BLOCKCHAINS AND ENTERPRISE MODELING: OPPORTUNITIES AND CHALLENGES

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BLOCKCHAIN

First international blockchain for science: bloxberg

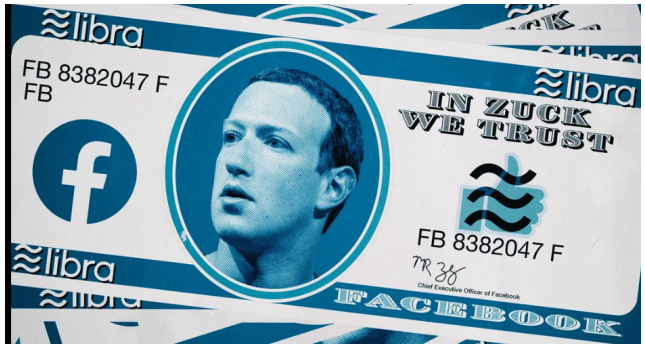
mpg.de, 2019-05-09

IBM, Maersk Finally Sign Up 2 Big Carriers for Shipping Blockchain

coindesk.com, 2019-05-28

BLOCKCHAIN

coindesk.com, 2019-05-13



theverge.com, 2019-07-01

amazon web services

AWS announces availability of Amazon Managed Blockchain service

cloudcomputing-news.net, 2019-05-02

bloxberg
The Trusted Research Infrastructure

First international blockchain for science: bloxberg

mpg.de, 2019-05-09

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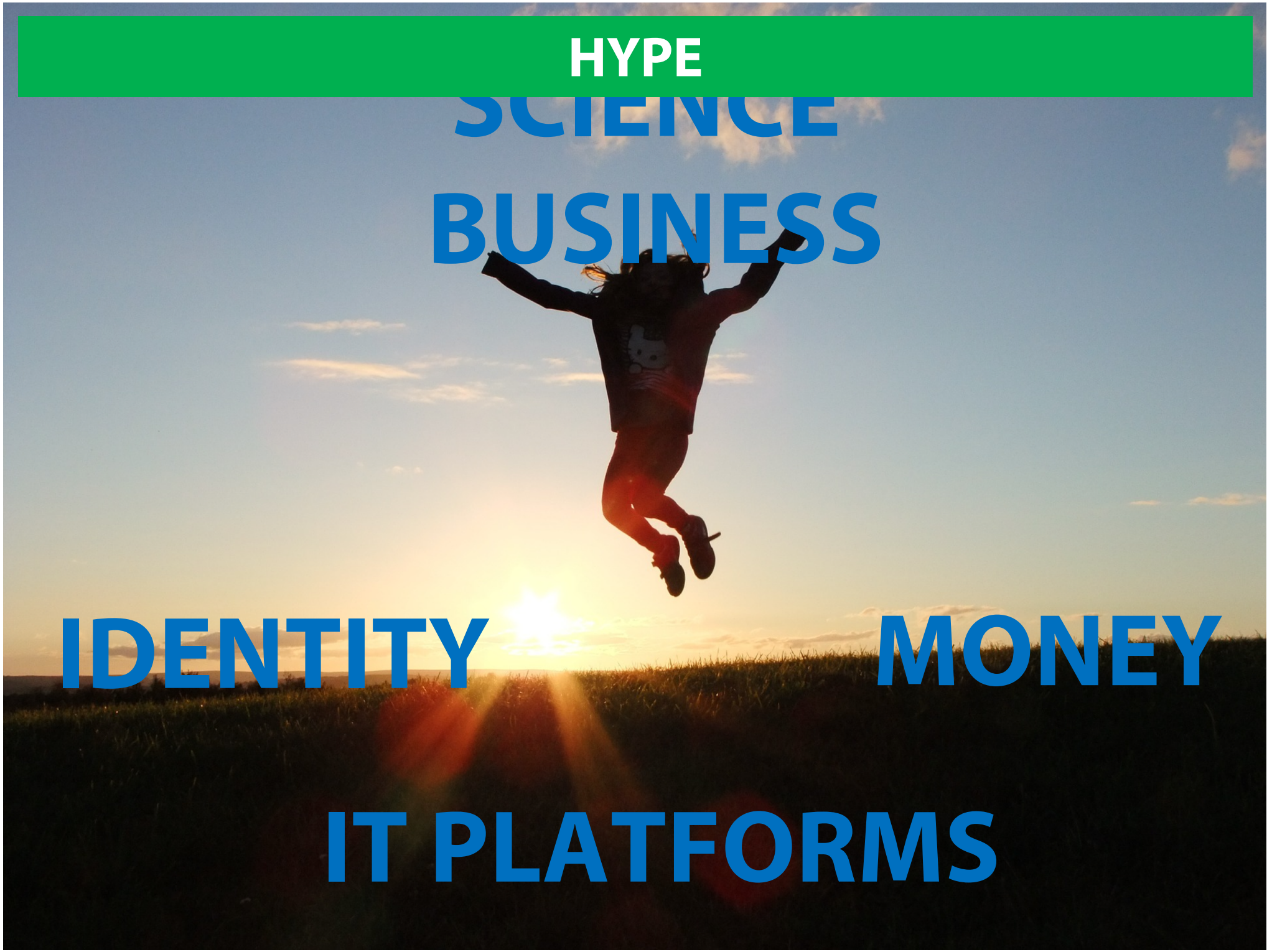
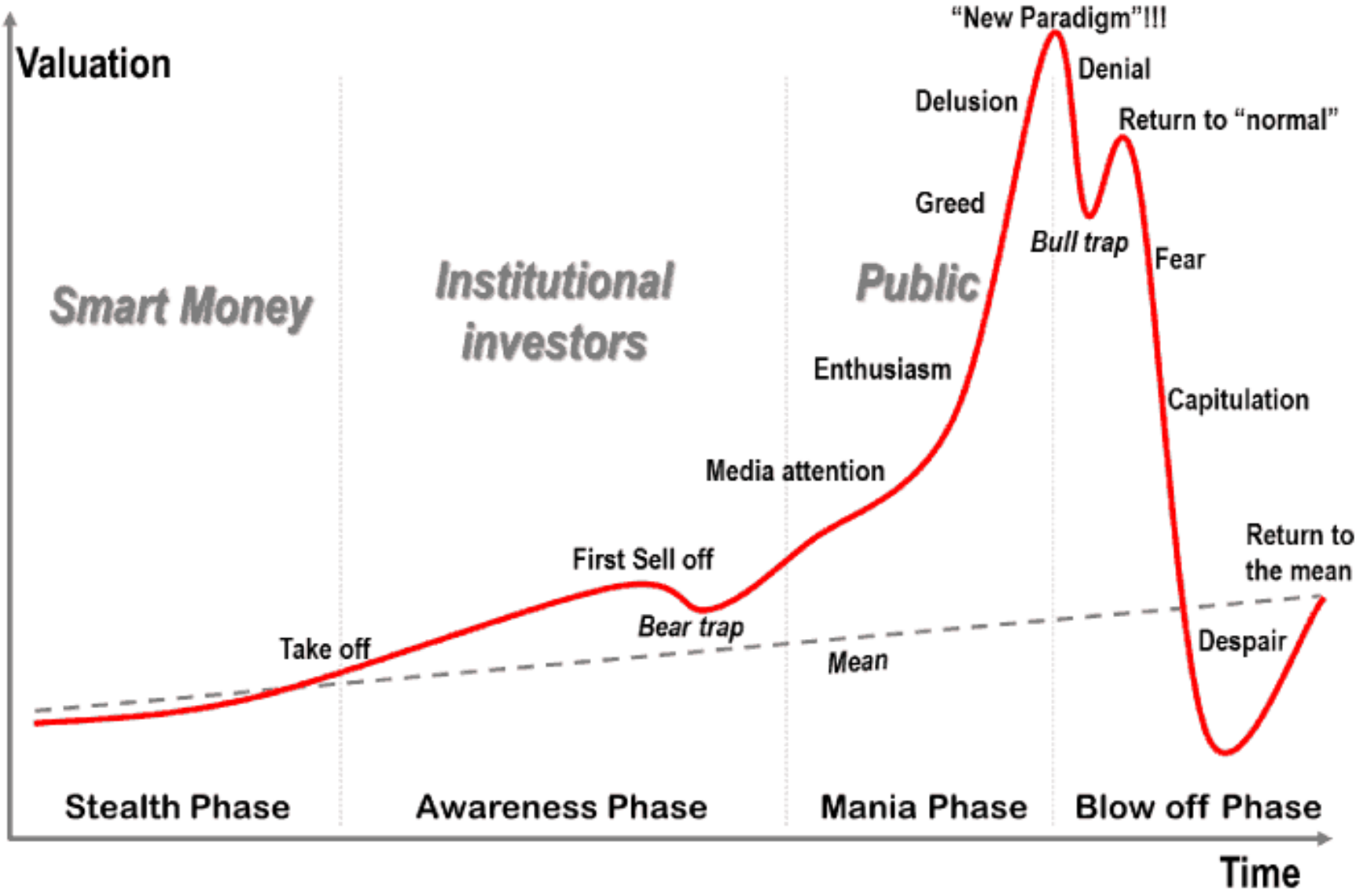
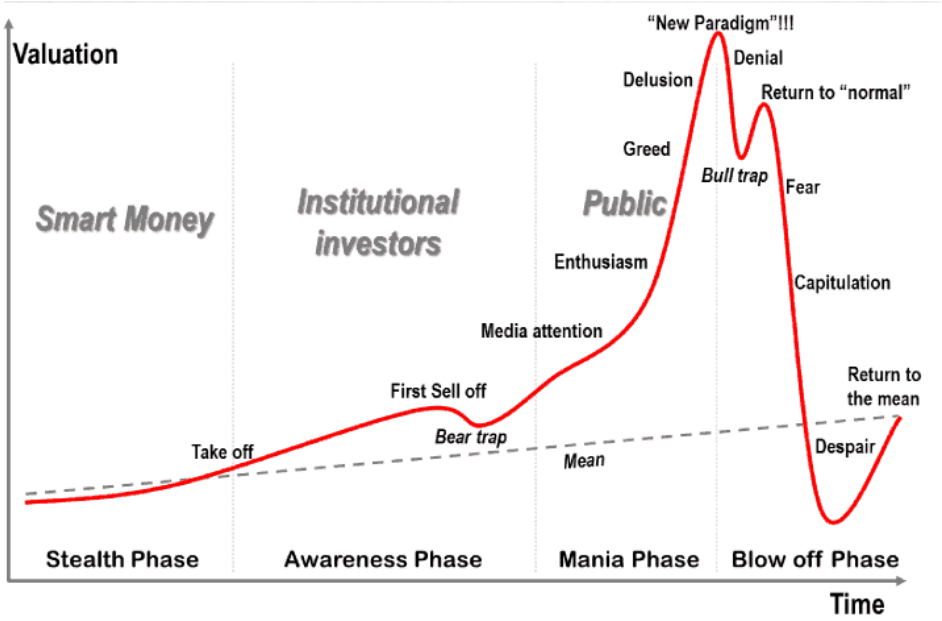

