IPIC 2024 - 10th International Physical Internet Conference
Empowering Resilient and Sustainable Supply Chain Ecosystems
May 29-31, 2024 | Savannah, GA USA

Toward Hyperconnected City Logistics On-Demand Synchromodal Urban Delivery Service Project in Bordeaux, France

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KEDGE Business School, Bordeaux, France

May 31st, 2024

Plenary Session F-1: Toward Physical Internet Enabled Hyperconnected City Logistics

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BORDEAUX METROPOLE, FRANCE

Bordeaux Métropole : 28 municipalities

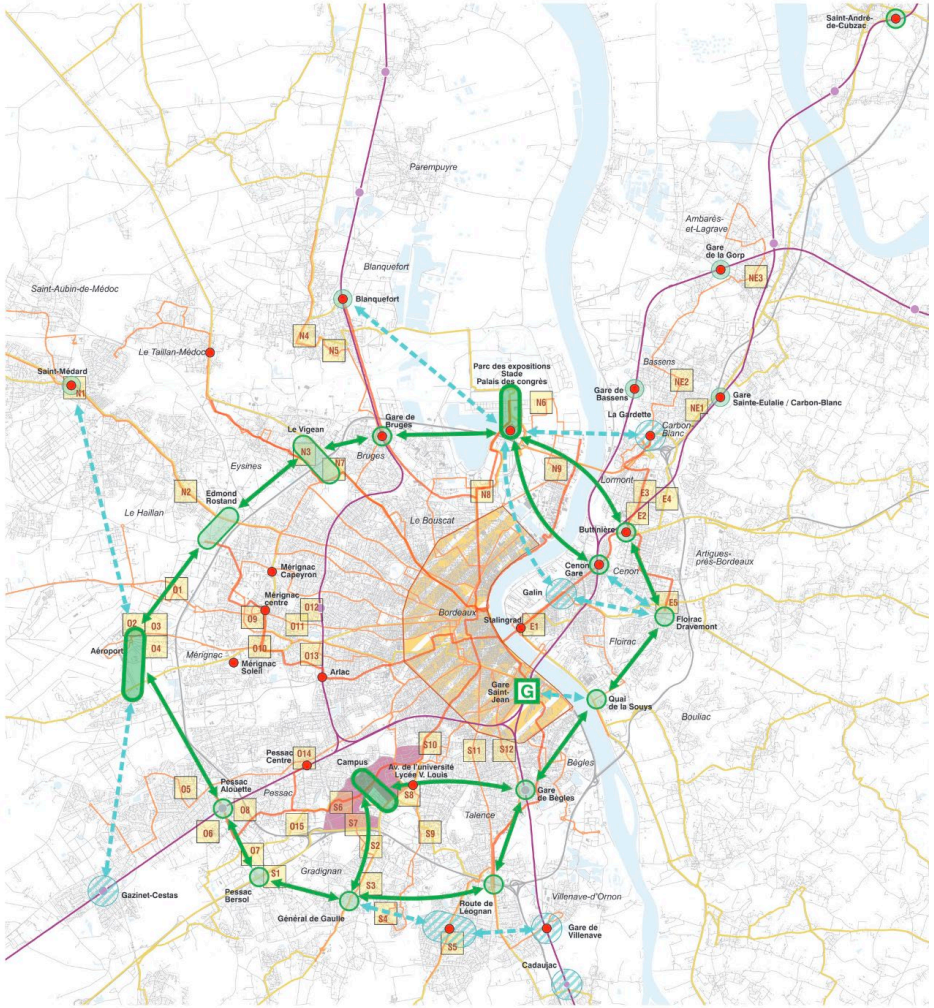
Population: 830 000
(Bordeaux: 256 000)
+15% in 10 years

France’s 4th largest metropolis

Area : 578 km²

MOBILITY CHALLENGES

A network centred on people mobility



Source : a'urba, Bordeaux Métropole, 2024

A negative perception of urban logistics

Freight transport is the responsibility of private operators, local authorities are not a "public operator".

Local authorities play a regulatory, planning and facilitating role : traffic and parking, road planning, economic development.

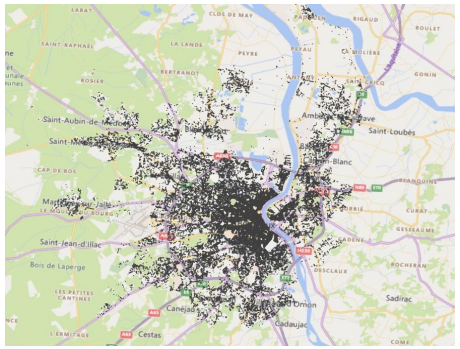
11am – city center

Reducing congestion
Improving air quality
Making public spaces safer
Eliminating negative externalities (noise)
Ensuring deliveries access

