Logistics Collaboration and the Physical Internet

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CELDi
Center for Excellence in Logistics and Distribution

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Volvo Logistics North America
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Walgreens There's a way

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Logistics Today: The Opportunity

We are shipping air and packaging
- 9 Billion tons of freight transported per year
- 25% of all miles are empty!
- 57% "full" when not empty!
- 42% average utilization
- $60B opportunity in the US alone!

CO_2 emissions are growing
- 40 Billon gallons of fuel/year
- 500+ Tg CO_2
- 200 Tg CO_2 emissions reduction opportunity!

Industry is segmented
- 75% of freight moved using dedicated resource

Logistics drives large EOQ's
- Truckloads for commodity items
- Large regional DC's with relatively infrequent deliveries

Truckers have become today's modern cowboys
- 100%+ turnover rate in the industry!
- Demonstrable negative health benefits!

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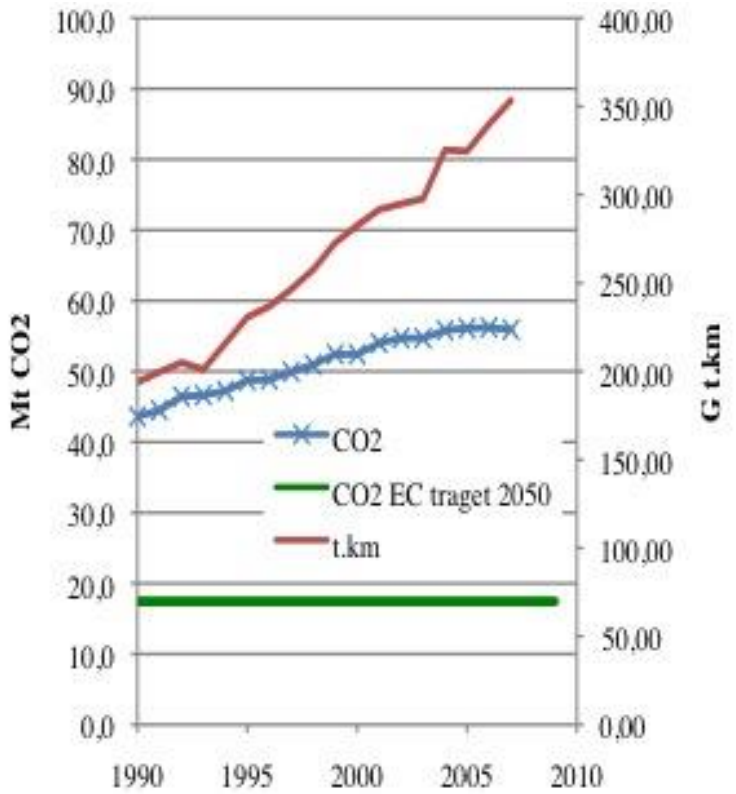
Logistics Today: At a Crossroads



We simply must do something different if we are to meet various reduction goals for CO_2 emissions.

Sarraj, R., Ballot, E., Pan, S., "Potential of Routing Protocols for Freight in Open Logistics Networks: the Case of FMCG in France," *Proceedings of the 4th International Conference on Information Systems, Logistics and Supply Chain*, 2012.

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The Global Logistics Sustainability Grand Challenge

Design a system to **move, handle, store, realize, supply** and **use physical objects** throughout the world in a manner that is **efficient** and economically, environmentally and socially **sustainable.**

Montreuil B. (2011) "Towards a Physical Internet: Meeting the Global Logistics Sustainability Grand Challenge," *Logistics Research*, **3**(2-3), 71-87, 2011.

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Horizontal Logistics Collaboration

Sharing Warehousing, Distribution, Trucking Capacity
Grew from business collaborations

Similar origins and destinations
Joint truckload, rail
Coordination of shipping quantities
[illegible]

Volume

[illegible]
Coordinated pickups from factories, deliveries to Tesco's warehouse
Coordinated by Tesco

Collaborated on deliveries with pet food, candy, condiment manufacturers
Built around collaborative logistics campus
Managed by third party provider

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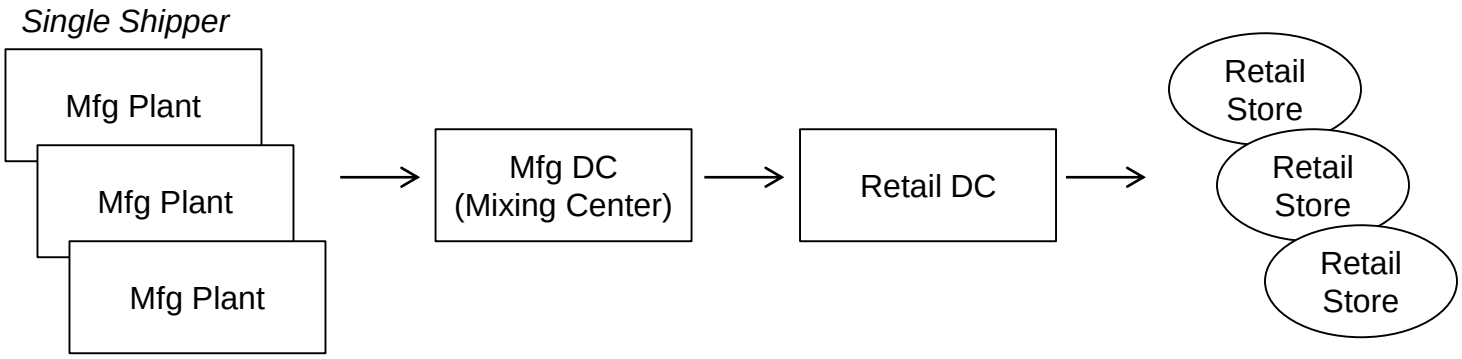
Why Horizontal Collaboration?

Fuller trucks, lower trucking costs, and energy savings are just the start…

Ultimately, the network will start to change

Current flow in a CPG-Retailer supply chain



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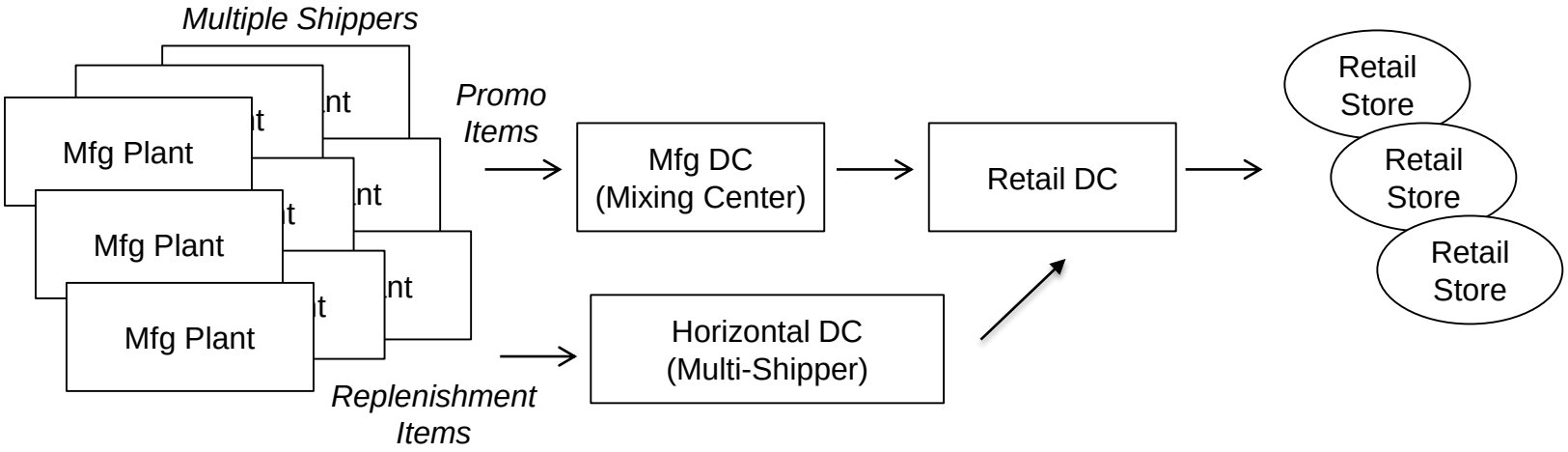
Why Horizontal Collaboration?

