

Pr. Eric Ballot



■ Logistic interconnection through the physical internet

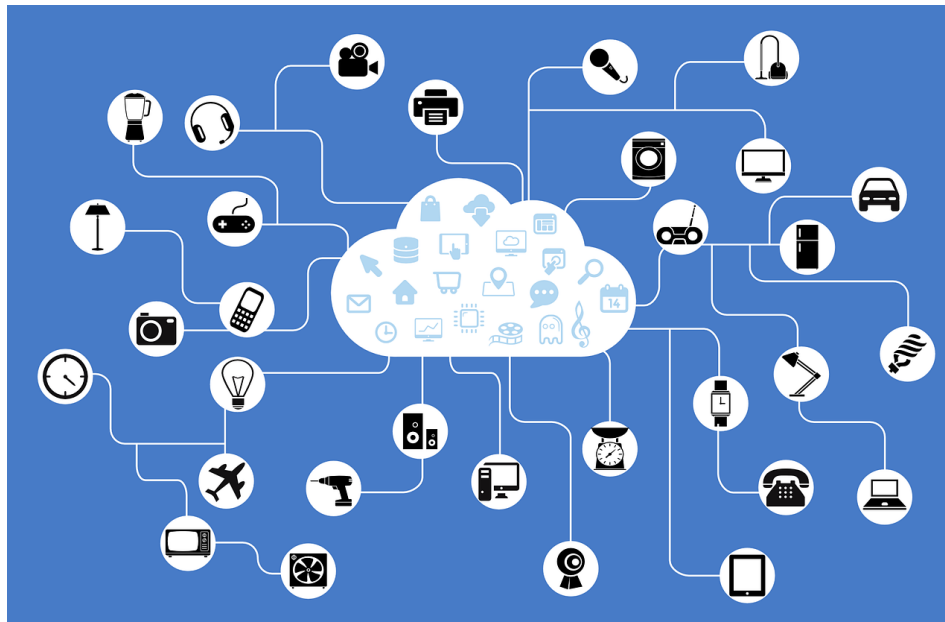
- Internet and Physical Internet
- The goals: efficiency, services, reliability and sustainability
- What is needed to make it work?
- First applications



○ Definition

“The Internet is the global system of **interconnected computer networks** that use the Internet protocol suite (TCP/IP) to link devices worldwide. It is a **network of networks** that consists of private, public... networks of local to global scope.”

Source: Wikipedia

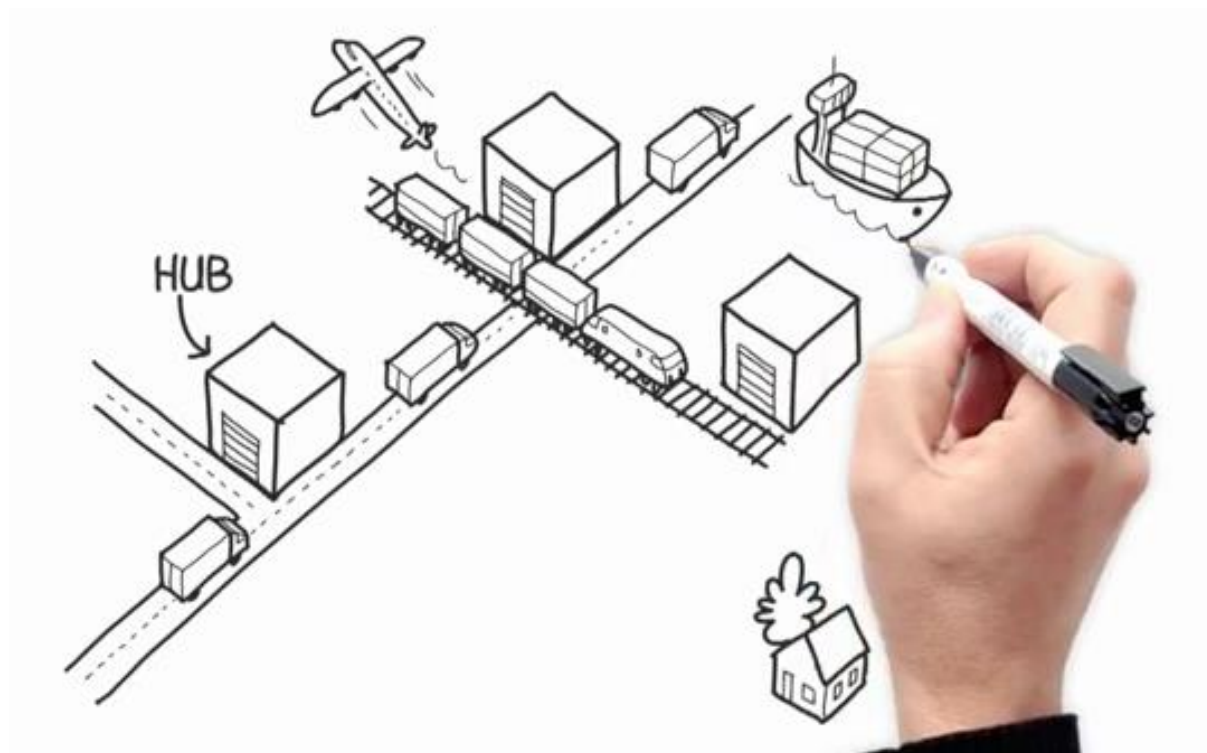


Now works with things: the IoT

○ Definition

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

Source: B. Montreuil, R. D. Meller & E. Ballot



Source: ALICE European Technology Platform

○ Shared infrastructures

Fiber-optic network



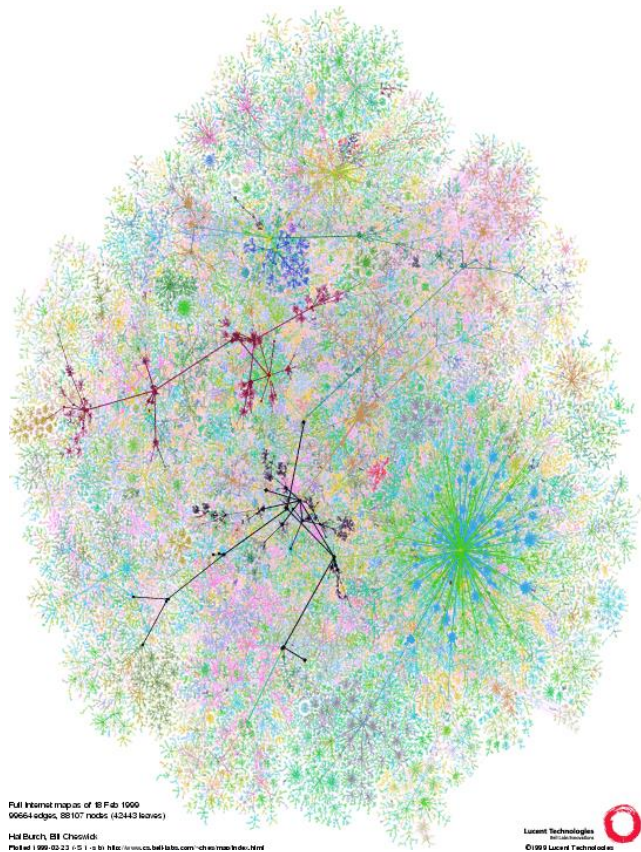
Highway network



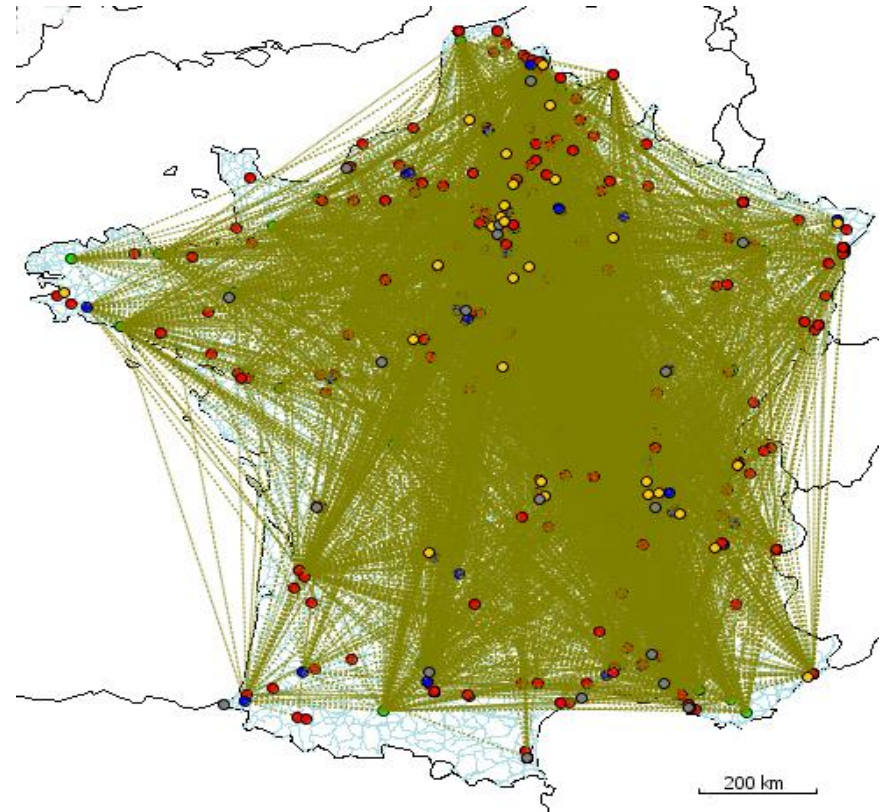
Internet vs. Physical Internet

○ Flows consolidation

Internet flows map



Goods flows (No interconnection)



