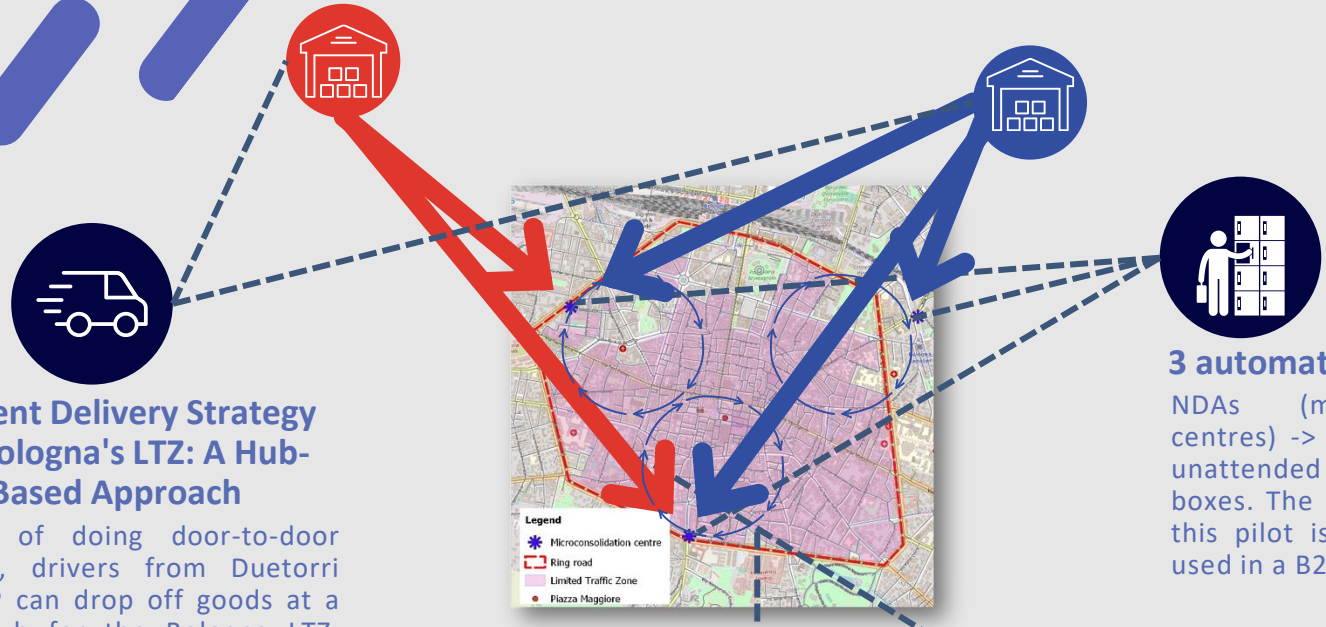
Efficient Delivery Strategy for Bologna's LTZ: A Hub-Based Approach

Instead of doing door-to-door delivery, drivers from Duetorri and TYP can drop off goods at a small hub for the Bologna LTZ. After that, they can carry on with their usual deliveries outside the LTZ.
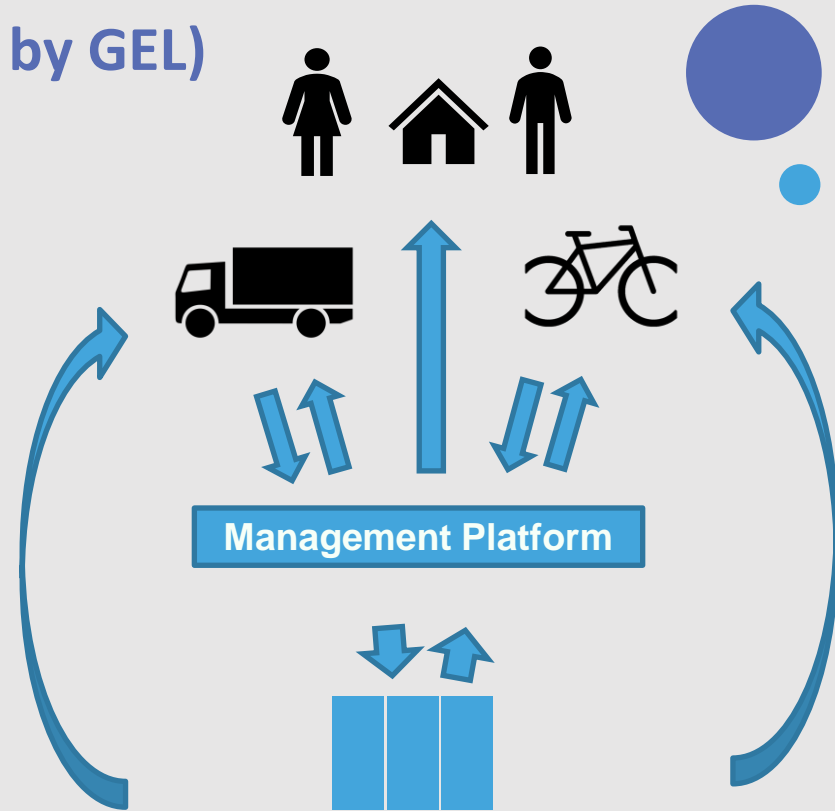
3 automated Micro Hubs

