



PI Concepts, Features and Protocols

ALICE PI Webinar

November 2022

Kostas Zavitsas

Head of T&L Analytics, VLTN



This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement No. 860274

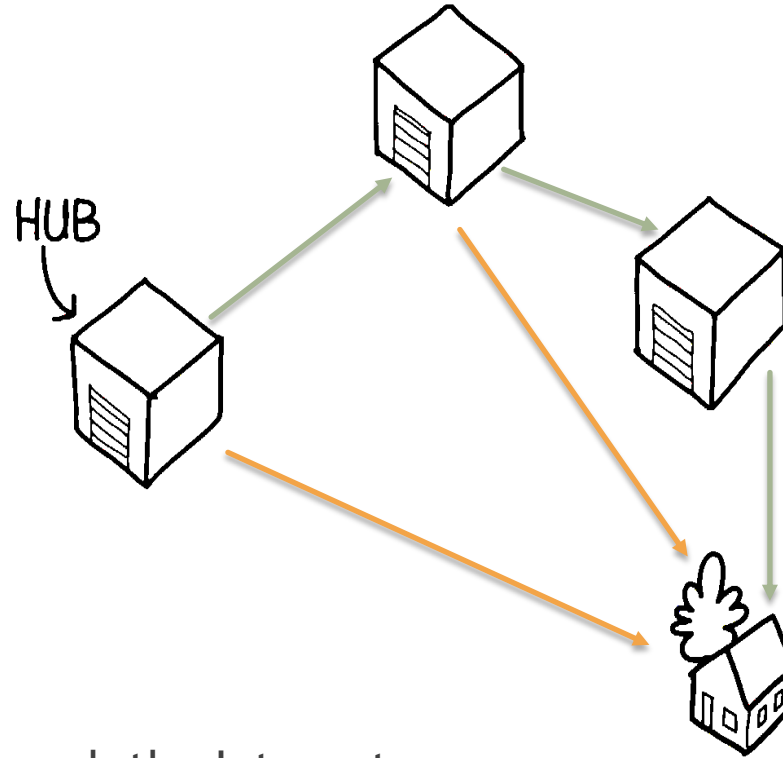
The future of logistics

► Current T&L practice performance:

- 20-30% of road freight km's are empty runs (Eurostat, 2020)
- low utilization of efficient transport modes (rail, river)
- low interoperability of modes
- 15% greenhouse gas emissions caused by freight transport
- limited supply chain visibility

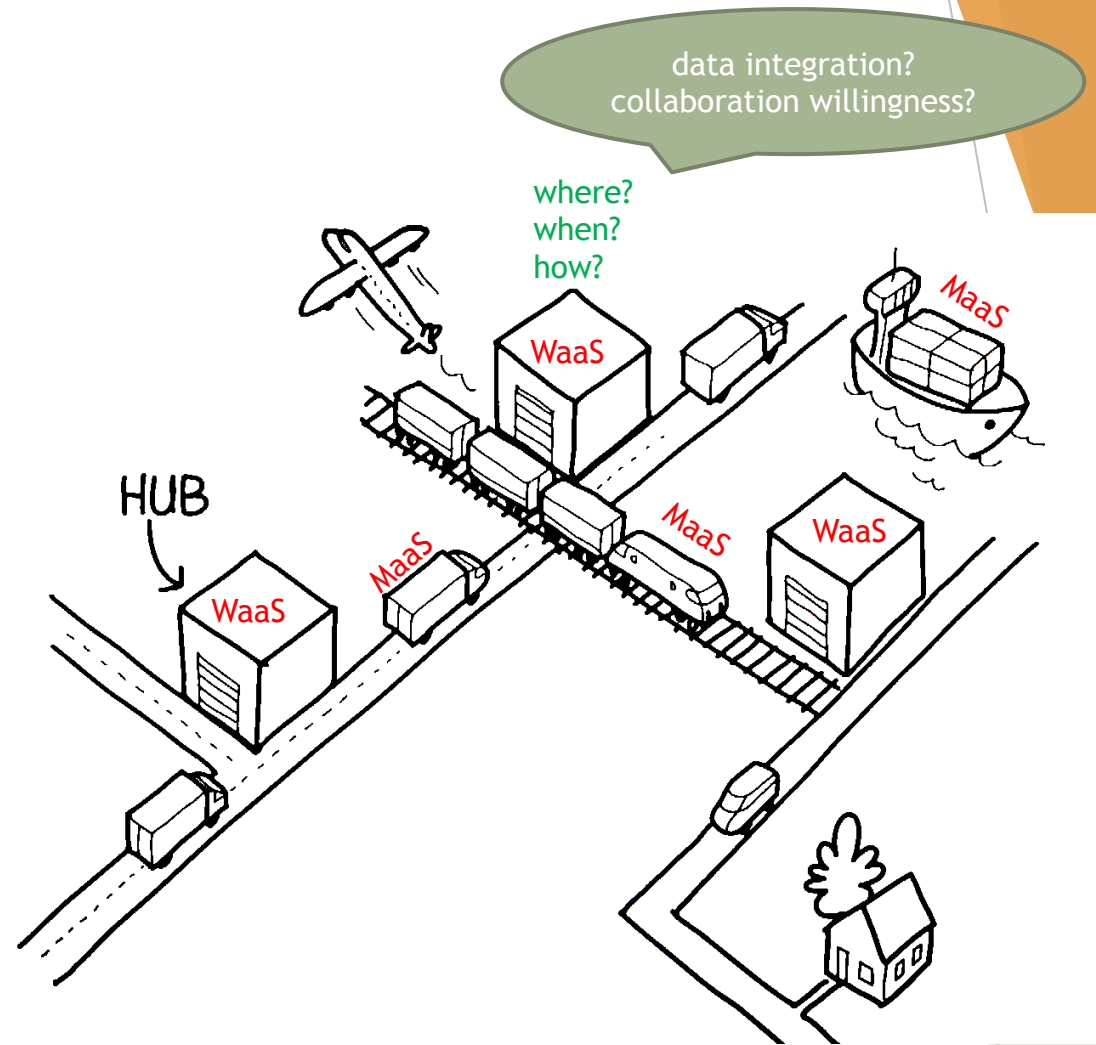
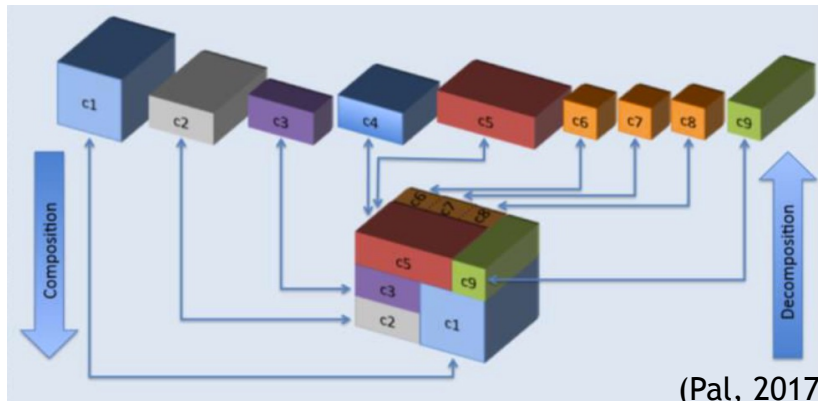
► How is the PI different?