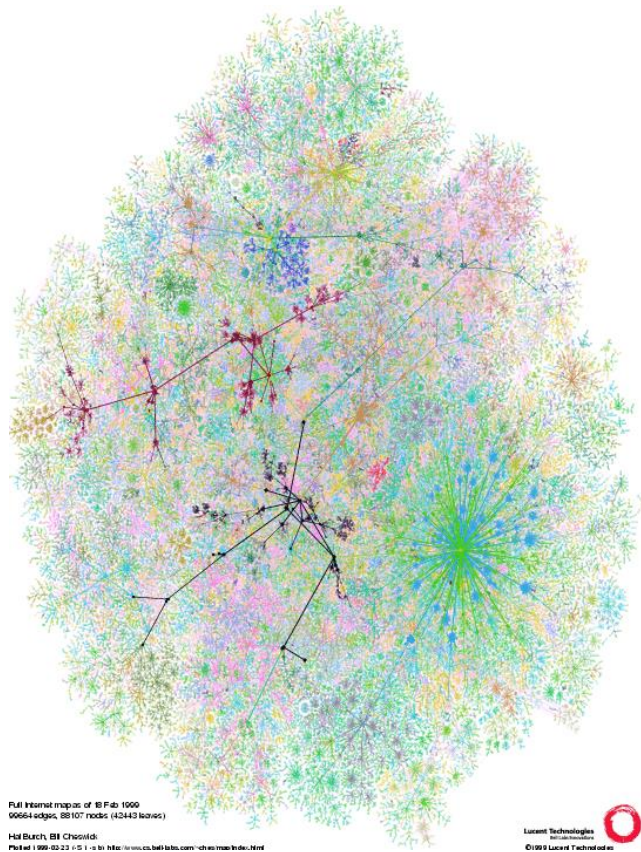
Map of actual FMCG flows

Source: PREDIT project

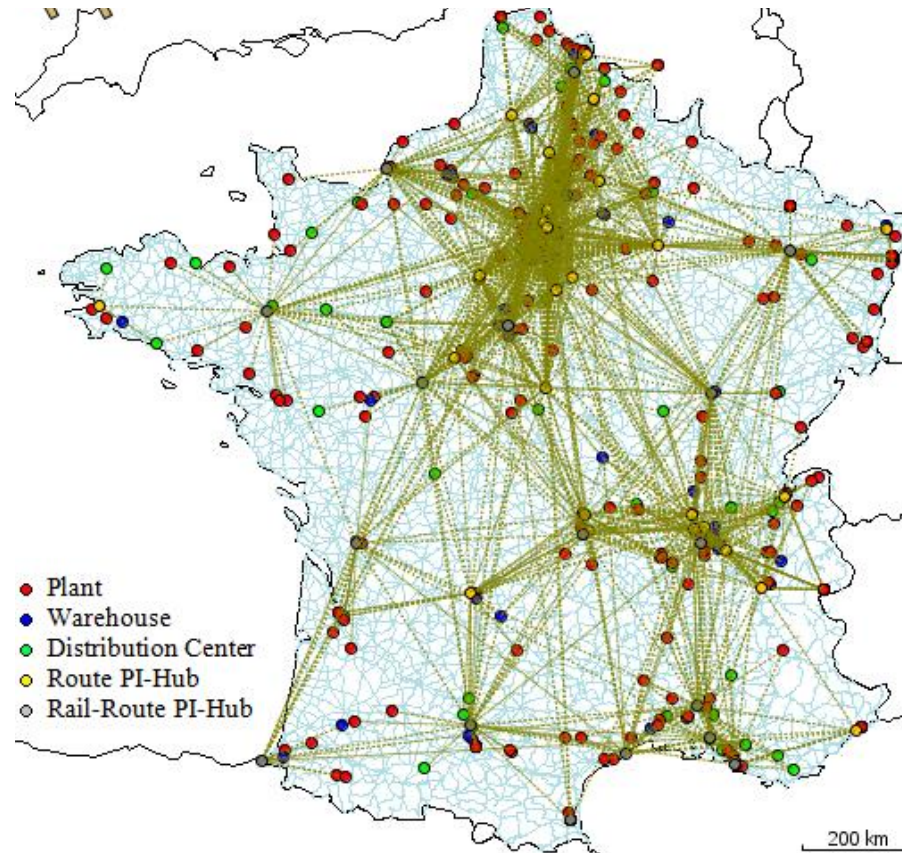
Internet vs. Physical Internet

○ Flows consolidation

Internet



Goods flows with interconnection



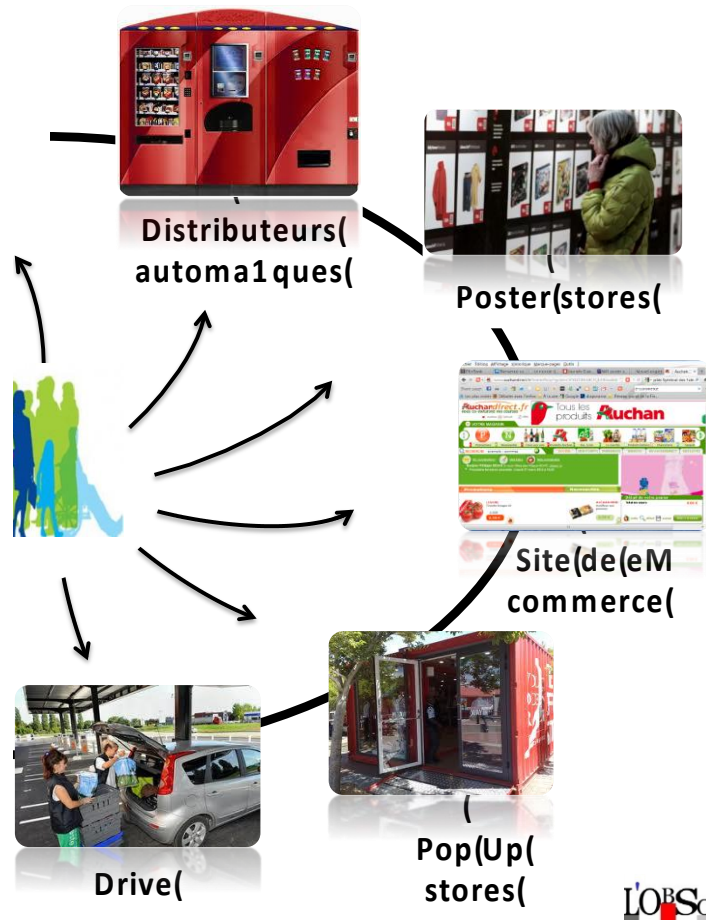
Simulation of interconnected FMCG flows

Source: PREDIT project

Why change the flows organization?