A Horizontal CPG Network



Horizontal collaboration moves the cost/service curve

Lower EOQ's, higher densities will increase numbers of facilities, frequency of smaller deliveries

Initial studies with partner data: Higher fill rate, 8% reduction in miles, 30% reduction in highway miles, 30% retailer inventory reduction, 5% network cost reduction, more DC's closer to customers, 3% increase in on-time deliveries

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Logistics Campuses & Intermediary Firms

Intermediary Firms

TRI ≡ VIZOR
THE WORLD'S FIRST CROSS SUPPLY CHAIN® ORCHESTRATOR™

Collaborative Warehousing + Outbound Logistics

ES3

kane is able
Dependable People. Exceptional Logistics.

WEBER LOGISTICS
The West Coast Logistics Leader

Logistics campuses

Americas Gateway Logistics Center

WILMINGTON AIR PARK

LogisticsHub UK

88% of firms believe in collaboration

Most companies who are using some form of collaboration see benefits

Benefits include lower costs, lower inventories, reduced carbon footprint, better service

But…

Only 10-30% use any form of collaboration, many report "failed collaboration projects"

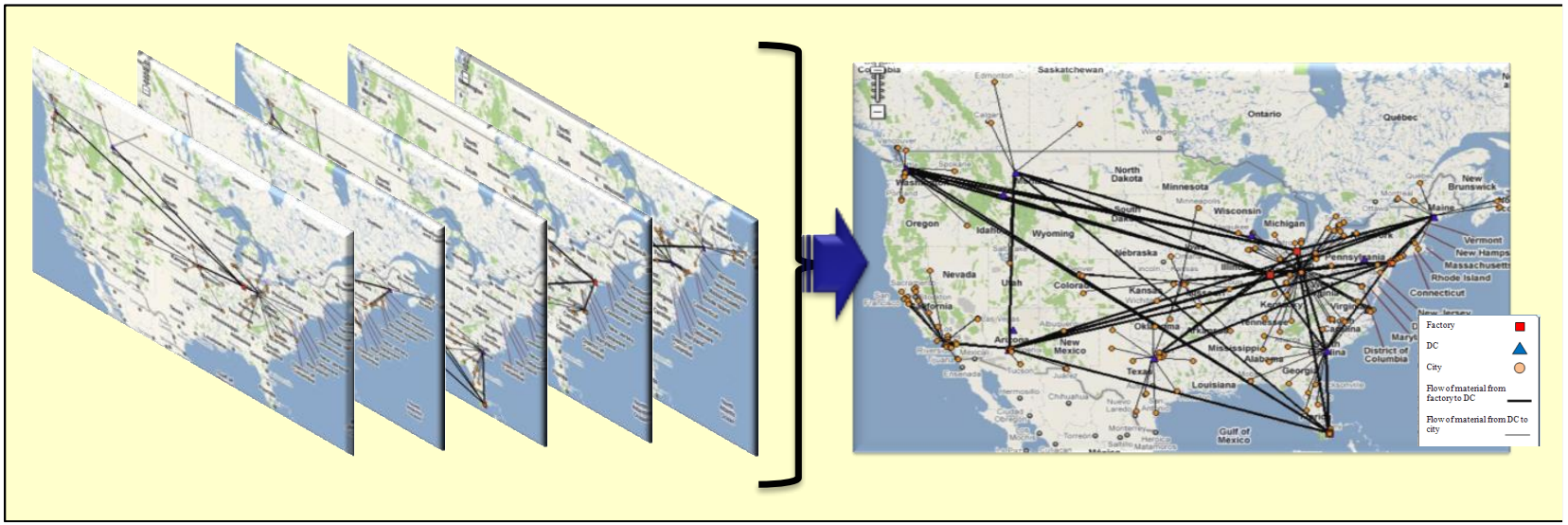
T Esper and L. Williams, "The Value of Collaborative Transportation Management (CTM): Its Relationship to Collaborative Planning," Transportation Journal, 42(4), 55-65, 2003.
J. Sutherland, "Collaborative Transportation Management-Creating Value Through Increased Transportation Efficiencies," Technical Report, Lehigh University, 2003.
L. Tesseras, "Dangerous to Ignore it," Supply Chain Standard, 10-11, October 2011.

Barriers & Research

Efforts are limited to a small number of firms
Efforts are limited to a single industry
Efforts are built around static, long-term commitments
Efforts limited to non-competitors
Efforts don't take full advantage of "changing the network"

Research effort built around IT, contracts and incentives, standards, and material handling technologies to overcome these limitations

The Potential:
Load Planning and Collaboration



What's the impact as we …

increase collaboration?

increase network visibility?

consider service requirements?

strive to get drivers home?

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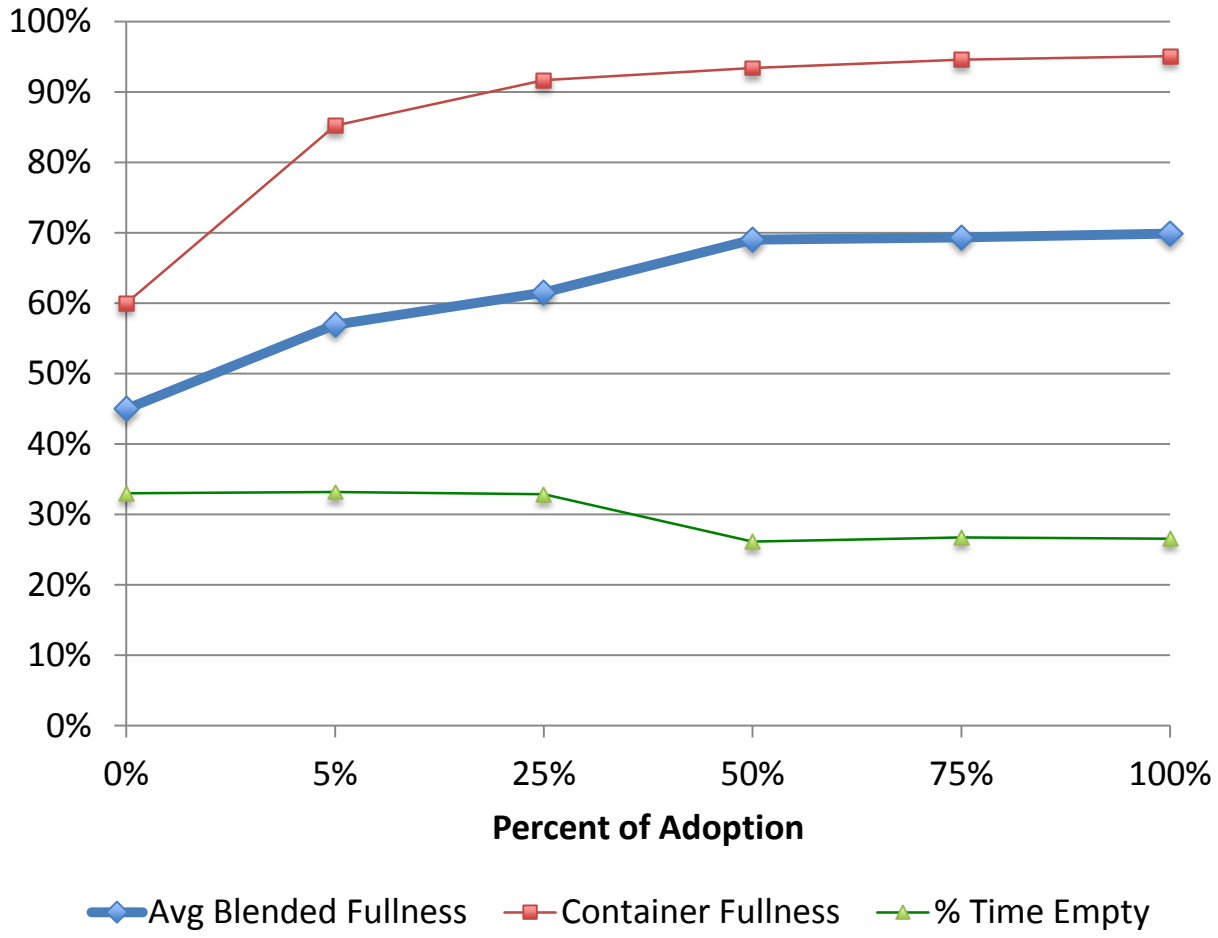
Trailer Fullness Modeling Results



