BDI along the supply chain

basic data infrastructure

Ewout Bouwman
NimbleNova
Architect Data In Logistics

Michiel Stornebrink
TNO
Research consultant
Semantic interoperability

Funded by the European Union
NextGenerationEU

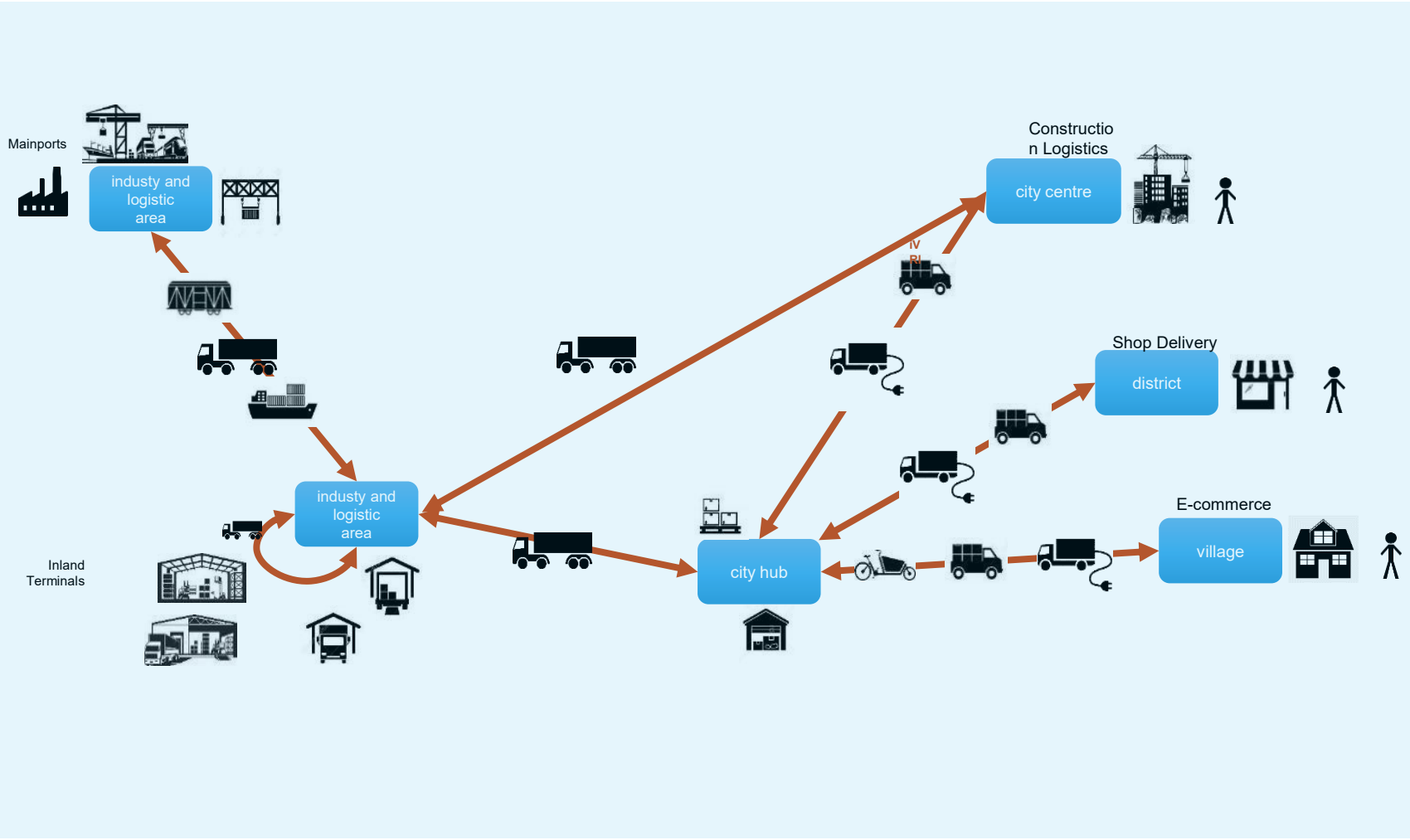
The world we work in

Supply chain management

Fast, ad-hoc & dynamic

Data only has temporary value

Logistics covers all continents across multiple sectors



Effective data sharing amongst chain parties is key

Contracts

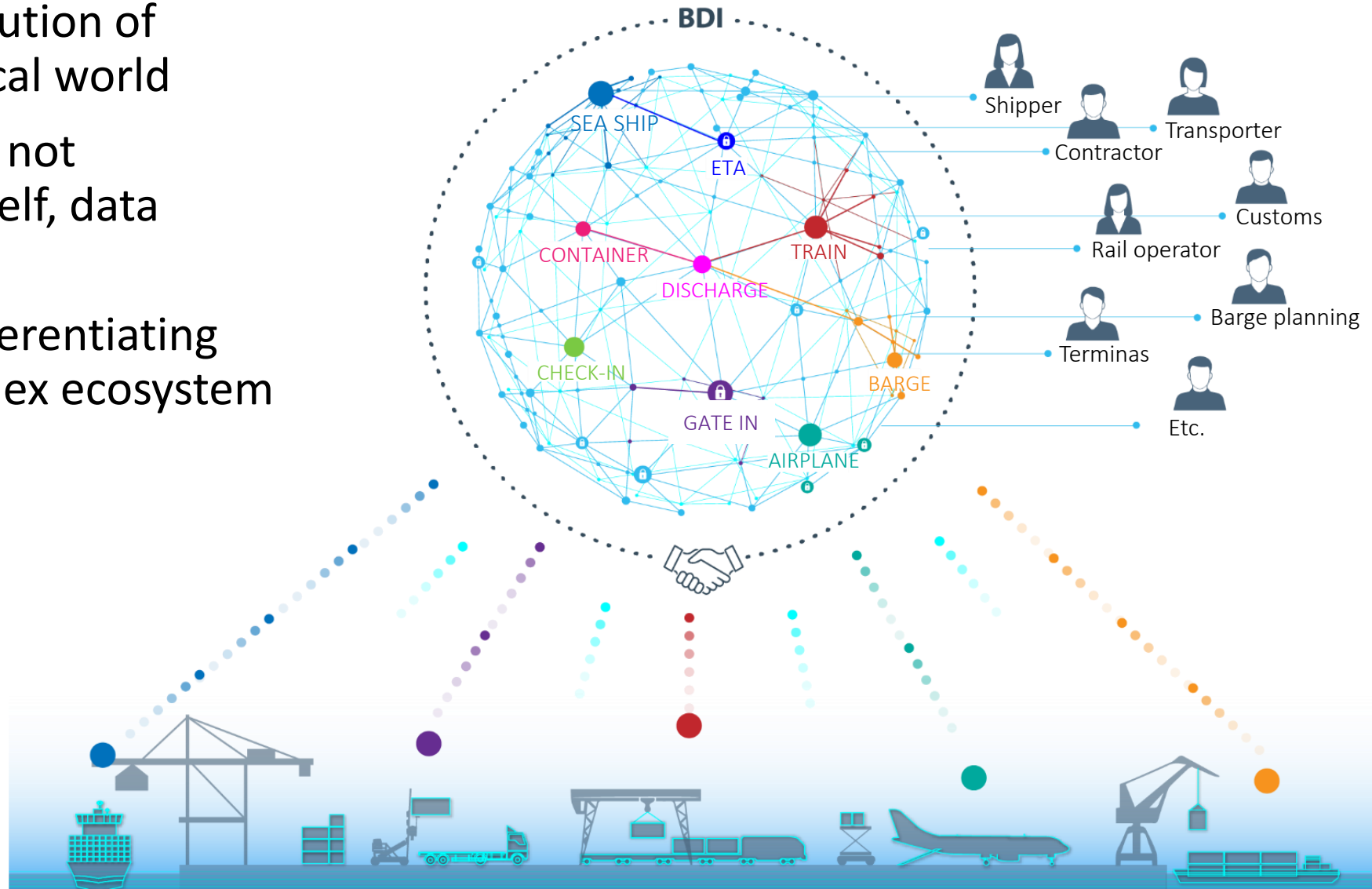
Coordination

Compliance

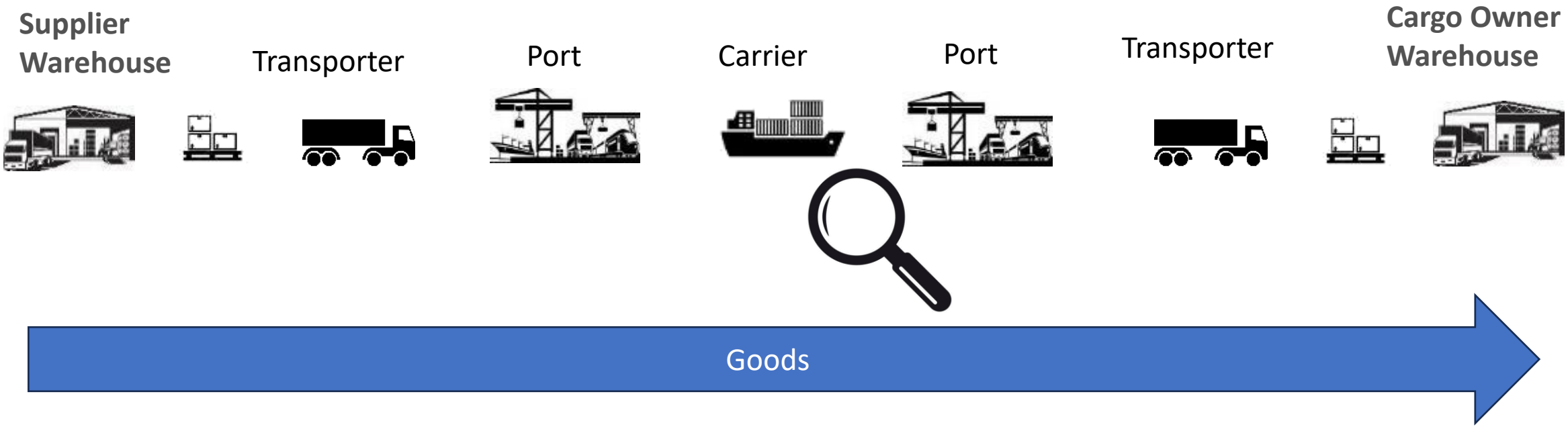
The required automated business interactions via IT systems (M2M) of business and governments

BDI: fostering operational excellence

- BDI supports the execution of contracts in the physical world
- Data in applications is not a tradeable item in itself, data enables efficieny
- BDI improves non-differentiating capabilities in a complex ecosystem



Tracking and Tracing along the Supply Chain



- A pallet of goods is transported from the supplier to the buyer, the Cargo Owner.
- The transport journey generates several events along the way, leading to data exchanges.
- Each step typically uses it own systems, platforms and formats.