HYPE
SCIENCE
BUSINESS
IDENTITY
MONEY
IT PLATFORMS

HYPES - REVISITED



Jean-Paul Rodrigue (2017): Stages in a Bubble, in: The Geography of Transport Systems, Routledge, ISBN 978-1138669574

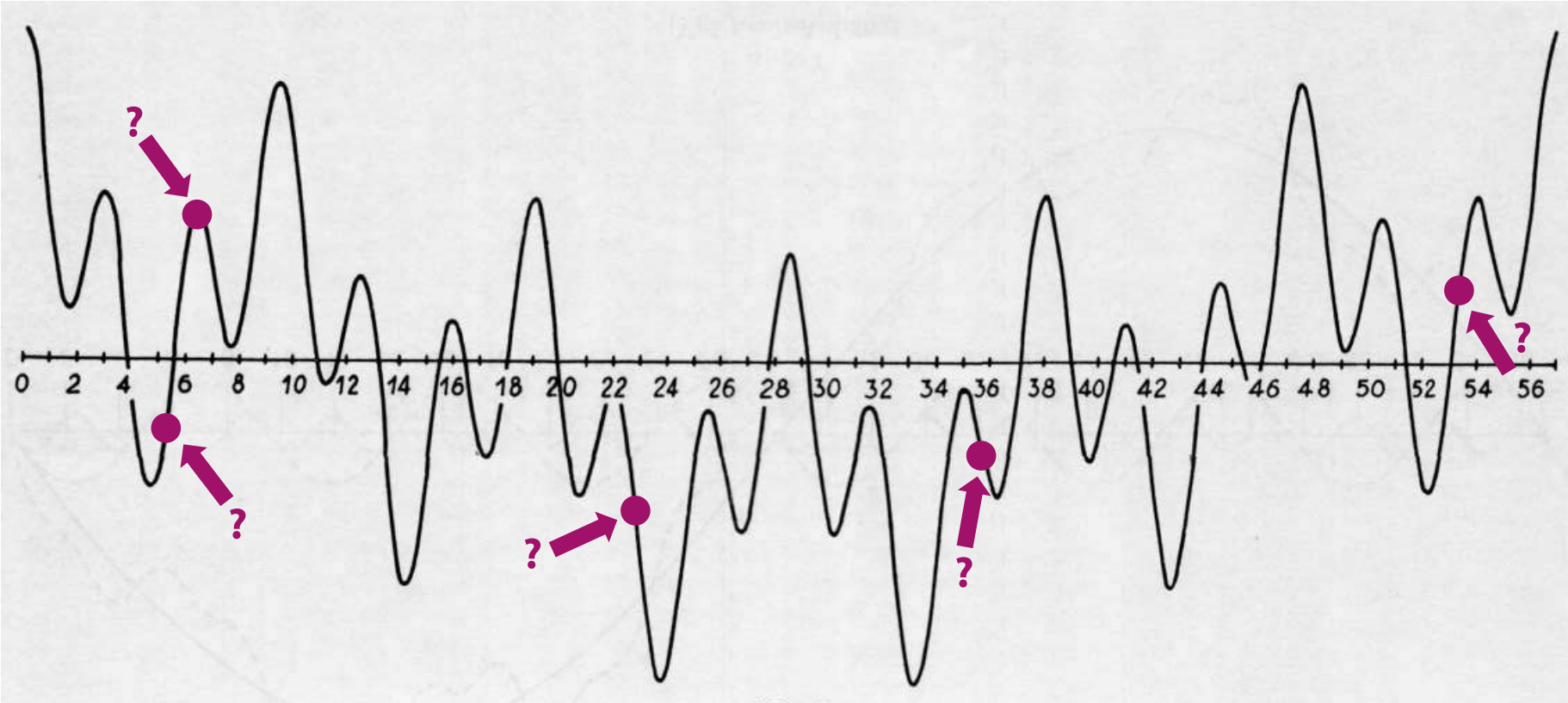
HYPES - REVISITED



Schumpeter, A. (1961): Konjunkturzyklen eine theoretische, historische und statistische Analyse des kapitalistischen Prozesses

HYPES - REVISITED

BLOCKCHAIN



Blockchains: A Research Topic for Academia & Industry

Schumpeter, A. (1961): Konjunkturzyklen eine theoretische, historische und statistische Analyse des kapitalistischen Prozesses

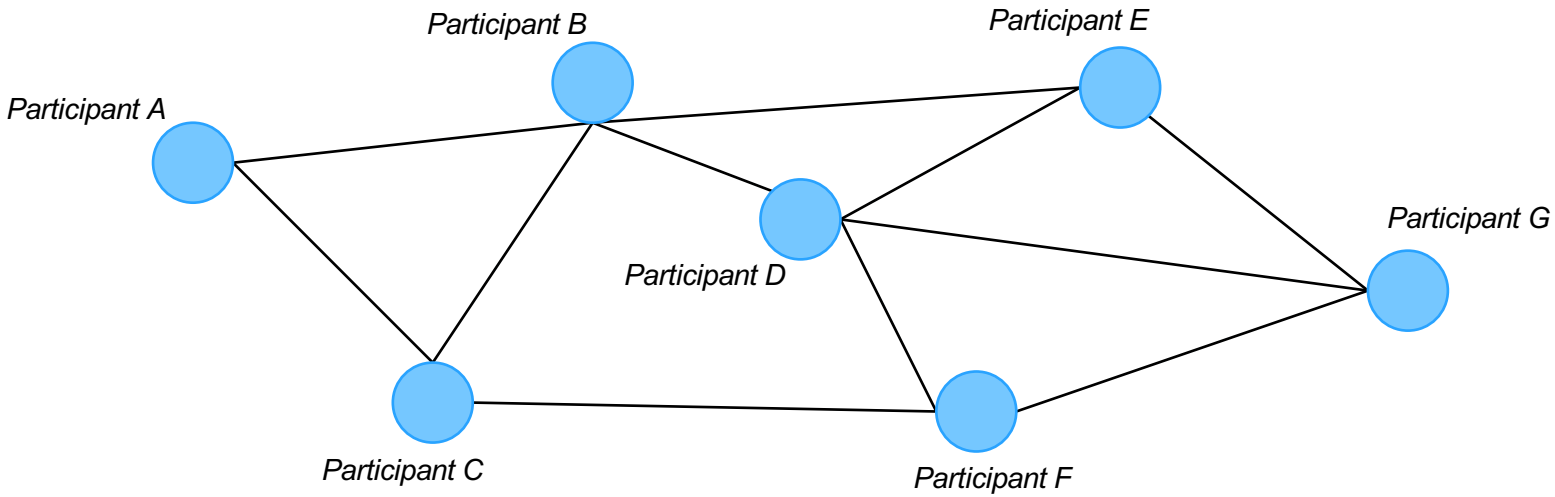
BLOCKCHAIN: CHARACTERISTICS

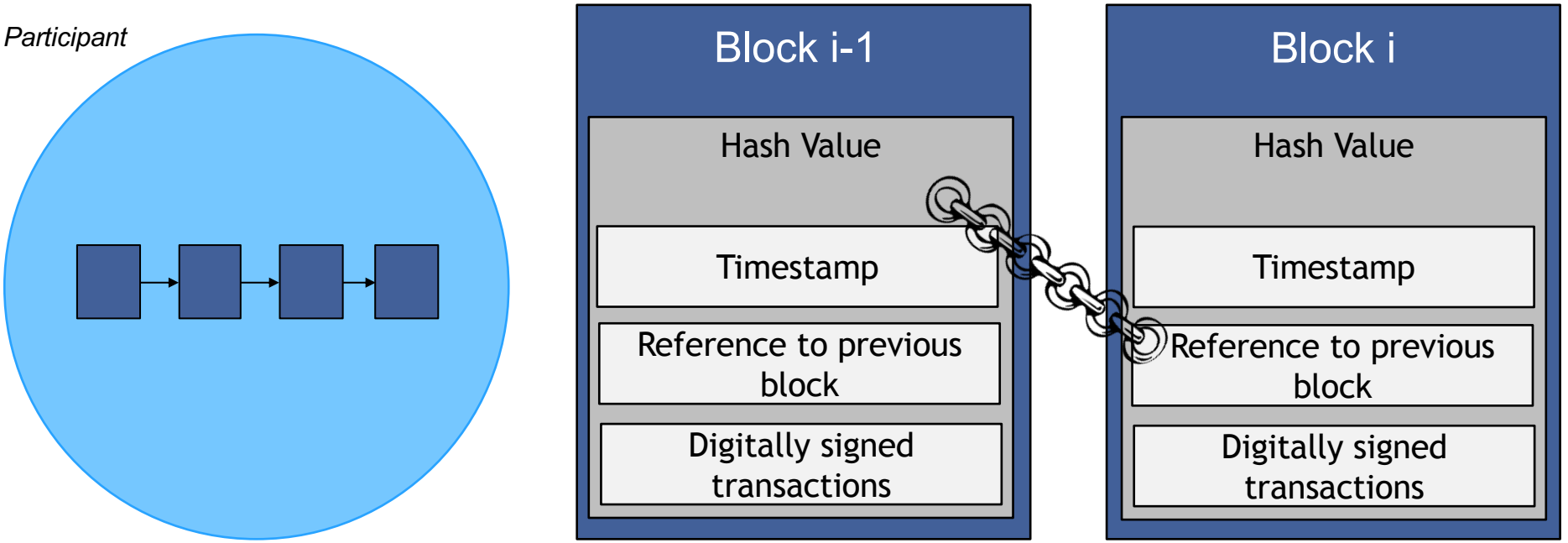
Blockchains:

- Distributed, electronic ledgers
- Immutable due to cryptographic procedures
- Transparent for all participants through individual, complete copies
- Transactions are digitally signed, currently without legal identity

- Public blockchains have no trusted third parties, but distributed consensus
- Decentralized lottery principle based on cryptographic puzzles for proposing new blocks
- Use smart contracts for decentralized execution of Turing-complete algorithms through transactions