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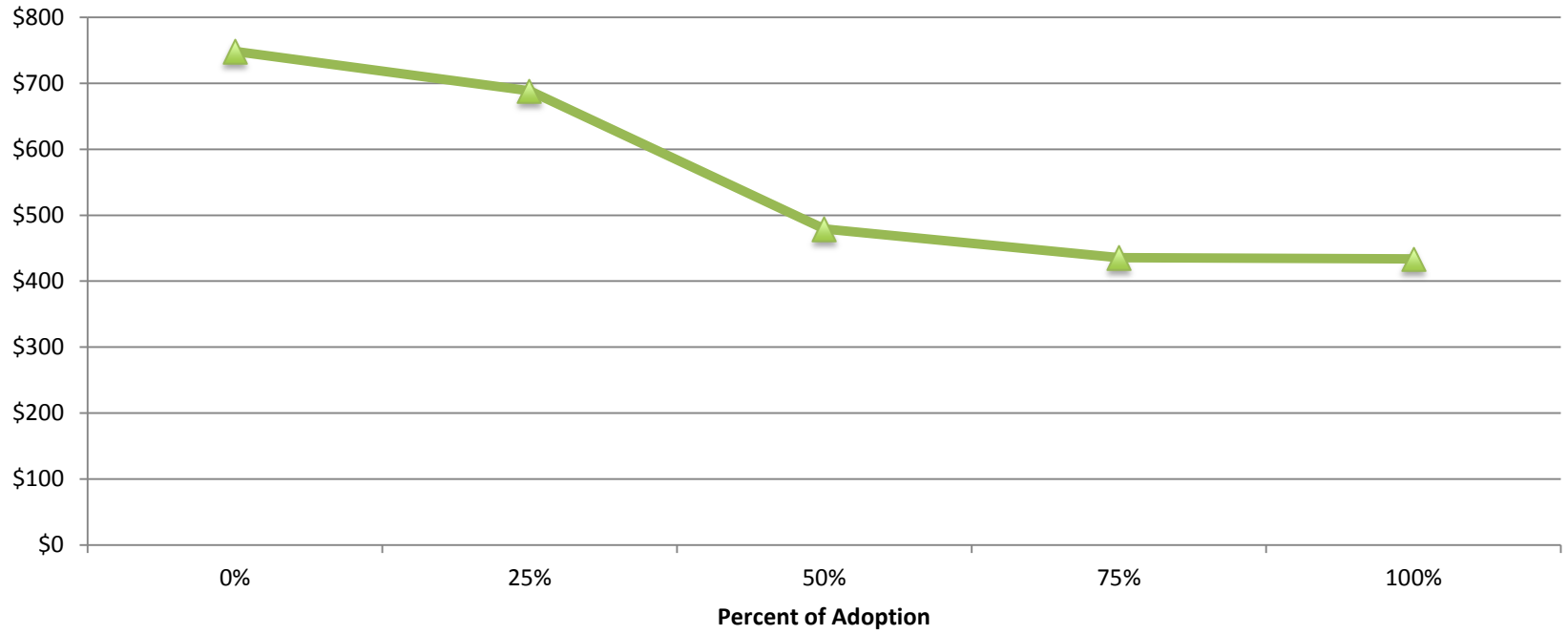
Total Cost per Shipment Results



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The Physical Internet Vision

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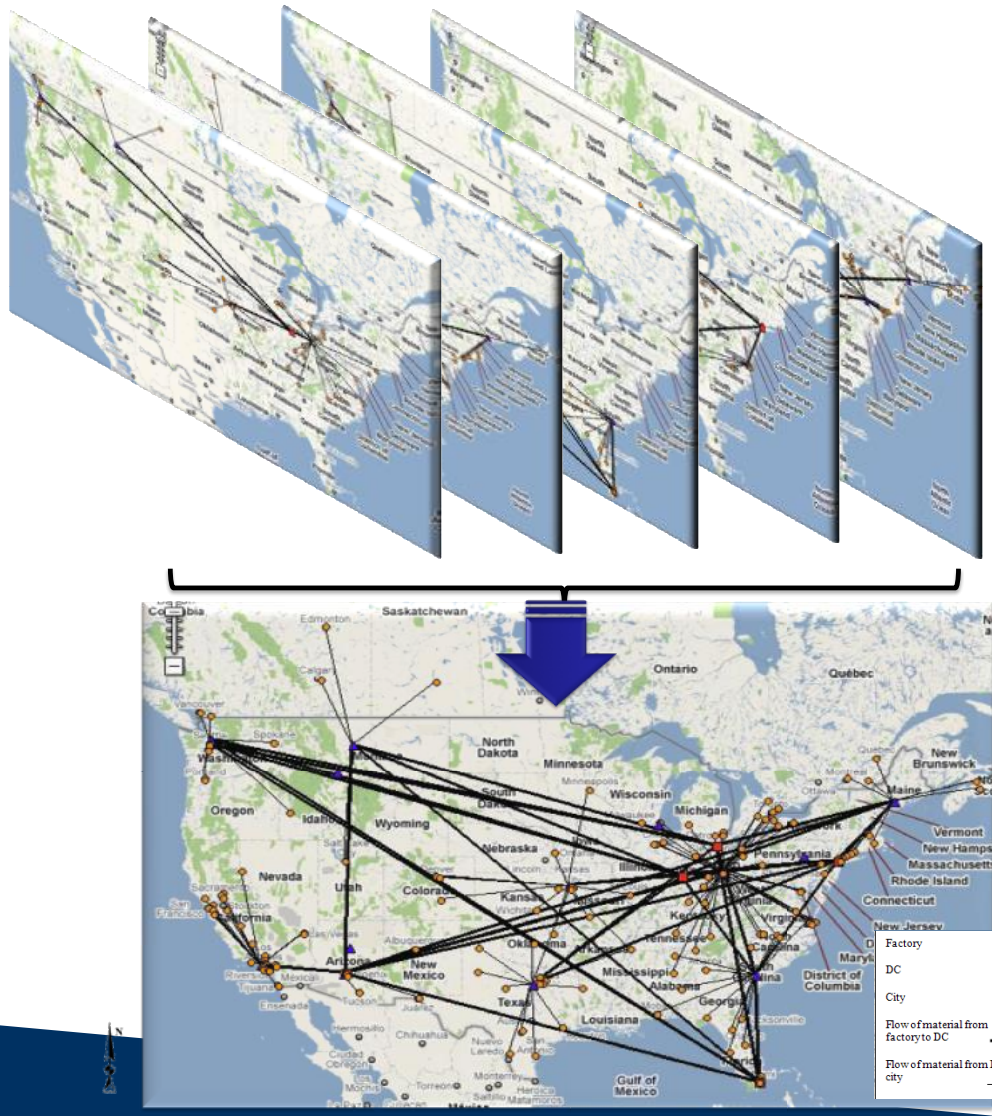
The Physical Internet

The Physical Internet (PI) is an open global logistics system founded on physical, digital and operational interconnectivity through encapsulation, interfaces and protocols.