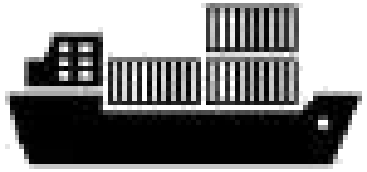
- It is now very hard for the ***Cargo Owner,*** at the very end, to follow all the steps in the supply chain.

They all want to share ***ETA event data*** for shipping, but they don't share any trust yet, and don't share a system, or a platform.

Can the BDI help solve this?

But I don't want to adopt all those different standards in my supply chain!

Estimated time of arrival of vessel at port



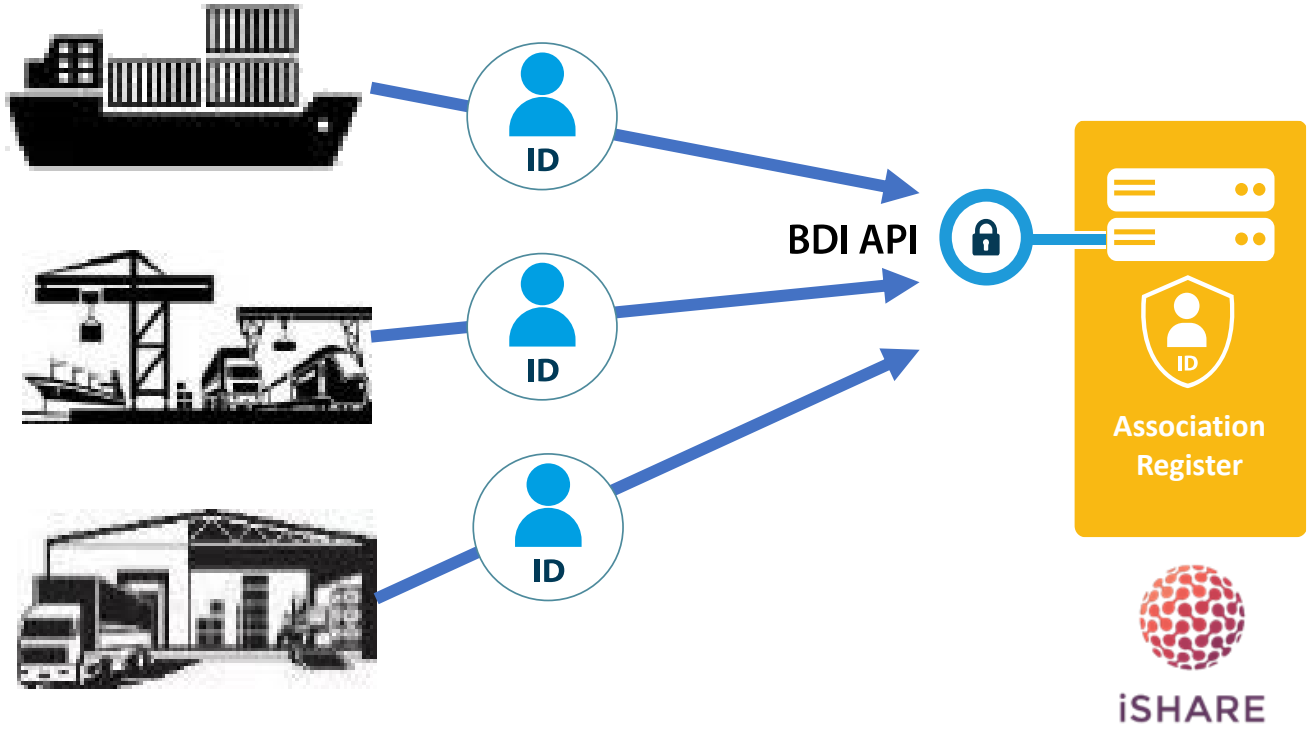
Container International Inc.
Role: *Carrier*
Identity provider: IdentTrust
Data standard: DCSA

Port of New City
Role: *Port / Terminal*
Identity provider: IAMConnected
Data standard: DCSA

Hyperion Products BV.
Role: *Cargo Owner*
Identity provider: E-Herkenning
Data standard: GS1

I need to keep using my existing standards

The BDI allows the parties to quickly form a data space based on their verified identities using the Association Register. Multiple identity providers are supported.



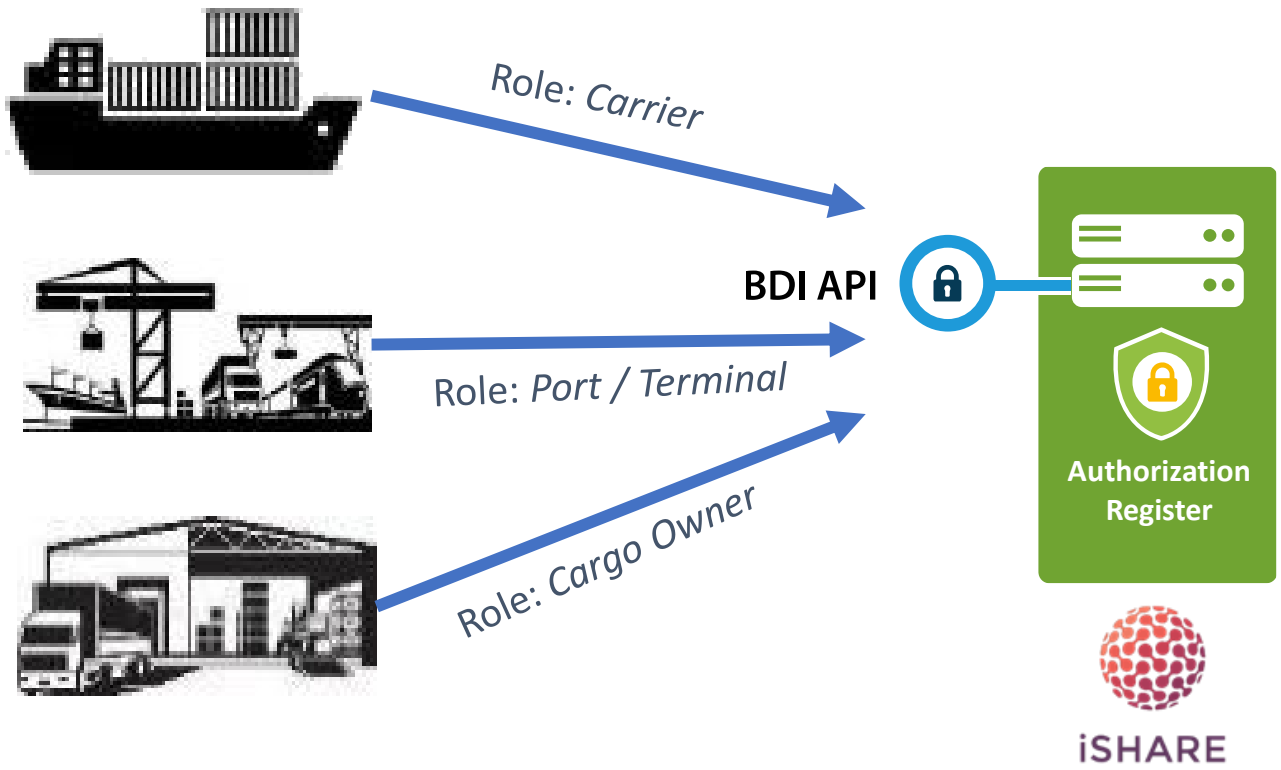
Governance defined by articles of association and legal framework of geography or nation.

Members are collectively in charge and responsible / liable.

Minimal functions

- onboarding members
- operate online association register service for authentication and trust

The parties add their roles and data access rights into the Authorization Register. ***Role-based authorizations*** are already pre-defined and ready to go but can always be overruled. Trust and data sovereignty are guaranteed.

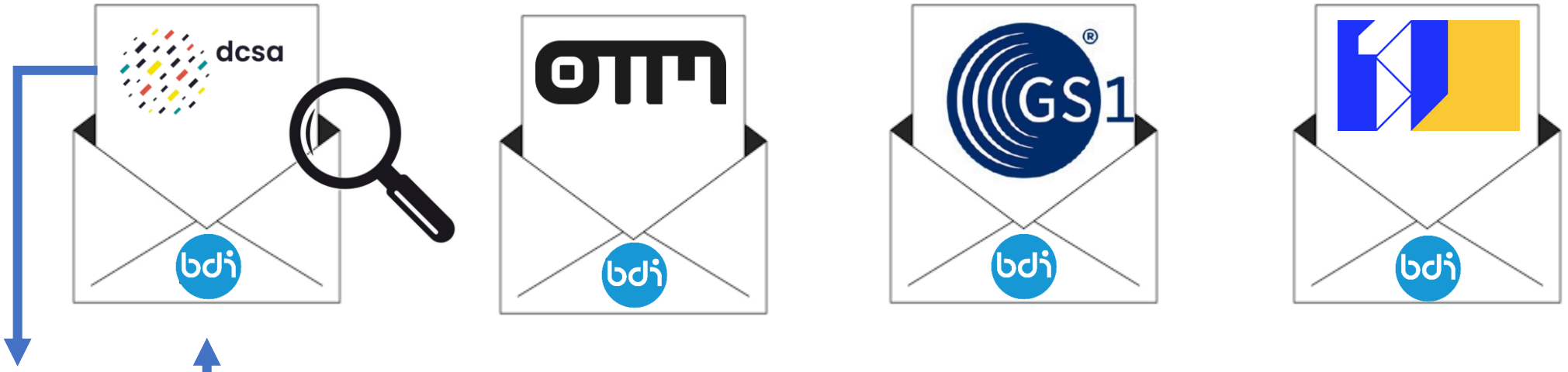


Pre-defined role-based authorizations:

- *Port / Terminal* is authorized to subscribe to, and request *ETA event data* from *Carrier*
- *Cargo Owner* is authorized to subscribe to, and request *ETA event data* from *Carrier*

But what format?

