



Pr. Eric Ballot



■ Introduction in Physical Internet

IPIC 2018

- Physical Internet
- The goals: efficiency, services, reliability and sustainability
- What is needed to make it work?
- First applications

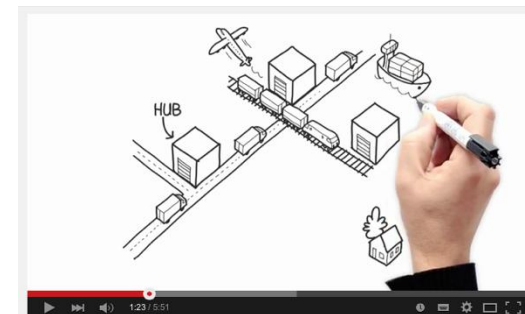


○ Definition

The Physical Internet is an interconnected global logistics system enabling seamless asset sharing and flow consolidation

The Physical Internet is founded on universal physical, digital, operational, business and legal interconnectivity achieved through standard open protocols, “encapsulation”, certification, performance assessment and monitoring.

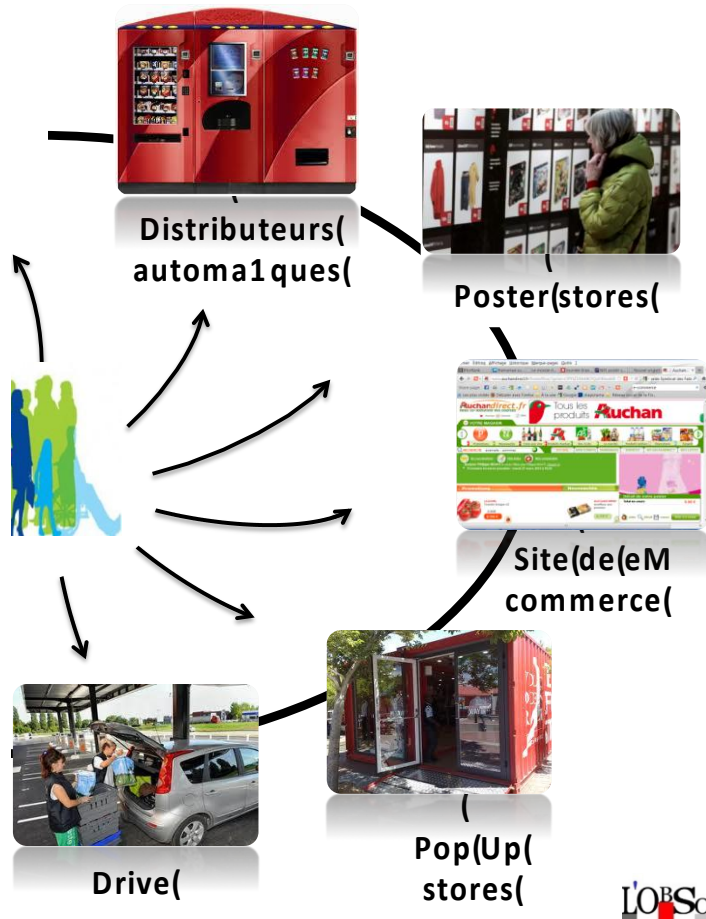
B. Montreuil, R. D. Meller & E. Ballot, June 9th, 2011



More and more fragmented deliveries

○ Logistics works! But several trends are against its sustainability

- Fragmented shipments in space and time



From mass transport to...

○ Logistics works! But several trends are against its sustainability

- Shipment median weight divided by 4,5 in 16 years in France.

