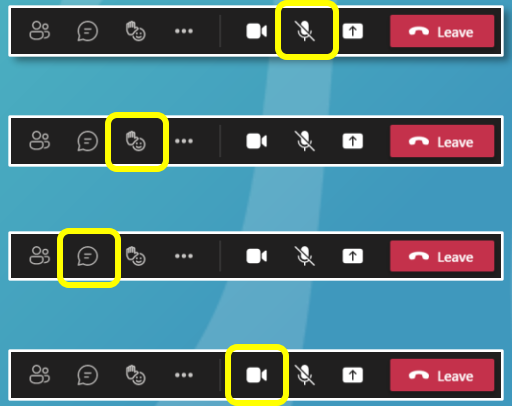
PILL MODEL PRESENTATION

THE MEETING STARTS SOON..

Please, kindly,

- **Mute** your microphone
- Have A question? **Raise your (digital) hand**.
- Also possible: put your question in the **chat**.
- Do you want to **switch on your camera**?



PILL MODEL PRESENTATION

ADVISORY BOARD MEETING

09/02/2022

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AGENDA

- Introduction of the day
- Status PILL
- Logistics Data Spaces and Digital Twins
- Standards and context
- Presenting the PILL model
- Break
- Reviewing the Use Cases
- Simulation model: sneak preview
- Dissemination & Outlook 2022
- Round up with Q & A

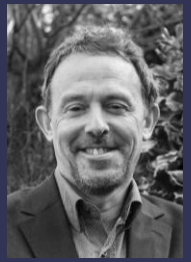
INTRODUCTION
BY VOLKER HOJA

TEAM PILL – NEW MEMBERS

Tomas Ambra (imec)
Research Lead

Cathérine Cassan (VUB)
Research Lead

Shiqi Sun (VUB-MOBI)
Researcher



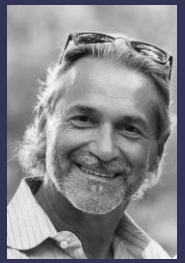
Stefan Bottu (VIL)
Project Manager

Volker Hoja (imec)
Project Manager

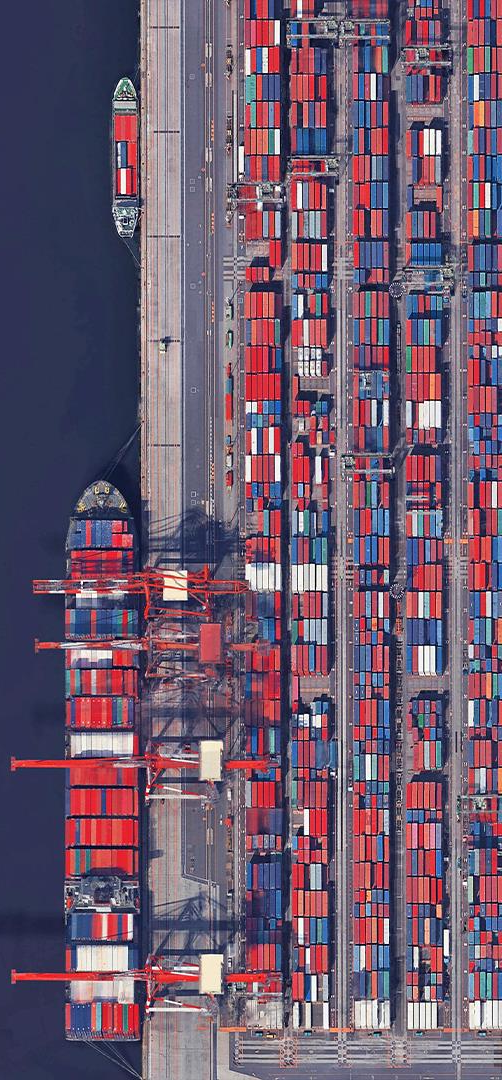
Yanick Van Hoeymissen (imec)
Functional Analyst

Vitor Lemos (imec)
Modelling Engineer

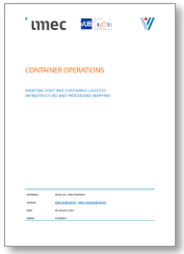
Philippe Michiels (imec)
Lead Architect

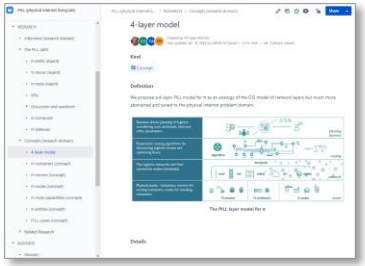


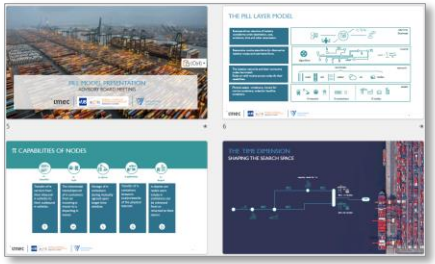
Dirk Jocquet (VIL)
Project Manager

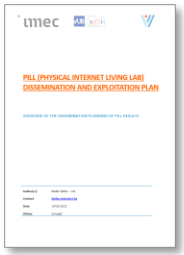


PILL DELIVERABLES 2021







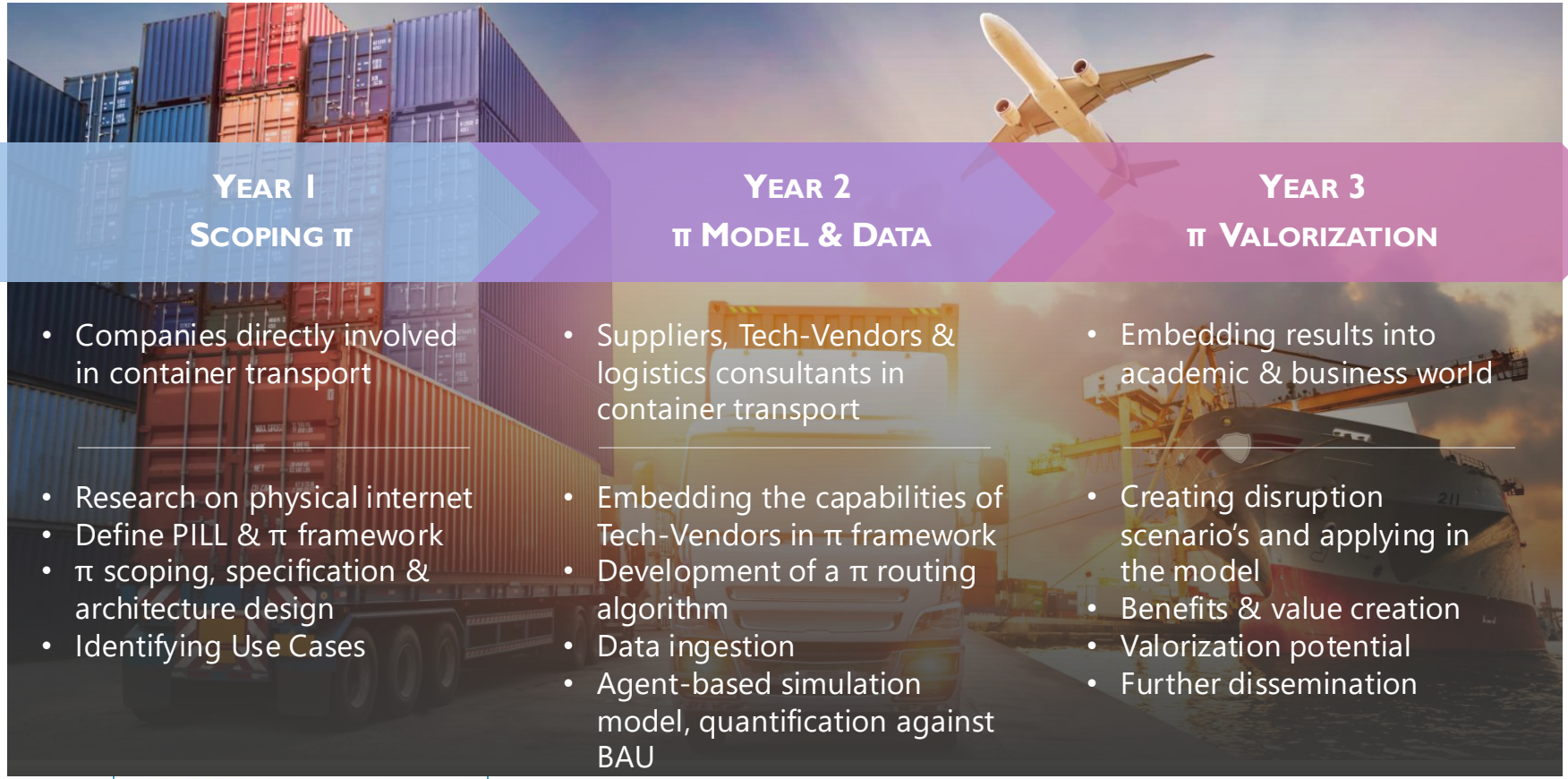


Workpackage #1	π Exploration
PILL State of the Art	
Container Operations & Maritime Processes	
Stakeholder Mapping	
Basic routing & algorithm description	

Workpackage #1 & #3	π Definition & Design
Confluence Site (Architecture & Design PILL)	
Board presentation (aggregating all info)	

Workpackage #5 & #6	Dissemination & PM
VLAIO yearly intermediate report approved	
Data Management Plan	
Dissemination Plan	

FOCUS AREAS PILL ROADMAP



YEAR 1
SCOPING π

- Companies directly involved in container transport

- Research on physical internet
- Define PILL & π framework
- π scoping, specification & architecture design
- Identifying Use Cases

YEAR 2
π MODEL & DATA

- Suppliers, Tech-Vendors & logistics consultants in container transport

- Embedding the capabilities of Tech-Vendors in π framework
- Development of a π routing algorithm
- Data ingestion
- Agent-based simulation model, quantification against BAU

YEAR 3
π VALORIZATION

- Embedding results into academic & business world

- Creating disruption scenario's and applying in the model
- Benefits & value creation
- Valorization potential
- Further dissemination

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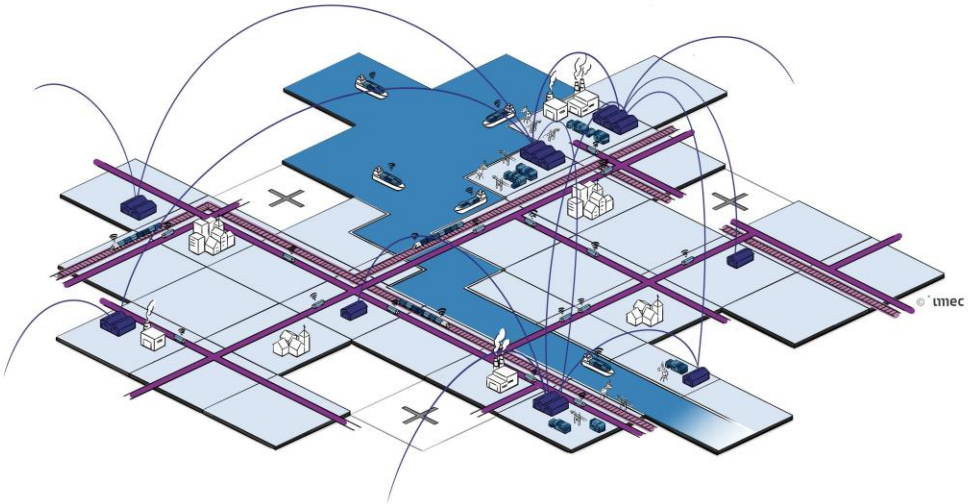
GENERAL CONTEXT
AND
LOGISTICS DATA SPACES AND DIGITAL TWINS

BY TOMAS AMBRA

WHAT IS THIS PROJECT ABOUT?

The Physical Internet (π) is an innovative concept, a next-generation vision on efficient, resilient and sustainable logistics.

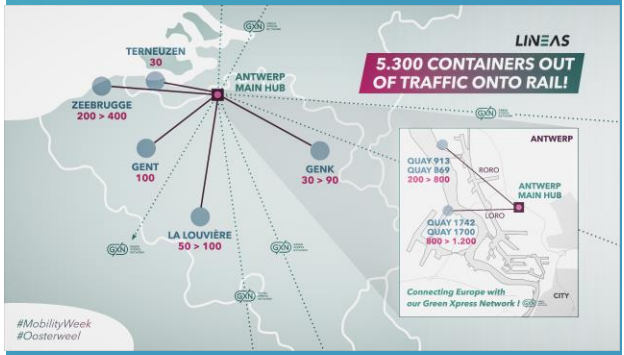
PILL uses the principles of the physical internet and smart data management to enable new innovations such as creating digital twins for Freight transport & logistics.

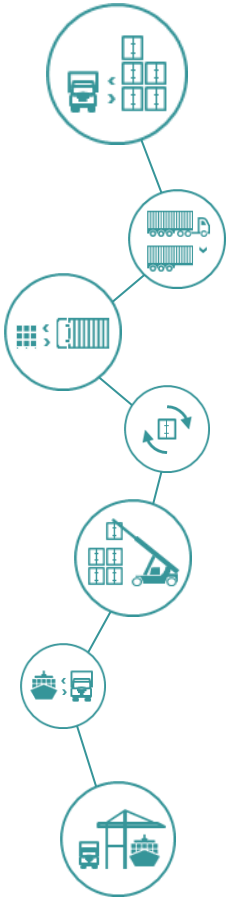


PHYSICAL INTERNET

HIGH-LEVEL PROBLEMS IN BUSINESS AS USUAL

- Limited use of the full Logistics network capacity
  - Focus on road transport with known partners
  - Little knowledge of optimization opportunities
- Bottlenecks in the network
  - Known bottlenecks limit throughput
  - Little insights workarounds and optimizations
- Digital disconnect between different stakeholders
  - Focus on internal optimizations and digital transformation
  - Lack of standards fosters non-scalable point-to-point connectivity





FOCUS OF PILL

WHAT WE WANT TO LOOK AT FIRST

- Design a system architecture for the Physical Internet
  - Quantify its benefits via agent-based modelling
  - Explore use cases and optimizations
  - Explore hypothetical scenarios (simulation)
- Contribute to the Logistics Data Space in line with DTLF, IDSA and Gaia-X
  - Define OSLO standards for logistics planning and reservations
  - On-board relevant data streams
- Define an architecture for digital twins in logistics
  - Further optimize hinterland logistics flows

DELIVERY GOALS

- Agent-based model for the Physical Internet
  - Proof-of-concept; systems, physical and info flows
  - Focusing on specific use cases
  - Understanding the potential of π
- Common standard(s) for agent-based logistics
- Define a roadmap for further digital transformation of hinterland logistics

PILL STEP-STONES

Gate 1

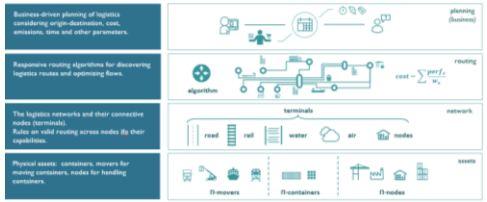
(Interviews)

The big PI picture

User scoping

Gate 2

PILL model

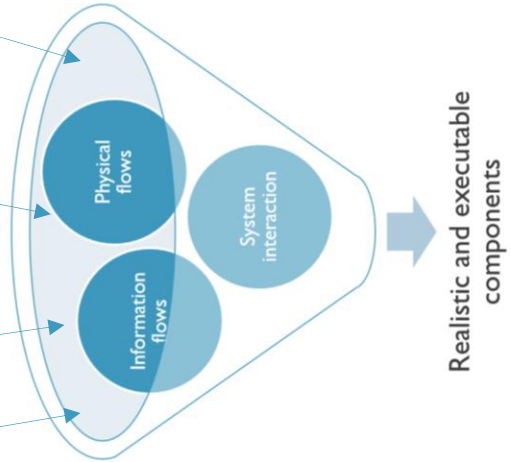


Calibration

Validation

Gate 3

(Reality-check)

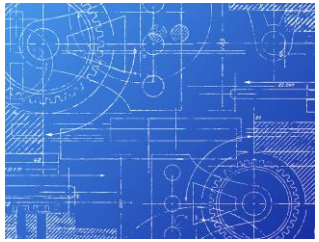


Tech Vendor/ company capabilities

Commercializable elements

Gate 4

(Finalization)