The PI enables an efficient and sustainable logistics web that is both adaptable and resilient.

The Power of an Interconnected Network

Interconnect distribution networks into logistics webs to fill trailers and distribution centers



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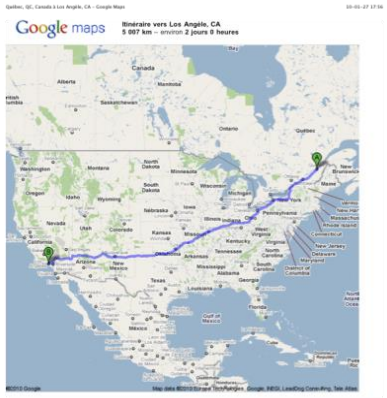
The Speed of an Interconnected Network

To Los Angeles (USA) from Quebec City (Canada)



	Current P2P	Proposed Distributed
Distance travelled one-way (km):	5055	5115
Drivers:	1	17
Trucks:	1	17
Trailer:	1	1
One-way driving time (h):	64	66
Total time at transit points (h):	0	8
Total trailer time (h):	124	74
Average driving time per driver (h):	64+	8

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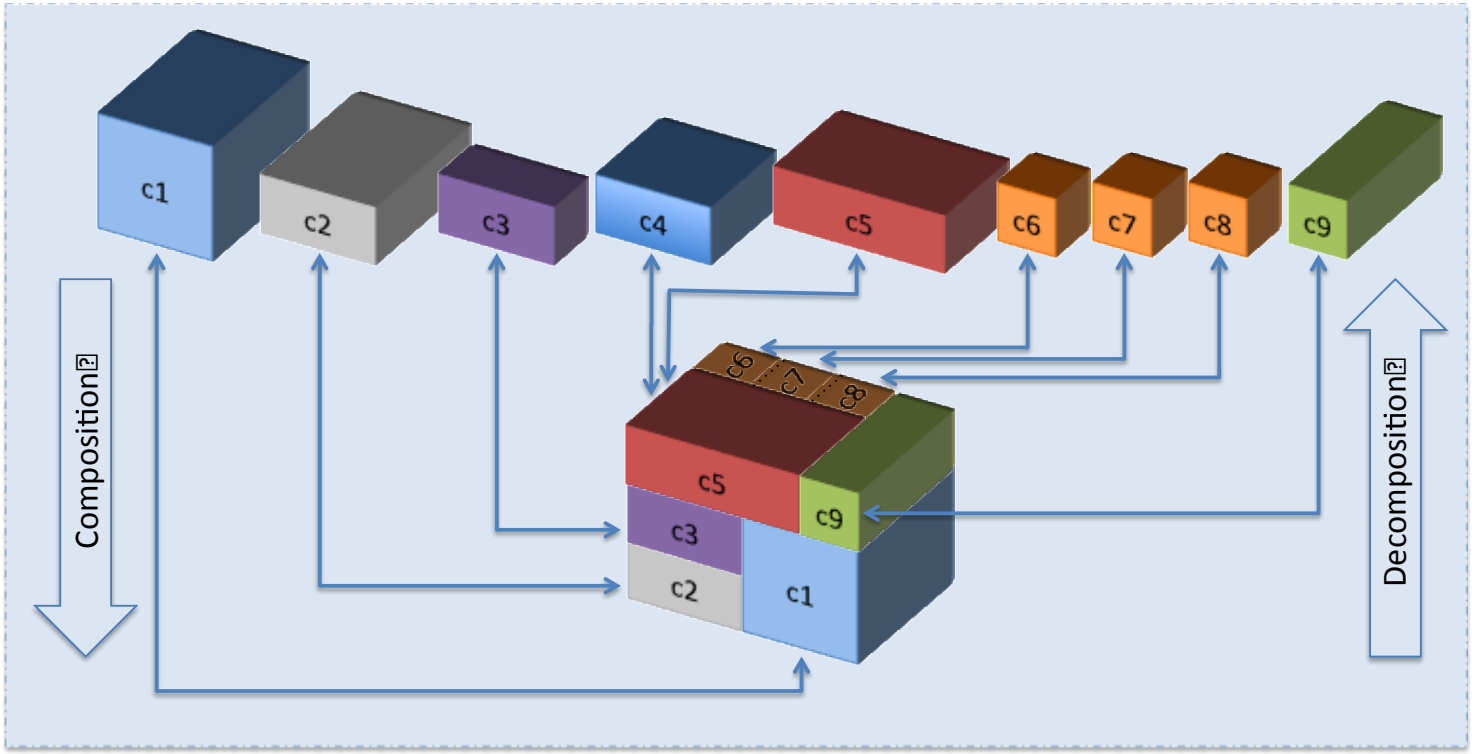
Original example appeared in Montreuil, B. (2011); modified by R. D. Meller (2012).