A "wall of trucks" on the Bordeaux ring road

AN EXPERIMENTAL TERRITORY

Micro-hubs, 2003



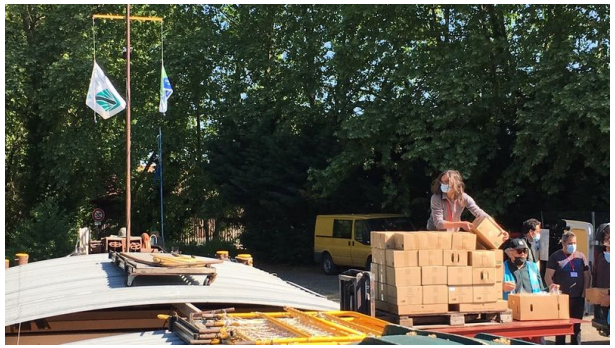
Urban freight survey, 2012-13

Tram freight pilot, 2015

Delivery by night, since 2016

Delivery by drone pilot, 2018

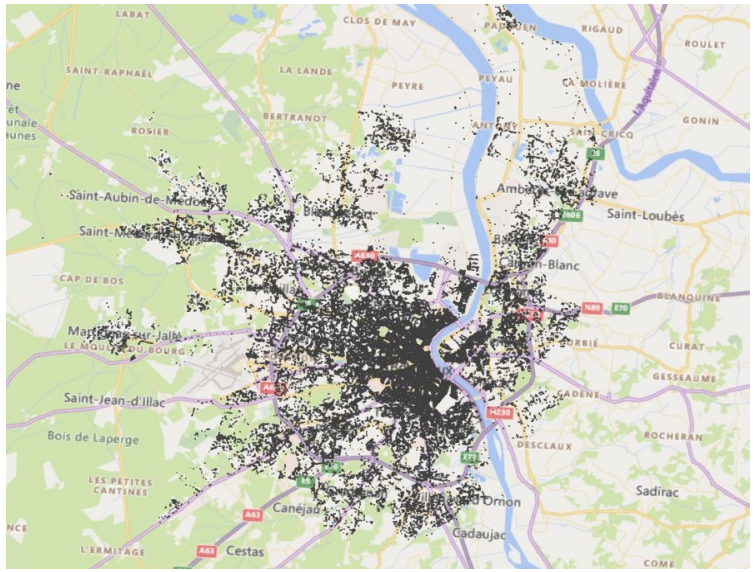
Cargo bikes, since 2020



Waterway delivery pilot, 2021-22

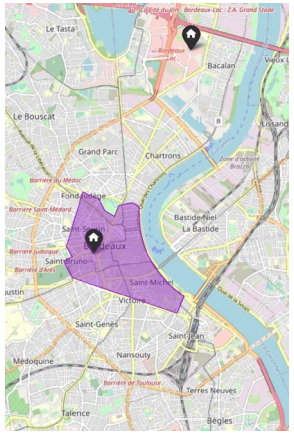
Low emission zone survey, 2023

A TERRITORY OF DATA



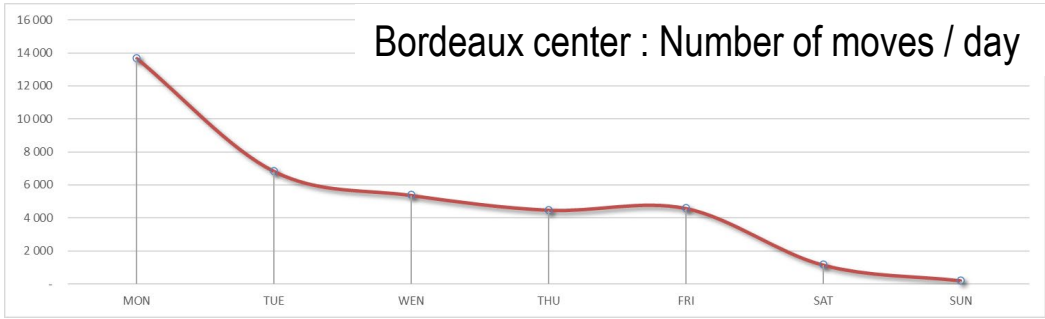
Source : Urban Freight Survey, Bordeaux, 2013

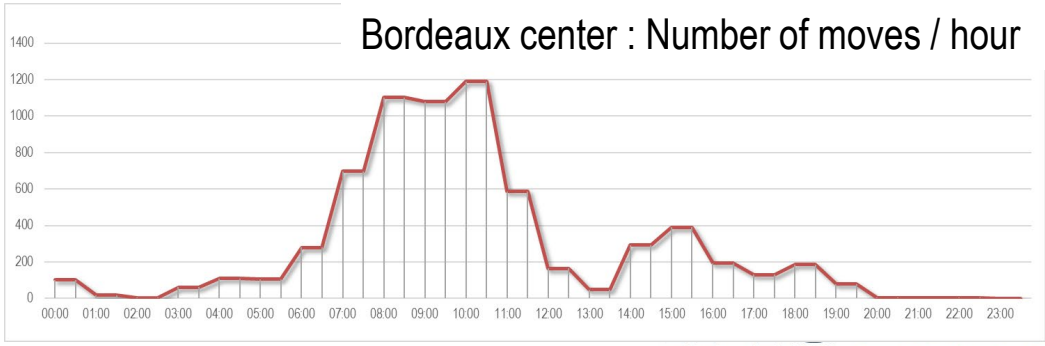
94,000 operations (picking & deliveries) everyday
70,000 B to B (economy generating logistics flows)
24,000 B to C (home delivery, lockers, click & collect...)



Complex zone (source : V. Salphati, 2023)

Parcel density (source : V. Salphati, 2023)



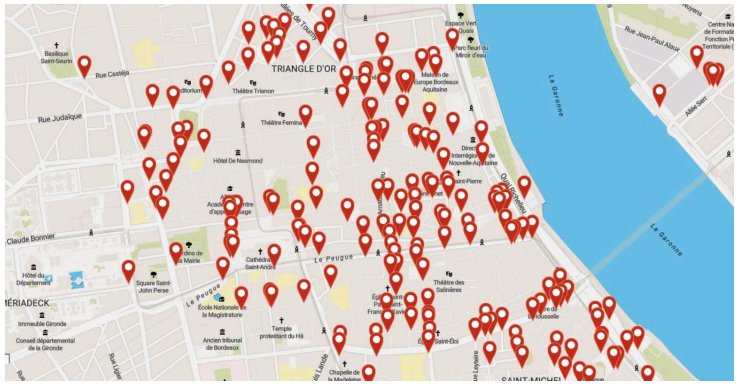


A LOW EMISSION TERRITORY

(Source : T. Baladon, 2023)

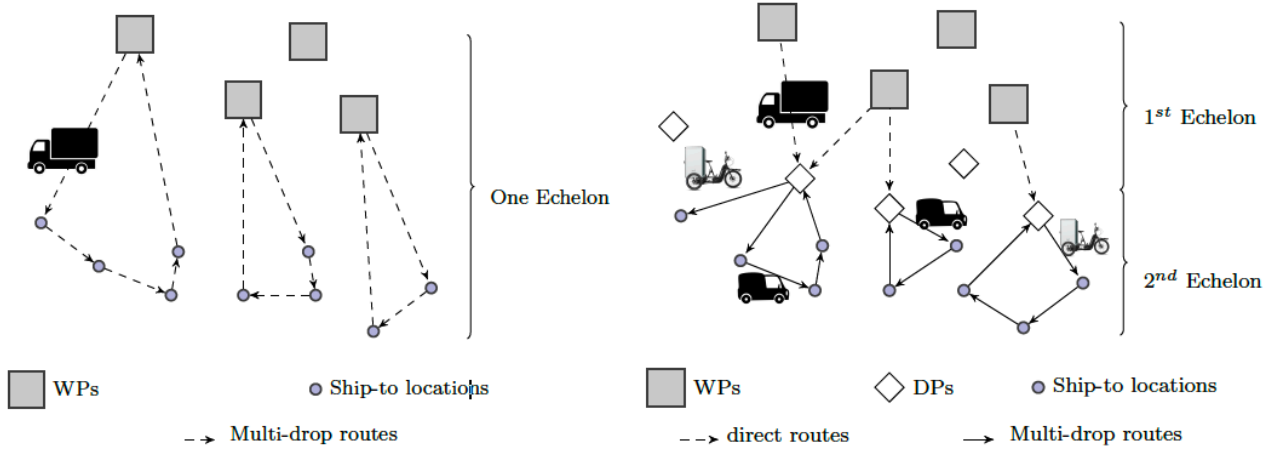
Access is prohibited with retractable bollards to ensure pedestrian safety

Deliveries are authorized between 7am and 11am, and limited to vehicles under 7.5 tons



(Source : opendata.Bordeaux-metropole.fr "Borne d'accès")

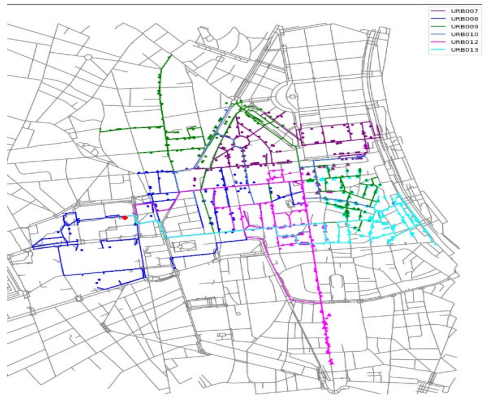
Cargo-bikes : 24/7



(a) One-echelon distribution network (b) Two-echelon distribution network

(Source : I. Ben Mohamed et al., 2023)

(Source : J. Leveque et al., 2023)



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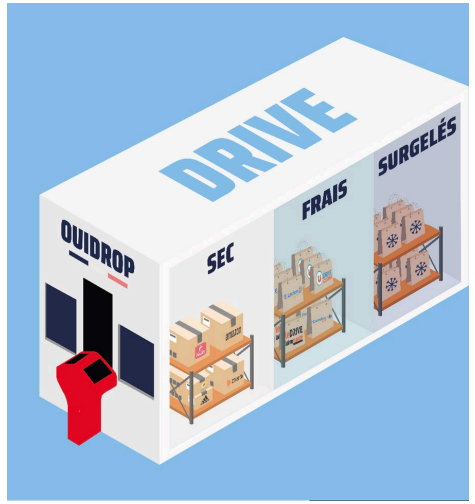
AN URBAN LOGISTICS TERRITORY

In May 2023, Bordeaux Métropole approved a new roadmap for the next 3 years.