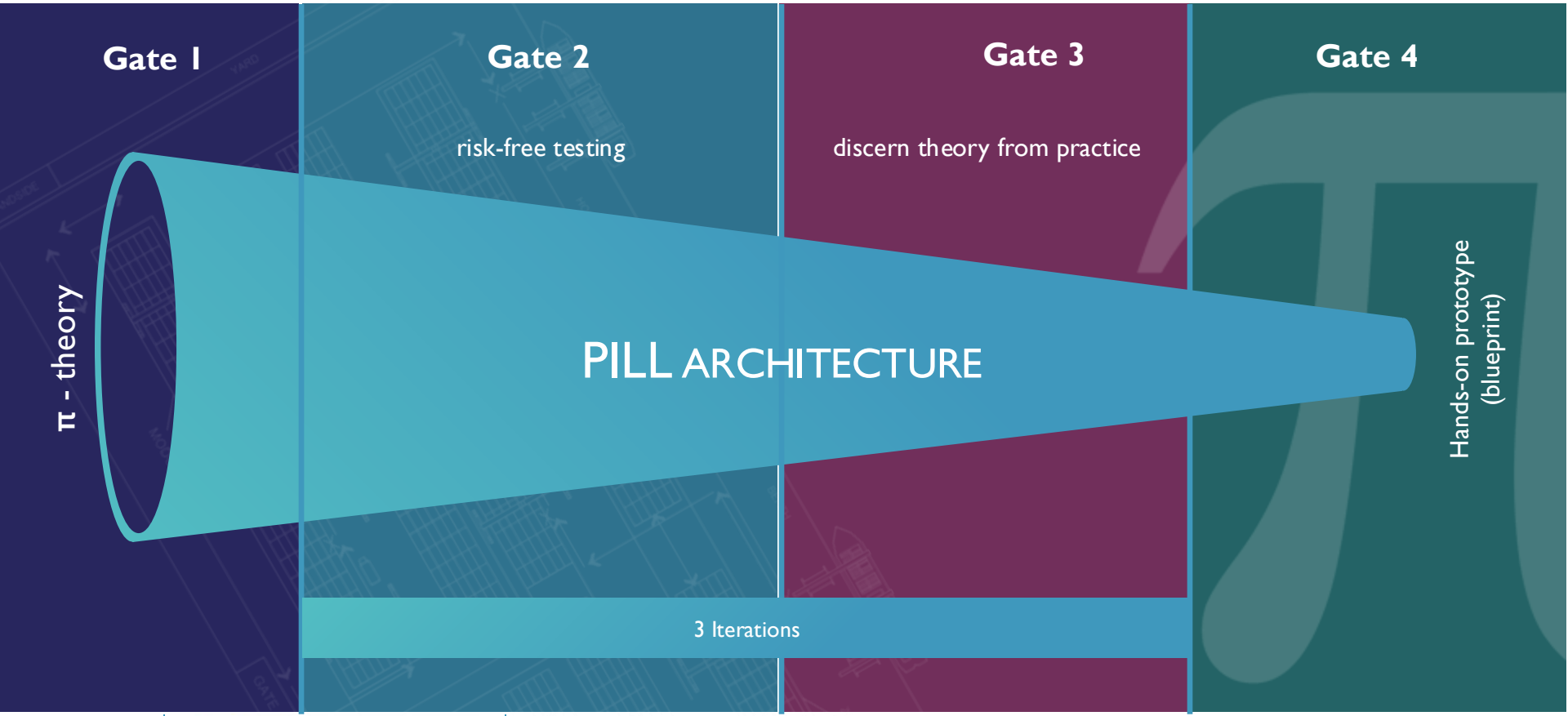


Scalable blueprint

Further Valorization

3 Iterations

PILL FROM THEORY TO PRACTICE



ALIGNING THE OUTSIDE WORLD

dcsa
Containers

UNECE UN/CEFACT
International trade, processes, procedures

GS1
Business information

IPCSA

DIGITAL TRANSPORT & LOGISTICS FORUM
FEDeRATED NETWORK OF PLATFORMS
FENIX NETWORK

tic4.0
Terminals

ISO International Organization for Standardization

FIWARE
Interoperability and portability
Context data, API (ETSI NGSI LD standard)

GAIA-X

INTERNATIONAL DATA SPACES ASSOCIATION

WORLD CUSTOMS ORGANIZATION
ORGANISATION MONDIALE DES DOUANES

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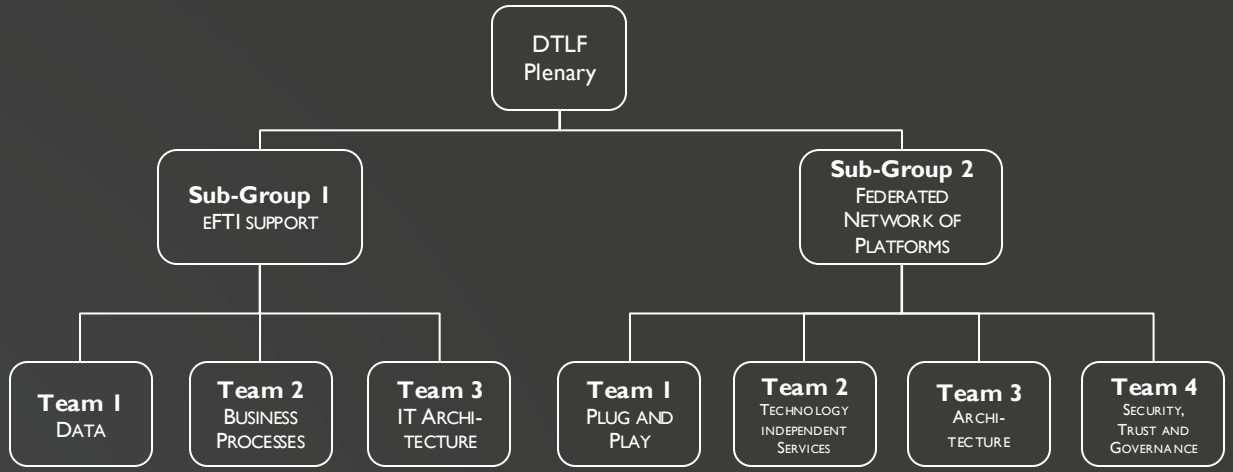
A DATA SPACE

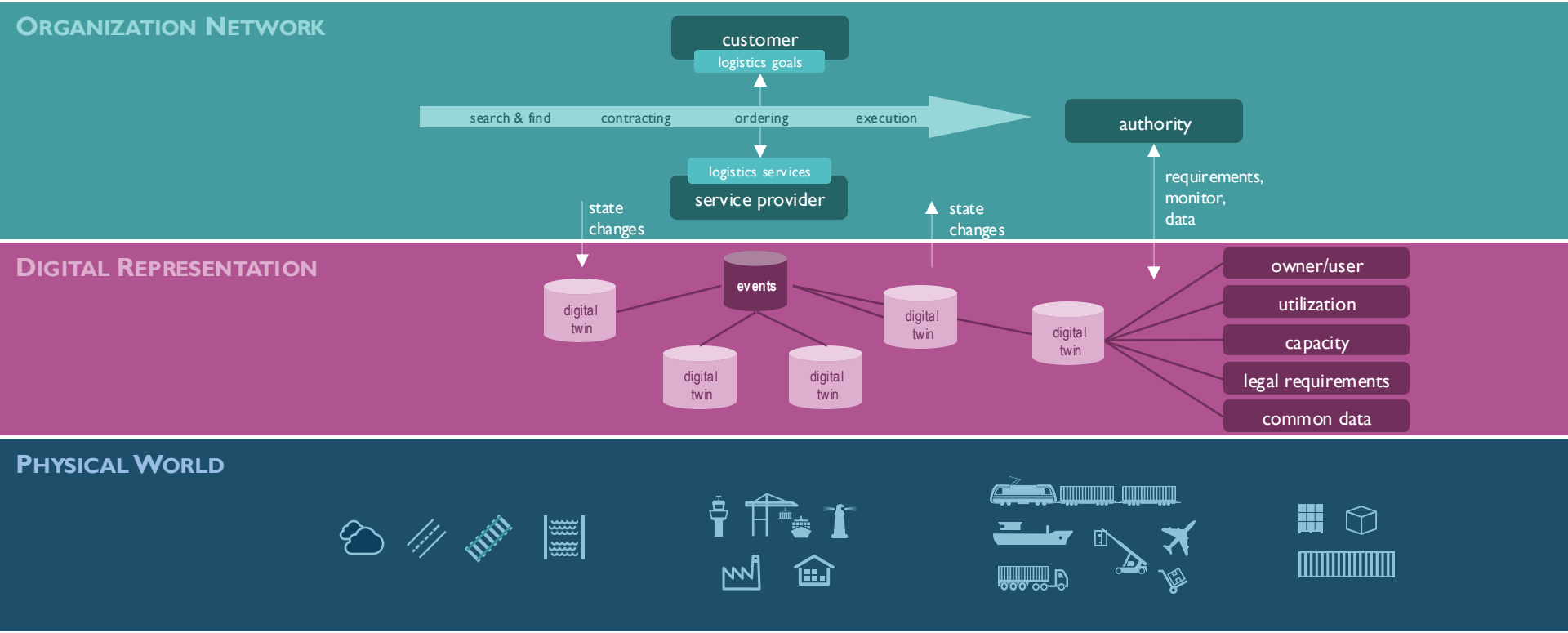
- A network of data end points which follow the same rules
- No physical data integration, leave data where it is (Federated architecture)
- Integration based on semantics
- Data Networking, data visiting and data co-existence

DTLF



- DTLF members:
  - **Type C:** ALICE, IPCSA, Lufthansa, IBM, Fraunhofer, Ericson, GS1 etc. (87)
  - **Type D**: 27 member states.
    - BE - MOW
    - NL -Ministry of Infrastructure and Environment
  - **Type E**: De Vlaamse Waterweg, UNECE (Economic commission for Europe)

DTLF
LAYERING DESIGN CHOICES



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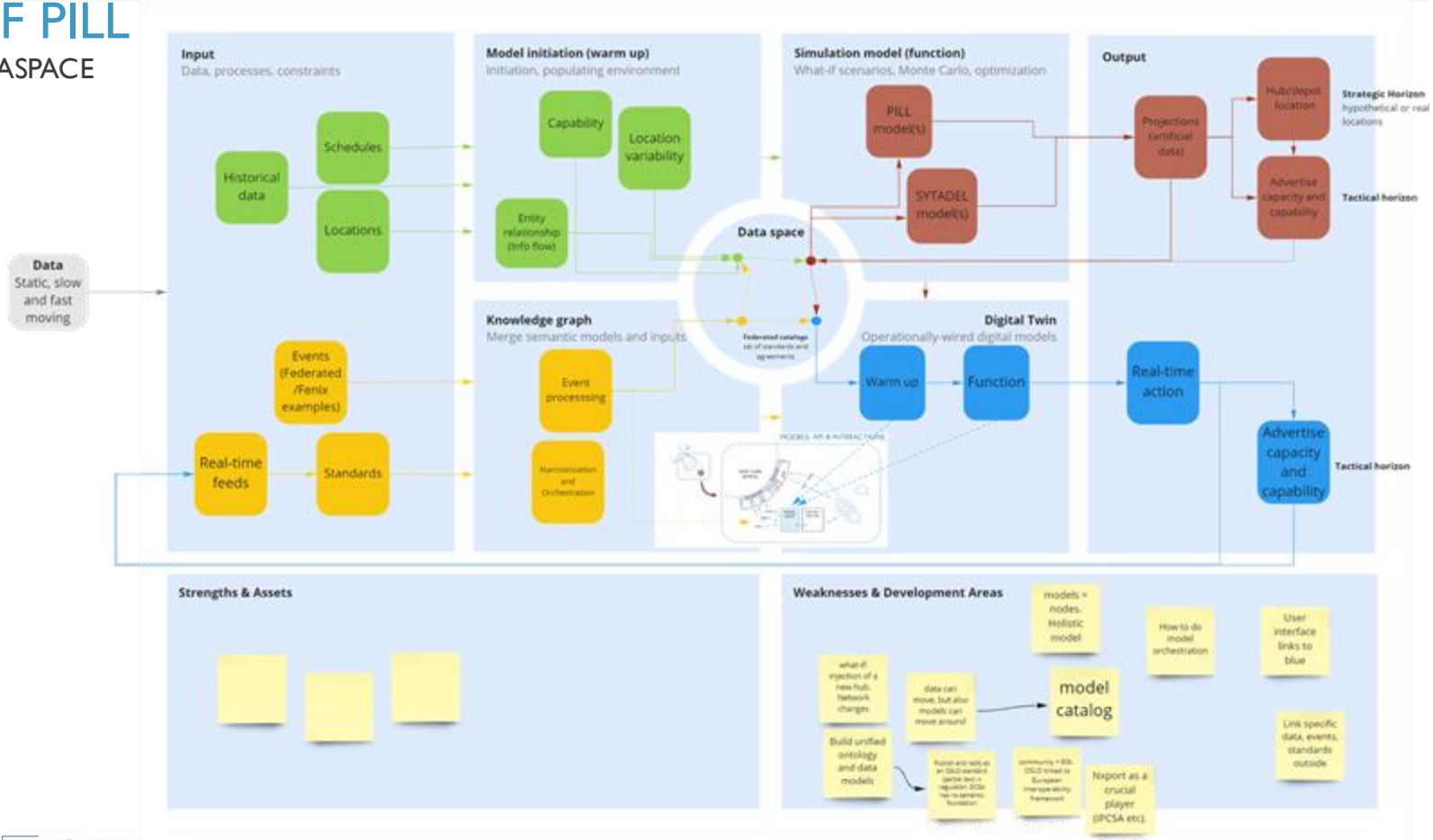
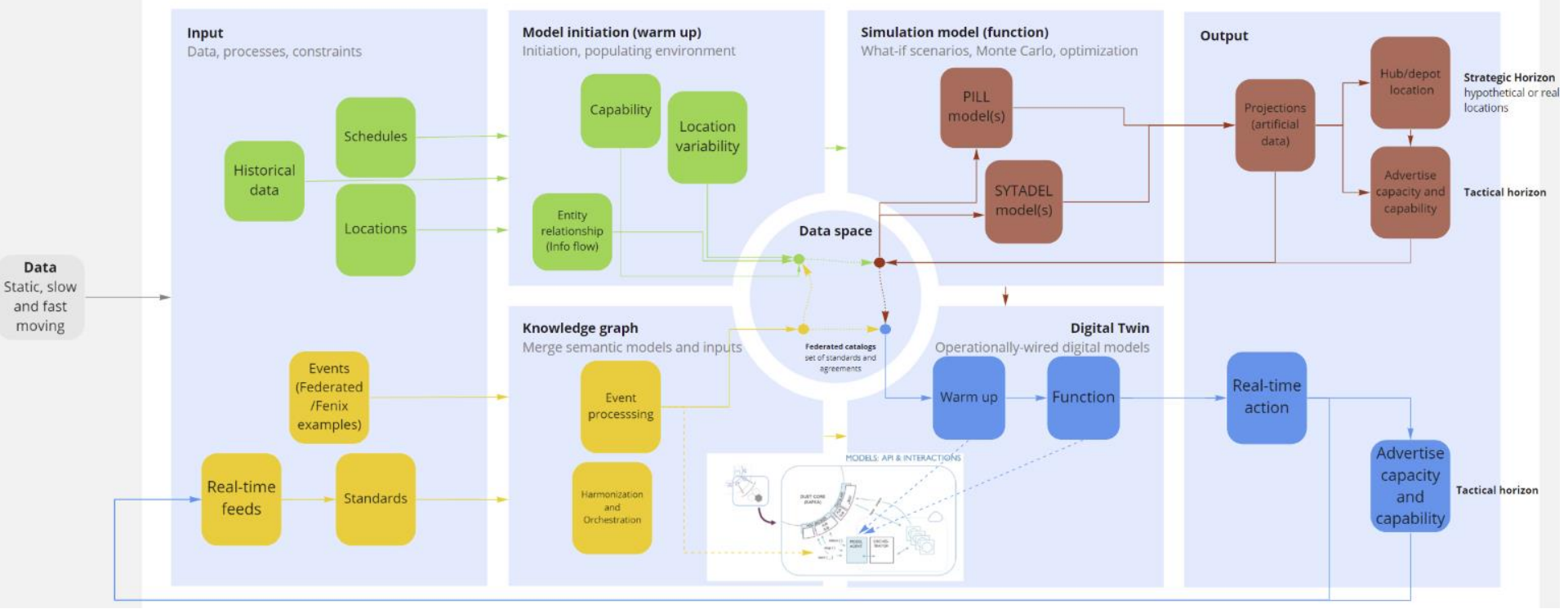
Source: Fenix

