

# › APPLYING BLOCKCHAIN TECHNOLOGY FOR SITUATIONAL AWARENESS IN LOGISTICS - AN EXAMPLE FROM RAIL

Towards a Supply Chain Visibility Ledger | Wout Hofman, Jacco Spek, Christian van Ommeren

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SMART  RAIL

## H2020 SMARTRAIL

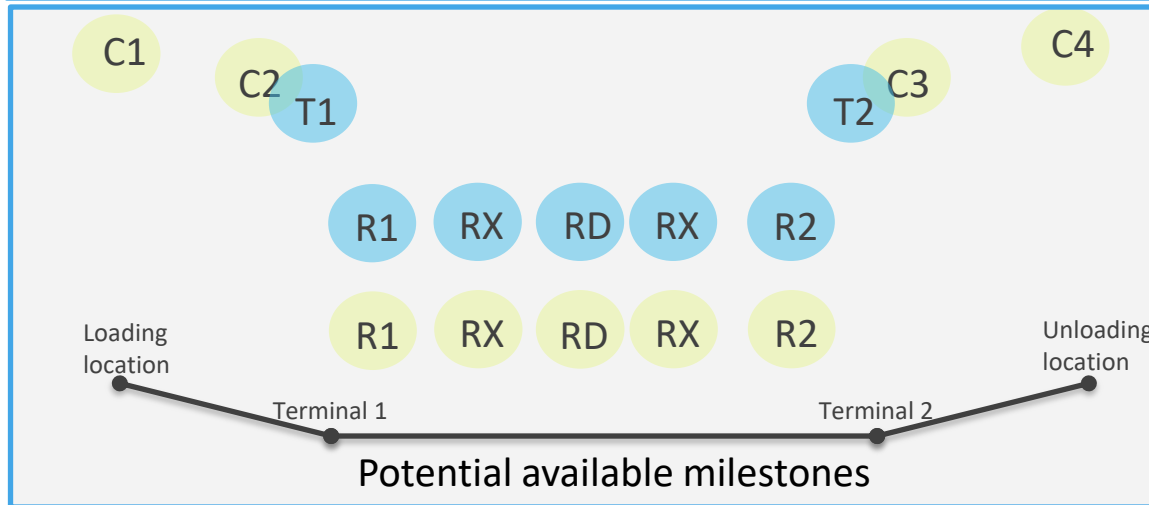
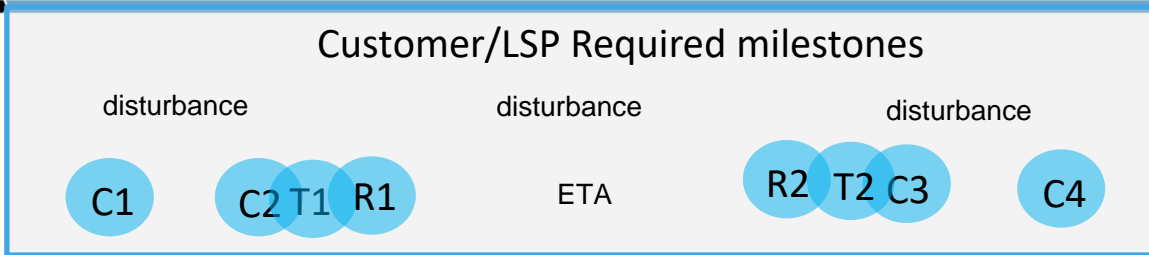
The overall objective of Smart-Rail is:

*To improve the freight rail services offered to the shippers, focussing on the five key performance indicators: reliability, lead time, costs, flexibility and visibility.*

specific (sub-)objectives :

- › Introduce a targeted set of innovative measures aiming to improve the freight rail services
- › Develop working business and governance models for cooperation between different stakeholders, both within the rail sector and with other stakeholders in the supply chain.
- › **Develop business, operational and technical solutions, including new technologies, technical devices, IT-services and business and governance models.**
- › **Test and improve these innovative measures in real-life situations (Continuous Improvement Tracks or CITs) as a first step in the deployment of project results.**
- › Contribute to a mental shift of the rail sector toward a client oriented and supply chain focus based on real-life implementation in three Living Labs.
- › Broad and effective exploitation of the results of the project towards the European rail community, their clients and other involved stakeholders.