- Inspired by the transfer of data in through the Internet
- cargo will move from hub to hub until they finally reach the recipient/ destination enabling higher **consolidation** and **efficiency**



The PI principles

- ▶ open (as-a-Service) access to both transport (MaaS) and warehouses (WaaS)
- ▶ multimodality, infrastructures/ operations interoperability and standardization
- ▶ continuous monitoring and smart decision making (routing, assignment)
- ▶ container modularization and encapsulation



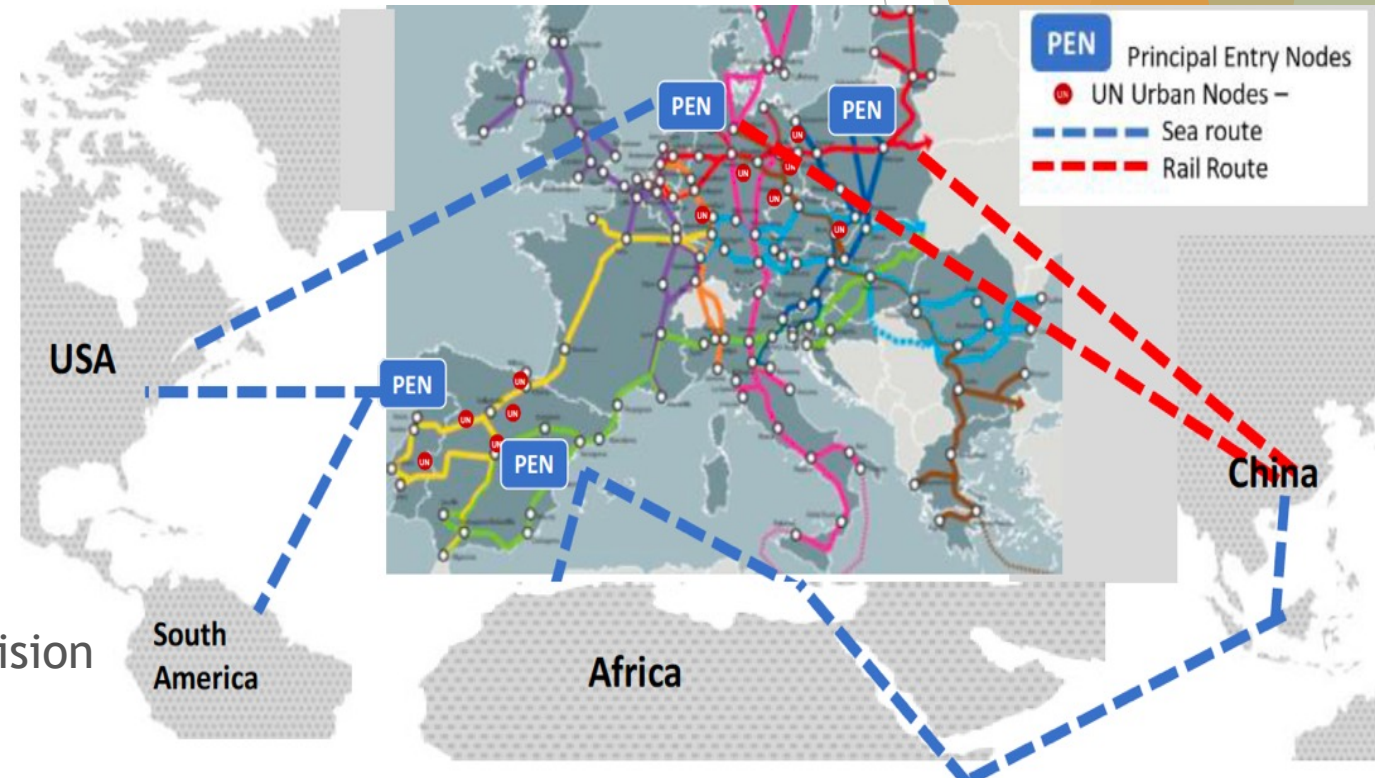
PLANET's vision

- ▶ Advance the European Commission's strategy for Smart, Green and Integrated Transport and Logistics
 - ▶ Efficiently interconnecting infrastructure with geopolitical developments
 - ▶ Optimising the use of current & emerging transport modes and technological solutions
 - ▶ ensuring equitable inclusivity of all participants
 - ▶ increasing the prosperity of nations,
 - ▶ preserving the environment,
 - ▶ enhancing Citizens' quality of life