BLOCKCHAIN: INNER WORKING

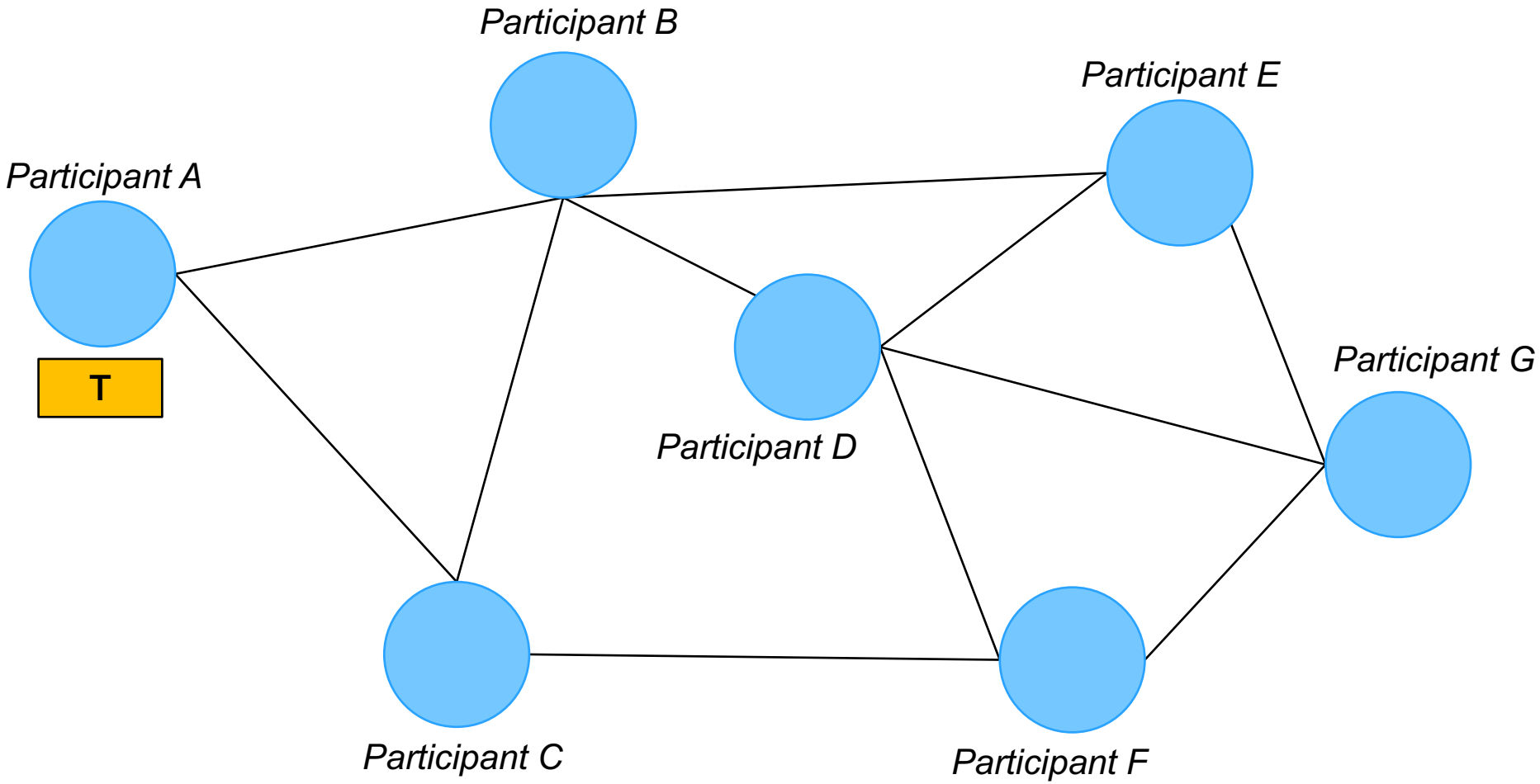




BLOCKCHAIN: ADDING BLOCKS

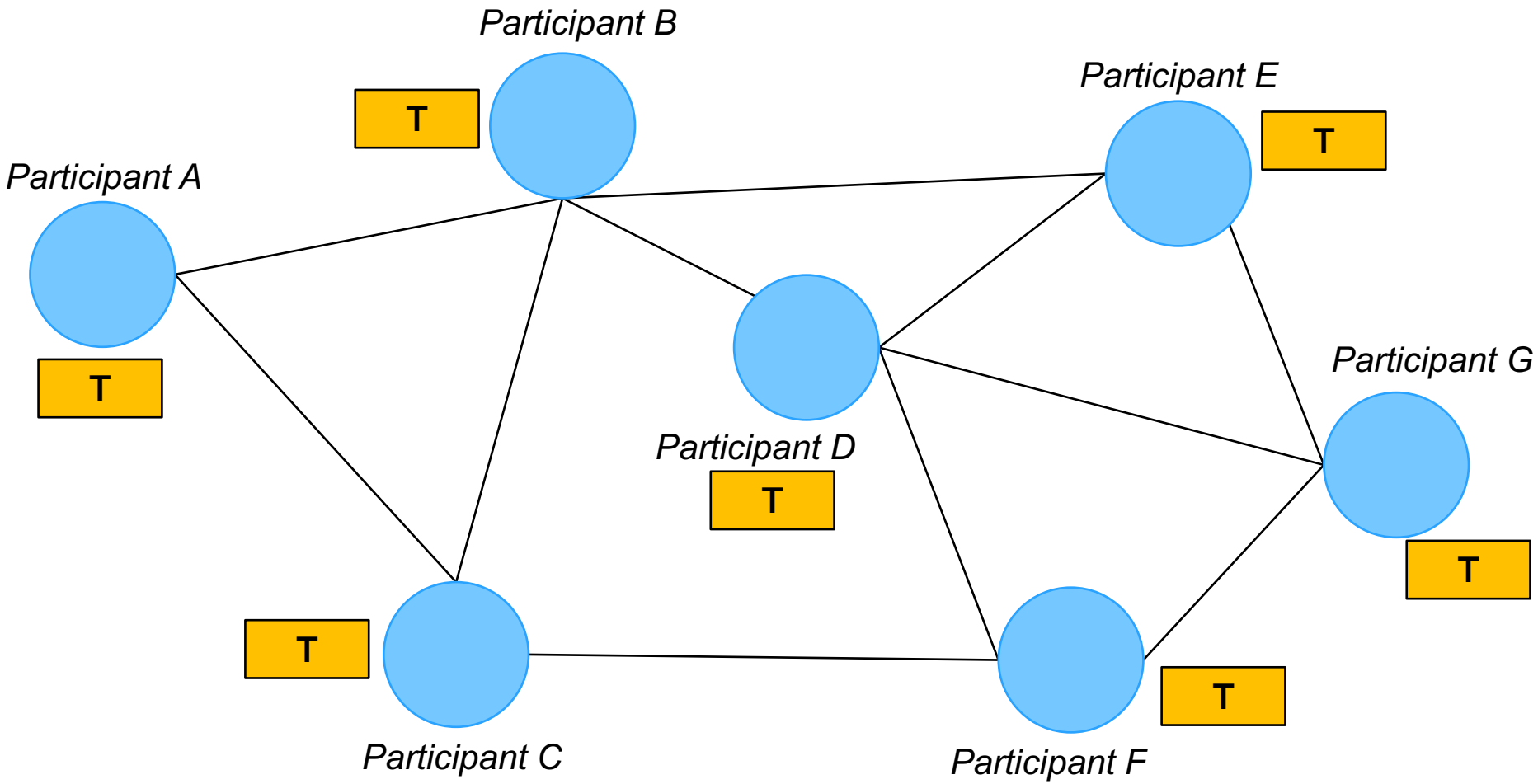
"A" wants to add a digitally signed transaction T to the blockchain.

Transaction T:
A pays B 10 EUR



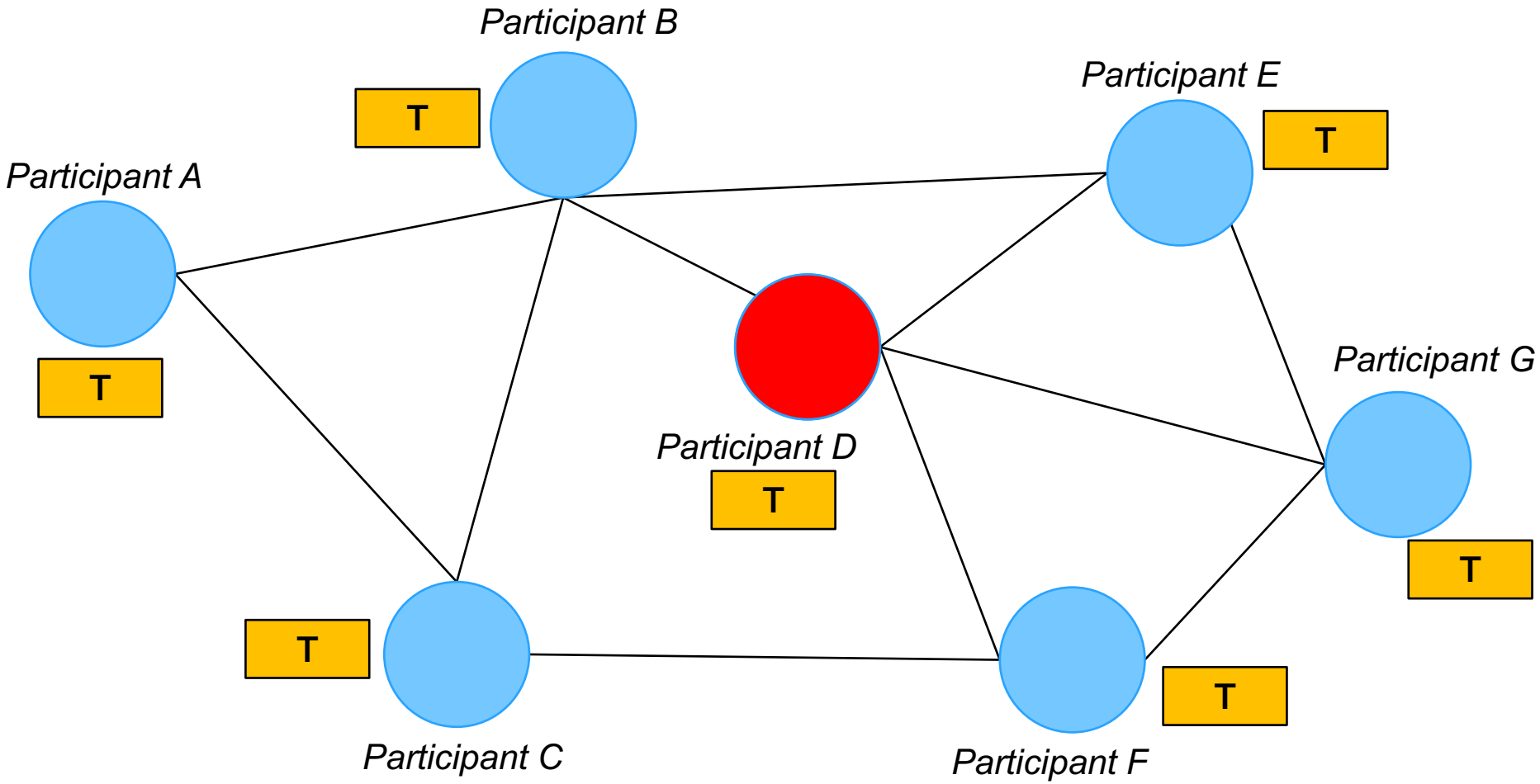
BLOCKCHAIN: ADDING BLOCKS

A transmits the transaction incl. a fee to its neighbors B and C, who forward it to their peers and so on.



