Blockchain - The Effects on Cross-Border Transactions

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Abstrato

Blockchain está recebendo mais atenção da mídia, política, profissionais e de acadêmicos tambem. No entanto, a literatura sobre o impacto da blockchain nas transações transfronteiriças é escassa. Sendo assim, essa tese analisará o impacto da blockchain nas transações transfronteiriças. Ele começa por explicando o papel dos intermediários no interior da fronteira no processo de transação e comparação de soluções atuais para enviar capital através das fronteiras. Também observa a troca predominante entre custo e ritmo. Segundo, a tese explica a tecnologia de blockchain e explica a ascensão de consórcios, enfatiza a importância do cumprimento da tecnologia, governança e responsabilidade, bem como os padrões legais e regulamentares. Posteriormente, discute e avalia os consórcios selecionados, Ripple Labs Inc e Libra Association a fim de fornecer uma visão geral de quão perto as soluções baseadas em blockchain de hoje têm impacto nas transações transfronteiriças.
Por fim, uma comparação entre as soluções atuais de soluções blockchain selecionadas serão demonstradas. Uma das principais conclusões deste trabalho é o fato de que o desenvolvimento de blockchain desencadeou entidades estabelecidas como SWIFT ou Bank of America para inovar o atual sistema de transações transfronteiriças. Além disso, blockchain aumenta o ritmo e diminui o custo da transação e portanto, resolve o comércio predominante fora. Além disso, essa pesquisa destaca como o mundo não bancário seria impactado pela implementação da blockchain e o que deve ser feito para desenvolver todo o potencial da tecnologia blockchain.

Abstract

Blockchain is getting increased attention from media, politics, practitioners as well as from academics. Nonetheless, the literature is scarce about the impact of blockchain on cross-border transactions. Thus, this thesis will analyze the impact of blockchain on cross-border transactions. It begins by explaining the role of intermediaries within the cross-border transaction process and comparing current solutions to send money across borders. Thereby, it remarks the prevalent trade-off between cost and pace. Second, the thesis explains the technology of blockchain and explains the rise of consortia and emphasizes the importance of the fulfillment of technology, governance and liability as well as legal and regulatory standards. Afterwards, it discusses and assesses the selected consortia, Ripple Labs Inc and Libra Association, in order to provide an overview of how close today's blockchain-based solutions are to having an impact on cross-border transactions. At last, a comparison between current solutions of selected blockchain solutions will be demonstrated. A major finding of this work is the fact that the development of blockchain triggered established players such as SWIFT or Bank of America to innovate the current system of cross-border transactions. Moreover, blockchain increases pace and decreases cost of transaction and thus, solves the prevalent trade-off. Additionally, this research highlights how the unbanked world would get impacted by the implementation of blockchain and what must be done in order to unfold the full potential of the blockchain technology.

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Keywords: Blockchain, Cross-Border Transactions, SWIFT, Ripple, Libra, Bitcoin, Payment

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List of Abbreviations

AML – Anti Money Laundering

B2B - Business to Business

BTC – Bitcoin

C2B – Consumer to Business

C2C – Consumer to Consumer

DLT – Distributed Ledger Technology

EUR – Euro

KYC – Know-Your-Customer

LIBRA - Libra Association

P2P – Peer-to-peer

PoW - Proof-of-Work

RIPPLE - Ripple Labs Inc.

RTGS - Real-Time Gross Settlement System

RTXP - Ripple Transaction Protocol

SCC - SEPA Card Clearing

SCT Inst - SEPA-Instant-Credit-Transfer

SEPA - Single European Payment Area

SME – Small and Medium Enterprises

SWIFT - Society for Worldwide Interbank Financial Telecommunication

TARGET - Trans-European Automated Real-time Gross Settlement Express Transfer system

