Blockchain and distributed ledger technologies in automotive use cases

A SWOT analysis of technological potentials and implications for future cars

- EXTENDED ABSTRACT -

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I. INTRODUCTION AND MOTIVATION

The term of *blockchain* finally became a buzzword and hype in late 2017 when a general run and speculation on crypto currencies occurred with a nearly worldwide extend [1]. However, the true meaning of blockchain is often misused and mixed up with the understanding of the Bitcoin currency [2]. Furthermore, the more general term of *distributed ledger technologies* (DLT) hardly was known in public discussions by that time [3]. In addition to the public interest and hype around blockchain, bitcoin and co, trend scouting and innovation management departments from companies and enterprises of a great variety of different industries started to look at the newly arising technology [4]. Also from the perspective of science, several institutes and universities publicized whitepapers or opinion papers [5, 6] as well as centers of competence were founded [7, 8, 9]. However, there is still great uncertainty about the true potentials of DLT in industrial applications in many sectors. In the here presented study, especially the mobility sector and automotive industry is addressed and analyzed. First proof of concepts and prototypes of DLT enabled solutions were already presented: applications in charging infrastructure [10, 11] automated payment wallets [12] or automated parking access [13]. However, more generalized and deeper evaluations of the technological potentials and its feasibility to solve challenges in automotive use cases are still hard to find and rarely publicized. Therefore, the presented study analyzes the technological potentials of DLT in automotive use cases from a holistic perspective.

II. RESEARCH OBJECTIVES

Based on the basic blockchain technology which was introduced with the bitcoin crypto currency [14], several improvements, additional features and even alternative technological solutions were presented over the years. This study focuses on two of the most prominent DLT: *Ethereum* and the *tangle* technology. Ethereum, sometimes also referred to as second-generation blockchain [15], includes and enables *smart contracts*, which allow inherent and automated contract conclusions [16]. The second focus is on the tangle technology which is backed and developed by the IOTA foundation. The tangle, sometimes called third-generation blockchain [15] breaks with the classical principal of the blockchain, as it merely uses a network instead of a chain for its blocks [17]. Both approaches promise several benefits in contrast to other DLT solutions and are therefore chosen for the presented analysis. The overall study objective is to determine whether applications of DLT in automotive use cases are technologically reasonable and capable, both today as well as under estimation of future developments. Therefore, benefits, disadvantages, challenges, potentials, and feasibilities to applicate DLT in this context is be determined and discussed.

III. METHODOLOGICAL APPROACH

This paper presents an analysis of technological potentials in defined uses-cases based on an adapted SWOT analysis. Usually, the SWOT analysis is a tool for evaluations of enterprise strategies and current situations of enterprises under consideration of their products, market, customers and competitors. A classic SWOT analysis divides into strengths, weaknesses, opportunities and threats, which leads to an internal and external analysis of the explored enterprises. Internal aspects include strengths and weaknesses of enterprises that can be e.g. unique core competencies or uncompetitive organizational structures. On the other hand, external aspects examine opportunities and threats that appear due to the surrounding of the respective company. These can be trends and changes in political, cultural, juridical, or technological manners [18, 19]. For the presented technology analysis, the SWOT analysis is found as an adequate tool, to evaluate a new-to-the-world-technology in pre-defined use cases. Since blockchain and DLT as well have to compete against existing technologies and are exposed to external trends, developments, and acceptance, a comparison to company strategy evaluations comes to mind. Therefore, the SWOT analysis is slightly adapted and the understanding of some terms have to be differentiated in contrast to a SWOT analysis used for company strategy evaluations. So the internal

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analysis presented in this study investigates strengths and weaknesses which arise in the specific examined use case due to the inherent attributes and characteristics of the underlying technology. The comparison with competitors is changed into a comparison with other technological solutions. The perspective of the customer is replaced by the perspective of potential end-users in the at hand paper. In addition to the internal analysis, the external analysis is adapted as well. Opportunities in case of the examined technology can be for example newly enhanced business models that foster a future usage of the underlying technology. In consequence, threats are understood as changes in the environment and ecosystem, which do not directly affect the technology, but impede the future acceptance and potentials of the technology, e.g. by regulations.

IV. EXAMINED USES-CASES FOR TECHNOLOGY APPLICATION

As the above-described methodological approach implies specific use cases for the technological evaluation, two major use cases are outlined and examined. Coming from the general understanding of future fully automated and connected vehicles and a future perspective on cars as smart and connected products within a system of systems [20], the "*smart car*" is described. It is concluded that several abilities will inhere future vehicles or smart cars, such as communication, storage and exchange of information as well as the ability to perform automated transactions of certain values or currencies. In a next step, this leads to several use cases of smart cars, whereas two of these promise good grounds for research as they widely include the just mentioned basic characteristics and abilities of the smart car: the "*car pass*" and the "*wallet*". The car pass is based on the assumption of storage and exchange of information about specific internal data and circumstances of future vehicles. The wallet is based on the assumption of automated transactions and an exchange of values.

V. EXPECTED RESULTS

The potentials to solve the technological challenges of these smart car use cases by the application of DLT-based solutions are evaluated during the conducted study. Looking at the wallet use case, it is expected that the examined blockchain technology of Ethereum brings along some major strengths, such as the ability to provide secure payment transactions without an intermediary entity on a decentralized basis. On the other hand, it is expected that the ability to freely program smart contract code can lead to bugs and technical failures. Nevertheless, there are several chances expected, like a higher standardization for codes with an increasing acceptance and industrial application of the technology. The situation is expected to be similar when looking at the use case of the car pass. In addition and contrast, when in the second step of research the use cases are evaluated with the tangle technology, it is expected that some of the before discovered weaknesses and threats can be eliminated. Nevertheless other challenges and disadvantages are expected to arise, which will have to be analyzed under consideration of the future development of the tangle technology. Overall, it is expected that today the current technological development stage of neither Ethereum's blockchain with the potentials of smart contracts, nor IOTA's tangle technology can provide a fully

applicable solution for the discussed use cases within a smart car ecosystem. Although, it is expected that the to be found chances and threats of each technology and respective use case will allow to derive insights for further needs of future research and development, in order to enable secure and practical applications of DLT in the automotive sector.

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