FOCUS OF PILL

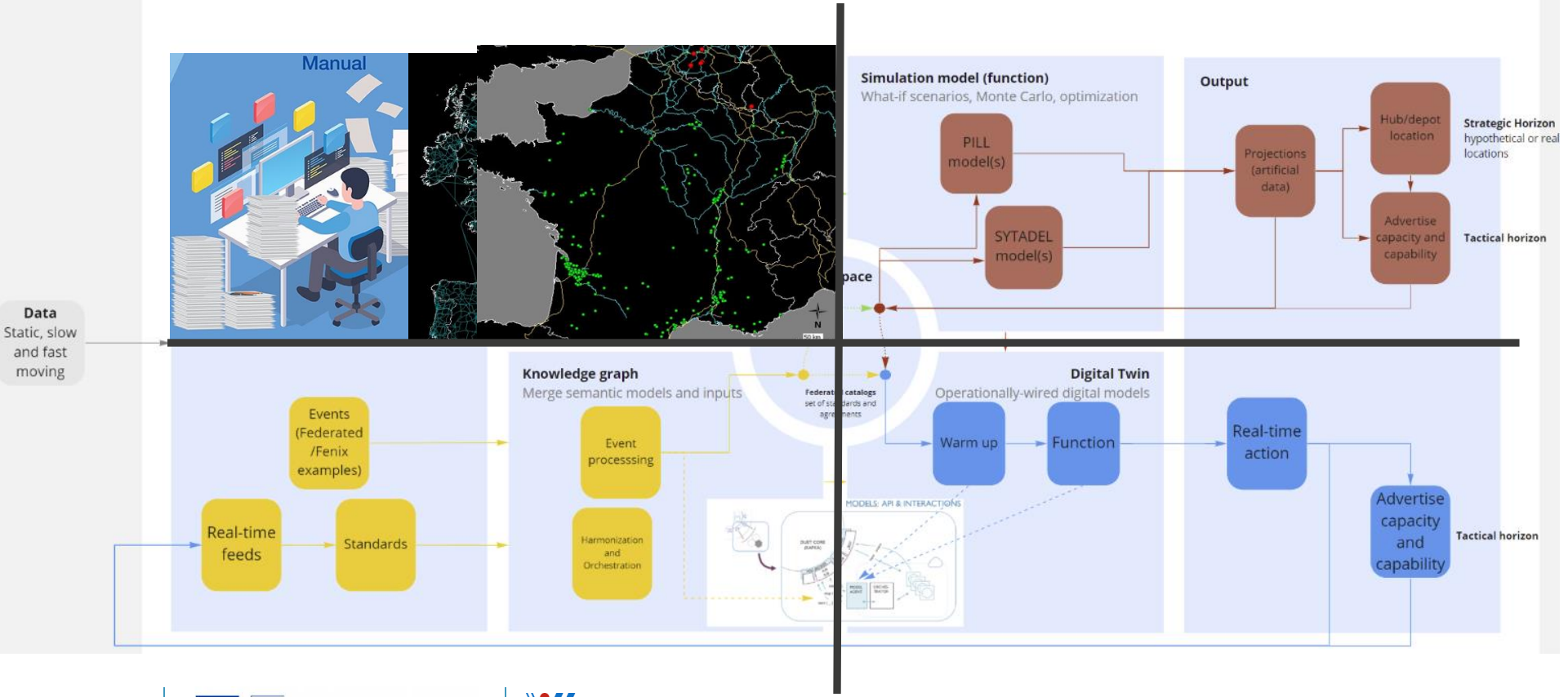
1 LOGISTICS DATASPACE



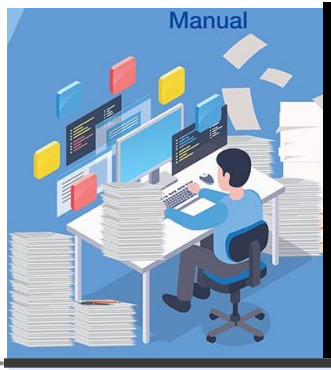
Freight & Logistics data space and DT architecture Canvas

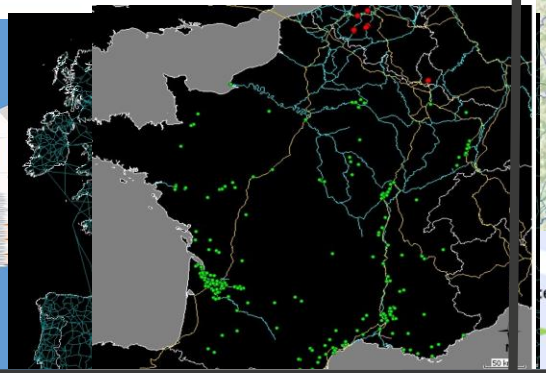


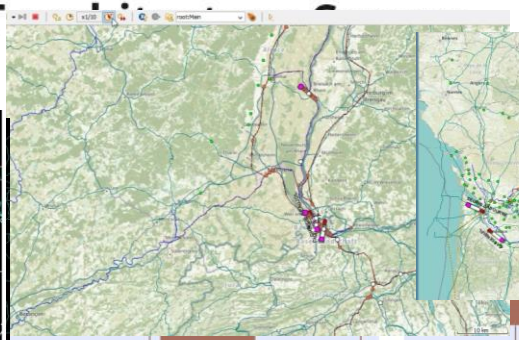
Freight & Logistics data space and DT architecture Canvas

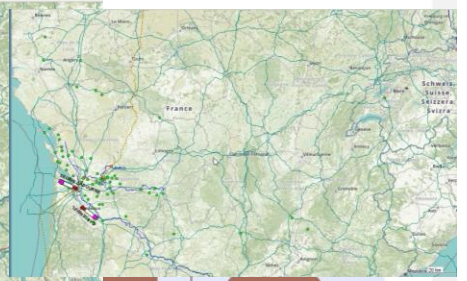


Freight & Logistics data space and DT









SYTADEL model(s)

Advertise capacity and capability

Tactical horizon

Data
Static, slow and fast moving

Knowledge graph
Merge semantic models and inputs

Federated catalogs
set of standards and agreements

Digital Twin
Operationally-wired digital models

Events (Federated /Fenix examples)

Real-time feeds

Standards

Event processsing

Harmonization and Orchestration

Warm up

Function

Real-time action

MODELS: API & INTERACTIONS

Advertise capacity and capability

Tactical horizon

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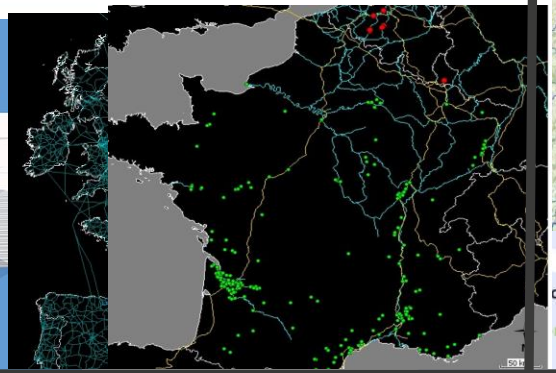
Freight & Logistics data space and DT

Data
Static, slow and fast moving



	type	agent	counter	speed	agent_type
1	Barge				
2	Truck	186	185	Order	<
3	Barge	187	186	Order	<
4	Truck	188	187	Truck	tr
5	Barge	189	188	Truck	tr
6	Barge	190	189	Order	<
7	Truck	191	190	Order	<
8	Truck	192	195	Truck	tr
9	Truck	193	196	Truck	tr
10	Barge	194	194	Truck	tr
11	Barge	195	197	Truck	tr
12	Truck	196	192	Order	<
13	Barge	197	191	Order	<
14	Truck	198	193	Order	<
15	Barge	199	198	Order	<
16	Barge	200	199	Order	<
17	Barge	201	202	Truck	tr
18	Barge	202	201	Truck	tr
19	Barge	203	203	Truck	tr
20	Barge	204	200	Truck	tr
21	Barge	205	204	Truck	tr
22	Barge	barges[9] : 382		7.722	

	agent_type	agent	transition	from_state	date
1	DC	dCs[4] : 135	transition	working	03-08-2016 00:00:41
2	DC	dCs[2] : 133	transition	working	03-08-2016 00:05:02
3	DC	dCs[0] : 131	transition	working	03-08-2016 00:05:34
4	DC	dCs[3] : 134	transition	working	03-08-2016 00:08:44
5	DC	dCs[1] : 132	transition	working	03-08-2016 00:09:09
6	DC	dCs[3] : 134	transition1	waiting	03-08-2016 03:14:01
7	DC	dCs[1] : 132	transition1	waiting	03-08-2016 03:14:07
8	DC	dCs[1] : 132	transition	working	03-08-2016 03:17:43
9	DC	dCs[3] : 134	transition	working	03-08-2016 03:24:34
10	DC	dCs[0] : 131	transition1	waiting	03-08-2016 03:28:54
11	DC	dCs[0] : 131	transition	working	03-08-2016 03:30:19
12	DC	dCs[2] : 133	transition1	waiting	03-08-2016 03:38:49
13	DC	dCs[2] : 133	transition	working	03-08-2016 03:48:20
14	DC	dCs[4] : 135	transition1	waiting	03-08-2016 04:08:36
15	DC	dCs[4] : 135	transition	working	03-08-2016 04:10:06
16	DC	dCs[0] : 131	transition1	waiting	03-08-2016 06:38:52
17	DC	dCs[3] : 134	transition1	waiting	03-08-2016 06:57:09
18	DC	dCs[3] : 134	transition	working	03-08-2016 06:59:55
19	DC	dCs[2] : 133	transition1	waiting	03-08-2016 07:06:43
20	DC	dCs[1] : 132	transition1	waiting	03-08-2016 07:07:02
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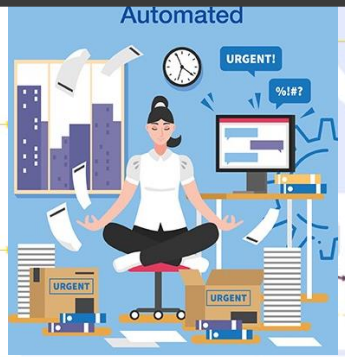
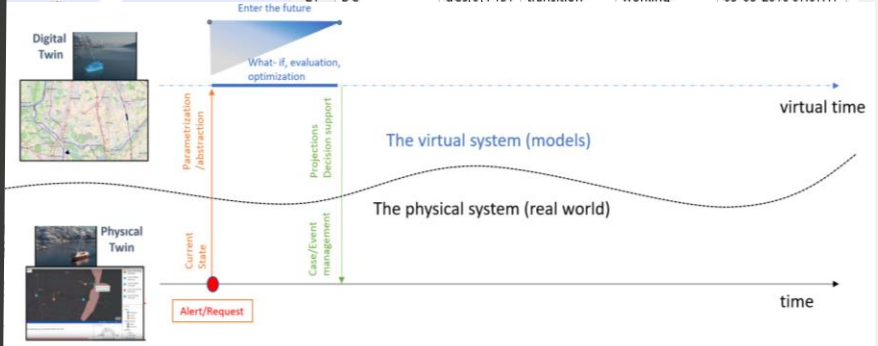
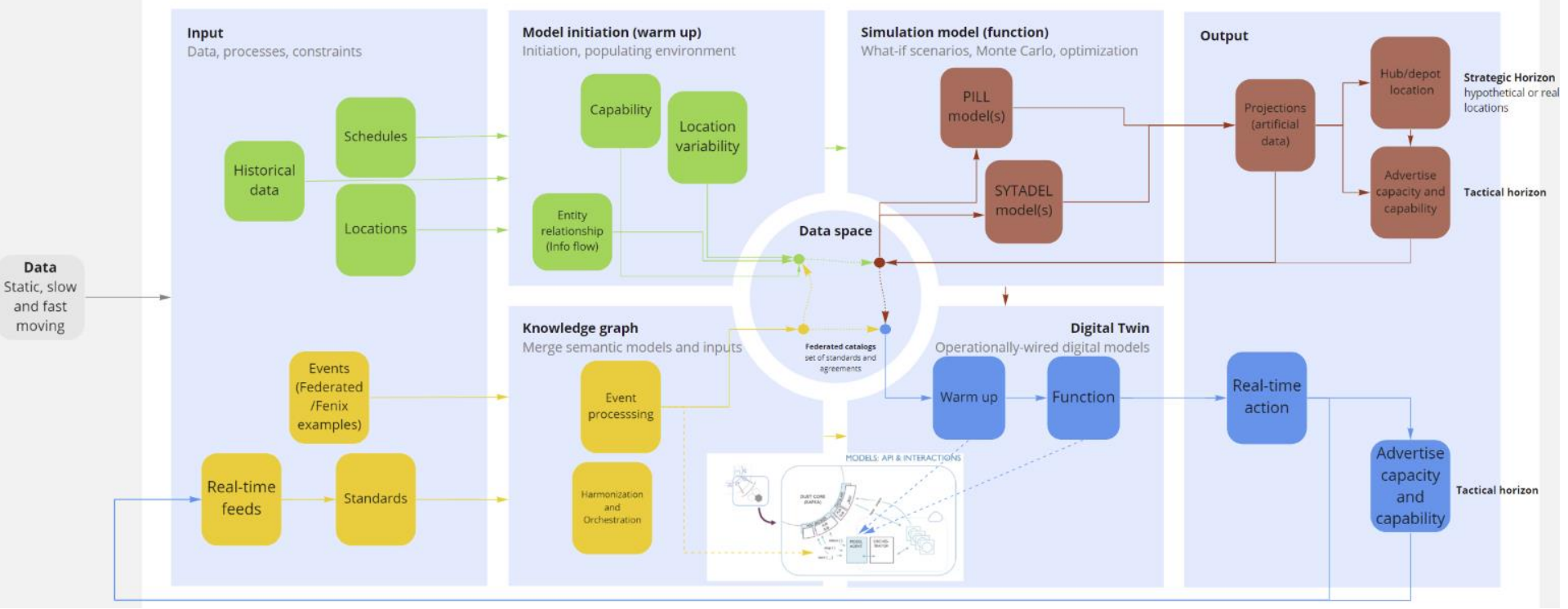




Freight & Logistics data space and DT architecture Canvas



STANDARDS AND CONTEXT
BY PHILIPPE MICHIELS

The agent-based model of PILL requires that the agents can plan routes freely across the network.

This implies data sharing by entities. How can we achieve this?

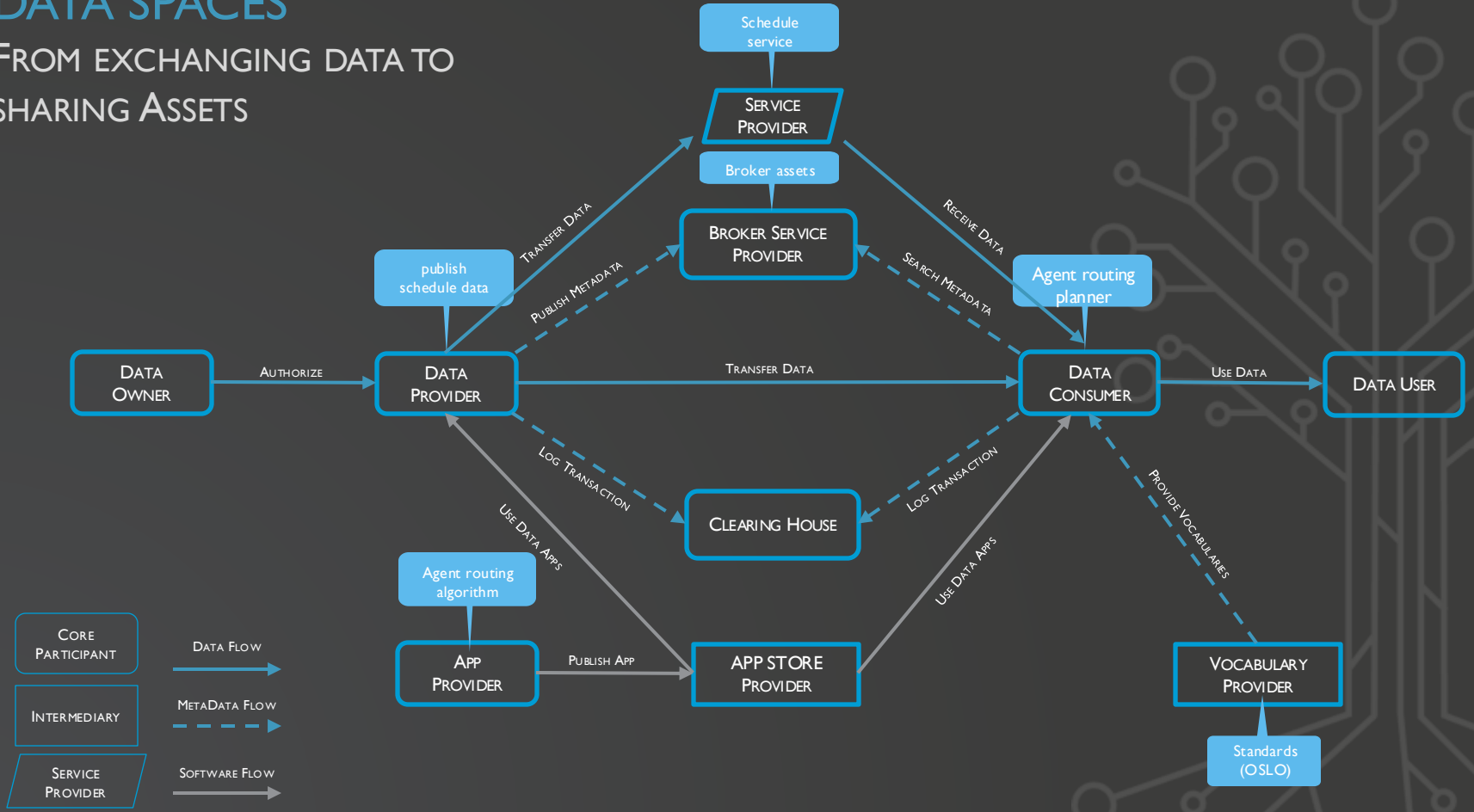
STANDARDS FOR LOGISTICS

OSLO AND THE EUROPEAN DATA ECOSYSTEM

- Dataspaces are decentralized networks of federated services
- Dataspaces attempt to converge on common principles in order to streamline exchange of assets
  - Decentralized authentication systems
  - Common vocabularies (vocabulary providers) and application profiles
  - Shared identifier strategies to ensure data sets can be linked
  - Federated metadata stores to ensure data discoverability
- Harbor existing standards: DCSA, TIC4.0, IPCSA, GS1
- OSLO as the main vocabulary and AP provider for the Flanders Logistics Data Space
  - Not about creating new standards!
  - Combining, linking, enriching, … existing standards to create a common vocabulary