Selected actions are grouped around the following areas:

- Integrating logistics flows in the city,
- Limiting emissions generated by logistics,
- Welcoming logistics activities in the city,
- Defining governance and spaces for exchange,
- Supporting start-ups.

OUIDROP : Designer of a robotic click & collect solution to provide a fully automated 3D storage space.



(Source : ouidrop.fr)

CONNECTING TRANSPORTATION SYSTEMS

Designing more efficient and sustainable urban logistics

Encapsulating goods in smart easy-to-handle and modular PI-containers

Enabling the emergence of Urban Logistics Webs

Van/trailer – Cubicycle
Source : DHL Group, 2016

Truck – Cargo Bike
City-Hub Rytle, 2018

Tramway - Cargo Bike
LastMileTram, 2019

Barge – Cargo Bike,
VNF, France, 2020

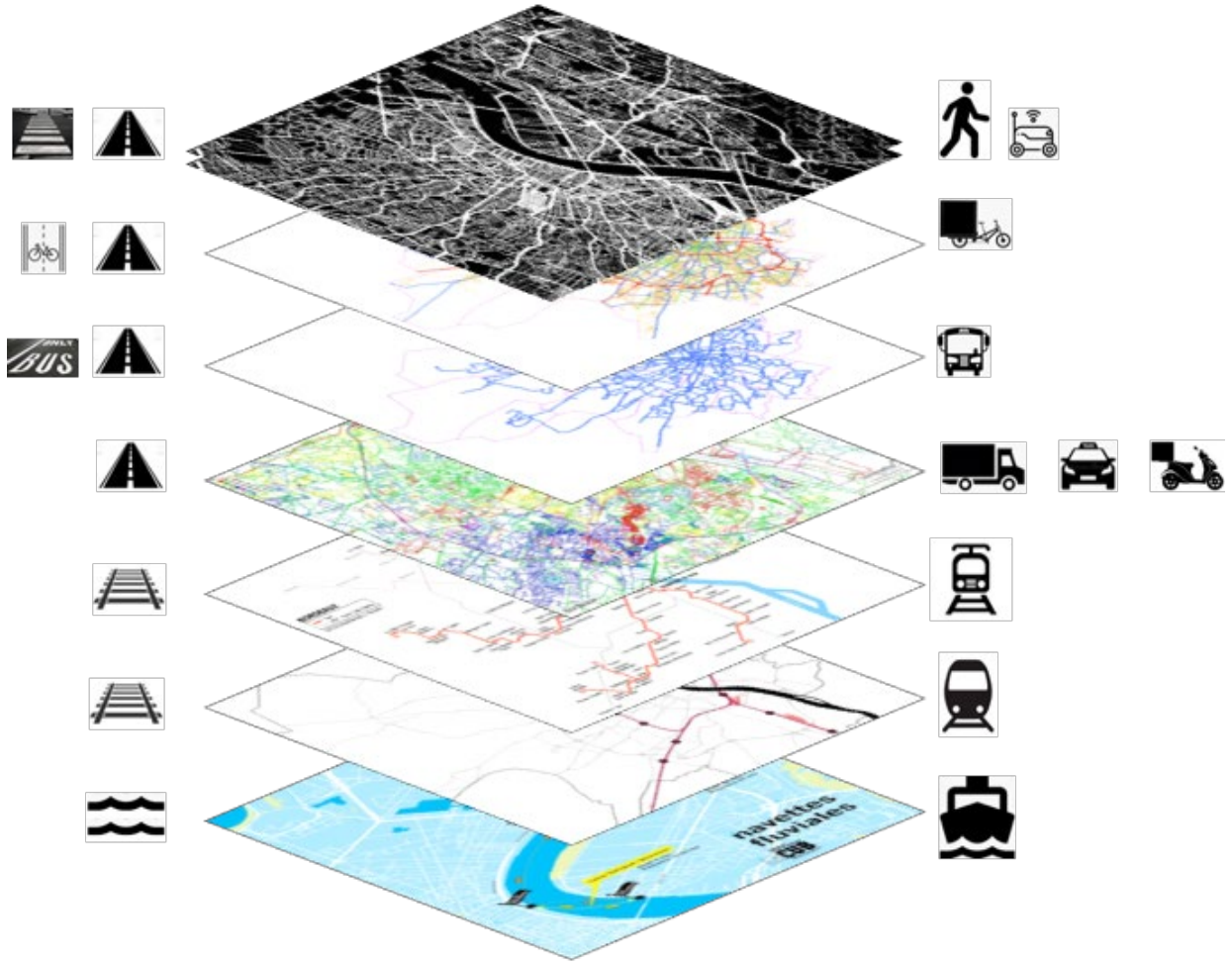
The Hub Company,
2022

MULTILAYER URBAN INFRASTRUCTURE

Hyperconnected City Logistics calls for novel approaches

Planning and responding for capacity and resources aligned with the emerging urban needs and challenges

Relying on the potential of exploitation of a network of networks



Source : O. Labarthe, G. Ahmadi, W. Klibi, J.-C. Deschamps, B. Montreuil, A sustainable on-demand urban delivery service enabled by synchromodality and synergy in passenger and freight mobility, *Transportation Research Part C: Emerging Te*chnologies, Vol. 161, 104544, 2024.

MULTIMODAL URBAN MOBILITY

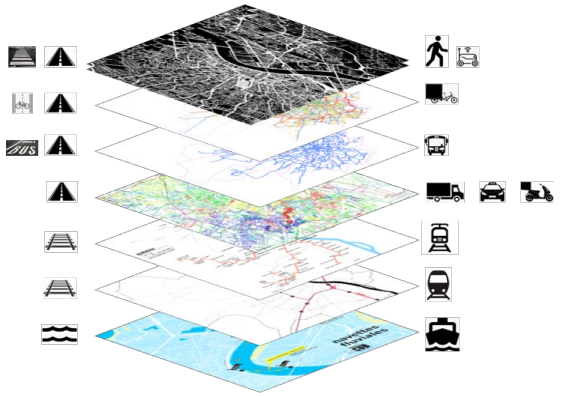
Underutilized spare capacity in **public transportation**

Multitude of mobility options in urban areas

+

Spare capacity in public transportation

How to transship goods based on the joint use of public transport modes and on-demand freight modes ?

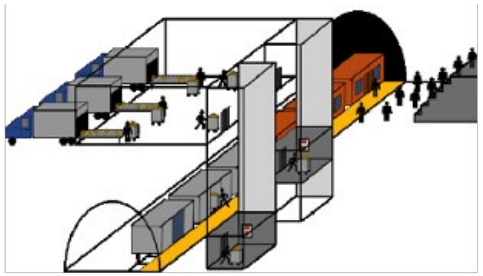


Different transportation **modes**

Synergies between Freight and People mobility

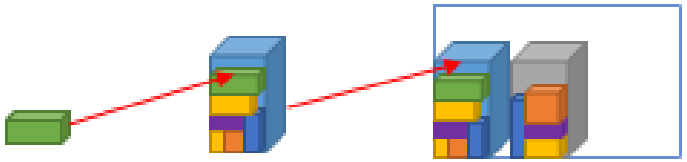
TRAM-FRET Pilot, Bordeaux, France, 2015.