Enabled by Standardized Modular Containers



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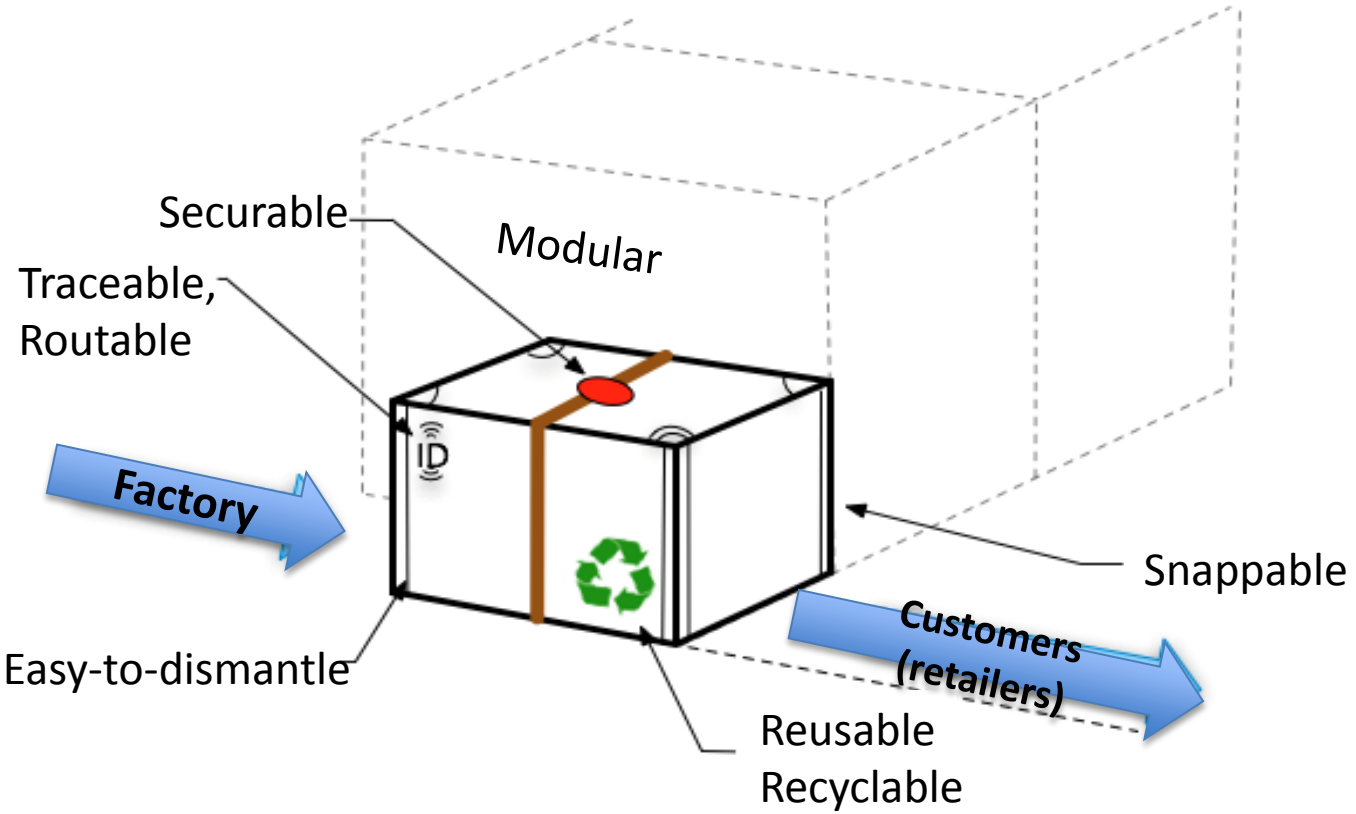
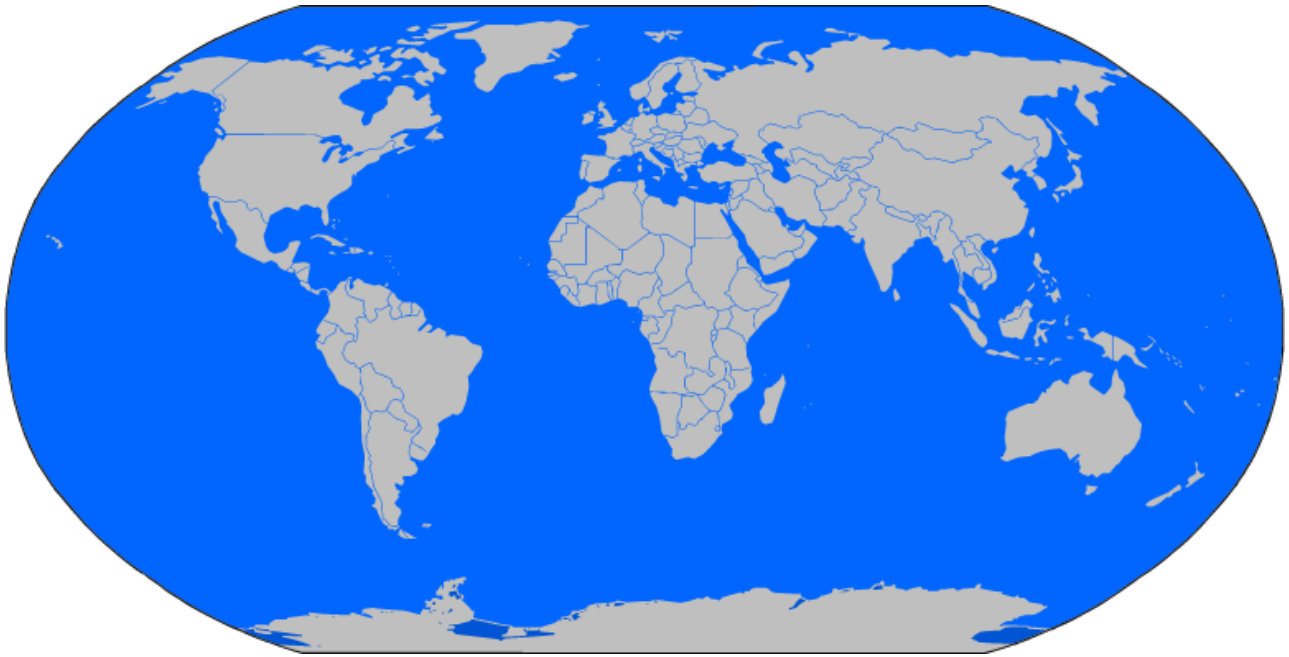
Montreuil, B., Meller, R.D., Ballot, E., "Towards a Physical Internet: The Impact on Logistics Facilities and Material Handling Systems Design and Innovation," in *Progress in Material Handling Research: 2010*, Material Handling Institute, Charlotte, NC, 305-327, 2010.

Enabled by Standardized Modular Containers



Original drawing by Eric Ballot, Mines ParisTech, adapted by Benoit Montreuil.

In a Unified, Multi-Scaled Network with Universal Interconnectivity



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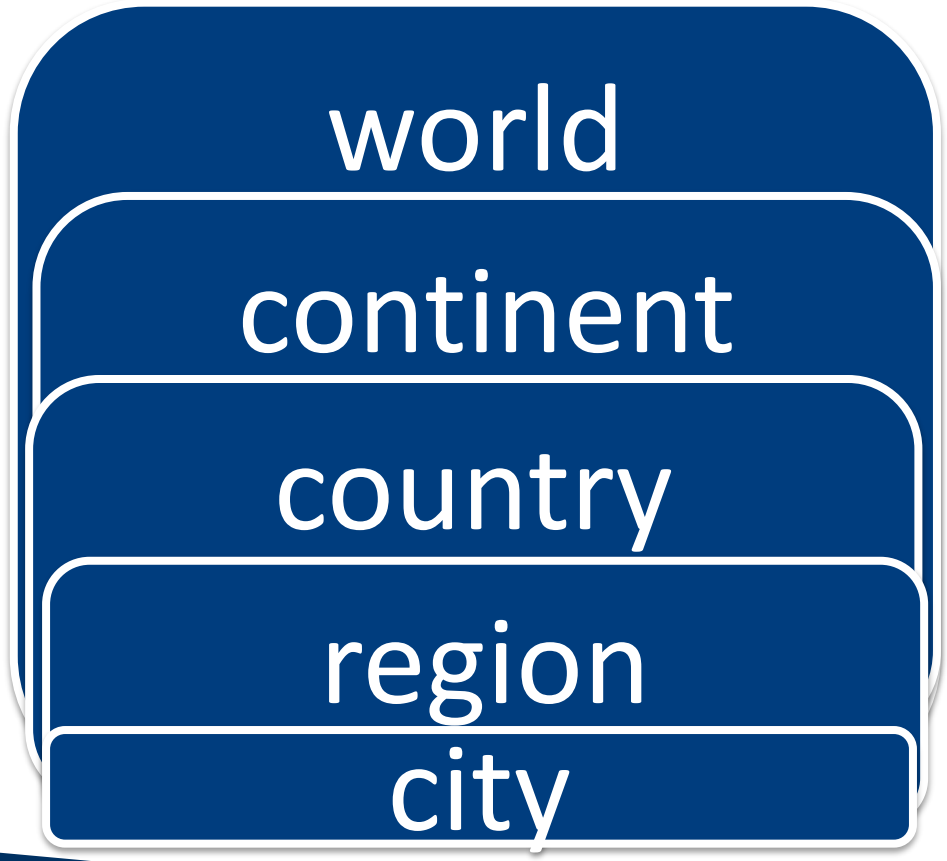
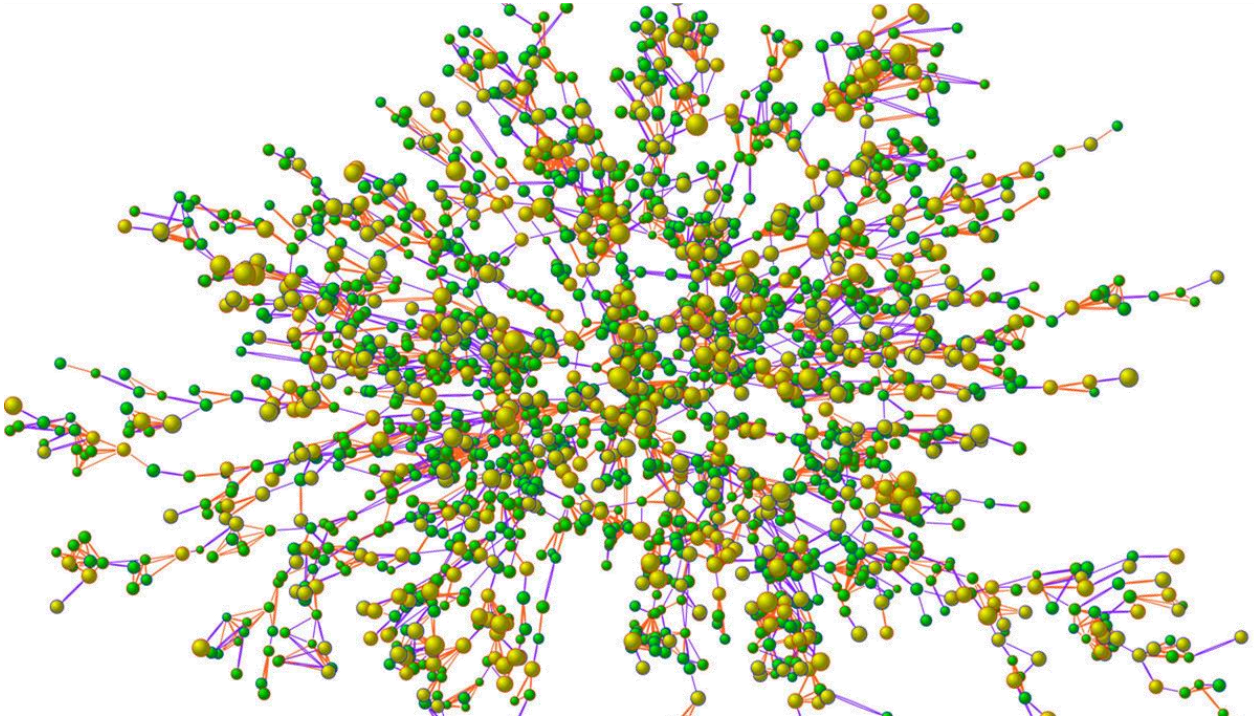