# THE VISIBILITY CASE



Terminal/Private IM

Railway Undertaking

Infrastructure Manager

Legend

C1: loaded

C2: Arrived at terminal

T1: Loaded on train

R1: Train departed

R2: Train arrived

T2: Discharged

C3: Departed from terminal

C4: Unloaded

CD: Carrier disruption

TD: Terminal disruption

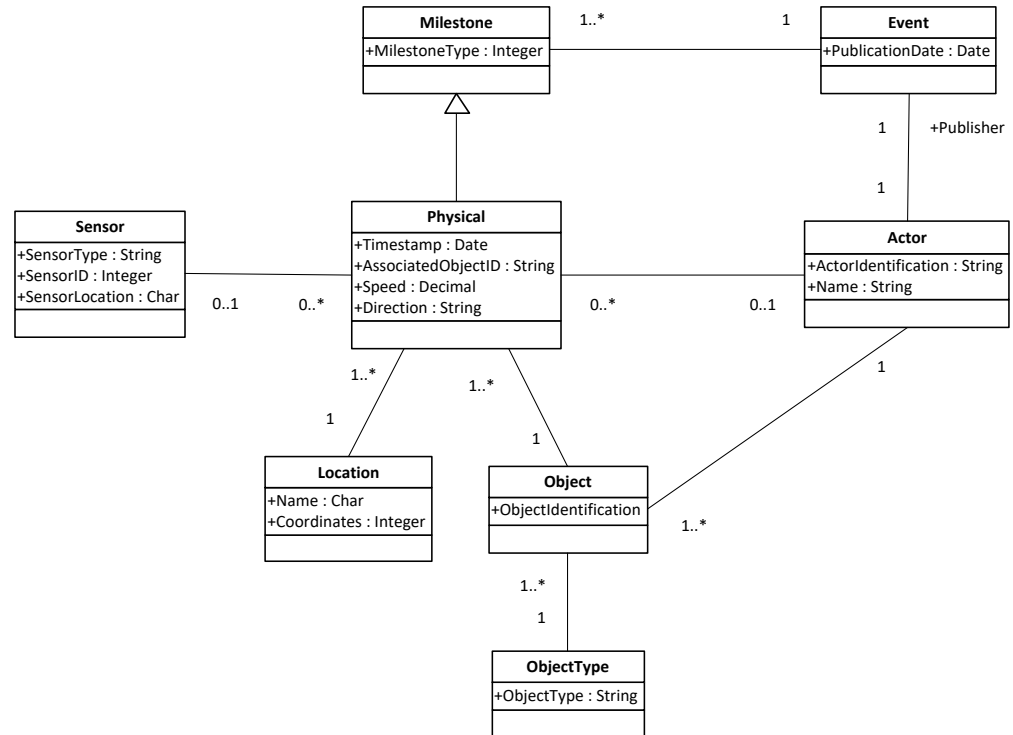
RD: Rail disruption

RT: Real-time information

RX: Predefined Critical points eg border crossings

# THE CHALLENGE – DATA GOVERNANCE AND - SEMANTICS

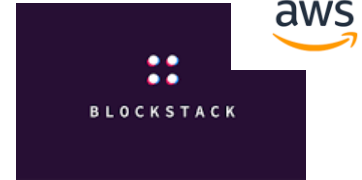
- › Granularity : cargo-wagon-train
- › Commercial sensitivity : hide trade relations
- › Open logistics network : all types of trading relations
- › Trust and identity
- › Data quality : correct, complete, consistent, and unambiguous