160 kg in 1988 - 30 kg in 2004

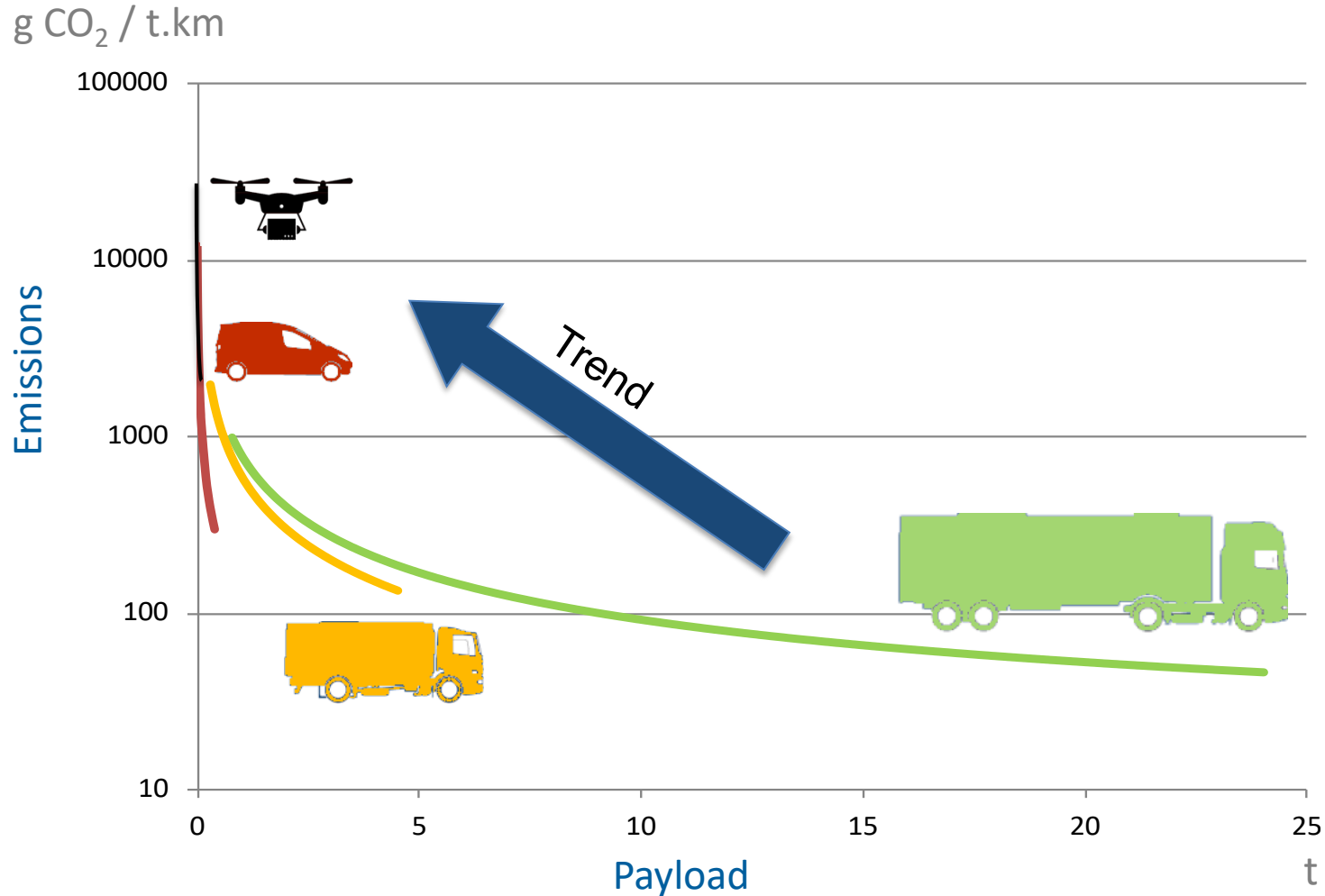
Source IFSTTAR 2013 – freight network

- In 2020? 6.6 kg ?
- In 2030? 1.5 kg?



Impact on transport means

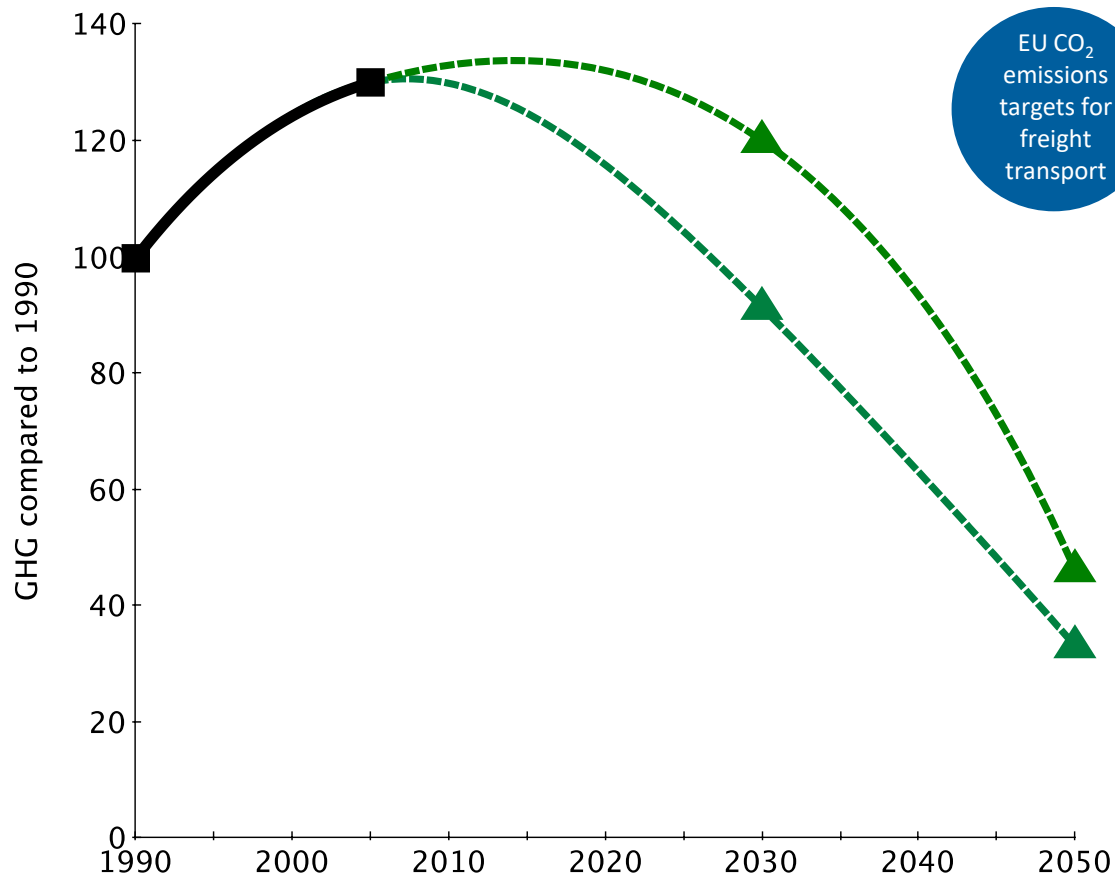
- Economies of scale are more and more difficult to obtain



Source: COST 319, Estimation of Pollutant Emissions from Transport. Final Report of the Action. Scientific State-of-the-art and Network of European Scientists

A strong contradiction with sustainability

- Sustainability is out of reach with business as usual

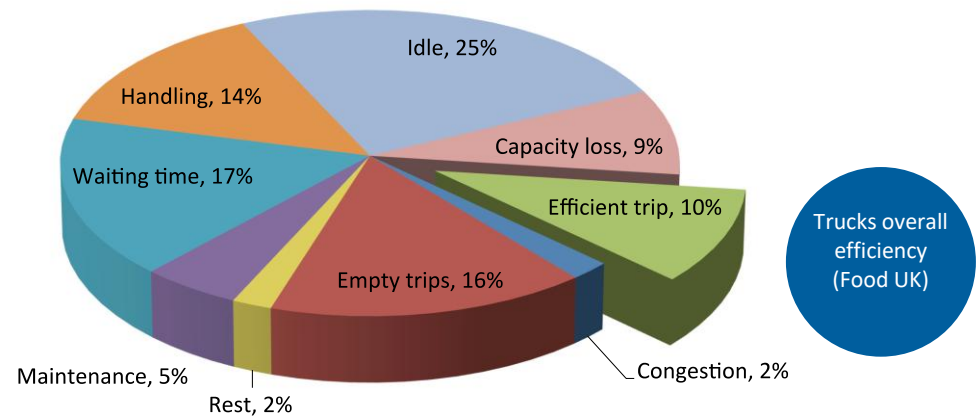


**-60% /1990 with the growth of traffic implies
-95% in 2050 of individual emissions!**

The goals of physical internet

○ Main properties of a meshed network of networks vs. overlapped dedicated networks