PLANET's EGTN & Living Labs

- ▶ The realization of this vision is what PLANET calls the **Integrated Green EU-Global T&L Network (EGTN)**

- ▶ Geo-economics aware
- ▶ Innovation embedding (optimisation readiness)
- ▶ Inclusive
- ▶ Integrated (global trade routes)
 - ▶ Resilient against risks
 - ▶ Responsive to changes
- ▶ Build industry/business to policy view in decision making for operations and infrastructure
 - ▶ Simulation capability & ICT infrastructure
 - ▶ Roadmap and capacity building



PLANET's EGTN Generic Use Cases

► T&L Intercontinental Corridor to Last Mile Process Description and Decisions

► Intercontinental corridor integration

- Multi-stakeholder multi criteria perspectives
- Flow modelling/ Transport gravity modelling/ Corridor Connectivity Index
- Synchro-modality - PI Hub Choice model

► PoE Hub

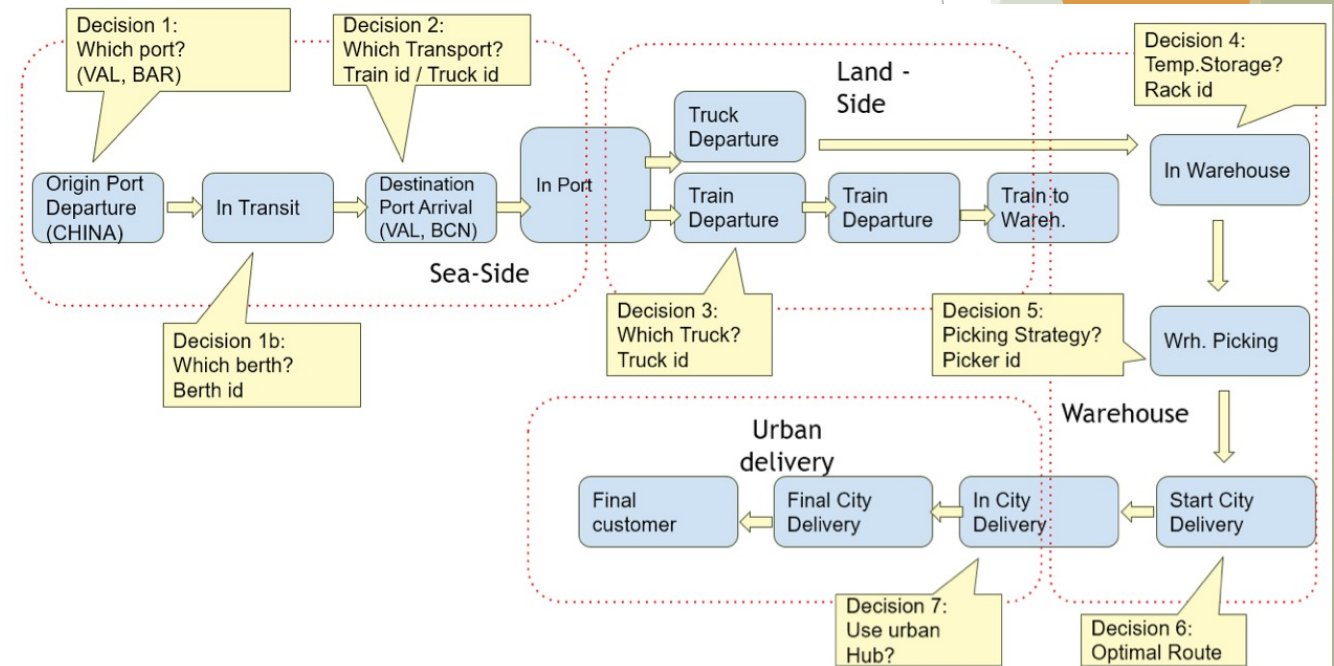
- Data standardization
- Encapsulation/ Forwarding

► Hinterland transport & storage

- Consolidation & efficiency
- Prediction & capacity planning

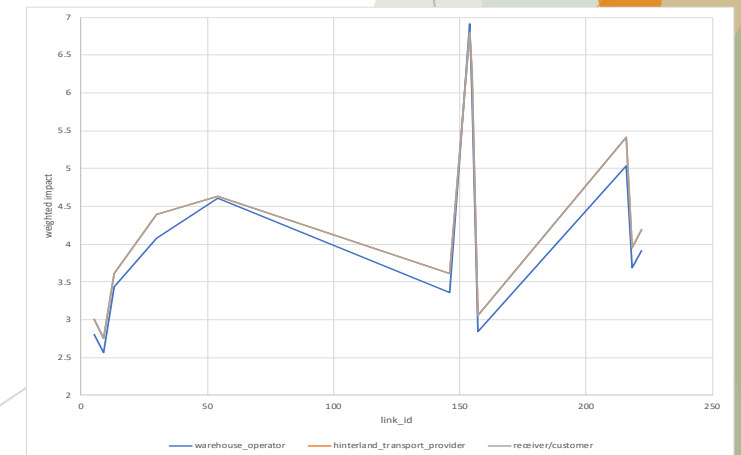
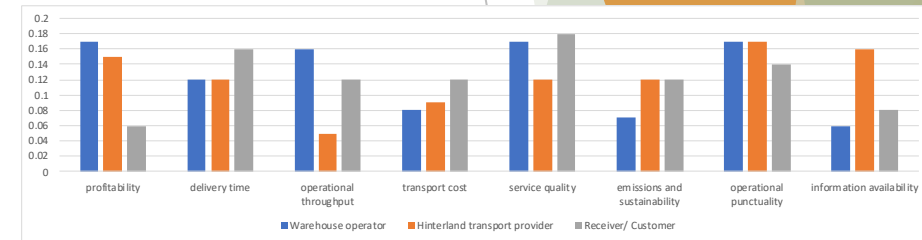
► Last mile delivery