Combined Passenger-Cargo, Miyazaki, Japan, since 2014.

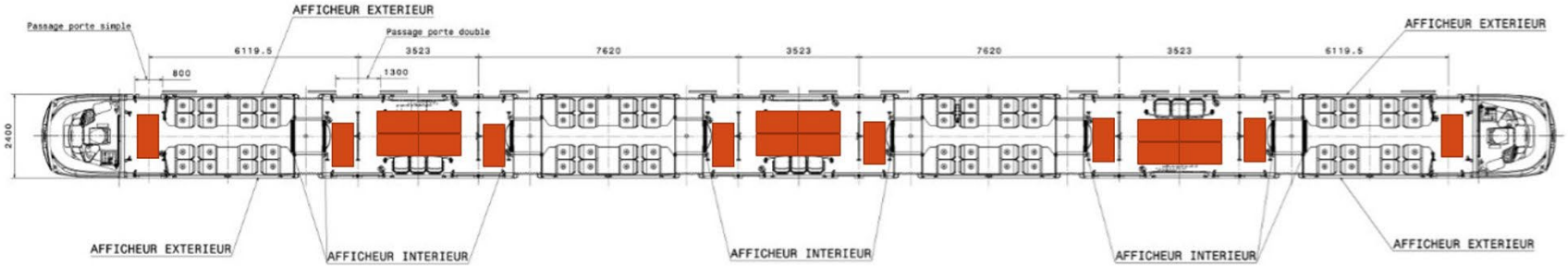


Subway Delivery (Montreuil *et al.*, 2018)

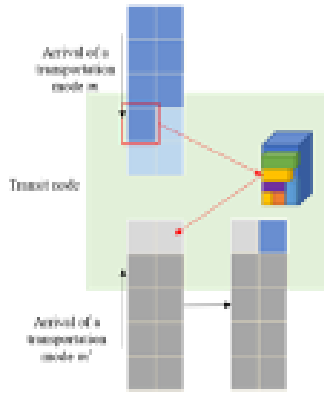
URBAN PARCEL DELIVERY CONSIDERING TRAMWAY



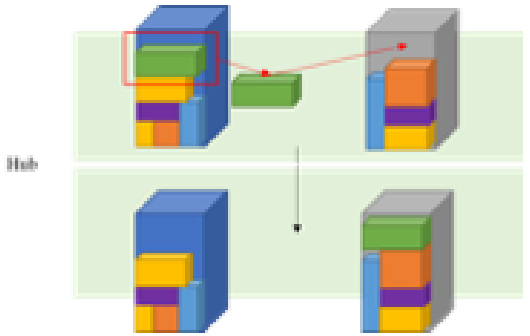
Parcel container,
Source : project-mo.de, 2020.



- ***Transshipment :*** Moving a container from a mode m to a mode m'



- ***Reload :*** Moving a parcel from a container Q to another container Q'

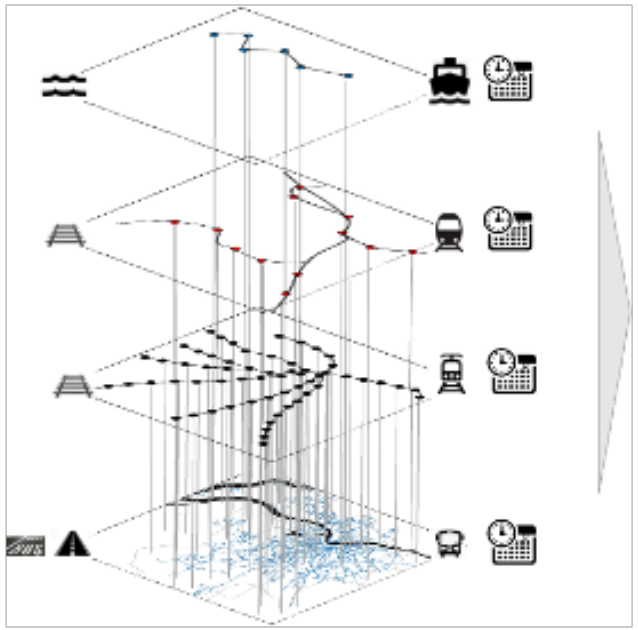


HCL INTEGRATING PEOPLE MOBILITY NETWORKS

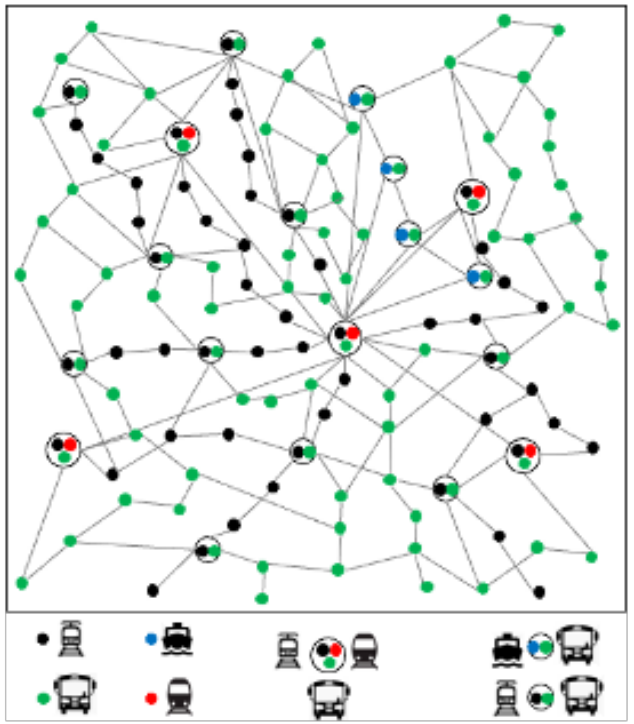
Investigates the feasibility of goods transshipment with a joint usage of public mobility and freight urban vehicles

Assess the potential benefit of a joint mobility system for goods delivery in urban areas

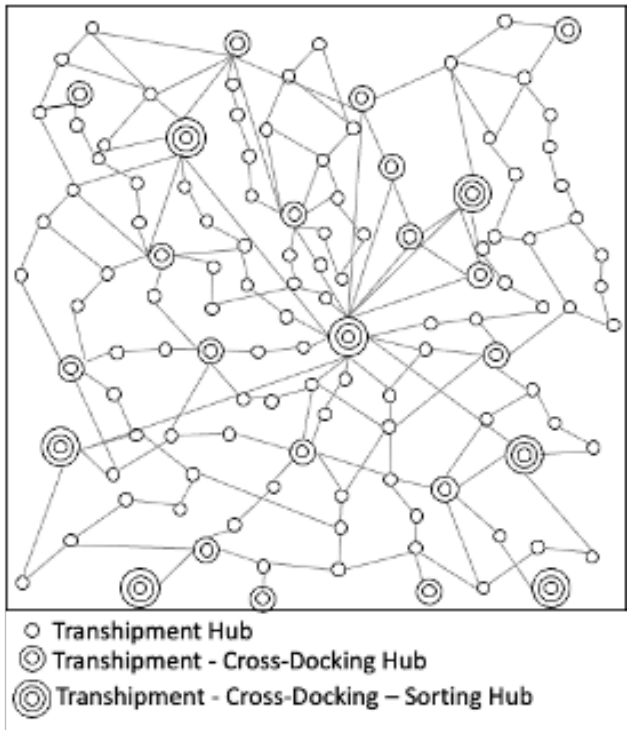
Multi-layer representation of the scheduled public transportation network