PI concepts at one level extending to the other levels

Governed by a Vast Network of Users

with Standardized Contracts and Supplier Ratings



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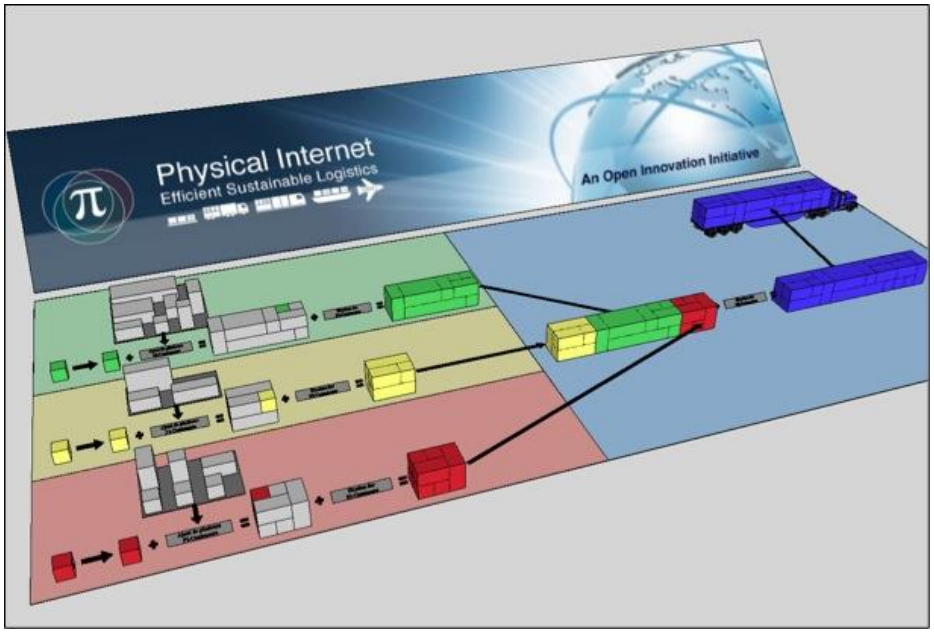
Simplified Mental Image of the PI



Montreuil, B., "Physical Internet," 2011.

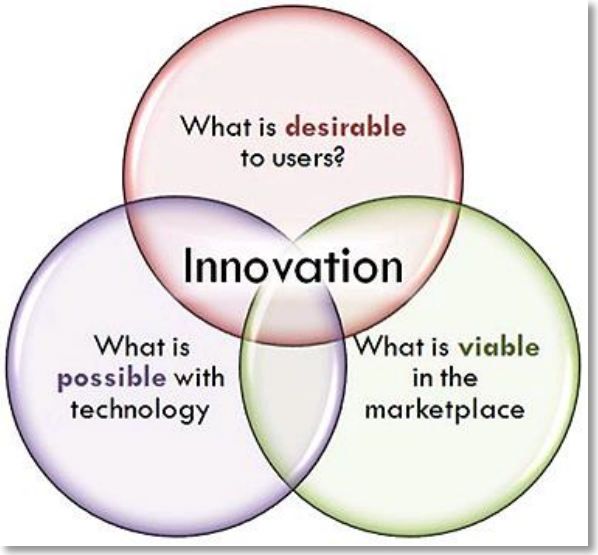
- eBay-like freight transportation "auction"
- handles "black box" modular containers
- open and shared transportation and distribution network
- vast community of users
- supplier ratings to drive logistics performance

Barriers to Full Interconnectivity

No standardization!

- **Shipping containers**
- **Carton sizes, pallet sizes**
- **Specifying volume, how to handle, etc.**

Smart, re-usable modular containers and technology are difficult to justify.



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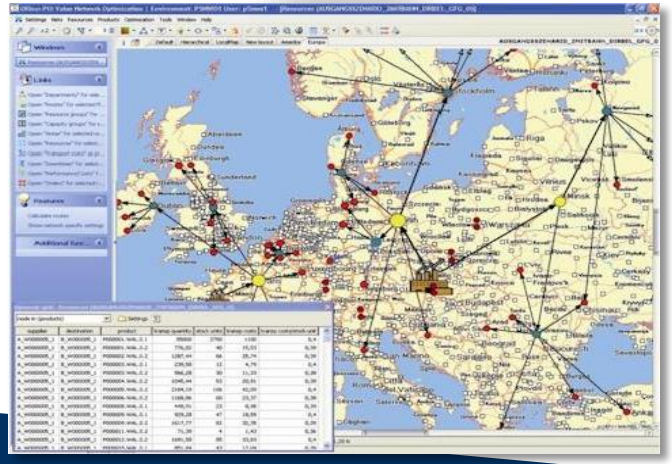
Barriers to Full Interconnectivity



Multi-modal transport systems greatly underperform

Collaborative distribution takes a lot of effort and does not scale

Logistics networks are neither secure nor robust

There are no standardized contracts or all-encompassing digital exchange

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Biggest Barrier of them All?

It is not the technology, it's inertia and a very real perception of "risk" that it won't work well.

Need to prove that interconnected logistics will work and that it will save money!

This requires addressing many physical, digital and operational interconnectivity questions.