- Collaboration



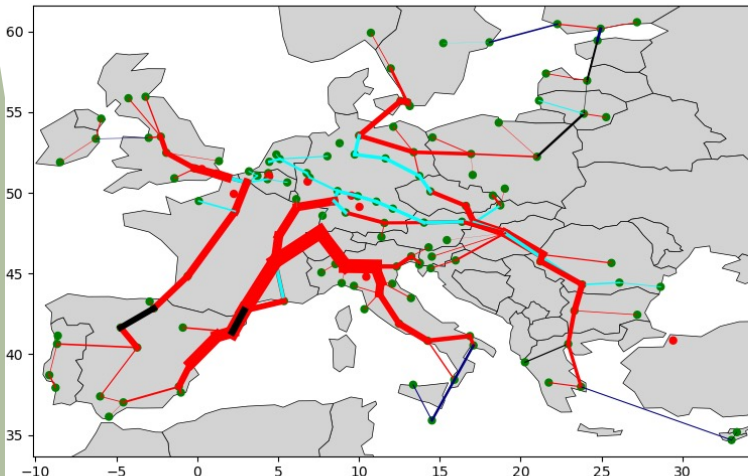
Multi-stakeholder multi-criteria perspective

- Network performance analysis in terms of multiple stakeholders and criteria weights (MAMCA). Can be used for:
 - Prioritisation of infrastructure investments (Strategic)
 - Impact of network link disruptions
 - Operational collaboration filtering



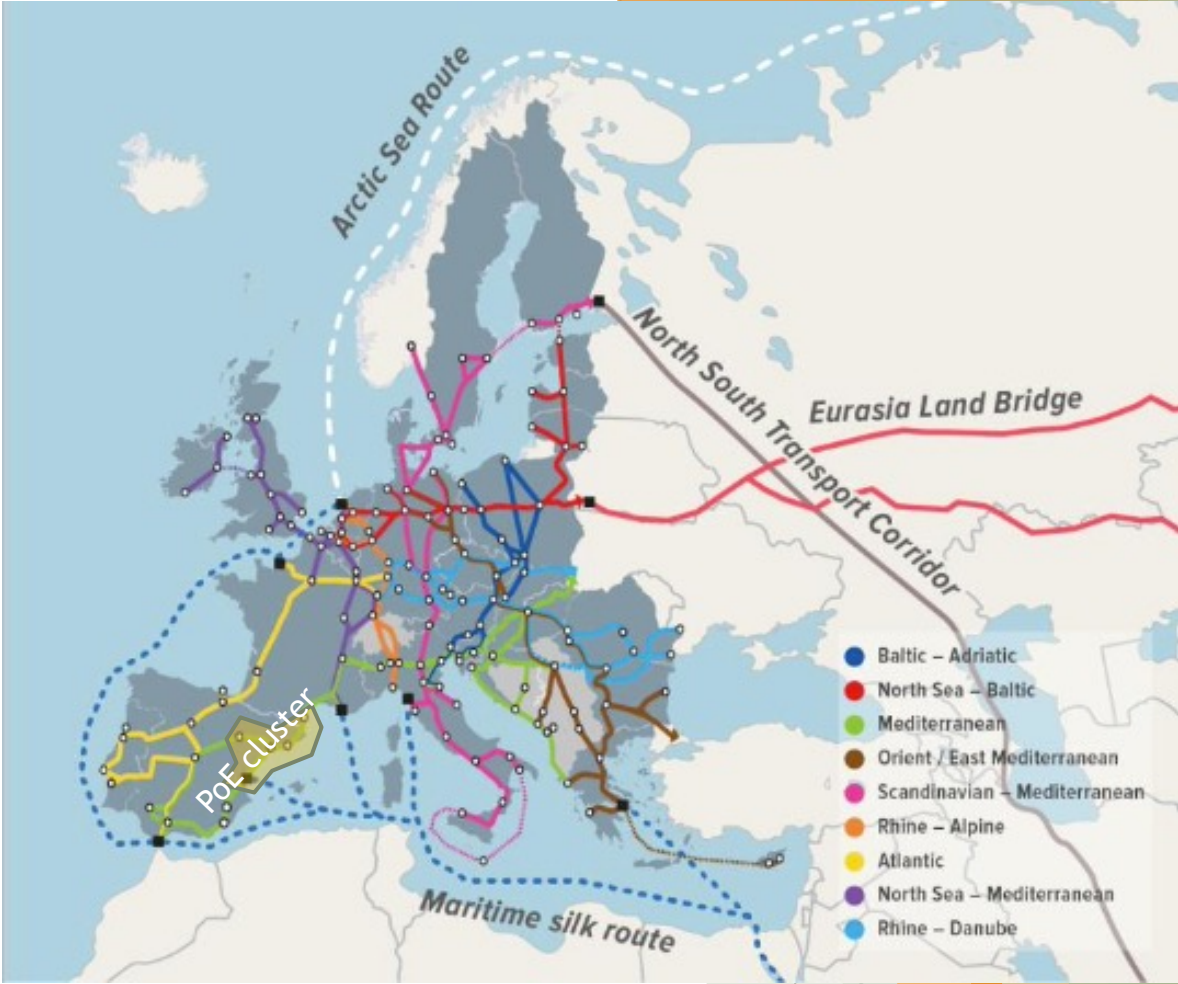
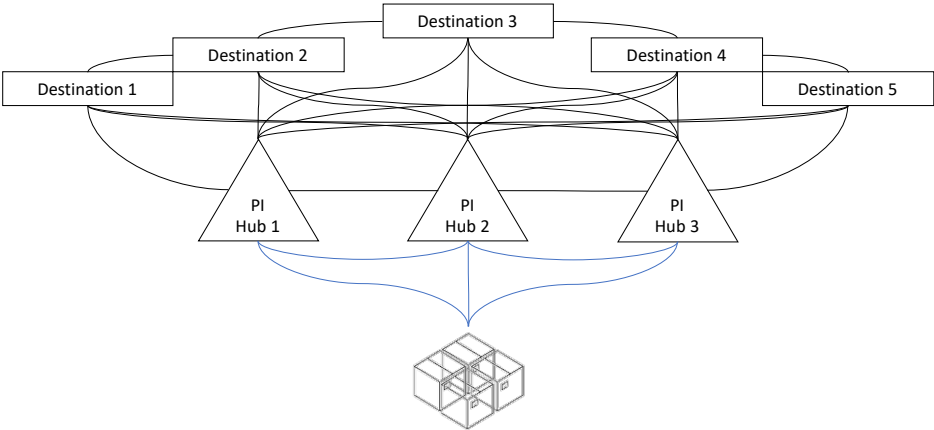
linkid	linkorigin	linkdestination	linkmode	costeuro	distkm	aveltimemi	capacity_low	crit_cost	%_increase	rank
216	Basel	Milan	Rail	78	341	255	0	4897395	12.6	1
155	Barcelona	Perpignan	Rail	44	193	144	0	4890767	12.5	2
30	Arad	Budapest	Rail	60	265	198	0	4790413	10.2	3
222	Milan	Verona	Rail	36	160	120	0	4760393	9.5	4
218	Lyon	Basel	Rail	94	409	306	0	4746620	9.2	5
146	Valencia	Tarragona	Rail	59	259	194	0	4714450	8.4	6
157	Rome	Florence	Rail	64	279	209	0	4657447	7.1	7
5	Athens	Thessalonik	Rail	115	501	375	0	4653119	7	8

