PI Data Sharing Infrastructure

Trusted, localized, configurable data sharing infrastructure

Wout Hofman, senior scientist TNO

What do we offer?

A trusted infrastructure with a multi-modal visibility service that can be configured by every organisation to suit its business.
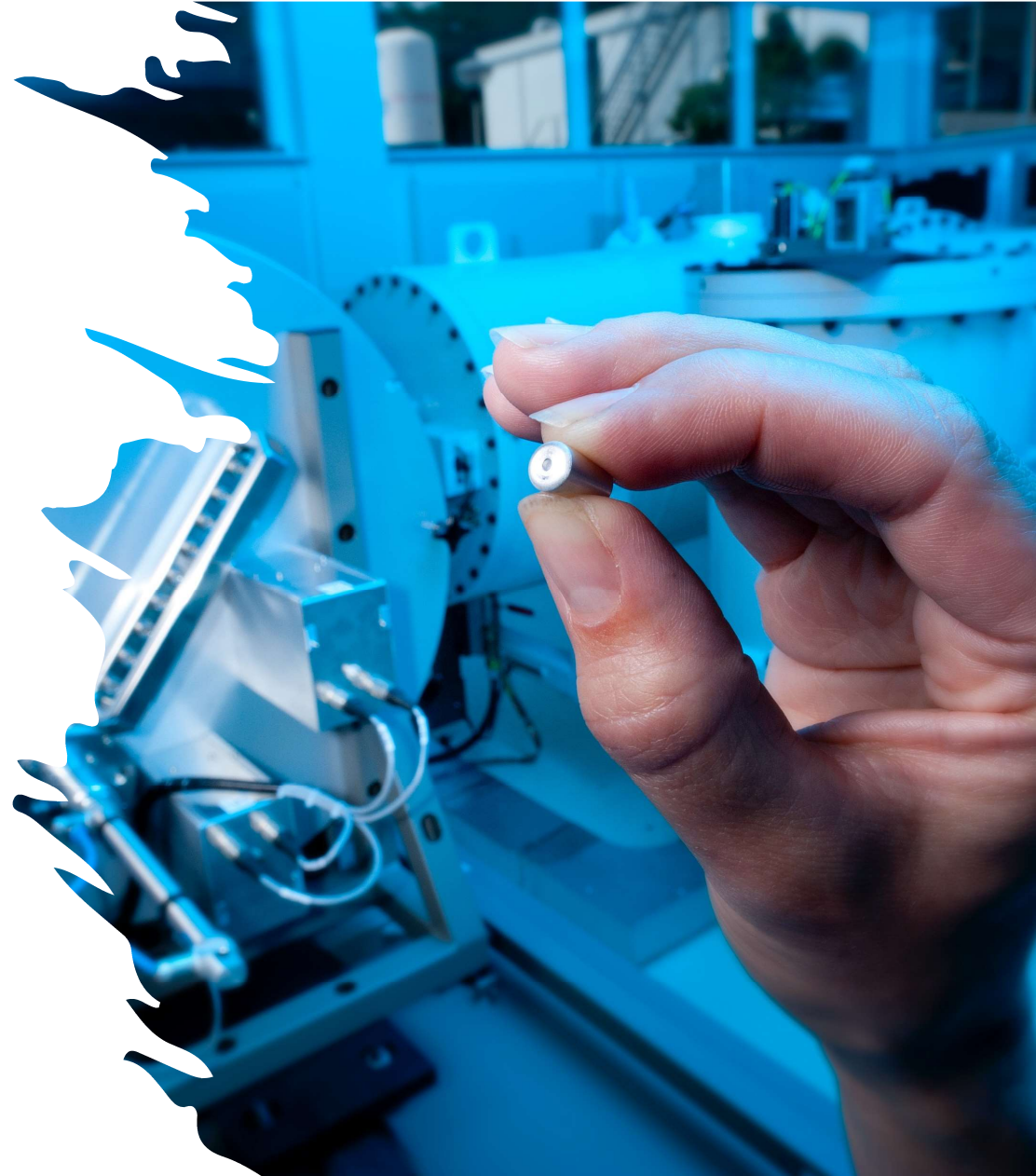
How is this achieved?