USD – US Dollar

1 Introduction

Lael Brainard, the Federal Reserve governor once said in an interview: “We are paying close attention to distributed ledger technology, or blockchain, recognizing this may represent the most significant development in many years in payments, clearing and settlement” (Popper, 2016). In 2016, this statement already indicated what potential blockchain technology might have on the payment industries and cross-border transactions. In 2008, Satoshi Nakamoto, the founder of Bitcoin and the concept of blockchain, already indicated that Bitcoin-blockchain aims to eliminate third parties within a transaction process and to enable two parties to directly interact and deal with each other via a peer-to-peer electronic cash system. In today’s news, blockchain and cryptocurrencies are mainly dominated by reports about its strong decrease within the last year, its high volatility and speculative character. However, when Satoshi Nakamoto described his concept of Bitcoin and its blockchain, the goal was, to introduce a way in which transactions are processed without an intermediary. He was criticizing the pace and cost of transactions within such a system and instead advocated for a solution, which replaces trust with a cryptographic proof. With his introduction of Bitcoin, he wanted to decrease costs of transaction and increase the pace of transactions and therefore change the established processing of cross-border transactions.

1.1 Research Motivation

Within the last decade, numerous areas were disrupted. However, the payment industry only slightly changed in a manner as correspondence banking is still prevalent, and development within the sector of cross-border payments is slow. When Nakamoto introduced Bitcoin and the Bitcoin-blockchain, he wanted to eliminate the reliance on intermediaries and third parties, mostly correspondence banks, as they deaccelerate the transaction process and increase cost of transactions. Following Nakamoto´s approach (2008), different blockchain solutions were introduced to the market and experienced their peak of attention in the end of 2017, when the market of cryptocurrencies skyrocketed. As blockchain proposes solutions for different fields, such as supply chain or accounting, Ripple Labs Inc (Ripple), focuses as company to build blockchain based solutions for the rarely touched field of cross-border transactions. Thereby, the company aims to change the current state of the cross-border transactions process. Besides Ripple, also Libra Association, a consortium led by Facebook, introduced the idea of a borderless payment technology based on Blockchain.

Additionally, McKinsey & Company (2018) shows the potential cost decrease of cross-border transactions at 90-95%. Furthermore, Holutiuk et al. (2017) focus on the implications for business models within the payment industry and therefore draw first possible effects on the payment industry and thus on cross-border transactions. Additionally, consortia merely focus on the effective usage of distributed ledger technology, and an increased number of big players in the payment industry are taking part in the research for Blockchain based transaction processes. Therefore, the payment industry started to consider implementing the blockchain technology, as it is a potential disrupter of the payment industry and the cross-border transaction process. Therefore, this thesis focuses on the possible effects of Blockchain on cross-border transactions and thereby, includes the very current developments within the area.

1.2 Aim of Research

The literature on blockchain evolved over the years and enjoyed more and more attention by researchers. Due to its disruptive character it is very difficult to foresee future consequences and further effects of the technology on the payment industry and cross-border transactions. Therefore, this thesis aims to describe the effects of blockchain on cross-border transactions. In more detail, it focuses on the one hand on the flaws of the current cross-border transaction system and on the other hand, how the blockchain technology could improve the current system. Additionally, this thesis examines different consortia to see how far the development of blockchain based alternatives is and what must be fulfilled in order to unfold the full potential of the technology.

1.3 Approach of Research

1.3.1. Literature Based Research

The thesis bases its research on the role of intermediaries and how trust could be assured by different blockchain solutions. Before comparing the current and possible solutions, the different proposed blockchain solutions were assessed based on important attributes such as pace, cost, fulfillment of Schupmann´s standards as well as the existence of network effects. Based on that, the thesis compares current solutions, such as SWIFT and different money transfer service provider with proposed blockchain solutions.

1.3.2 Expert Interviews

1.3.2.1 Selection of Method

Expert interviews were chosen in order to enrich the thesis by qualitative information regarding the topic of blockchain and its effect on cross-border transactions. The goal was to gather insights about the current political opinion, the status of the technology, in order to be a viable option for cross-border transactions and the effects blockchain might have on cross-border transactions.