linkid	linkorigin	linkdestination	linkmode	costeuro	distkm	aveltimemi	crit_time	%_increase	rank
154	Barcelona	Perpignan	Road	293	193	130	10899606	8.31	1
210	Lyon	Turin	Road	474	312	219	10813342	6.66	2
136	Valladolid	Vitoria	Road	364	240	153	10722480	4.93	3
182	Kaunas	Warsaw	Road	653	430	303	10715935	4.8	4
172	Perpignan	Lyon	Road	685	451	253	10694203	4.39	5
54	Tallinn	Riga	Road	468	308	246	10688563	4.28	6
221	Milan	Verona	Road	243	160	119	10668927	3.9	7
177	Bordeaux	Paris	Road	890	586	342	10584015	2.28	8
155	Barcelona	Perpignan	Rail	44	193	144	10546263	1.56	9
7	Igoumenits	Thessalonik	Road	489	322	204	10533509	1.32	10
211	Turin	Novara	Road	145	96	76	10531152	1.27	11
13	Sofia	Craiova	Rail	60	262	196	10523169	1.12	12



PI Hub Choice service

- ▶ Intercontinental corridor integration - PoE and clusters
- ▶ Considers:
 - ▶ transport congestion at multimodal terminals
 - ▶ hinterland transport options to cargo destination
- ▶ Solves MILP to determine:
 - ▶ which multimodal terminal to use
 - ▶ where individual containers should be discharged
- ▶ Service integrates intercontinental corridor, PoE, and hinterland transport operations



final destination	discharge port, x	
	Barcelona	Valencia
Zaragoza	1	0
Madrid	0	1
Albacete	0	1
Zaragoza	1	0
Zaragoza	1	0
Madrid	0	1
Madrid	0	1
Valencia	0	1
Murcia	0	1
Barcelona	1	0
Call port, y	1	1
Call, LHS	100	100
Call, RHS	4	6
M	100	100
Call cost	0	0

final destination	discharge port, x	
	Barcelona	Valencia
Zaragoza	0	1
Madrid	0	1
Albacete	0	1
Zaragoza	0	1
Zaragoza	0	1
Madrid	0	1
Madrid	0	1
Valencia	0	1
Murcia	0	1
Barcelona	0	1
Call port, y	0	1
Call, LHS	0	100
Call, RHS	0	10
M	100	100
Call cost	2000	2000

final destination	discharge port, x	
	Barcelona	Valencia
Zaragoza	1	0
Madrid	1	0
Albacete	1	0
Zaragoza	1	0
Zaragoza	1	0
Madrid	1	0
Madrid	1	0
Valencia	1	0
Murcia	1	0
Barcelona	1	0
Call port, y	1	0
Call, LHS	100	0
Call, RHS	10	0
M	100	100
Call cost	100	5000

Capacity Pre-booking service

- ▶ The service considers:
 - ▶ the prediction and confidence intervals for a 10 day horizon
 - ▶ a capacity booking cost structure including cancellation cost
- ▶ Stochastic analysis (replenishment theory) using Monte Carlo simulation
- ▶ Determines optimal capacity to book automatically through a **smart contract**

