Georgia Tech Physical Internet Center
Supply Chain & Logistics Institute

The Physical Internet

Towards Hyperconnected Automotive Supply Chain Logistics

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Need for a Better Supply Chain

Evolve towards Hyperconnected Automotive Supply Chain

Why?

- Almost every company is operating its own supply chain (Imports, Transportation, Warehousing and Distribution)
- Auto parts imports are received in different ports
- Inefficient transportation (Lack of consolidation between parties, Long lead times)
- Every assembly plant has its own DCs, which is incurring higher inventories or inefficient imports (Not full containers)

Drivers for Change

Evolve towards Hyperconnected Automotive Supply Chain

Why?

17.6 million

Sales Forecast

ROI: 60 to 1

Economical Implications

1 million a day

Employment Implications

Existing infrastructure that support expansion

Strong Interstate System

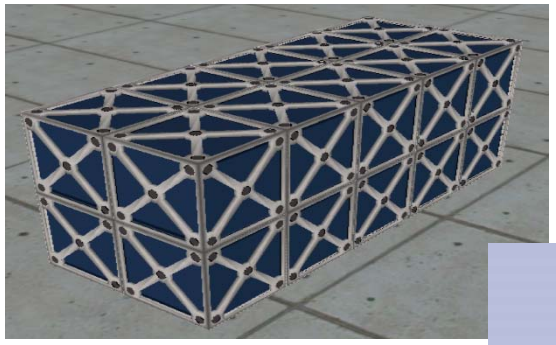
Synergies with other industries

Car as a Doctor

PI Enabler: Evolve towards π-containers at all scales

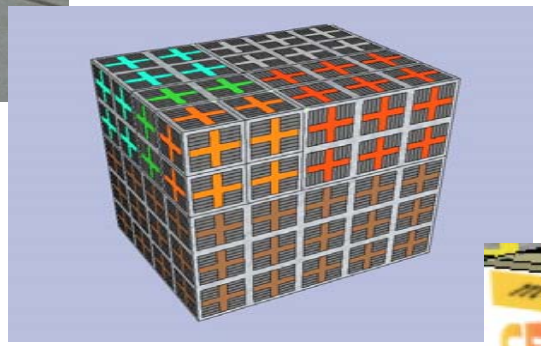
Beyond current containers, pallets, totes, cases and boxes

12m
6m
4,8m
3,6m
2,4m
1,2m



Transport Containers

Modular fit in π-certified vehicles



1,2m
0,8m
0,6m
0,4m
0,3m
0,2m
0,1m

Handling Containers

π-Boxes

Modular fit in transport containers

1,2m
0,6m
0,48m
0,36m
0,24m
0,12m

Packaging Containers

π-Packs

Modular fit in handling containers

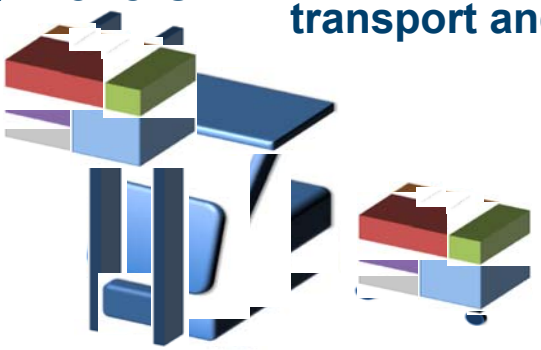
The Modulushca project has prototyped the two first generation of π-Boxes, TU Graz has engineered and prototyped the first generation

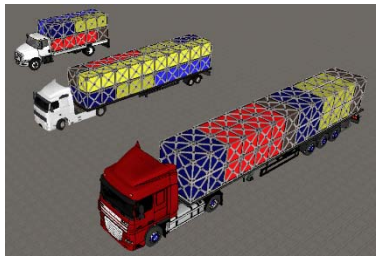
Montreuil B., E. Ballot, W. Tremblay (2015). *Modular Design of Physical Internet Transport, Handling and Packaging Containers*, **Progress in Material Handling Research Vol. 13**, Ed. J. Smith et al., MHI, Charlotte, NC, USA, to appear.

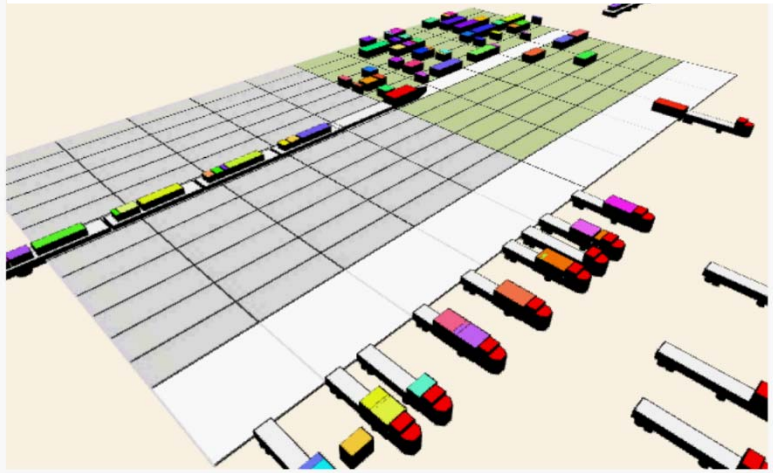
PI-Enabler: π-container handling & storage technologies

New generation of technologies and logistics facilities enabling seamless, fast, cheap, safe, reliable, distributed, multimodal transport and deployment of modular containers across the Physical Internet