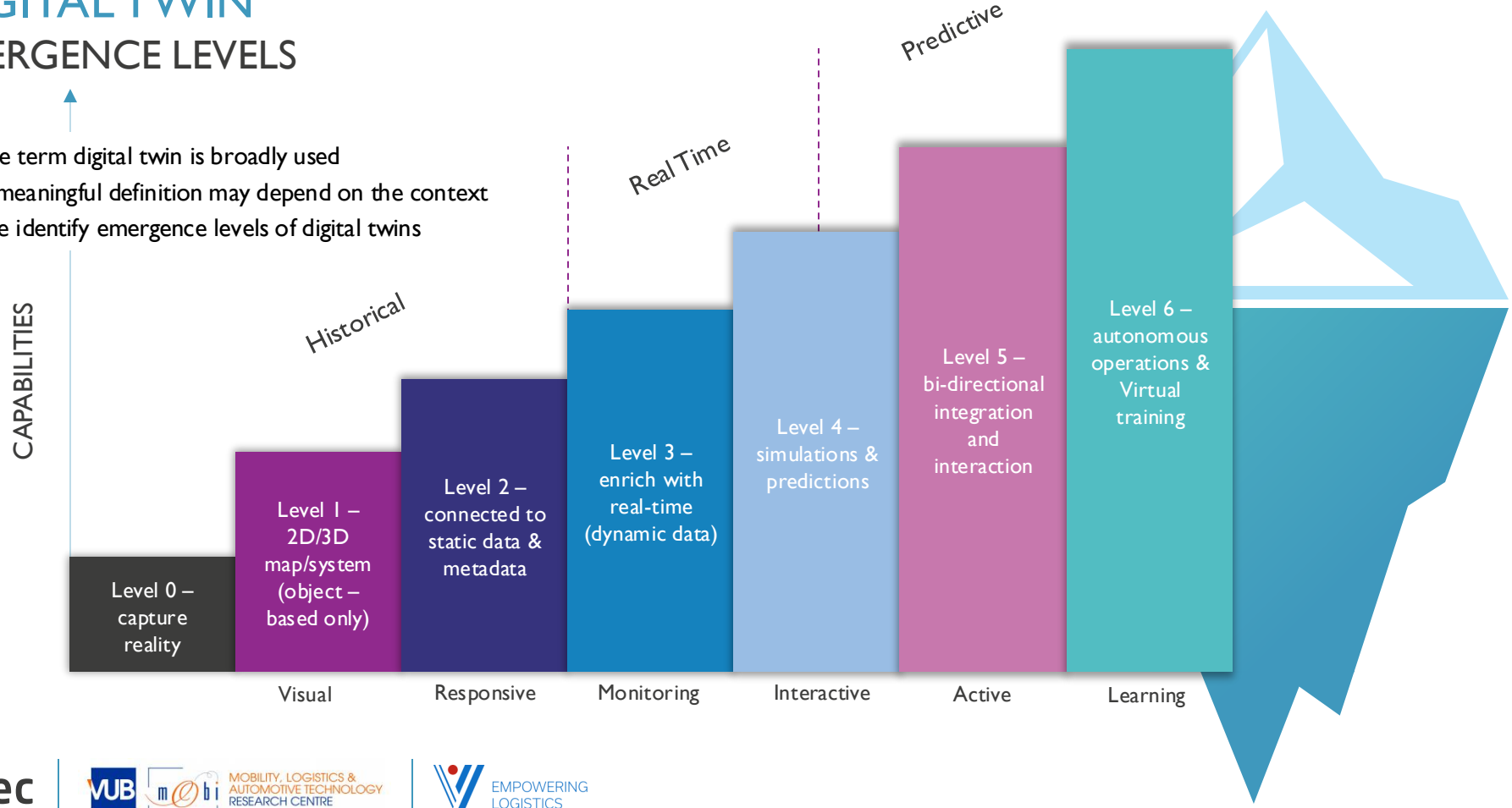
DATA SPACES

FROM EXCHANGING DATA TO SHARING ASSETS



DIGITAL TWIN
EMERGENCE LEVELS

- The term digital twin is broadly used
- A meaningful definition may depend on the context
- We identify emergence levels of digital twins



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THE PILL MODEL & DATA

WHAT DATA DO WE NEED?

SHAPING THE NETWORK

- PILL is envisioned as a network of logistics hubs where certain services are offered
- We need the data in terms of
  - Locations: what hubs are there in the network,
  - Mover service availability and schedules
  - Services: what capabilities are offered at the hubs,
  - Capacities: what is the capacity for the services offered

  … to shape a realistic network

SIMULATING THE REAL WORLD

- The PILL model tries to find out ways to balance traffic over the entire network
- Increasing reliability, resilience, cost, …
- But we model only part of the network, so modeling
  - Road, rail, water occupation/saturation
  - Overall network capacity
  - Disruptions

  … needs to be done using statistics based on historical data

THE PILL MODEL & DATA

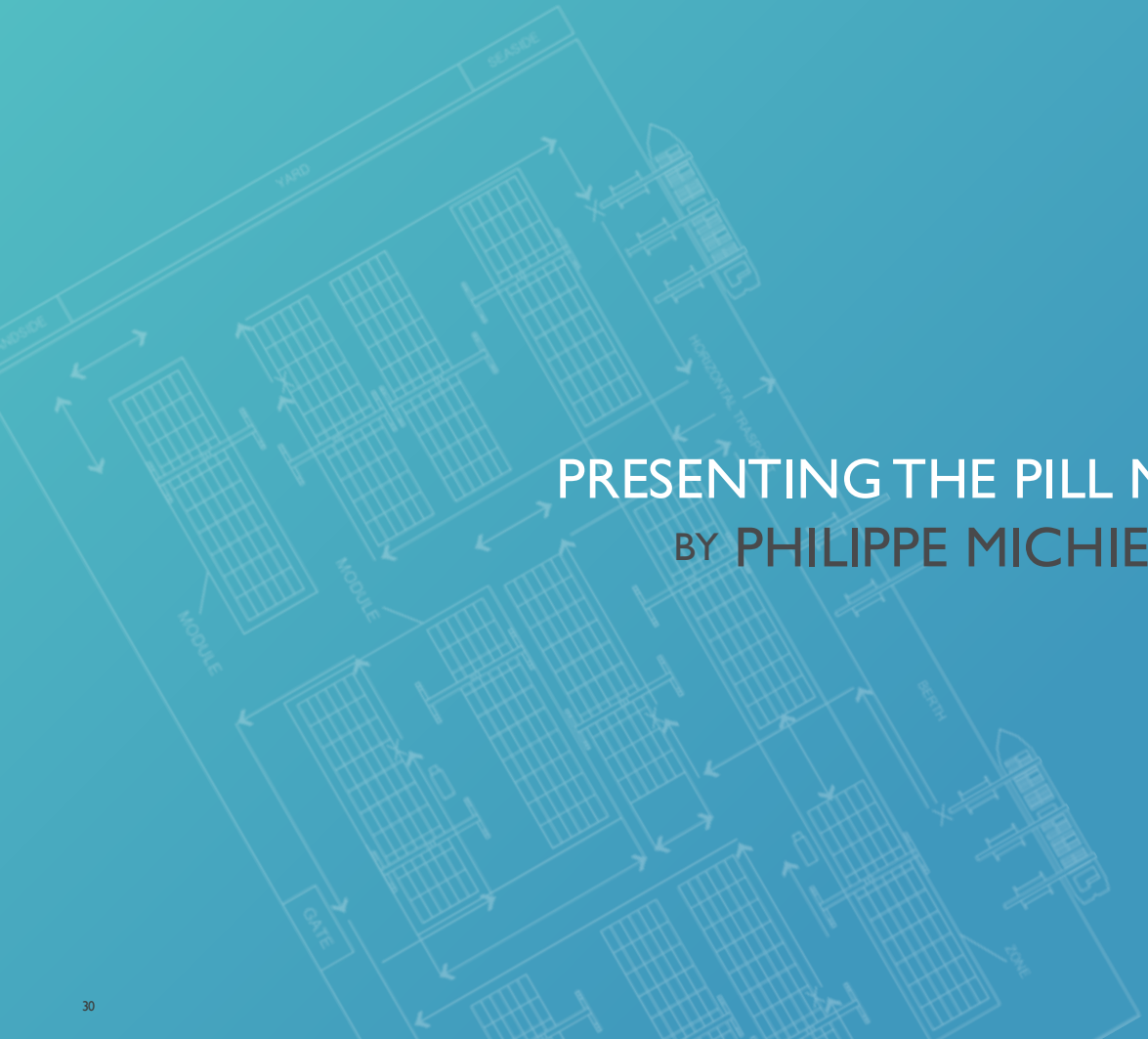
WHAT WILL HAPPEN WITH THE DATA?

We need to understand the dynamics

- Of individual nodes in the network
- Across the network in general

For the first category, we can use your historical data.

The data will only be used for modeling purposes in PILL and will not be made public. The more data we can get, the more accurate we can model.

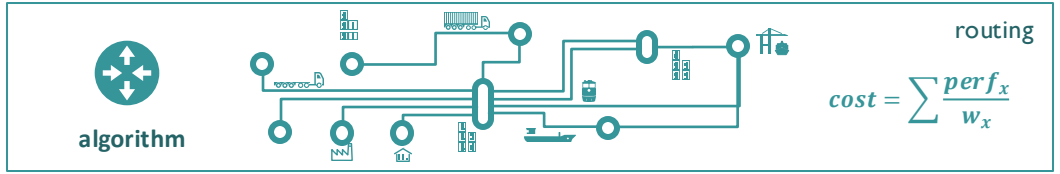


PRESENTING THE PILL MODEL
BY PHILIPPE MICHIELS

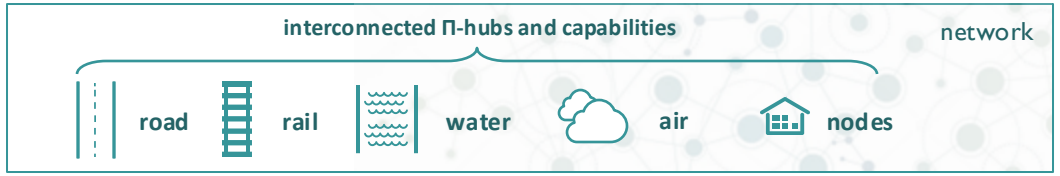
THE PILL LAYERS

Business-driven planning of logistics considering origin-destination, cost, emissions, time and other parameters.

Responsive routing algorithms for discovering logistics routes and optimizing flows.



The logistics networks and their connective nodes (terminals).
Rules on valid routing across nodes ifo their capabilities.



Physical assets: containers, movers for moving containers, nodes for handling containers.

PLATFORM CONNECTIVITY

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π ASSETS LAYER

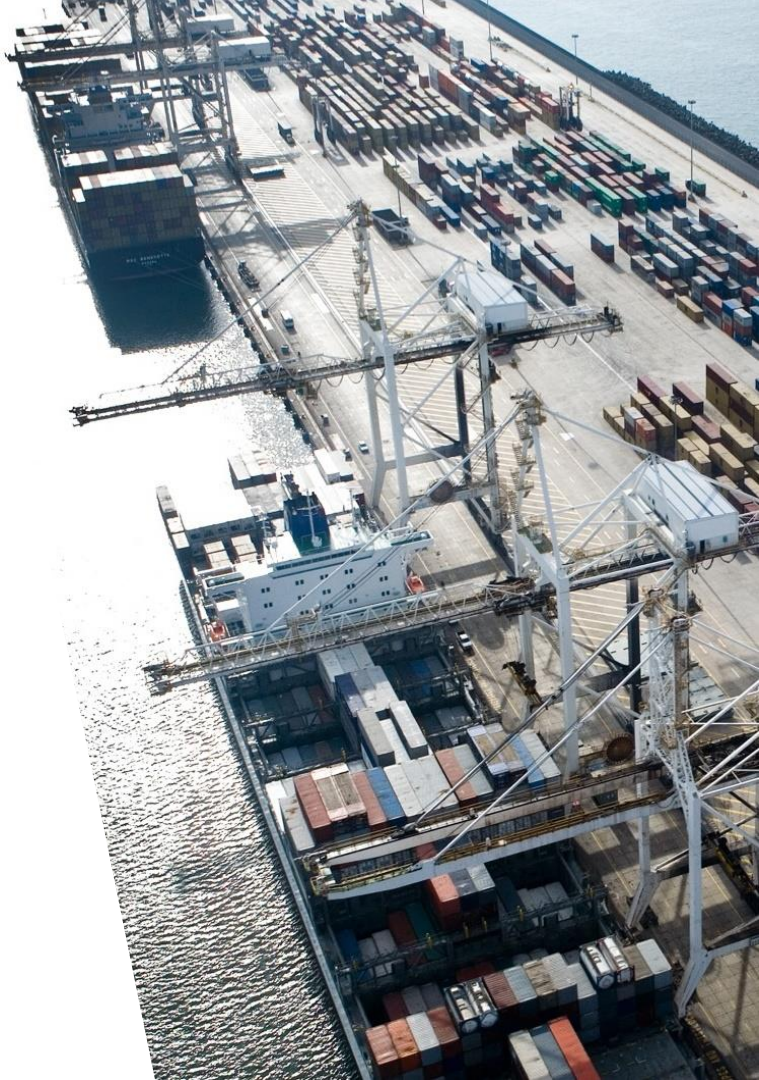
CONTAINERS

- The π-containers are the unit loads in Physical Internet
  - standardized logistics modules
  - facilitate their handling, storage, transport
  - act as packets in the digital Internet
  - have an information part analogous to the header in the digital Internet
- We are limiting the scope to standard shipping containers (for now)
  - 20 foot
  - 40 foot
  - High cube
  - Reefers
  - …

π ASSETS LAYER
NODES

The π-nodes are the locations where operations are performed on π-containers, such as receiving, moving, routing, handing, storing, shipping, …
Examples:

- Terminals
- Warehouses, factories
- Transporter yards, container hubs



π ASSETS LAYER

MOVERS

- In the Physical Internet, π-containers are generically moved around by π-movers. Moving is used here as a generic equivalent to verbs such as transporting, conveying, handling, lifting and manipulating
- We are mostly focusing on transporters
  - Trucks
  - Trains
  - Barges

π CAPABILITIES OF NODES

π-transfer

Transfer of π-carriers from their inbound π-vehicles to their outbound π-vehicles.

T

π-hub*

The intermodal transshipment of π-containers from an incoming π-mover to a departing π-mover.

H

π-store

Storage of π-containers during mutually agreed upon target time window.

S

π-gateway

Transfer of π-containers between (sub)networks of the physical internet.

G

π-depot

π-depots are nodes were empty π-containers can be retrieved from or returned to their owner.

D

* Also referred to as π-transshipment

π CAPABILITIES OF NODES

π-composer

Constructing or deconstruc-ting composite π-contai-ners from specified sets of π-contai-ners. E.g., stuffing or unloading a container.

C

π-service provider

Nodes were services around π-containers are provided, such as customs clearance, weighing, fumigation.