# MAIN FEATURES OF BLOCKCHAIN TECHNOLOGY

- › Immutability – data can not be changed (proof, acceptance by courts?)
- › Transparency – all participants have access to the same data
  - › Intermediaries (like LSPs) – focus on their core capabilities
  - › Billing and payment – no invoices, direct payment
  - › Compliance monitoring – support of (risk based) inspection by authorities (customs, NVWA, ILT, police, ...)
  - › Process synchronisation – improved visibility of goods flows, cost reduction, stock management
- › Resilient and robust (cyber-attacks) – always available
- › Ease – easy to install, easy to use, limited (central) governance

BIGCHAIN<sup>DB</sup>



HYPERLEDGER



# CONTROLLED DATA SHARING AND - TRANSPARENCY

## Write

› BigChainDB : published data  $\text{BigChainDB} = \text{SK}_S\{\text{Data}\}$  (1)

› Published Data =  $\text{PGP}\{\mathcal{V}_R, S\}, \text{E}_S\{\text{Published Data}_{\text{BigChainDB}}\}$  (2)

where

- $\text{SK}_S$  encryption of the data with the secret (private) key of a sender to ensure authenticity
- $R$  intended recipient of the data
- $\text{PGP}$  PGP algorithm to encrypt  $S$  that can be decrypted by all intended recipients with their private key
- $\text{E}_S$  encryption of the data with symmetric key  $S$

## Read

›  $S = \text{PK}_R \{ \text{PGP}\{\mathcal{V}_R, S\} \}$  (1)

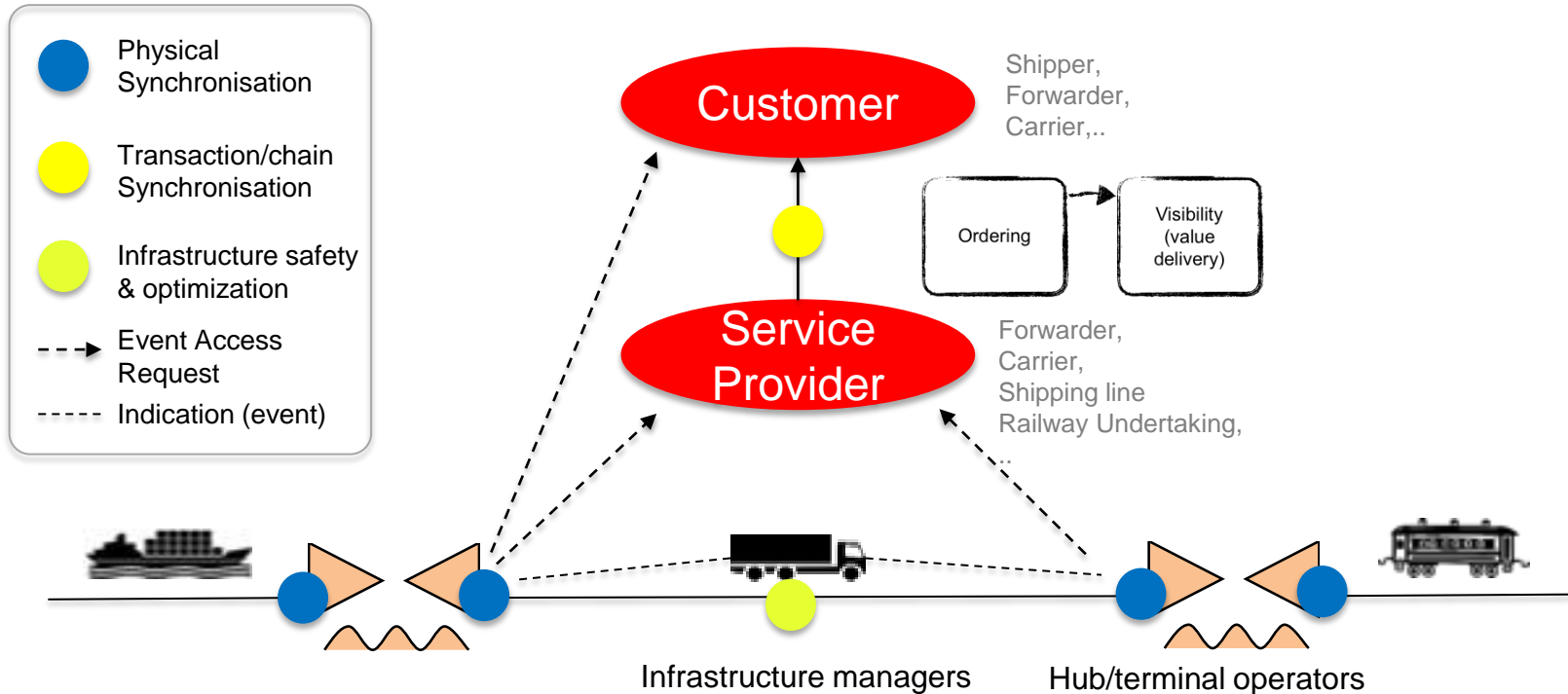
› published data  $\text{BigChainDB} = \text{D}_S \{ \text{E}_S\{\text{Published Data}_{\text{BigChainDB}}\} \}$  (2)