- Flow concentration
 - Competition on services: best services to attract more flows
 - Utilization of less means and less infrastructure for the same t.km
- Reliability and resilience
 - Alternate routes
 - Decentralized inventory
- Sustainability
 - -60% of CO₂
 - More direct routes -15% of t.km
 - No sizing at the peak of activity
- New services
 - Warehouse as a service
 - IP service provider

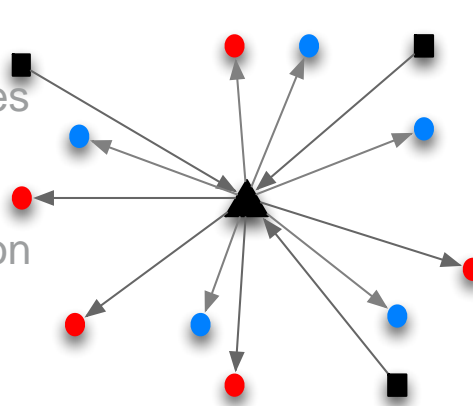


McKinnon, A., Y. Ge, and D. Leuchars, *Analysis of Transport Efficiency in the UK Food Supply Chain*, L.R. Centre and S.o.M.a. Languages, Editors. 2003: Edinburgh. p. 38.

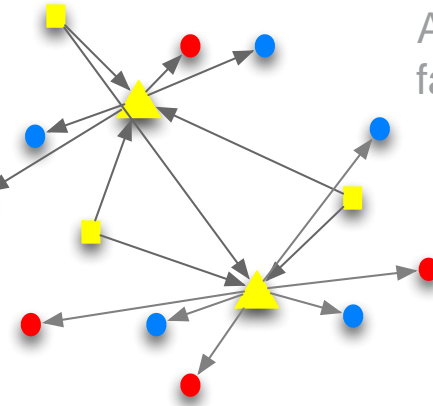
From dedicated networks

○ Change networks organization

A supplier with 3 factories distributes via a central warehouse 10 regional distribution centers of two customers



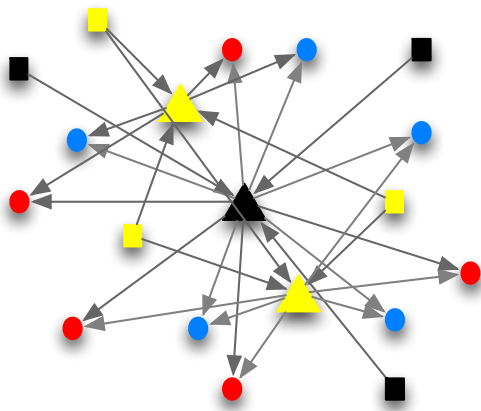
+



Another supplier with 3 factories distributes via 2 warehouses to 10 regional distribution centers of two customers

=

- DC of retail chain 1
- DC of retail chain 2
- Plant of manufacturer 1
- ▲ WH of manufacturer 1
- Plant of manufacturer 2
- ▲ WH of manufacturer 2

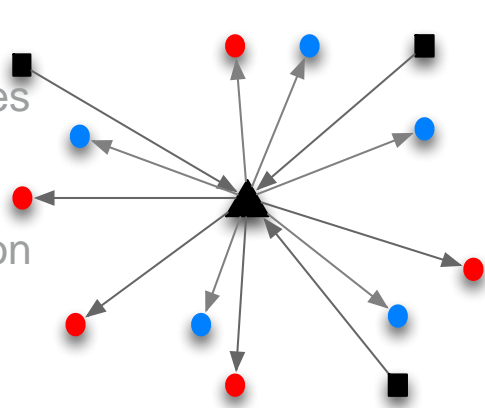


Two dedicated supply chains: overlapping each other

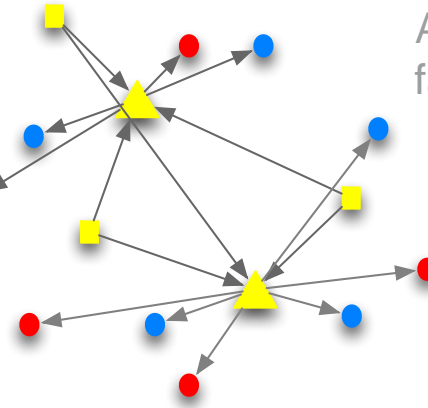
To interconnected networks

○ Change networks organization

A supplier with 3 factories distributes via a central warehouse 10 regional distribution centers of two customers