1.3.2.2 Selection of Experts

The experts were selected by their expertise within the areas of cross-border transactions, blockchain, or political fields that have touchpoints with blockchain. Thereby, it was important that at least one expert was able to give an opinion about the political area and provide insights about the general opinion on blockchain within politics. Furthermore, an expert from a financial institution was needed, as this area is mainly affected by blockchain in the process of cross-border transactions. Additionally, for a 360-degree view on the topic, it was crucial to include current entrepreneurs within the blockchain area in the expert panel. In total, four experts from the different beforementioned areas were interviewed. Appendix 1 shows an overview of the different experts.

1.3.2.3 Conduction of Expert Interviews

The interviews were conducted between 28th of June 2019 and 18th of July 2019. Three interviews were conducted by telephone and one interview in person. As explained before, four interviews were conducted in total.

For the expert interviews, a semi-structured interview guide (Kallio, Pietilä, & Johnson, 2016) was used. In total, six questions were given to each of the interviewees. Each interviewee received the questions one day before the interview. The questions were based on the conducted research and aimed for opinions and insights about the current status of blockchain and correspondence banking. Furthermore, the questionnaire included a question that asked for necessities for blockchain in order to be globally adopted for the use of cross-border transactions.

1.4 Structure of the Thesis

In the following, the outline of the thesis is explained. The structure follows an approach of Schuhmann (2018) to explain effects on cross-border transactions. *Chapter 2* presents a

literature review that gives an overview of the literature used in this research. The goal of *chapter 3* is to explain the current role of financial intermediaries within the financial markets. Additionally, the procedure of a domestic transaction, here the Single Payment Euro Area (SEPA), is introduced to demonstrate the differences between the processes of domestic and cross-border transactions. In *chapter 4,* the goal is to introduce the process of cross-border transactions. Thereby, the cost and pace of transactions will be explained by an exemplified transaction from Germany to Japan. Additionally, *chapter 4* includes alternatives to the classical cross-border transaction, in the form of money transfer service providers and compares those to the classical bank transaction. *Chapter 5* explains the Blockchain technology and a transaction based on the Bitcoin blockchain. It aims to explain the different network structures as well as a transaction process and the verification process of the Bitcoin Blockchain. Furthermore, *chapter 5* demonstrates the cost and pace of transactions with Bitcoin in order to use those data for a comparison of different Blockchain technologies, the prevalent money transfer service providers and the classic bank transaction. After *chapter 5* built an understanding for the blockchain technology, *chapter 6* aims to present different consortia, which are focusing on cross-border transactions. Thereby, it introduces different consortia and additionally explains standards, introduced by Schupmann (2017), for an effective usage of the blockchain. Following this, *chapter 7* presents Ripple Labs Inc. and the new project within the area of Blockchain and cross-border transactions, the Libra Association (Libra). Thereby, it aims to explain different characteristics of the two consortia and cost and pace of cross-border transactions and further analyzes their fulfillment of the beforementioned standards for a successful consortium. Following this, in *chapter 8,* the thesis aims to compare the presented solutions with each other and the classic cross-border transaction via a financial institution by cost, pace, network effects, security, and transparency. At last, *chapter 9* brings the different findings in perspective and summarizes the current and possible future effects on cross-border transactions.

2 Literature Review

The literature review has the aim to provide an overview of already investigated topics and findings within the fields of Blockchain technology and the payments industry.

As blockchain is a relatively new topic of research, literature is scarce. Three kinds of literature dominate research about blockchain. First, Libertarian, second, technology-focused literature and third, finance-focused literature.

The first kind of literature includes *Libertarian* thoughts of a minimization of control from the state on the day-to-day life of its citizens. Ammous (2013), for instance, argued in favor of the Bitcoin and describes "the intriguing possibility that developing countries could sidestep of a traditional financial system and a mass adoption international online digital currency". Atzori (2017) argued against the general idea of libertarians about blockchain and found out that "the state [is] a necessary central point of coordination in society".