Urban area interaction network for passengers



Hyperconnected transshipment based on people mobility networks

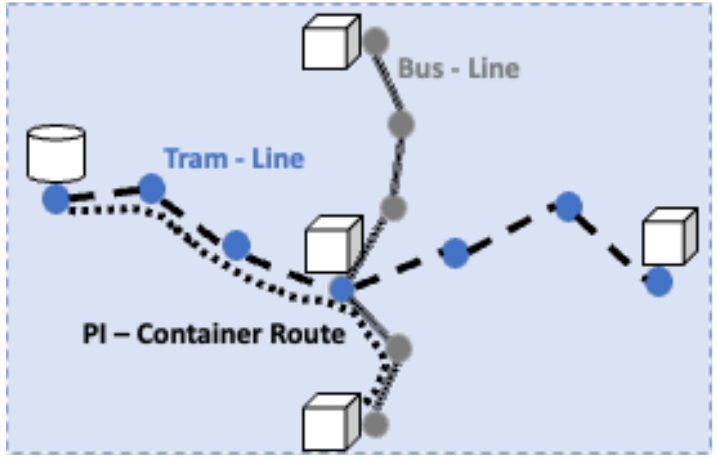


HYPERCONNECTED URBAN SYNCHROMODALITY

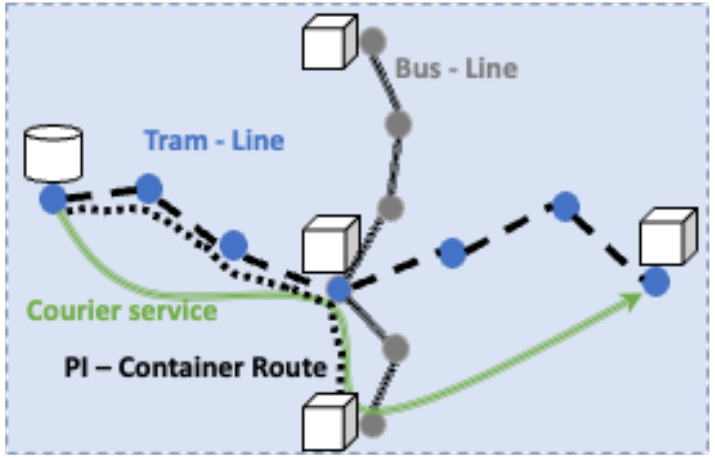
Network-based Hyperconnectivity	Freight Mobility (excluding Air)		
	Multimodality (Traffic-centered)	**Intermodality (Loading units-centered)**	**Urban Synchromodality (Time-centered)**
Low	# of planned freight modes = 2 Waterway-Rail OR Waterway-Road OR Rail-Road	# of planned freight modes = 2 Combined Transport *Road usage as short as possible* (Waterway-Road) OR (Rail-Road) Co-modality *Optimal & sustainable utilisation of resources* (Waterway-Rail) OR (Waterway-Road) OR (Rail-Road)	# of transportation modes =2 Planned dedicated freight mode (Waterway or Rail or Road) On-demand freight mode (Waterway or Rail or Road) Scheduled Public transport mode (Waterway or Rail or Road)
High	# of planned freight modes > 2 Waterway & Rail & Road	# of planned freight modes > 2 Combined Transport *Road usage as short as possible* Waterway & Rail & Road Co-modality *Optimal & sustainable utilisation of resources* Waterway & Rail & Road	# of transportation modes > 2 Planned dedicated freight mode (Waterway or Rail or Road) On-demand freight mode (Waterway or Rail or Road) Scheduled Public transport mode (Waterway or Rail or Road)

MULTIMODAL ON-DEMAND TRANSSHIPMENT

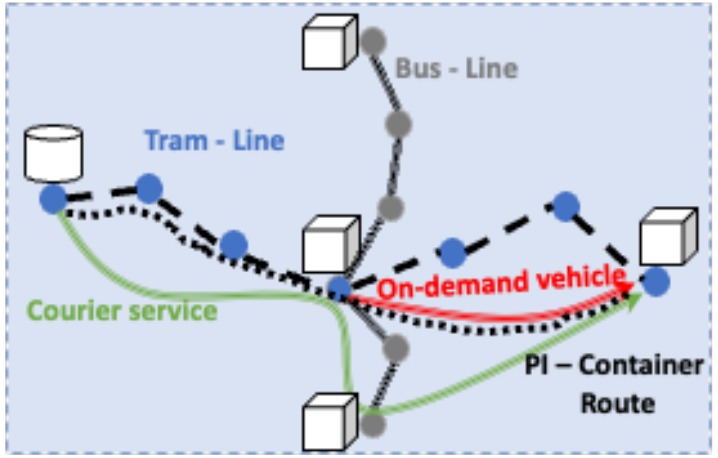
Public scheduled transport



Multimodal scheduled delivery



Multimodal & on-demand delivery



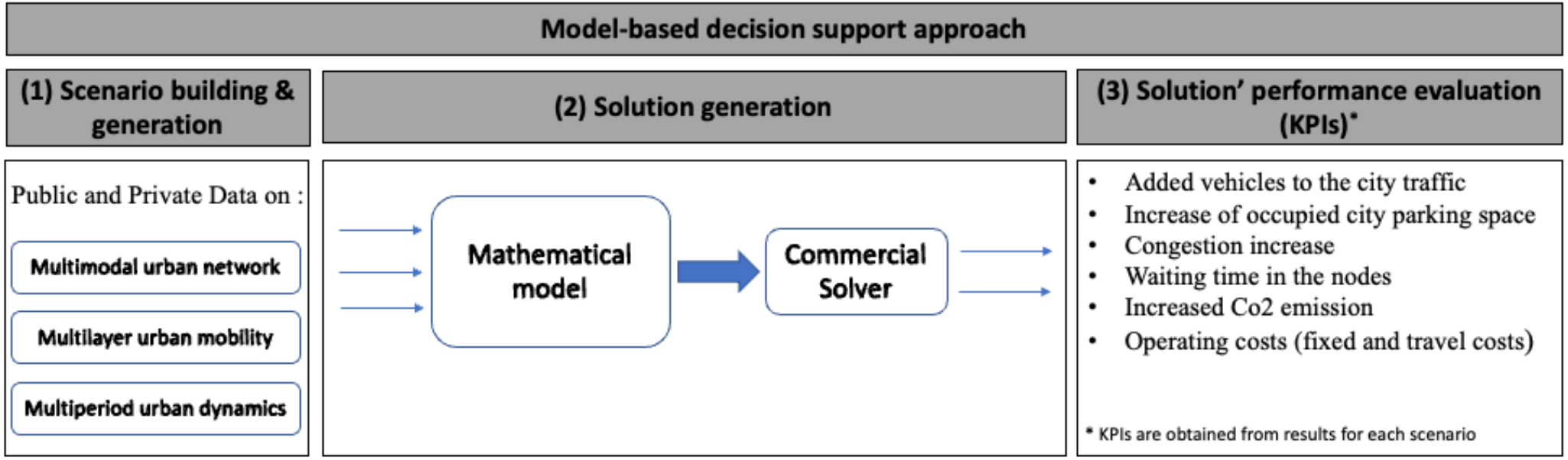
Local hub
Access hub
Rail
Road
Tram
Bus
Road
Courier service
Road
On-demand vehicle
PI – Container Route

Multiple transportation options for each PI–Container.