X

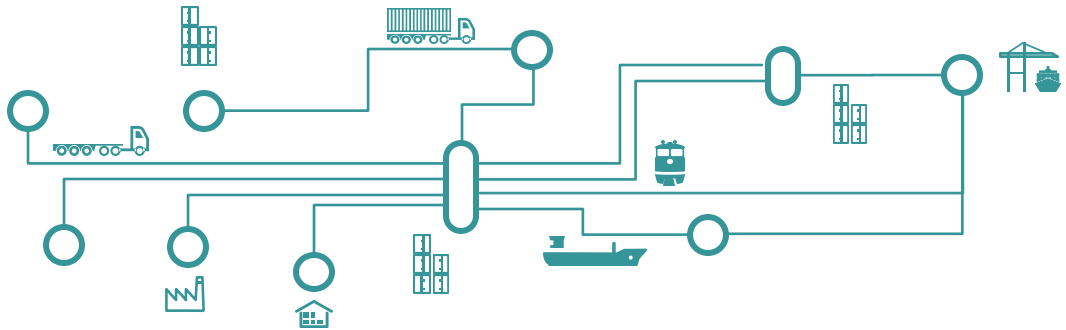
Other capabilities

(other capabilities to include in the future)

π NETWORK LAYER

CONNECTING NODES WITH CAPABILITIES

1. Nodes are connected via different modalities: road trucking, rail, inland water, maritime
2. Network layout
    1. π- gateways are at the boundary of the network
    2. π-hubs (terminals in our current scope) interconnect modalities
    3. nodes without hub or gateway capabilities are unimodal
3. The **capabilities** of the nodes determine to what extent connections can be made



π ROUTING LAYER

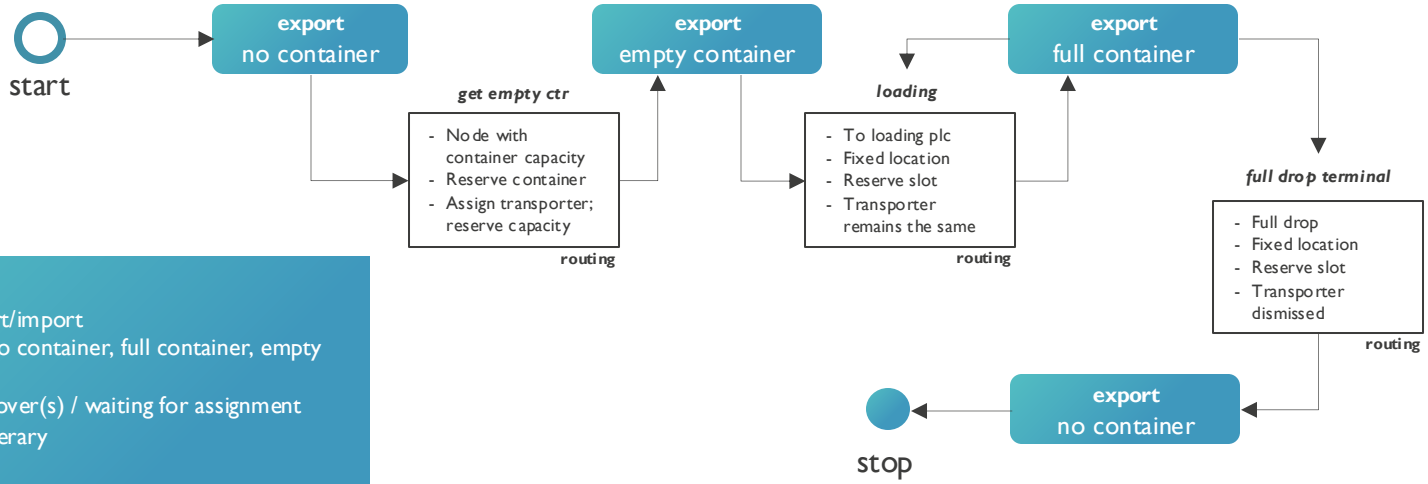
ROUTING ACROSS NODES

- A routing is done based on the planning of a transport in the planning layer
  - Between an origin and a destination
  - Constraints: timing, cost, emissions, use of specific carriers and so on
  - Correct chain of hops across nodes with sufficient capabilities

- Routing is a search across the network
  - Different routes may exist
  - The best route is determined with a weighted cost function
  - Agents dispatch a routing request to other nearby agents who recursively look for valid routes

π ROUTING LAYER: A TRANSITION OF STATES

FORMALIZING STATE TRANSITIONS

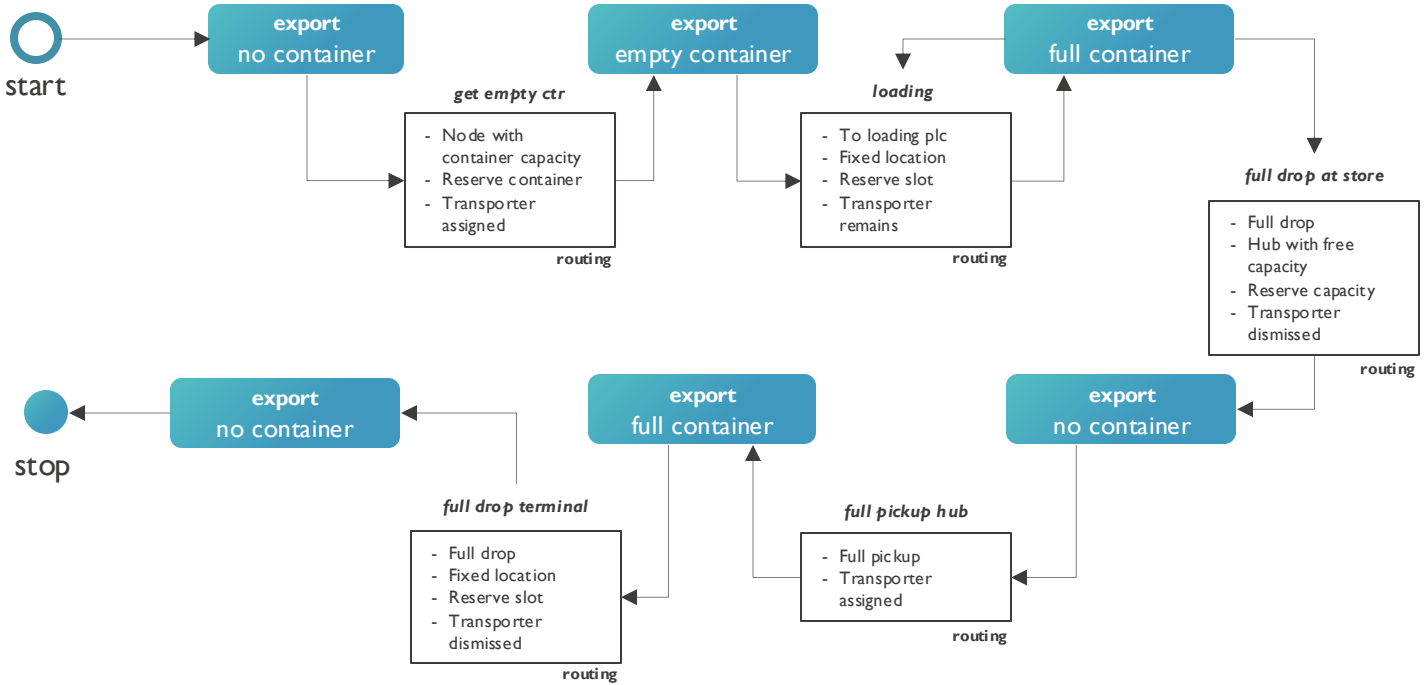


STATE IS:
- Type: export/import
- Ctr State: no container, full container, empty container
- Assigned mover(s) / waiting for assignment
- Planned itinerary

FIXED:
- Loading location(s)
- Final drop location
- Demurrage / Detention times

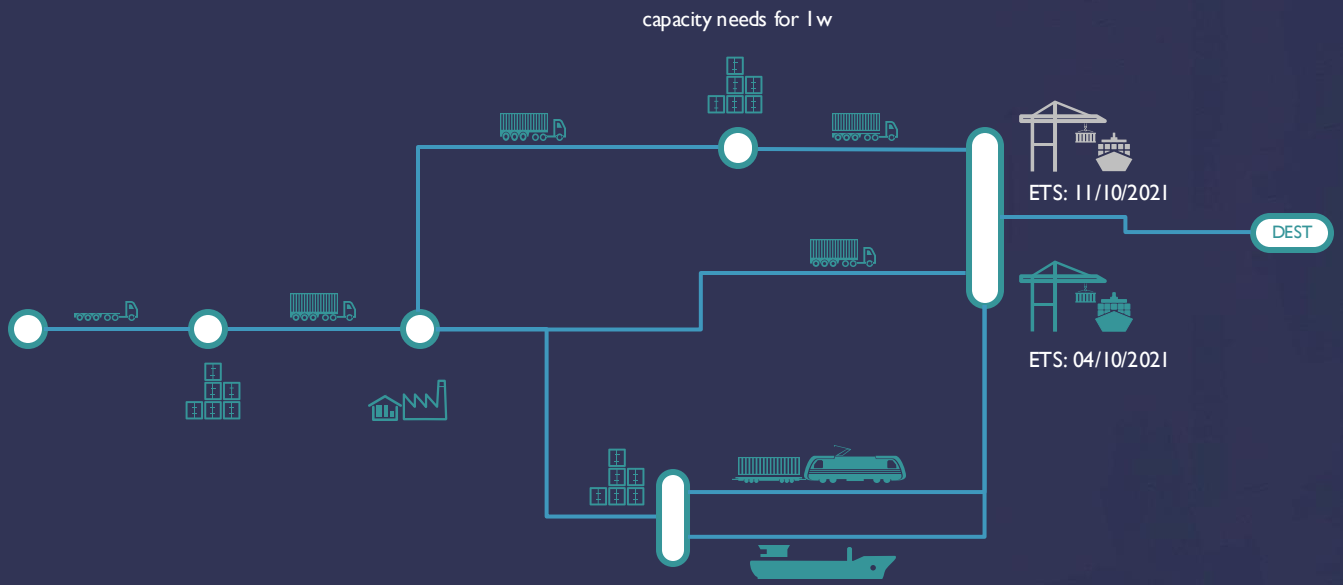
π ROUTING LAYER: A TRANSITION OF STATES

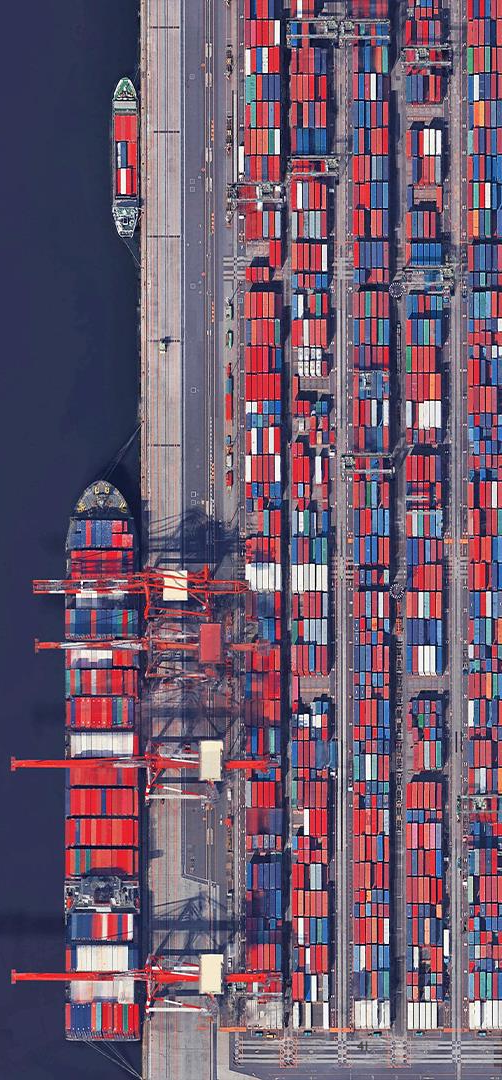
ALTERNATIVE TRANSITIONS



THE TIME DIMENSION

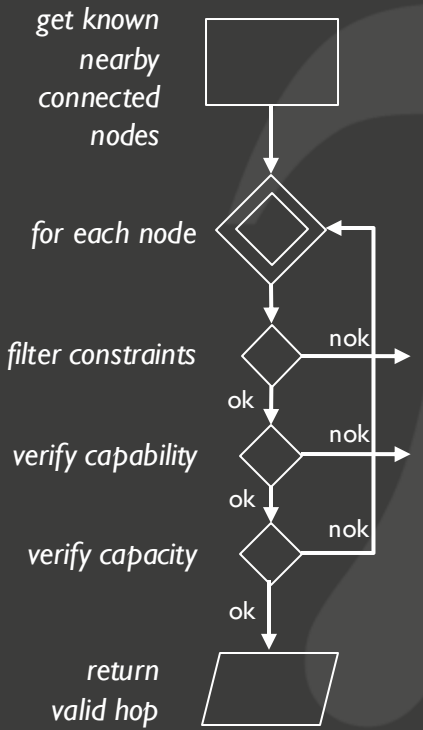
SHAPING THE SEARCH SPACE





π ROUTING LAYER
ADVERTISING CAPACITY

- The agents are scanning the network of nodes
- Looking for potentially valid next hops to another node
- The next hop advertises capabilities and capacity
  - **Capabilities** determine validity
  - **Capacity** determines if sufficient means are available in a time window
  - **Constraints** limit options further



π ROUTING LAYER

RESERVATION OF CAPACITY

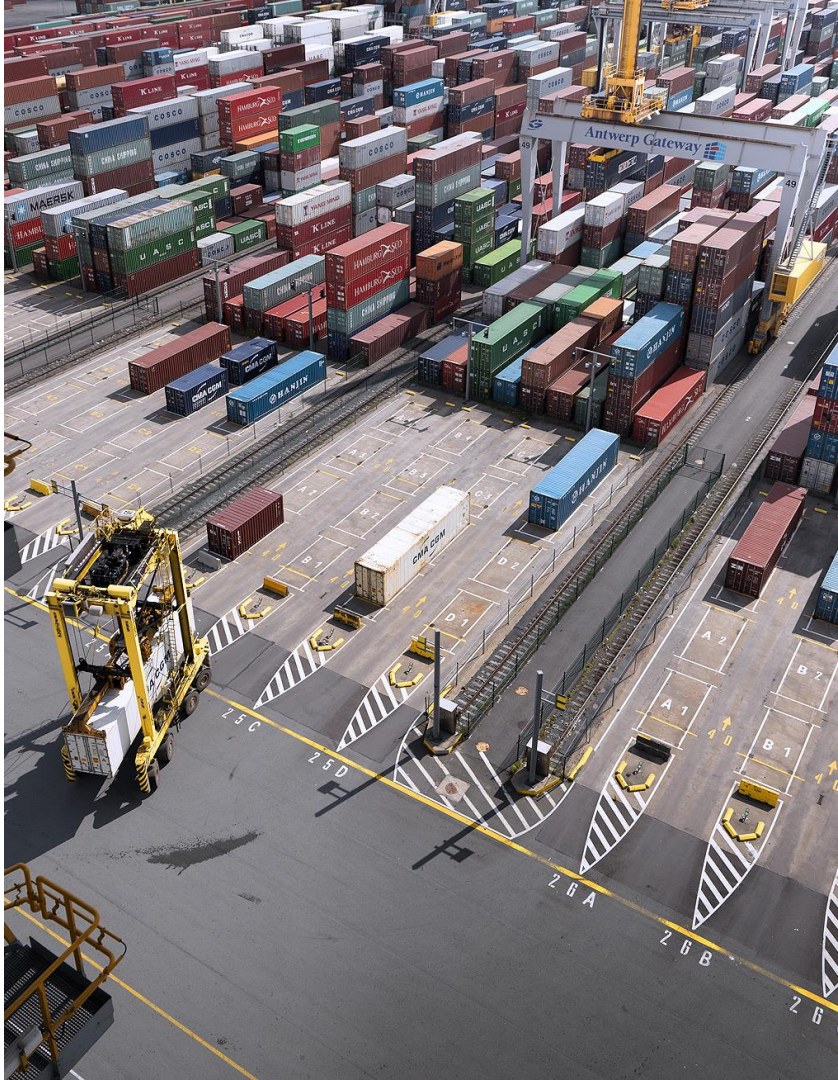
- After selecting a route, reservations are made along that route
- This requires communicating 'who' will use 'what capacity' at a given time
- More transparency early in the process → more efficiency

π PLANNING LAYER

ENTITIES

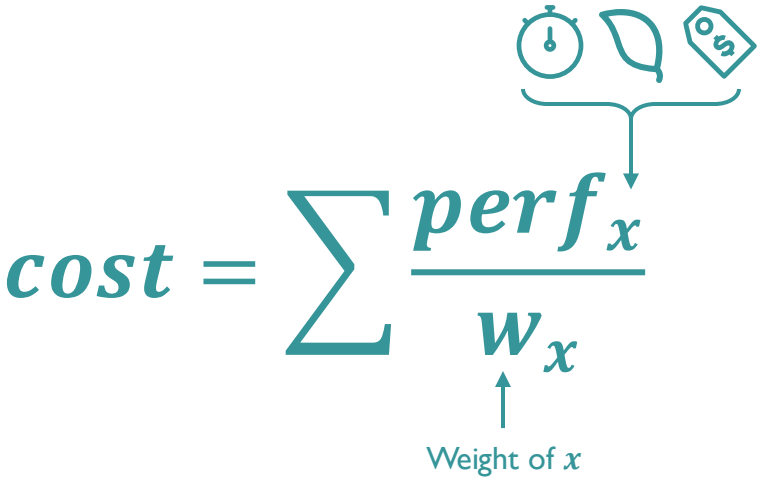
- A π-entity is the business entity that typically corresponds to a π-node
- A company may have multiple sites, warehouses, factories, terminals, etc.
- Entities are the real-world businesses and persons that control the ordering and execution of the logistics flows.

- Entities impose the constraints applied to orders and determine the parameters of the cost function.