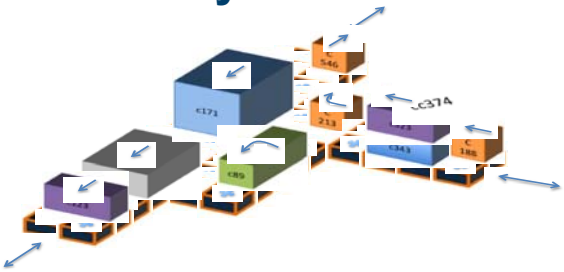
π-movers

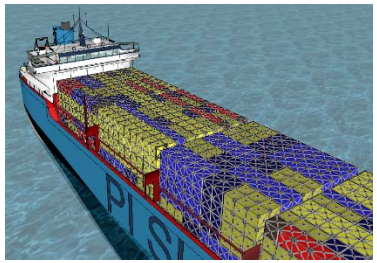


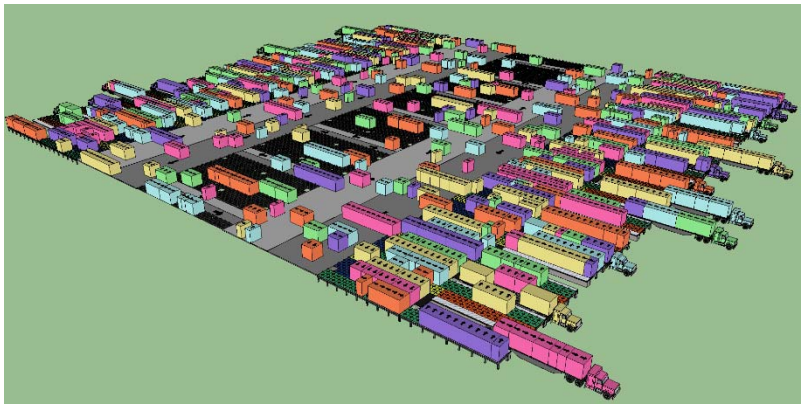




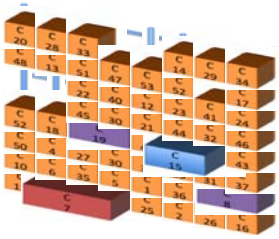
π-conveyors

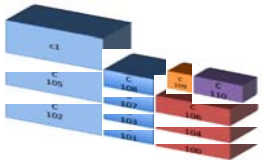


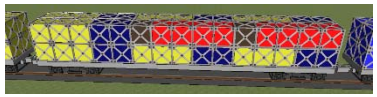




π-stores





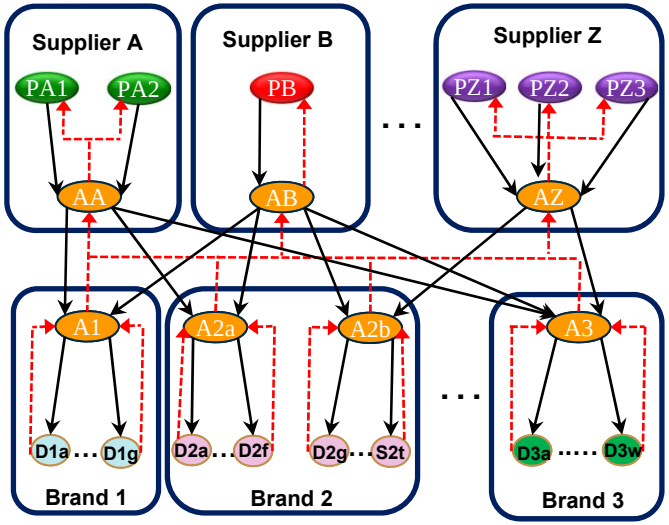


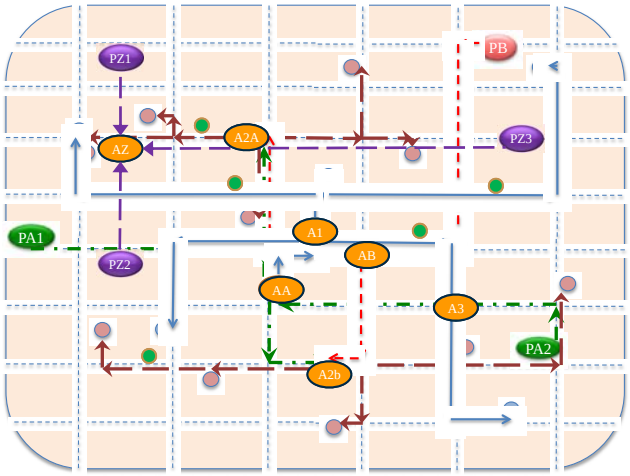
Reference: Montreuil, B., R.D. Meller, E. Ballot (2010) *Towards a physical internet: the impact on logistics facilities and material handling systems design and innovation*, in Progress in Material Handling Research, Edited by K. Gue et al., Material Handling Industry of America, 23 p., 2010.

Hyperconnecting Distribution

Current Distribution

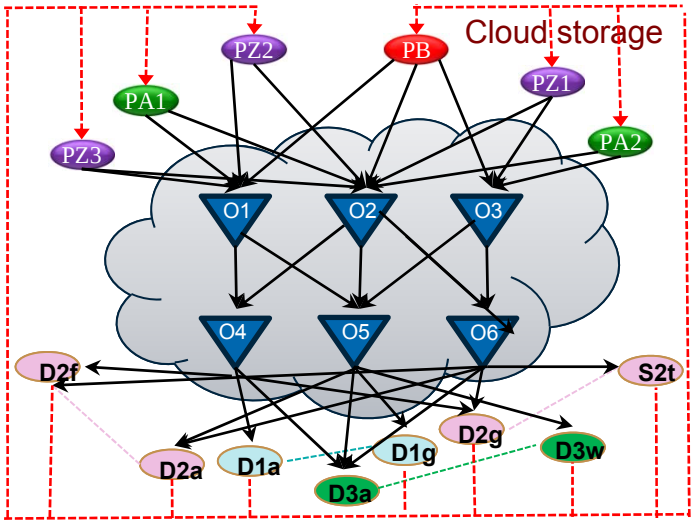
Dedicated assets
Static structure

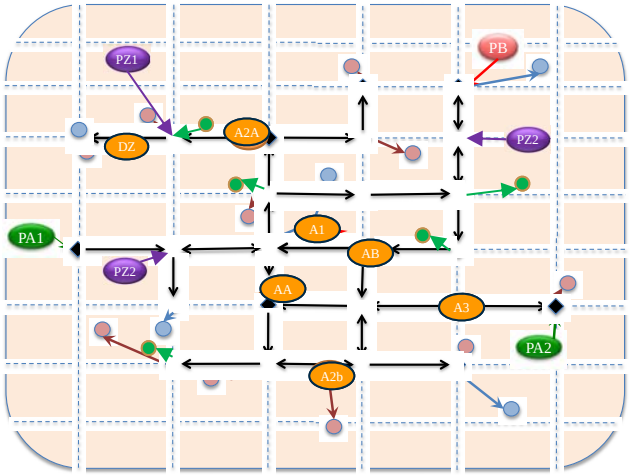




Hyperconnected Distribution

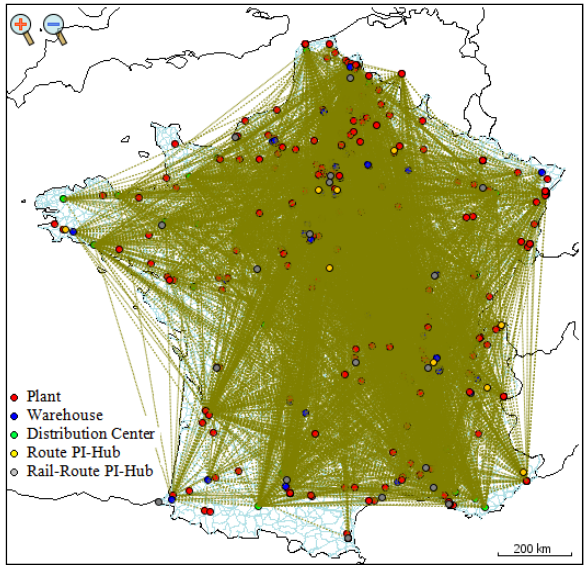
Deploy stock in openly shared DCs as demand fluctuates



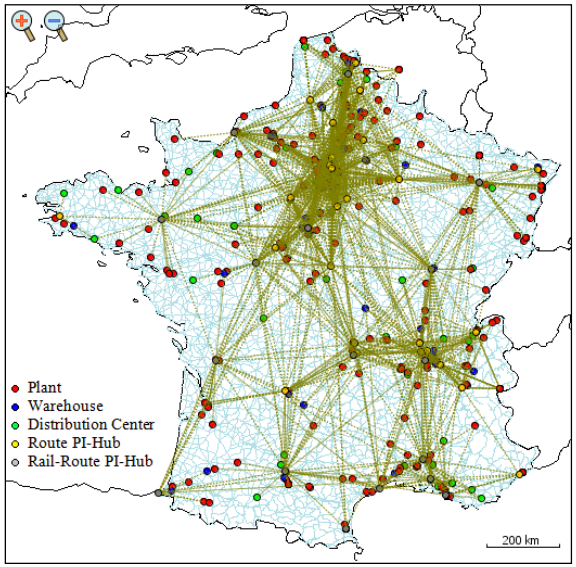


Hyperconnected Transportation

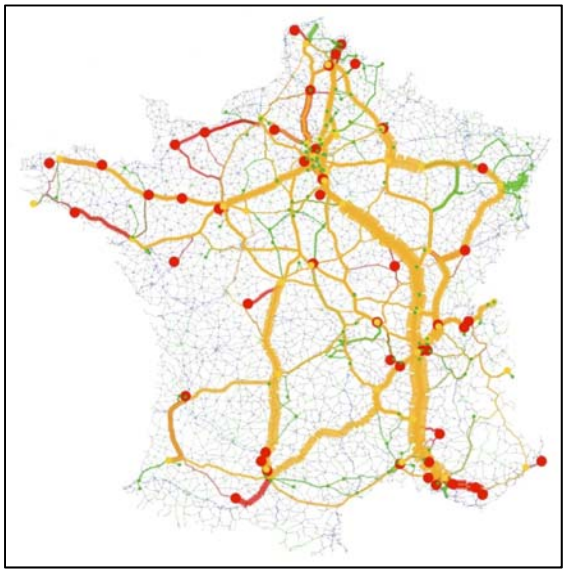
Results from a simulation experiment with top retailers Carrefour and Casino in France and their 100 top suppliers



Current flows



Hyperconnected flows



Current: Trucks
Hyperconnected: Trucks & Rail

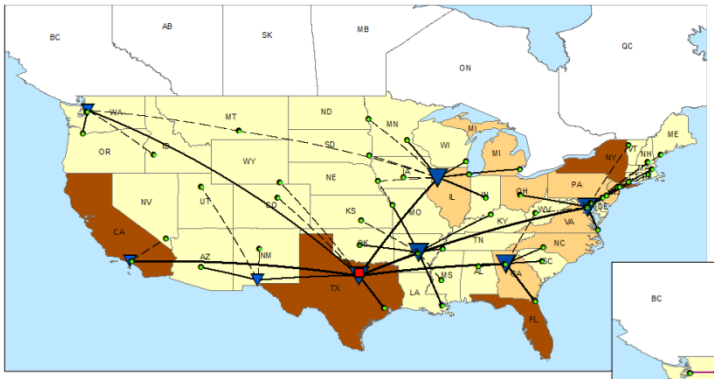
Economical: Up to 32% overall cost saving

Environmental: About 60% reduction of greenhouse gas emissions

Ballot É., B. Montreuil, R. Meller (2015),
The Physical Internet: The Network of Logistics Networks, Documentation Française.

