A conceptual model for blockchain-based trust in digital ecosystems

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Motivation

- Trust is a difficult concept
- Definition varies across different disciplines, contexts, and types of participant relationships
- (McKnight and Chervany 2001) *"The extent to which one party is willing to depend on the other party in a given situation."*

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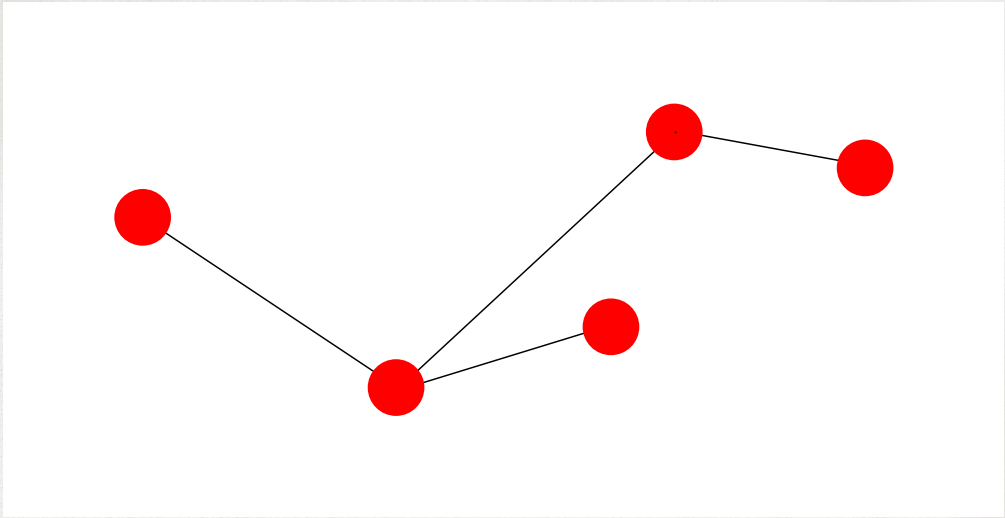
- 4 constructs:
  - **Disposition to Trust** (individual's willingness to rely on others)
  - **Institution-based Trust** (assurances provided by institutions or systems)
  - **Trusting Beliefs** (positive traits of others)
  - **Trusting Intention** (readiness to rely on others)

Motivation: Trust in interoganisational business processes



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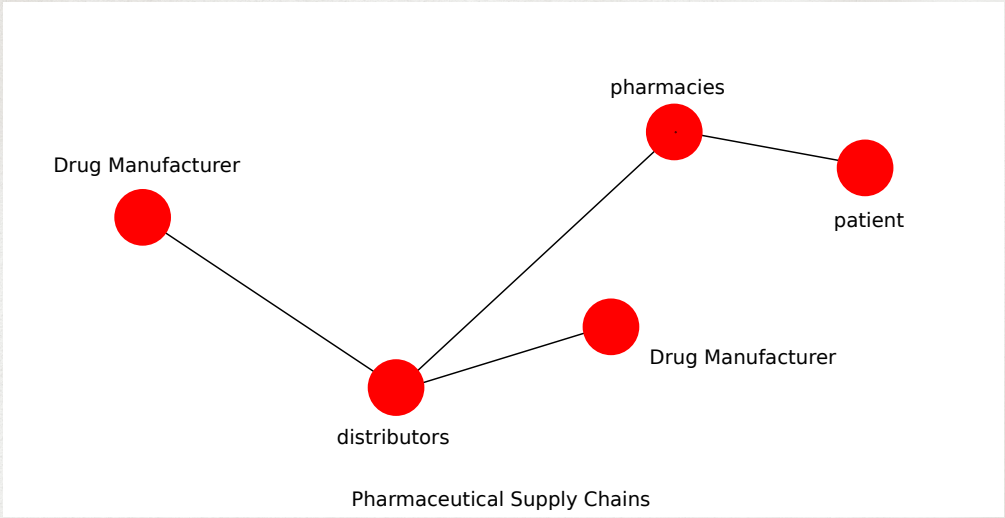

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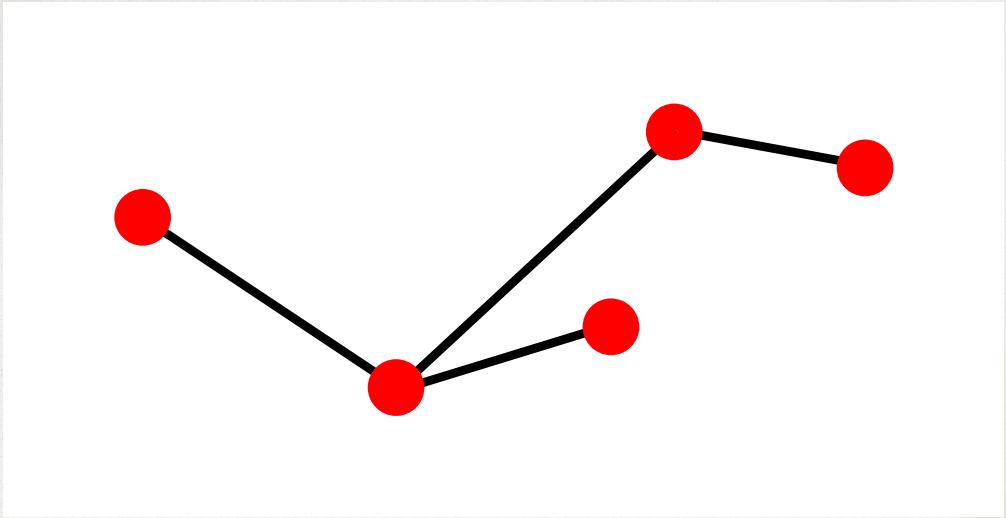