› BigChainDB : Data =  $\text{PK}_S \{ \text{Published Data}_{\text{BigChainDB}} \}$  (3)

where

- $\text{PK}_R$  the private key of a recipient
- $\text{PGP}$  PGP algorithm to encrypt  $S$  that can be decrypted by all intended recipients with their private key
- $\text{D}_S$  decryption of the encrypted data  $\text{E}_S\{\text{Data}\}$  with symmetric key  $S$
- $\text{PK}_S$  the public key of the submitter of the data

# DATA GOVERNANCE IS THE KEY – WHO ARE THE RECIPIENTS



# USER INTERFACES – CURRENTLY IMPLEMENTING DATA GOVERNANCE

SMART RAIL Welcome Mauna

Events

Show all

Show 10 entries Search:

Id	Railway object name	Type	Event	Departure station	Departure date	Arrival station	Loading terminal	Destination terminal	Net loading mass	Train number	Blockchain received date
69	335345577175	Wagon	Departure	Faisceau Chalon sur Saone	05/03/2018	PLEH	APROPORT CHALON	ZSP	9	180305CSSLN	2018-03-30T17:04:34.258467+02:00
63	378049936966	Wagon	Departure	Faisceau Chalon sur Saone	05/03/2018	PLEH	APROPORT CHALON	ZSP	12	180305CSSLN	2018-03-29T15:06:19.657967+02:00
62	378049936966	Wagon	Departure	Faisceau Chalon sur Saone	05/03/2018	PLEH	APROPORT CHALON	ZSP	12	180305CSSLN	2018-03-29T14:53:46.610035+02:00
61	378049936966	Wagon	Departure	Faisceau Chalon sur Saone	05/03/2018	PLEH	APROPORT CHALON	ZSP	12	180305CSSLN	2018-03-29T14:14:44.585348+02:00
58	378049937071	Wagon	Departure	Faisceau Chalon sur Saone	05/03/2018	PLEH	APROPORT CHALON	ZSP	12	180305CSSLN	2018-03-29T11:21:24.604532+02:00
57	378049937071	Wagon	Departure	Faisceau Chalon sur Saone	05/03/2018	PLEH	APROPORT CHALON	ZSP	12	180305CSSLN	2018-03-29T11:19:00.310142+02:00