Combination of existing IT technologies (semantic - and blockchain technology, docker/kubernetes)
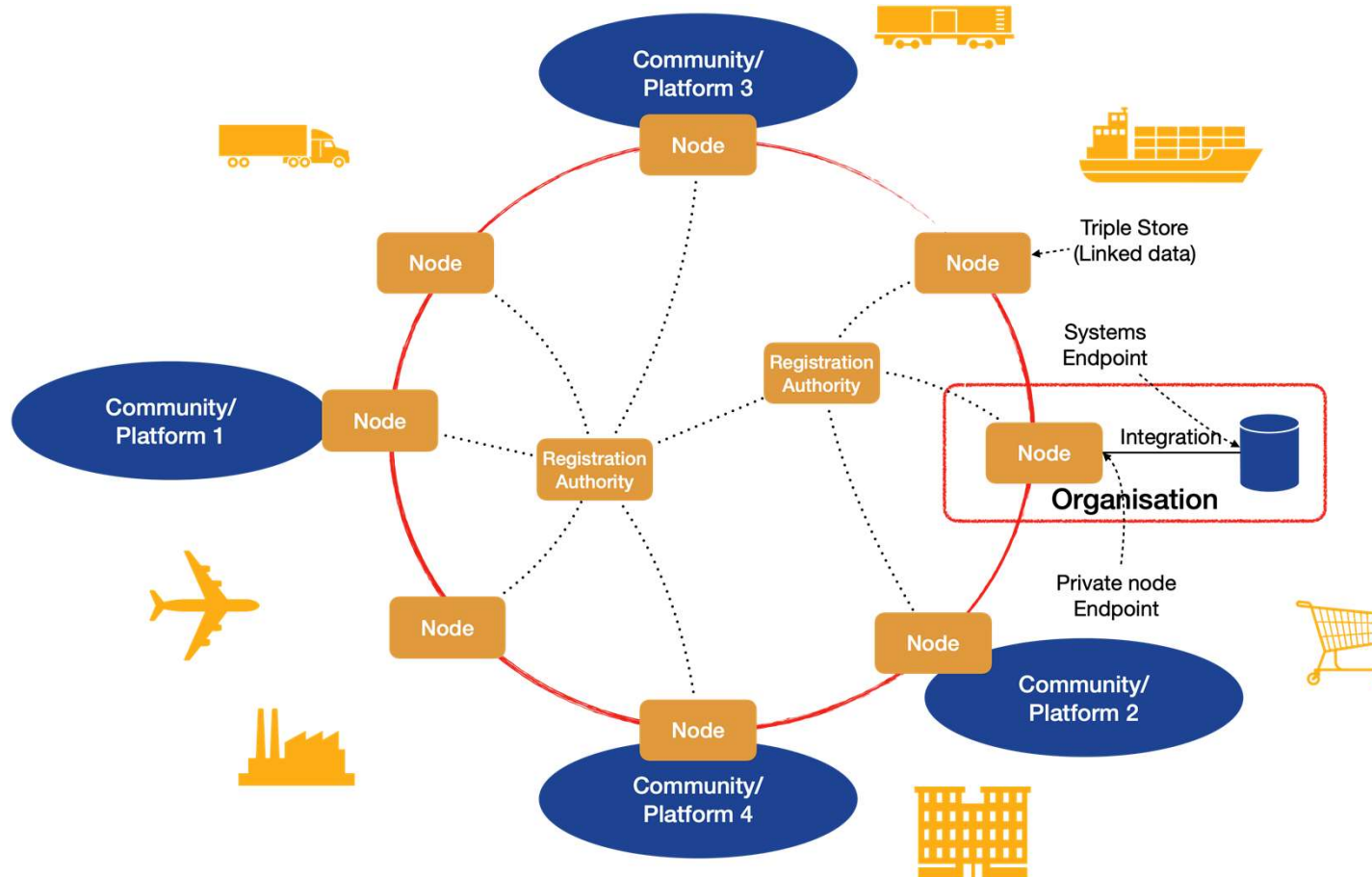
Where do we differ?

Service Registry for design, development, and maintenance of industry – and government standards to configure the infrastructure by localized interfaces.