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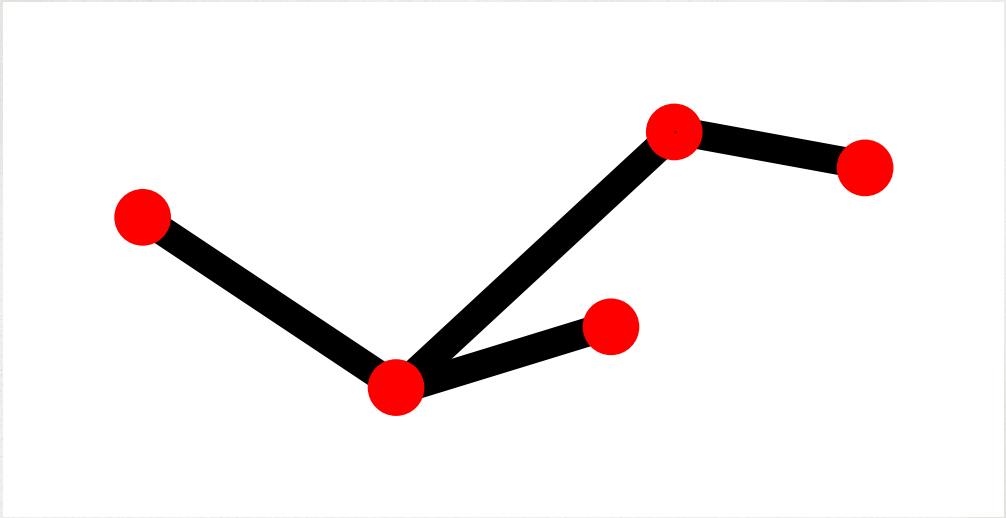
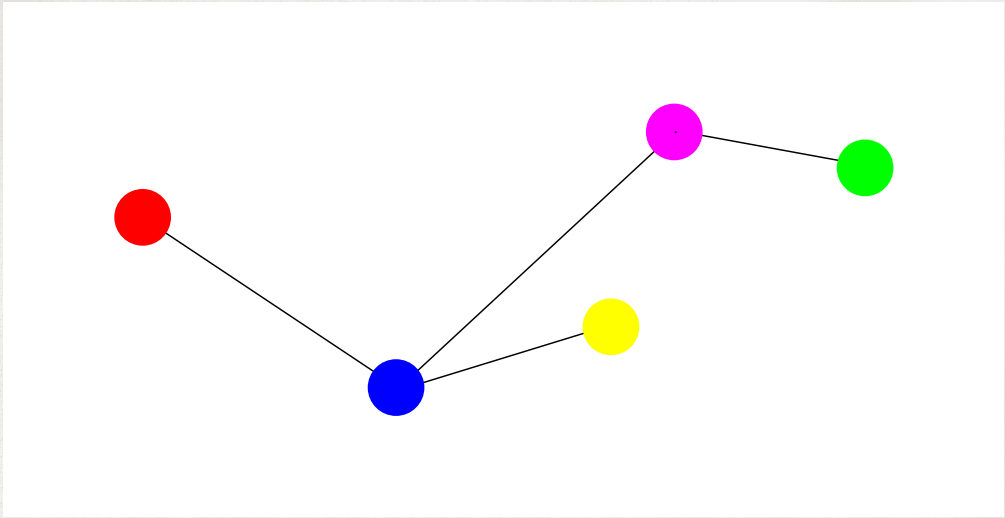


Motivation: Trust in interoganisational business processes

If Processes and actors are stables

- Actors trust based on previous experience
- ↗ Trusting Beliefs
- ↗ Trusting Intention
- ↗ Trust, ↘ Control
- ↗ Efficient processes

