The Concept of Dynamic Smart Contracts to Enable Automated Payments in the PI

Malte Spanuth, Rod Franklin

IPIC 2023

9th International
Physical Internet Conference
June 13-15, 2023
Athens, Greece

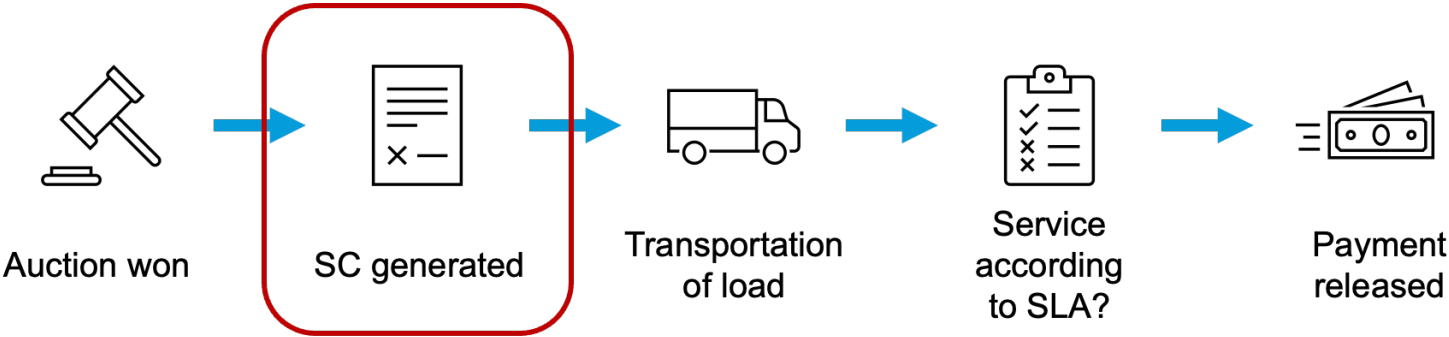**KLU** KUEHNE LOGISTICS UNIVERSITY

Problem & Motivation

One area of research that has not been extensively studied in the Physical Internet (PI) domain concerns how stakeholders receive payments for the services they have provided. While a payment mechanism is required for any transaction that occurs in the movement of a shipment from origin to destination (e.g., loading, unloading, load assembly, storage, etc.) we focus in this research on one type of transaction - the auctioning of a load to a carrier and the carrier's movement of that load from one node to another node. Due to its decentralized architecture, blockchain (BC) represents a promising technology for handling this process. Thereby, smart contracts (SC) are stored on the BC. Once a previously defined event occurs, the SCs are automatically executed and release the payment. The SCs must be generated as soon as the winner of an auction has been determined and it is thus clear which carrier will transport the packet from the current to the next node. Due to the large number of different components of the auctions (including, e.g., certain country-specific regulations or handling requirements), standardized SCs cannot be created. They must be adapted each time to the parts specified in the auction. Performing this process manually would be inefficient and not feasible in the long run.

Objectives

The aim of our research is to develop a frame SC model that can be implemented and used in the PI. As data security is a major concern to the stakeholders the SCs will be deployed on a private permissioned blockchain using Hyperledger Fabric. On the one hand, this has the advantage that only the parties involved in the process have access to the transaction data and, on the other hand, due to an other consensus mechanism more transactions can be realized than with public permissionless blockchains such as Ethereum. This is an important factor for the scalability of the solution.