○ Logistics works! But several trends are against its sustainability

- Fragmented shipments in space and time



EXPRESS SHIPPING 

Consequences of flows fragmentation

○ 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

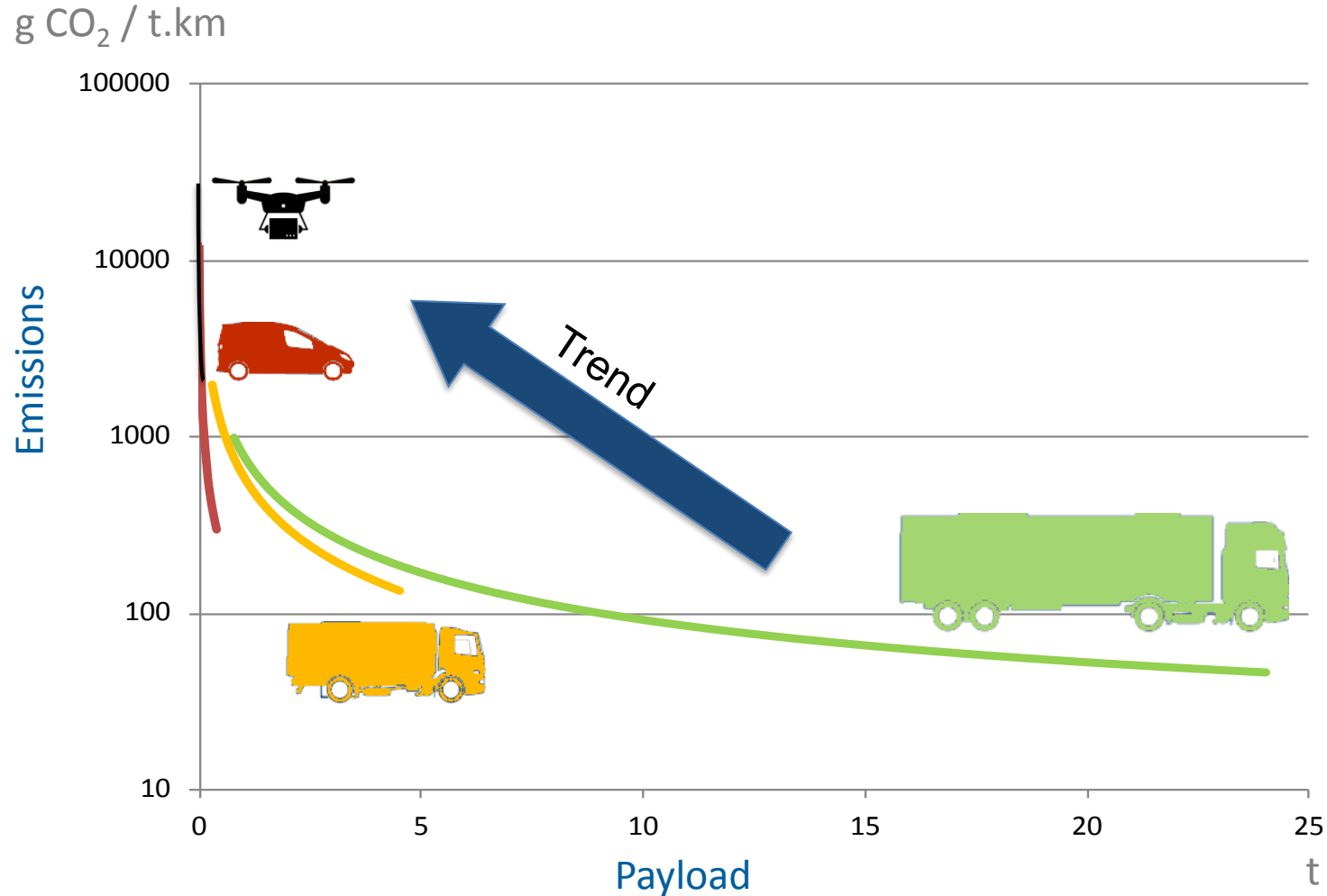


- In 2020? 6.6 kg ?
- In 2030? 1.5 kg?



Consequences of flows fragmentation

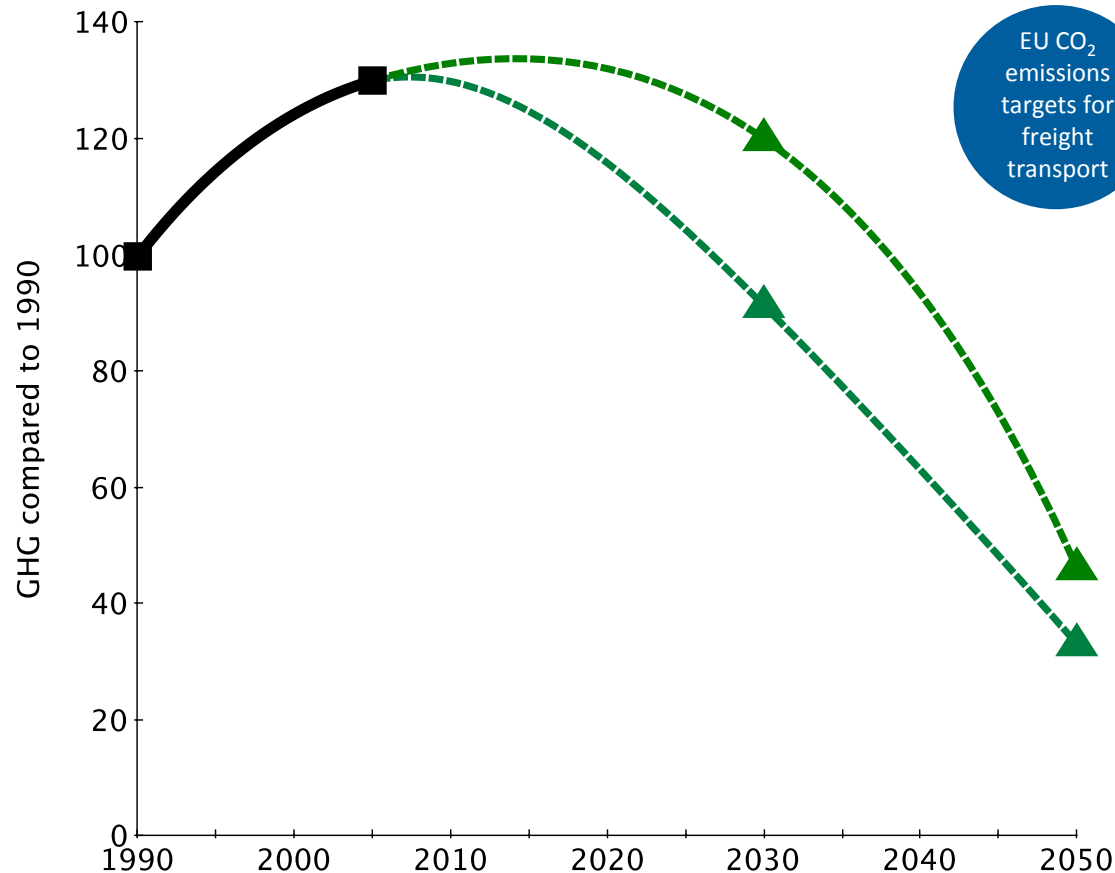
- Economies of scale are more and more difficult to obtain



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

Consequences of flows fragmentation

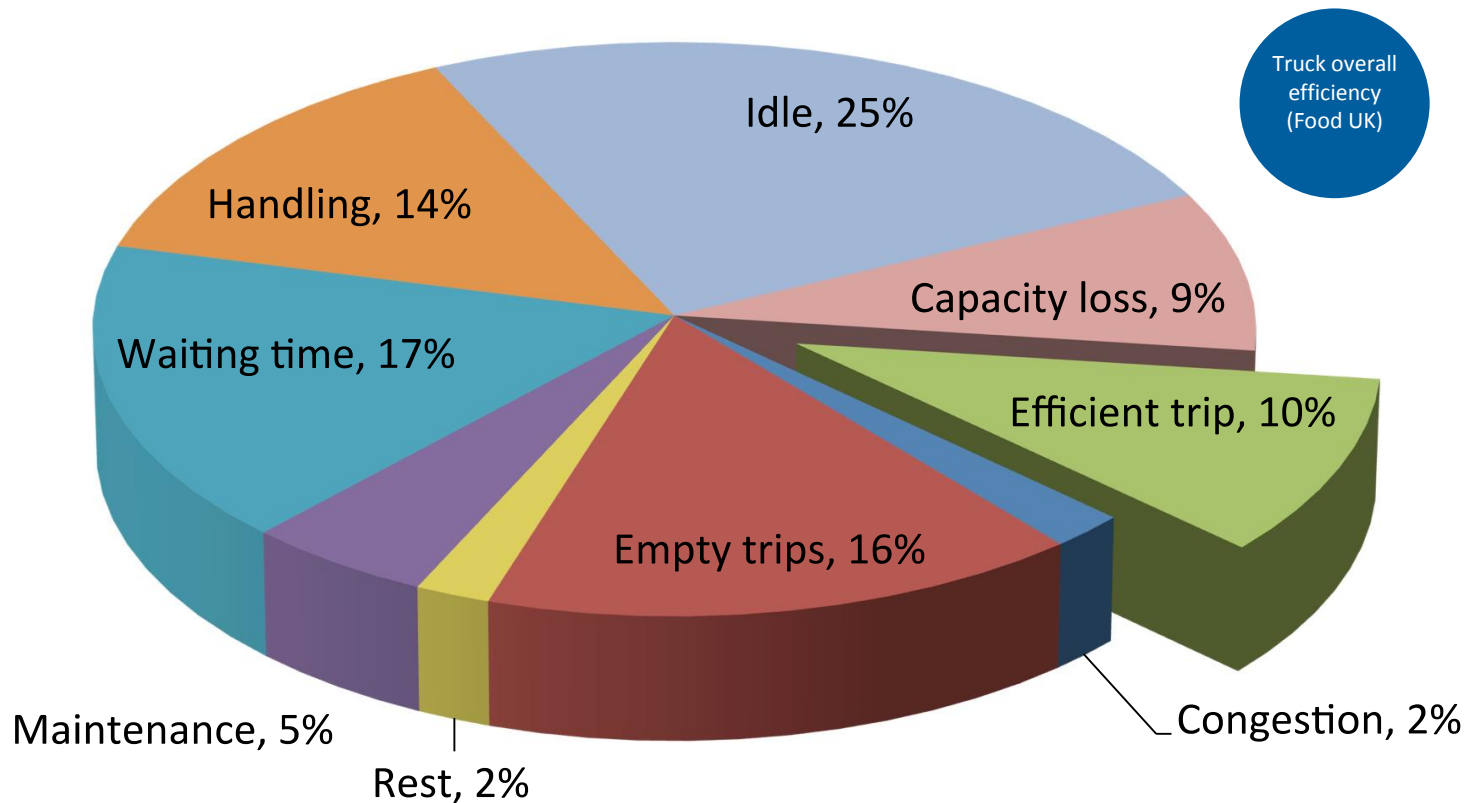
- Sustainability is out of reach with business as usual



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

Consequences of flows fragmentation

- Difficult to optimize transport: electric vehicles won't solve all issues

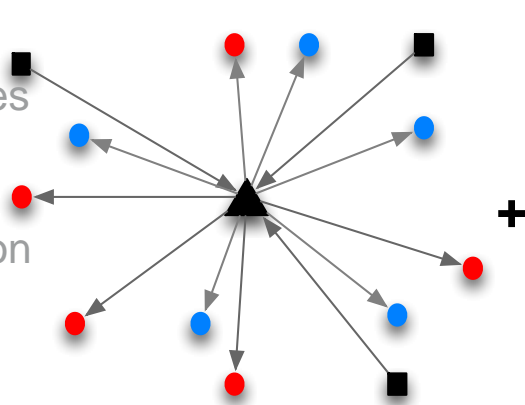


Sources: McKinnon, A., Y. Ge, and D. Leuchars, *Analysis of Transport Efficiency in the UK Food Supply Chain*, L.R. Centre and S.o.M.a. Languages, Editors. 2003: Edinburgh. p. 38. and Ballot E. and Fontane F. Overall vehicle efficiency, 2008, CGS white paper 2007.

