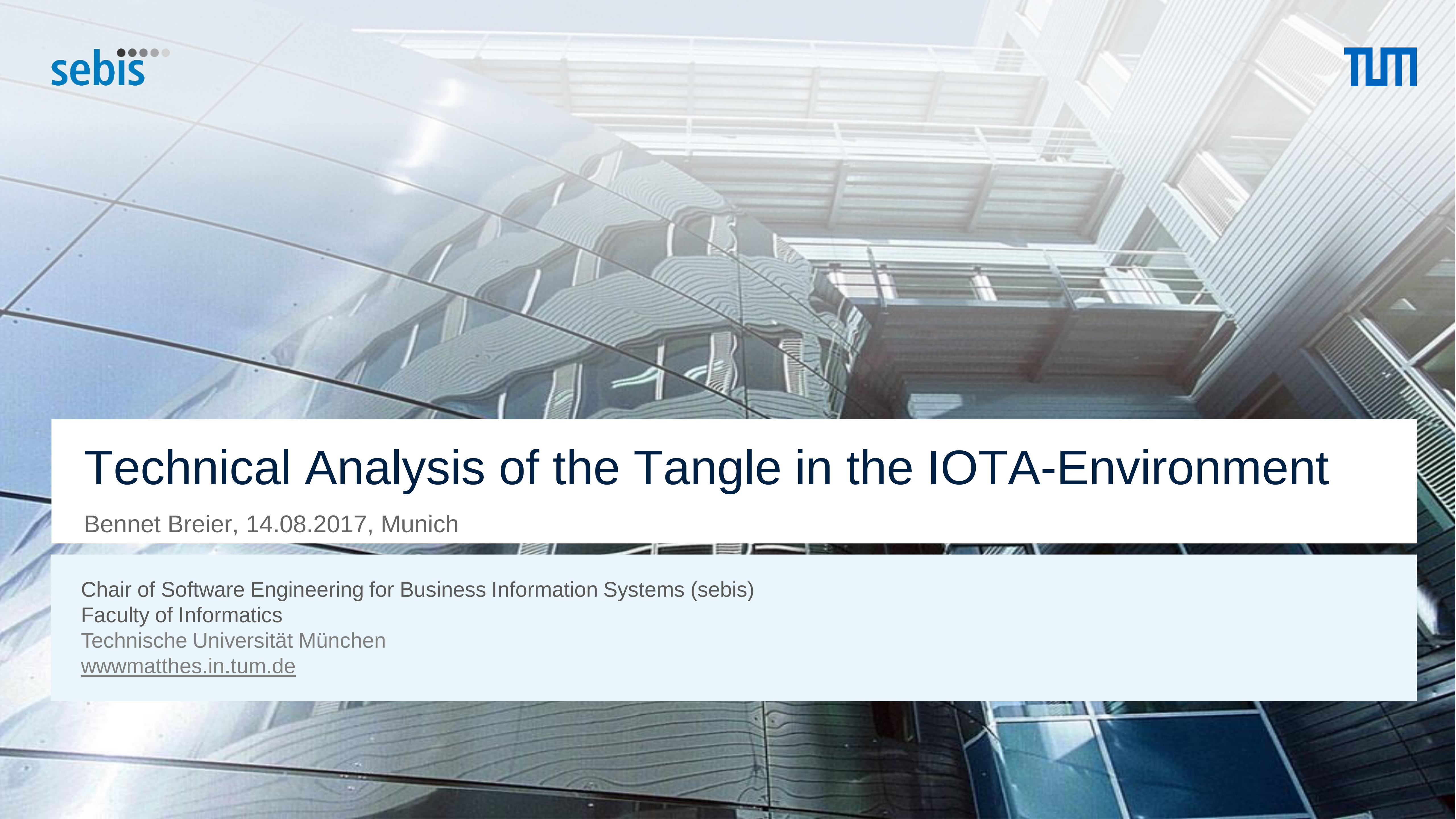

Technical Analysis of the Tangle in the IOTA-Environment

Bennet Breier, 14.08.2017, Munich

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Outline

1. Motivation
2. Research Questions & Approach
3. Timeline
4. Example Analysis

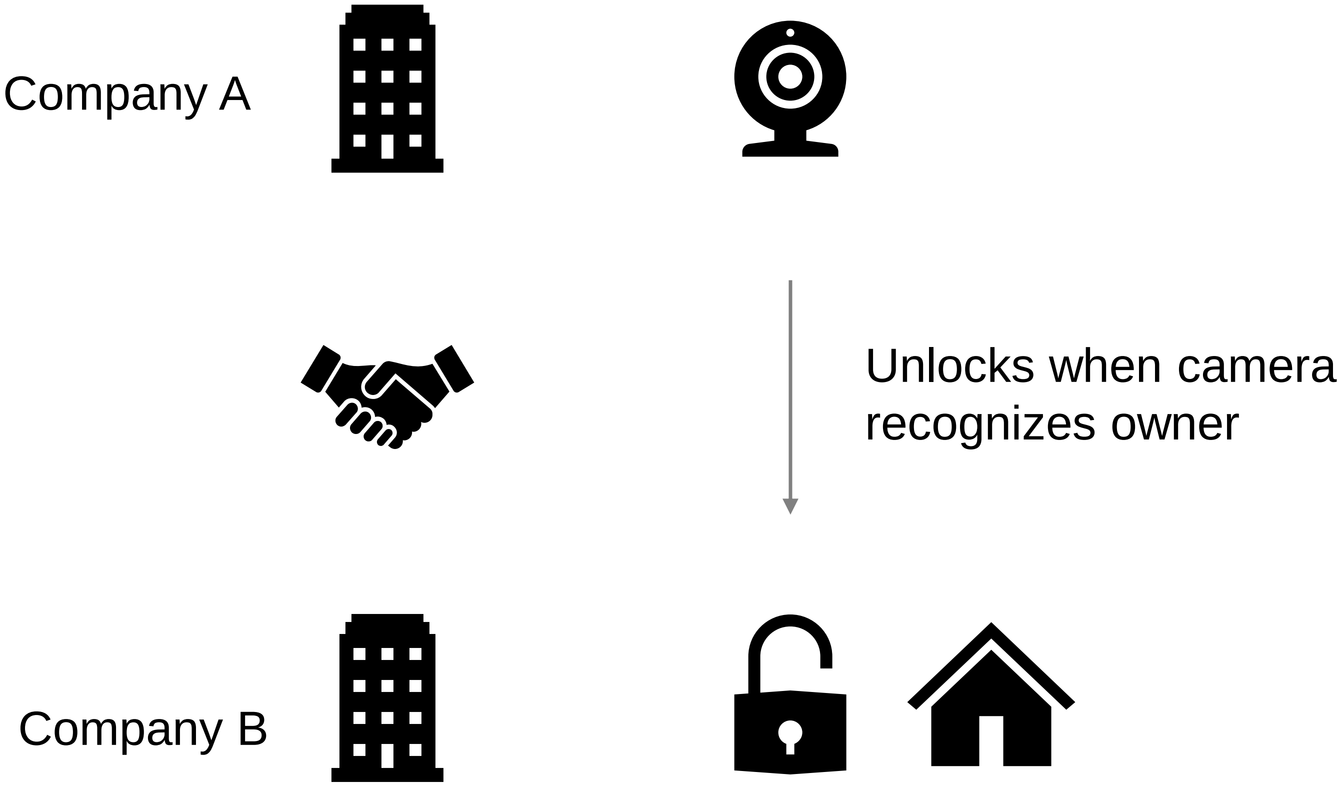
Motivation – Simple Example

Distributed Ledger Technology:

✓ Smart devices can communicate

✓ The ledger is legally binding

✓ And immutable



Company A

Unlocks when camera recognizes owner

Company B

Motivation

IOTA

- ✓ no fees
- ✓ scalable
- ✓ fast (700 txs/sec, gets faster with more users)
- ✓ works offline
- ✓ quantum secure

➡ Better suited for IoT use-cases

ethereum

- ❖ 0.25 € per tx (transaction)
- ❖ Scalability issues not resolved
- ❖ 25 txs/sec
- ❖ needs internet connection
- ❖ RSA, ECC not quantum secure