Agenda

- Vision
- Challenge
- Solution
- Components
- State
- Future

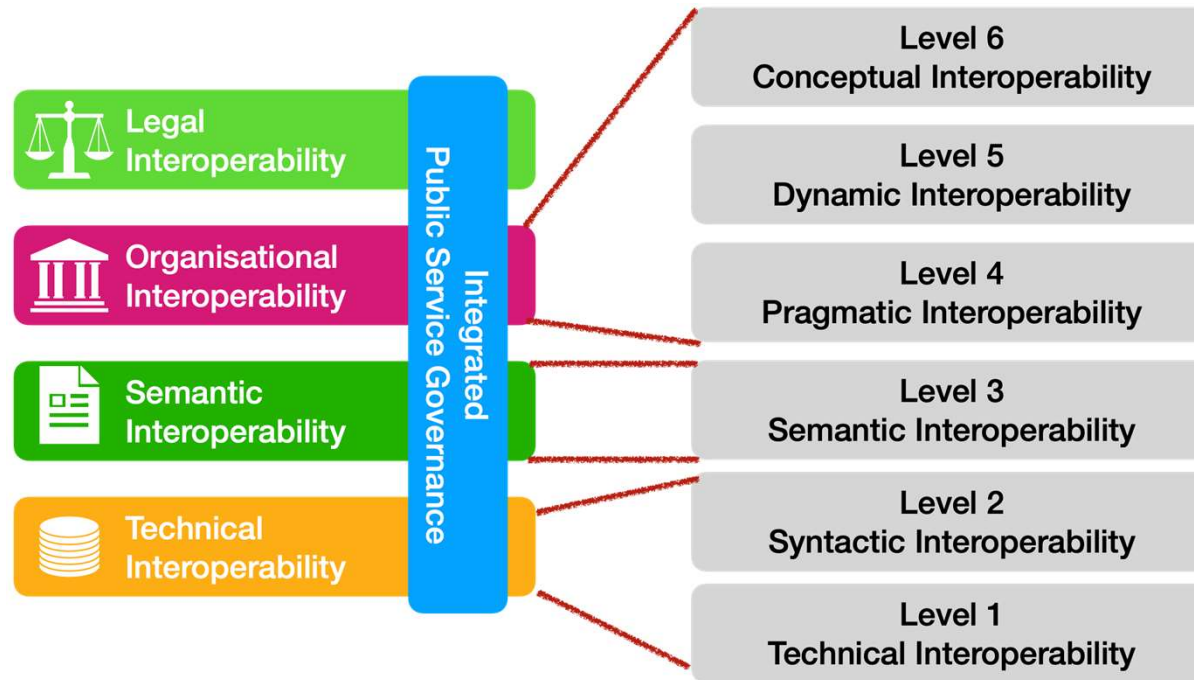# Localized, configurable data sharing infrastructure
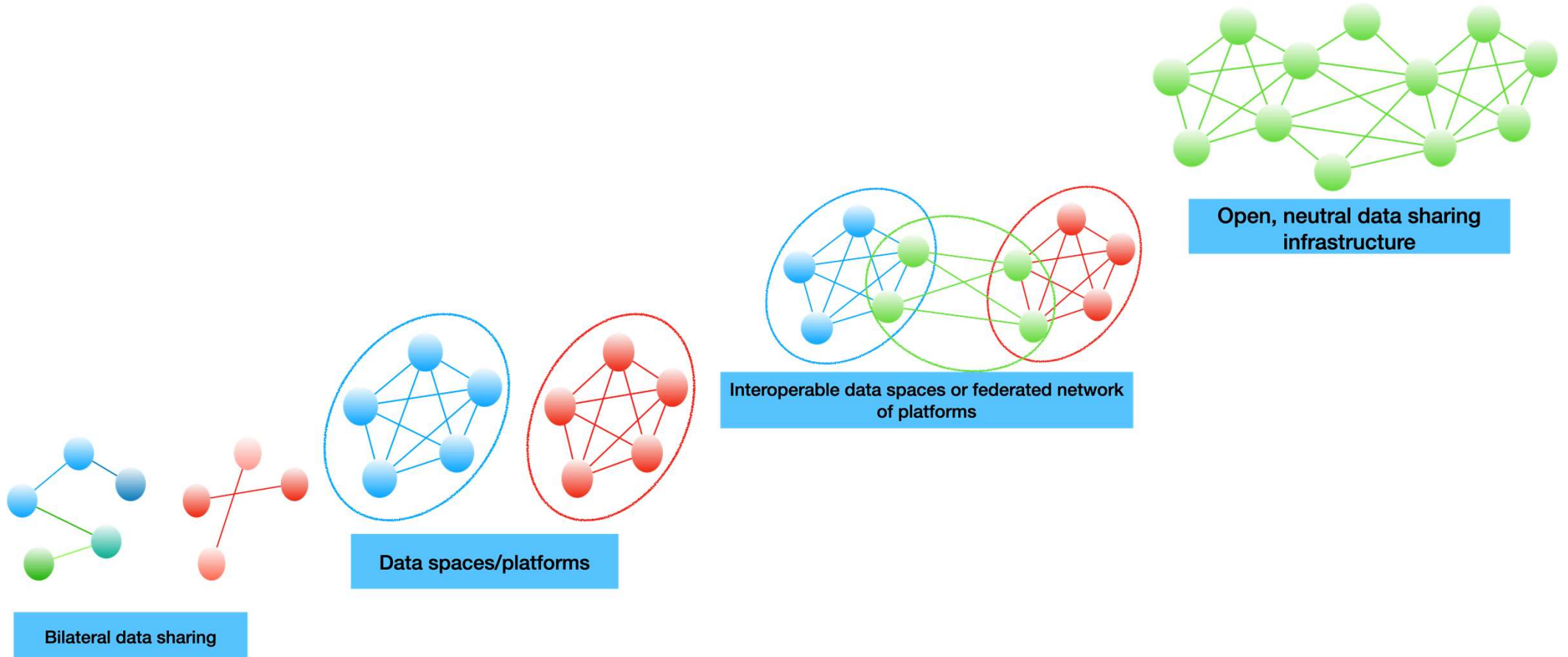
Acknowledgements

Interoperability frameworks

European Interoperability Framework

Detailed levels of Interoperability (Wang et.al)

Towards an open, neutral data sharing infrastructure

Open, neutral data sharing infrastructure

Interoperable data spaces or federated network of platforms

Data spaces/platforms

Bilateral data sharing

There is a need for flexibility and extendibility

Data value

- (collaborative) decision making supported by data analytics
  Collaborative planning
  Coordinated risk assessment
  Corridor Management
  ITS
  ....