Hyperconnected Distribution

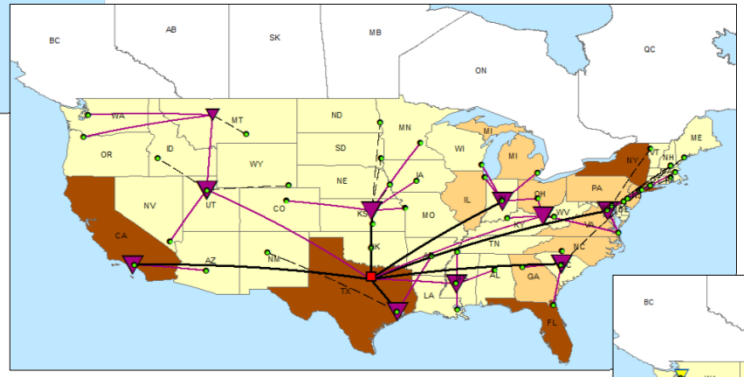
Stable Network



Dedicated Distribution

Cost: -11%

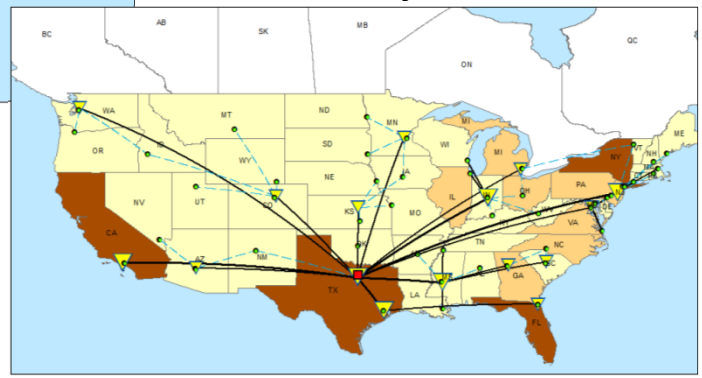
Stable Network



Collaborative Distribution
2 partners

Cost: -25%

Dynamic Network



Hyperconnected Distribution

Cost: -33%

Hyperconnected distribution is by far the best alternative, even better as consumer delivery has to be faster

1-2-3-Day Service Level

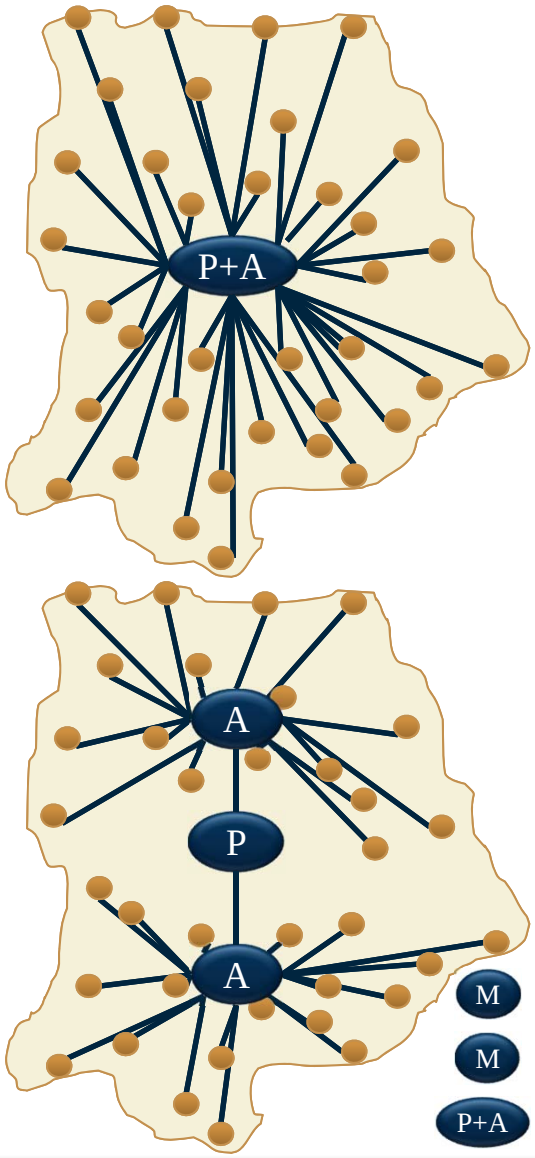
Case of ten illustrative companies serving Canada-USA markets: Optimization of distribution networks

Source: H. Sohrabi & B. Montreuil, An Optimization Based Assessment of Dedicated, Collaborative and Hyperconnected Distribution: Modeling & Preliminary Results, NOW 2015, France

Hyperconnected Manufacturing

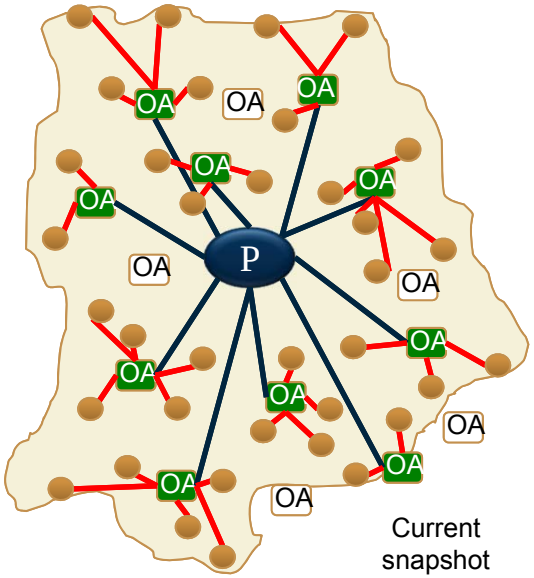
Beyond current outsourcing, subcontracting, offshoring, reshoring compromises

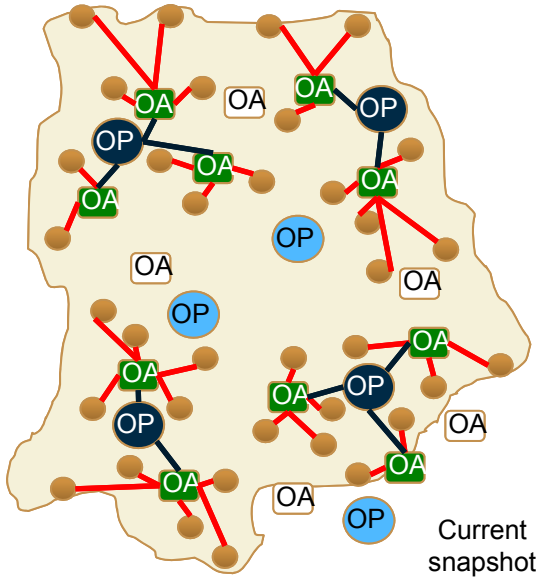
Dedicated realization



Hyperconnected realization

Enabling Efficient & Agile on-Demand Near Point-of-Use Product Realization





M Producer

M Assembler

P+A Integrated producer+assembler

Client

OP Currently exploited certified open manufacturer

OP Currently unexploited certified open manufacturer

OA Currently exploited certified open assembler

OA Currently unexploited certified open assembler

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Evolution of
Logistics, Transportation, Production & Supply Chains

Physical Internet, Logistics Web
Open hubs, DCs & fabs, Co-operation Platforms
Efficiency, Sustainability, Resilience, Agility

Hyperconnected

Horizontal & Vertical
Collaboration with SC partners
Economies of Scale/Scope, Green