From dedicated networks

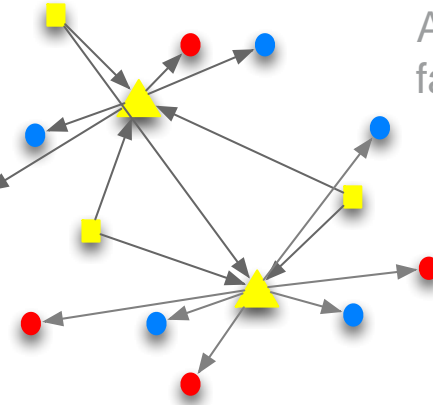
○ Change networks organization

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



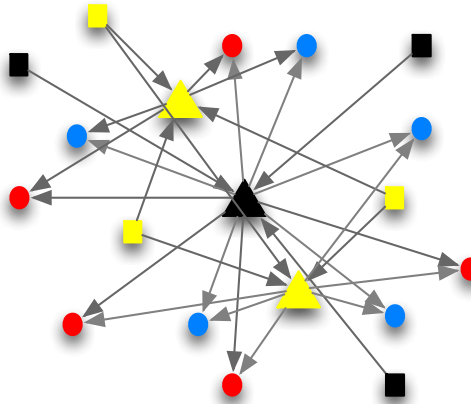
+

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

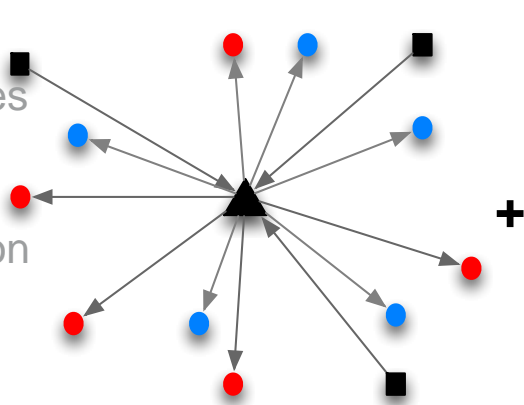


Two dedicated supply chains: overlapping each other

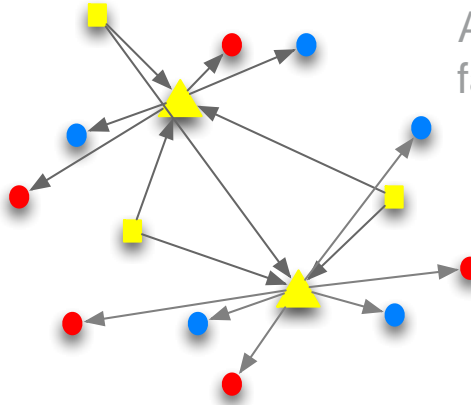
To interconnected networks

○ Change networks organization

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



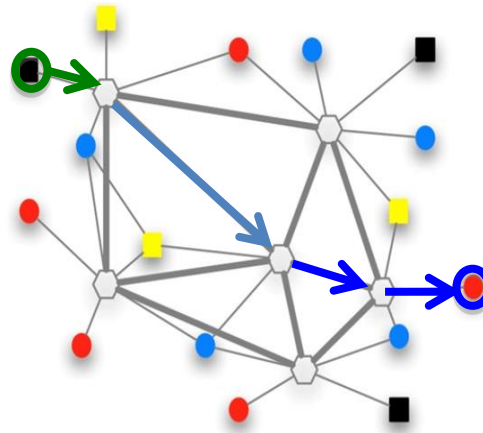
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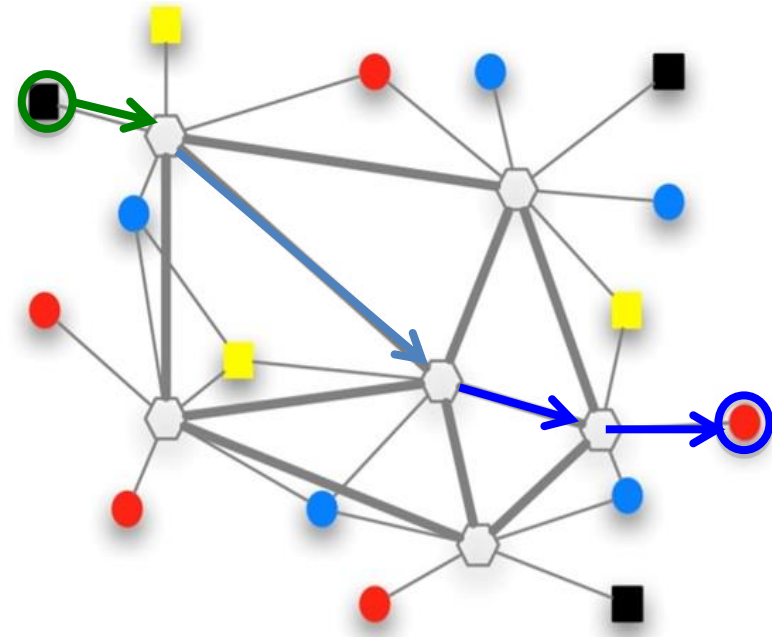


An interconnected network

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
 - Alternate routes
 - Decentralized inventory
- Sustainability
 - -60% of CO₂
 - More direct routes
 - No sizing at the peak of activity
- New services
 - Warehouse as a service
 - IP service provider



The interconnection requirements

○ What is needed to build a Physical Internet?

• Infrastructure

- Arcs: roads and railroads but also
- Nodes: ports, hubs, inland terminals, urban DC

• Protocols

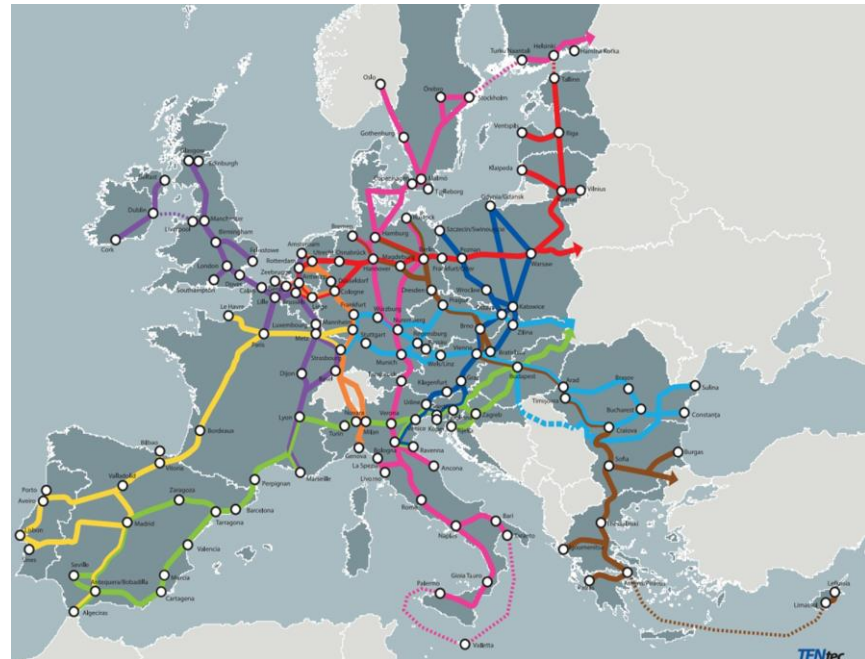
- Containerization
- Addresses
- Routing