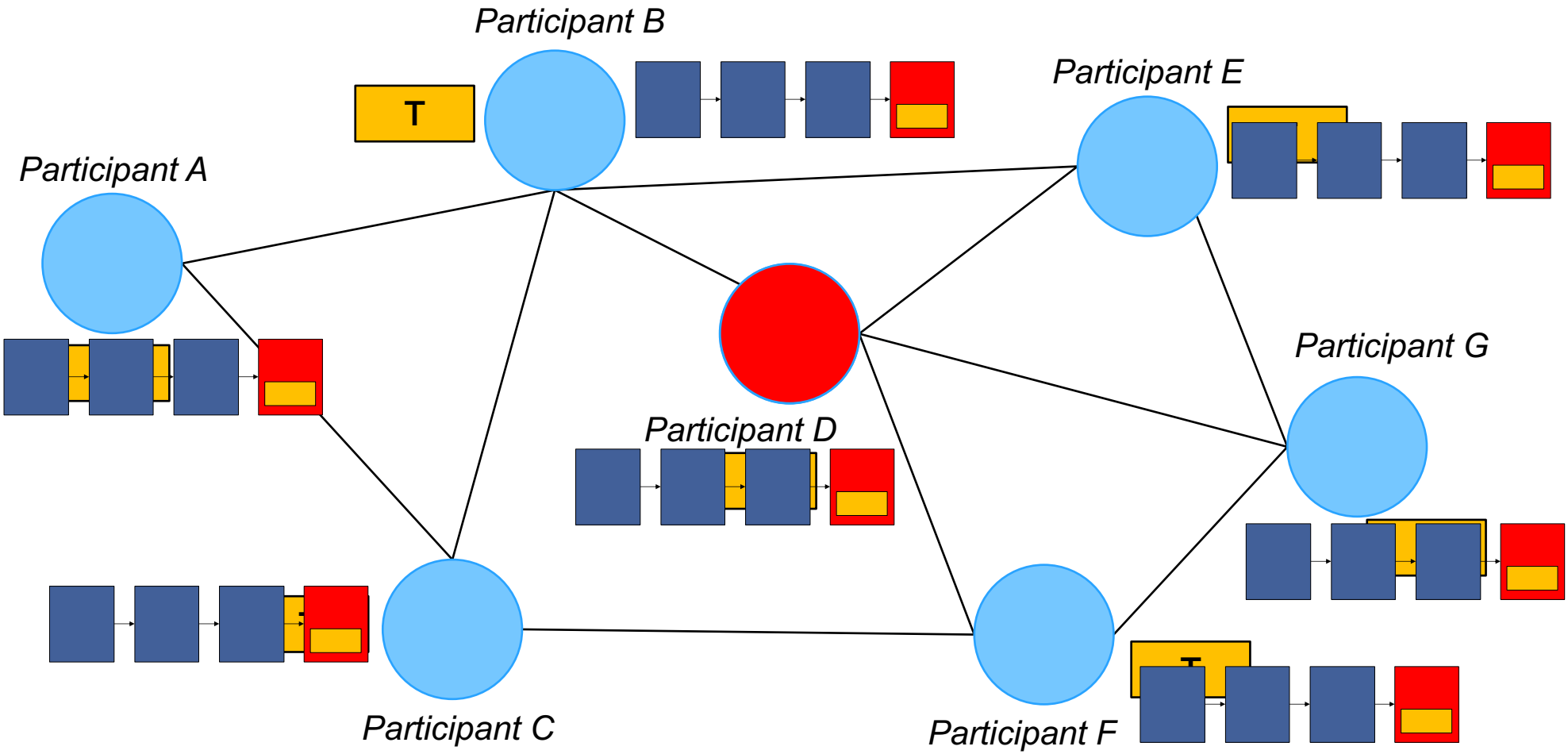
BLOCKCHAIN: ADDING BLOCKS

One participant is selected through a decentralized lottery (cryptographic puzzle).



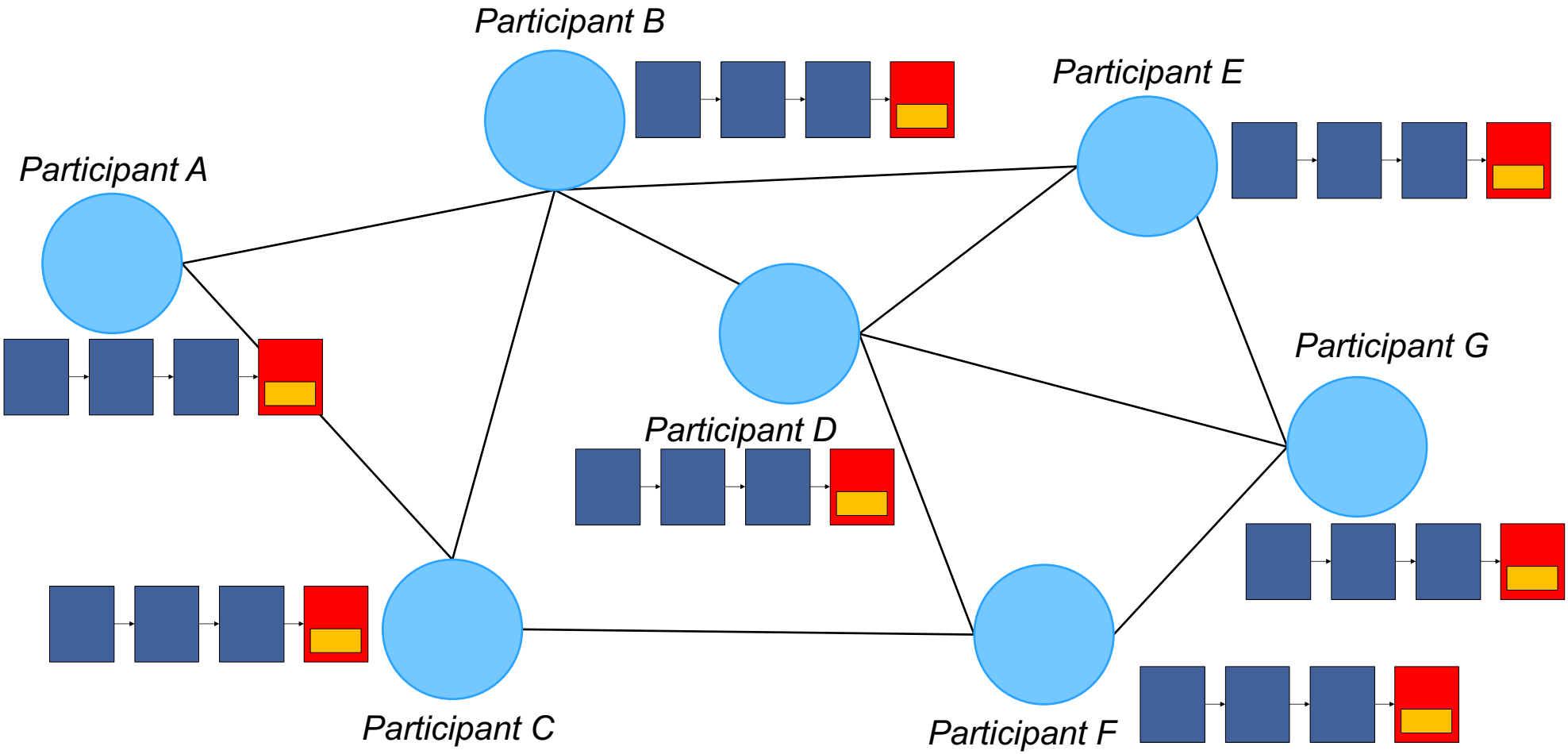
BLOCKCHAIN: ADDING BLOCKS

This participant adds the transaction as a new block to the blockchain and distributes the information to its peers.



BLOCKCHAIN: ADDING BLOCKS

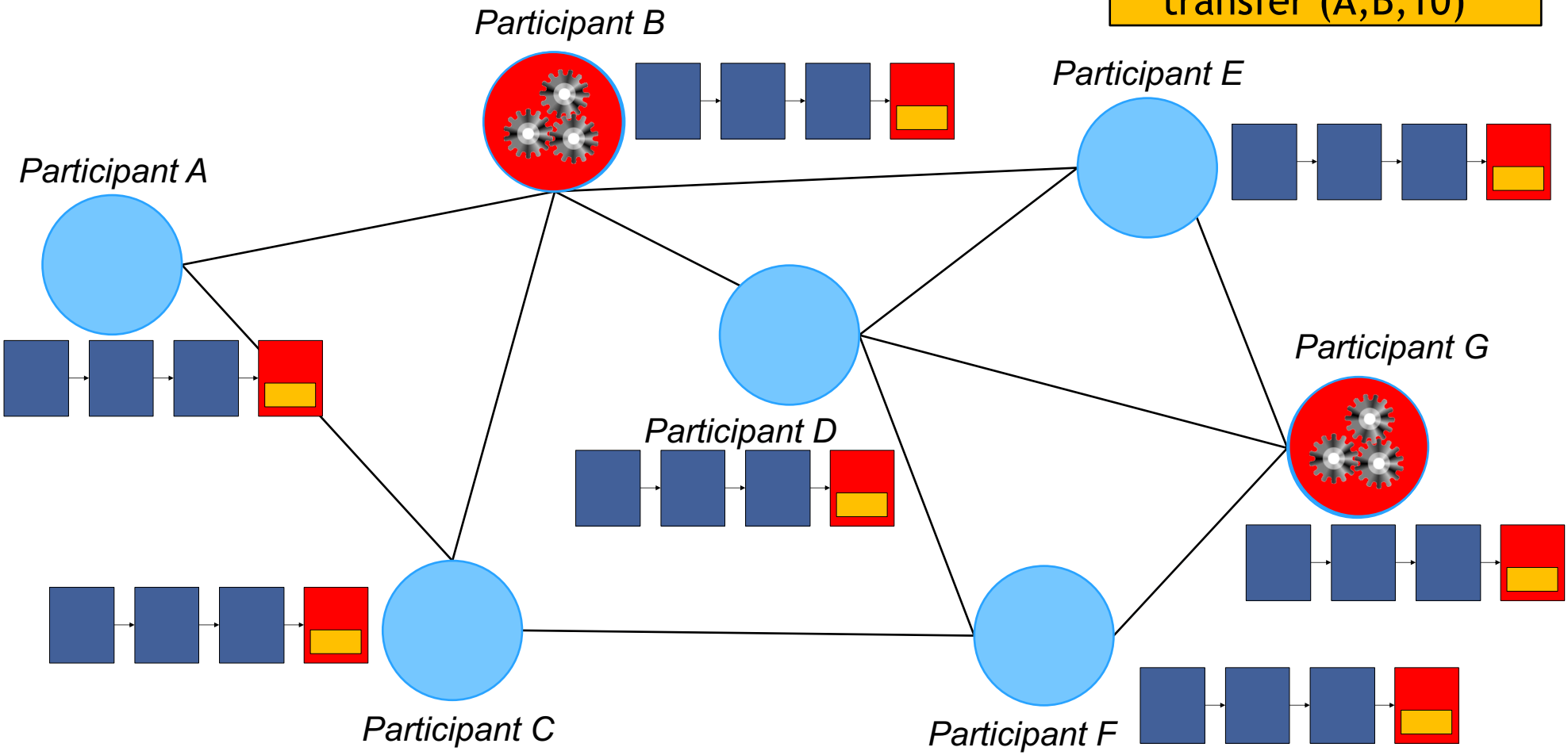
Every participant validates the blockchain. If multiple versions exist, the longest chain (in terms of effort) prevails.