Collaborative

Long to Deal
Tough to Adapt
Hard to Scale

Asset intensive
Bounding

Integrated

EDI, Just-In-Time, ECR, Lean
Dedicated & Centralized DCs & Factories
End-to-End Supply Chain

Atomistic

Fragmentation, Solo Operations
Long leadtime, big lots, large inventory

Timeline

Original concept by Benoit Montreuil & Jean-Claude Dufour

Physical Internet Induced Innovation

Thread 1 for the Automotive Industry:

Hyperconnected Vehicles and Transportation Systems

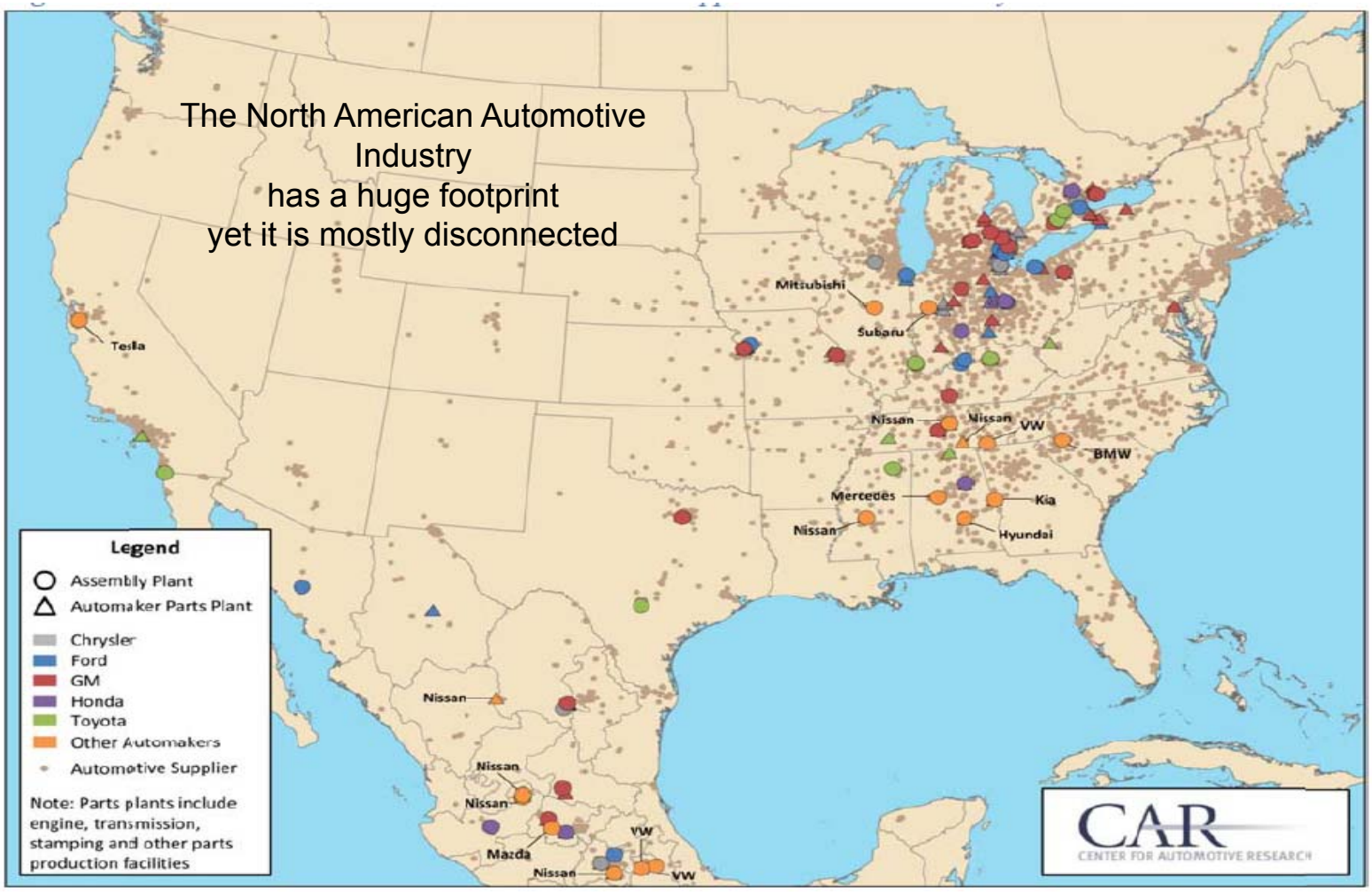
Mercedes-Benz has just announced the Physical Internet as Key to Its Vision of the Future

Hitching a ride through the physical internet. https://www.mercedes-benz.com/en/mercedes-benz/next/mobility-concept-next/hitching-a-ride-through-the-physical-internet/

Physical Internet Induced Innovation

Thread 2 for the Automotive Industry:

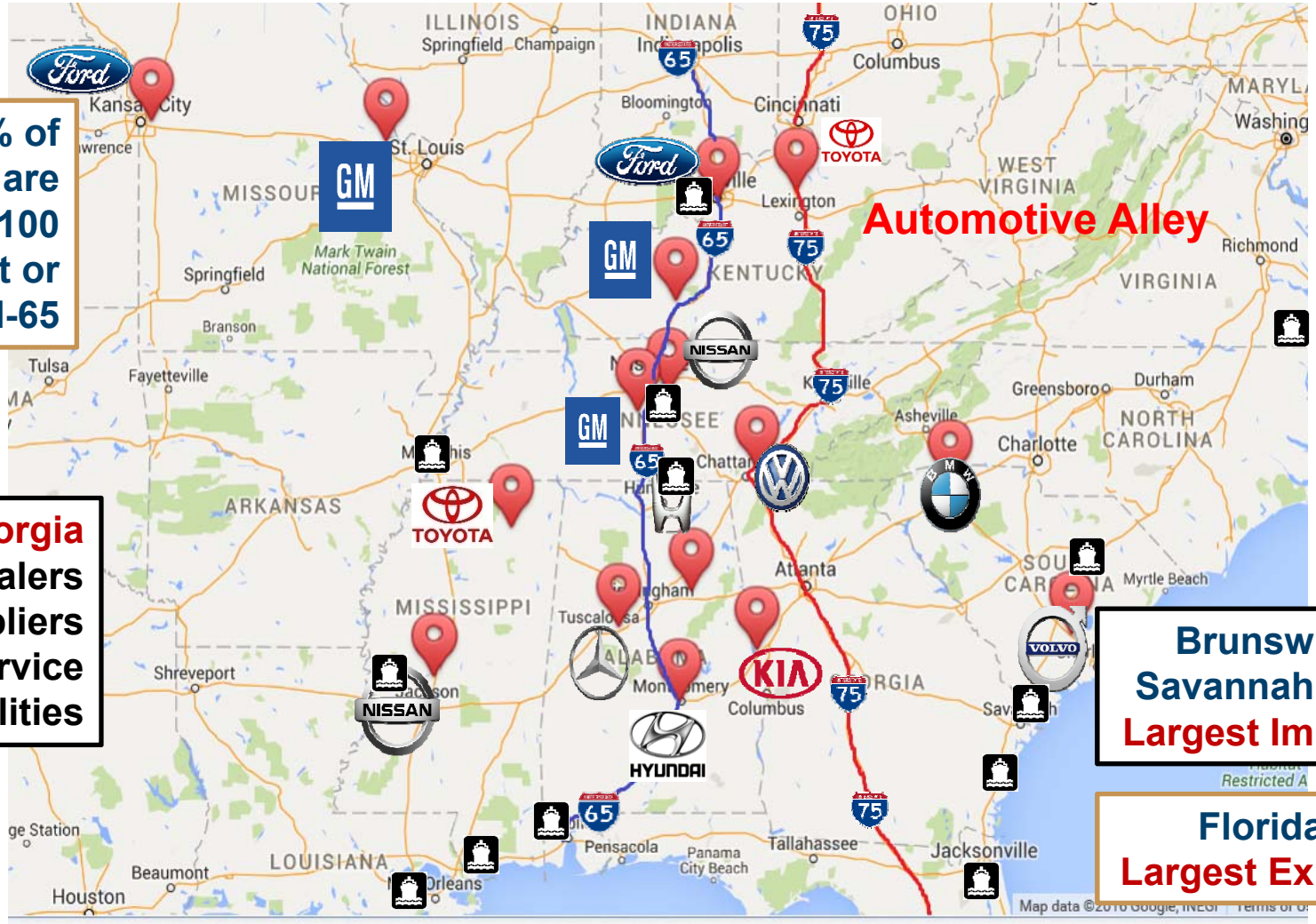
Hyperconnecting the Worldwide Automotive Supply Chain