• Business model

- Intermediation
- Contracts

• Governance

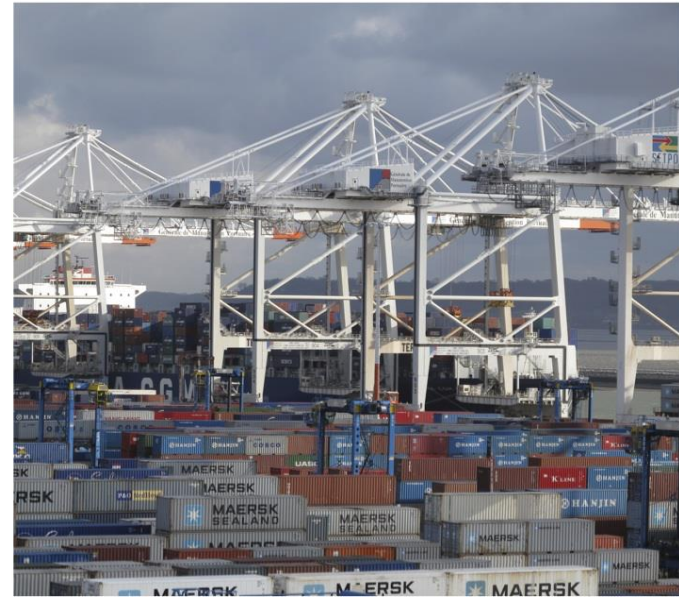
- Trust
- Standardization



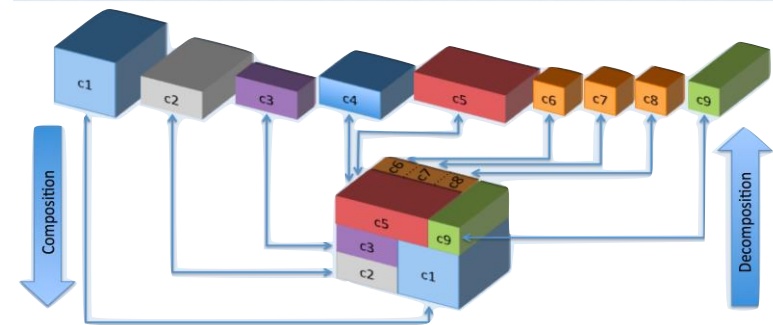
- A generalization of containerization: transport and handling containers small and modular boxes, pallets footprint free



Handling
cost
/ 10
in 50 years



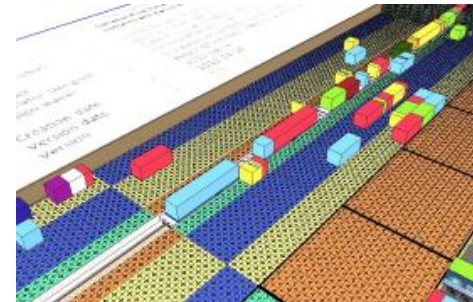
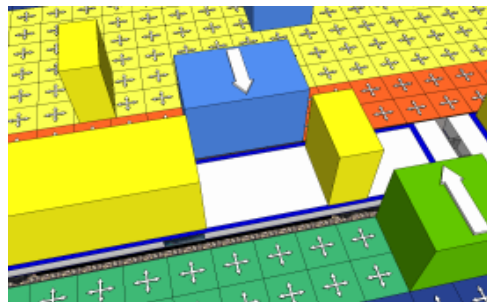
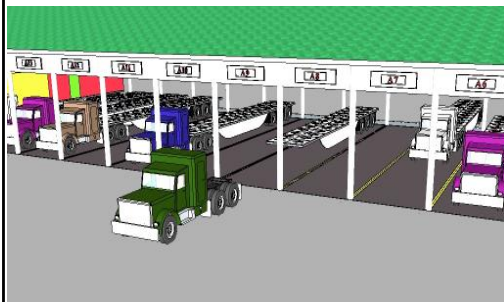
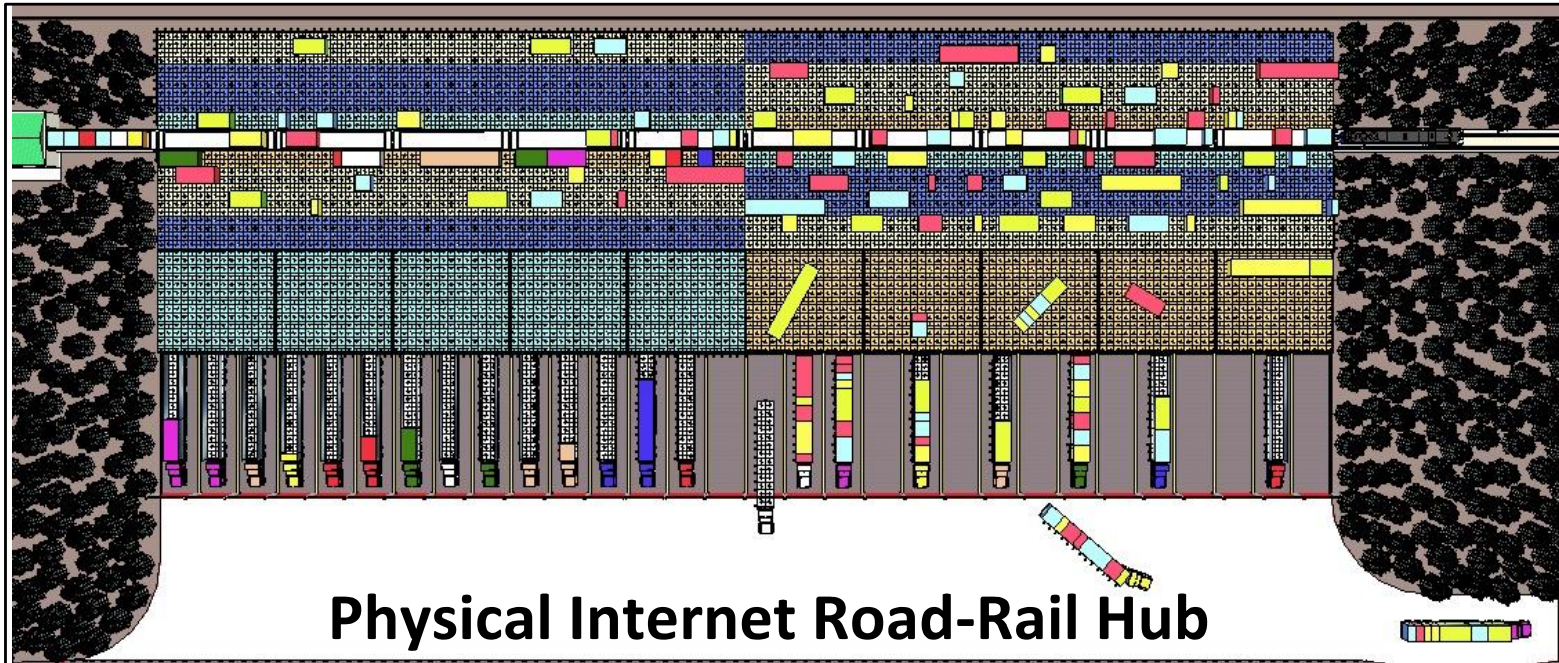
How to achieve
the same
improvement?



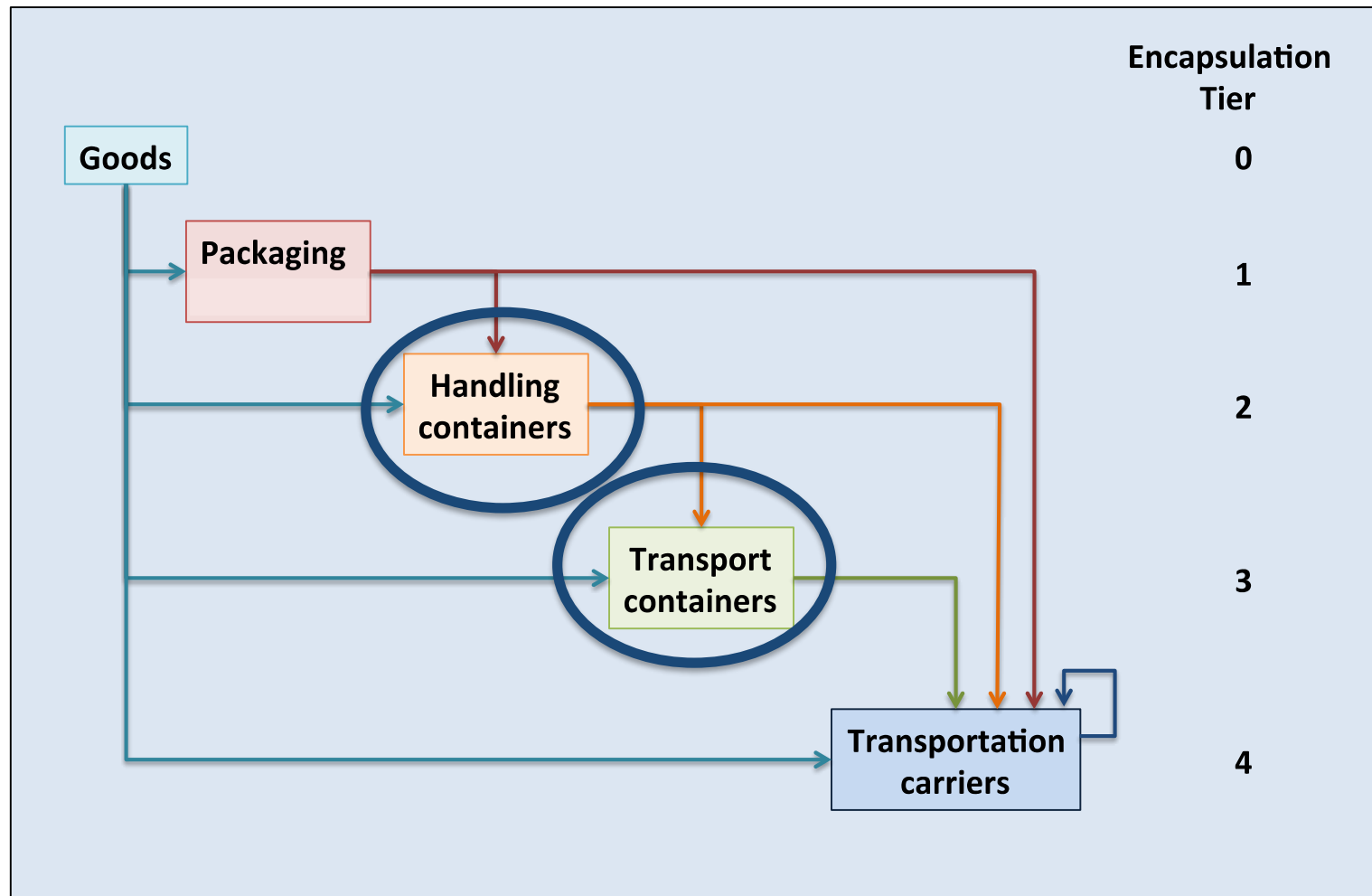
Montreuil, B., Meller, R. D. and Ballot, E. (2010). Towards a Physical Internet : the impact on logistics facilities and material handling systems design and innovation. In: AL, K. G. E. (ed.) *Progress in Material Handling Research. Material Handling Industry of America*