Setup of this Bachelor’s Thesis

Title: Technical Analysis of the Tangle in the IOTA-Environment

Author: Bennet Breier (bennet.breier@tum.de)

Advisor: Patrick Holl (patrick.holl@tum.de)

Start: 15 August 2017

End: 15 November 2017

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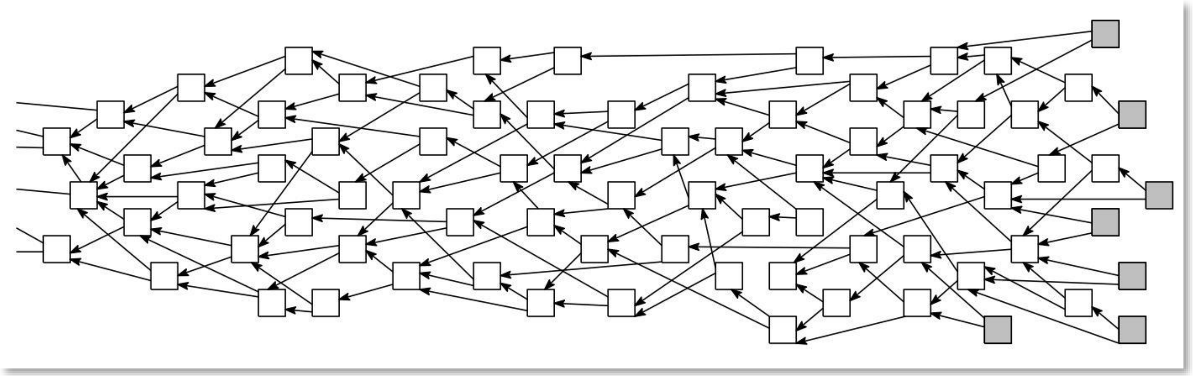
Research Questions and Approach

1. What is the theoretical foundation of the tangle?

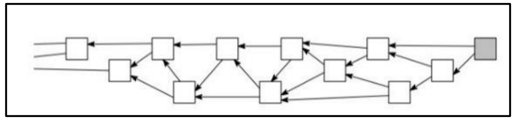
- Processing of Transactions
- Tip selection
- Byzantine Fault Tolerance
- Proof-of-Work
- Hashing (Curl & Kerl) & cryptography
- Scalability
- Privacy
- Quantum resistance

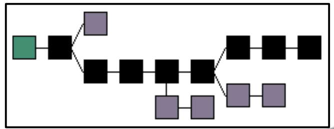
- Conditions for a secure & stable system
- Attack vectors (Sybil Attack, Parasite Chain Attack, Splitting Attack, 300% Attack)



Research Questions and Approach

2. What are the key differences between tangle vs. blockchain?





Comparable characteristics: (argued along a comprehensive use-case)

- Data structure
- Scalability, Transactions per second
- Fee structure
- Time to confirmation
- Privacy
- Security

Research Questions and Approach

3. How does IOTA use and advance the tangle in its environment?

- Facts about IOTA Foundation (business relations, adoption/advantages of their technology, …)
- IOTA-Implementation (deviations from theory)
- Coordinator
- peer discovery

Approach

Research questions

R1

- Theory behind the tangle

R2

- Tangle vs. Blockchain

R3

- IOTA environment

Research Approach

✓ Literature & online research (google scholar, ….)

✓ Online-communities

- Slack team
- forum.iota.org
- reddit
- Github (+ code review)
- Stackoverflow (coming soon)