Second, there is literature that focuses on the *technological* side of the blockchain and the possible future effects an implementation might have. In 2008, Satoshi Nakamoto released the whitepaper about Bitcoin and the Bitcoin blockchain. Thereby, he explained the usage of Blockchain for the transfer of funds. The goal of his whitepaper was to propose an electronic payment solution that is free of a third party and therefore, cheaper than usual transactions via a financial institution. He introduced Bitcoin and the Bitcoin blockchain and further elaborates on the usage of it as replacement of the current transaction systems, such as SWIFT. An elaboration of Nakamotos´ approach in order to increase the pace of the network was given by Poon and Dryja in 2016 when they introduced the Bitcoin Lightning Network, which has the aim to increase the pace of transactions on the Bitcoin Blockchain. Thereby, they proposed a faster validation process by introducing separate payment channels of two or more parties with a multi-signature address. Furthermore, Badev and Chen (2014) provided a technical overview of Bitcoin and defined Bitcoin as a "scheme designed to facilitate the transfer of value between two parties". Additionally, Andoulaki and Karame (2016) conducted research about the security of the Bitcoin-blockchain and noted that "securing Bitcoin transactions additionally depends on the ability of users to protect their private keys" (Andoulaki & Karame, 2016, p. 206). In addition, Lin conveyed a survey about blockchain security issues and challenges, whereby he found out that the "characteristics of decentralized systems will weaken the central bank´s ability to control the economic policy and the amount of money, that makes government cautious of blockchain technologies. [Therefore], authorities have to research this new issue [and] accelerate formulating new policy" (Lin & Liao, 2017, p. 658). Based on the theories about blockchain and its potential by different authors, literature also analyzed the most discussed blockchain-focusing players within the payments sector. Thereby, the white papers of Ripple, Bitcoin, and Libra have been examined. The different white papers presented the verification process within the costs and pace of transaction. Additionally, they touched the field of governance and structure. In the case of Bitcoin, Nakamoto (2008) proposed an "electronic payment system based on cryptographic proof instead of trust" (p. 1). The crux is

that no governance and liability standards are foreseen for Bitcoin as everything would be done by "honest nodes [who would] control more CPU power than any attacker nodes" (p. 1). Furthermore, he outlined that within this system, no reversal is possible, which would make a party, who can correct access or input data. Furthermore, Schwartz, Young, and Britto (2018) outlined the Ripple protocol consensus algorithm whereby they presented a different approach to the consensus for the Byzantine Generals Problem, which had the aim that not all nodes within a network have to communicate synchronously. Thus, the authors presented an approach which "utilizes collectively trusted subnetworks within a larger network. Besides the two beforementioned kinds of literature, there is (3) the *finance*-focused literature. Holotiuk, Pisani, and Moormann (2017) explained the impact of Blockchain on business models within the payment industry. They concluded that Blockchain has "potentially a disruptive power" (Holotiuk, Pisani, & Moormann, 2017) and further stated that new services will be introduced, which "foster [Peer-to-Peer] transactions, cross-border and cross-currency transactions, as well as the connection between contracts and transactions, and, hence, make current services obsolete". Furthermore, they further investigated the topic and assessed Blockchains´ impact on cross-border transactions in 2019. Thereby, the authors found out that "Blockchain requires much work regarding its standardization and integration into existing systems" (p. 925) and that "Blockchain changes the concept of core features of transactions in the payments industry by implementing P2P transactions, cross-border transactions, and connecting transactions to contracts" (p. 925). Additionally, to the beforementioned findings, they also found out that "performance in the process is increased by Blockchain and leads to greater efficiency" (p. 925). Guo and Liang (2016) conducted research about the effects on the banking industry and concluded that "Blockchains could revolutionize the underlying technology of the payment clearing and credit information systems in banks, thus upgrading and transforming them" (p. 11). Furthermore, Schlatt, Schweizer, Urbach, and Fridgen (2016) published a discussion paper for Blockchain. In the paper, the authors explained how a transaction process on the Bitcoin blockchain works and additionally found out that the technology is still in a very early phase with the potential of more efficiency or full automation. Besides, they also noticed that "previous problems of the digital transactions, such as high costs and long transaction times can be solved by the blockchain" (p. 32). However, the authors also remarked that regulatory challenges would come up, which have to be tackled in order to use the full potential of the technology. Moreover, Neyer and Geva (2017) found out that "at the current level of maturity of the technology and legal frameworks, blocktech is not superior to existing mechanisms, except certain niche circumstances" (p. 215). Additionally, Shrier, Larossi, Sharma, and

Pentland (2016) found "a significant market benefit of blockchain is the collapsing of additional custodial layers, achievable through the use of a single ledger and transparent auditing" (p. 13). However, they also added that some functions of intermediaries "are still required for a properly functioning market but is it not clear "who or what performs these functions... [as] it might differ on based asset classes" (p. 13).