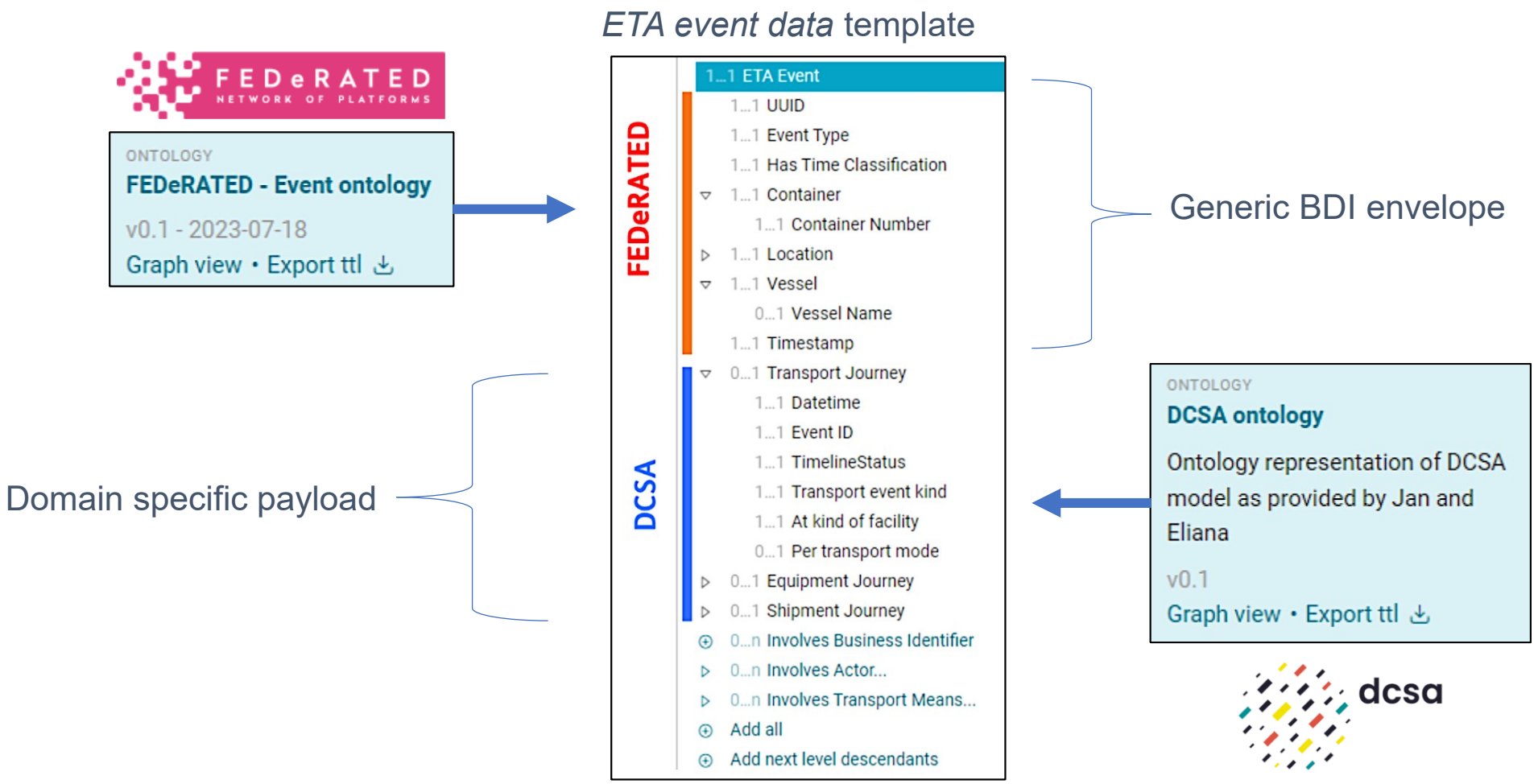
What if we could encapsulate the domain specific data in a generic envelope shared by the whole data space?



Minimal data needed for tracking and tracing is written on the envelope in the common BDI format.

- Multiple ontologies used in combination, allowing parties to incorporate or migrate to a common BDI format in their own tempo.
- Supporting a BDI shared format, but still allow for domain specific formats at the same time

The BDI comes with a library of ***pre-defined event formats*** that allow for reusing existing semantic data standards. And also allows for a generic BDI envelope.



The Port uses the ***domain specific part*** of the ETA event data, with rich information that can be directly loaded into their existing DCSA compliant systems landscape.

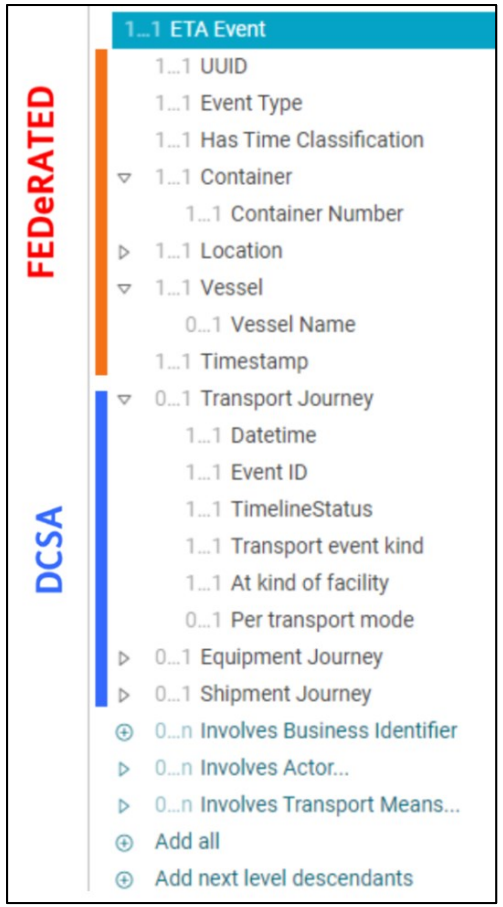
FEDeRATED

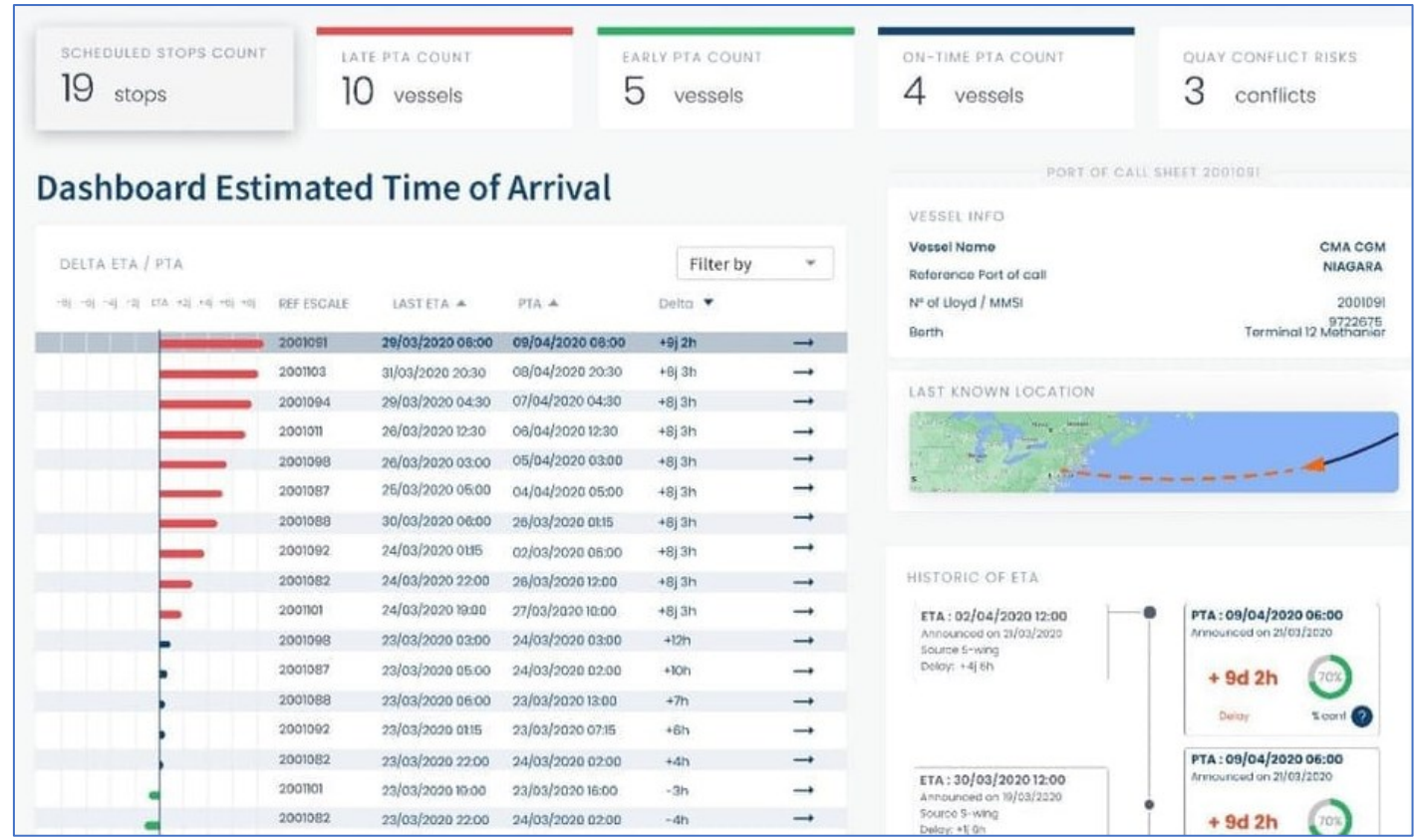
DCSA

- 1...1 ETA Event
  - 1...1 UUID
  - 1...1 Event Type
  - 1...1 Has Time Classification
  - 1...1 Container
    - 1...1 Container Number
  - 1...1 Location
  - 1...1 Vessel
    - 0...1 Vessel Name
  - 1...1 Timestamp
  - 0...1 Transport Journey
    - 1...1 Datetime
    - 1...1 Event ID
    - 1...1 TimelineStatus
    - 1...1 Transport event kind
    - 1...1 At kind of facility
    - 0...1 Per transport mode
  - 0...1 Equipment Journey
  - 0...1 Shipment Journey
  - 0...n Involves Business Identifier
  - 0...n Involves Actor...
  - 0...n Involves Transport Means...
  - Add all
  - Add next level descendants