More possibilities to satisfy due dates.

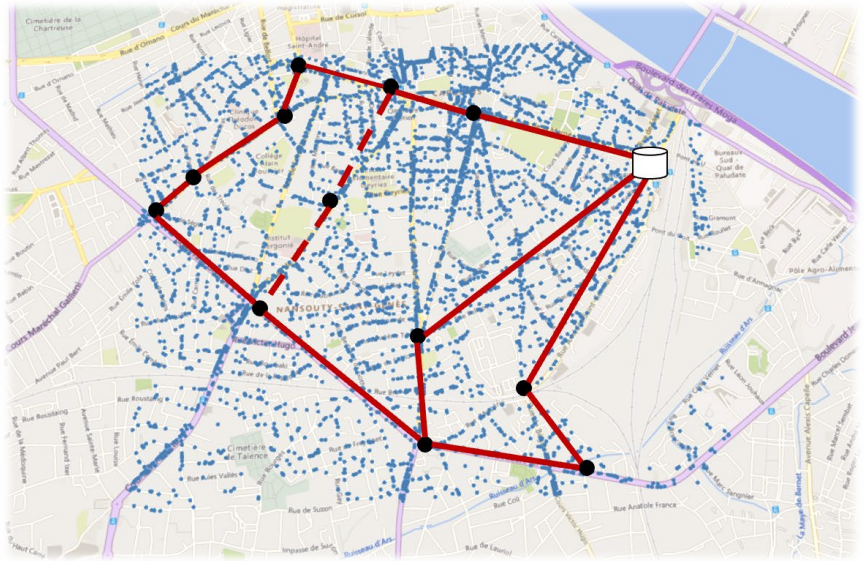
THREE-PHASE DECISION SUPPORT APPROACH

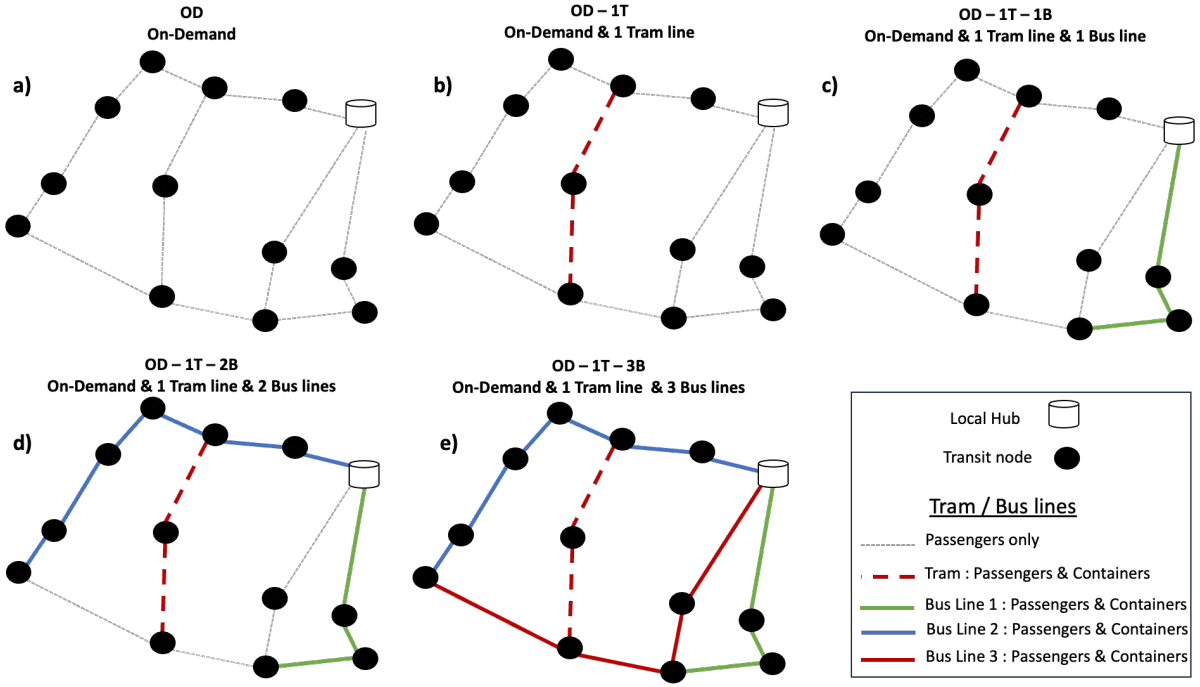
Minimize the impact of containers' journey in the time and space of urban transport network.

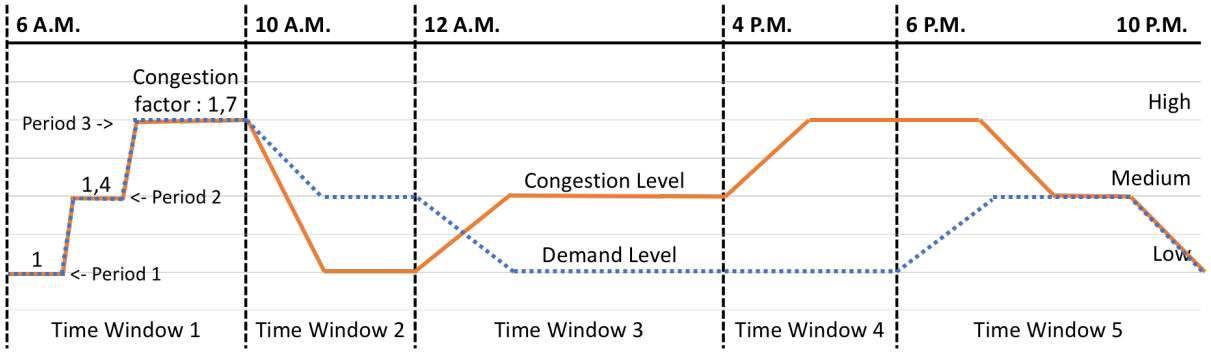


The objective considered in this planning problem is to commit to a high service level (all requests delivered before the due date) with the minimum urban footprint.