- Operation (business transactions, declarations)

Data Domain standards

- Industry Associations, regulatory bodies

- Lack of alignment

- Inflexible and not extendible

- Differences in data carriers

- Representing document flows

The need for a configurable data sharing infrastructure

Proposal: knowledge graphs

Data browsing

Data at the source

Open (W3C) standards (RDF, OWL, SHACL)

Graph databases

Extendible, flexible

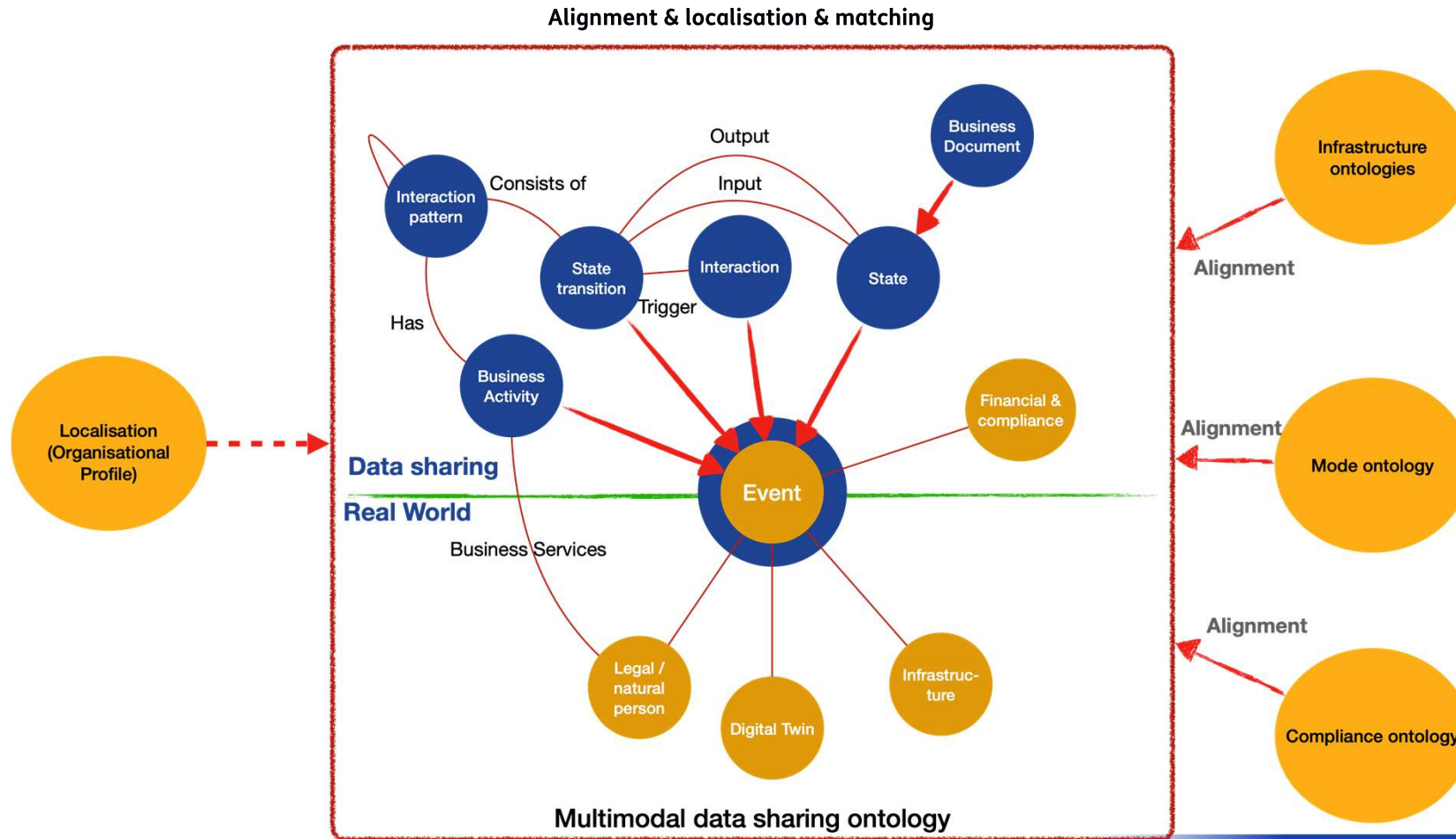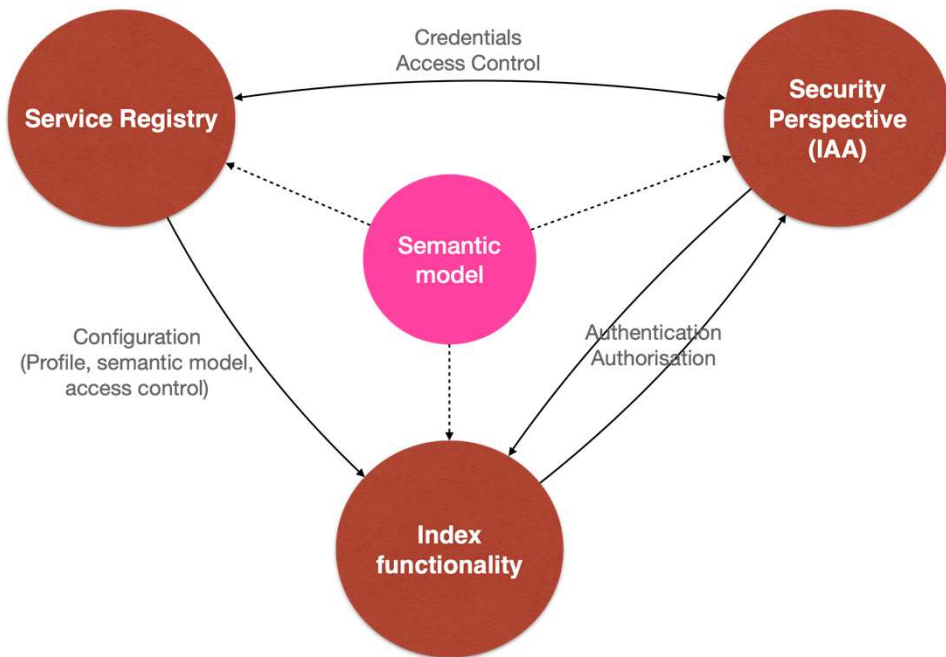Alignment & matching