Auction won → SC generated → Transportation of load → Service according to SLA? → Payment released
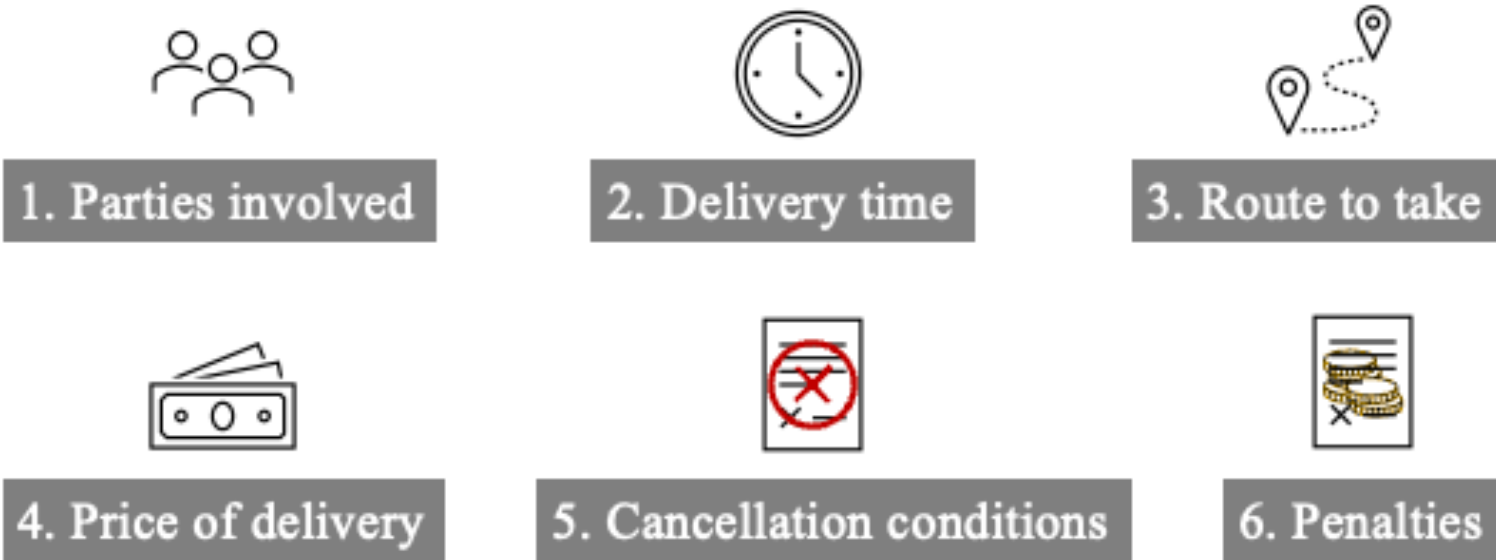
Methodology

Design Science Research (DSR) is a well established methodology within the Information Systems research area for creating artefacts and thus will be used for our study [1]. Peffers et al. (2007) developed a process for conducting DSR which we follow [2]. We are tackling a problem-centered initiation, as our research started with the need for a payment scheme for the PI that has not yet been developed.
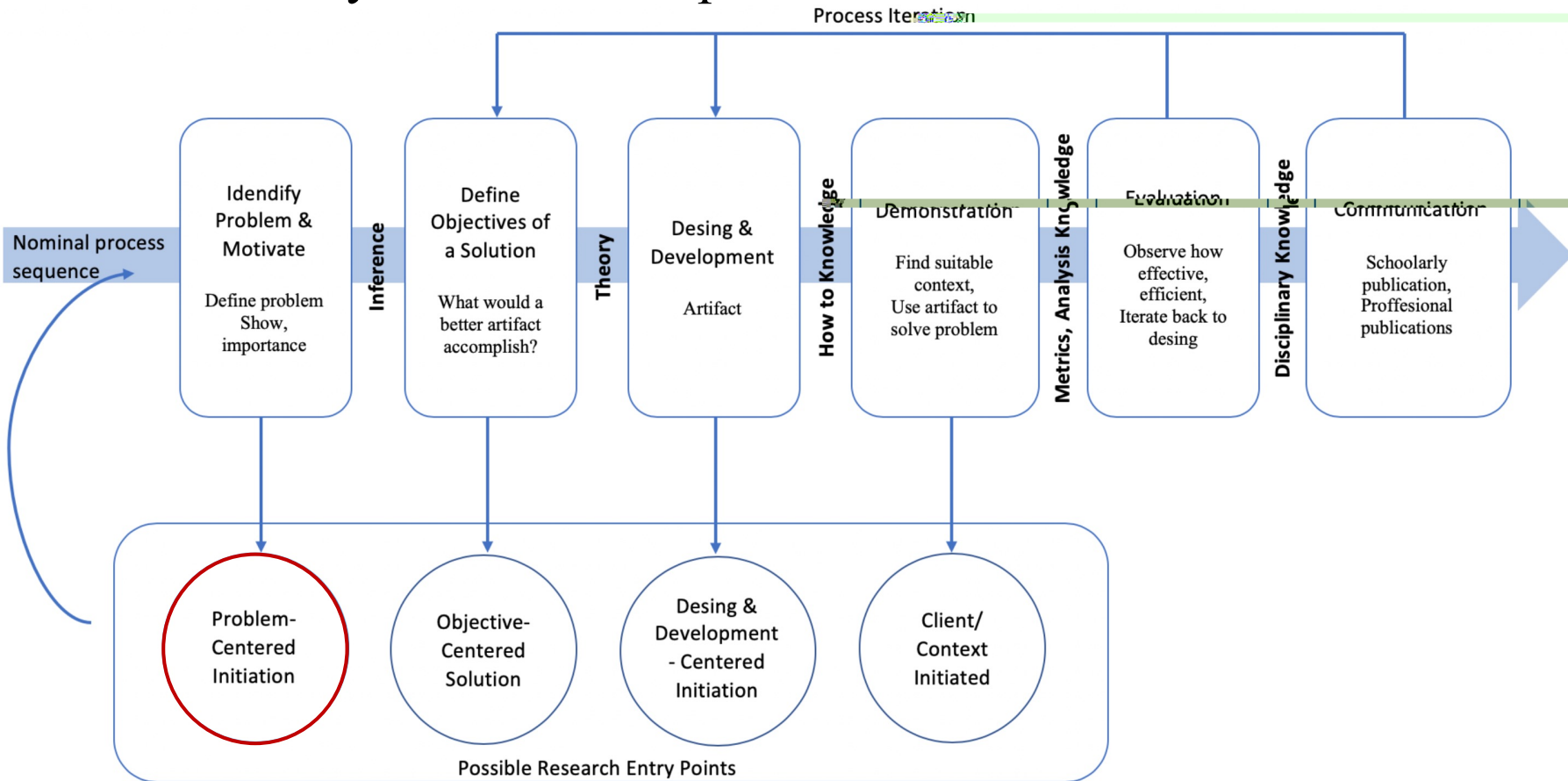
[1] Gregor S, Hevner AR (2013) Positioning and Presenting Design Science Research for Maximum Impact. MIS Quarterly 37(2):337–55.
[2] Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2007). A design science research methodology for information systems research. Journal of management information systems, 24(3), 45-77.

