On-demand transshipment of freight deliveries in urban areas: A physical Internet-enabled multi-mode mobility

Olivier Labarthe, Walid Klibi, Jean-Christophe Deschamps and Benoit Montreuil

Objectives

- Investigates the opportunity to exploit an **on-demand goods transshipment** service in **urban areas**.
- A joint usage of urban and goods mobility tools in urban areas within the Physical Internet context.
- An approach based on the **simulation** and **optimization** of an associated **multi-modal on-demand transshipment problem**.

Context : the city of Bordeaux

A schema of urban distribution system

- 28 **municipalities**
- Population : 783 081 (2016)
- Density : 1354 h/Km^2
- Area : 578,3 Km^2

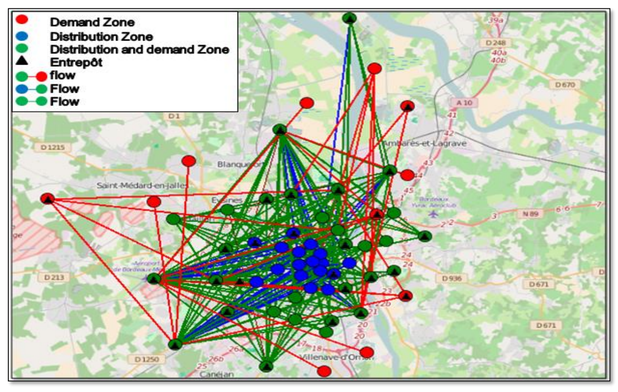


Fig 1 : Flows between Regions

- > 60 000 mvt per day
- 25% retail operations
- 50% Hyper-Center
- 45% of Large Trucks
- 30% Population growth

How to enable efficient and sustainable routing in urban areas ?

✓Pick-up and Delivery Capabilities ✓Hubs Interconnectivity Capabilities

Methodology

Monthly / Weekly Decisions

Location of urban hubs
Capacity reservation at open spaces
Assignment of the transportation capabilities