As different authors already pointed out the difficulty of standardization of Blockchain, Schupmann (2017) investigated the three primary standards needed for blockchain to function as efficient cross-border payments infrastructure. These are (1) Technology Standards, (2) Governance and Liability Standards, and (3) Regulatory and Legal Standards. Thereby the author explained that technology used by the consortium has to be possible to integrate within the current system and therefore allow "interoperability" (Schupmann, 2017, p. 8). Furthermore, she explained that for effective management of the blockchain needs clear governance and liability standards. Thus, "clear governance structures that provide for who may access, input and correct data, among other things" (Schupmann, 2017, p. 9). At last, she also pointed out that it is inevitable to comply with existing laws and regulations in order to act as a player on the global. Therefore, she suggests that the institutions either "integrate blockchain within their existing systems of regulatory compliance or build new systems" (Schupmann, 2017, p. 9). Consequently, it is a crucial success of blockchain that institutions, working with technology, or providing such technology, fulfill Schupmann´s standards.

Furthermore, Dierksmeier and Seele (2018) showed that Blockchain could reduce poverty through the reduction of transaction costs, reduce costs of global B2B and B2C operations and reduce hyperinflation of monetary supply, as it "gives citizens of states with corrupt governments a financial opt-out option" (p. 6). However, the authors also pointed out the risks of shadow-banking, high volatility, and potential tax evasion.

Additionally, market studies were used. McKinsey and Company (2018) provided a yearly overview of the payment industry. Thereby, they found out that the payment industry increased its revenue partly due to the increase in cross-border transaction volume. Furthermore, McKinsey and Company (2018) provided an overview of a fee structure within cross-border payments and noticed a strong saving potential from up to 90-95%. Additionally, the authors found that e-commerce is one of the biggest drivers of the increase of cross-border transactions, as, through worldwide web presence and social media channels, more customers can be reached compared to a decade ago. Moreover, they also remarked that cross-border transaction fees are one main hurdle, which prevents the expansion of e-commerce activities as

customers do not want to pay specific markups due to cross-border transaction fees. Furthermore, the World Bank publishes the “Findex" report, which stated that more than 1.7 billion people are unbanked and that “digital financial services can lower the cost of receiving payments”.

Overall, the research regarding blockchain is evolving. Different authors focused on the blockchain-technology, and some emphasized on possible impacts and implications for the payment industry and the world as a whole. Thereby, they observed that Blockchain has an effect on different fields, and one of them is the field of cross-border transactions. Therefore, this thesis aims to intensify the focus on the current and potential effects of cross-border transactions rather than the payment industry as a whole. The following chapter will discuss the role of financial intermediaries and explain the process of a domestic transaction.

3 Financial Intermediaries and Their Role of Trust Within a Transaction Process

The goal of this chapter is to explain the primary role of financial intermediaries within the process of transaction. Thereby, the chapter discusses the occurrence of moral hazard and adverse selection within a transaction between two parties. Furthermore, it will explain the decisive role of trust in financial intermediaries.

3.1 Financial Intermediaries and the Problem of Moral Hazard and Adverse Selection

Within economics, the terms of “moral hazard” and “adverse selection” have been used to describe the situation in which two parties are interacting with each other, and one of those two parties is at a disadvantage (Nickolas, 2019). In general, moral hazard occurs under the condition that one of the two parties interacting with each other, agrees to a transaction and provides false information or behaves differently, as it does not expect any consequences by doing so. Adverse selection defines a situation in which one party has more information about a specific matter than the other party. Therefore, information asymmetry is the basis for the occurrence of both actions.