Challenges:

- New (complex) technology

- Relational databases

- Known technology: openAPIs, messaging

- Impact on business processes and IT systems: document – to data flows

- Non-functional requirements

- Localization versus globalization

- Migration

- Adoption

Semantics is at the core

Alignment & localisation & matching

Multimodal data sharing ontology

Three components

Service Registry

Security Perspective (IAA)

Credentials
Access Control

Semantic model

Configuration
(Profile, semantic model,
access control)

Authentication
Authorisation

Index functionality

Service Registry:

- Design, specialization & alignment
- Configuration
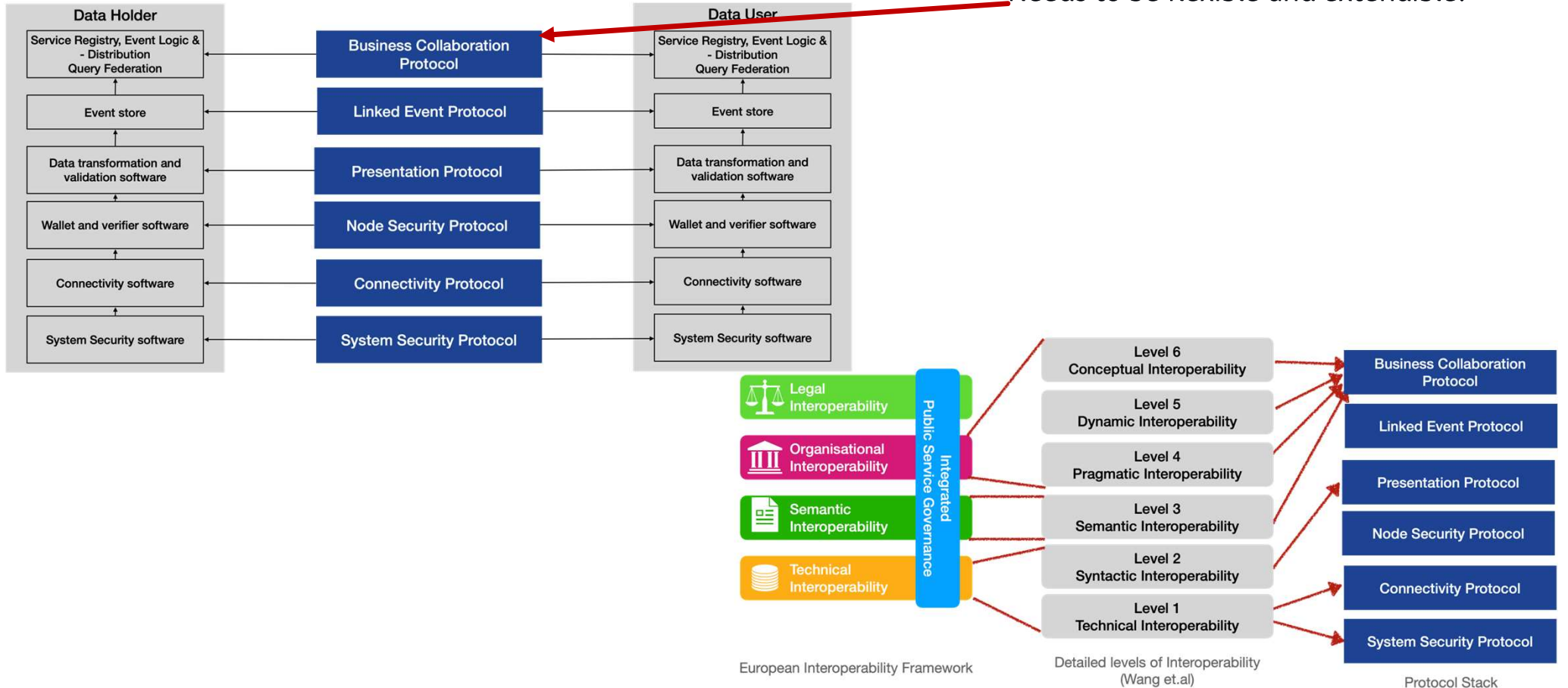
Index functionality ('node')

- Events storage & - distribution
- Link based authorization
- Data validation
- Event logic
- Query federation