Nodes: an example

- Inspired by container terminals in ports



○ Two main encapsulation levels

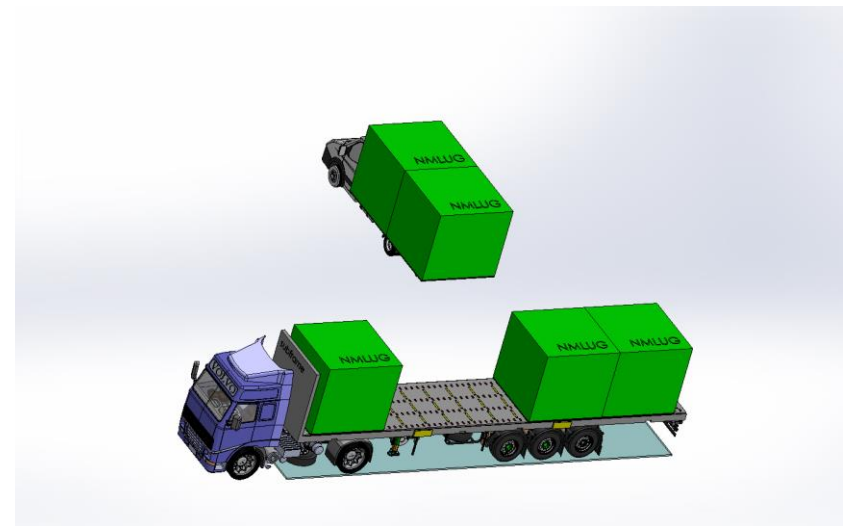
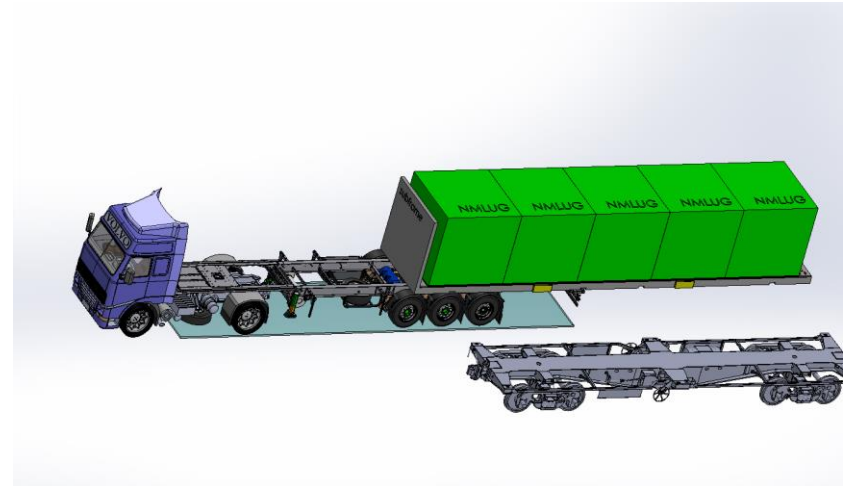


Source: B. Montreuil, E. Ballot and W. Tremblay Modular Design of Physical Internet Transport, Handling and Packaging Containers, in IMHR book 2017

Containerization: transport level

○ 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

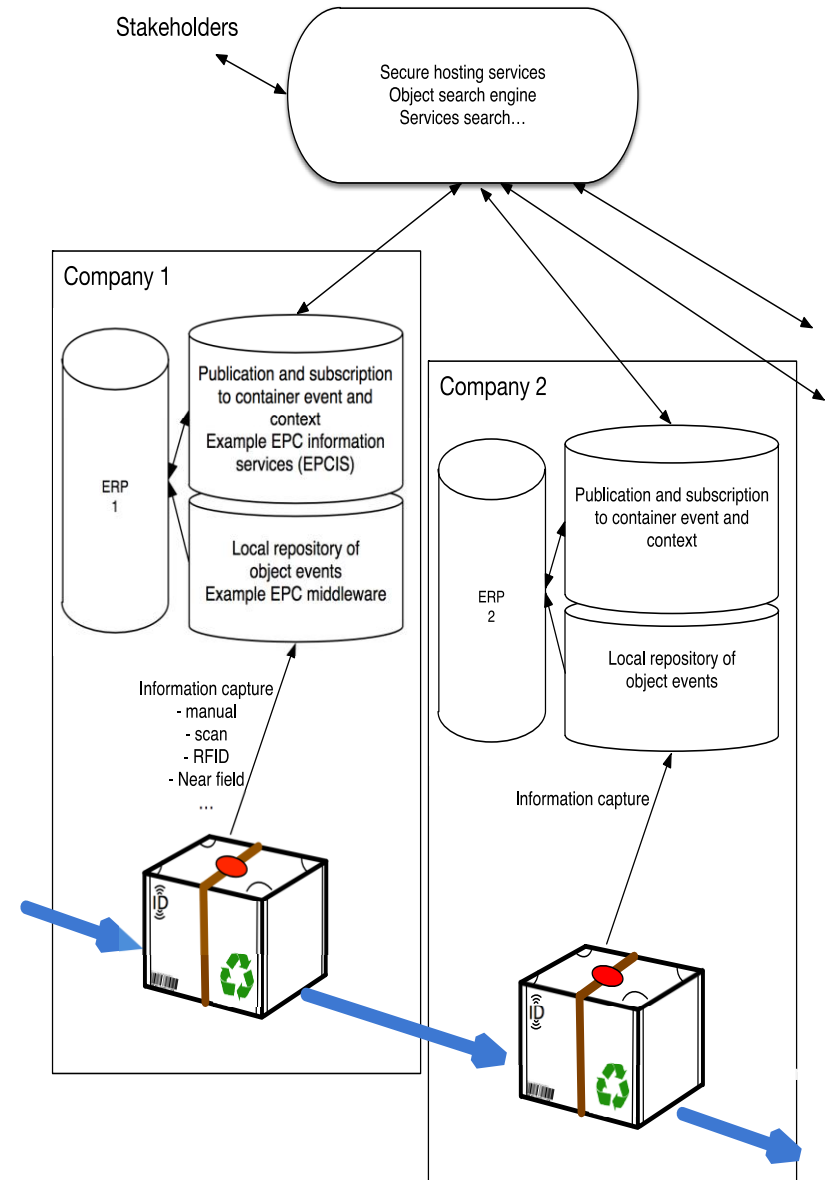
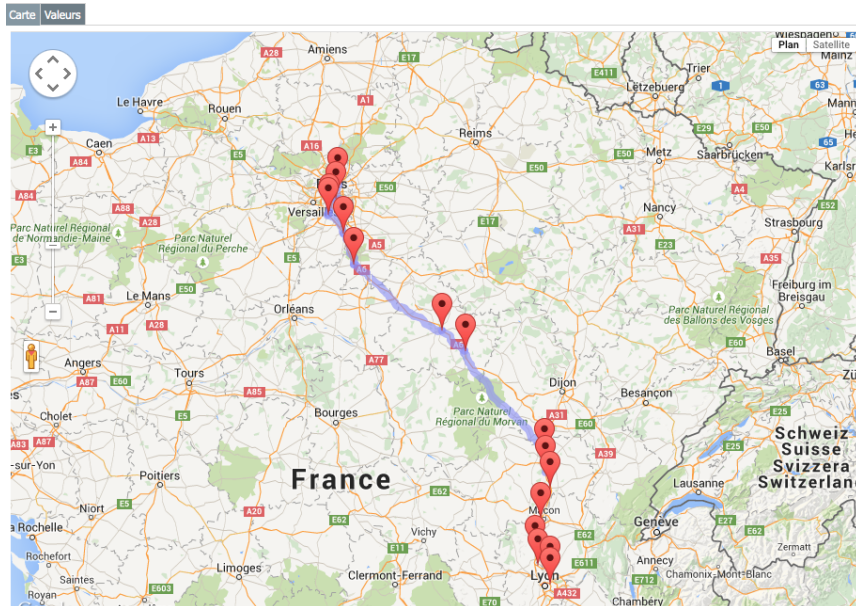
- A set of modular boxes for all products
 - Handling productivity
 - Better space utilization
 - Proved lifetime > 10 years
 - **Improved security:**
anonymization of the content,
mixed goods and blocks
sealed
 - Savings > 20% of logistics cost