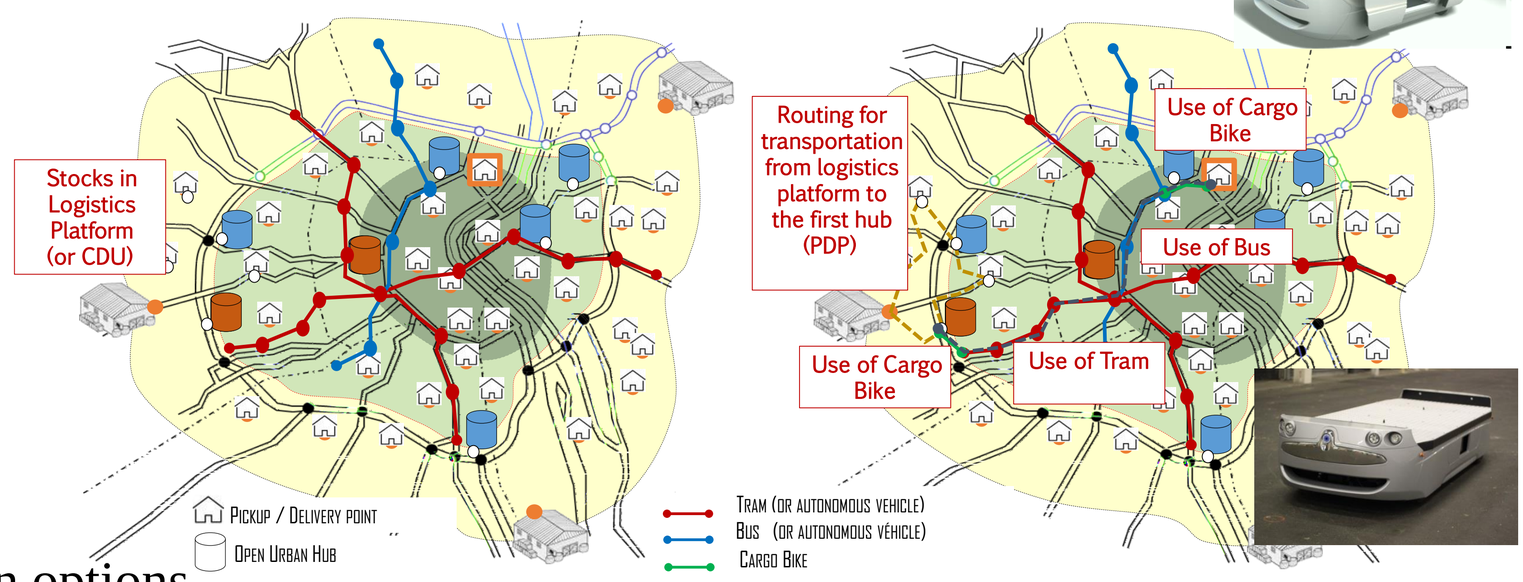
Daily Decisions

Transportation fleet positioning per hub
PI-Containers deployment to primary hubs

Per Time Window Decisions

PI-Containers Pick-up and Delivery routes through the multi-segments distribution web

- Definition of routes in accordance with customers' requests
- Transport from hubs to hubs included in routes



Possible transshipment at each hub
Multiple time windows and transportation options
PI-enabled urban transportation problem (VRP + PDP)

Fig 2 : Integration of Mixity and On-Demand Transport

Results

- 10 customers to serve with a combustion engine vehicle
- Primary routing problem : VRP – Secondary routing problem : PDP
- Transport after transshipment ensured by electric vehicles or cargo bikes (no ecological impact)

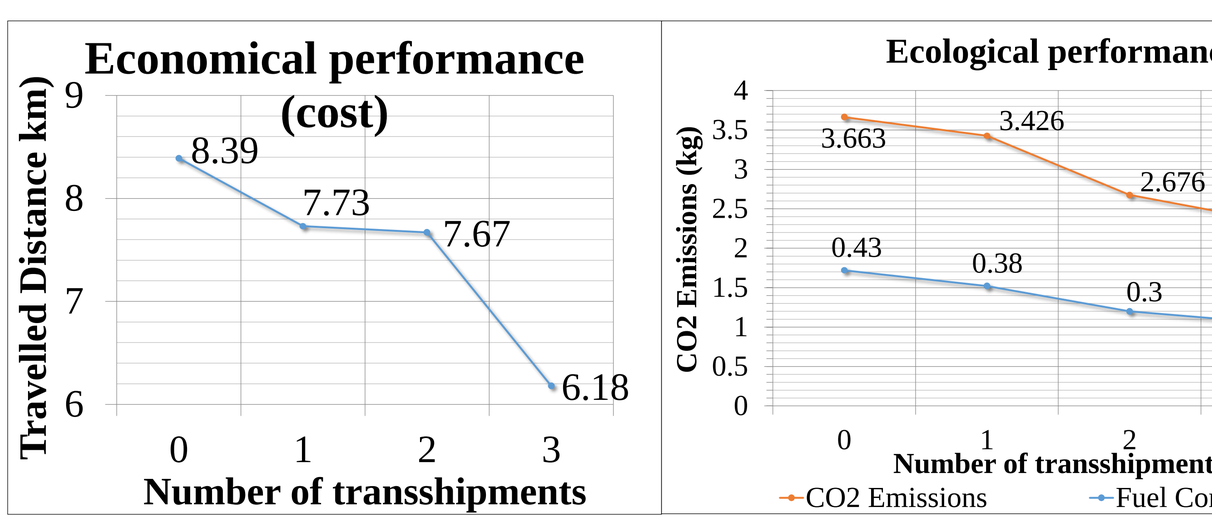


Fig 3 : Opportunities to exploit an on-demand goods transshipment service in urban areas

- One mode : on-demand truck system (50 vehicles)
- Two modes : 50 vehicles + 50 bikes
- Three modes : on demand truck system jointly with Cargo-bike and AVs (in total a fleet of 150)

Fig 4 : Performances of the transshipment system