BLOCKCHAIN: SMART CONTRACTS

Transactions may also contain executable code = smart contract, which is executed decentrally upon request, results stored in blockchain

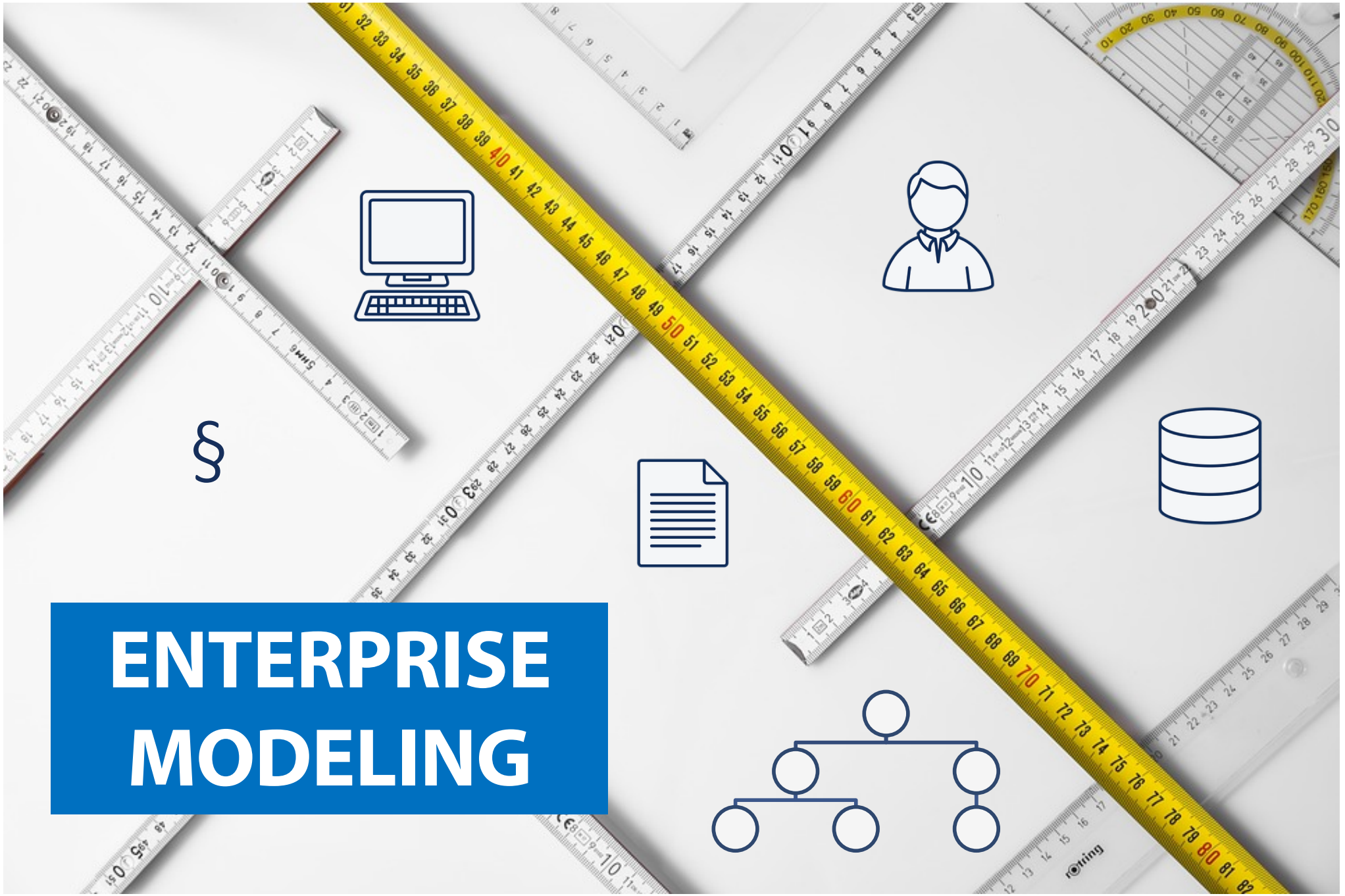
```
Transaction T:
contract c
 function check (x, y)
  if (x>y)
   transfer (A,B,10)
```



POTENTIAL APPLICATIONS

Potential applications for blockchains include:

- Virtual currencies
- Public registers
- Attestation and traceability of information
- Decentralized electronic identities
- Decentralized applications (DApps)


§
ENTERPRISE
MODELING

APPROACHING THE TOPIC

dblp
computer science bibliography

"Enterprise Modeling" ||
"Enterprise Modelling"

466 Results

4.618.764 Titles

METHODS

INFORMATION

ANALYSIS

LANGUAGES

DATA

ALIGNMENT

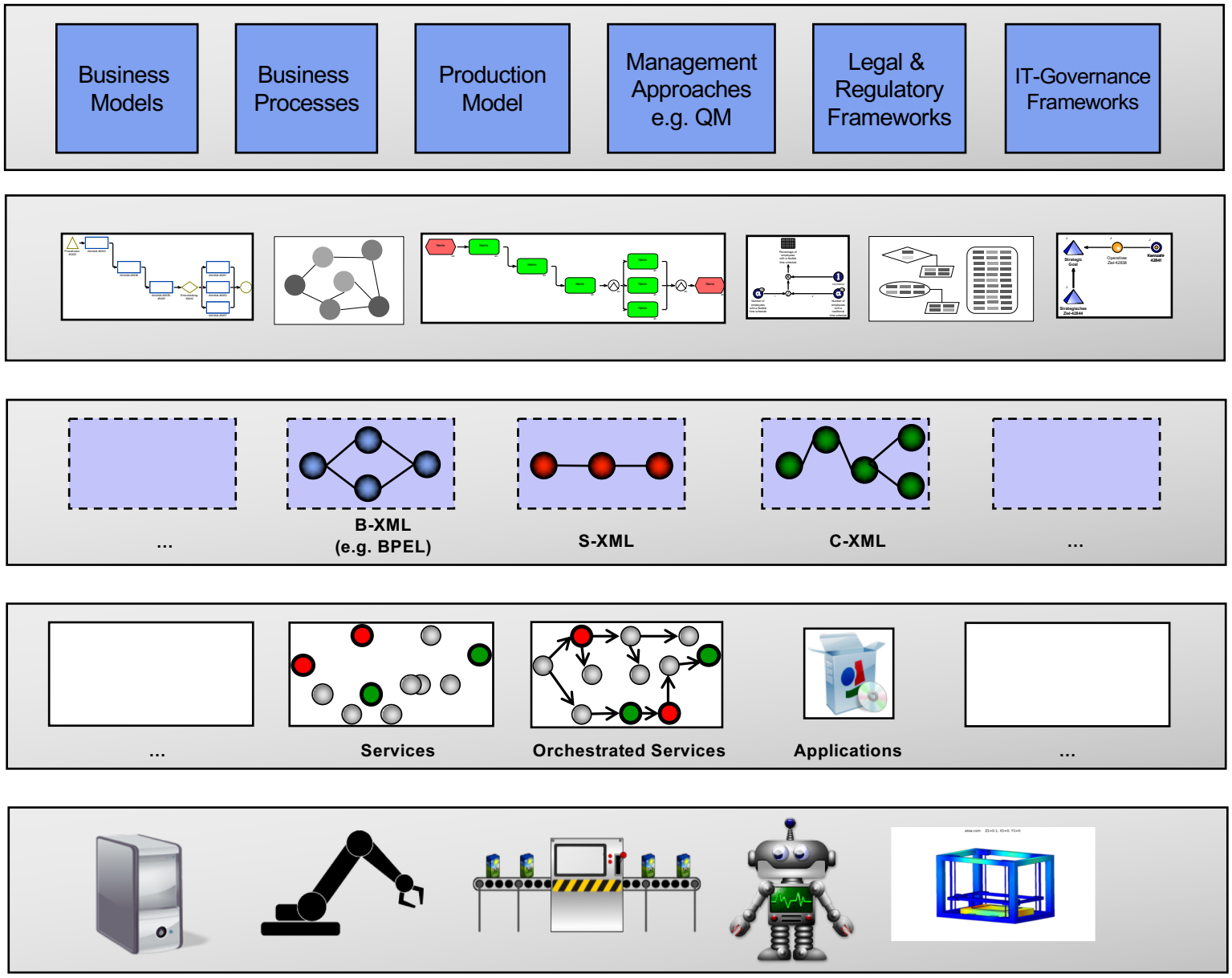
DESIGN

PROCESSES

BUSINESS

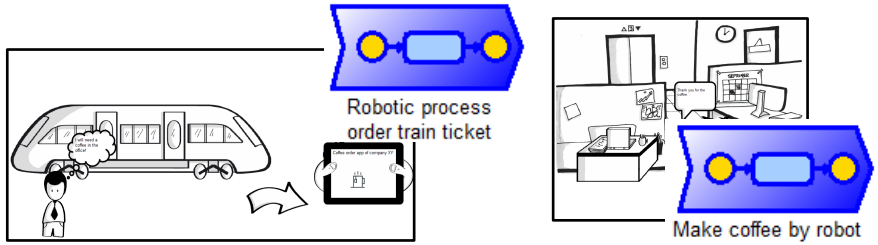
Included Titles: Articles, Inproceedings, Incollection, Book, Phdthesis, Masterthesis