✓ 2 – 4 Interviews with members of IOTA

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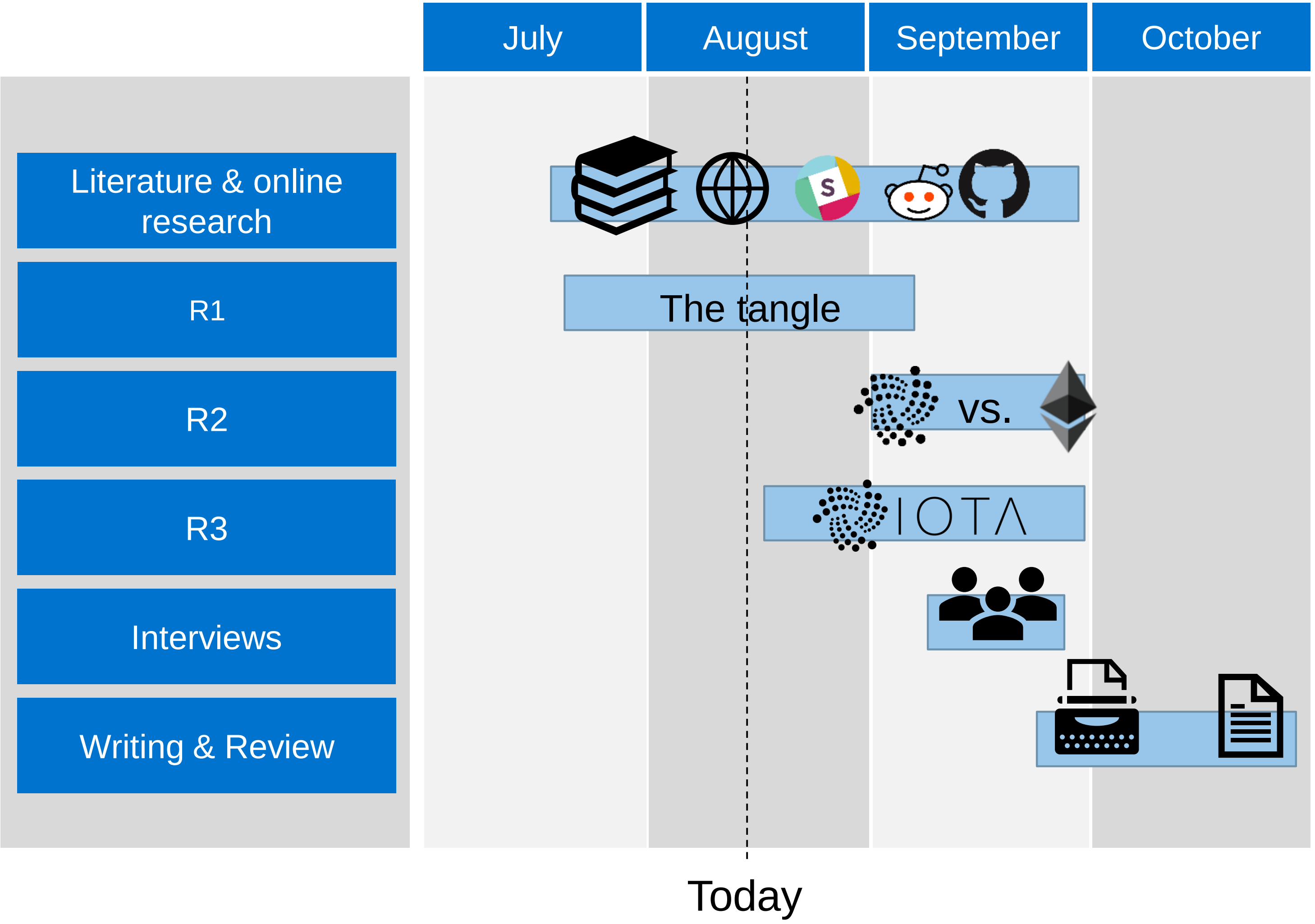
Timeline