Reference : Center for Automotive Research 2014 (supplier locations from ELM Analytics and MarkLines)

Illustrative Focus on Hyperconnecting Southeast Automakers

63% of plants are within 100 miles east or west of I-65



Georgia
5000 dealers
300 suppliers
15000 service facilities

Brunswick and Savannah Ports : Largest Importers

Florida Ports: Largest Exporters

Significance of Existing Infrastructure and Ports

Away from OEM-Supplier Specific Totes, Cages and Pallets To Pan-Industry Standard Modular Containers

Illustrating the current state

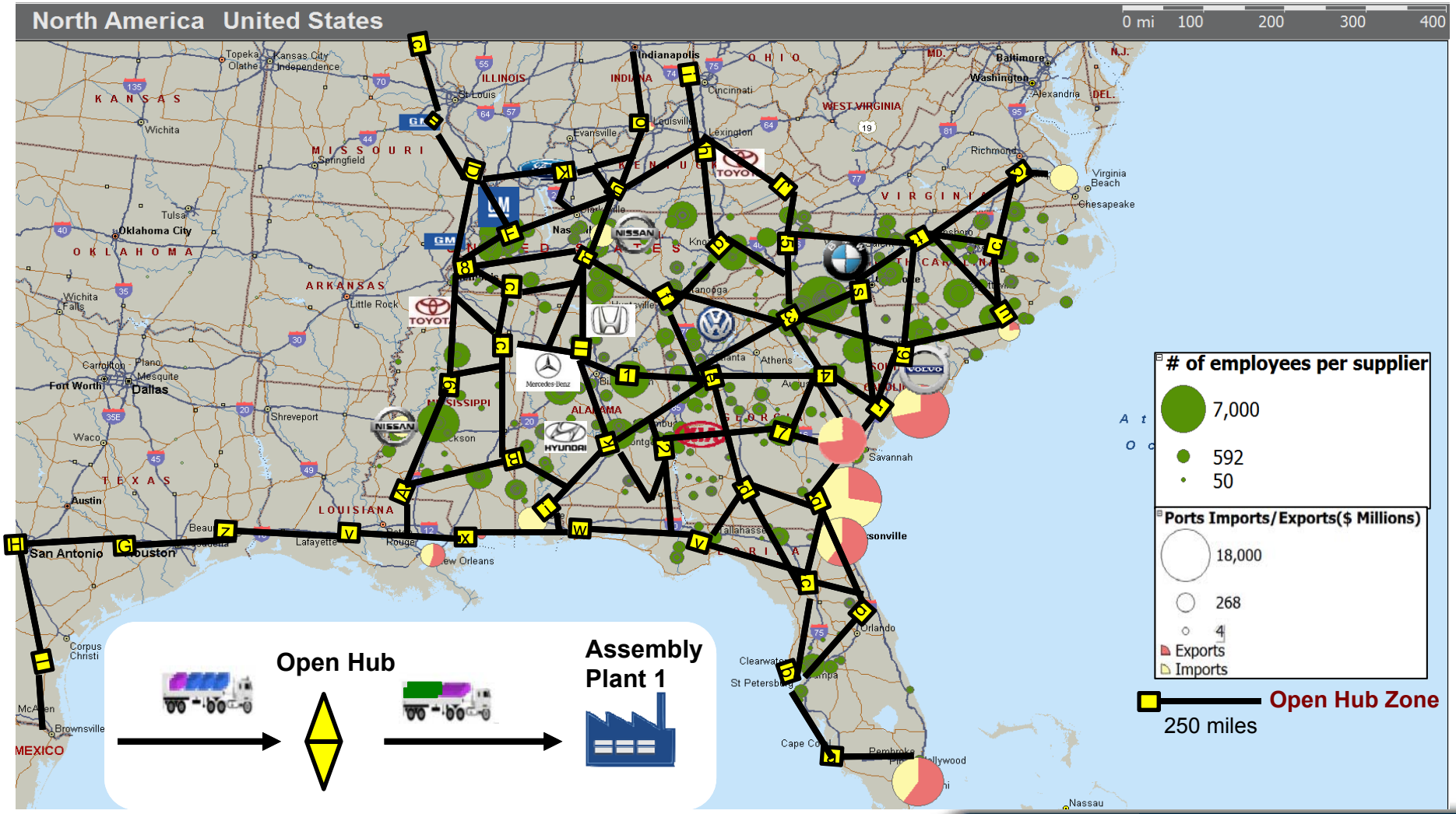
Illustrating the future state

Hitching a ride through the physical internet
https://www.mercedes-benz.com/en/mercedes-benz/next/mobility-concept-next/hitching-a-ride-through-the-physical-internet/

Hyperconnected Supplier-OEM-Dealer Transportation

Multimodal, Multi-Party, Inter-Hub, Relay Transportation

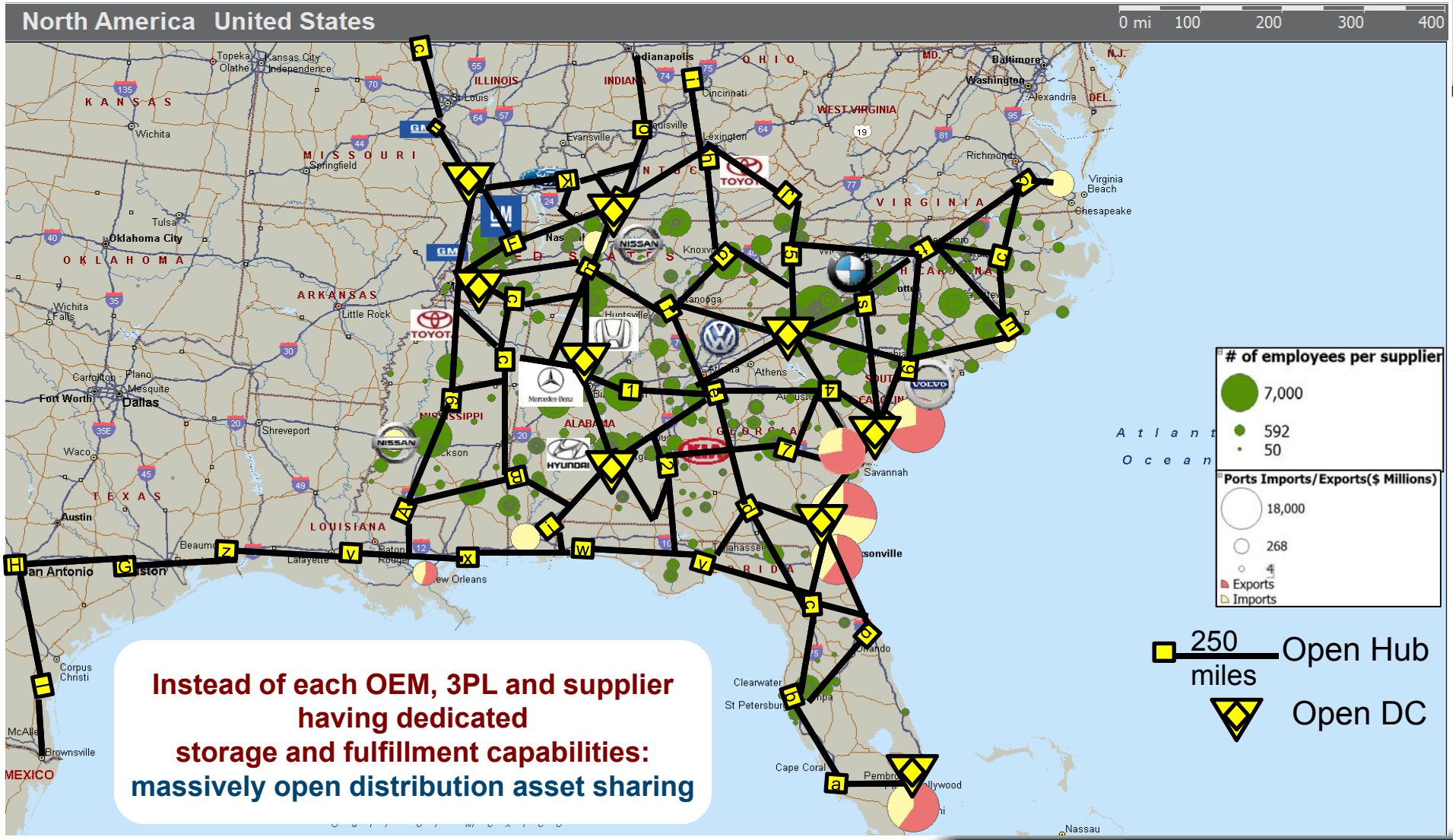
Massively Open Transportation Asset Sharing and Flow Consolidation



Specific links and hub locations are illustrative, not engineered yet!