VIEWS IN ENTERPRISE MODELING



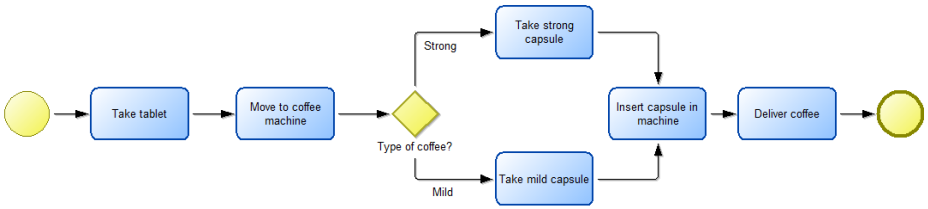
EXAMPLES IN ENTERPRISE MODELING

Business View



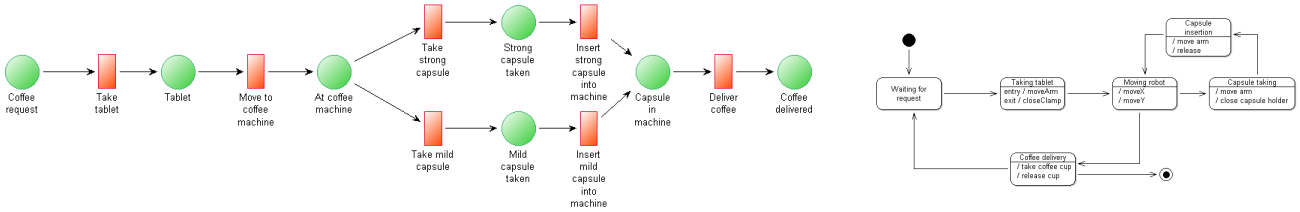
Scene Models for Business Model Innovation

Semiformal View



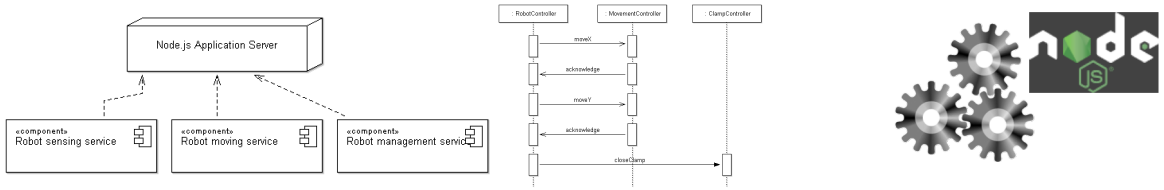
BPMN for Business Processes

Formalized View



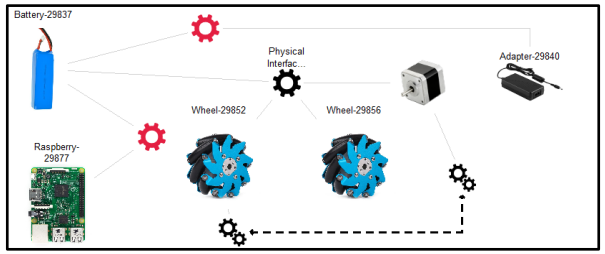
Petri Nets, State Charts for Formalization

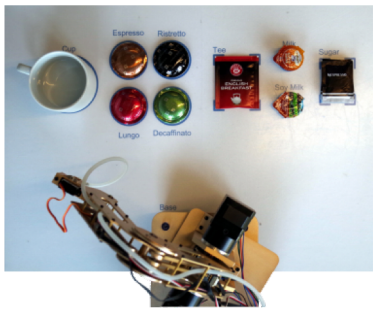
Technology View



UML Deployment, Sequence Diagrams / Node.Js Engine

Cyber Physical / Infrastructure View





Architecture Model for Cyber Physical Systems / CPS

OMiLAB®

Modeling Methods & Tools from:
www.omilab.org

BLOCKCHAIN
ENTERPRISE
MODELING

BLOCKCHAIN → **ENTERPRISE MODELING**

Enterprise models as knowledge sources combined with blockchain technologies:

- Decentralized, immutable storage of knowledge / information
- Decentralized execution / monitoring of models

Recent examples:

- ✓ Knowledge Blockchains
- ✓ Decentralized Attestation of Models
- ✓ Decentralized Coordination of Business Processes

KNOWLEDGE BLOCKCHAINS

General Idea:

- Blockchains for storing and distributing knowledge in the form of conceptual models
- Encode models in blockchain data structures for tracking changes, ownership of contained information, potentially rewarding contributions
- Mechanisms for permission management
- Specific mining protocol for validating information

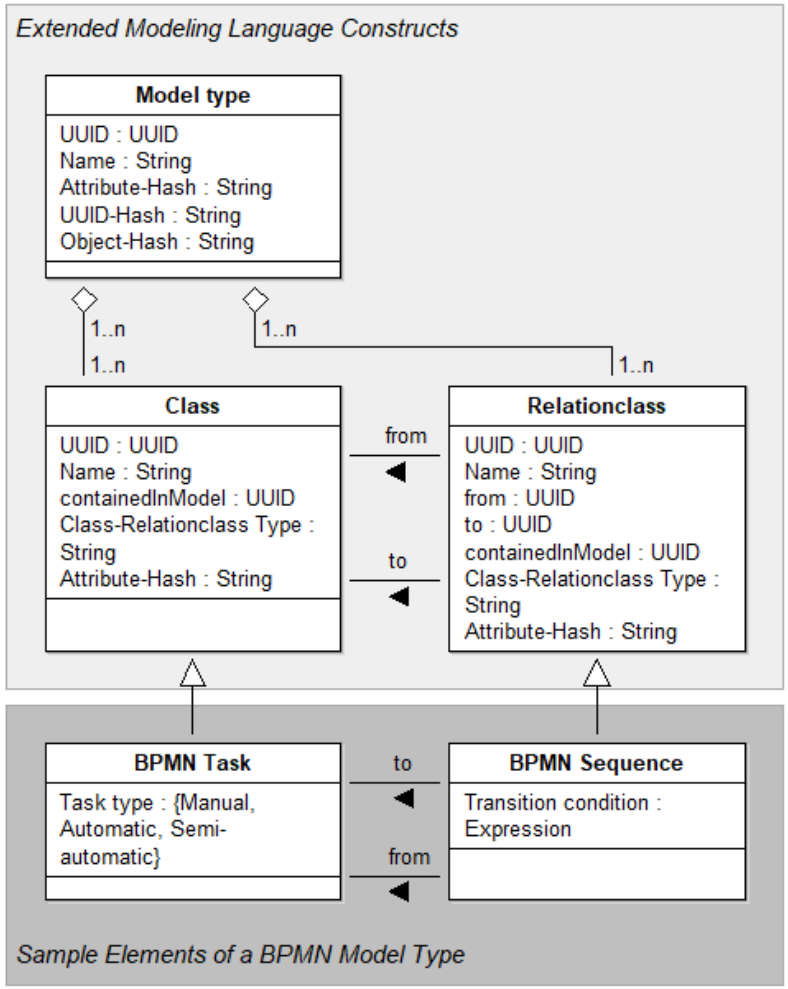
Requirements:

- Suitable blockchain technologies
- Adaptation of modeling languages and tools for blockchains
- Transformations from models to blockchain data structures
- Solution for storing model information on blockchain infrastructures

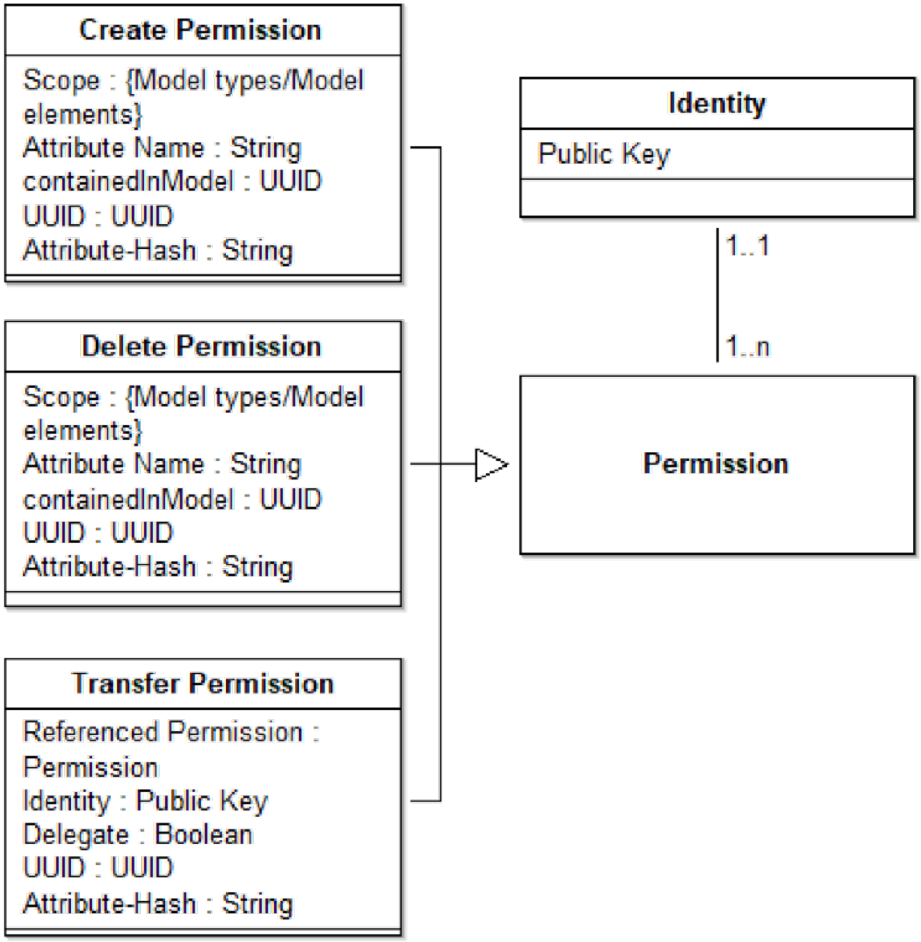
Fill, Hans-Georg, Härer, Felix (2018): Knowledge Blockchains: Applying Blockchain Technologies to Enterprise Modeling, HICSS'51, AIS, pp.4045-4054.