Motivation: Trust in digital Ecosystems



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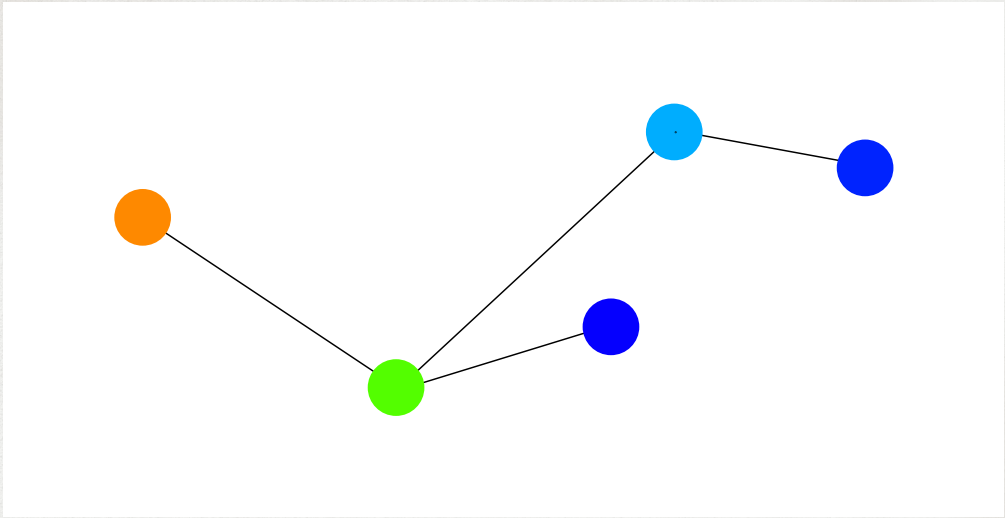

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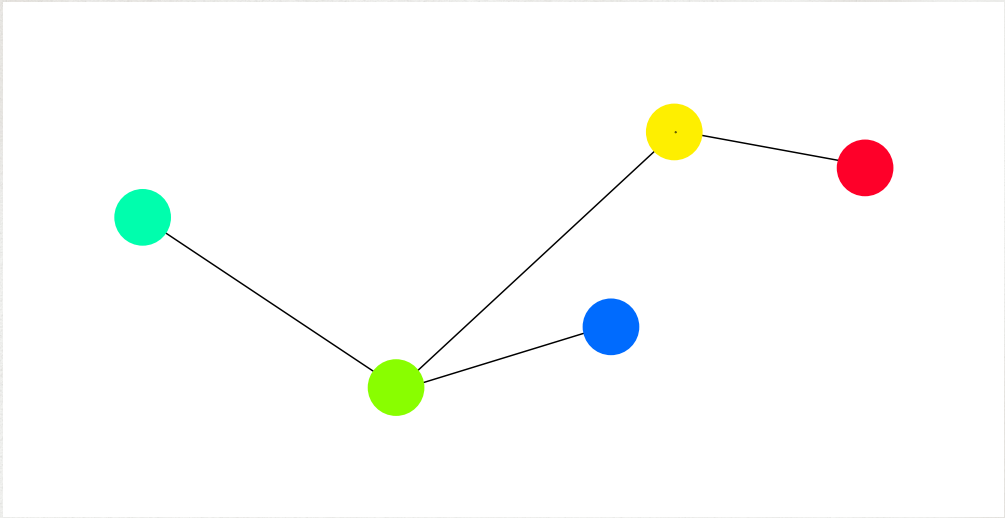

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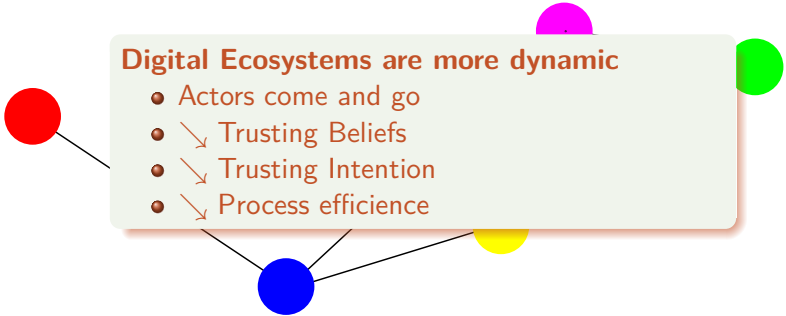

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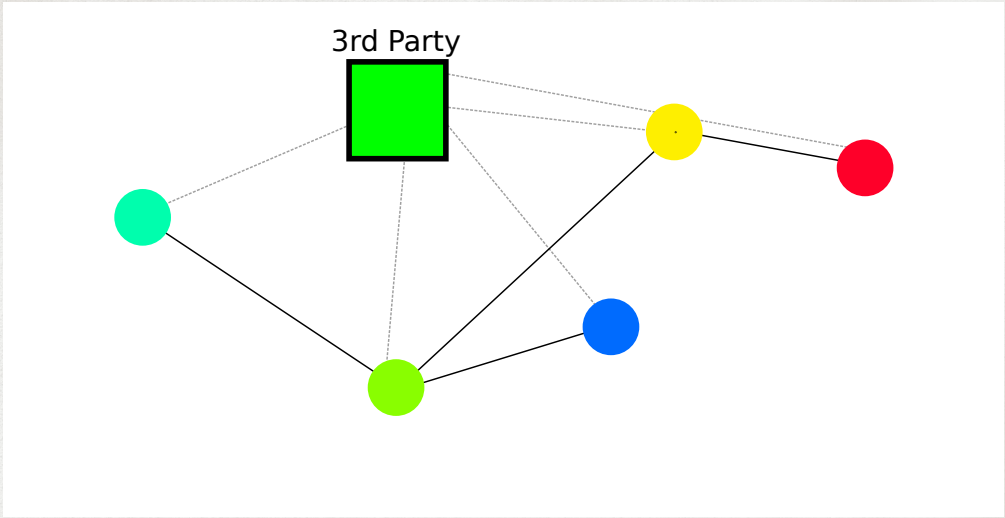