Internal backoffice systems landscape

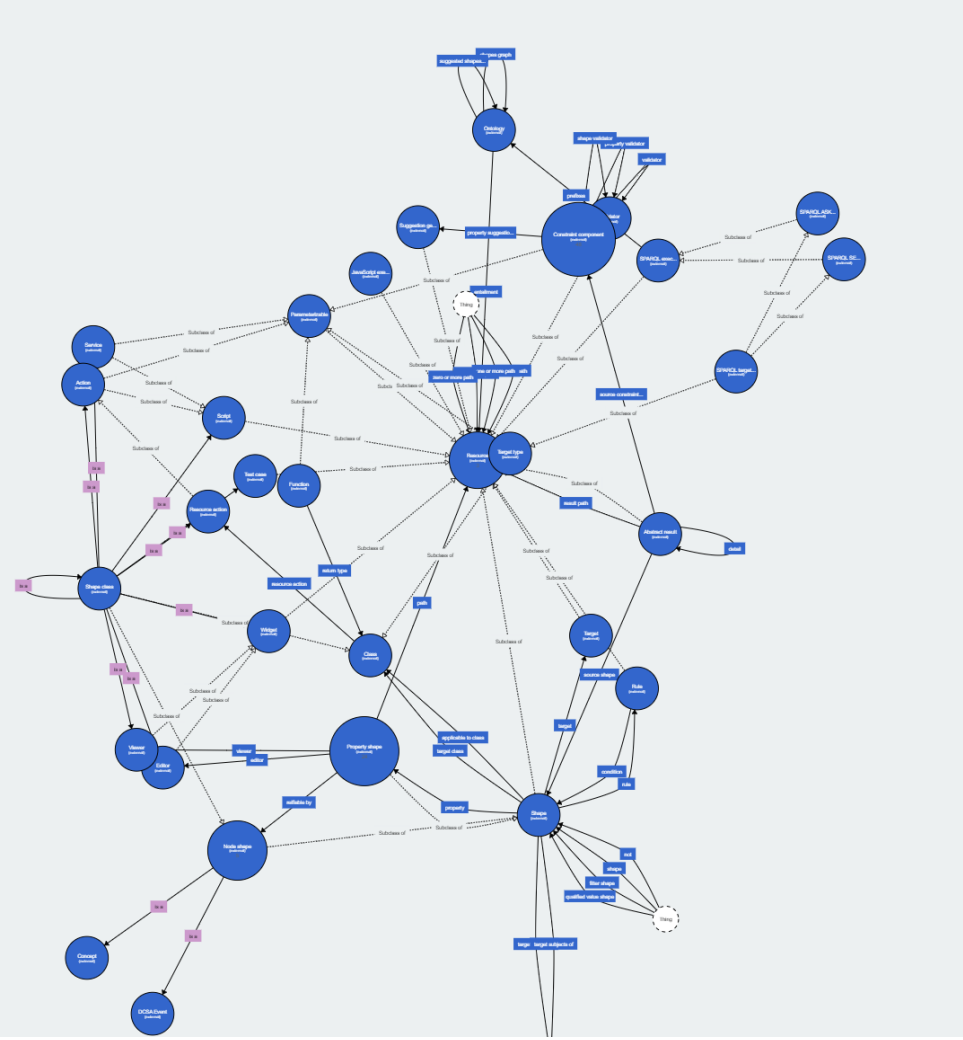
The Cargo Owner retrieves the data and uses the ***Generic BDI envelope*** to get tracking and tracing visibility without having to use the domain specific standard. *He can now do this for all the steps in his supply chain!*



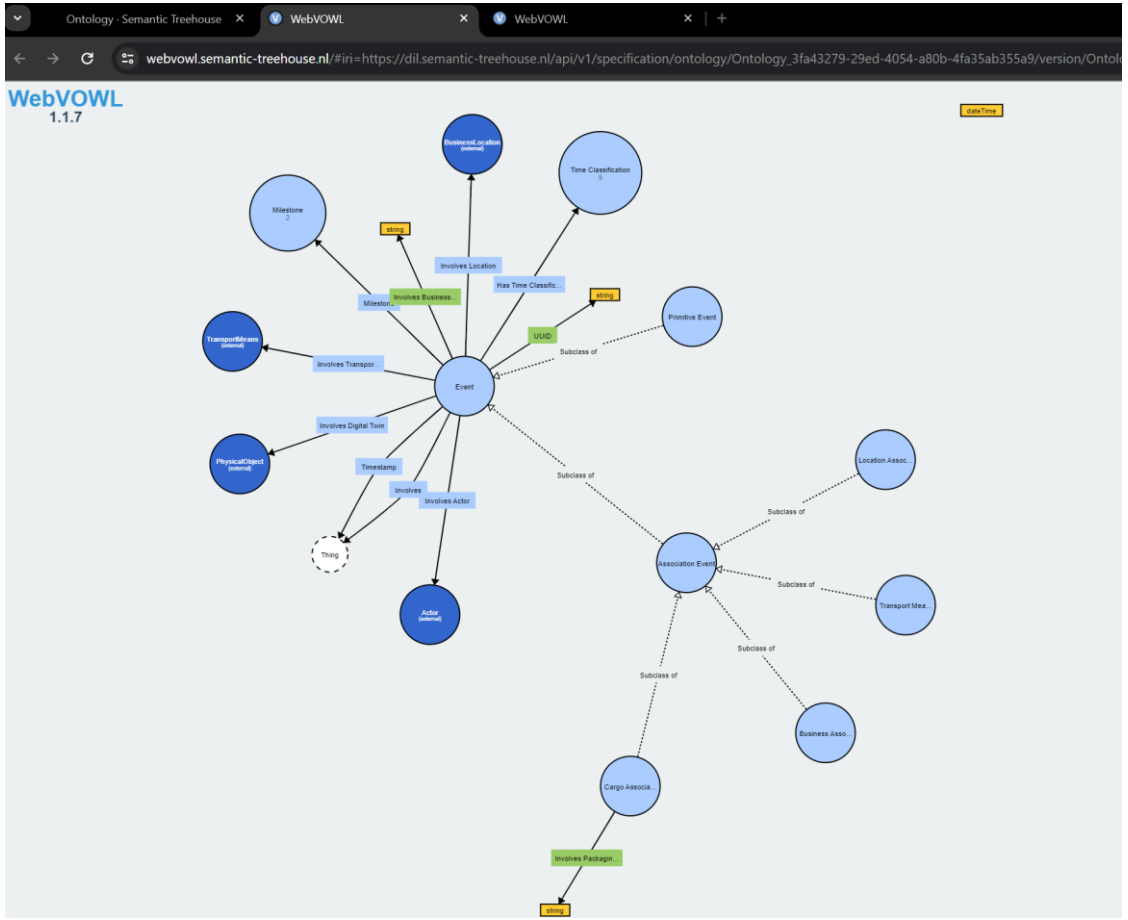


Example ETA user interface

Semantic interoperability?
Our approach: combine ontologies and serialize output



Ontology representation of DCSA model



FEDeRATED Event ontology

Semantic Treehouse as vocabulary hub implementation

Vocabulary Hub

https://dil.semantic-treehouse.nl

Semantic Treehouse

- Specifications
- Codelists
- Validator
- Issues
- Groups
- People
- Organizations
- Uploads

Specifications

DIL

public

ONTOLOGY
DCSA ontology
Ontology representation of DCSA model as provided by Jan and Eliana
v0.1
Graph view • Export ttl

ONTOLOGY
DIL alignment
v0.1
Graph view • Export ttl

ONTOLOGY
DCSA lists
Ontology representation of DCSA lists as provided by Jan and Eliana
v0.1
Graph view • Export ttl

Event flow

public

MESSAGE
1. Loading Event
Pallet is loaded into container into truck A
v0.1

MESSAGE
2. ETA
Estimated time of arrival of truck A at port A
v0.1

MESSAGE
3. Gate in
Truck has arrived at port A, gate in
v0.1

MESSAGE
4. ETA
Estimated time of arrival of vessel at port B
v0.1
Tree view

MESSAGE
5. EDT
Estimated dis… container
v0.1

MESSAGE
6. Customs cleared
Customs cleared, ready for pickup
v0.1

MESSAGE
7. Gate out
Gate out, actual time of departure of truck B
v0.1
Tree view

MESSAGE
8. ETA
Estimated time of arrival of truck B at warehouse B
v0.1

MESSAGE
9. Unloading
Pallet unloaded from container at warehouse B
v0.1

FEDeRATED ontology

public

ETA event data template

FEDeRATED

DCSA

- 1…1 ETA Event
  - 1…1 UUID
  - 1…1 Event Type
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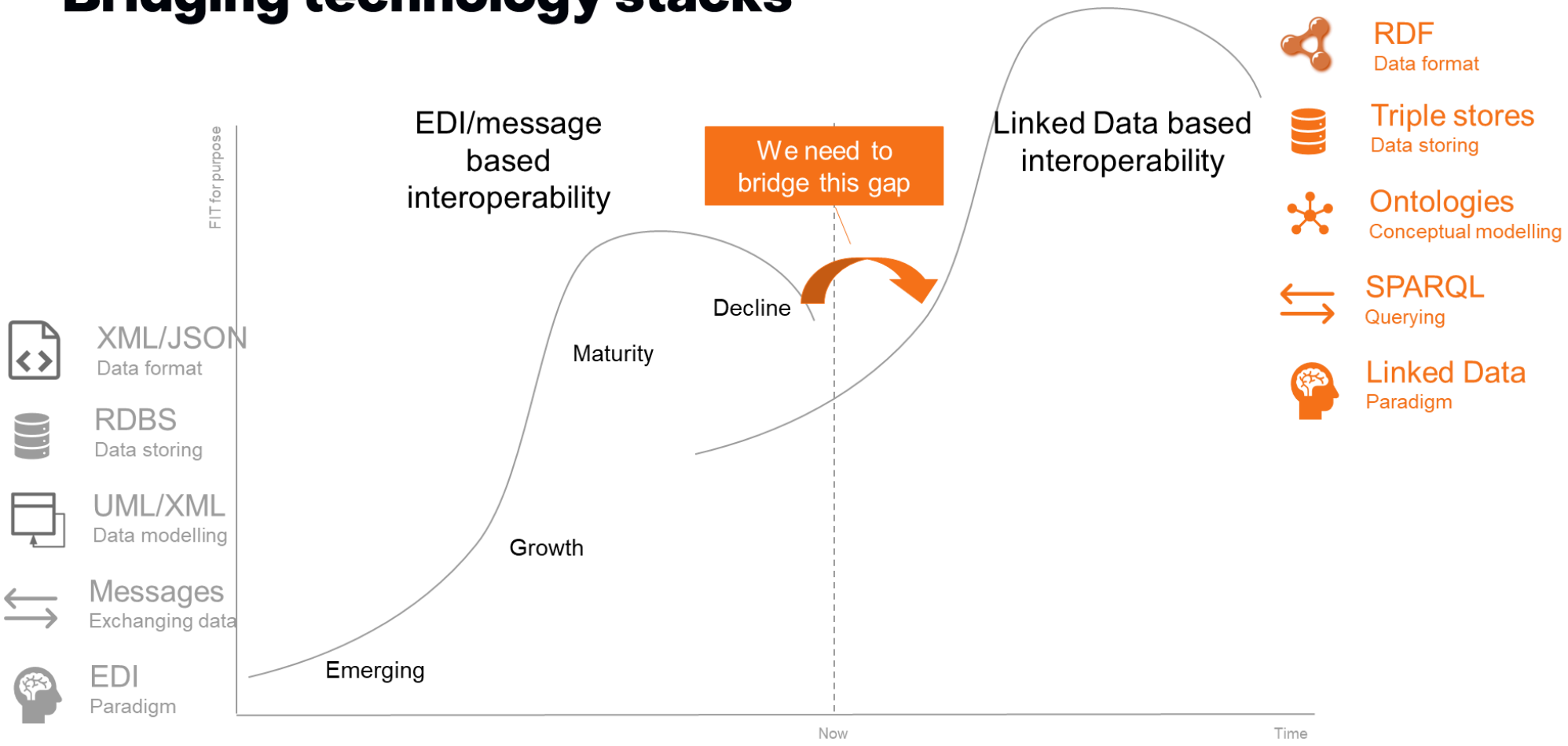
Using semantic technologies today?