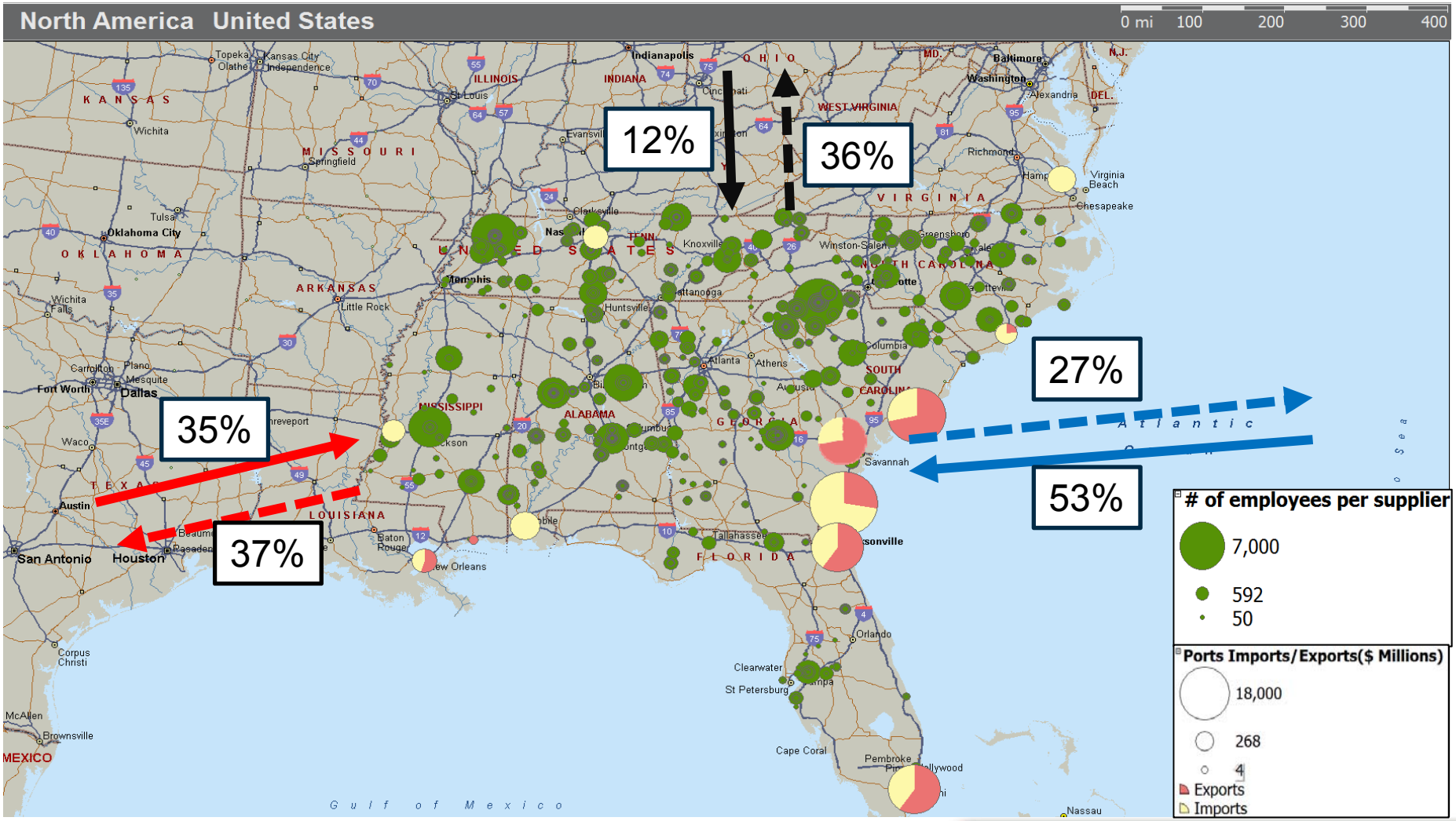
Hyperconnected Automotive Parts & Vehicle Distribution