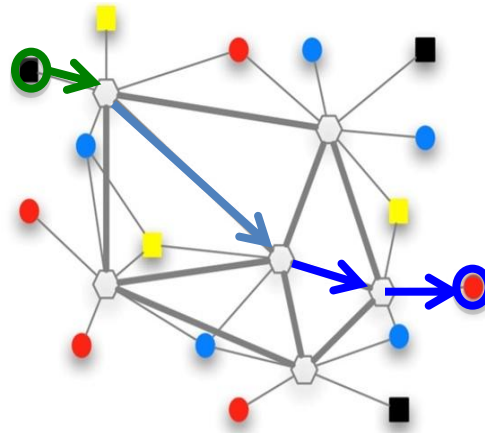
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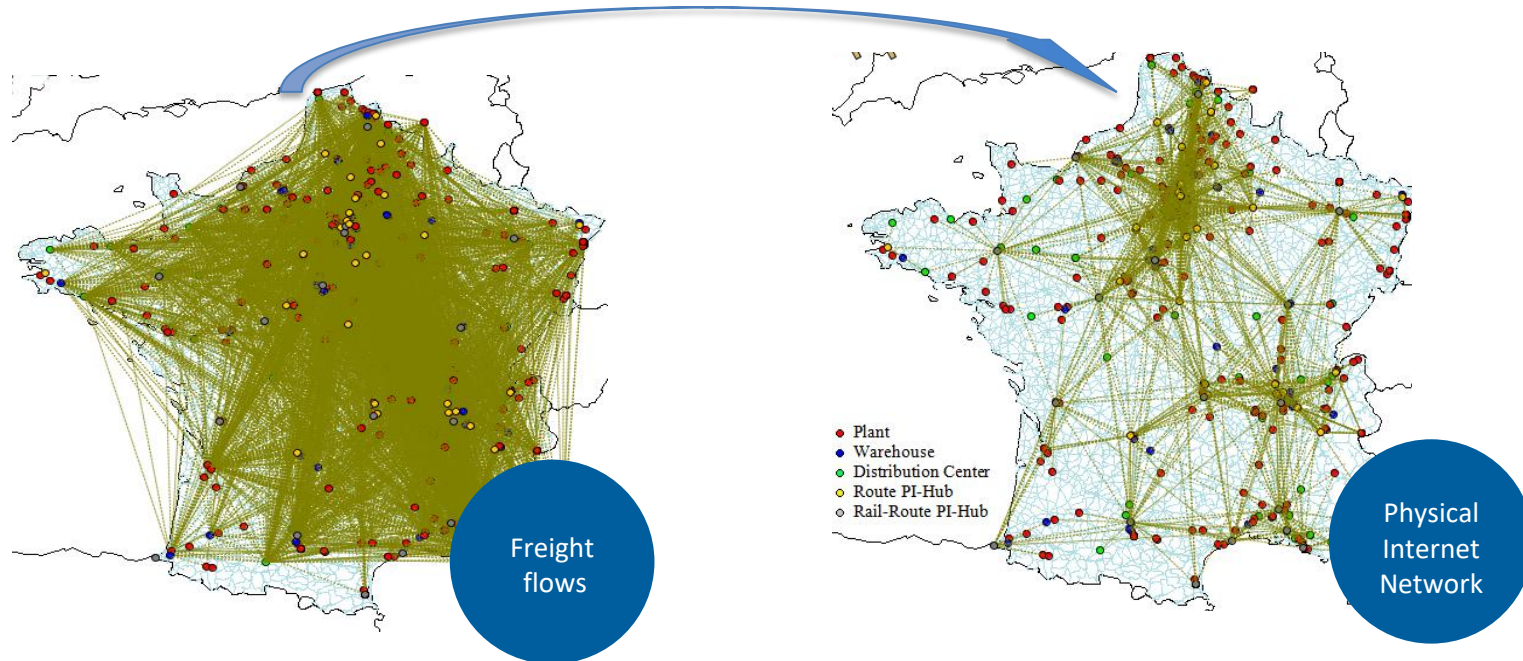
- DC of retail chain 1
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- ▲ WH of manufacturer 2



An interconnected network

A simulation model with 2 main retailers

○ If we have a reconfigured network it works...



Inventory: $\div 3$

CO₂: -60%

Tkm: -15%

Delivery failures: - x%

Loss of capacity: $\div 2$

Availability on shelves: +y%

Handling cost: $\div 3$

Empty trips : - z%

...

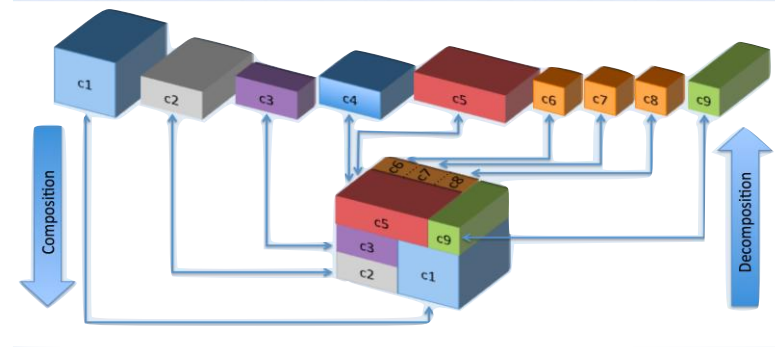
- A generalization of containerization: transport and handling containers small and modular boxes, pallets footprint free



Handling cost / 10 in 50 years



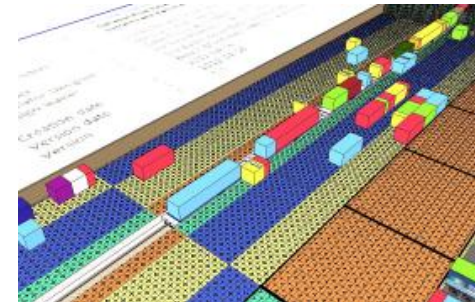
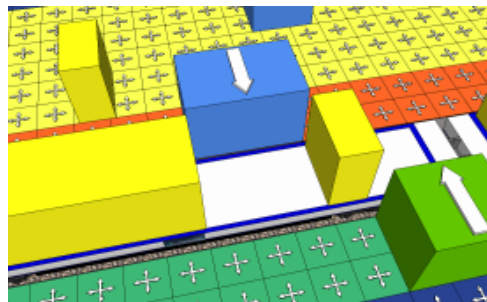
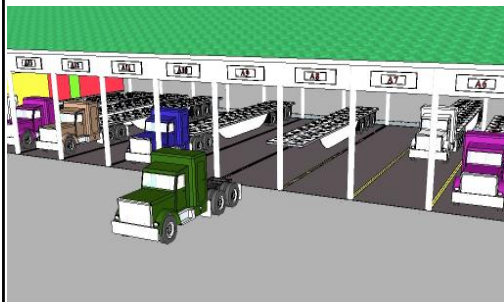
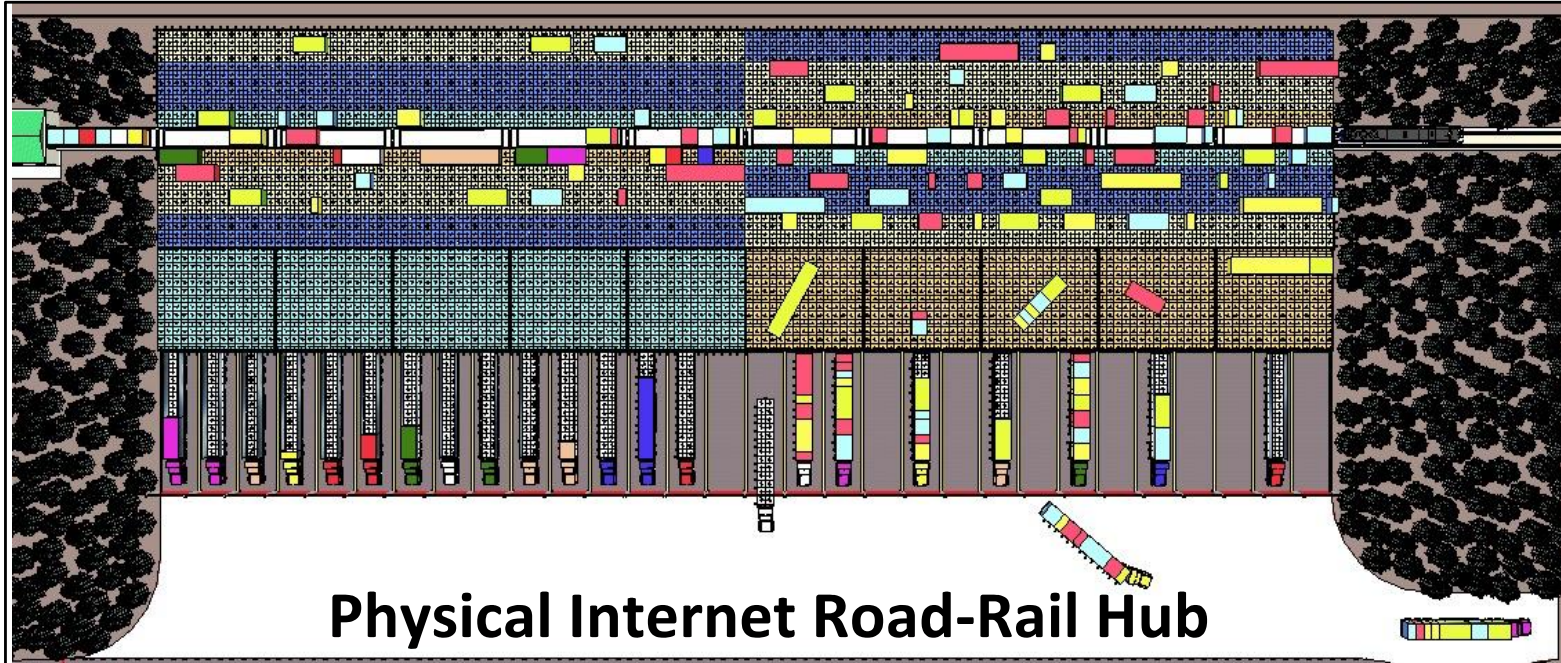
How to achieve the same improvement?