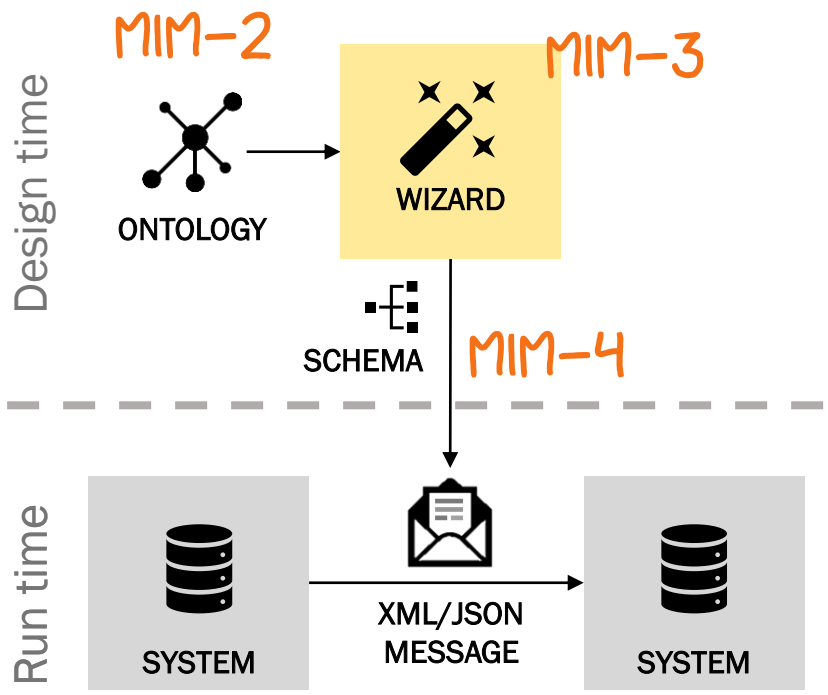
Semantic web technology for data sharing

Bridging technology stacks



Wizard approach

1. Prepare the message model specification by defining the **ontologies to import** (owl, rdfs, shacl, json schema), set the namespaces, define a root element and select the class that serves as the entry point to the ontology.
2. Model the **information requirements for the use case** by selecting from the ontologies. This shapes an abstract message tree (AMT). The wizard component allows users to 'cherry pick' the relevant classes and properties from the ontology and keeps the link
3. Let the wizard **generates a technology-specific syntax** binding for the AMT. The resulting schema can be used for the data plane.

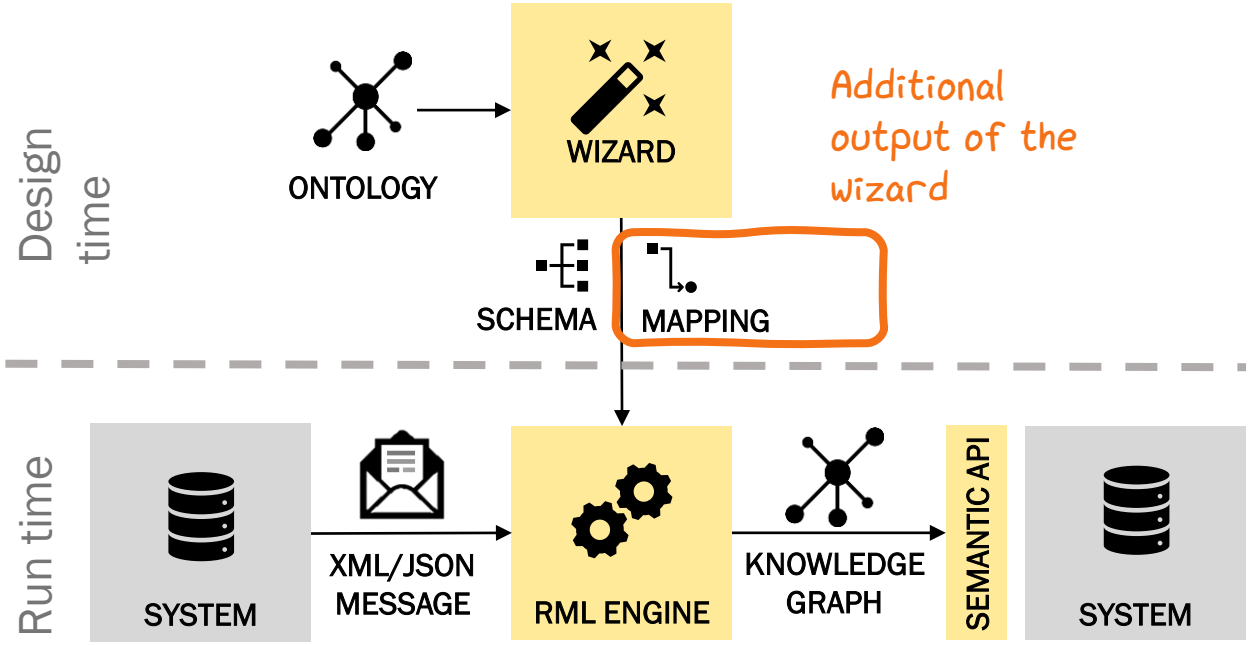


For Metamodel Informatie Modellering niveau reference see: https://docs.geostandaarden.nl/mim/mim/

Towards Linked Data

Technology of today, ready for the future

- *The link between schema elements and ontology classes/properties is used to generate a mapping specification*
- *Mapping is formalized in RDF Mapping Language (RML)*
- *An RML engine is used to transform message data to triples according to the ontology*
- *This approach allows for a large set of heterogeneous data sources being mapped to the same ontology*



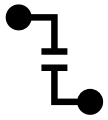
Building blocks for data spaces

DATA SPACES SUPPORT CENTRE

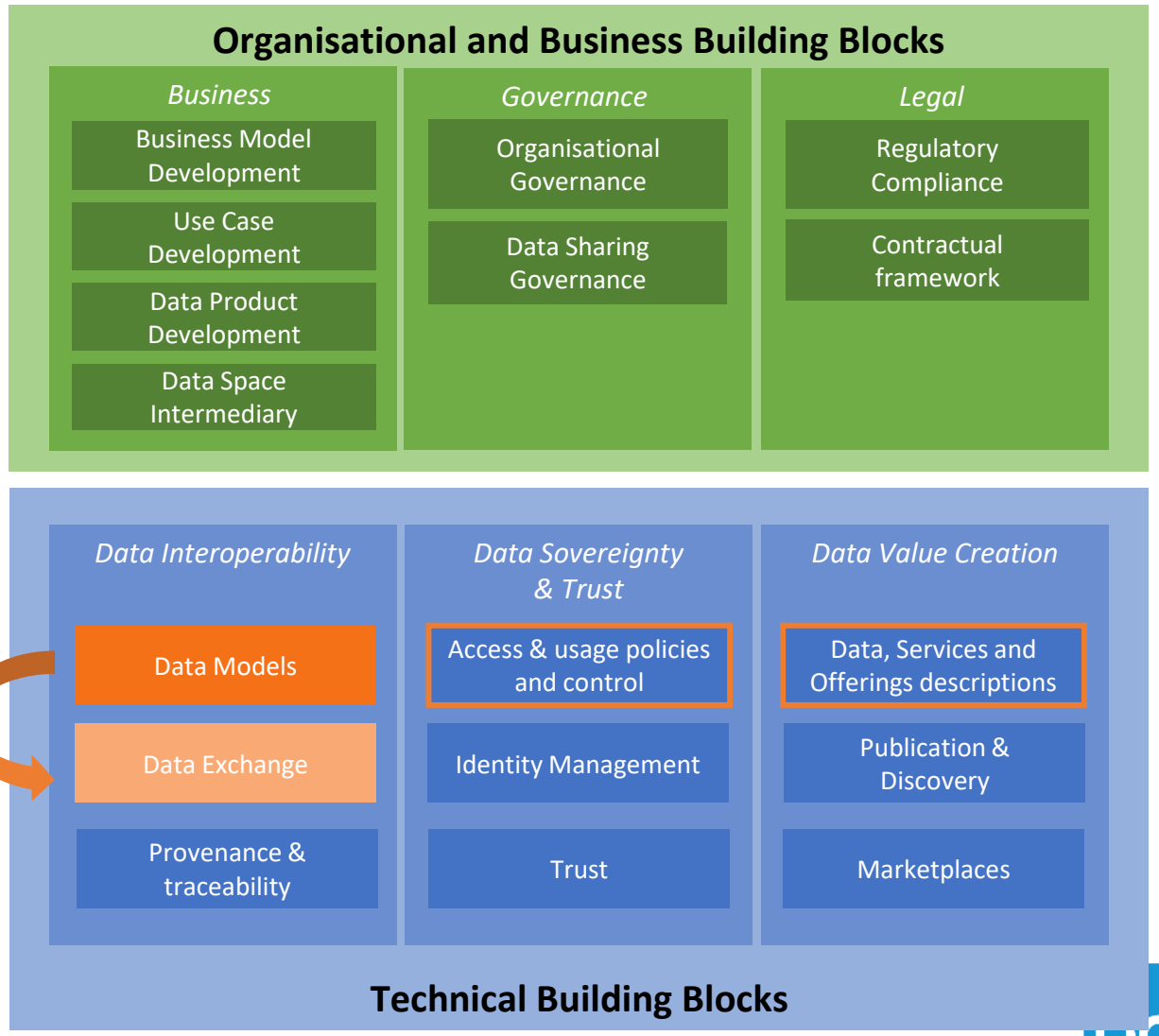
- Facilitating semantic interoperability is the primary topic of the Data Models building block
- and is important for other building blocks as well
- This requires methods, best practices and tools (components)
- For BDI we explored method and tooling to combine existing semantic models in logistics to configure the “data plane” in the data space.