Dynamic Deployment in Near Point-of-Use Open Multi-Party Distribution Centers



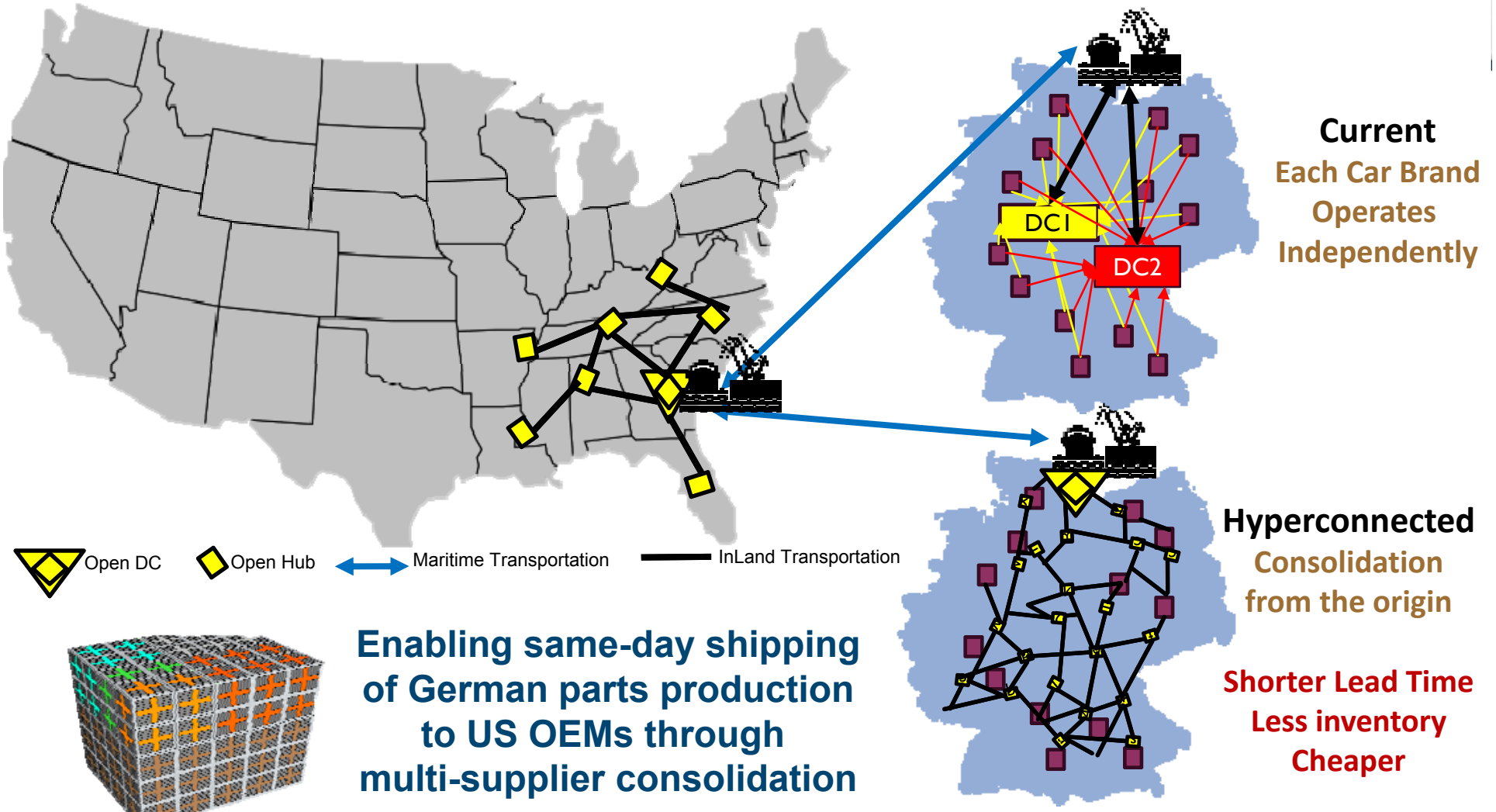
Hyperconnecting Automotive Supply

U.S. Continental, International Imports/Exports



Reference :US Trade Report http://www.trade.gov/td/otm/assets/auto/AP_Trade.pdf

Hyperconnected International Supply:
Germany and USA Example



Current
Each Car Brand Operates Independently

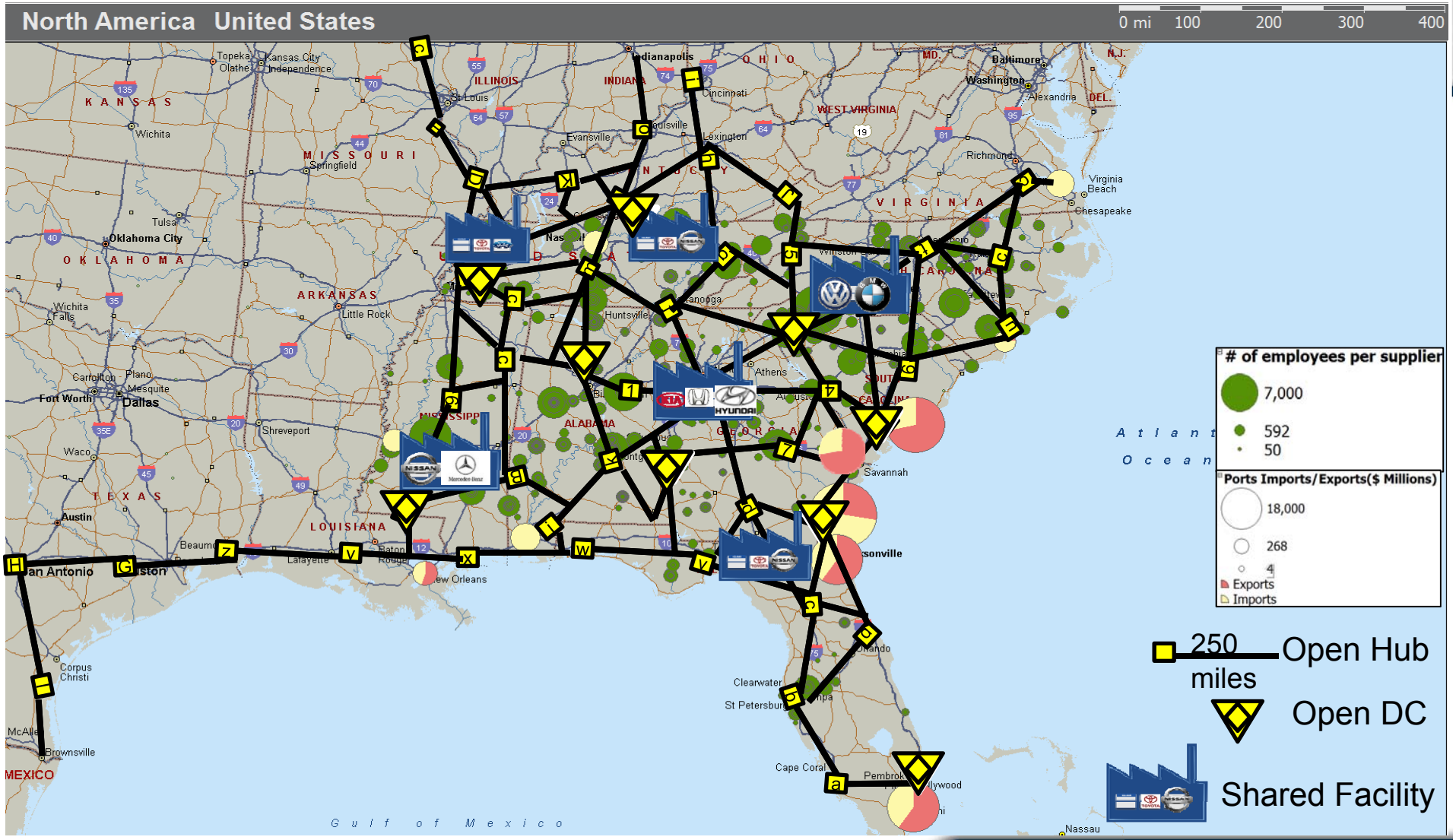
Hyperconnected
Consolidation from the origin

Shorter Lead Time
Less inventory
Cheaper

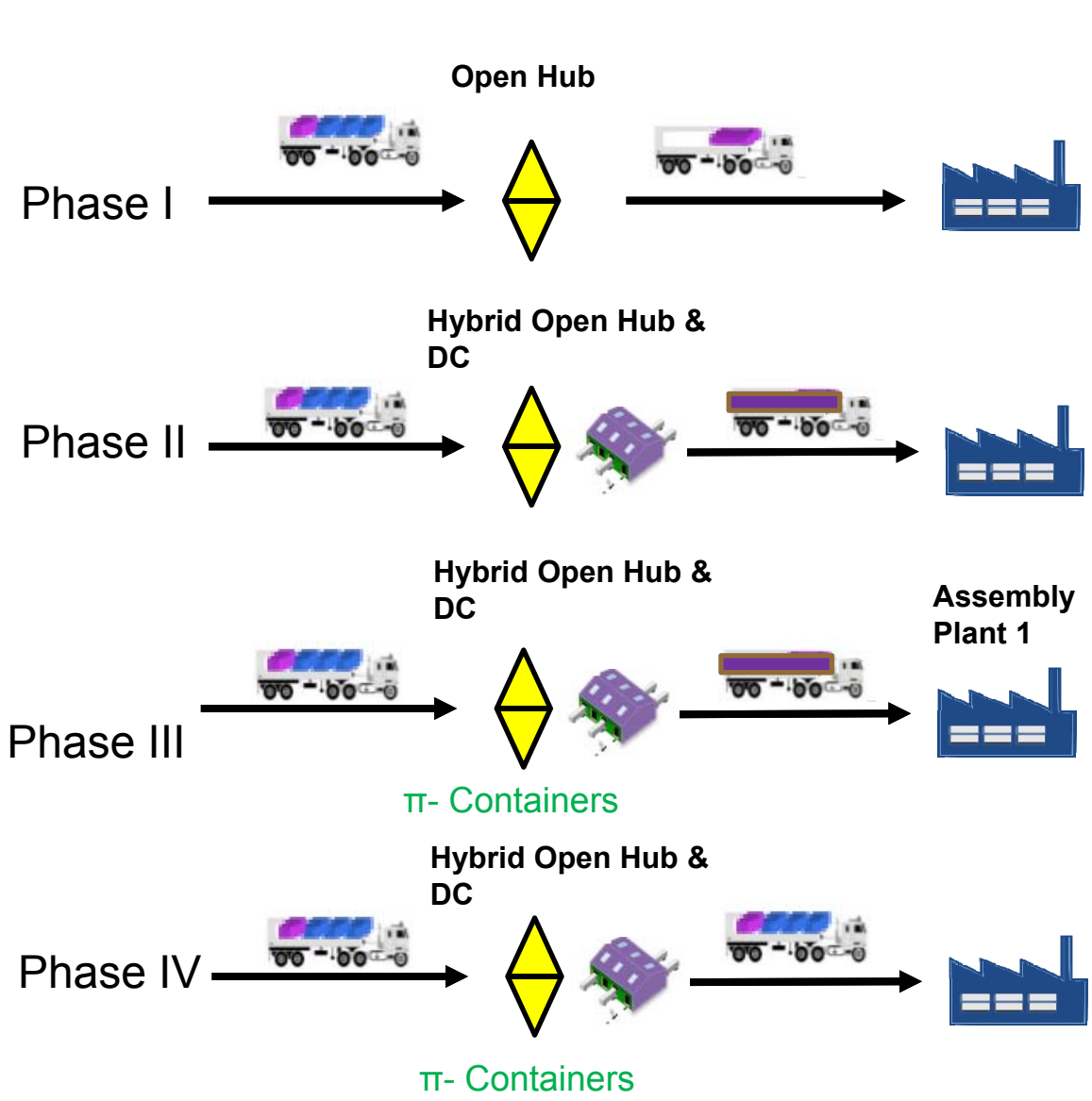
Enabling same-day shipping of German parts production to US OEMs through multi-supplier consolidation