Montreuil, B., Meller, R. D. and Ballot, E. (2010). Towards a Physical Internet : the impact on logistics facilities and material handling systems design and innovation. In: AL., K. G. E. (ed.) *Progress in Material Handling Research, Material Handling Industry of America*

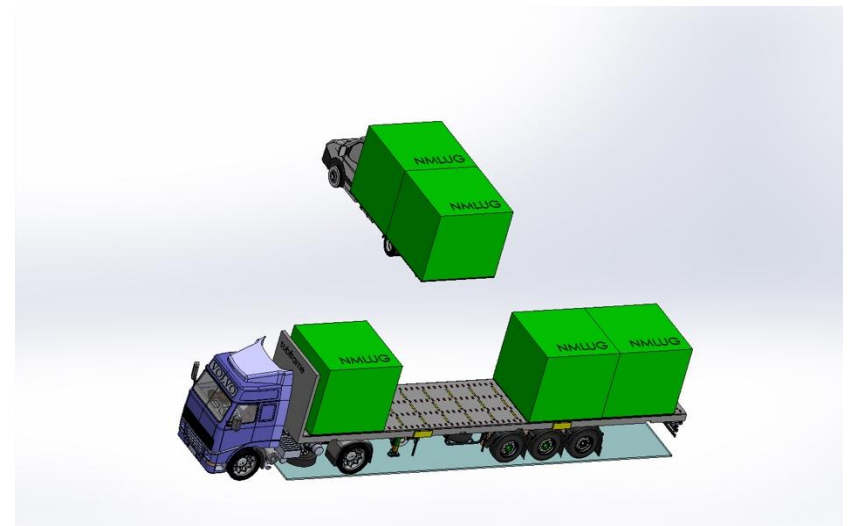
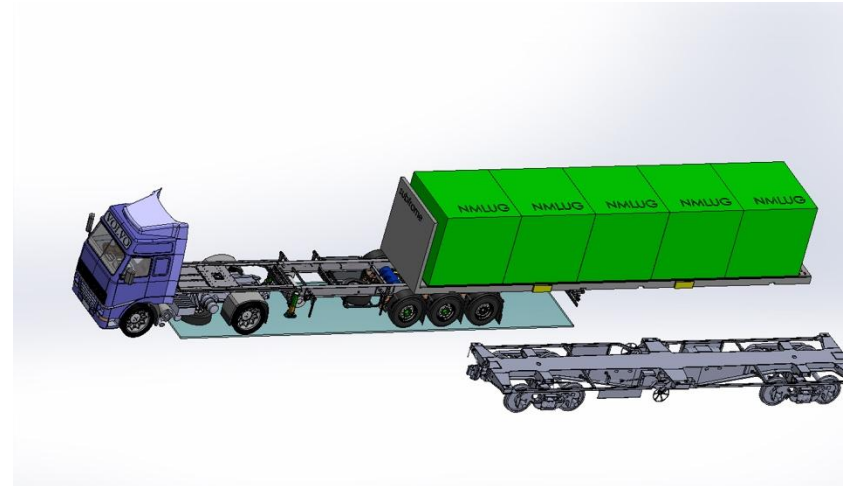
Nodes: an example

- Inspired by container terminals in ports



○ A set of modular containers for inland transportation

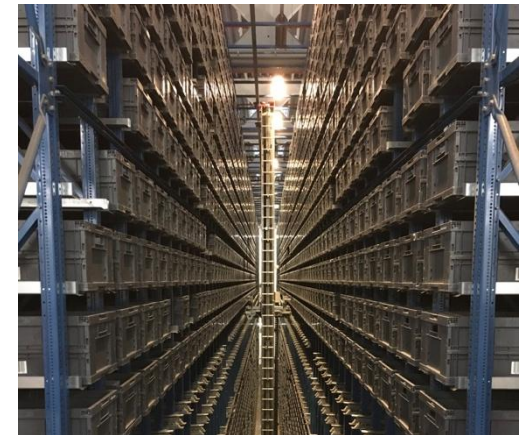
- A set of modular and multi modal containers for the trans European network and local services
- For fast movers: a full container from the suppliers to the users



