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
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

Customer/LSP Required milestones

Legend
- C1: loaded
- C2: Arrived at terminal
- T1: Loaded on train
- R1: Train departed
- R2: Train arrived
- CD: Carrier disruption
- TD: Terminal disruption
- RD: Rail disruption
- RT: Real-time information
- RX: Predefined Critical points eg border crossings

Terminal/Private IM
Railway Undertaking
Infrastructure Manager

Loading location
Terminal 1
Unloading location
Terminal 2

Potential available milestones
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

Applying Blockchain Technology for situational awareness in logistics - an example from rail
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
CONTROLLED DATA SHARING AND - TRANSPARENCY

Write

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

› Published Data = $\text{PGP}\{\forall R, S\}, \text{E}_S\{\text{Published Data}_{\text{BigChainDB}}\}$
  \hspace{1cm} (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

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

› $S = \text{PK}_R\{\text{PGP}\{\forall R, S\}\}$  
  \hspace{1cm} (1)

› published data $_{\text{BigChainDB}} = \text{D}_S\{\text{E}_S\{\text{Published Data}_{\text{BigChainDB}}\}\}$
  \hspace{1cm} (2)

› BigChainDB : Data = $\text{PK}_S\{\text{Published Data}_{\text{BigChainDB}}\}$
  \hspace{1cm} (3)

where

$\text{PK}_R$ the private key of a recipient

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

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DATA GOVERNANCE IS THE KEY – WHO ARE THE RECIPIENTS

- Shipper, Forwarder, Carrier,..
- Customer Service Provider
- Infrastructure managers
- Hub/terminal operators
- Physical Synchronisation
- Transaction/chain Synchronisation
- Infrastructure safety & optimization
- Event Access Request
- Indication (event)

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Applying Blockchain Technology for situational awareness in logistics – an example from rail

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

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- Logistics Model
- Visibility APIs (data semantics, interactions)
- Self Sovereign Identity Blockchain (experiment - TNO environment)
- Data semantics
- Data validation
- Authorities, Transaction integrity (process mining), etc.
- Order data
- Itinerary (data governance)
- Linked Data?
- Supply Chain Visibility Ledger (experiment - TNO environment)
- Deployment APIs
- Blockchain nodes
- Cloud environment
- Order data
- Order data
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