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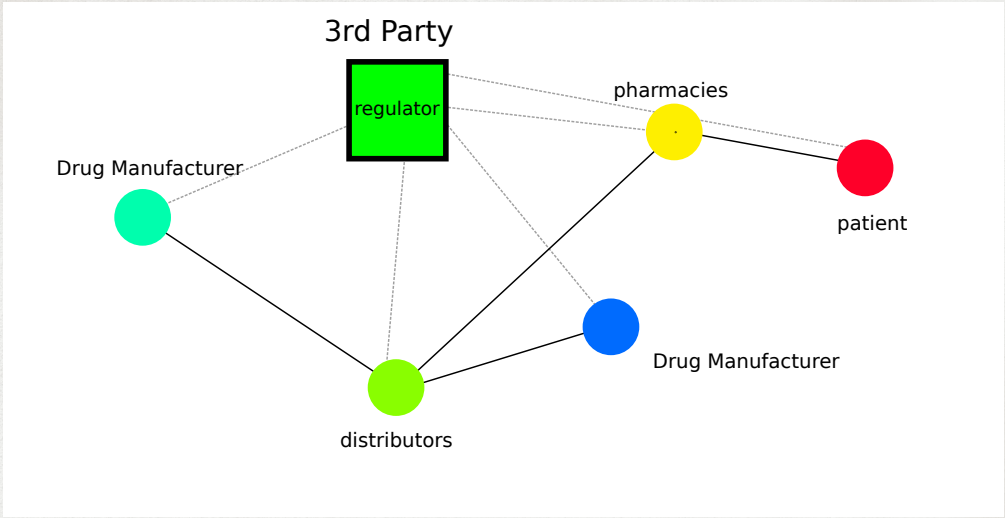

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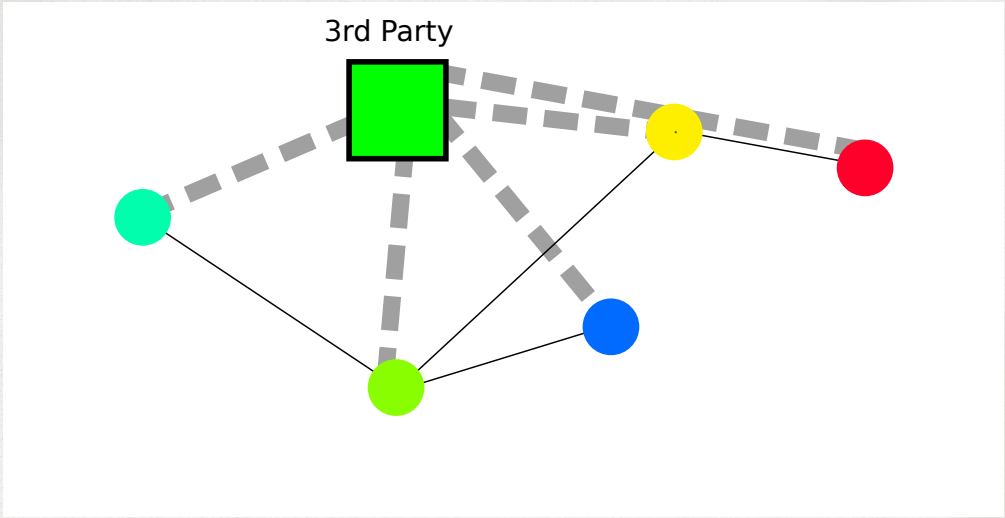

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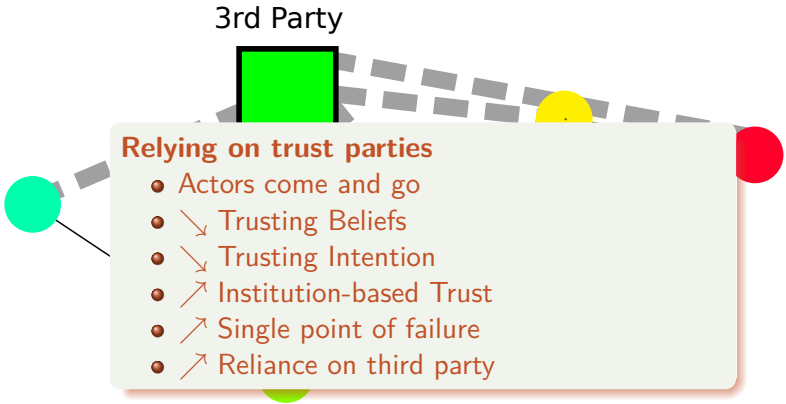