Hyperconnected Automotive Manufacturing

Use of Shared Vehicle Assembly and Parts Production Facilities

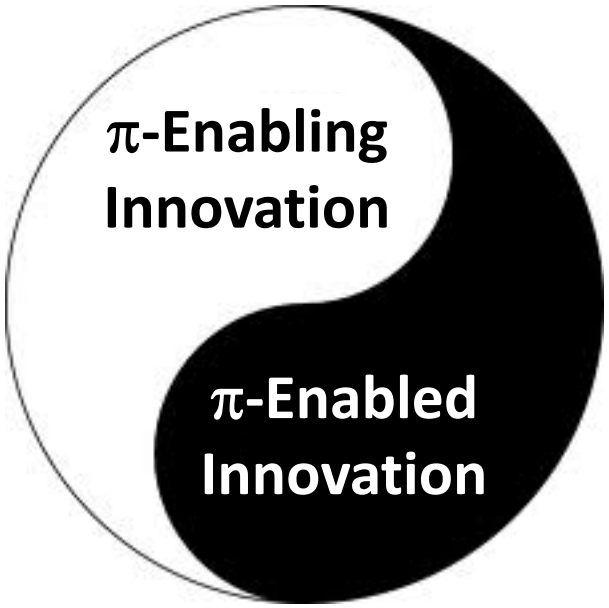


Road Map for Hyperconnected Automotive Supply Chain



Collaboration	Fill Rate	Technology	Investment
+	+		+
++	++	+	++
++	++	++	+++
+++	+++	+++	++++

Physical Internet Induced Automotive Supply Chain & Logistics Innovation



Process Innovation

Technological Innovation

Infrastructural Innovation

Cultural Innovation

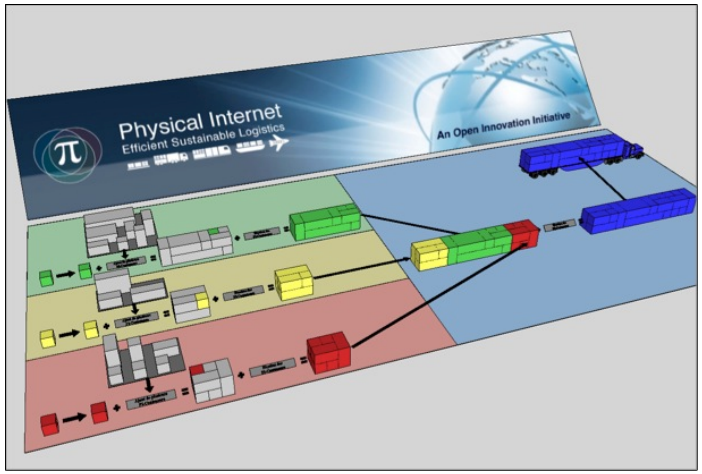
Business Model Innovation

Legislative Innovation

Four Concurrent Research and Innovation Axes Toward Physical Internet Enabled Hyperconnected Automotive Supply Chains

Axis 1 : Conceptual and Functional Design
Vision, Roadmap, PI constituents, Hyperconnected Supply Chains …

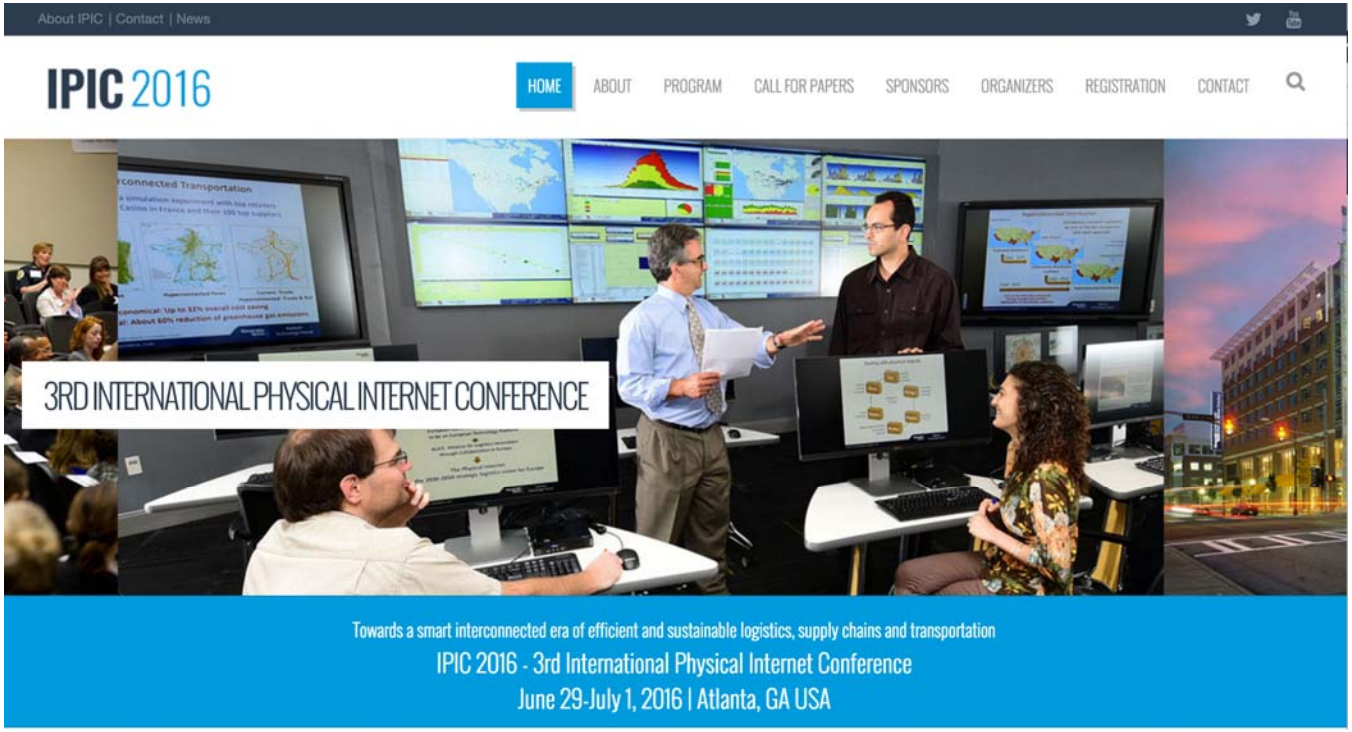
Axis 2 : Assessment of Efficiency, Sustainability & Capability
Improvements Through Analytics, Optimization, Simulation



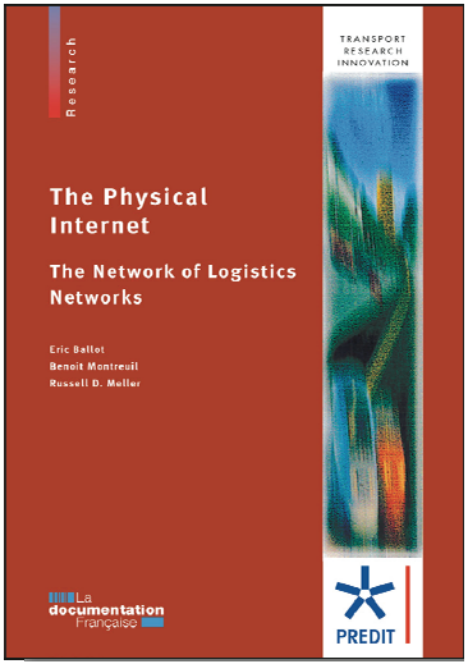
Axis 3 : Engineering Solutions
Containers, MH systems, Facility design, Business Models, Decision models, Digital platforms …

Axis 4 : Validation
Case studies, Field pilots, Virtual pilots, Living labs

Questions, comments and ideas are most welcome



www.pi.events



eBook

We are shaping a research & innovation initiative on hyperconnected automotive supply chains & logistics
We welcome your feedback, support & engagement!

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