Real time monitoring of containers

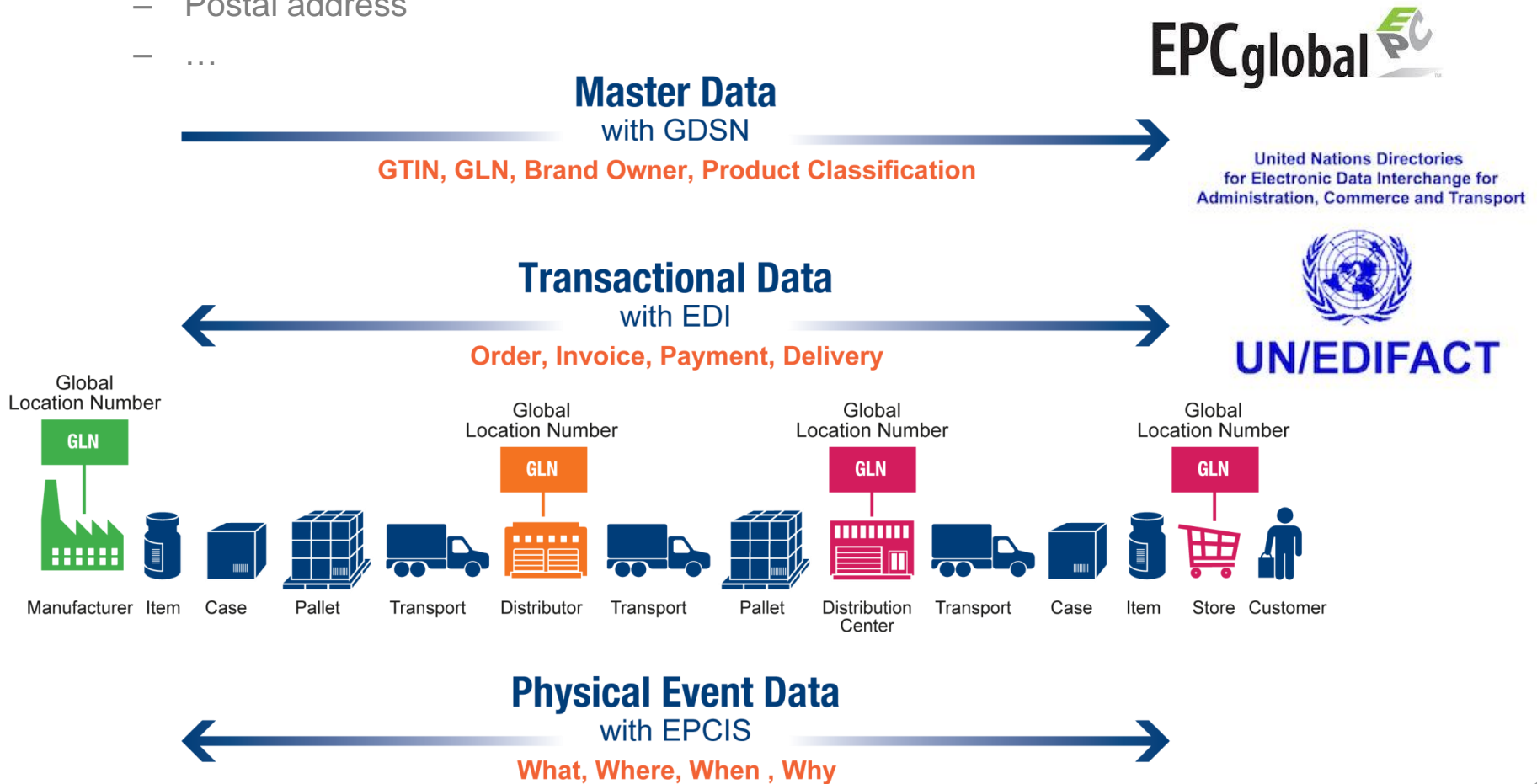
○ Part of the Internet of Things

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



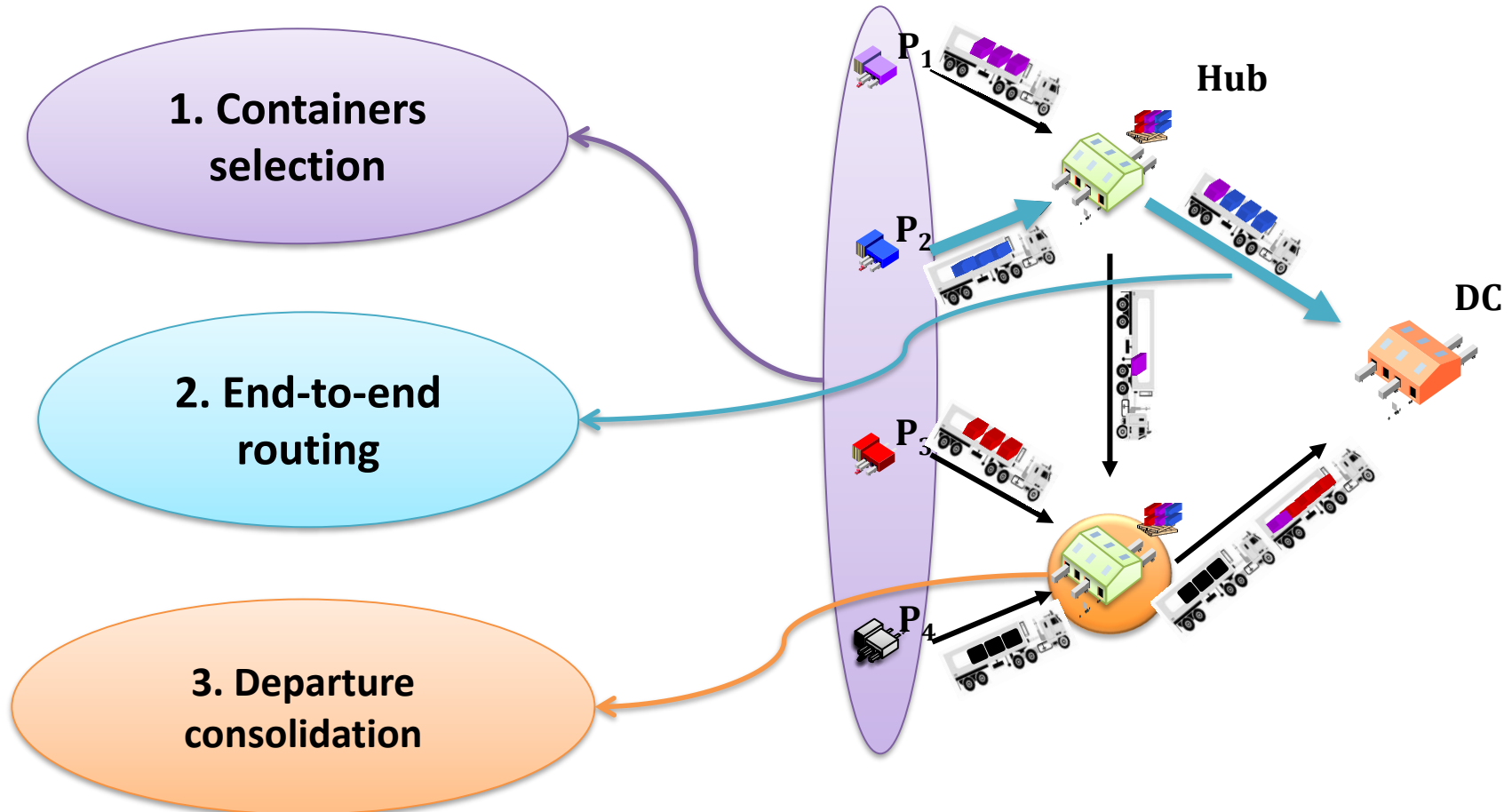
○ A code to define each position in the world: still a burden to maintain accurate location database

- A code (GLN, IATA...) linked to
 - Geodetic datum: GWS 84
 - Postal address
 - ...