CASE STUDY OF THE CITY OF BORDEAUX





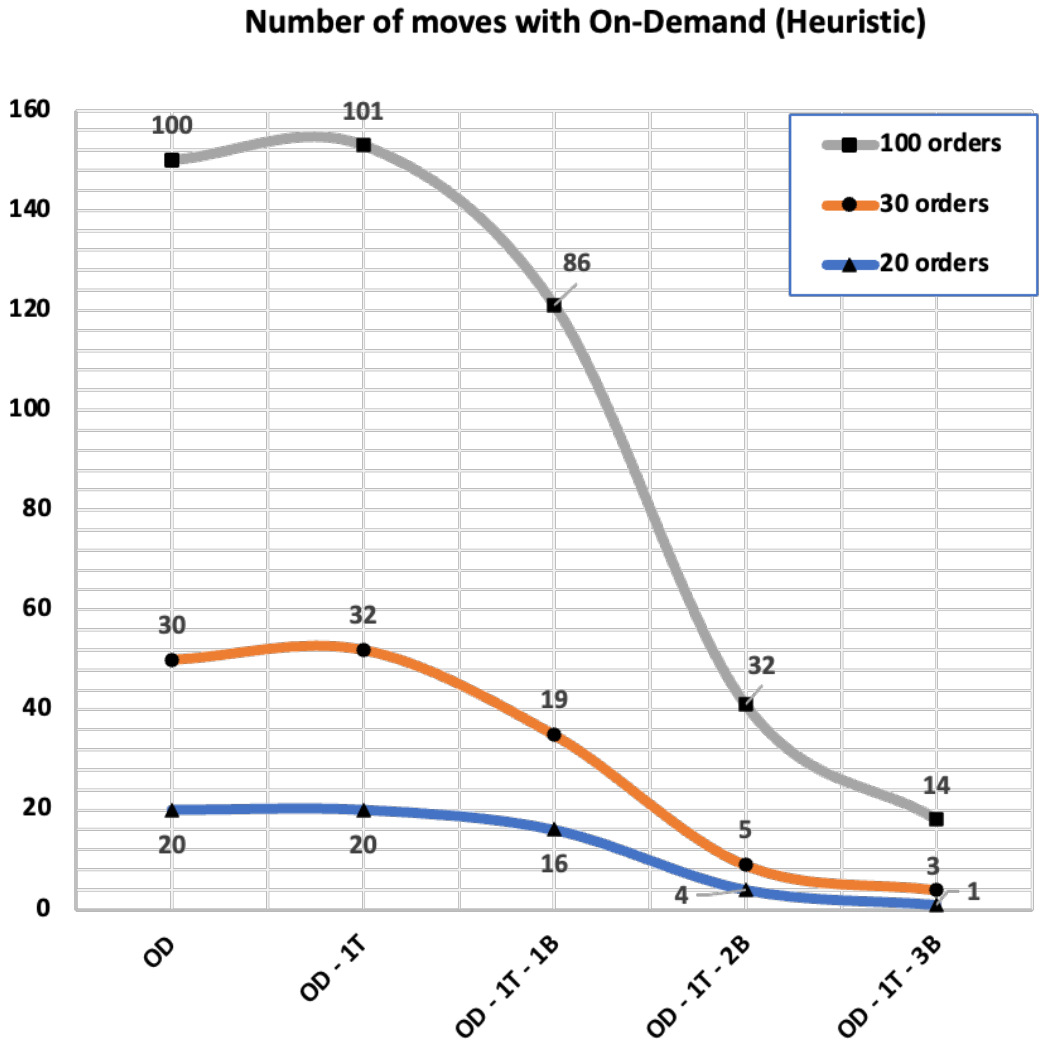


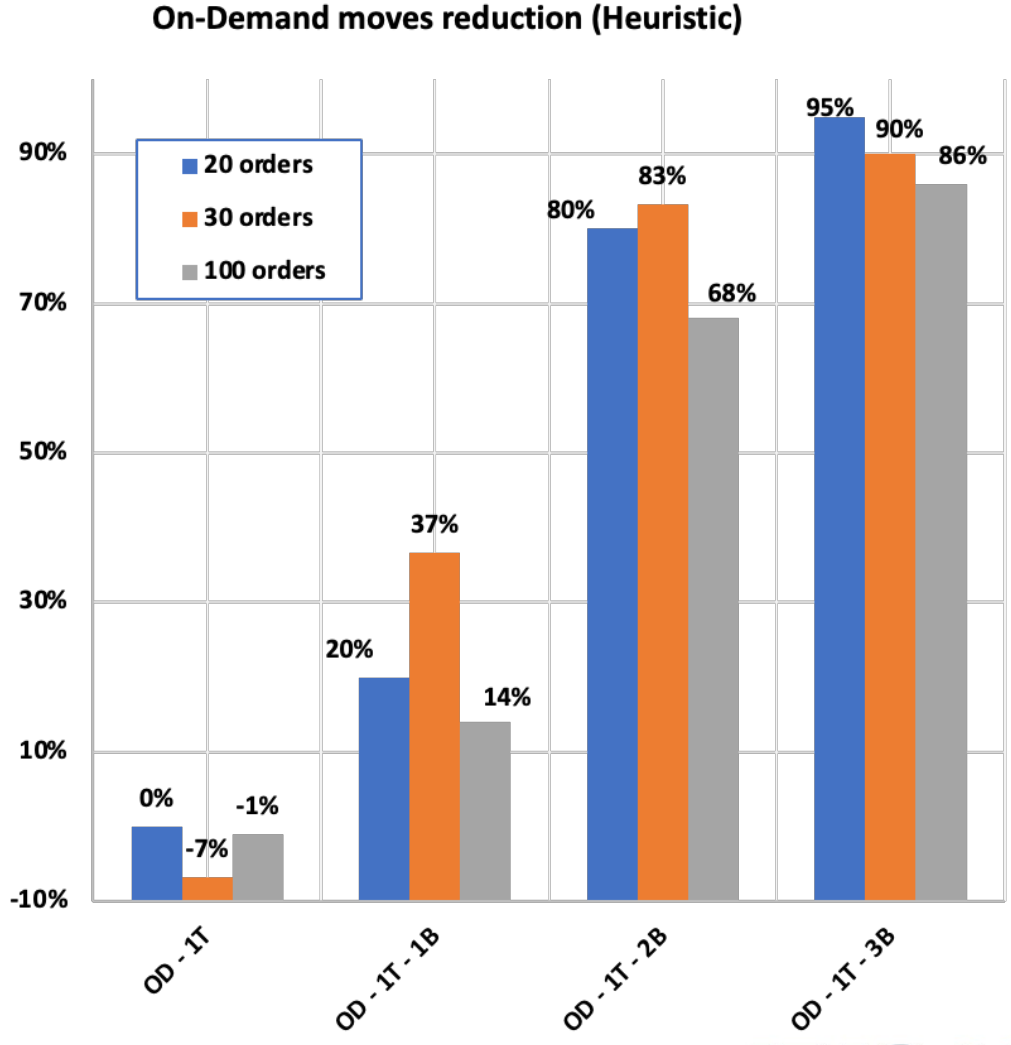
Travel-time based on transport mode and congestion factor.

Capacity of each transportation mode vary during the day.

Capacity decrease with the increase of congestion level.