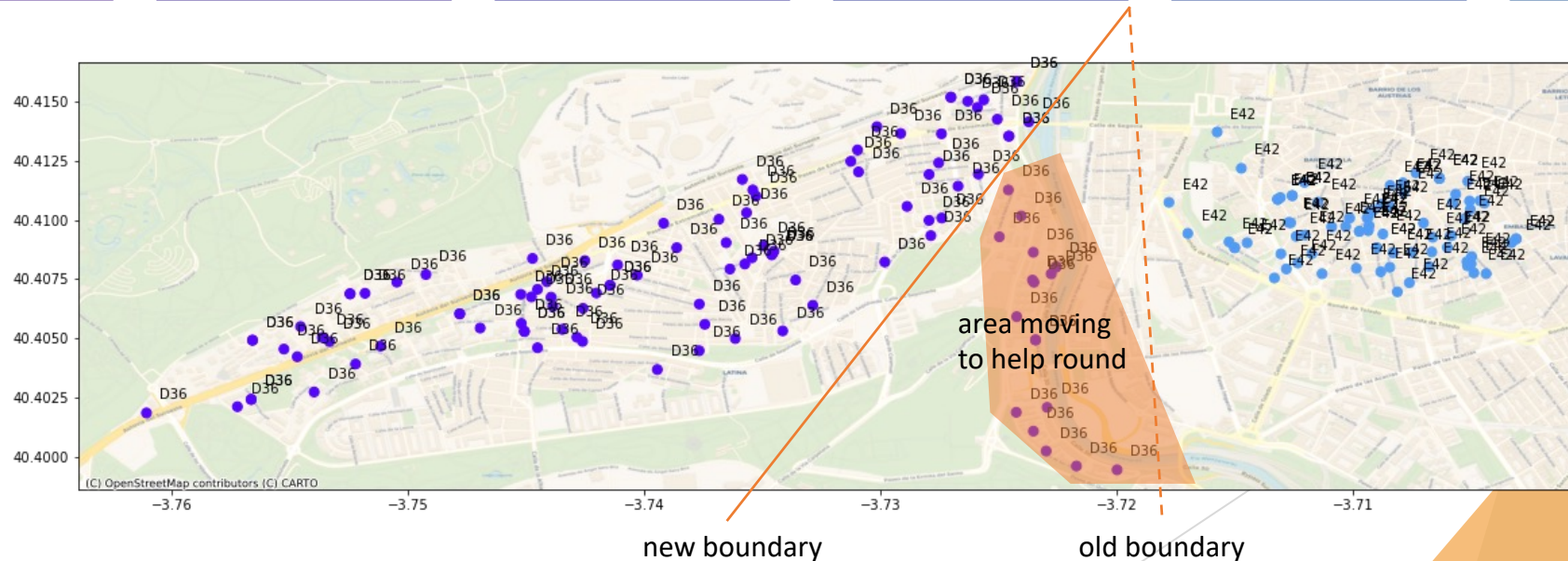
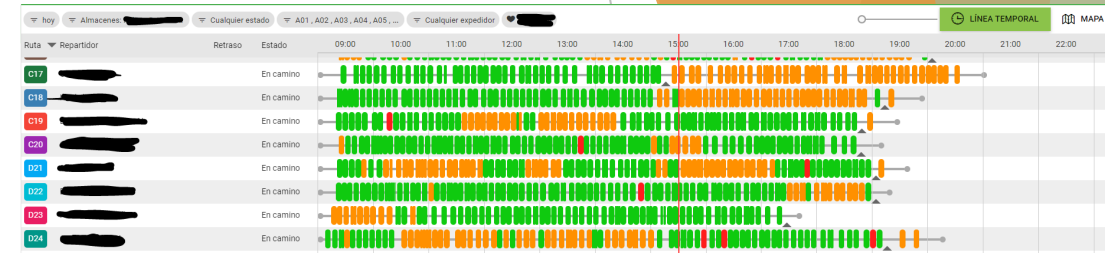