THE COST FUNCTION

WEIGHTED SUM OF INDIVIDUAL COSTS



DECENTRALIZED VIRTUAL CAPACITY

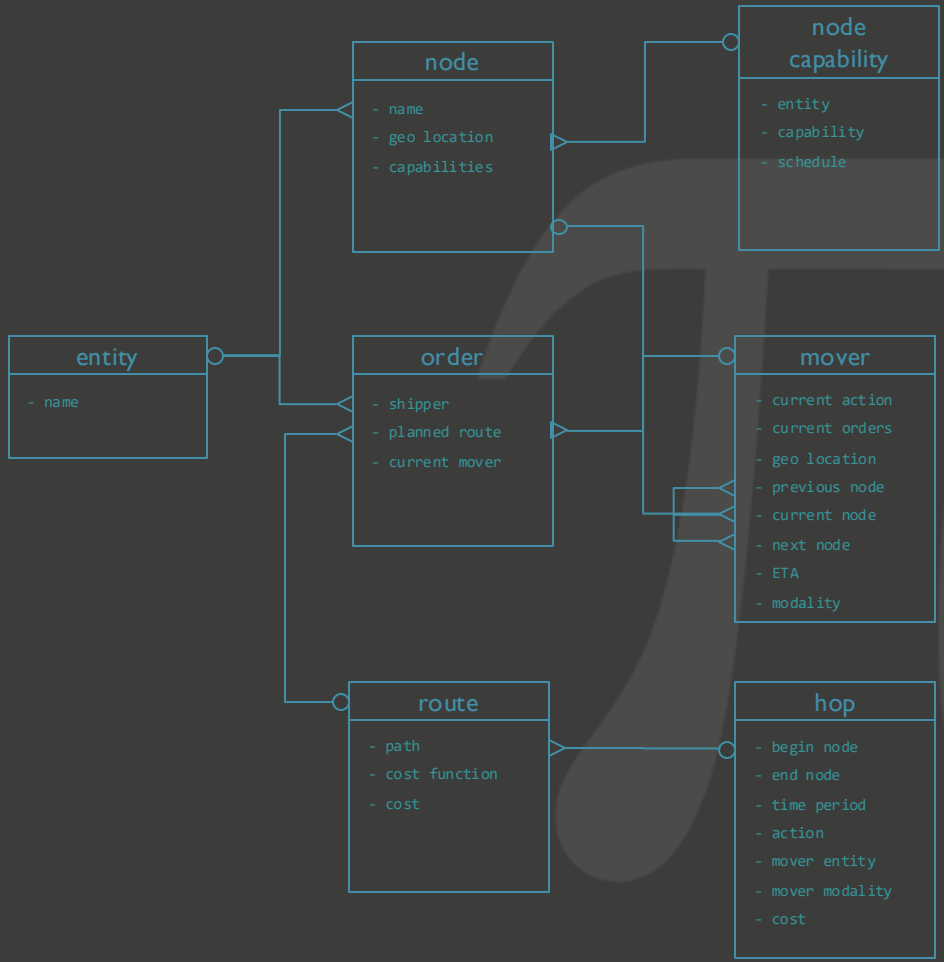
KEY PRINCIPLES

PRINCIPLE 1: DECENTRALIZED SYSTEM

- The network is huge, and availabilities change continuously
- A centralized approach will not work/scale

PRINCIPLE 2: VIRTUAL CAPACITY

- Advertised capacity does not need to reflect actual capacity
- Capacity can be infinite

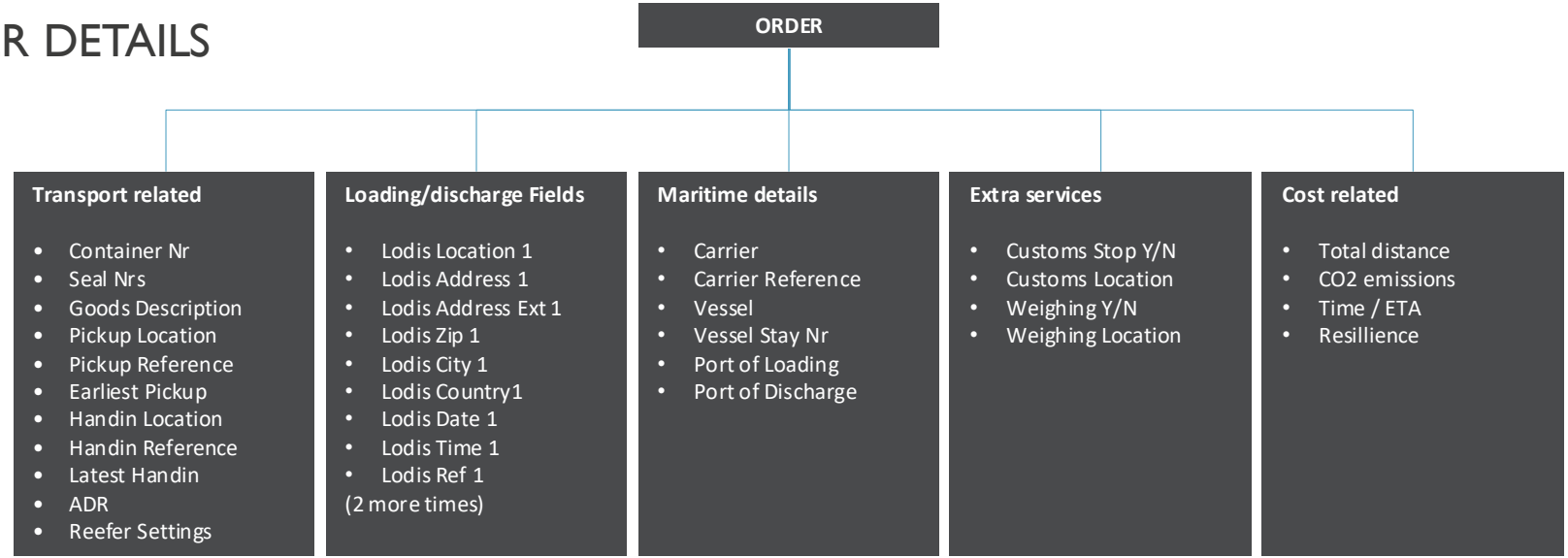


PILL DATA ARCHITECTURE

3 INGREDIENTS

1. The PI-system entities
   - Entities, locations, movers, routes
   - The Network
2. Orders:
   - Order details
   - Order constraints (locations, timings, …, cost)
   - Order state
3. Movers:
   - Mover schedules
   - Mover capacity
   - Mover state

DATA MODEL
ORDER DETAILS



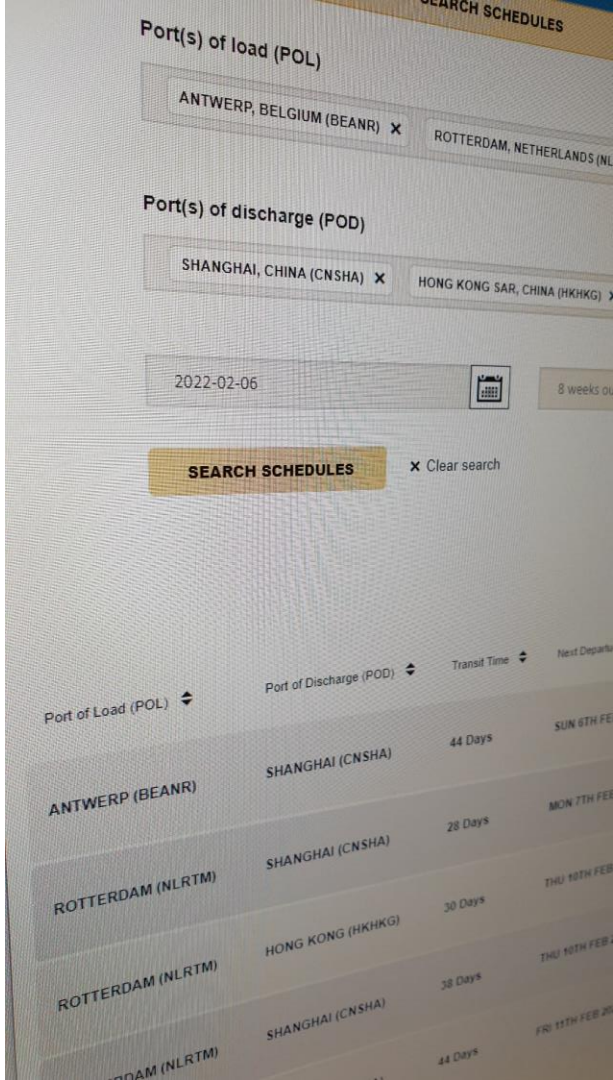
Most – if not all – of these data elements are part of existing standards.
How can we align?

DATA MODEL
SCHEDULE FOR MOVERS

Transport related

- Entity
- Modality
- Schedule
- Begin (departure)
- End (arrival)
- Supported Container Types
- …

- We assume a schedule-based approach
- Movers have a schedule and capacity
- Departure and arrival times are optional (e.g., trucks)
- Certain constraints may apply



Optimization opportunity
Movers may consider applying piggy-backing strategies such as picking up containers after performing a drop at the terminal for a different order. PILL allows such optimizations by design.

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PILL AS AN AGENT BASED MODEL
SUMMARY

- Every node in the network is represented by (an) **agent(s)** that
  - Advertises capabilities and capacity
  - Takes reservations
  - Can find next hops for a route
    - Given a certain starting state
    - Taking into account other constraints
- Movers have schedules
  - Can execute hops
  - Depending on schedule/capacity

- Nodes/agents operate **independently** from each other just like the businesses in the real world
- Shippers/consignees are the **entities** that trigger route planning, specifying the **constraints**
  - Where to load / unload
  - Where to pick up / drop off
  - Time window / ETA
  - ….

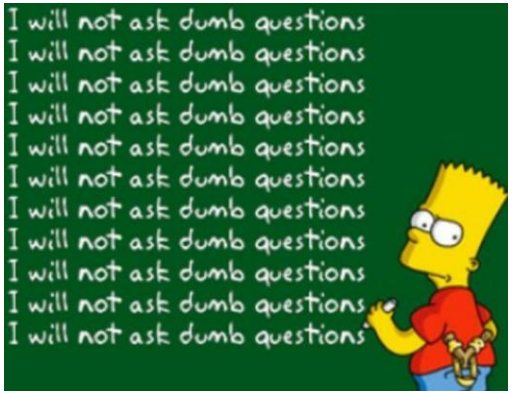
π BREAK

REVIEWING THE USE CASES

BY CATHÉRINE CASSAN & YANICK VAN HOEYMISSEN

USE CASES PILL

METHODOLOGY



Bilateral meetings

Business process, what are their possible gains, loss of time/money, ….

Is there a significant difference between operations in port and in hinterland?

What are the limitation for use of the network?

1. Length, weight,…

Who determines which train can use which track, when (port/hinterland)?

1. How flexible? Last minute changes?
2. Who takes initiative for changes? Who decides?

USE CASES PILL

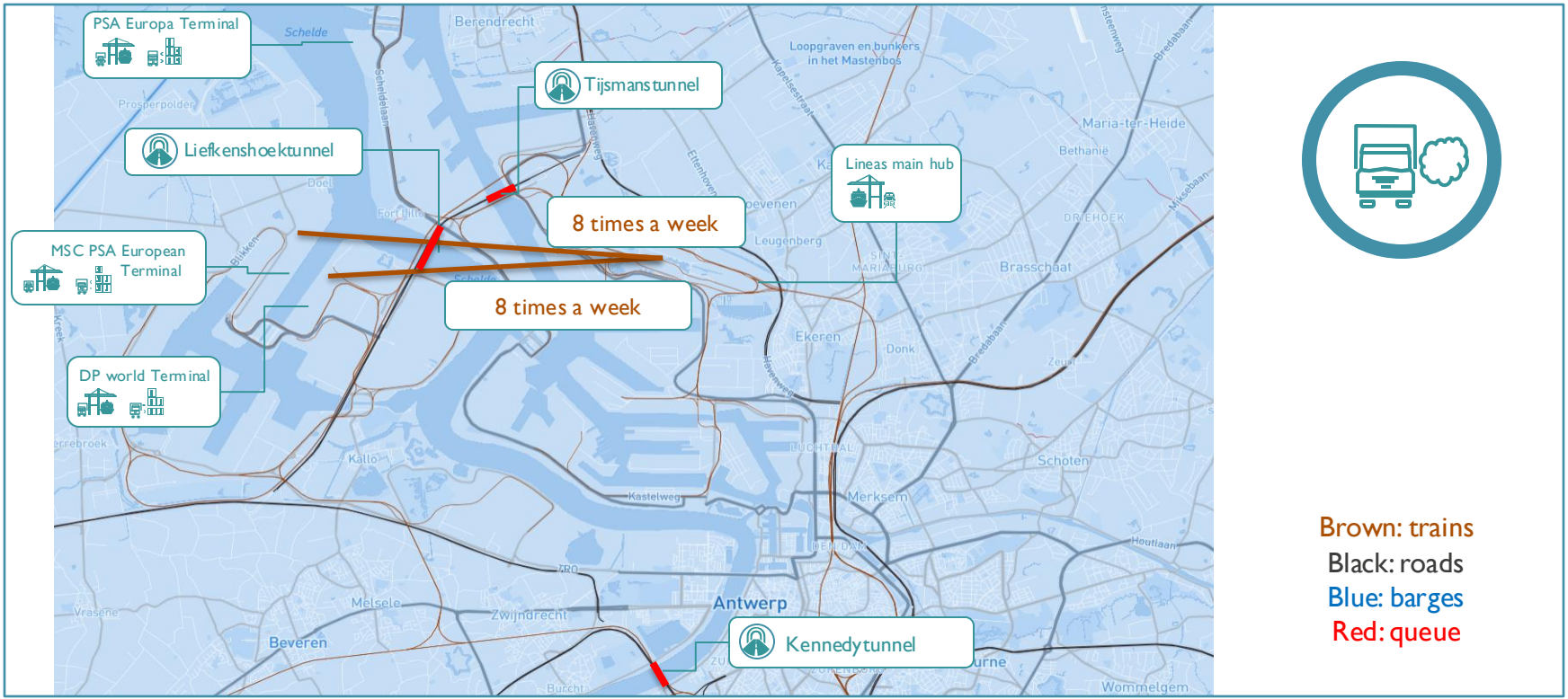
1. UC 1: Optimization of **intra port** logistics processes
   - Userstory 1: Intra port alternatives
   - Userstory 2: Next mode of transport

2. UC 2: Aligning import/export and **hinterland**
   - Userstory 1: Optimization of flows
   - Userstory 2: Adapt to changing ETA
   - Userstory 3: Find free capacity

3. UC 3: **Empty container** flow optimization
   - Userstory 1: Container reuse
   - Userstory 2: Container repositioning

USE CASE 1: OPTIMIZATION OF INTRA PORT LOGISTICS PROCESSES

USER STORY 1: INTRA PORT ALTERNATIVES



USE CASE 1: OPTIMIZATION OF INTRA PORT LOGISTICS PROCESSES

USER STORY 1: INTRA-PORT ALTERNATIVES

As a Transport Provider **I want to** avoid traffic jams inside the port **So that** I can be faster

How? Making transporter aware of availabilities on barge / train for intra port moves

Advantage: less moves inside port, less queues

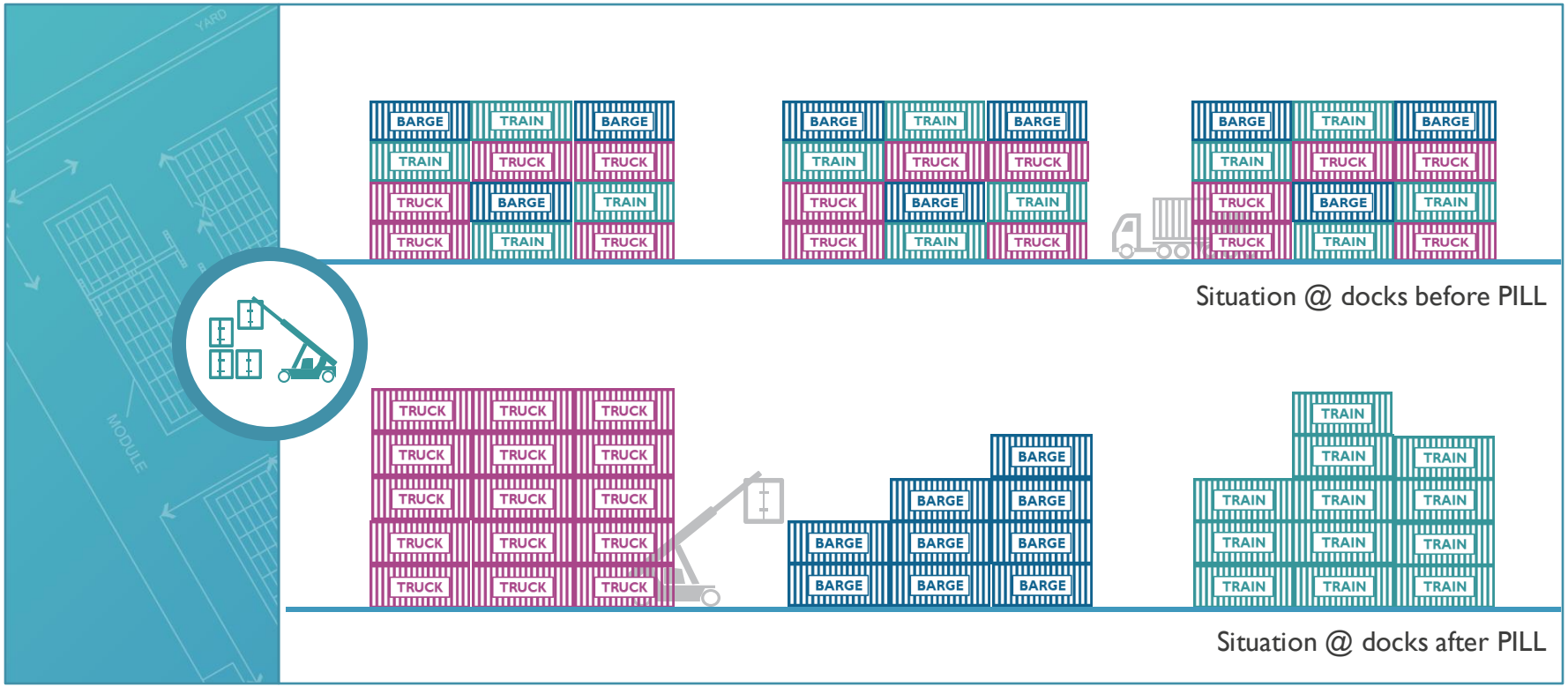
Current state

- Containers are mostly moved during business hours
- Containers directly placed at terminal of arrival/departure (inside port)
- Use trucks because of their flexibility / no view of alternatives

Involved stakeholders: Terminal operator, Transport providers

USE CASE 1: OPTIMIZATION OF INTRA PORT LOGISTICS PROCESSES

USER STORY 2: NEXT MODE OF TRANSPORT



USE CASE 1: OPTIMIZATION OF INTRA PORT LOGISTICS PROCESSES

USER STORY 2: NEXT MODE OF TRANSPORT

As a Terminal operator **I want to** know the next transport modes **So that** I gain time so that I can optimize my operations and reduce waiting times

How? Sharing next mode & pick up time so that the terminal operator can optimize placing of import containers.