Ongoing Research Efforts

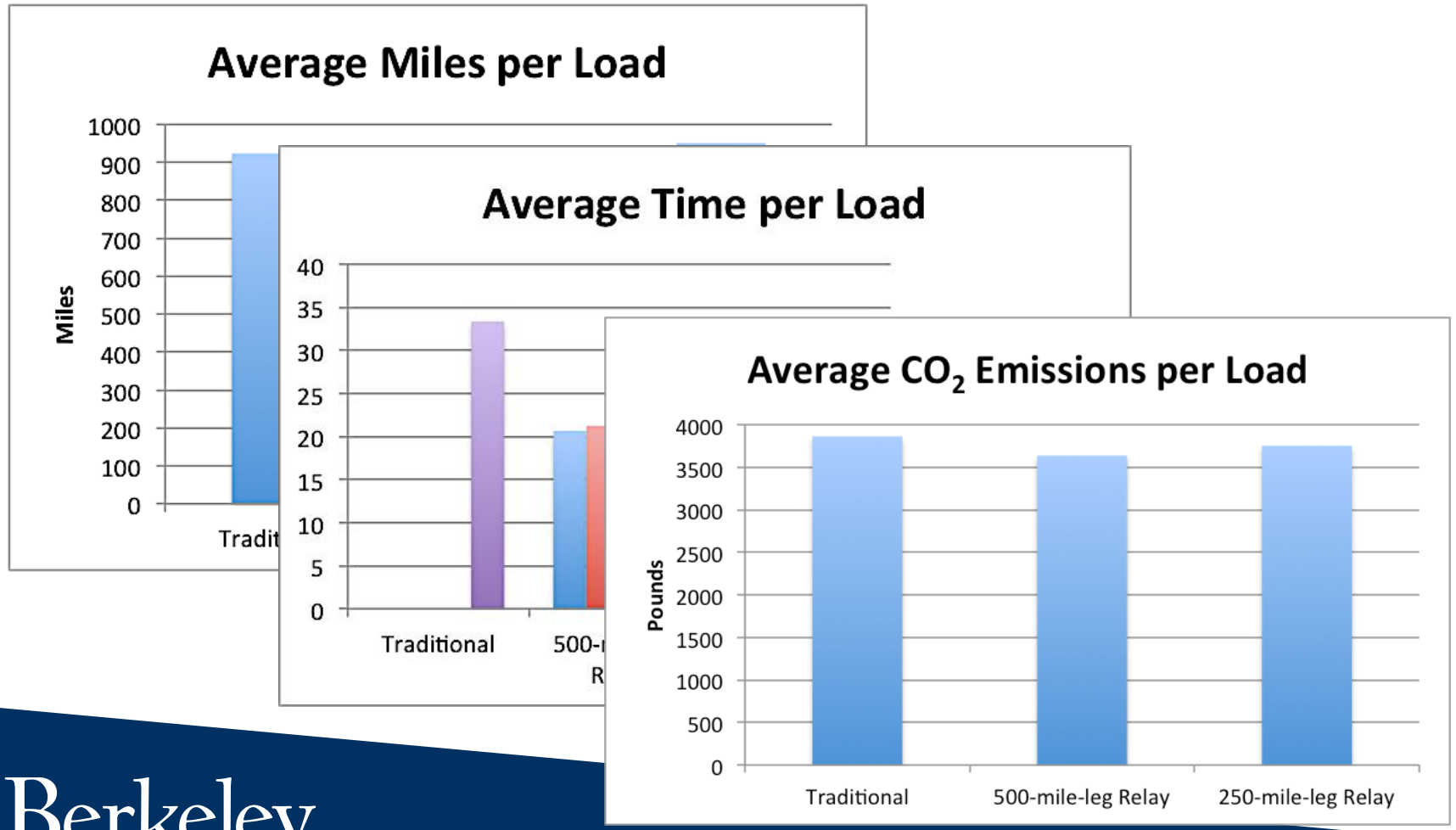
- What are the potential logistics system gains of the PI?
- The CELDi Physical Internet Project focuses on establishing the impact on the performance of a truck-based supply chain:
  - Mathematical models
  - Real data
  - Load Planning [above]
  - Relay network impacts – speed and driver turnover
  - Distance through network – shorter distances..
  - Inventory – rise or fall..
  - Container sizing – negate other results?

- Simulation and field-based proof of concept
- Testing facilities and containers

R.D. Meller and K.P. Ellis, "An Investigation into the Physical Internet: Establishing the Logistics System Gain Potential," in *Proceedings of the 2011 International Conference on Industrial Engineering and Systems Management*, Metz – France, 575-584, 2011.

Relay Networks

Relay Networks



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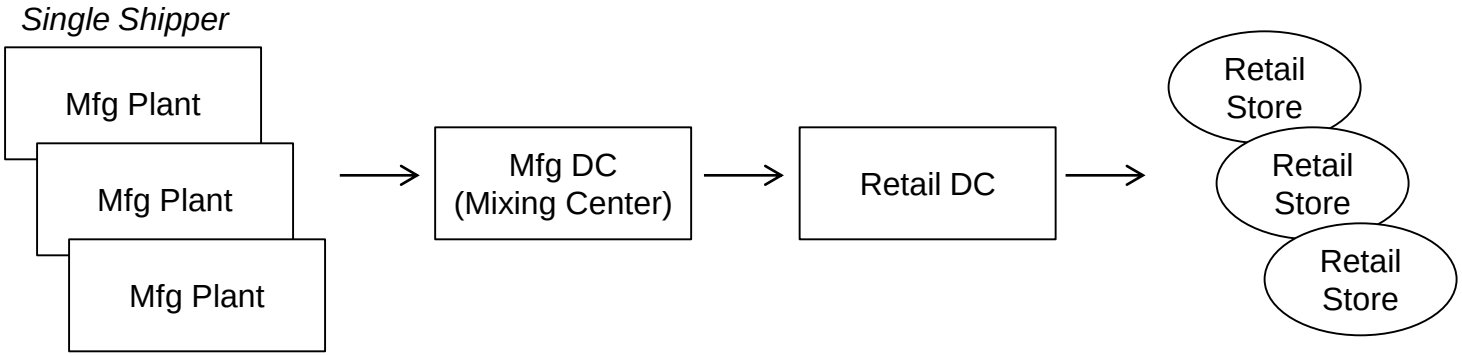
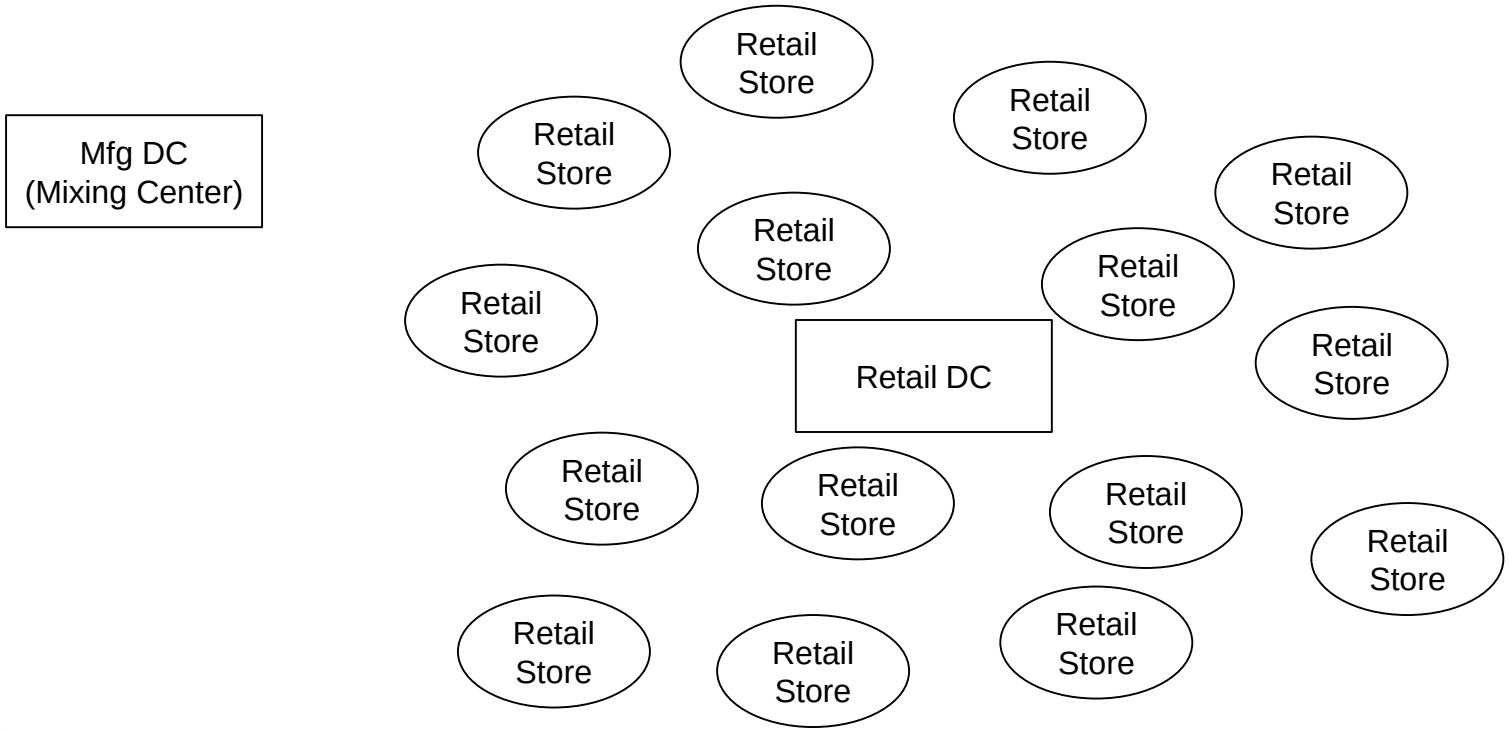
Distance Through a PI Network