Containerization: handling level

○ A set of modular boxes for inland transportation

- A set of modular boxes for all products
 - Handling productivity
 - Better space utilization
 - Proved lifetime > 10 years
 - Improved security: anonymization of the content, mixed goods and blocks sealed
 - Savings > 20% of logistics cost

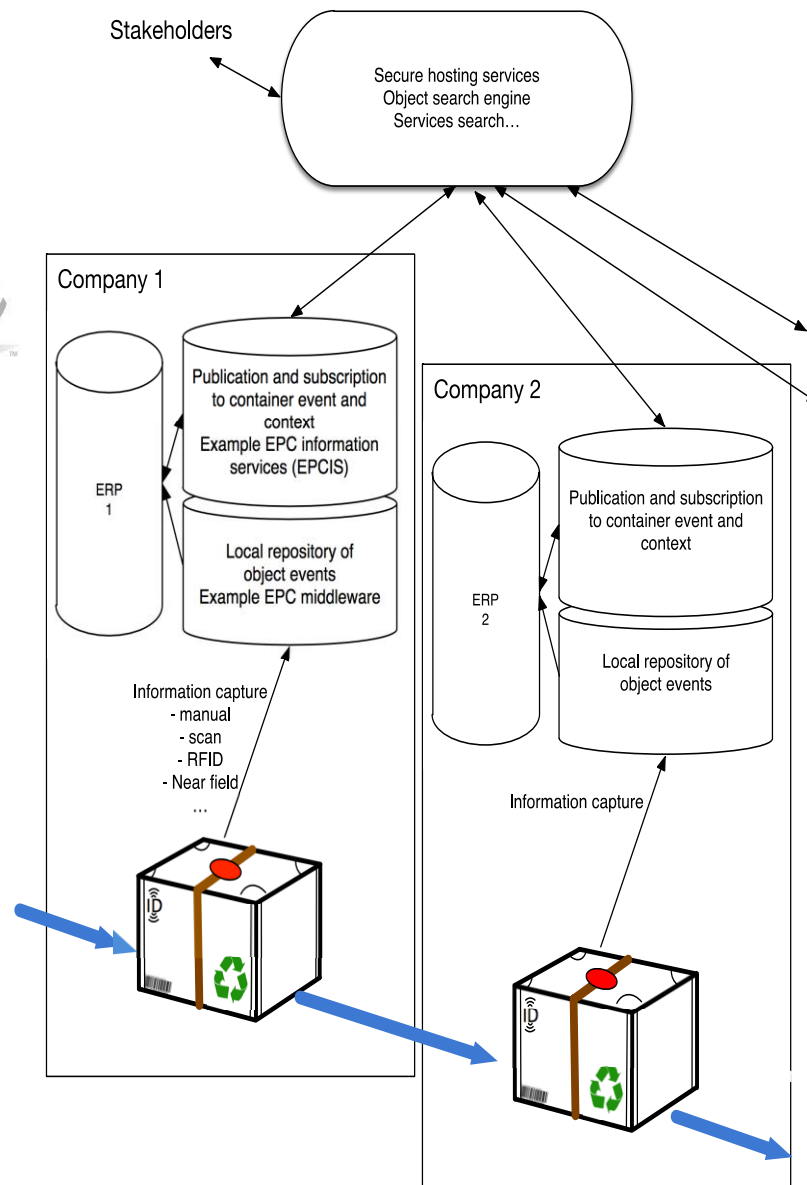
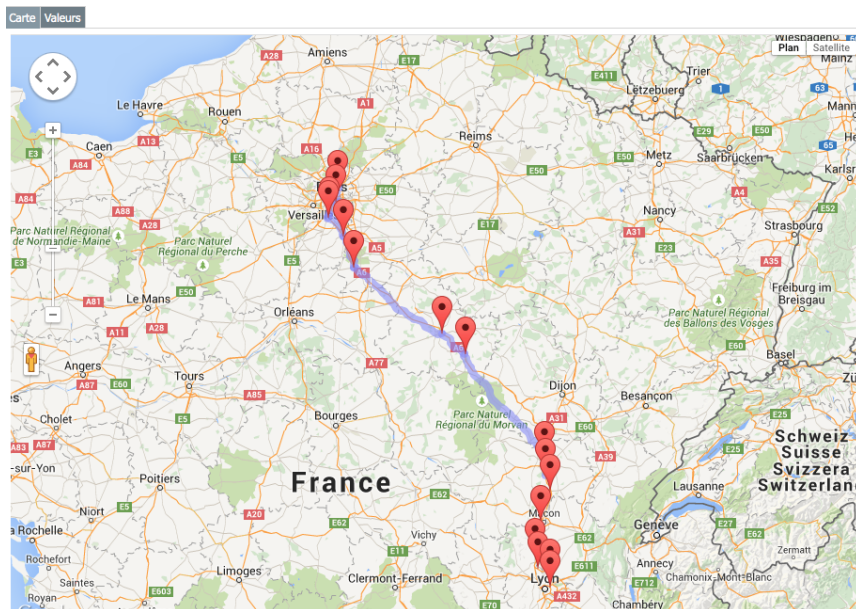