Advantage: Optimization of yard planning, faster loading times

Current state

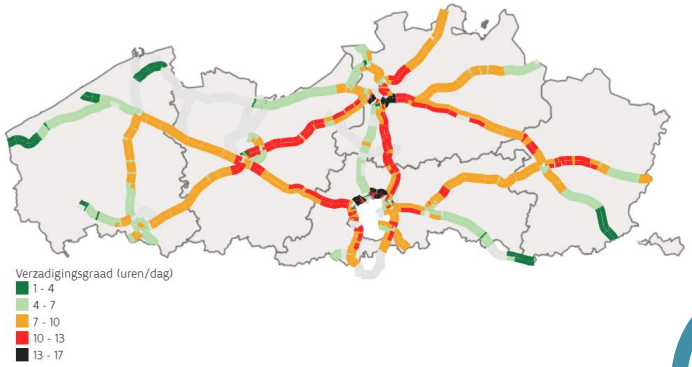
- Terminal operators don't know who is responsible for the container
- Inbound containers cannot be stacked according to mode/pick up time

Involved stakeholders: Terminal operator, Shippers, Transport providers

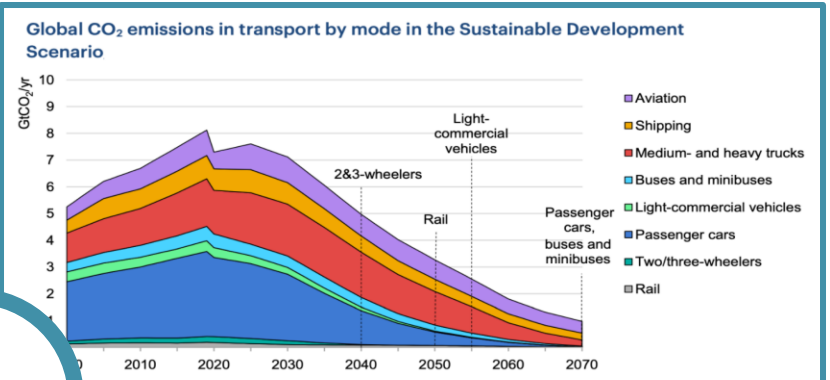
USE CASE 2: ALIGNING IMPORT/EXPORT AND HINTERLAND

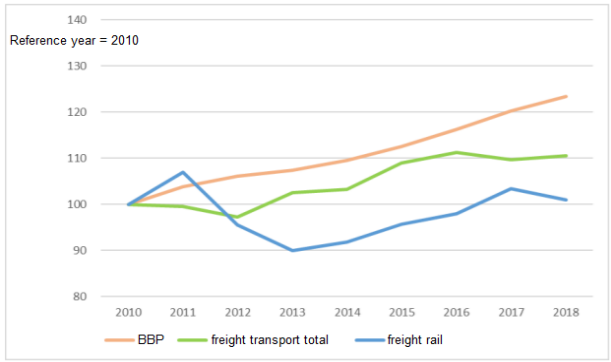
USER STORY 1: OPTIMIZATION OF FLOWS

SOURCE: VERKEERSCENTRUM

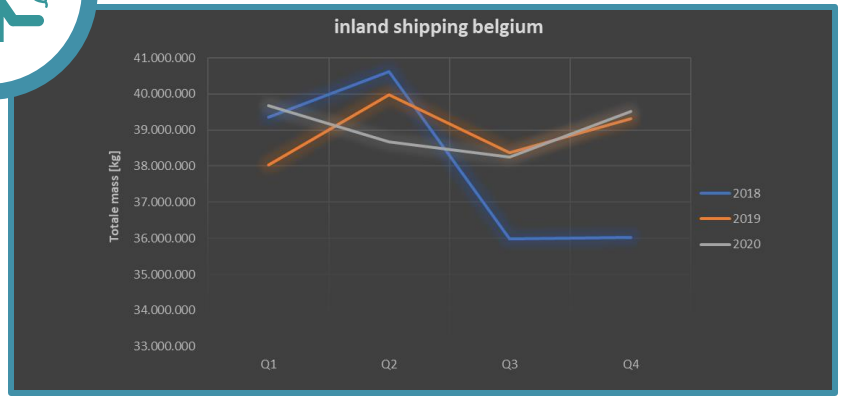


SOURCE: INTERNATIONAL ENERGY AGENCY





SOURCE: EUROSTAT



SOURCE: STABEL

USE CASE 2: ALIGNING IMPORT/EXPORT AND HINTERLAND

USER STORY 1: OPTIMIZATION OF FLOWS

As a governmental organization **I want to** optimize logistic flows to lower ecological footprint **So that** external costs are decreasing

How? Make all (cheaper, more reliable and more sustainable) available alternatives visible

Advantage: increase use of alternatives (cheaper/sustainable), reduce empty kilometers

Current state

- Logistic chain is built upon trusted historical relationships
- Free capacity and cheaper/sustainable alternatives are not easily findable

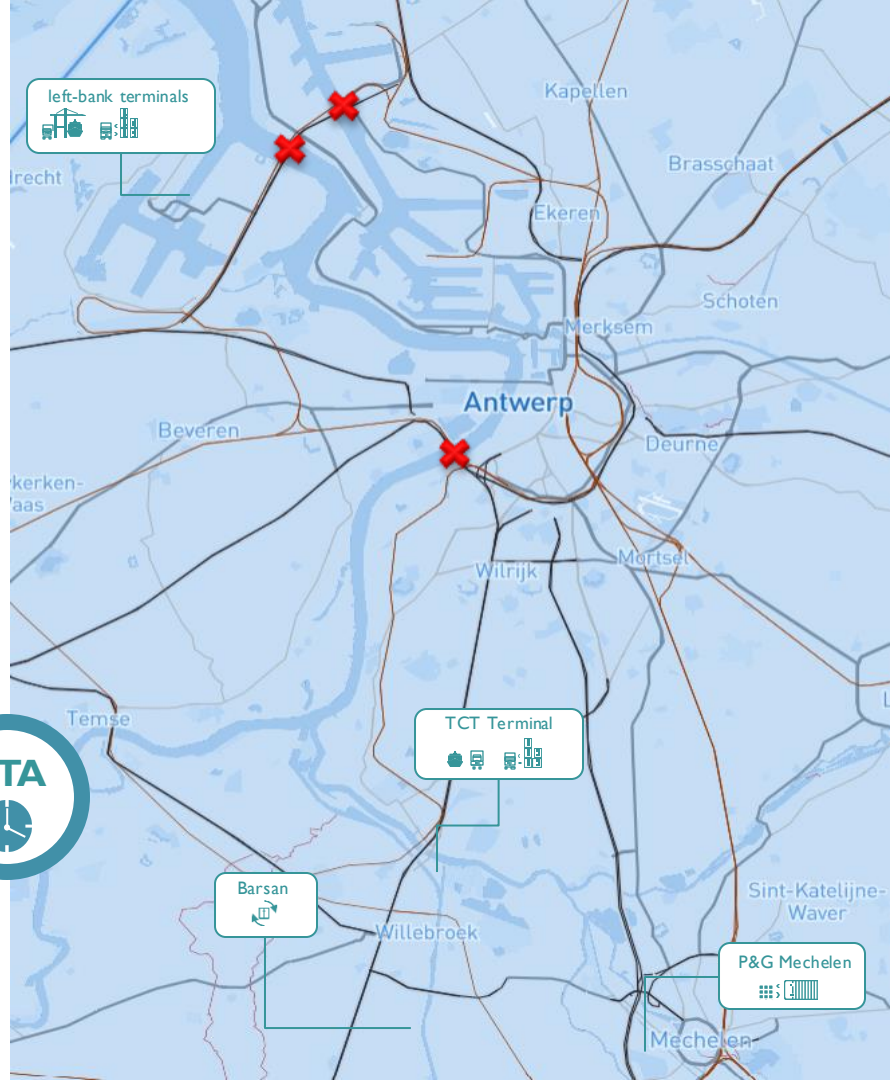
Involved stakeholders: Shippers, Consignee, Transport providers & governmental organizations

USE CASE 2: ALIGNING IMPORT/EXPORT AND HINTERLAND

USER STORY 2: ADAPT TO CHANGING ETA

Examples

- Traffic accident in Kennedytunnel, can I still make my train?
  - Cancel & rebook next modes
- Barge is delayed, can I change modes to arrive on time?
  - Change routing at nearby node
- Train line unavailable due to works of Infrabel, how can I get my container at the destination?
  - Recalculate optimal route



USE CASE 2: ALIGNING IMPORT/EXPORT AND HINTERLAND

USER STORY 2: ADAPT TO CHANGING ETA

As a shipper **I want to** get an updated ETA **So that** I can optimize my flow of goods

How? Update the data/information in (nearly) realtime to alert shipper to changes in ETA

Advantage: overview of alternatives (cheaper/sustainable), possibility to prioritize flows (better planning), adapt production planning

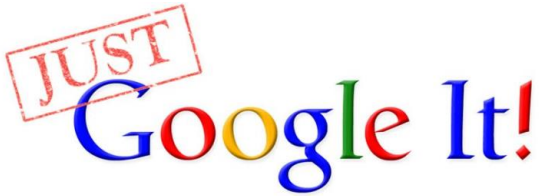
Current state:

- No (nearly) realtime updated ETA available
- It is difficult to intervene for a shipper in the logistics chain if there are delays

Involved stakeholders: Consignee, Transport providers, Terminal operator, Government

USE CASE 2: ALIGNING IMPORT/EXPORT AND HINTERLAND

USER STORY 3: MAKE FREE CAPACITY FINDABLE



USE CASE 2: ALIGNING IMPORT/EXPORT AND HINTERLAND

USER STORY 3: MAKE CAPACITY FINDABLE

As a transport provider **I want to** make my free capacity findable **So that** I can sell my free capacity / optimize my flows

How? Make the free capacity findable for all stakeholders (but not necessarily visible)

Advantage: reduce empty kilometers / create critical mass for economically sustainable alternatives (train/barges)

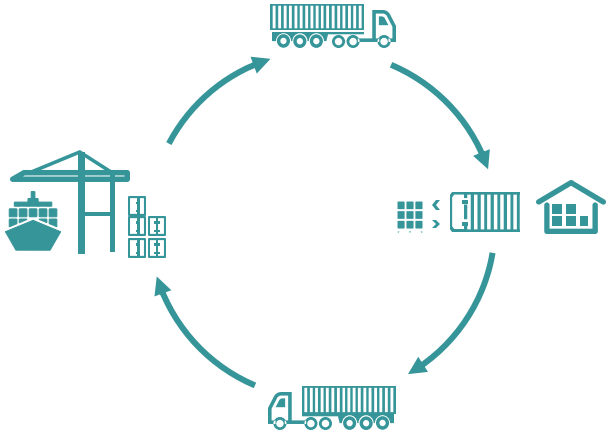
Current state:

- Difficult to find free capacity (trains/barges/trucks)
- Make use of the familiar modes of transport

Involved stakeholders: Shippers, Consignee, Transport providers

USE CASE 3: EMPTY CONTAINER FLOW OPTIMIZATION

USER STORY 1: CONTAINER REUSE



Avoid unnecessary round trips by reusing containers.

USE CASE 3: EMPTY CONTAINER FLOW OPTIMIZATION

USER STORY 1: CONTAINER REUSE

As a Shipper **I want to** check if reuse of an empty container is possible / profitable **So that** I avoid unnecessary trips with empty containers

How? Alert container owner that container is available for reuse. Get a (nearly) realtime overview of all suitable nearby empty containers.

Advantage: reduce empty kilometers

Current state:

- Return of container to depot often needed
- 30-40% empty containers / empty trips

Involved stakeholders: Shipper-consignees, carrier / container owners

USE CASE 3: EMPTY CONTAINER FLOW OPTIMIZATION

USER STORY 2: CONTAINER (RE)POSITIONING

Use efficient transport means to make empty containers available in hinterland terminals.

USE CASE 3: EMPTY CONTAINER FLOW OPTIMIZATION

USER STORY 2: CONTAINER (RE)POSITIONING

As a hinterland terminal operator, **I want to** check if empty containers will be available/needed **So that** I can balance my equipment

How? To predict (know) future needs of available containers to get a well-balanced equipment (business value)

Advantage: reduce empty kilometers, opportunities for sustainable transport

Current state:

- Schedules are resulting in an equipment unbalance (per season)
- 30-40% empty containers/empty trips

Involved stakeholders: Terminal operator, depot operator

USE CASES PILL FURTHER STEPS

- First step: Data of PILL stakeholders
  - Already high percentage on barge/train
  - Limited optimization possibilities in terms of modal shift
- Next step: Add non-optimized flows of other logistic players
  - Through data tech vendors
  - Through data FOD economy
  - Other data?
- Apply statistics to get an idea of entire logistic flow
- Analyze optimization potential when applying use cases

SIMULATION MODEL: SNEAK PREVIEW

BY VITOR LEMOS

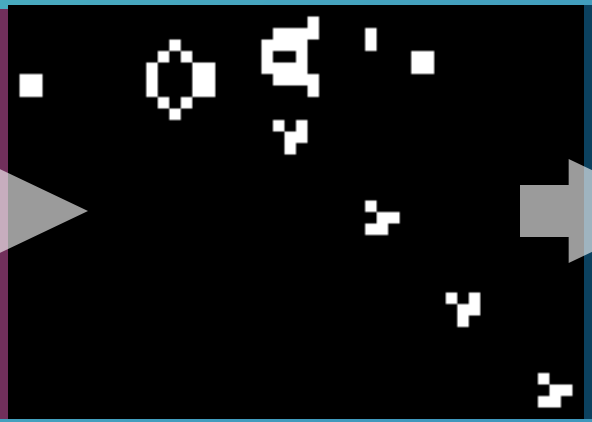
- Explain tooling
- Where are we going with this?
- What are the next steps?

WHY AN AGENT-BASED MODEL?
FROM SIMPLE RULES TO COMPLEX PATTERNS

Conway's Game of Life (1970)

Simple agent rules

Individual states
Decentralized behavior



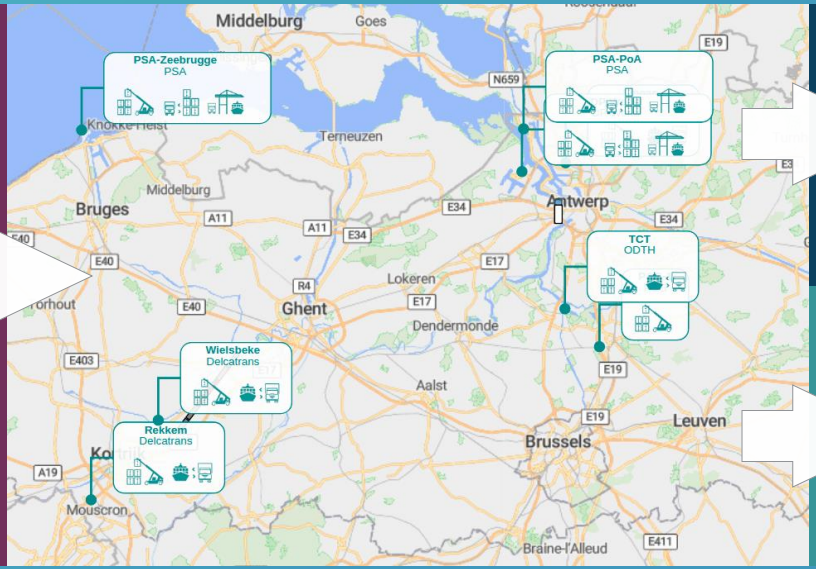
Complex patterns

Measure each agent decision or action
Rich set of outputs

- White cell is alive, black cell is dead (state)
- Fewer than 2 alive neighbours, cell dies
- 2 or 3 alive neighbours, cell continues alive
- More than 3 alive neighbours, cell dies of overpopulation
- Exactly 3 alive neighbours, dead cell becomes alive

PILL AS ABM
BASELINE VS Π-NETWORK

Historical data
+
Business rules



Baseline

Business as usual

VS

π-Network

Cost optimizer
GHG emission optimizer
Hybrid optimizer
...