Vocabulary Hub

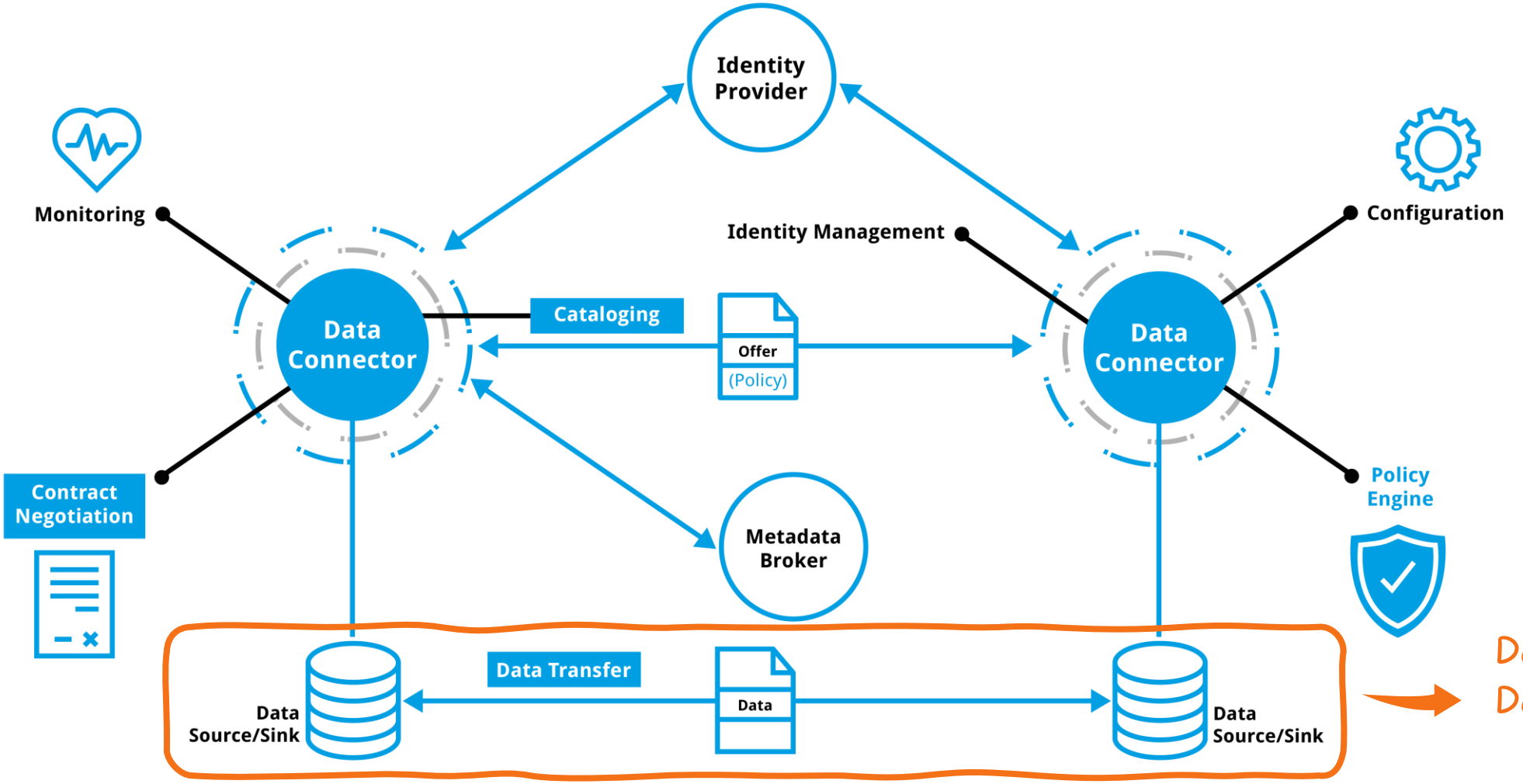
Data Plane Specification Wizard



Transformation Engine

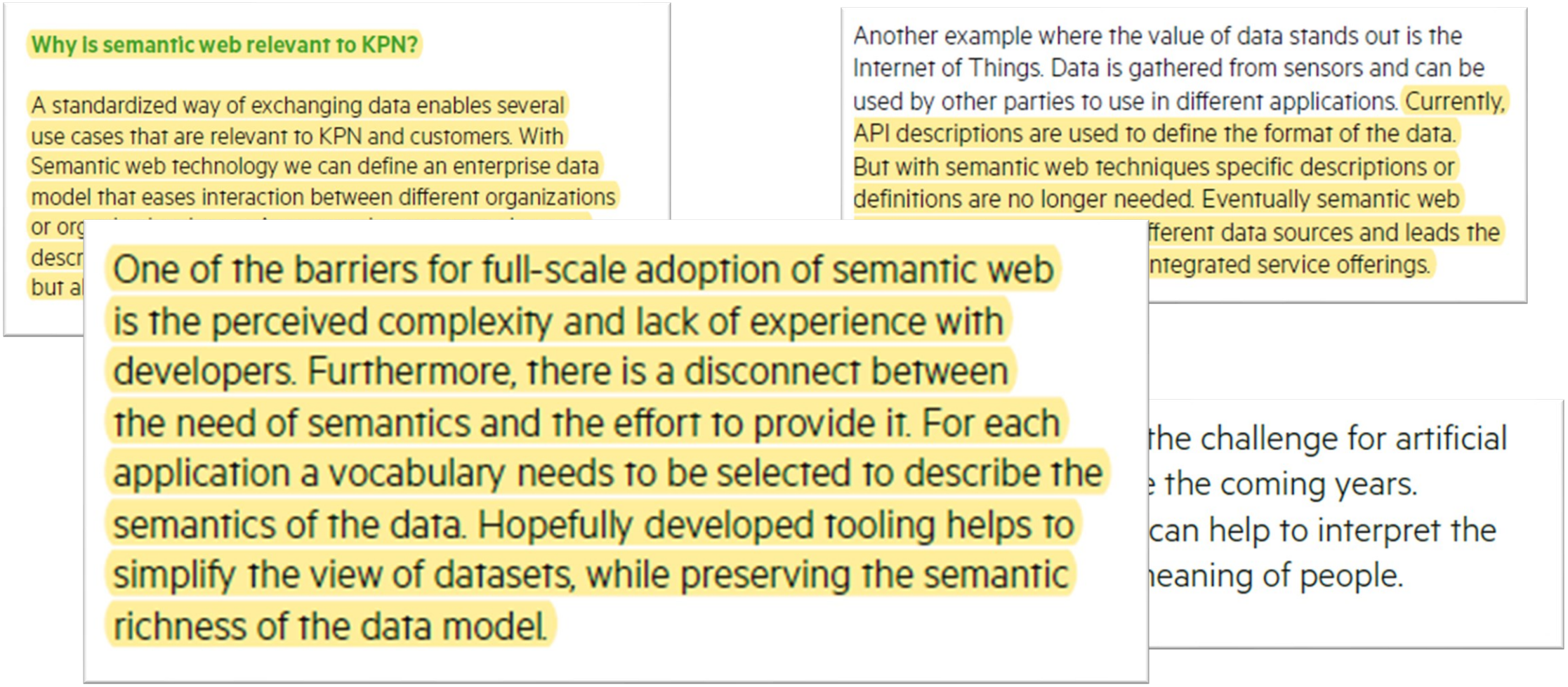


The data plane as part of data space protocol



Data models
Data exchange

KPN's technology radar recognizes the challenges



Why is semantic web relevant to KPN?

A standardized way of exchanging data enables several use cases that are relevant to KPN and customers. With Semantic web technology we can define an enterprise data model that eases interaction between different organizations

Another example where the value of data stands out is the Internet of Things. Data is gathered from sensors and can be used by other parties to use in different applications. Currently, API descriptions are used to define the format of the data. But with semantic web techniques specific descriptions or definitions are no longer needed. Eventually semantic web

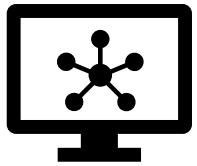
ifferent data sources and leads the
ntegrated service offerings.

One of the barriers for full-scale adoption of semantic web is the perceived complexity and lack of experience with developers. Furthermore, there is a disconnect between the need of semantics and the effort to provide it. For each application a vocabulary needs to be selected to describe the semantics of the data. Hopefully developed tooling helps to simplify the view of datasets, while preserving the semantic richness of the data model.

the challenge for artificial
e the coming years.
can help to interpret the
eaning of people.

Source: KPN Technology Book, feb 2020

Related data space components



Vocabulary Hub

Registry service providing facilities for publishing, editing, browsing and maintaining vocabularies and related documentation. Vocabularies incl. ontologies, reference data models, schema specifications, mappings and API specifications that can be used to annotate and describe data sets and data services. The vocabulary hub can mirror a set of third-party vocabularies ensuring availability and resolution.