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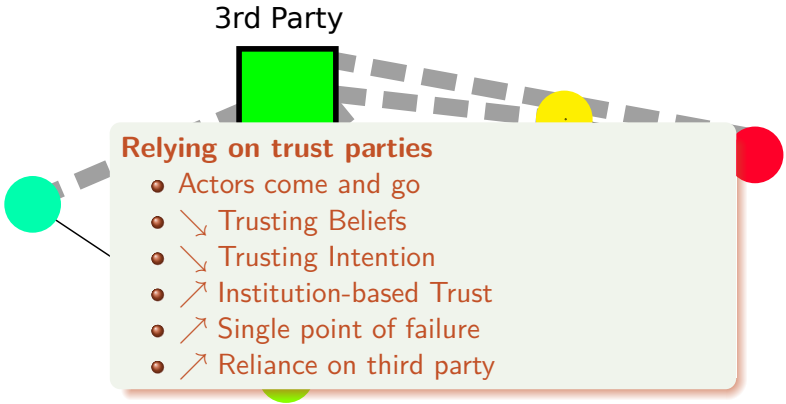

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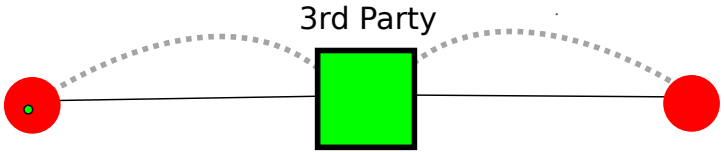

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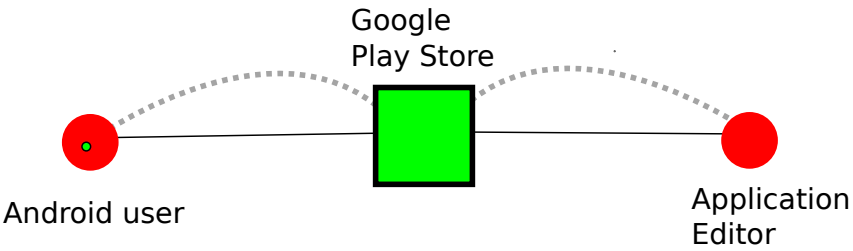

Trust facilitator => market maker

Motivation: Blockchain as a trust Maker

- **Trust is Critical:** Fear of unmet expectations discourages collaboration.
- **Traditional Models:** Centralized systems lack flexibility.
- **Blockchain Solution:** Facilitates decentralized, robust, and trusted processes.

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Research Questions

- **RQ1:** How to model trust issues in inter-organizational business processes?
- **RQ2:** How to prove that a blockchain-intensive system addresses trust issues?

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Related Work

Trust Ontology

- **McKnight et al.:** Four constructs - Disposition to Trust, Institution-based Trust, Trusting Beliefs, Trusting Intention (McKnight and Chervany 2001)
- **Amaral et al.:** Reference Ontology of Trust (ROT), focusing on social and institution-based trust (G. Amaral et al. 2019).

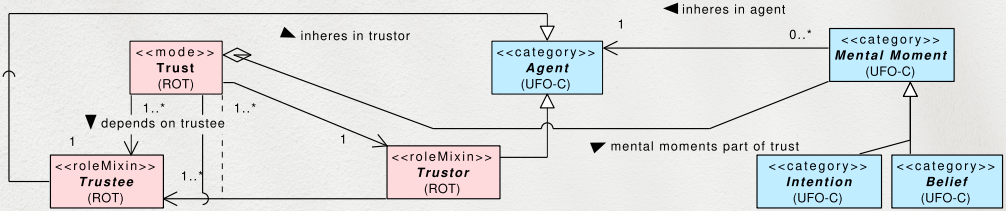
Blockchain and Trust

- **Hawlitschek et al.:** Blockchain's potential to organize decentralized markets and reshape trust dynamics (Hawlitschek, Notheisen, and Teubner 2018).
- **Sayed et al.:** Blockchain removes intermediaries, ensuring transparency and integrity (SAYED and ORAL 2023).

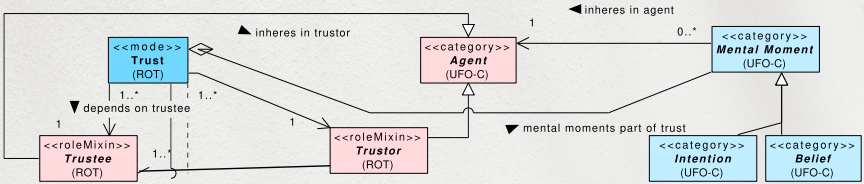
RQ1: Conceptual Model

UFO Ontology and Reference Ontology of trust

- Our work is grounded on:
  - Unified Foundational Ontology => providing foundational support for conceptual modeling (Guizzardi 2005)
  - Reference Ontoloy of trust => investigated the ontological nature of trust and formalize it (G. Amaral et al. 2019), (G. C. M. Amaral et al. 2021)
  - OntoUML => easy-to-use formalization language for UFO-based ontologies



Ontology of trust of Digital Ecosystems



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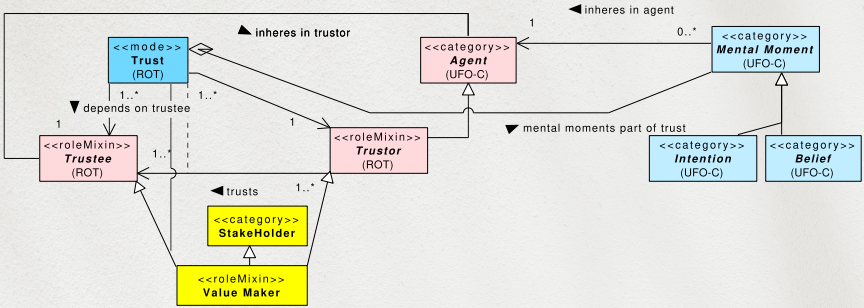