Design & Development

1. Analysis of SLAs & Contracts

1. Parties involved
2. Delivery time
3. Route to take
4. Price of delivery
5. Cancellation conditions
6. Penalties

After the components of SLAs in the transport sector have been identified in an initial literature analysis, these results must be reviewed and supplemented in a second step together with practitioners. Based on the feedback, the individual components are sorted into groups, which later form the individual components of the frame contract model.

2. Documentation of Delivery Process

In a second step, the events that trigger the SCs must be identified. For this purpose, the delivery process with the points at which data is generated is illustrated.
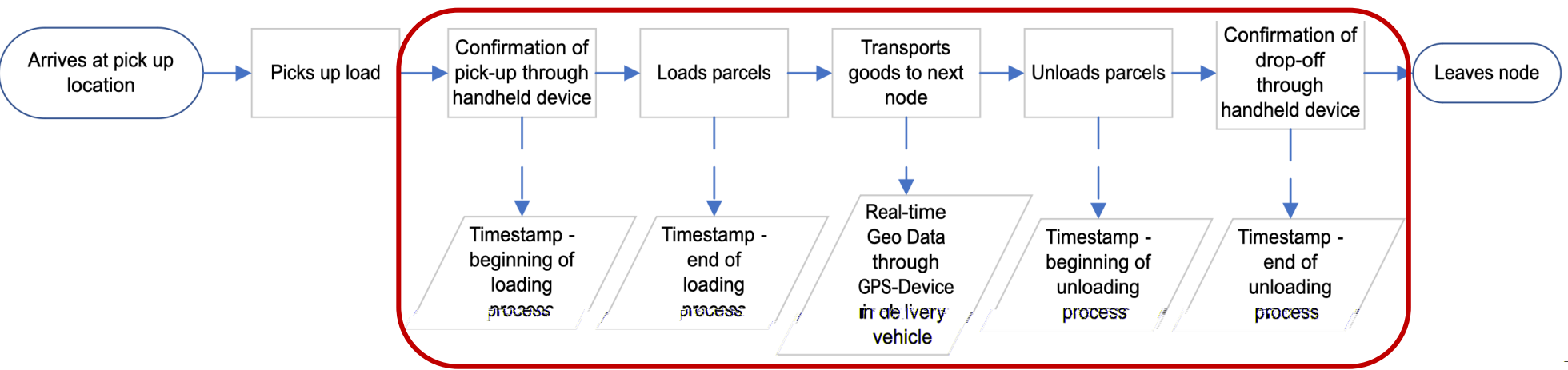
3. Development of Pseudo Code & Frame Contract

To achieve acceptance of the stakeholders and to enable a larger group to review the contract and make suggestions for improvement, a frame contract model and a pseudo code will be developed. The results that will be revised with practitioners will serve as the basis for the creation of the code with Golang.

4. Creation of Code and Implementation on BC

In this phase, the pseudo code is converted into an actual code using Golang. The SC will be stored and tested on a private permissioned blockchain in Hyperledger Fabric after completion. Once it works in the test environment, it will be tested in a real-life scenario in the next step.

Demonstration & Evaluation

Demonstration

In the fourth step of Peffers et al. (2007) DSR process, the artefact, in our case our frame SC model, is demonstrated and tested in real-life scenario. Thus, we will deploy the SC on the BC in a living lab within the URBANE project. Due to the close cooperation with the living labs, they offer the optimal environment for a first demonstration and provide insights into whether the artefact needs to be revised.

Evaluation

Based on the results of the demonstration, the frame contract model must be evaluated if it meets the objective and enables efficient payments in the PI.

Conference Sponsor-Logo Area