In the transaction environment, the classical problem of information asymmetry is still prevalent, because one of the two parties of a transaction knows more than the other party. Therefore, both parties of a transaction must deal with moral hazard and adverse selection risks.

Due to those risks, intermediaries are used as trustworthy authorities in order to protect against those interdependent risks (Allen & Santomero, 1998).

In our current financial system, transactions are usually not handled directly between two parties. The general case includes other parties, which act as the financial intermediary and handle the communication between the two parties and additionally processes the transaction. Transaction costs occur due to the involvement of several parties and the time effort necessary to securely process a transaction. Therefore, trust is created by the intermediary, and the transaction costs can be seen as the price to counteract the problem of information asymmetry (Accenture, 2016, p. 3). The following abstract focuses on the trust, which two interacting parties gain through an intermediary.

3.2 Trust Through Intermediaries

Due to the current development in the economy, networks are globalized; relationships across borders, payments are being made globally without an evident bond between parties, and globalization keeps moving forward. Especially the growing popularity of digital commerce contributes actively to the increase in electronic transactions. In 2017, for instance, the global digital commerce volume exceeded $3 trillion. The current market trends and the status quo of global payment will be further discussed in section 4.1 of this thesis. When the number of electronic payments rises sharply year over year, and the two parties do not have a relationship with each other, a party of trust is usually needed. The main task of the third party is to secure the identity of both parties and to process the agreed transaction (Schupmann, 2017). If the beforementioned case occurs, and both parties use the same financial institution in order to transfer capital, an intermediary is not needed since the financial institution can handle the verification of liquidity and identity within its organization. This scenario would be comfortable in terms of processes and cheap in terms of costs (Schupmann, 2017). However, it is rarely the case that two international parties are using the same financial institution; in this case, the process of validation gets more complicated. In this scenario, it should be emphasized that just by using a third-party, trust is not automatically guaranteed between both parties. The acceptance of the intermediary by both parties creates trust. Both parties´ trust is very fragile since a mistake in identity or liquidity verification can lead to a sudden loss in reputation of intermediary and therefore, in a loss of trust in this particular intermediary. Therefore and as already mentioned, it is the main aim of an intermediary to create trust between the two parties, which cannot fully trust each other or in case the costs of creating the necessary trust are too

high (Schupmann, 2017, p. 3). If both parties use different financial institutions, a clearinghouse is used as an intermediary, where central banks or private institutions can take this role. In the next abstracts, the role of clearinghouses and the general process of clearing and settling will be discussed further.

Nonetheless, national borders drive transaction costs. Therefore, a difference between international and national transactions must be made. The European Payment Council, for instance, introduced the "Single Euro Payment Area" (SEPA), within which the same conditions, rights, and obligations are applicable. "It is possible for each citizen, company and economic participant to make quickly processed payments in euro, within Europe for the same conditions regardless of whether of a cross-border or within-border transaction" (European Payment Council, 2019). Therefore, borders are not making a difference in the occurrence of transaction costs. Due to this, the SEPA procedure will be further seen as an example for national transactions. While conditions and transaction costs are equal within the SEPA-area, international cross-border transactions are more expensive and time-intensive.

Since the scope of this thesis are intermediaries within the process of transactions, transfer provider and clearinghouses are, for instance, treated as intermediaries. These are partly included in a typical transaction process and act as financial intermediaries, not between the consumers but the financial institutions (Schuhmann, 2018). The goal of financial intermediaries in form of privately held companies or central banks, is to ensure financial institutions a secure and working communication network, as for instance the "Society for Worldwide Interbank Financial Telecommunication" (SWIFT) or a standardized system for the process of clearing as the "Trans-European Automated Real-time Gross settlement Express Transfer system" (TARGET2) (World Bank, 2007) .

In total, it can be said that the provision of international standardized procedures and systems is the service financial intermediaries provide and charge for. As a logical consequence, transaction costs increase, especially for international cross-border transactions, transaction costs can amount to up to 7% of the transaction amount (McKinsey, 2018).