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DEMO
IMPACT OF TRANSPORT MODES

- Early version (work in progress)
  - Simple route selection
  - No empty container logic
  - Many simplifications

AIR	ROAD	RAIL	WATER
700g GHG per tonne-km	**100**g GHG per tonne-km	**25**g GHG per tonne-km	**10**g GHG per tonne-km

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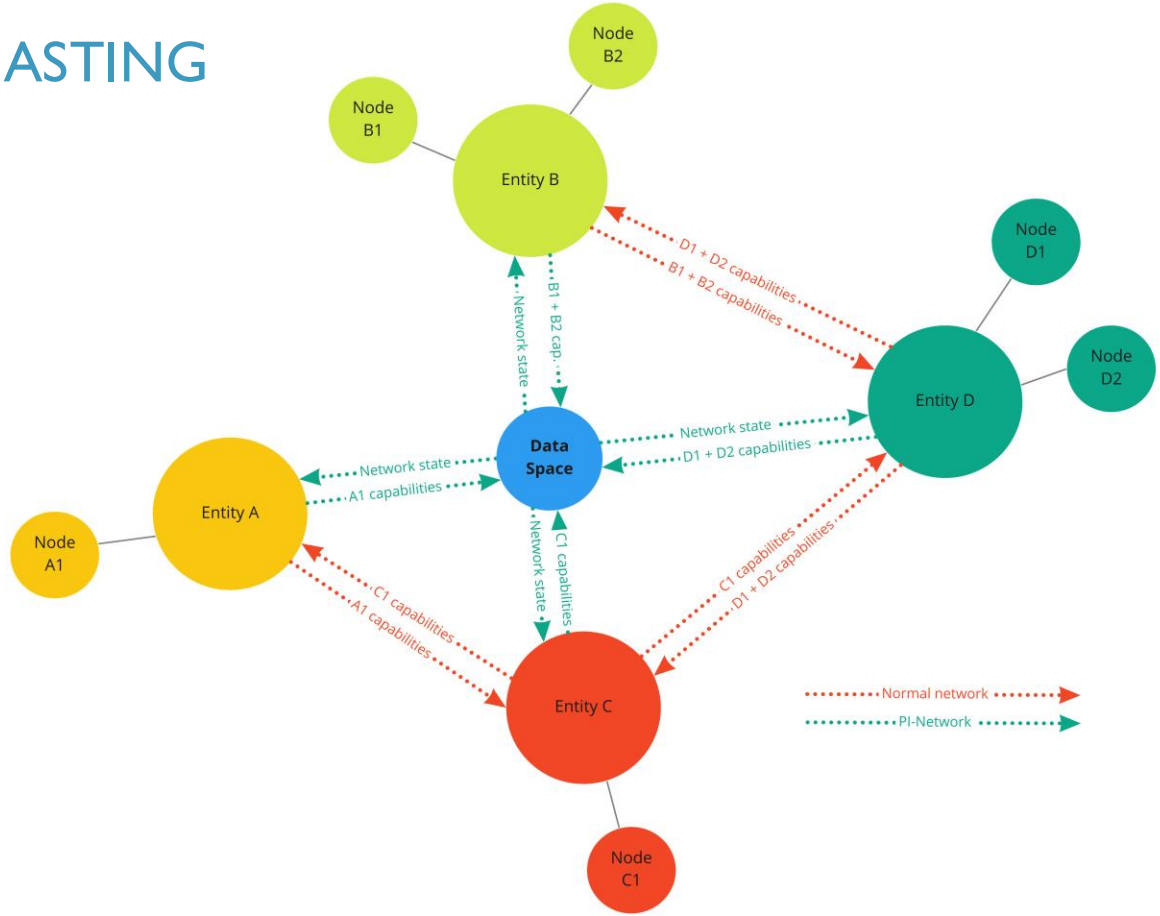
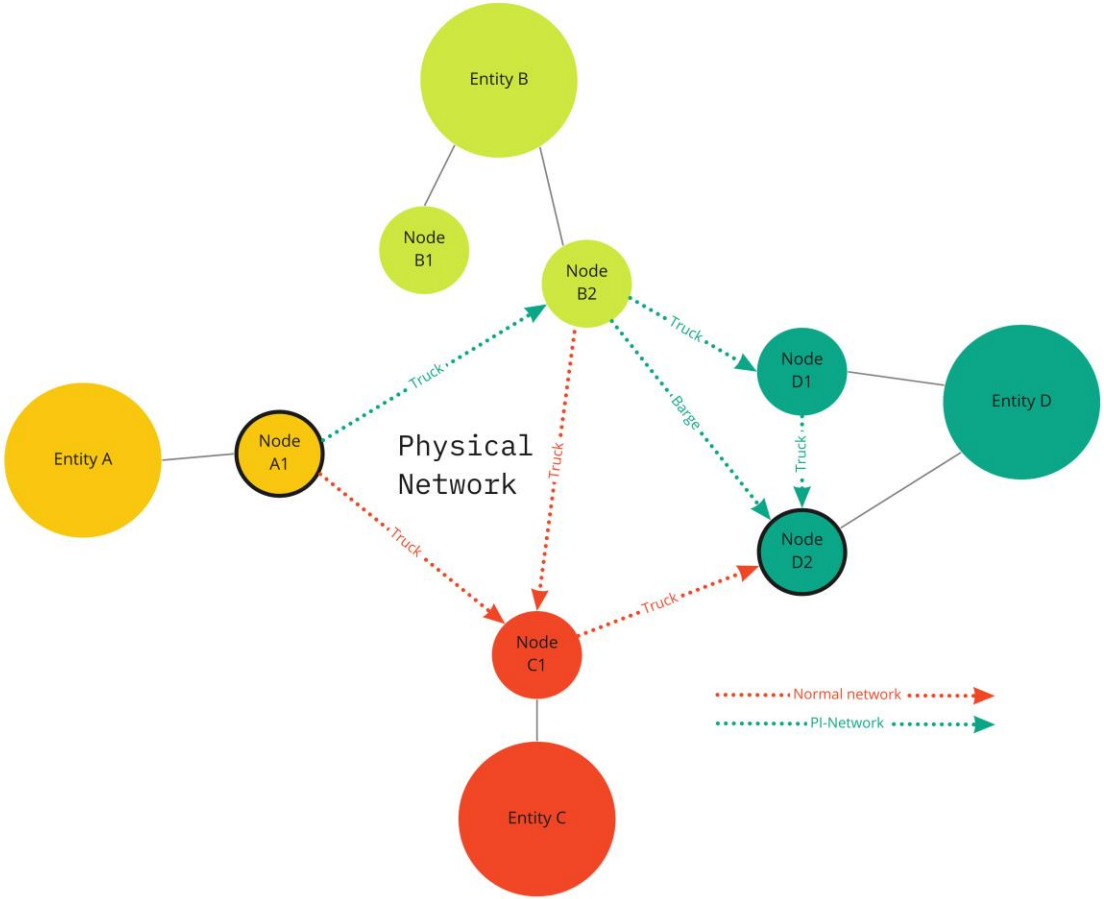
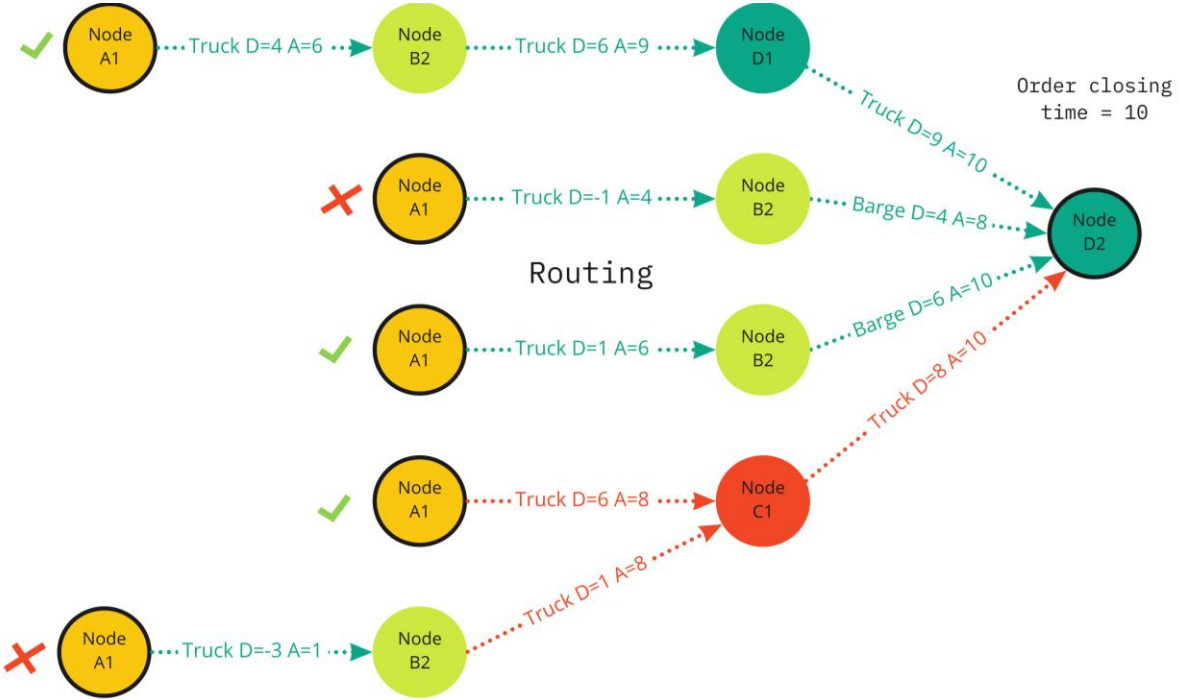
CAPABILITY BROADCASTING



NETWORK STATE



ROUTING



Why backtracking?

- Since trucks are quite flexible, by backtracking we know how late can the truck arrive to catch the next mover

THE ROAD AHEAD
FOR MODEL DEVELOPMENT

1. Scope definition (abstraction level)
2. Model development + verification and validation
3. Baseline calibration vs historical data
4. Experiments with π-**Network setup**
   - **Monte Carlo simulations (deal with uncertainty)**

PLANNING: LOOKING AHEAD

BY STEFAN BOTTU (DIRK JOCQUET) & VOLKER HOJA

DISSEMINATION INTERMEDIATE RESULTS PILL

- First focus on PILL stakeholders, but preparing for broader dissemination in Flanders at the end of project.
- PILL dissemination plan
  - Overview of all project deliverables.
  - What is already available.
  - What is planned by when?
  - In which format.
  - Will be updated 2-3 times/year.
  - Available to all stakeholders.

DISSEMINATION INTERMEDIATE RESULTS: WHAT'S ALREADY AVAILABLE

- SOTA PILL (State of the Art) : completed.
- Container operations & Maritime processes : completed.
- Stakeholder Mapping : version 1 of 3 completed.
- Basis Routing and algorithm description: version 1 of 3 completed.

- Will be send by email on request.
- Content is integrated within this meeting.

DISSEMINATION WEBSITE PILL

- In development (May-June).
- For project stakeholders.
- Content:
  - PI framework in Flanders
  - Dissemination
  - Description of living labs
  - Relevant documents
  - Other requirements?

FUTURE EVENTS TO SHOWCASE PILL

FUTURESUMMITS

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NEXT STAKEHOLDER MEETING:
LOG!VILLE

- Prior or after summer.
- Physical live event!

PLANNING 2022

- Enhancing π model with capabilities of tech suppliers
- Insights in operational model by adding business value to π
- Develop approach to long term planning & reservation with π

- Extending π System Architecture based on logistics data
- Simulation Model and data ingestion to feed it
- Quantification & validation of the PI network
- Define disruption & last-minute optimization scenario's
- Test results at execution

QUESTIONS AND DISCUSSION ROUND


Thank you
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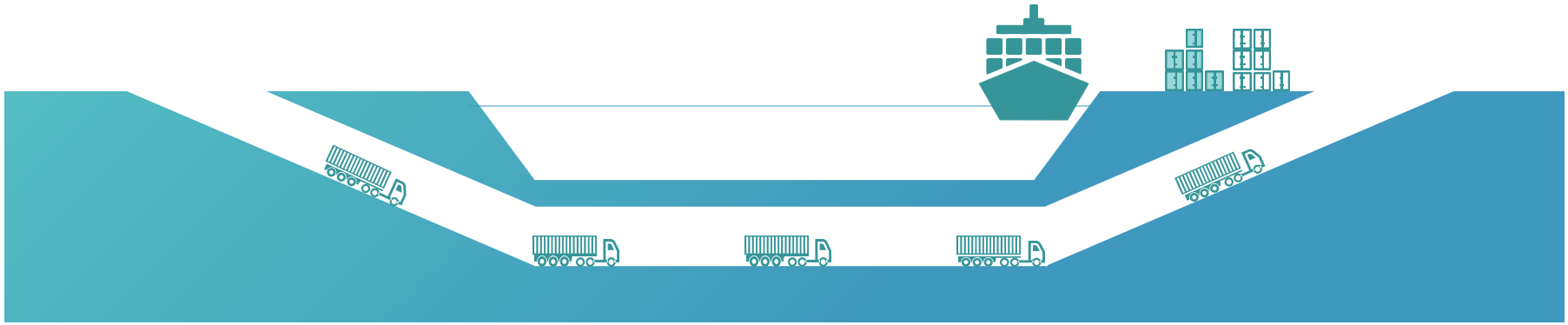
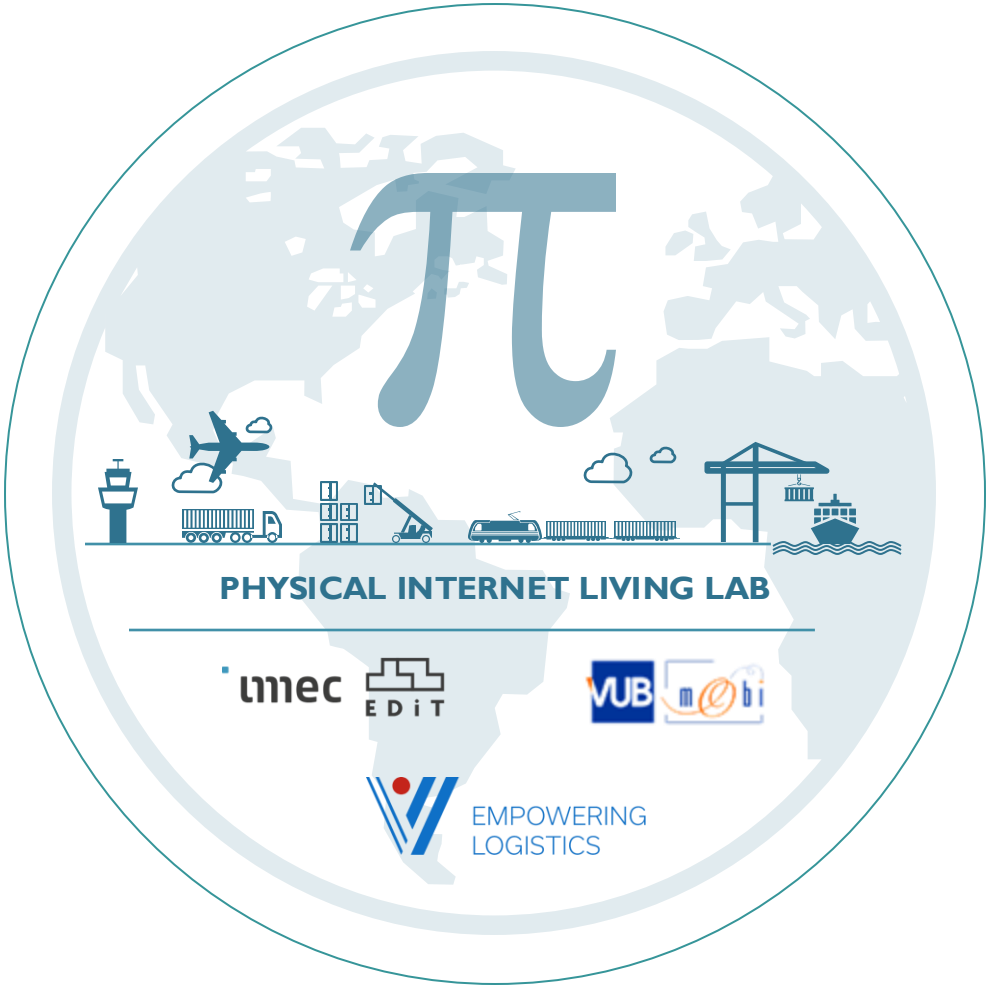


USE CASES PILL

1. UC 1: Optimization of **intra port** logistics processes
   - Userstory 1: Intra port alternatives
   - Userstory 2: Next mode of transport
2. UC 2: Aligning import/export and **hinterland**
   - Userstory 1: Optimization of flows
   - Userstory 2: Adapt to changing ETA
   - Userstory 3: Find free capacity
3. UC 3: **Empty container** flow optimization
   - Userstory 1: Container reuse
   - Userstory 2: Container repositioning

1. UC 1: Improve planning reliability
   - Userstory 1: Intra port alternatives
   - Userstory 2: Next mode of transport
   - **Userstory 3: increase reliability of import moves**
   - Userstory 4: Optimization of flows
2. UC 2: Make resilient against disruption
   - Userstory 1: Adapt to changing ETA
   - Userstory 2: Find free capacity
   - **Userstory 3: adapt route selection**
   - **Userstory 4: optimize infrastructure use**
3. UC 3: **Optimise future flows**
   - Userstory 1: Container reuse
   - Userstory 2: Container repositioning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