Identification & Authentication

- Verifiable Credentials and Decentralised Identifiers
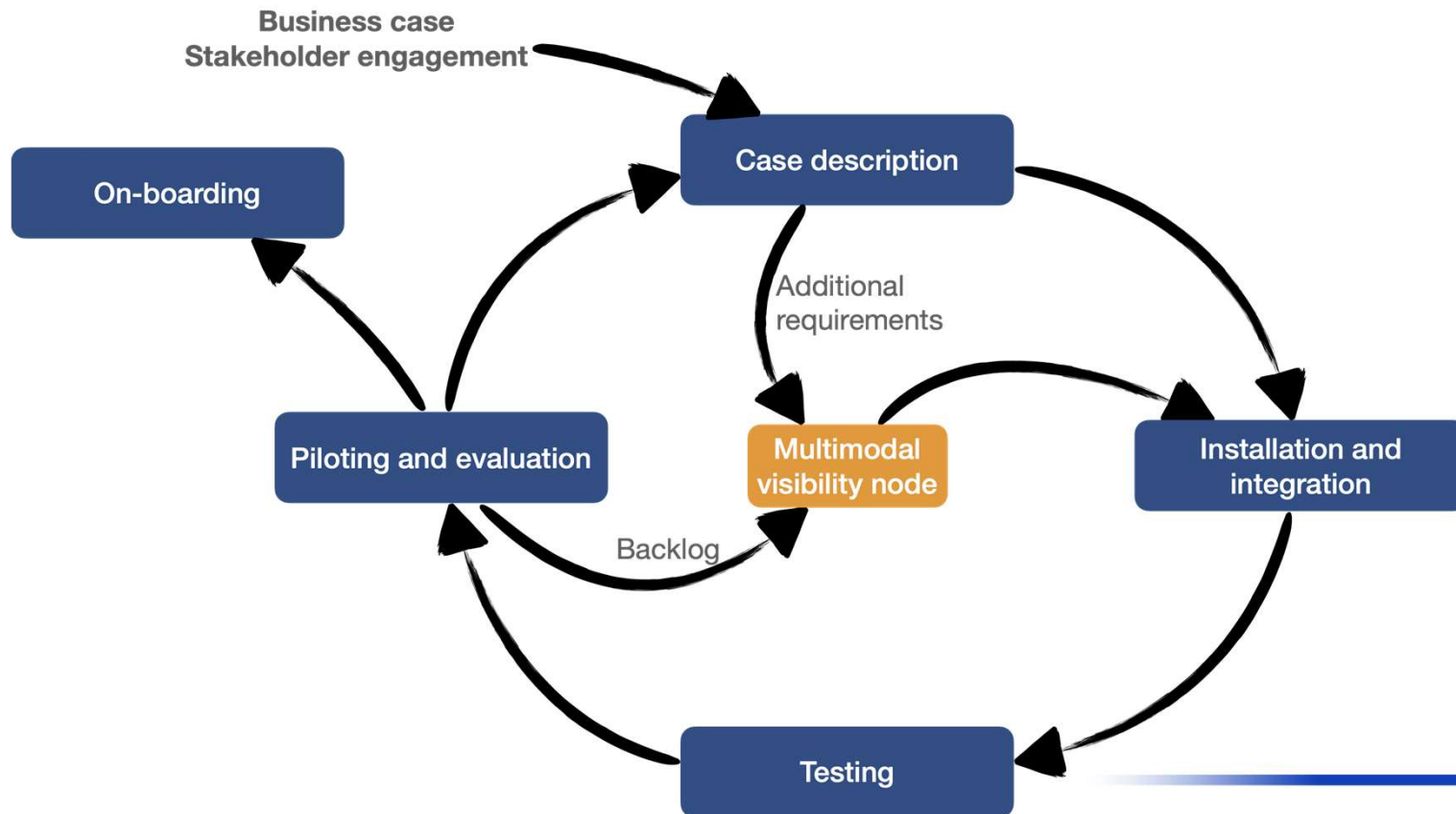- Regulator, Registration –, and Certification Authorities
- OAUTH 2.x

TNO innovation for life

Towards a set of agreements

Needs to be flexible and extendible!

Data Holder		Data User
Service Registry, Event Logic & - Distribution Query Federation	Business Collaboration Protocol	Service Registry, Event Logic & - Distribution Query Federation
Event store	Linked Event Protocol	Event store
Data transformation and validation software	Presentation Protocol	Data transformation and validation software
Wallet and verifier software	Node Security Protocol	Wallet and verifier software
Connectivity software	Connectivity Protocol	Connectivity software
System Security software	System Security Protocol	System Security software

Legal Interoperability
Organisational Interoperability
Semantic Interoperability
Technical Interoperability

Integrated Public Service Governance

Level 6 Conceptual Interoperability
Level 5 Dynamic Interoperability
Level 4 Pragmatic Interoperability
Level 3 Semantic Interoperability
Level 2 Syntactic Interoperability
Level 1 Technical Interoperability

Business Collaboration Protocol
Linked Event Protocol
Presentation Protocol
Node Security Protocol
Connectivity Protocol
System Security Protocol

European Interoperability Framework

Detailed levels of Interoperability (Wang et.al)