Real time monitoring of containers

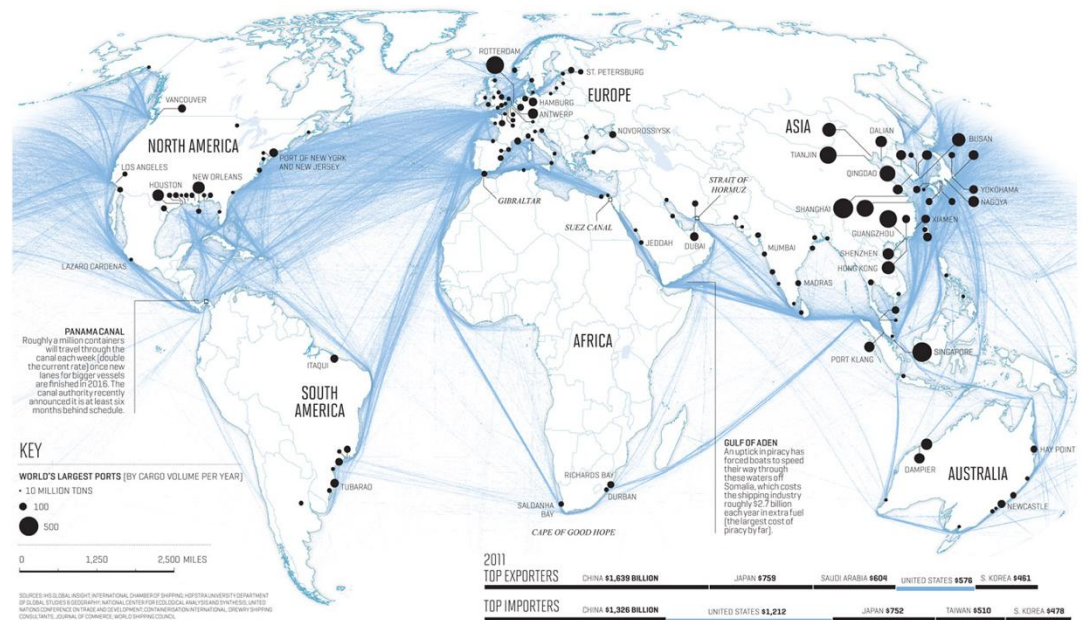
Part of the Internet of Things

- All logistics assets could be connected soon... thanks to the IoT
- With access limited to authorized stakeholders

EPCglobal

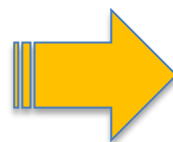


- How to build offers in an interconnected world?
 - A problem already known by several sectors
 - Dynamic pricing as a proxy for the remaining capacity
 - Based on will and interest of each company
- Interconnection platforms attract flows as ports
- Each hub becomes a marketplace for independent operators
- Transport requests allocation or reallocation
- Transshipment only if it improves current solution
- Contract standardization between trusted partners





Fragmentation
"Silo effect"



Dominant
position

"The winner
takes all"



International
treaty

"UN
bureaucracy"



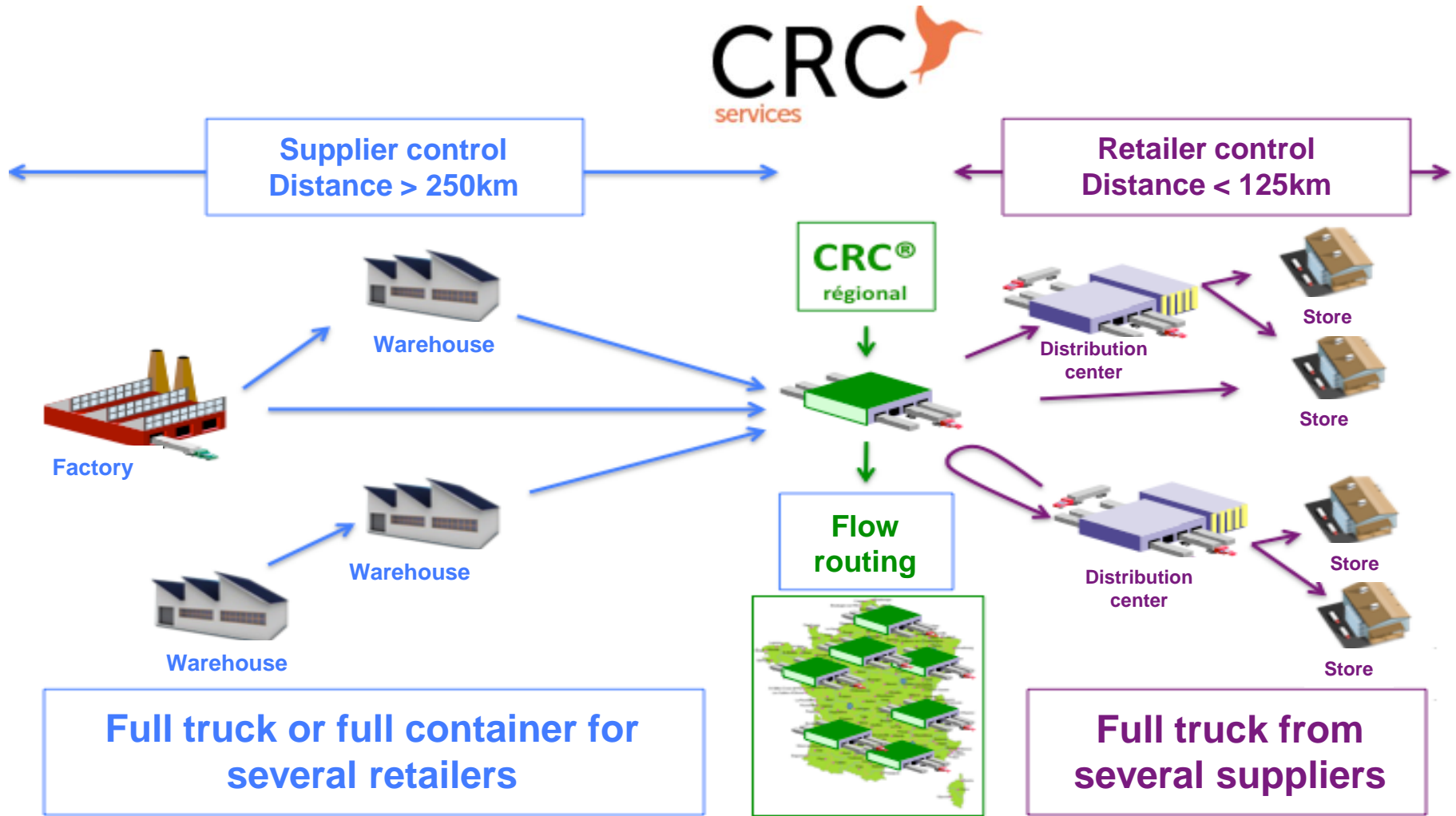
Interconnection

"Decentralization
commitments &
trust"



An example: a routing center start-up

○ How to connect industrials to retailers?