NDAs (micro consolidation centres) -> three automated and unattended micro-hubs with 40 boxes. The solution identified for this pilot is three lockers to be used in a B2B manner only

Last miler

The last-mile operator collects the packages from the micro-hubs and delivers them to the end users in the historic center of Bologna.

Legend
* Microconsolidation centre
— Ring road
Limited Traffic Zone
• Piazza Maggiore

Logical flow (managed by GEL)

- **Collection of the delivery requests** sent by TYP and Due Torri
- Checking of the **availability of the boxes of the lockers** and **assignment of the parcels to the available boxes of the locker**
- Put into **communication** the **vans drivers** and **last miler** with the lockers, in order to **indicate the boxes where to place or to pick-up** the parcels and *managing of potential adverse events*
- Put into **communication the final client of the shipment** in order to keep him updated about the status of the shipment

Management Platform

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Stakeholders and their role

Institutions
Comune di Bologna
CITTÀ METROPOLITANA DI BOLOGNA

Research
ITL ISTITUTO sui TRASPORTI e la LOGISTICA

IT Provider
gel PROXIMITY

Transport operators
typ
DUE TORRI Logistics Partner

Observers
Comune di Ravenna
SPQR COMUNE DI REGGIO NELL'EMILIA
COMUNE DI PIACENZA
Regione Emilia-Romagna
ubm urban bike messengers
URBICO URBAN BIKE COURIER
AICAI Associazione Italiana Corrieri aerei Internazionali
Interreg CENTRAL EUROPE — Co-funded by the European Union
GRETA

Last miler (contracted)
SALERNO TRASPORTI S.R.L.

Micro-Hub (contracted)
RICOH imagine. change.