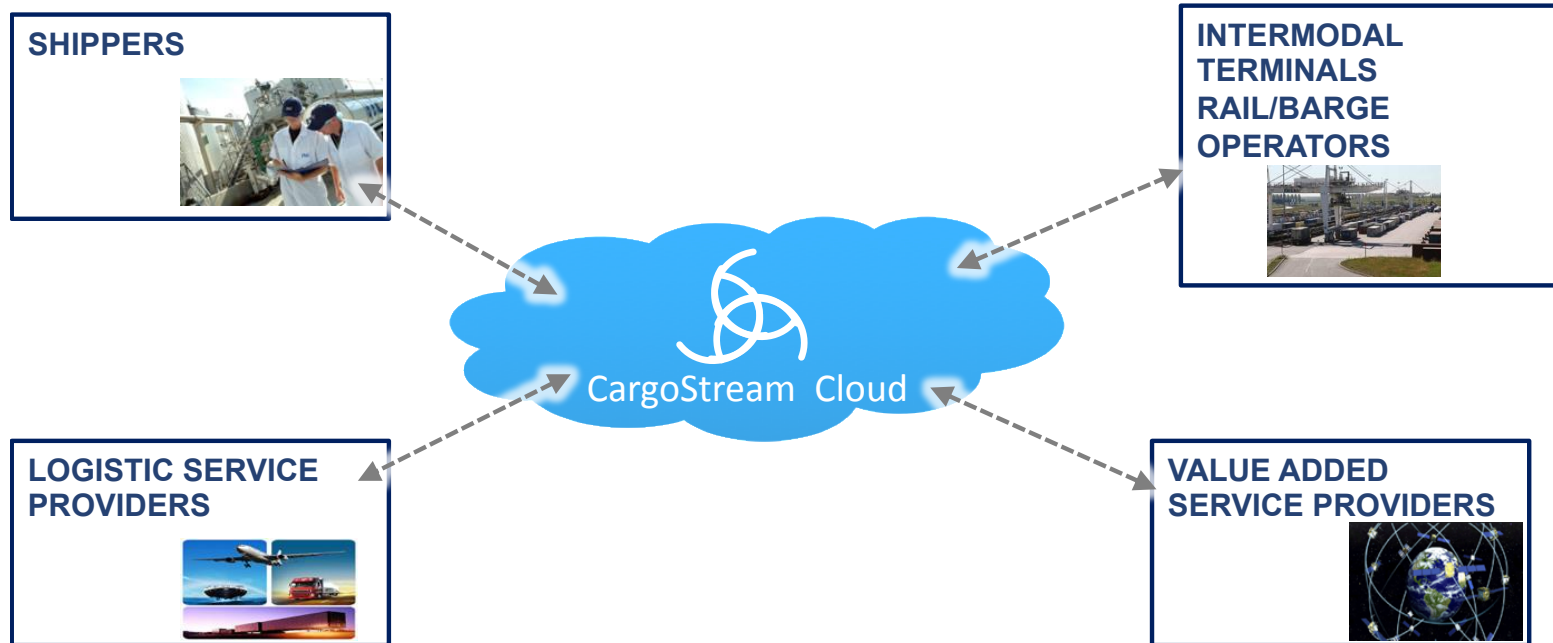
○ A set of protocols different from TCP to ensure end to end routing and efficiency

- Several levels already implemented in a simulation tool



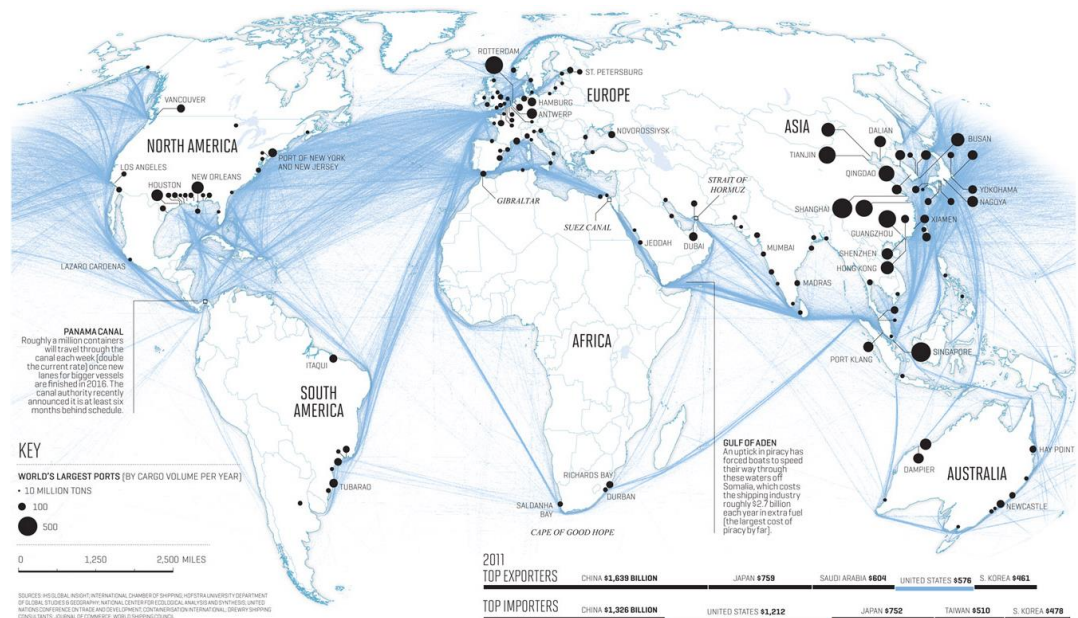
○ Where demands meet offers

- Based on available and published services by logistics services providers or operators
- Selected by shippers or logistics services providers



- Example of routing criteria: day+3, min CO₂...

- How to build offers in an interconnected world?
 - A problem already known by several sectors: maritime, airlines...
 - 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

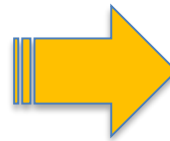


Interconnection platforms

○ How to interconnect?



Fragmentation
"Silo effect"



Dominant
position
"The winner
takes all"



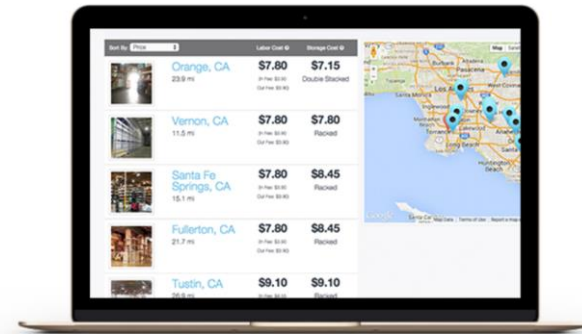
States'
operators
International
treaty



Interconnection
"Decentralization
& trust"

Start-ups close to PI

○ Physical Internet development roadmap



FLEXE connects you to warehouse capacity **when**, **where**, and **how** you need it.

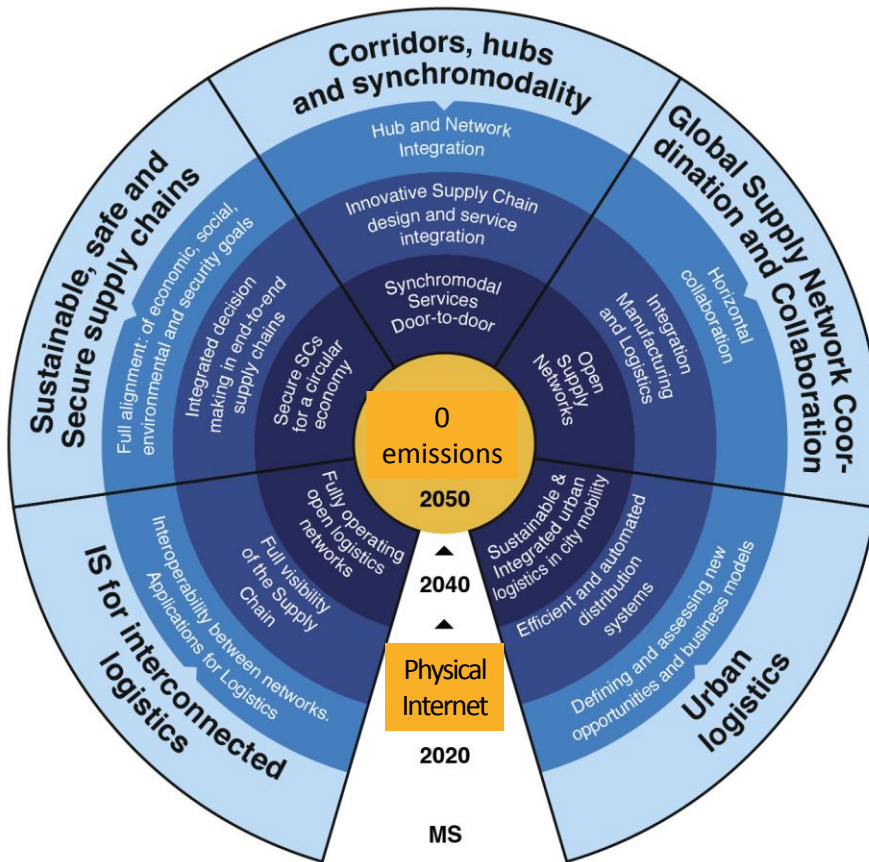
To be continued...

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

- Collaborative design of 5 roadmaps towards physical internet components and guidelines
- At European level: 150 organizations

alice | Alliance for Logistics Innovation through Collaboration in Europe

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



- A roadmap from actual practices to
 - 2020: Physical intranet
 - 2025: Vertical interconnection
 - 2030: Horizontal interconnection
 - 2035: Full PI implementation

One catchword: The Physical Internet

- One goal : logistics efficiency

Inventory: $\div 3$ CO₂: -60% Tkm: -15%
Loss of capacity: $\div 2$ Delivery failures: - x%
Handling cost: $\div 3$ Availability on shelves: +y%
Empty trips : - z% ...

- What we share
 - Standardization
 - Sustainability
- What PI brings
 - A vision
 - Possible regulation from data
 - A better market organization

Thank you



IPIC 2019

6th International Physical Internet Conference | London



2020 Shenzhen and Hongkong

<https://www.pi.events>