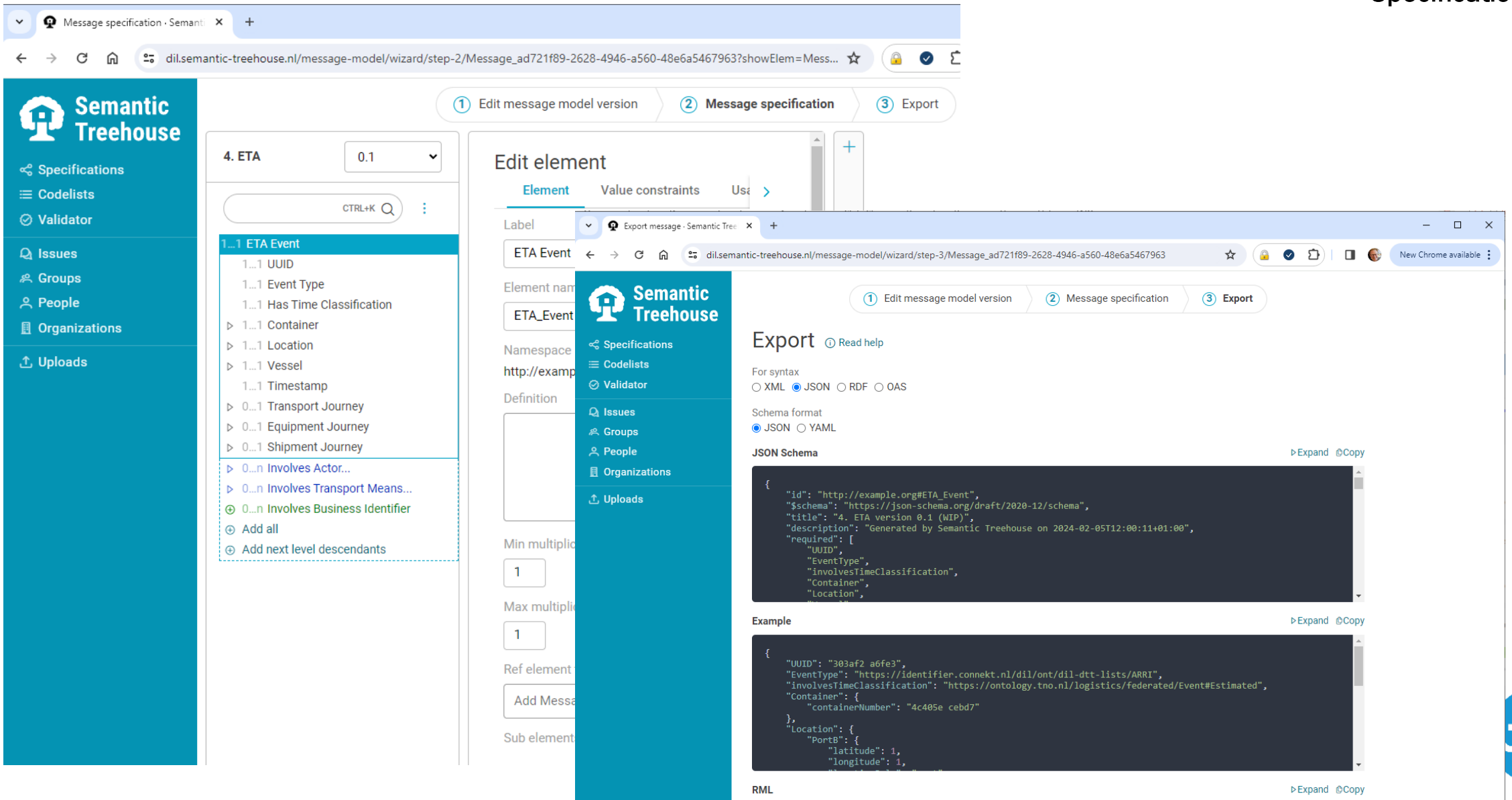
Data Plane Specification Wizard

Wizard to configure the data plane specifications (the data exchange protocols) for data sharing. This is primarily done by creating ontology based API-specifications to specify the semantic interface between data provider and -consumer. Additionally the dataspace connector configurator can assist in creating mapping specifications if needed. These can be used in the Semantic Transformation Engine.

Wizard approach applicable for BDI

Vocabulary Hub

Data Plane Specification Wizard

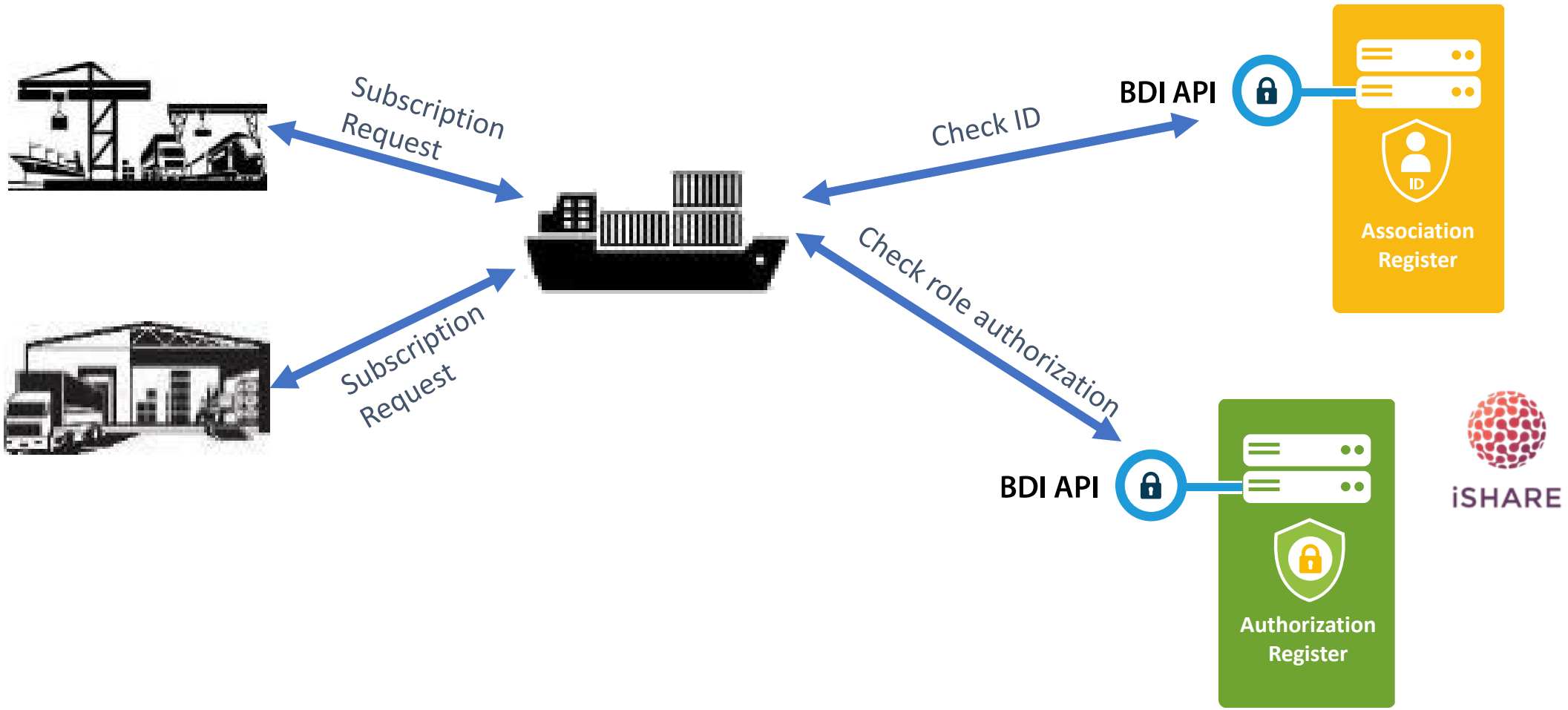


To summarize

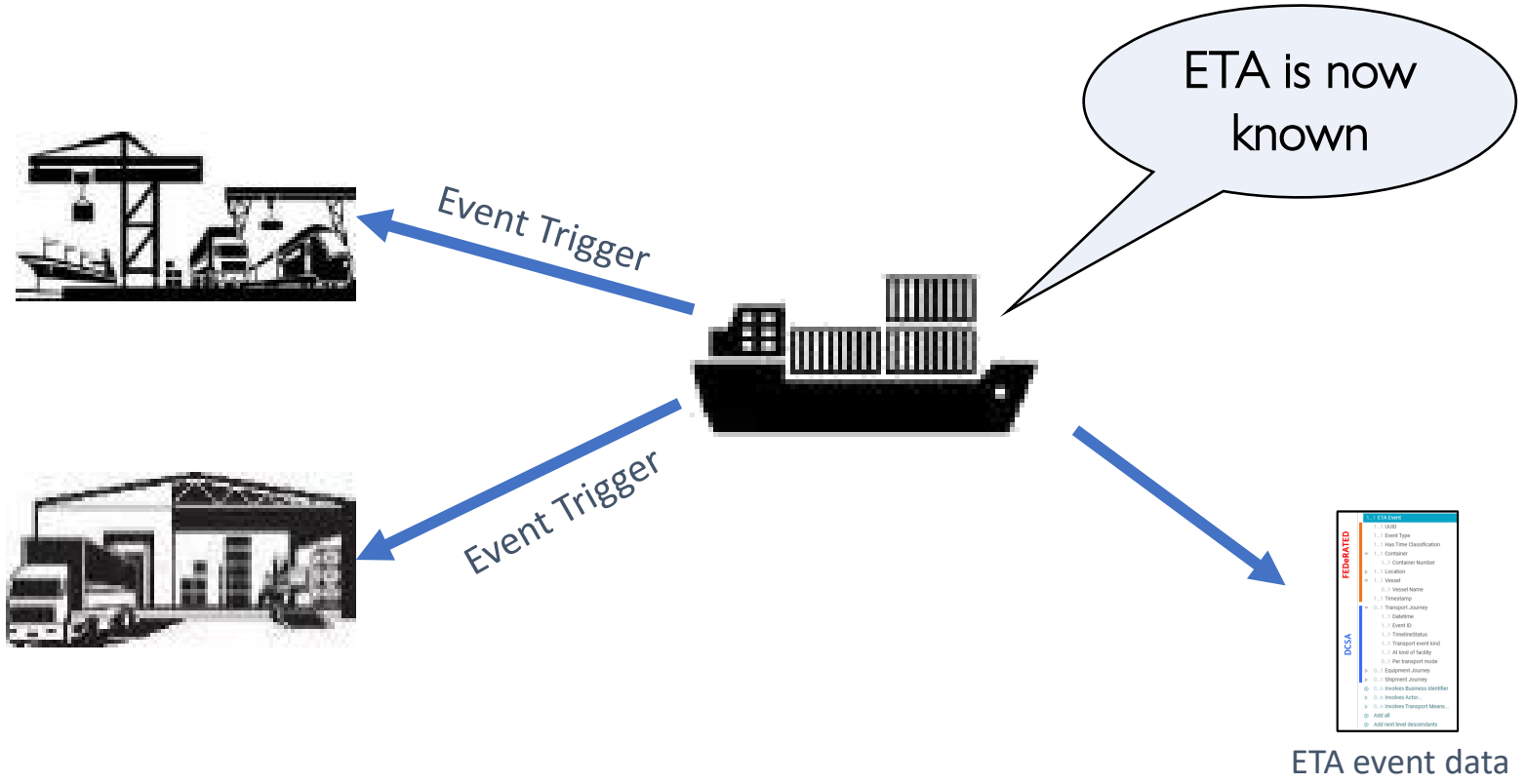
- Methods and tooling are needed to allow for:
  - easy adopting of semantic technologies
  - reuse existing domain models (like DCSA, OTM, etc.)
- Separation of concerns between providing reusable domain models (MIM 2) and designing use case specific data models (MIM 3) allows for agility
- Specifications for the data plane (MIM 4) can be generated based on the above.