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Physical infrastructure

Infrastructure needed for URBANE

Each NDA -> **3 modules (1 Master + 2 slave)**

Control Unit + 13 cells
- 3 L: 37Lx48Lx33P
- 7 M: 37Lx48Px22H
- 3 S: 37Lx48Px98H

16 cells/module
- 4 L: 37Lx48Lx33P
- 8 M: 37Lx48Px22H
- 4 S: 37Lx48Px98H

LL model (3 NDA): 135 cells

Master module

Slave module
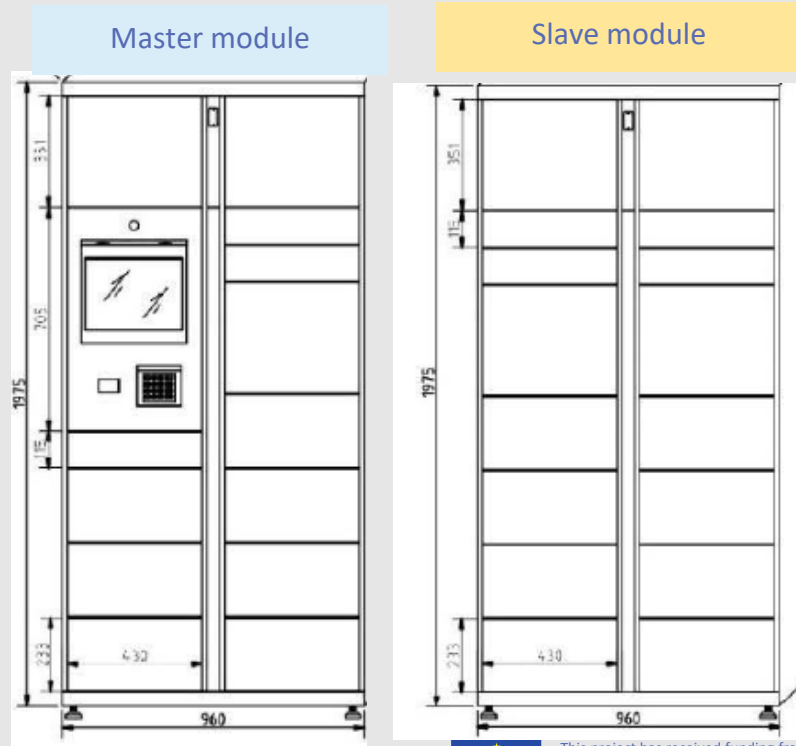
Digital infrastructure

To manage the delivery flow to the microhubs it was necessary for all the partners involved in the LL (Transport Operators and Last Miler) to carry out **a technological integration on their systems with GEL Proximity**, which acts as orchestrator/integrator of all the information that must be shared for the correct management of the process.

The methods of integration take place **via REST API with JWT authentication**.

To allow the verification of the integration on different systems, GEL Proximity offers two different types of environments: **Test** and **Production**.

Testing environment: the environment to be used during integration with GEL or during any testing activity.

Production Environment: the environment to be used only in a process that generates real shipping and return orders.

GELPROXIMITY - TEST TESI
(gel-proximity)

- Backoffice Admin Frontend
- Backoffice Merchant Frontend
- Backoffice Backend

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LL trial set up and preparation

Testing phase preparation:

➤ **Preparation of the technical documentation and APIs creation for the technological integration with all actors** from June to November 2023

➤ **Telematic testing activities (one-to-one)** between GEL and the individual carriers and between GEL and RICOH/WIB including a physical test in Ivrea (Piemonte – Italy) in December 2023

➤ **The microhubs were transported and installed in Bologna city centre**, in the 3 identified NDAs, and the microhub wrap was installed in January 2024.
Also **security cameras** were installed

➤ **End-to-end telematic tests involving all LL actors** took place on 25th and 30th January 2024

➤ **Physical tests** in the testing environment (2nd February) and in the production environment (8th February)

Pilot start (go live)

12th February 2024

Models & tools developed/used/extended in URBANE

Blockchain and smart contracts

In Bologna LL this technology can be used mainly to certify the occurrence of events relating to the logistics process (called **Key Points**), so that in cases of dispute, the Transport operators/Last Milers can have concrete evidence to support the proof of delivery.

The **smart contract** will serve mainly as **Proof of Delivery**: the procedure actually depends on shipper requirements, they are some asking for signature or PIN code, in other cases no proof is required.

PoD is the main added value of the To BE situation for the blockchain. All actors will have visibility increased and can access info during and after the shipment process to have steps certified (according to respective needs).

The longer-term impact would be to attract more operators and make more efficient their operations but at the same time to aggregate info about volumes and flows (link to Physical Internet concepts).

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Models & tools developed/used/extended in URBANE

SKEMA Collaborative Delivery Model

Objectives:
- Limiting the number of operators in the same zone
- Optimizing the allocation of parcel in the automated micro-hub to minimize emissions.

Approach: Innovative modeling approach that captures the tradeoffs between city-level stakeholders (e.g. minimize number of delivery vehicles) and service providers (e.g. maximize profit, client satisfaction).

Model characteristics:
- Assign packages from first-milers to most suitable lockers
- Assign packages from lockers to most suitable last-milers (optimize their pickup & delivery)

LM 1
LM 2

Original Delivery Locations → Consolidated Delivery Locations
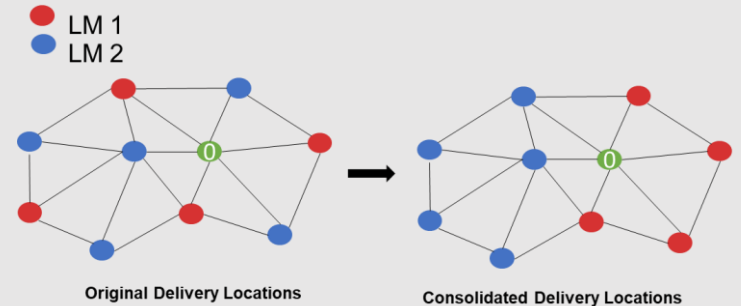
Models & tools developed/used/extended in URBANE