Current flow in a CPG-Retailer supply chain



Distance Through a PI Network

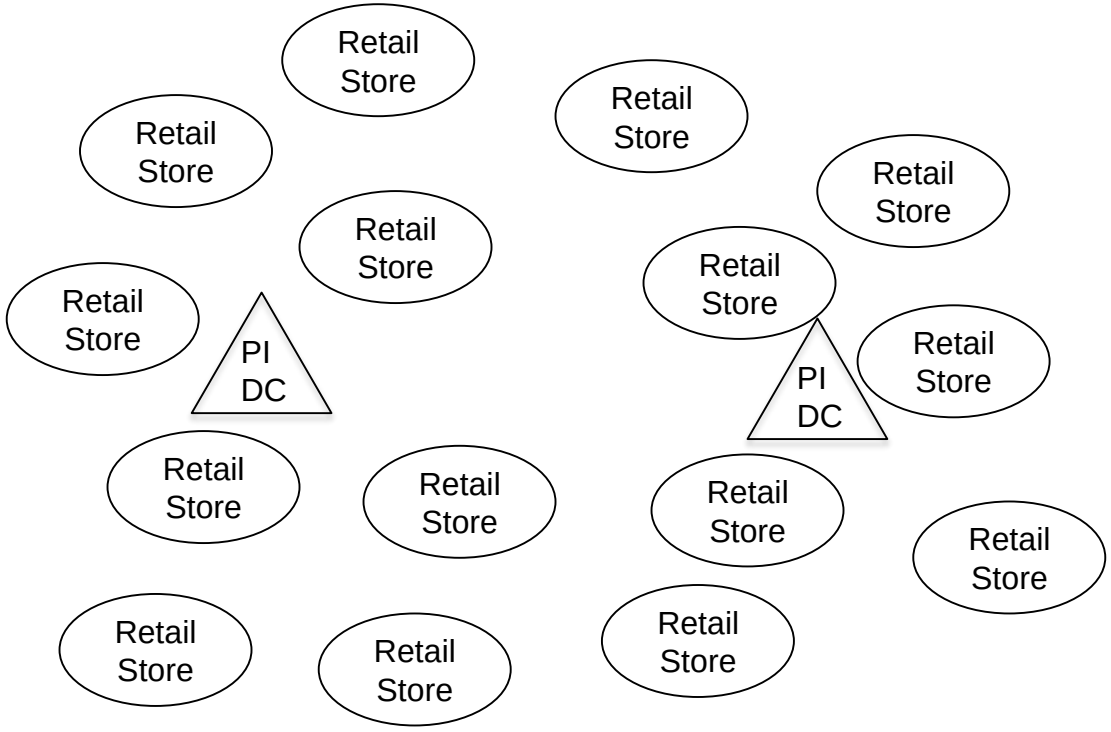
Current flow in a CPG-Retailer supply chain



Distance Through a PI Network

Flow in a CPG-Retailer PI supply chain

Mfg DC
(Mixing Center)



Distance decreases (~20%)

Inventory impacts?

Inventory Changes

- **CPG:**

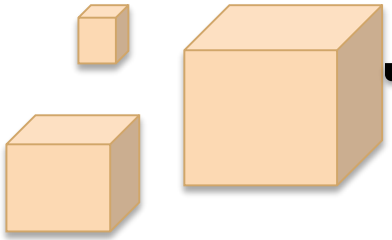
Increase in # of DCs Used	% Total Inventory Increase
50%	-59%
100%	-46%
150%	-32%
200%	-19%
250%	-5%
300%	8%
350%	22%
400%	36%

- **Retailer: 33%+ decrease**

PI

Cases

Pallets



Mboxes

Unit Loads

Example PI Possibility:
5 (All)

Modular Container Use in the Physical Internet

What's the impact as we …

limit the number of case sizes?

allow the number of items per case to change?

allow item dimensions to change?

Meller *et al.*, "A Decomposition-Based Approach for the Selection of Standardized Modular Containers," in review with *EJOR;* "The Impact of Standardized Metric Physical Internet Containers on the Shipping Volume of Manufacturers, *Proceedings of INCOM12*, 2012; "The Impact of Standardized Physical Internet Containers on Shipping Volume," *Proceedings of the 4th International Conference on Information Systems, Logistics and Supply Chain*, 2012.

Modular Container Selection for the PI

Retailer
1715 CPG products
850 shelf packages

1057 case sizes

If the PI reduces the choices, how does it affect how much volume is shipped?

What impact is there at the pallet level?

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Modular Container Selection for the PI

Retailer
1715 CPG products
850 shelf packages

1057 case sizes

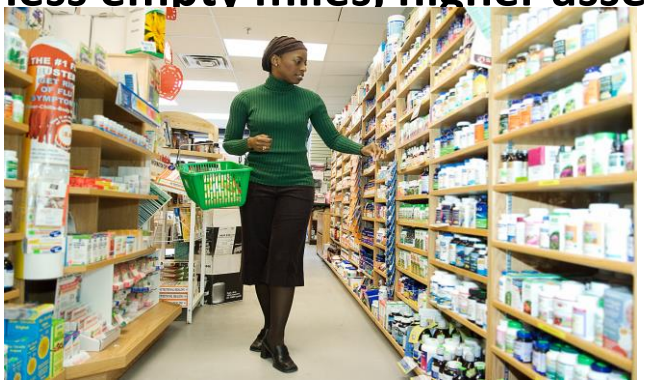
At the case level, there there is a net increase of 8%

At the pallet level, there there is a net savings of 20%!

Virtuous Cycle

TSP: trailers more full, less empty miles, higher asset utilization, less turnover

Customer pays less!



TSP charges Shippers lower rates

Shippers: lower rates, EOQ from truckload to pallet

Shipper positions inventory closer to Retailer, frequent shipments, lower price

Retailers: more backhauls, lower inventory, less stock outs

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Sizing the Prize, in the U.S.

- **Economic: $100B+ annually**
- **Environmental: 200+ Tg of CO_2 annually**
- **Social: turnover down from 100%+ to 24%**

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Collaboration is Key!

- Horizontal collaborative logistics – how can we grow this from the bottom up?
- Standardized containers, contracts, and systems – how can we grow this from the top down?