Showing 1 to 6 of 6 entries Previous 1 Next

SmartRail

Contacts Ledger Map

Logged in as Seacon Logistics Sign out

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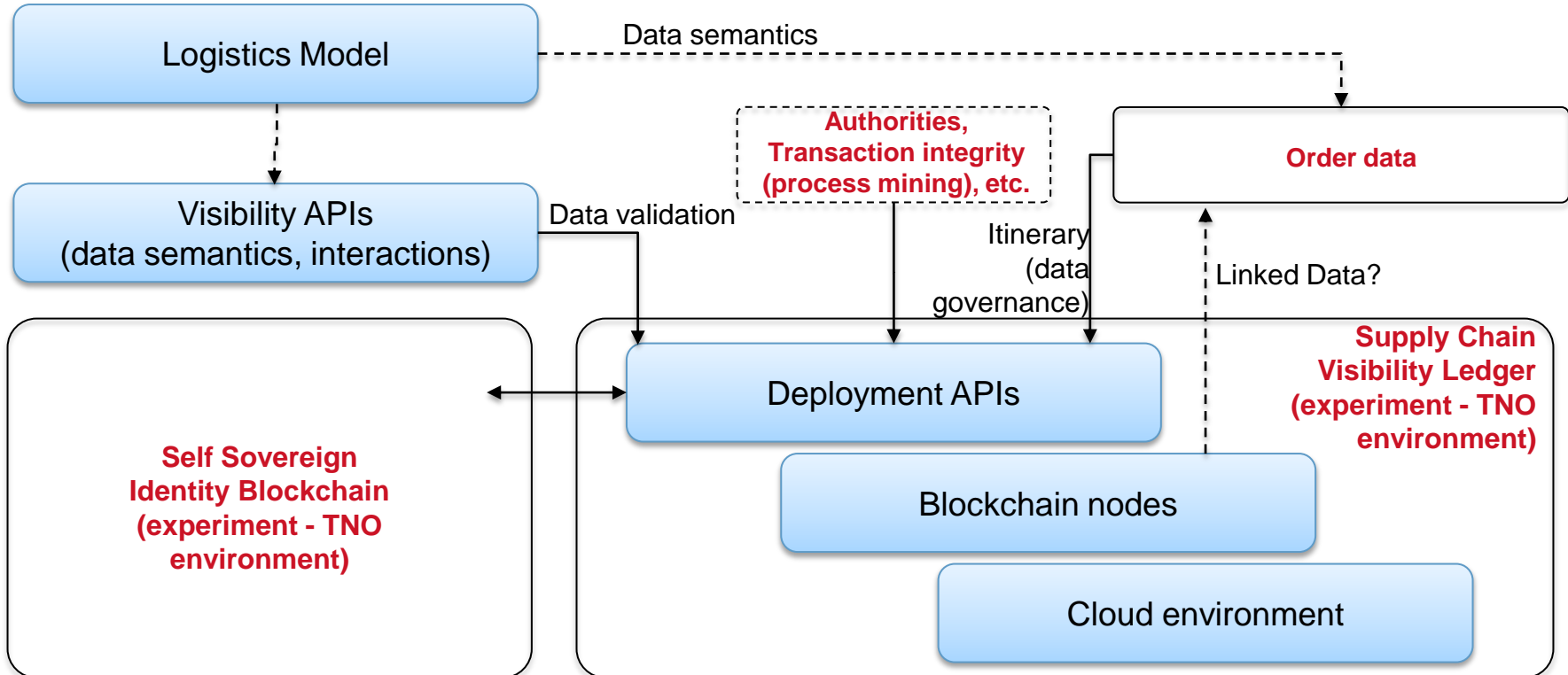
- CMA CGM

Publish event

1. Encrypt data with symmetric key
2. Encrypt symmetric key with public PGP keys of recipients
3. Publish encrypted data + encrypted symmetric key with Betuwe Express crypto ID as sender on blockchain



# FUTURE EXTENSIONS



# CONCLUSIONS

- › Blockchain Technology can be applied to implement data governance
- › Chosen technology (BigChainDB) has a sufficient transaction rate (over 200 per second → over 6 billion per year)
- › Future extensions are required for practical applications
- › Governance on different levels
  - › Deployment environment (nodes, APIs)
  - › Development and maintenance environment (models and functional APIs)
- › Supply Chain Visibility ledger will enable the Physical Internet
- › Challenge – do organization trust their data to be shared in a distributed ledger?
- › Will you join us in our Blockchain Living Lab program for the next couple of years?

## TO END WITH

The logistics industry will not innovate if all stakeholders (carriers, LSPs, shippers) just implement their own distributed ledger, hiring a technology partner

(Bloomberg, April 2018)

# › QUESTIONS

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Voor meer inspiratie:  
**TIME.TNO.NL**

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