- With the wizard approach, and the implementation in Semantic Treehouse, we demonstrated that DCSA T&T model can be combined/aligned with FEDeRATED event ontology such that an ETA event can be modelled and specifications for data plane can be generated.

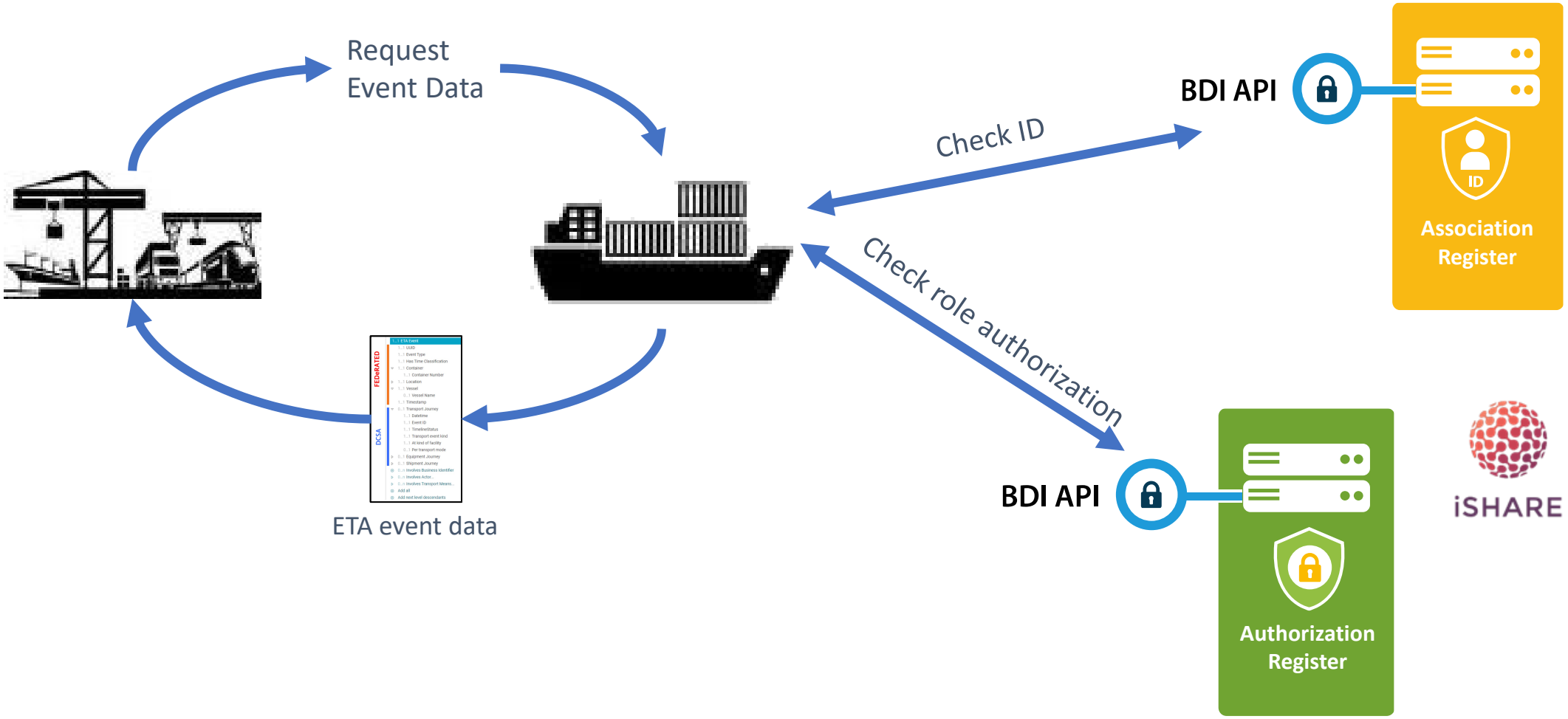
The parties ***subscribe*** to the events streams they are interested in. In this case the ETA event data. Their identities and role-based authorizations are checked first before the subscriptions go active.



The ETA is now known, the ETA event data is stored, and a ***trigger is published*** to the parties who have subscribed. The trigger contains an *EventID, EventType,* and a link to the *EventData*. The data is kept at the source, waiting to be requested by the subscribers.



When the Port and Cargo Owner ask to access the event data, their identity and role-based authorizations are checked again (zero-trust). The ***ETA event data***, both the generic envelope and domain specific payload, are then send to both.

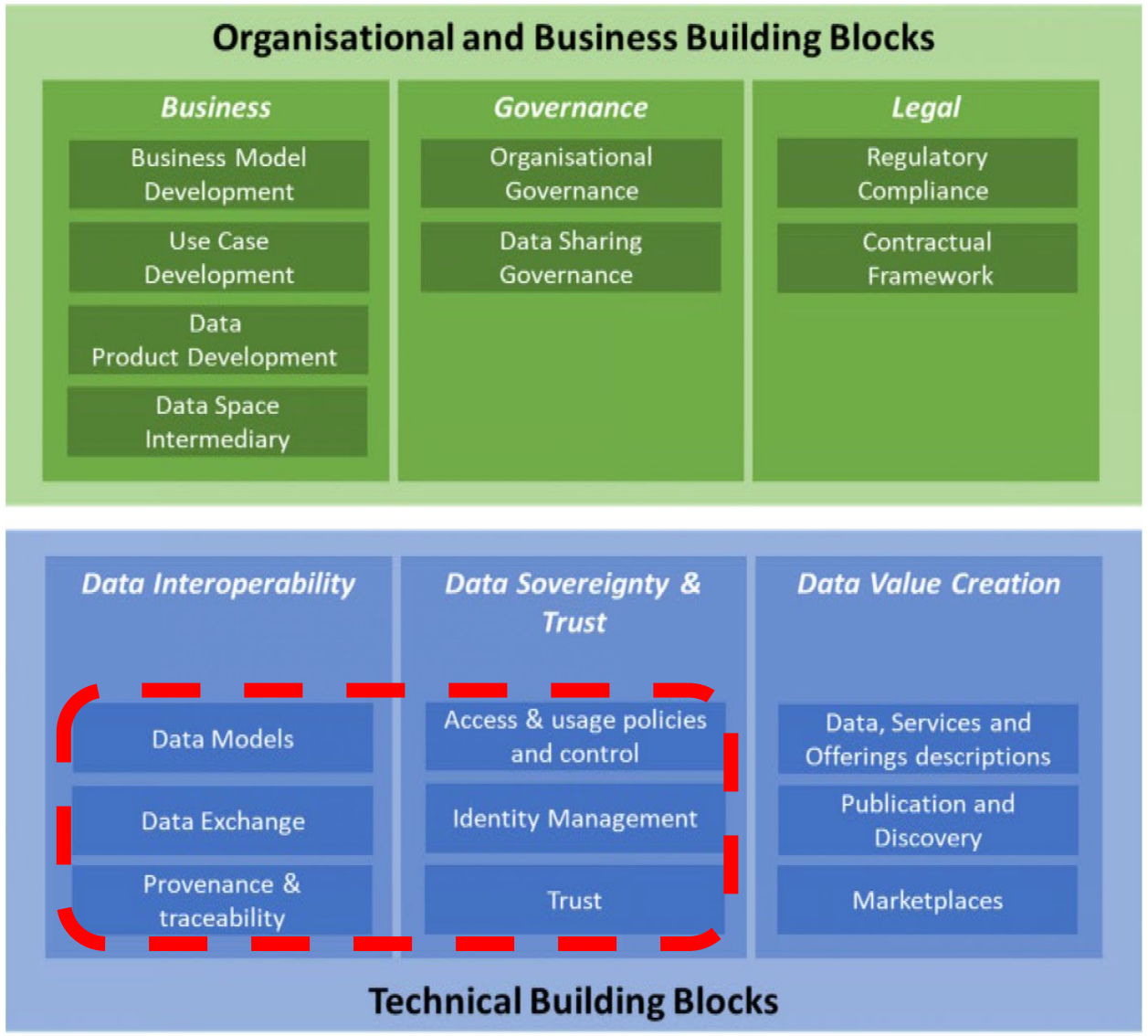


Suggested Focus Events for further Use Cases in co-operation between: Portbase / DCSA / BDI

Export / Import	Event description	Key event data for BCO's DCSA standard
Export	Gate in of Laden Equipment at Port terminal	Gate in actual
Export	Load of Laden Equipment onto Vessel at Port terminal	Loaded on vessel
Export	Departure by Vessel at Port terminal	Actual Time of Departure
Import	Arrival by Vessel at Port terminal	Actual Time of Arrival
Import	Discharge of Laden Equipment from Vessel at Port terminal	Carrier discharge / Unloaded
Import	Gate out of Laden Equipment at Port terminal	Actual Time of Departure modality/Pick up Rail Truck Barge

What we addressed in this demo …

- Association and Enrollment
- Roles and Role-based Authorizations
- Zero-trust
- Events and Triggers
- Publish and Subscribe
- Semantics and Standards



Questions

basic data infrastructure

https://bdinetwork.org/

Contact

Connekt
Ezelsveldlaan 59
2611 RV Delft

Postbus 48
2600 AA Delft

+31 15 251 65 65