Protocol Stack

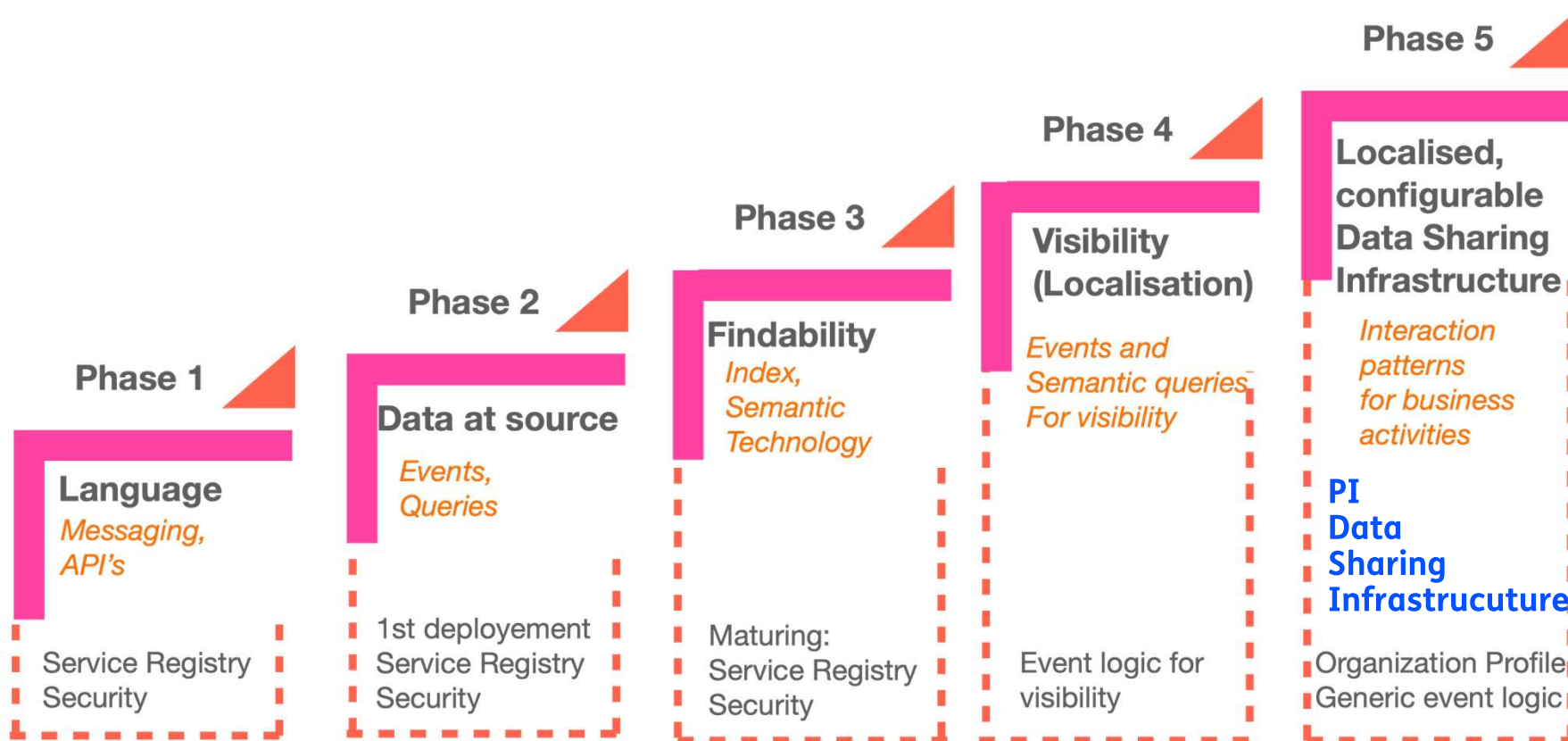TNO innovation for life

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From use case to on-boarding

A multimodal visibility service with a set of openAPIs and a SPARQL endpoint

Local APIs based on modality and cargo

Beyond a multimodal visibility infrastructure

Phase 1

Language
Messaging, API's

Service Registry
Security

Phase 2

Data at source
Events, Queries

1st deployement
Service Registry
Security

Phase 3

Findability
Index, Semantic Technology

Maturing:
Service Registry
Security

Phase 4

Visibility (Localisation)
Events and Semantic queries For visibility

Event logic for visibility

Phase 5

Localised, configurable Data Sharing Infrastructure
Interaction patterns for business activities

PI Data Sharing Infrastrucuture

Organization Profile
Generic event logic

Node

Existing

- openAPIs with internal IT systems
- Sharing of triples (RDF) between nodes (events with links to data)
- Simple semantic adapter (openAPIs to triples)
- Data validation (correctness and completeness according to specifications)
- Data storage with a triple store providing an endpoint for querying (SPARQL)
- Simple data distribution mechanism (type of 'smart contract')
- Connectivity: Corda-based
- On-boarding and trust: Corda network manager
- Non-repudiation (log/audit trail): Corda Notary Network
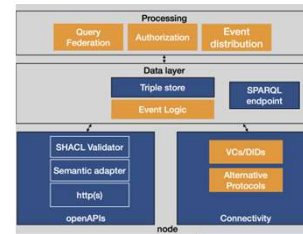
Planned

- Improved data distribution mechanism
- Link based authorization
- Access policy evaluation based on semantic model
- Event logic to support event sequencing
- Query federation (data provenance)
- Support of other connectivity protocols
- On-boarding: VCs/DIDs
- Other types of non-repudiation (log/audit trail)
- Improved semantic adapter for multimodal visibility

The code

https://github.com/tno/federated-bdi
- Source code
- Technical documentation
- Unit and integration tests
- Gitlab CI pipeline
- Configured for a demonstration use case

https://github.com/federated-bdi/docker-bdi-node
- Docker node

https://github.com/federated-bdi/Kubernetes-bdi-node
- Kubernetes node

www.federatedplatforms.eu
- All documentation, semantics, etc.