CERTH Impact Assessment Radar

The impact radar in Bologna LL will receive input by the Collaborative routing model (SKEMA), will **model the economic KPIs and will calculate the breakeven by tuning the logistics variables** (number of MicroHubs, number of operators and number of parcels) **in the SKEMA model and economic-operational variables** (total cost of the shipment, costs of permits, time windows for entering the city center, availability of loading bays…)
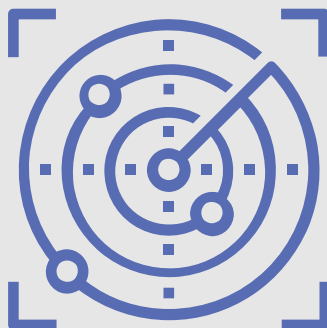
Physical Internet interventions in the LL

In the Bologna Living Lab, **two potential competitors (TYP and Due Torri)** are collaborating in the distribution of the parcels in the boxes.

This part of the business model represents a concrete step towards the **Physical Internet concept**.

One of the aims of the LL is to find a **sustainable business model** that can run even without the European project financing.
The PI concept will increase when there will be more than one last miler and other carriers collaborating in the freight distribution scheme.
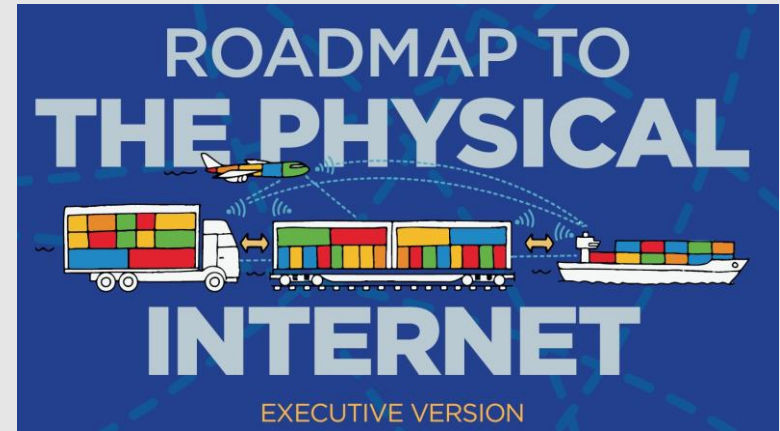
ROADMAP TO THE PHYSICAL INTERNET
EXECUTIVE VERSION

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Activity in progress and next steps
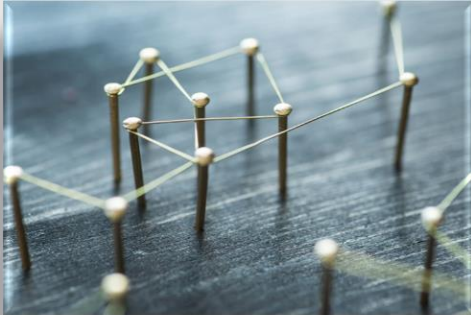
From February 12th, carriers began with low shipment volumes to **test and optimize the process flow of the new solution**. They are currently increasing the shipments.

LL partners will **involve new operators** interested in the solution. Ad hoc **questionnaire** has been prepared in order to investigate **the level of interest in innovative solutions** for the delivery of goods in urban areas, for possible future expansions of the model itself or activation of new solutions.

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Activity in progress and next steps

The **blockchain/smart contract modules, the collaborative routing model and the impact assessment radar** developed by URBANE WP3 partners will be integrated and tested in the coming weeks.
The objective is to identify a **sustainable business model at both financial and operational level** that allows to increase collaboration between multiple transporters and last miler, thus allowing the application of the **Physical Internet** concept.

Activity in progress and next steps

Test the solution also in the **Food Delivery Logistic Market and with other zero-emission vehicles (e.g. cargo bikes, automated vehicles)** in order to deliver food to local retailers located in the LTZ of Bologna. This can be tested through other funded projects.

Synergies with other projects

GRETA

2023 – 2026

Last mile delivery green pilot solutions in FUAs: microhubs and curbside management solutions

DISCO

2023 – 2027

Digital transformation of urban logistics and sustainable planning

MED COLOURS

2024 – 2027

Last mile delivery green pilot solutions in FUAs and SULPs development

Visibility in the main media at local and national level

Thank You!

Alice Benini
Institute for Transport and Logistics
alice.benini@fondazioneitl.org