pre-book plan:
10 days ahead
adjust 3 days ahead
adjust 0 days ahead

	\$ savings (%)
Baseline	0
average	2.54
start_low	5.35
start_EOQ	6.39

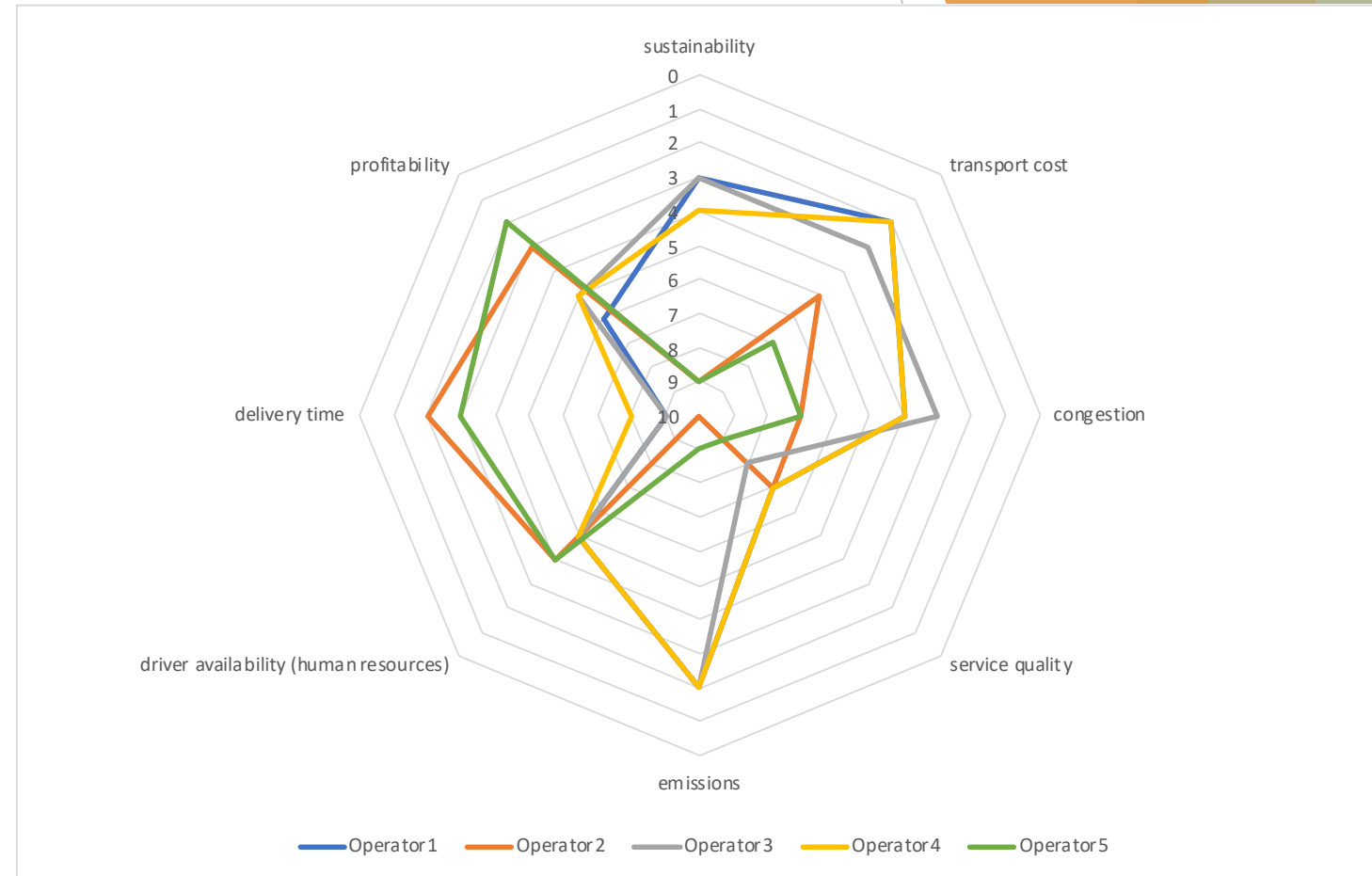
Parcel Reshuffling service

- ▶ Last mile collaboration for dynamically addressing delivery delays
- ▶ Automates and optimizes reshuffling process that is currently undertaken manually aiming to make it more efficient



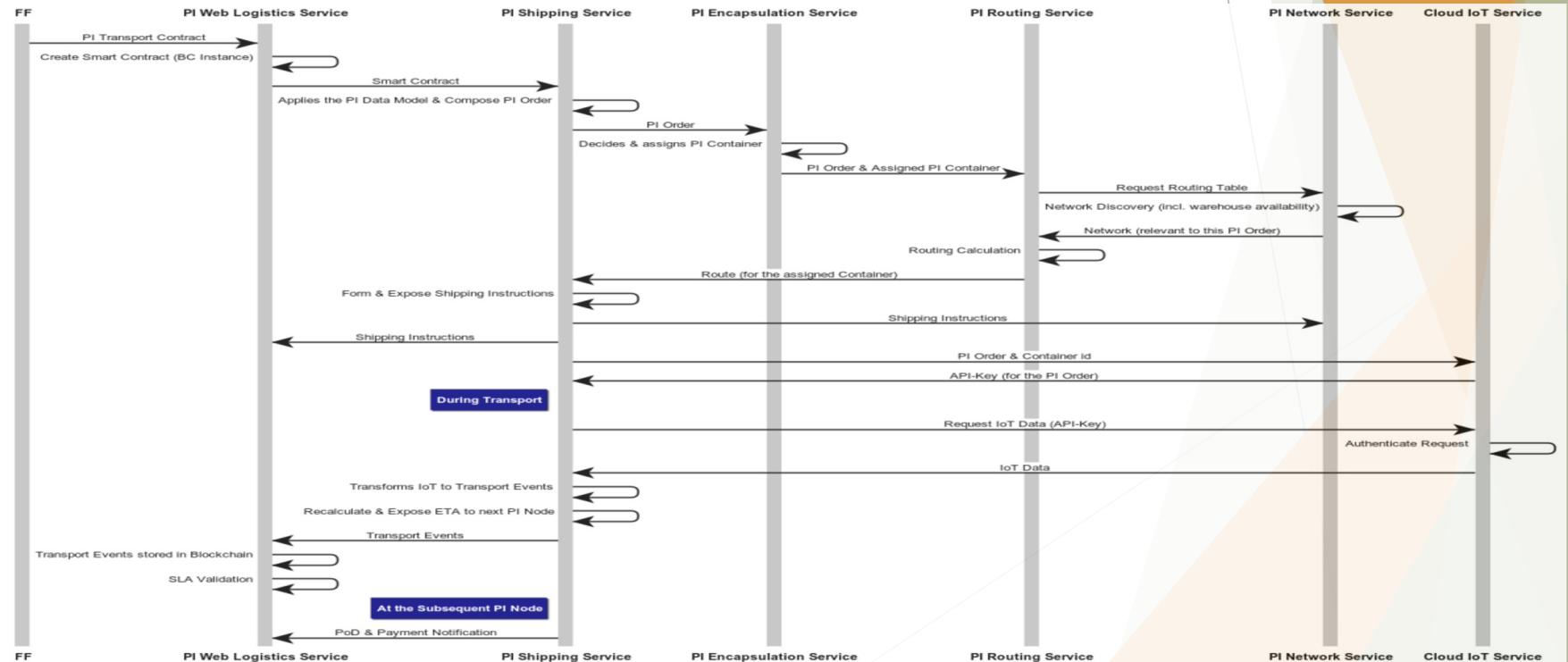
Collaboration filtering

- ▶ Multi-criteria multi-operator operator ranking:
 - ▶ Feedback/ Rating capability
 - ▶ Operator capability mapping
- ▶ Pre-defined collaboration filtering
- ▶ Integration into DSS for dynamic decision making
 - ▶ Routing
 - ▶ Assignment