Official Start Date: 15.08.2017

Official End Date: 15.12.2017

Supervisor: Patrick Holl

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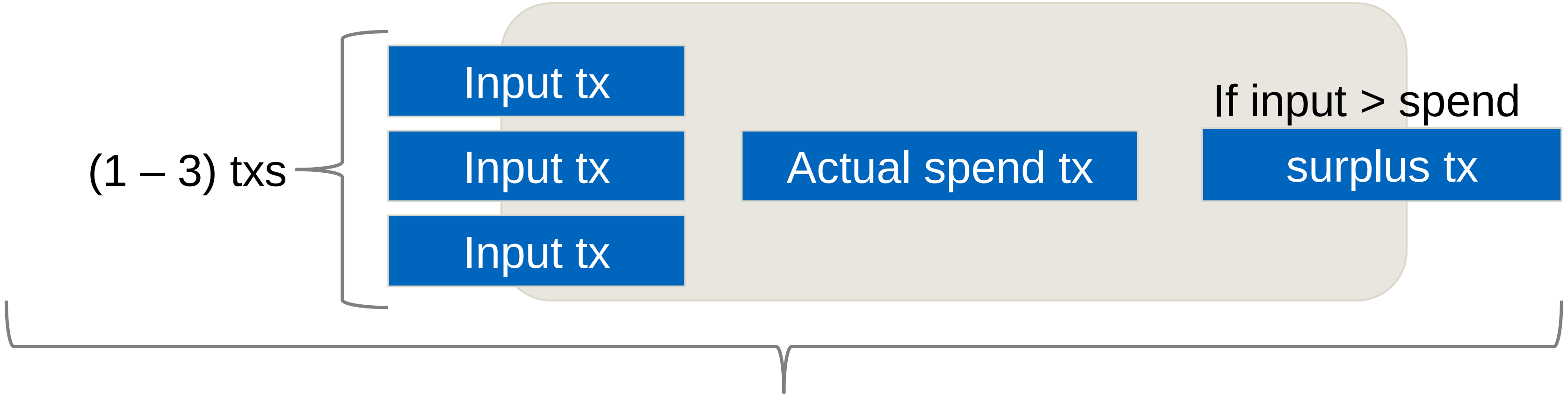
Example Analysis Process

Processing of Transactions

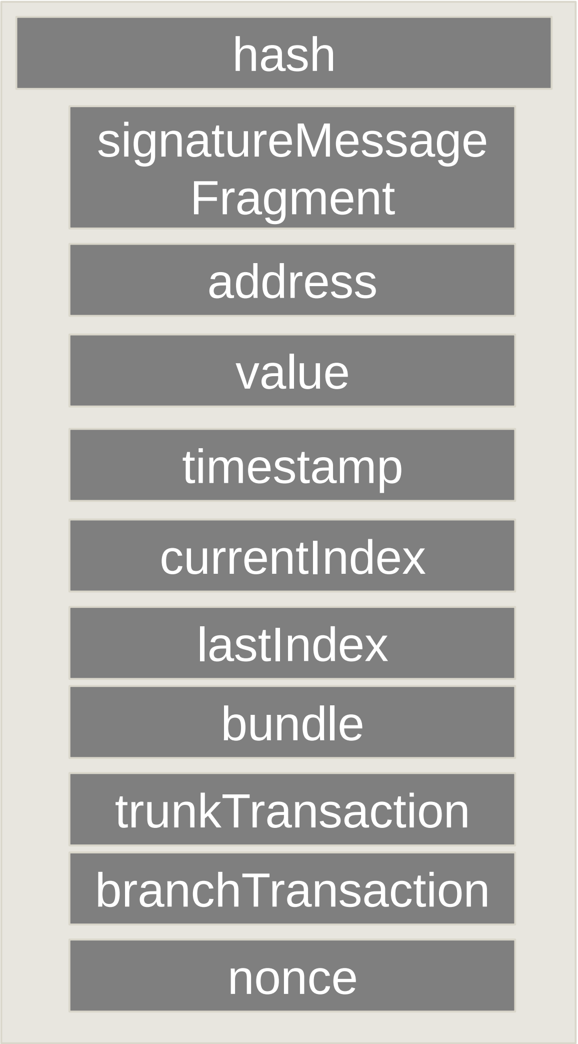
1. Constructing the bundle and signing of inputs
2. Tip selection
3. Proof of Work