Next steps

Operationalisation and application of a multimodal visibility infrastructure

- Participants?

- Integration with existing solution ('matching')

- Specifications for open innovation

Towards a general purpose data sharing infrastructure

- Actors as 'node' of the infrastructure (index functionality and semantic endpoint)

- Advanced Service Registry deployed by all stakeholders

- The 'node' (as component) can function as gateway

Support of data analytics

- Exposing of data by exposing its semantics by 'nodes'

- Relating access rights to data and its semantics

- No need for a separate infrastructure with data brokers, etc.

Towards Regulation and governance

- Standardization of the upper ontology (W3C?)

- Regulation (voluntary) based on VCs of trusted registration authorities

- Governance in the context of the EU Data Strategy

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Why are we different?

We must be adaptable and flexible for future data sharing needs.

THANK YOU

**Let's continue
the conversation**

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FEDeRATED
NETWORK OF PLATFORMS

INVITATION TO JOIN US - 30 NOVEMBER 2023
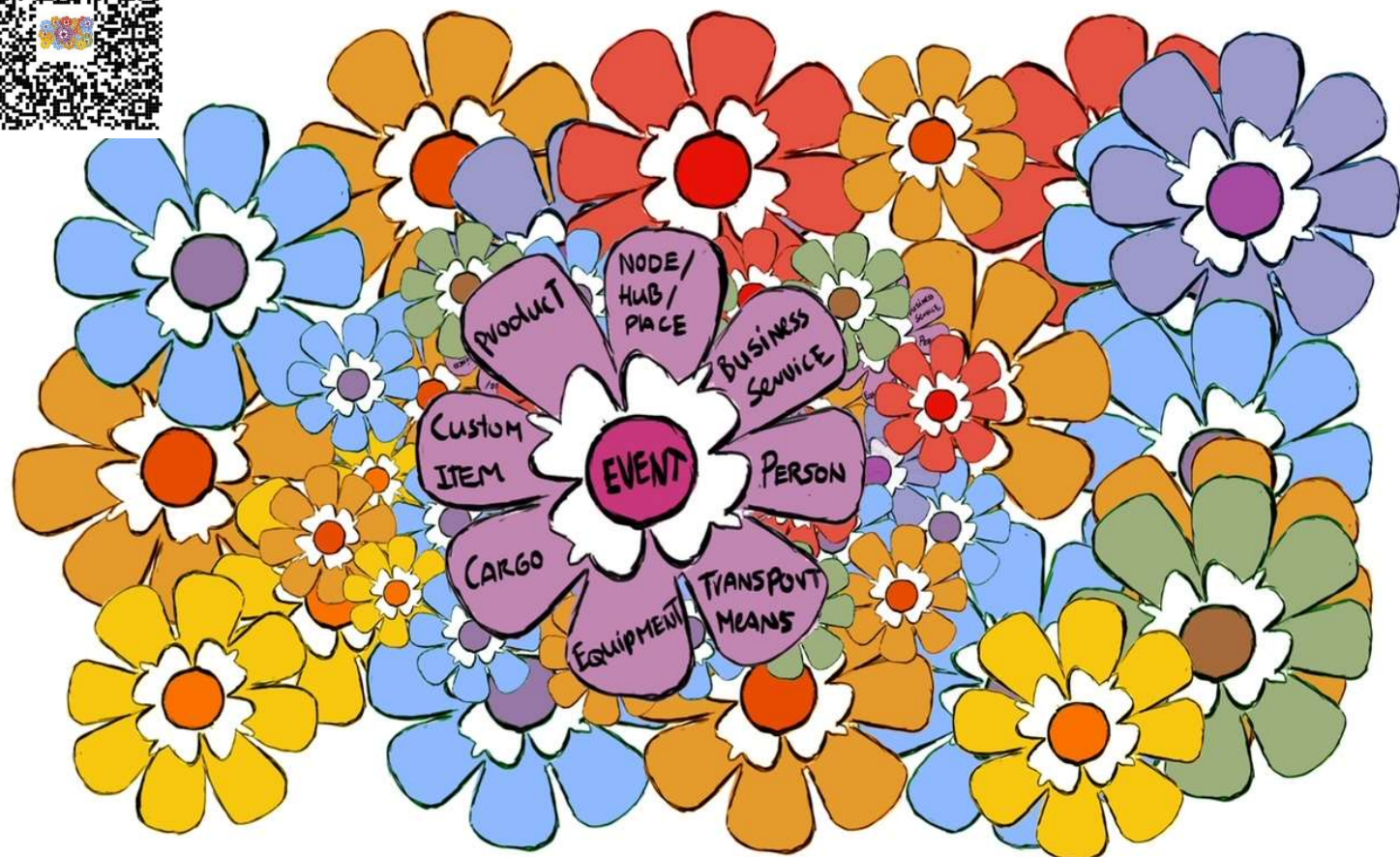
EU DATA LOGISTICS FESTIVAL - BRUSSELS