Master Thesis Project

Distributed Ledgers for Industrial Service Applications

Supervisor:	David Kozhaya
Professor:	Roger Wattenhofer
Start Date:	April 1, 2019
Submission Date:	September 30, 2019
Required Work Time:	6 months

Introduction and Motivation

There is tremendous interest in the blockchain, the distributed ledger that powers the Bitcoin network. A key advantage of distributed ledgers compared to centralized solutions is that a distributed ledger removes the need to trust any particular party. In other words, trust is shifted from a specific party to a distributed system and its embedded protocols. As a conse- quence, one needs to trust that the majority of the parties involved in maintaining the ledger follows the protocols, ensuring that the ledger operations are carried out as intended, and the remaining (malicious) entities cannot corrupt the system. Since trust is a valuable and crucial commodity in any distributed system, numerous use cases for blockchain technology have been proposed.

The focus of this Master's thesis is on industrial applications, in particular service applications for electricity network operators and/or (renewable) energy consumers and providers. For example, smart meters can be reliably used to determine the amount of energy that is generated or consumed, and this information can be processed automatically in a distributed system in order to trigger appropriate payments. Automated distributed applications, so-called smart contracts, can also be used to facilitate the management of service contracts between any service provider and consumer in this domain. While several distributed ledger platforms exist, e.g., Hyperledger Fabric [?, ?], Corda [?], or Tendermint [?], their applicability to industrial use cases has not been studied.

The objective of this Master's thesis project is to determine the applicability of distributed ledger technology to industrial service applications as outlined above. After identifying the strengths and weaknesses of existing technologies, the main goal is to find and develop solutions to mitigate current limitations, e.g., in terms of scalability, throughput, or security features (with respect to confidentiality, integrity, and availability).

Tasks

1. Familiarize yourself with the state of the art in distributed ledger technology.

2. Familiarize yourself with specific industrial service use case scenarios.

3. Analyze the applicability of existing platforms to the defined use case scenarios.

4. Devise mechanisms that migitate shortcomings of existing platforms in terms of specific performance metrics.

5. Implement the proposed mechanisms to evaluate their performance and showcase their effectiveness.

6. Write a report that documents the proposed mechanisms and the experimental results.

Deliverables

1. Regular meetings will be held between the supervisor and the student in order to discuss progress and the work items for the upcoming weeks. The student may be requested to give short presentations of his current work and provide short written summaries.

2. Source code and experimental data must be made available to the supervisor.

3. The final report must be written in English and typeset in LaTeX. It should include an introduction, an overview of related work, and a detailed description of the obtained results. Three copies of the final report must be delivered to the supervisor.

4. At the end of the thesis, a presentation of 30 minutes must be given, which should include a description of the context, the contributions, and details of the work.

The grading will be based on the scientific contributions of the work, the initiative and commitment of the student, and the quality of the report and the presentation.