1. Constructing the bundle and signing of inputs



1 bundle = (2 – 5) txs

Structure of a transaction



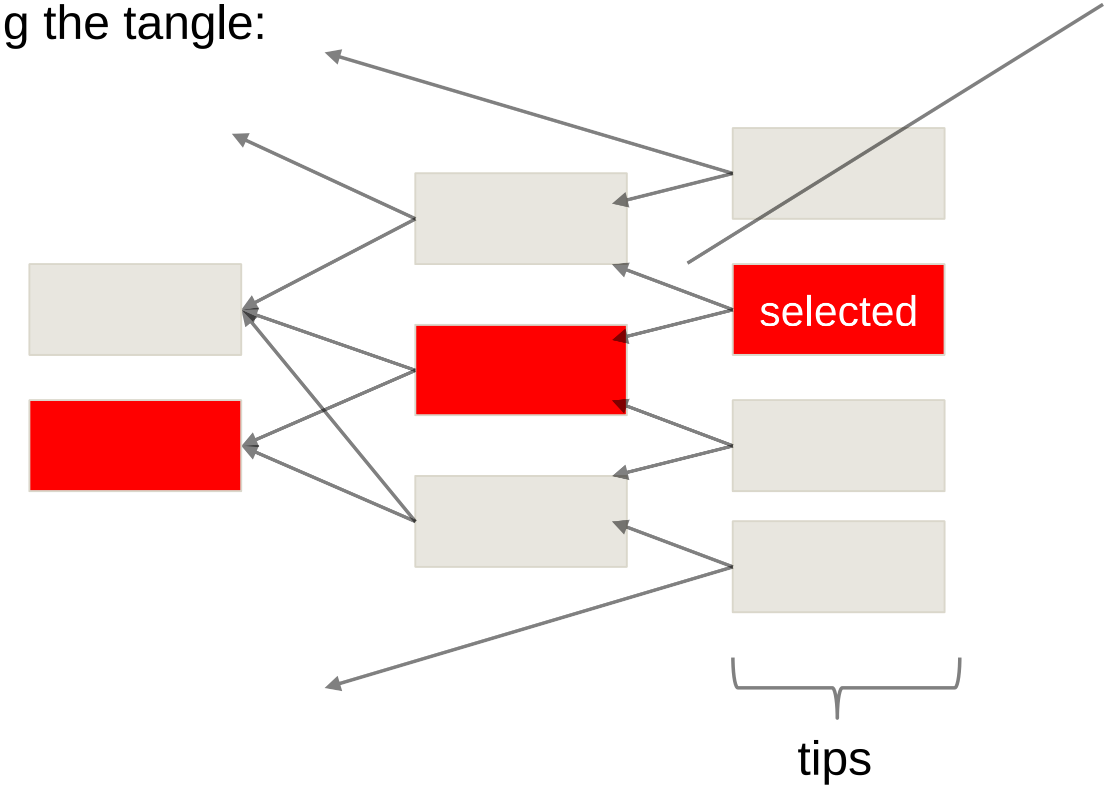
Example Analysis Process

Processing of Transactions

2. Select 2 tips according to a tip selection strategy

- Random tip selection
- **Markov Chain Monte Carlo:**

Perform multiple random-walks along the tangle:



the transition-probability is proportional to the **cumulative weight** of the tx

cumulative weight =
own weight of tx + sum of weights of all approving txs

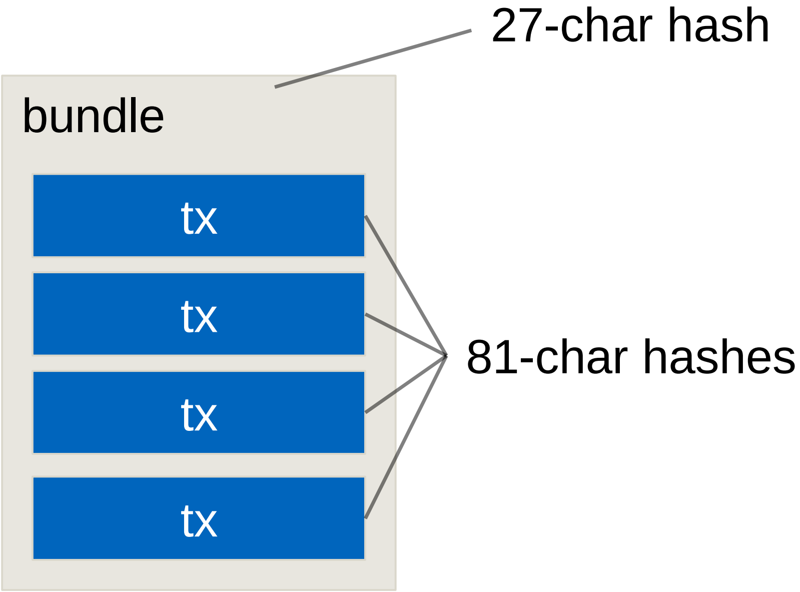
own weight of a tx is proportional to the amount of work put into it