KNOWLEDGE BLOCKCHAINS

Extensions of Modeling Languages with UUIDs



Definition of a Permission Model Language



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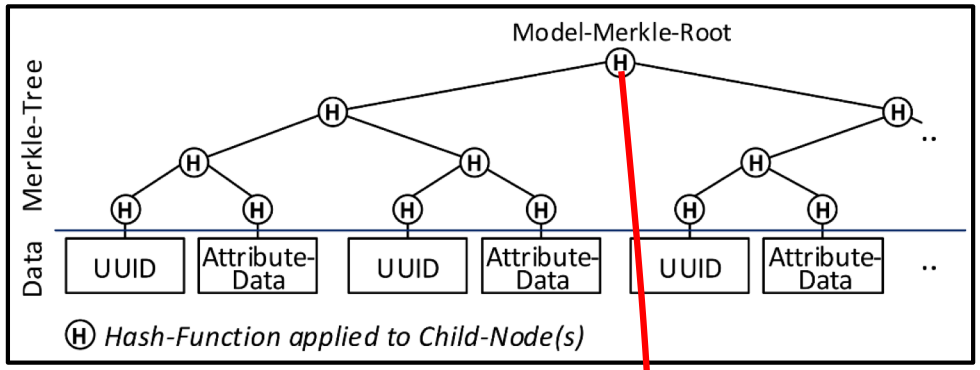
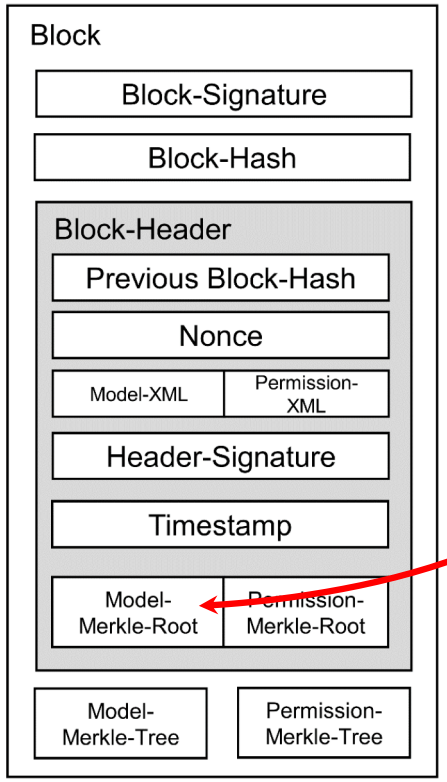
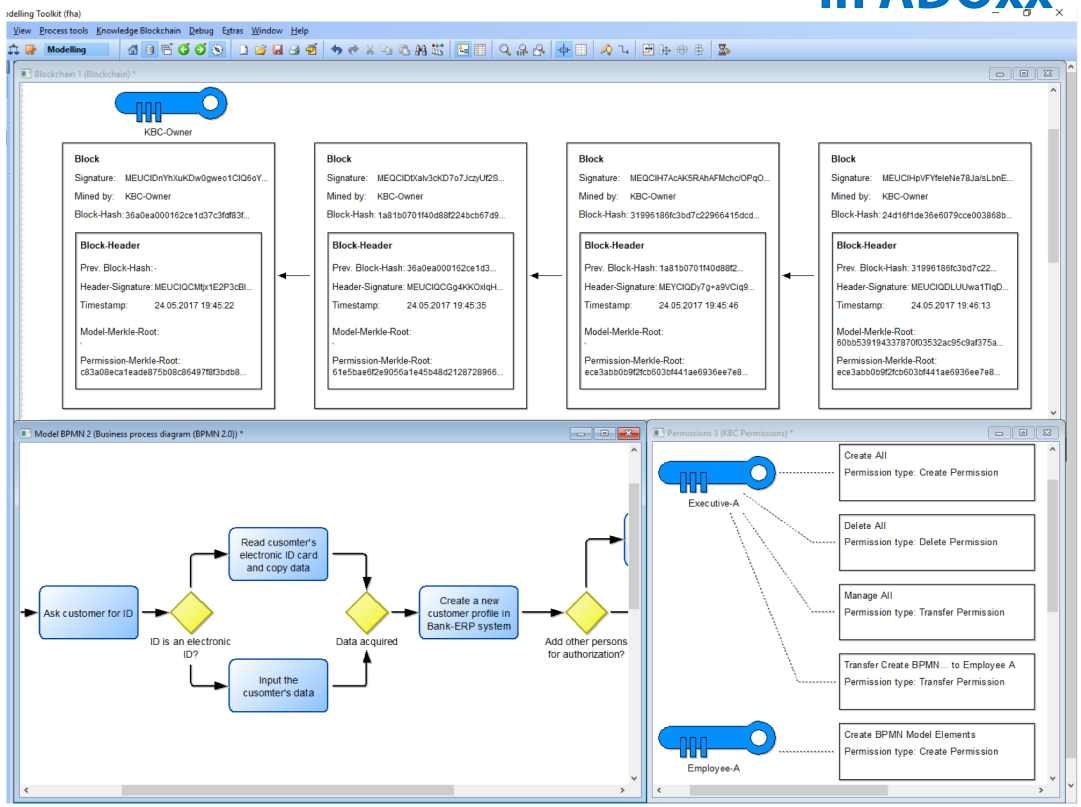
KNOWLEDGE BLOCKCHAINS

Use of Blockchain Data Structures





Prototypical Implementation in ADOxx



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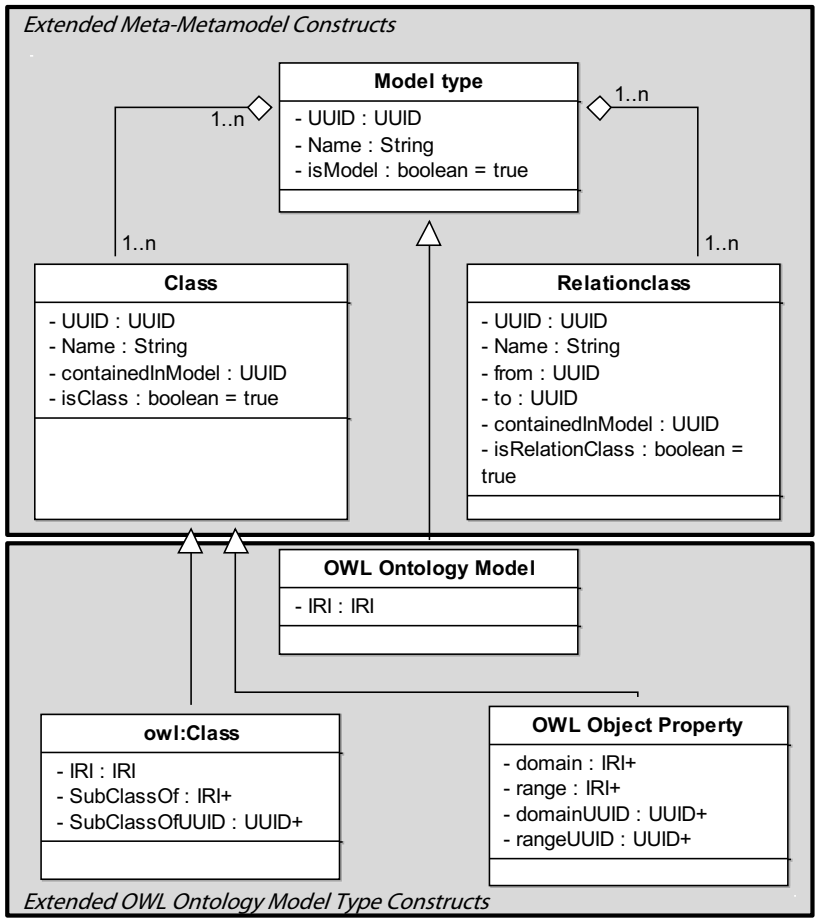
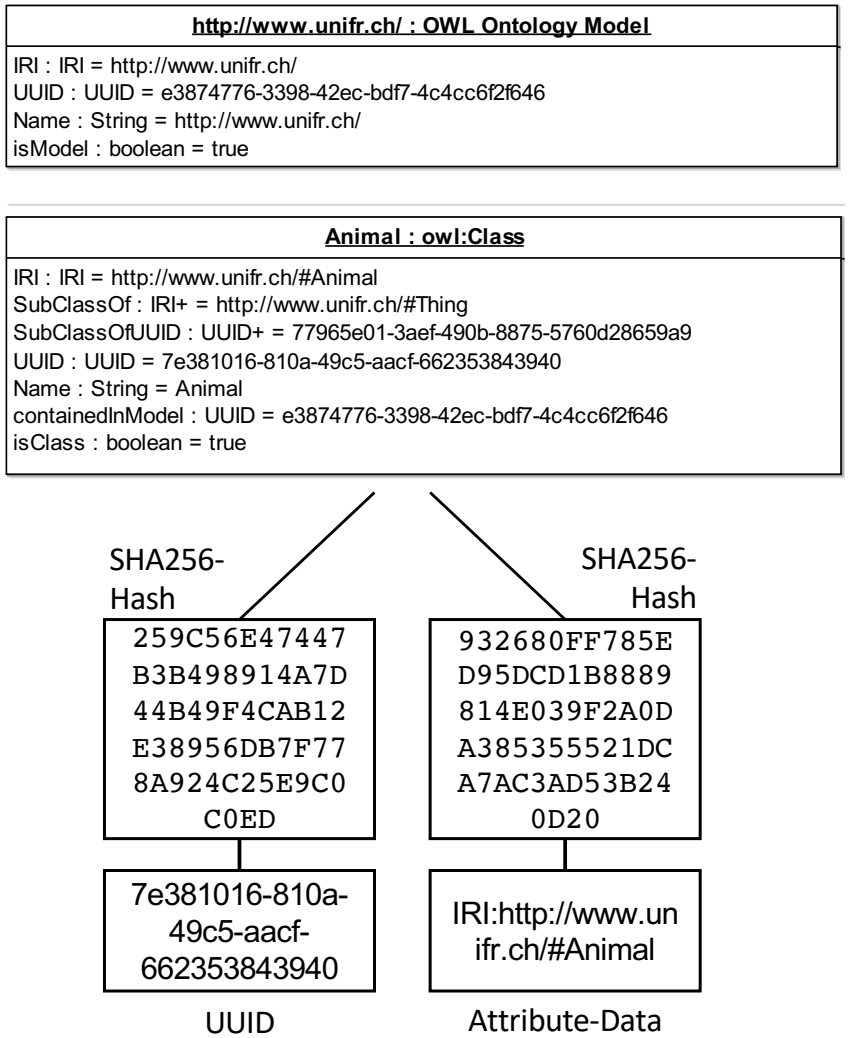
KNOWLEDGE BLOCKCHAINS

Recent Application to OWL Ontologies





Fill, Hans-Georg (2019): Applying the Concept of Knowledge Blockchains to Ontologies, in: AAAI 2019 Spring Symposium on Combining Machine Learning with Knowledge Engineering, Stanford University.

KNOWLEDGE BLOCKCHAINS

Benefits of Knowledge Blockchains

- Decentralized Monitoring of Evolution and Provenance of Concepts
- Digitally Signed Content
- Decentralized Permission and Delegation Schemes
- Zero-Knowledge Proofs for Sensitive Environments
- Foundation for possible reward mechanisms, e.g. quality assurance, decentralized remuneration, etc.