87% fill-rate, 99% service level

All online orders are redirected to my local delivery provider

- I can have all deliveries at once or not
- A provider who knows me and my preferences

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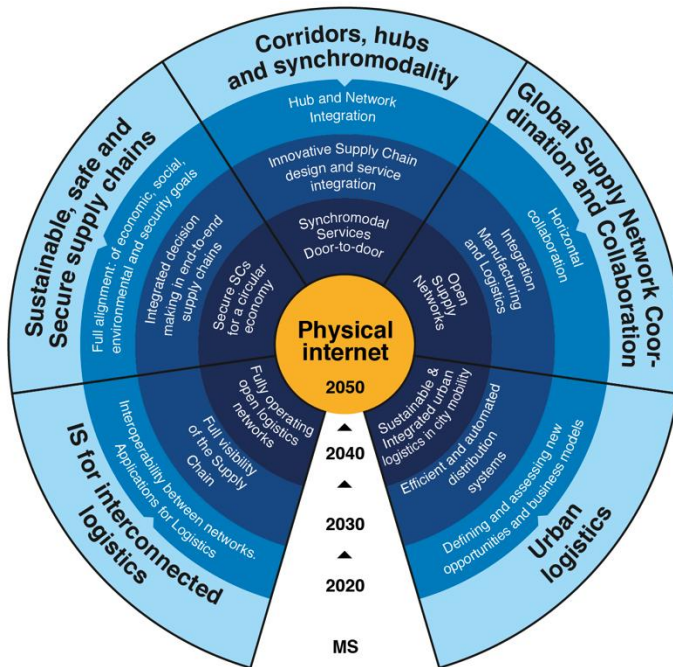


○ How to build coordination and trust in a new system?

- Collaborative design of 5 roadmaps towards physical internet components and guidelines
- At European level

alice | Alliance for Logistics Innovation through Collaboration in Europe

<http://www.etp-logistics.eu>



- **Update:**
 - 2030 PI
 - 2050 carbon neutral supply chains

ALICE membership per type of organization		
Type of Organization	Members	EU/International Associations
Shippers & Retail	P&G, SOLVAY, Ford, Mondelez, Casino, HOFFER, BAYER	ES C, EUPEG, GS1
Logistics Service Providers, Courier and Postal operators & Freight Forwarders	Adventor Alsea, KLEIDO, FM LOGISTIC, Posteitaliane, LINEAS, GEODIS, BORUSAN LOJISTIK, CHEP	CLECAT, HEALTH, RU
Ports, Hubs, Intermodal terminals & Transport Infrastructure	TRAFIKVERKET, JLL, INTERPORTO BOLOGNA, duiport	INE
Vehicle Manufacturers & Logistics operations, handling (modular units)	VOLVO, MAN, DAIMLER, LOGIFRUIT	eucar
Information and Communication Technologies & Consultancy	AIA, LOGSE, BIMAR, nallian, PNO, inelcom, PTV GROUP, HaCon	ERTICO, E-LA
Regional & Member States Logistics Clusters	vni, vni, Euralogistic, CLOSER, LUTE, LIMOWA, novelog, VLS	SMART FREIGHT
Research and technology Centers	Fraunhofer, ZLC, BIBA, UFG, TU/e, RISE, TU/e	ECTRE, E-LA
European Technology Platforms /PPPs	WATERBORNE, ERRAC, ERTRAC, EFFRA, MANUFACTURE-EU	
Member States and innovation Funding*	DINALOG, COMET, Vinnova, bmvi, VINNOVA	

Thank you



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Interconnected logistic networks and protocols: simulation-based efficiency assessment
Rachid Nargi¹, Eric Ballot², Shoko Pan³, Dina Hakimi⁴ and Ronald Montiel⁵

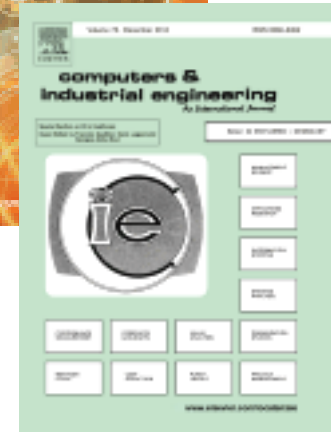
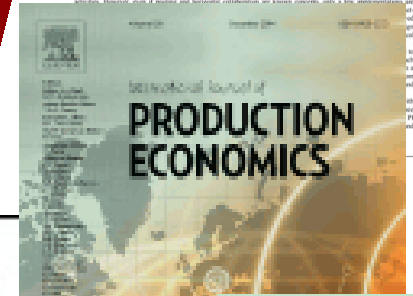
¹Centre de Gestion Scientifique (CGS), Mines ParisTech, Paris, France; ²Centre National Local (CNL), Canada (Received 3 May 2013; accepted 3 September 2013)

Logistic networks, viewed as the means of transportation and storage facilities to deliver goods, therefore, these logistic networks are still poorly understood and this ignorance is responsible for a lack of consolidation and flow efficiency. To cope with the existing contradictions of production, customer and distribution network needs, a major improvement in supply networks is sought here. This new organization is based on the natural atomization of logistic activities, namely a Physical Internet where goods travel in smallest containers for the sake of atomization in open networks. If this is a logical point of view, saving container flows should improve efficiency, an demonstration of the potential has been studied and proven to be true in a large-scale research. To reach this operational assessment goal, we studied the synchronization aspects and criteria of containers within an atomized network of services. But the best planarity for each container and minimize the use of transportation means. To carry out the demonstration and assess the potential value, we use a set of small flows from the manufacturing companies under study in France. Various transportation protocols and scenarios are tested, creating interesting results for efficiency indicators such as CO₂ emissions, cost, lead time, delivery speed time, and so forth. As this is a first work in the field of these transportation, the attention model and experiment express many further research avenues.

Keywords: transportation protocols; open logistic networks; physical Internet; sustainable development; logistic protocols; discrete path

1. Introduction

Today's logistic performance is limited in pursuing two antagonistic goals within the current organization of supply chains. The first goal seeks small high-frequency shipments in a just-in-time philosophy while the second goal seeks better environmental performance by best use of transportation means, usually heavier yet cleaner means. Mostly dedicated logistic services and independent supply networks make the fragmentation of logistic flows and thus the difficulty to overcome this antagonism. Increasing the collaboration between supply chain or networks is a key to exploit synergies between them and to then jointly improve their logistic performance, notably of the transportation activities. However, this is a long and systematic collaboration, one knows, concerns, with a long-anticipatory use



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