Example Analysis Process

Processing of Transactions

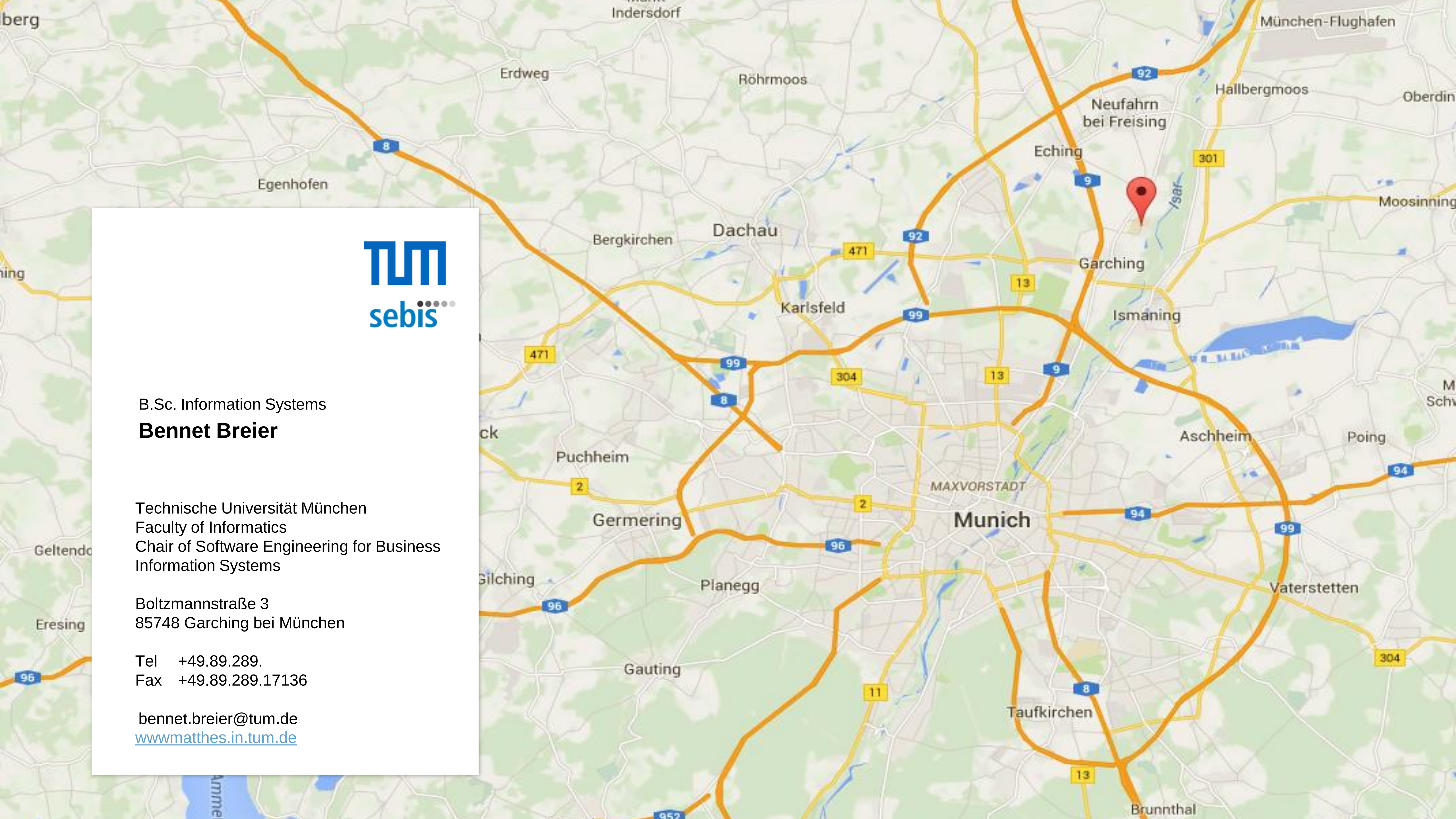
3. Proof of Work

Principle:	**Hashcash**
Hash function:	**Curl** (from the sponge family hash functions)



Thank you for your attention

Further questions?



B.Sc. Information Systems

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Appendix