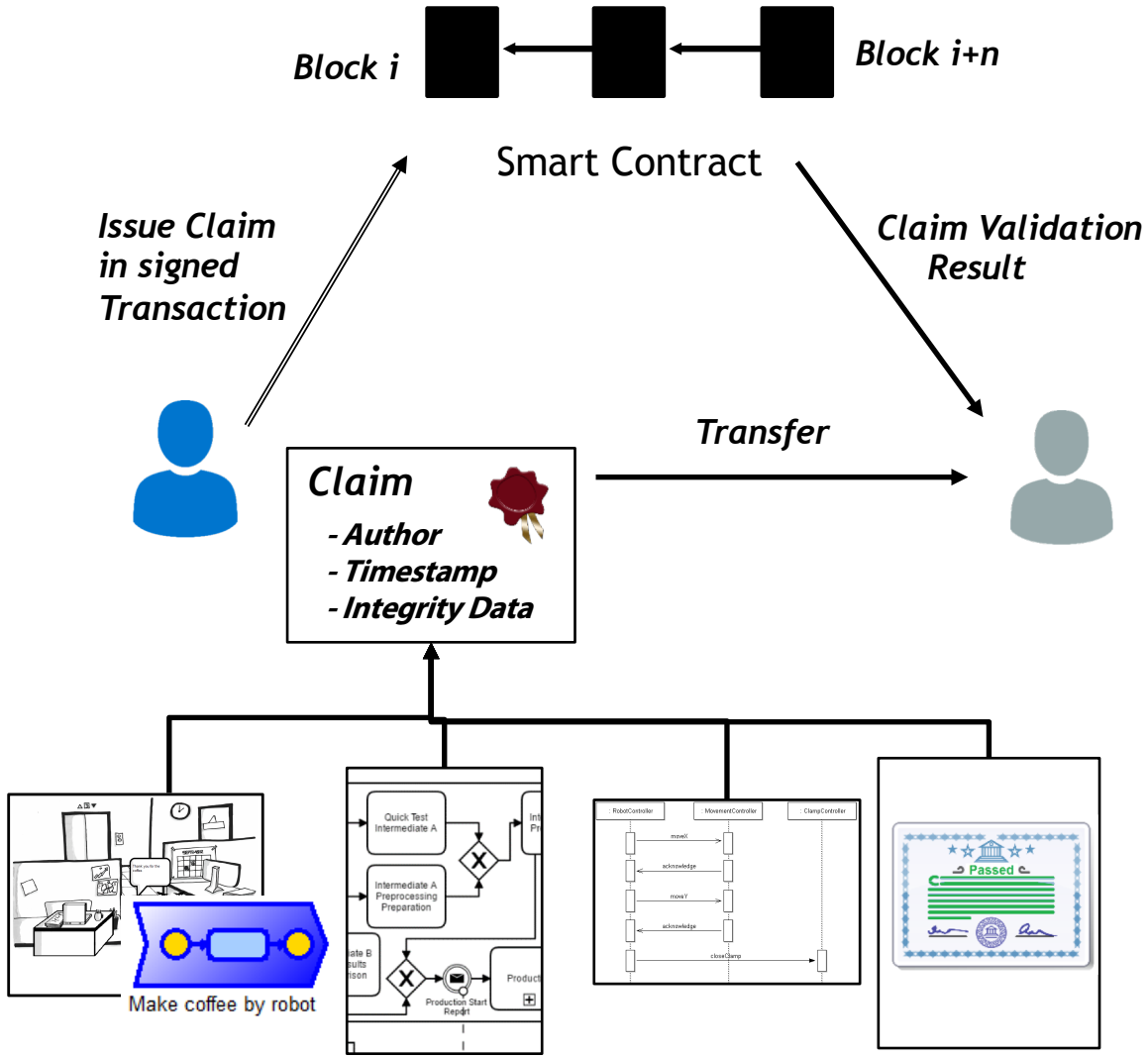
Current Limitations

- Compatibility with existing blockchain platforms
- Storage of models

DECENTRALIZED ATTESTATION OF MODELS

Attestation without a trusted third party

- Proves the existence of information at a certain point in time
- Issuance of Claims, e.g. on
  - Intellectual Property
  - Contractual Agreements
  - Certifications and Degrees
  - Business Processes
- Modeling of specific attestations in ADOxx
- Issuance and Verification of Claims in Ethereum

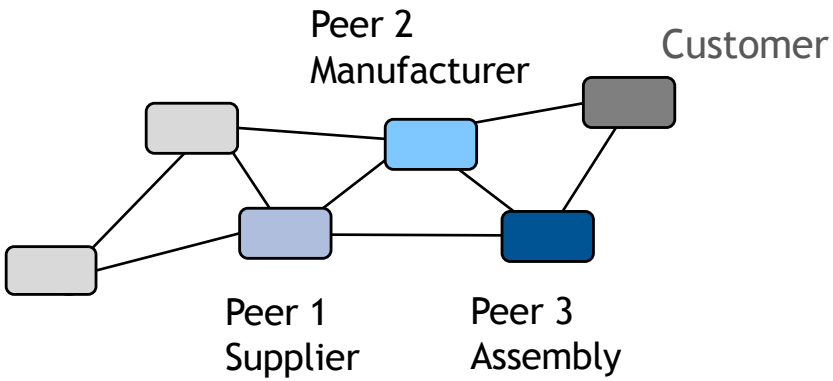


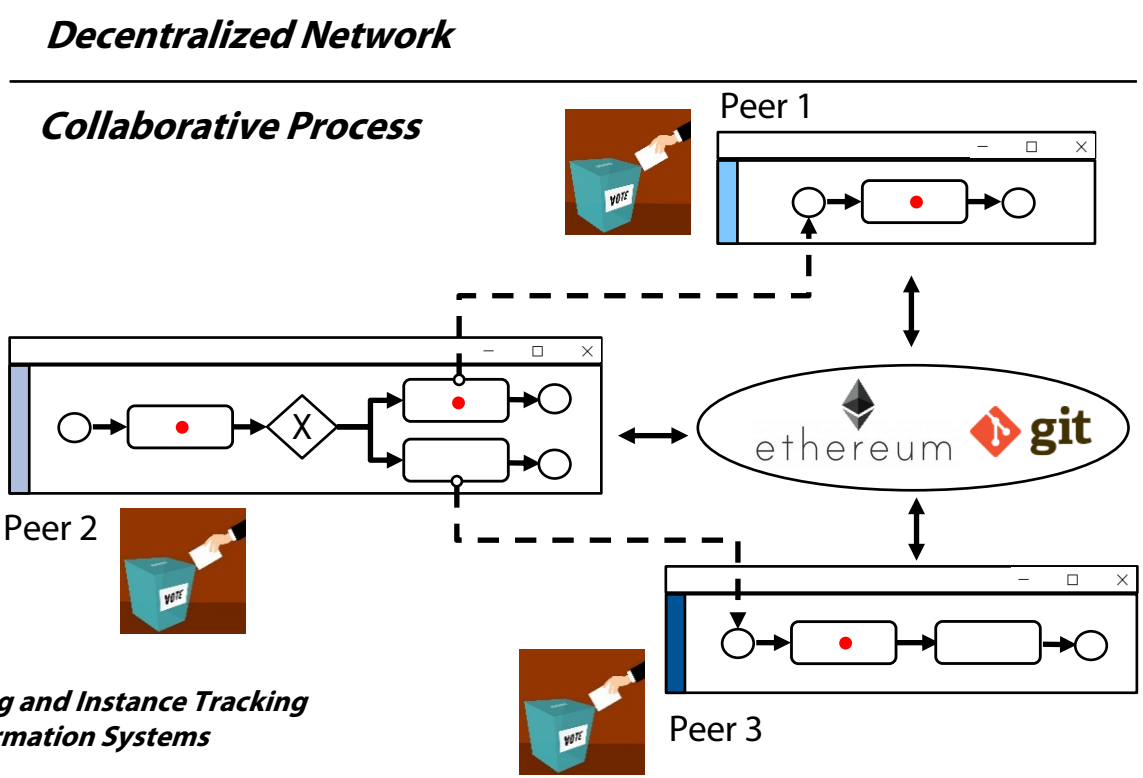
Härer, Felix, Fill, Hans-Georg (2019): Decentralized Attestation of Conceptual Models Using the Ethereum Blockchain, 21st IEEE International Conference on Business Informatics (CBI)

DECENTRALIZED COORDINATION OF BUSINESS PROCESSES

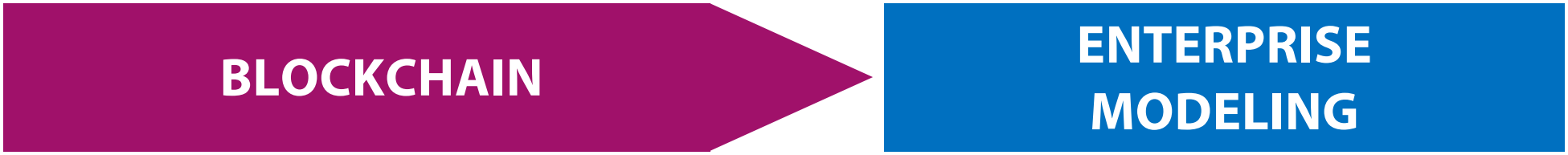
Interorganizational Business Processes

- Formation of organizations where no single entity is in control
- *Process Planning*
  - Collaborative process modeling
  - Global processes and local views per peer
  - Agreement controlled via voting by smart contract
- *Instance tracking*
  - Distributed tracking of execution states
  - Global verifiability



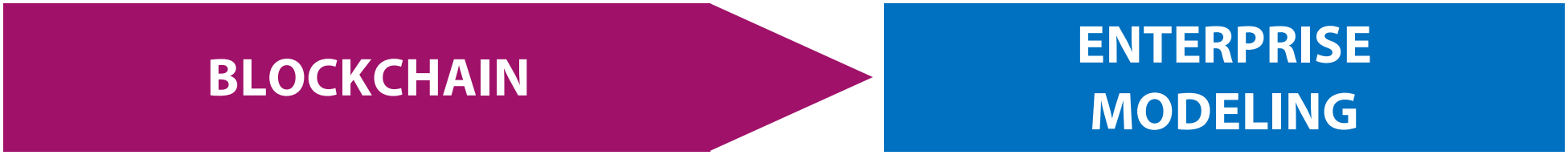


Härer, Felix (2018): Decentralized Business Process Modeling and Instance Tracking Secured by a Blockchain, 26th European Conference on Information Systems



Opportunities

- Blockchains for decentralized cooperation and coordination in enterprise modeling
- Smart contracts for processing of model information without central engines
- Well-suited for distributed scenarios with many, potentially untrusted parties who require transparency



Challenges

- Decentralization & transparency require fundamental re-thinking of all views in enterprise modeling
- Blockchains and smart contracts require in-depth technical knowledge for successful application to modeling
- Current technical limitations of public blockchains (speed, scalability, energy consumption)

OUTLOOK

- Further advancement of approaches for attesting models, e.g. using qualified signatures
- Provision of open-source implementation for Knowledge Blockchains
- Blockchains as an interesting research subject: Transparency, Decentralization, Cryptographic Methods

THANK YOU FOR YOUR ATTENTION!

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