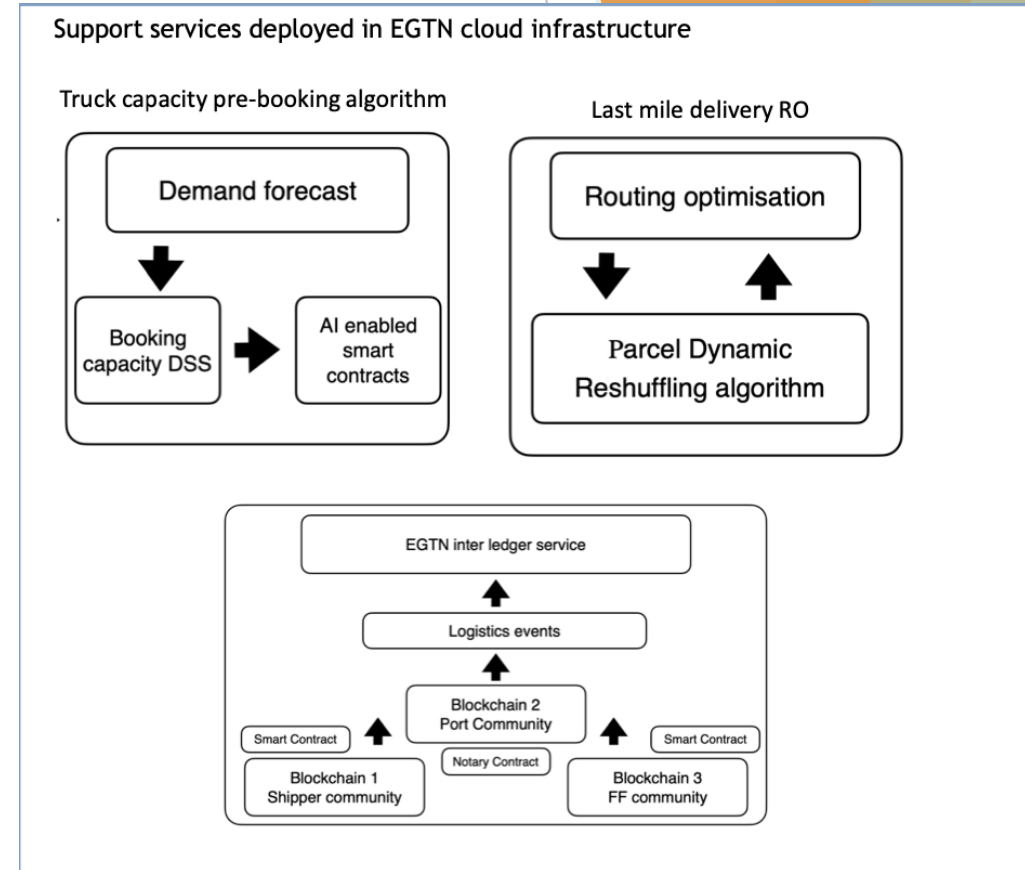
Implementation into Standardized Processes

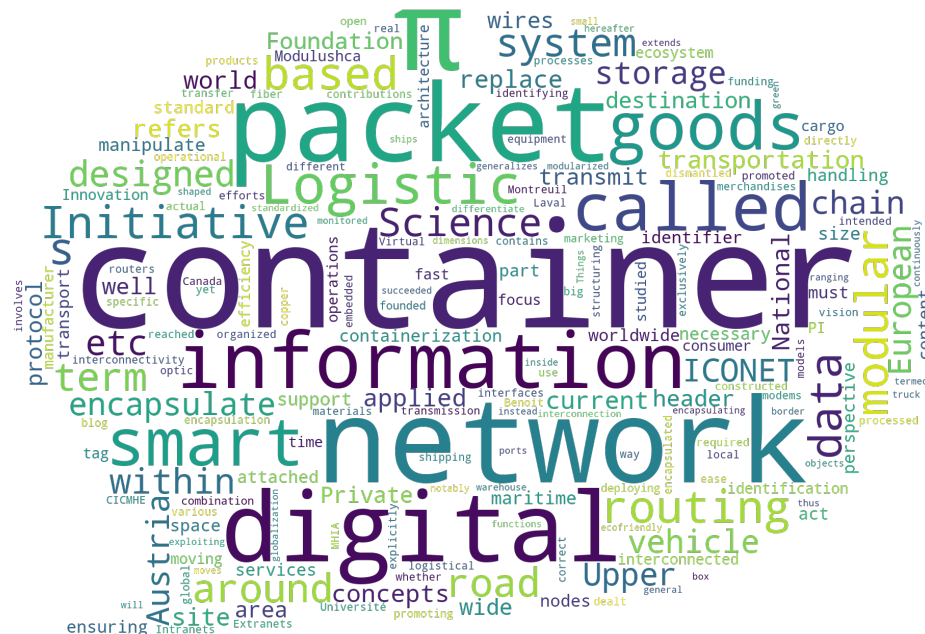
- ▶ PI Unique use case offerings
- ▶ Operational layers (Digital Internet equivalent)
- ▶ Protocol development (Routing, Consolidation at Node etc.)
 - ▶ Participation
 - ▶ Versatility
 - ▶ Efficiency



Outputs and Next Steps

- ▶ Contribution to TEN-T development
- ▶ EGTN platform
 - ▶ support services
 - ▶ Track & trace/ Connection to legacy systems
 - ▶ Knowledge Graph
 - ▶ Dashboard
 - ▶ interoperable solutions
 - ▶ Predictive capability
 - ▶ Optimisation DSS
 - ▶ Smart contracts
 - ▶ Blockchain
- ▶ LL testing starting now





Digitization key for accessing tomorrow's market
Analytics and Smart DSS key for competitiveness

Thank you!