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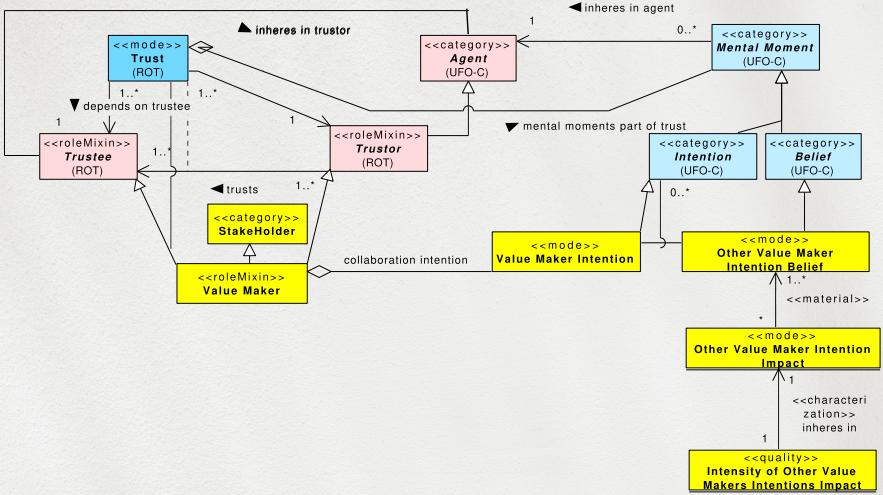

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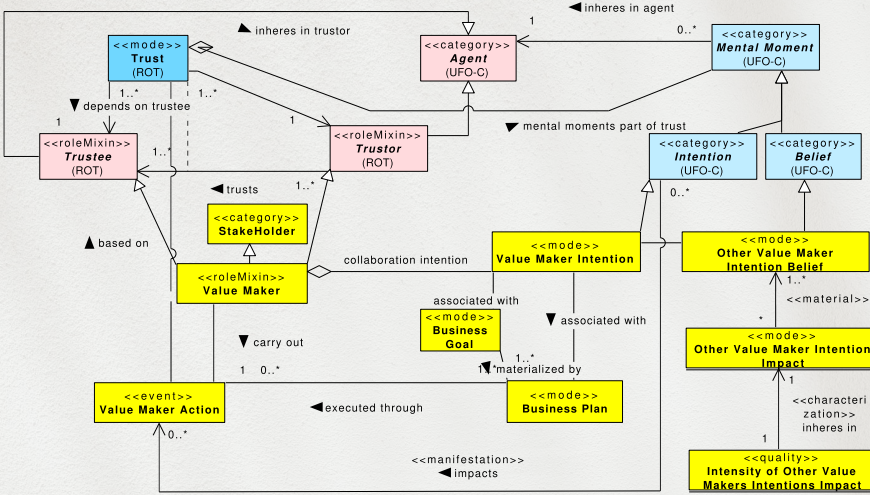

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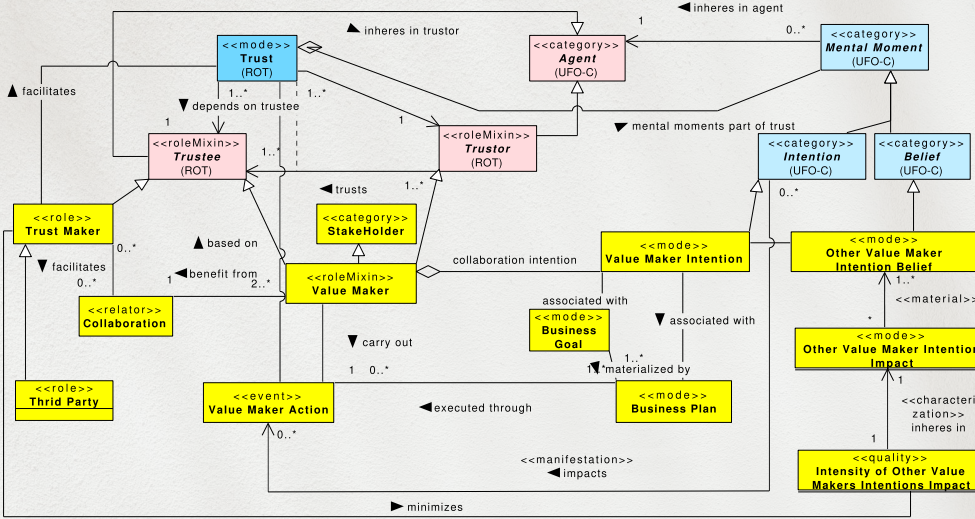

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Ontology of Trust in Digital Ecosystems