IMPACTS OF NETWORK CONNECTIVITY

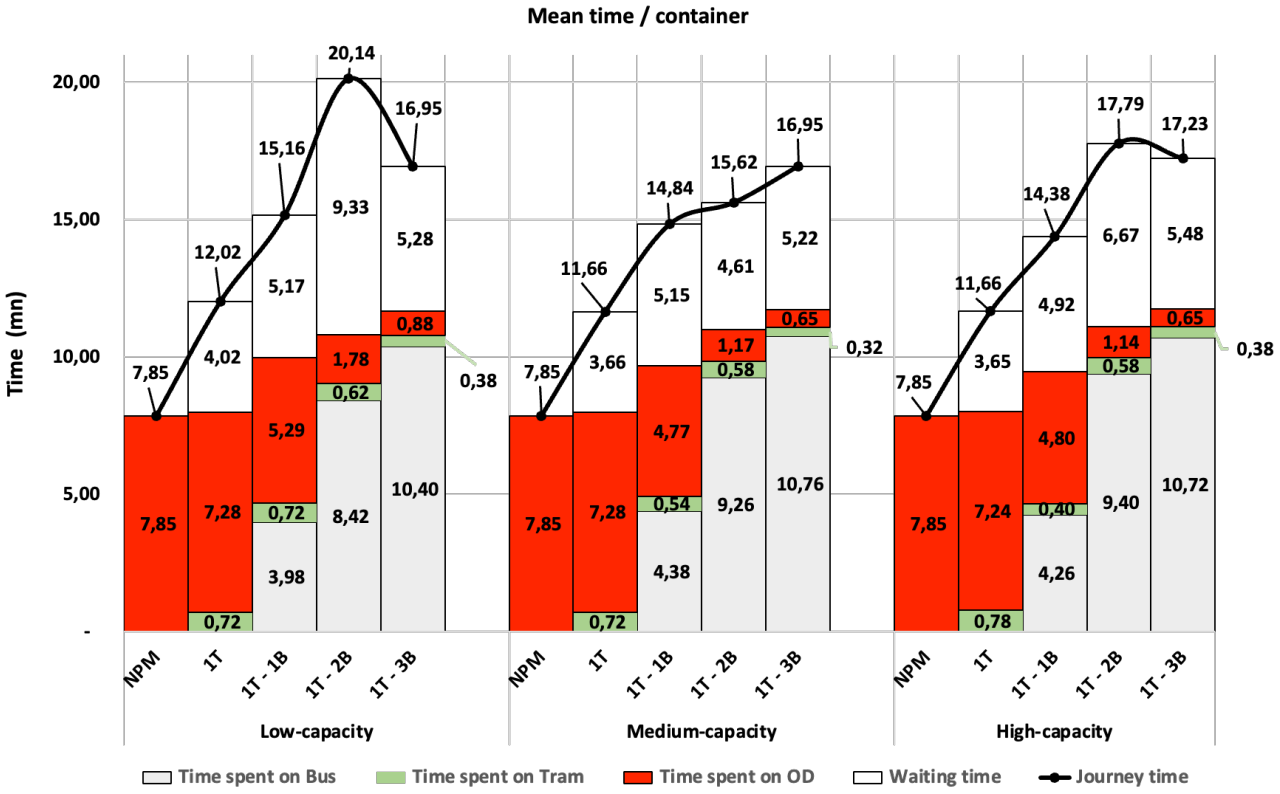


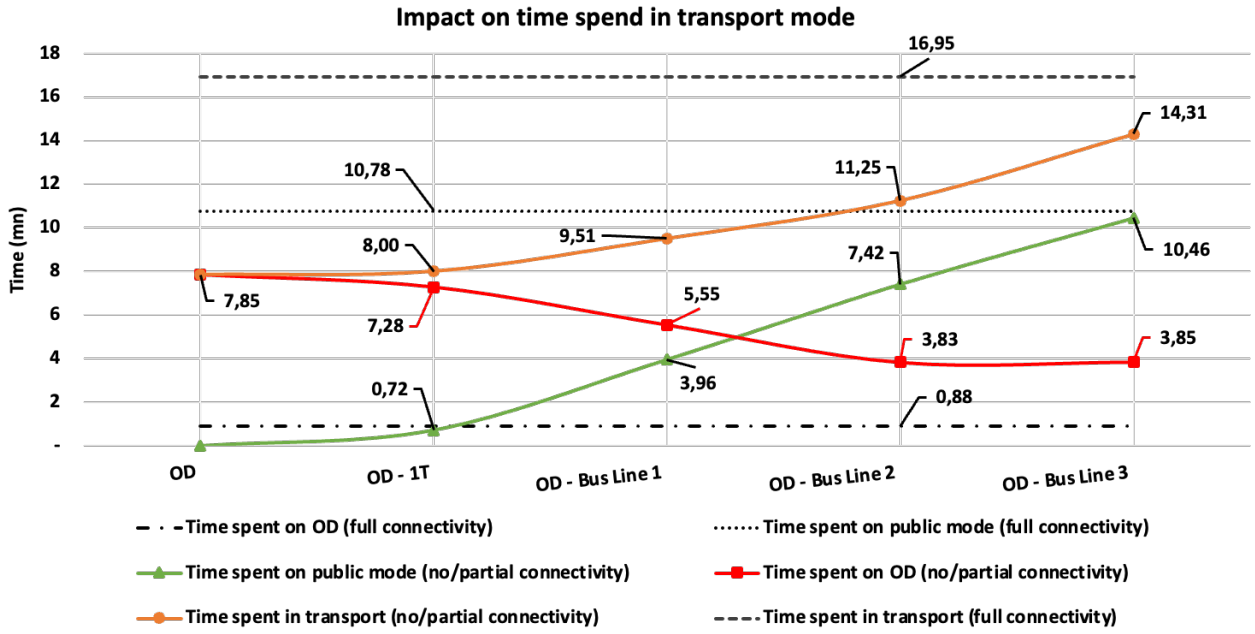


IMPACT OF TRANSPORT CAPACITY

Transportation mode capacity (Container)

Public transportation mode	*Low-capacity level*	*Medium-capacity level*	*High-capacity level*
Tram	8	20	25
Bus	8	15	25
On-demand vehicles			
Cargo bike	1	1	1
Van	1	1	1





CONCLUSIONS AND PERSPECTIVES

New approach for urban freight transshipment based on joint use of on-demand mode and public transport

The role of synchromodality reducing parcels footprint and congestion levels

Extending the model to consider several local hubs, more vehicle types/services in an on-demand mode

MOBILE

Micro-depots UPS, Hamburg, Germany, 2012.

Mobile depot TNT Express, Brussels, Belgium, 2013.

CubiVan, City-Hub, Source : DHL Group, Germany, 2017.

City-Hub Rytle, Source : Krone Group, Germany, 2018.

EZ-PRO Renault & DPDgroup scenarios, 2018.

STATIONARY

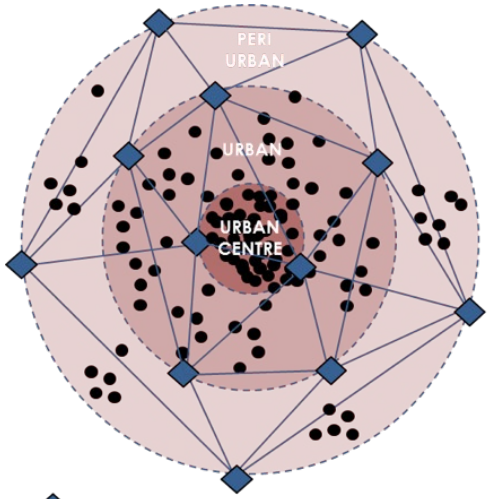
Micro-platform project, Bordeaux, France, 2003.

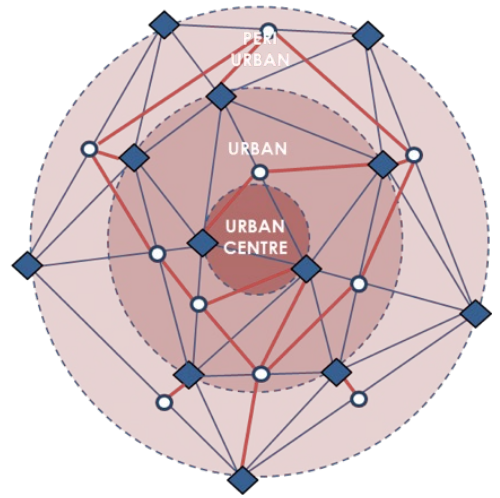
Micro-platform project, Barcelona, Spain, 2014.

KoMoDo project, open micro hub, Berlin, Germany, 2018.

Micro depot in public spaces, source : DPD, Germany, 2019.

Micro-hub, Paketin GmbH 2020.





Towards a hyperconnected city Logistics : already addressed ten years ago

Thank you for your attention

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