Value Makers

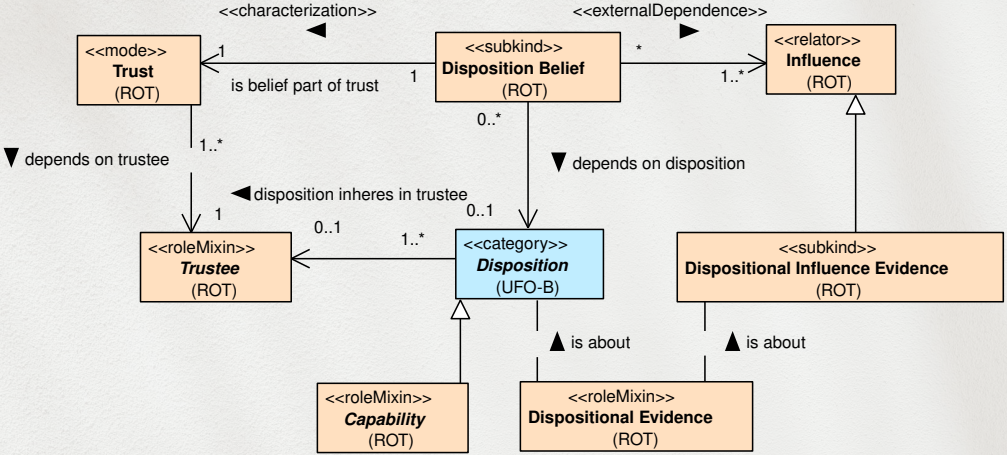
- Collaboration in Interorganizational Business Process (IBP), both trustor and trustee
- Can have trustworthy/untrustworthy intentions implemented through business goals
- Have particular beliefs in other Value Makers intentions and their impacts

Trust Makers

- Independent third parties facilitating trust without value creation.
- Minimize the impacts of other Value Makers Intentions
- Facilitate the collaboration between Value Makers

Role of the blockchain

- Grounded on (G. C. M. Amaral et al. 2021)



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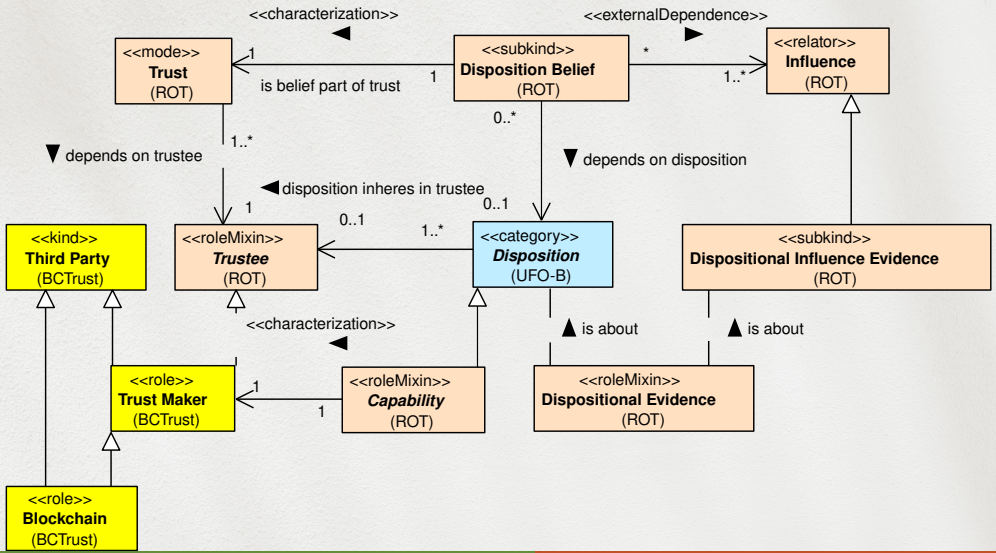

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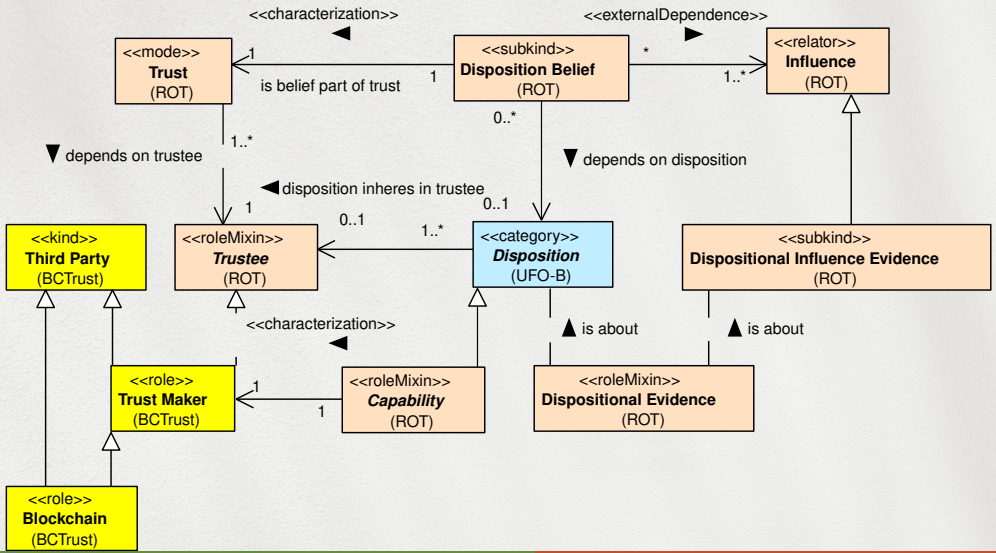

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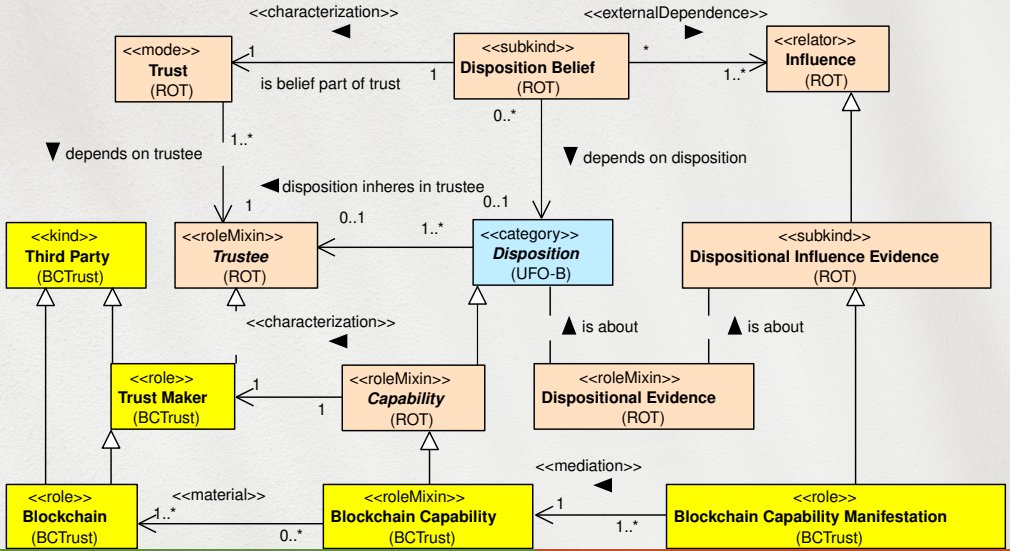

Role of the blockchain

Capabilities Manifestation

- **Capabilities:** Properties that manifest under specific conditions.
- **Trust in Blockchain:** Based on dispositional evidence.

Blockchain = Intentionless Trust Maker

- To foster trust in IBP one need to trust BC ~~intentions~~ Capabilities
- BC Capabilities can be assessed through Capability manifestations
- Required Capability manifestations depends on a risk analysis of the IBP.
- Finally, we moved to a trust in technology problem.

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RQ2: Fostering trust in BC System

1. Risk Analysis of the BP
2. Collect BC required trustworkth capabilities for the BP
3. Deduce types of evidence for each capability
4. Provide evidence

Evidence of Risk Mitigation

Risks	Risk Mitigation Manifestation	Capabilities at stake	**Type of Evidence to provide**
sybil attack	Network joining fee, Monitor nodes, Nodes authentication	Integrity, Traceability	Network State
double spending	Increase confirmed blocks, Pluggable consensus	Integrity, Traceability	Type of consensus
51% attack	Monitor computing power, Transaction Fee	Integrity, Traceability	Type of consensus
De-anonymi-zation	Fresh keys for each transaction, Mixing techniques, Zero-knowledge proofs	Privacy	Smart Contracts design, Blockchain design
	Strong repeat protection, Opt-in repeat protection, Lock digital assets	Integrity, Non-Repudiation	Smart Contracts design
Bugs in	Code Coverage	Functional	Code Coverage

Conclusion

- **Summary:** Conceptual framework leveraging blockchain for trust in digital ecosystems.
- BC are conceptually good thrid parties, since they don't have intention
- **Findings:** Blockchain enhances trust through its capabilities privacy, integrity, and traceability.
- **Findings:** However, we need evidence for capability support
- **Challenges:** Risk management, code auditability, governance.

Future work

- Framework Refinement: Tailoring evidence to specific DE risks.
- Code Auditability: Importance of verifying smart contract implementations.
- Blockchain Governance: Deployment and maintenance by a consortium.

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Backup Slides

Case Study: N7 Digital Ecosystem

Motivation

- **Objective:** Establish a secure digital ecosystem for multimedia content.
- **Stakeholders:** Content Owners, Content Providers, Service Providers.
- **Challenges:** Trust issues impeding collaboration.

Trust Analysis

- **Trust Issues:** Data privacy, access rights, service verification, view counts.
- **Blockchain Capabilities:** Privacy, integrity, traceability.

Evidence Collection

Blockchain Type and Consensus

- **Platform:** Hyperledger Fabric.
- **Consensus:** Crash Fault Tolerant (CFT).

Network State and Smart Contracts

- **Features:** Multi-channel, business isolation, smart contract execution.
- **Transparency:** Source code verification.

Acceptance Testing

- **Automation:** Gherkin Syntax for test cases.
- **Coverage:** Control and data flow testing.

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