4 Domestic Transactions Within the SEPA-Area

The SEPA-transaction process is usable in all member states of the European Union and has the aim to equalize the conditions monetary transaction of any citizen or company within this "area." The conditions include pace and cost for any ordered transaction. Since these conditions lead to a harmonization of the currency zone and since no differences are made between

citizens, these transactions will not be defined as cross-border but rather as domestic transactions.

Initially, this chapter will provide an explanation of the terms “clearing” and “settlement” and describes the classical transaction process within the SEPA-area and subsequently discusses the topics of “costs” and “pace” of transactions within the SEPA-area.

4.1 Process of Clearing and Settlement

In this abstract, the goal is to explain the terms clearing and settlement generally. Thereby, it

Clearing and settlement are processes which are used in the interbank segment. The goal of the different processes is to process transactions initiated by the client successfully. The client is not in contact with any of the intermediaries. The interbank transaction process divides itself into two parts. Clearing defines a process which covers all the steps from the entry of transactions towards the netting of receivables and liabilities between two parties (Helms, 2019). If the beneficiary bank is not included in a network of banks such as the “Cash group”, clearing gets complicated, and the goal of clearinghouses as an intermediary is to simplify the transaction process. Two different methods are applied. One method has the goal to avoid the clearing of each individual transaction order. At this moment, the *sum* of transaction orders between the different financial institutions is identified and cleared. If this method is not used, a clearing over the interbank market will be initiated (Schuhmann, 2018).

The second part of the interbank transaction process is called settlement. It describes the process whereby the sending institution transfers the transaction amount irreversibly to the receiving institution, and the receiving institution is crediting the recipient account (Alt & Puschmann, 2016).

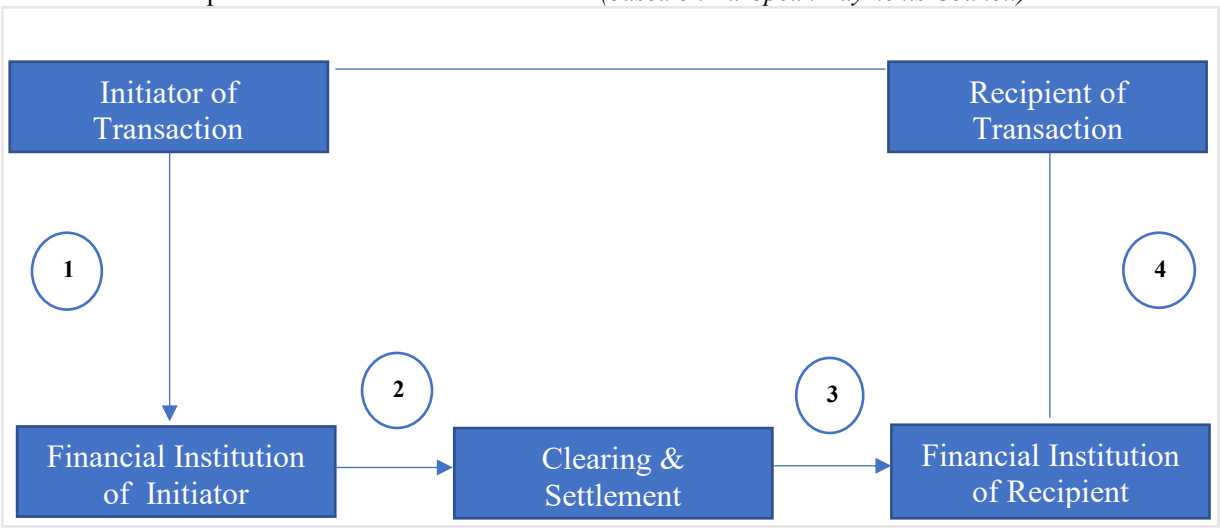
The next abstract will explain the four steps of a domestic transaction within the SEPA-area.

4.2 The Four Steps of the SEPA-Transaction Process

The *first* step of the transaction process is the initiation of a transaction order from the constituent. In this step, the bank gets information in which the constituent asks his/her bank to do a transfer of a certain amount to another party (Hettwer Unternehmensberatung GmbH, 2019). As a *second* step, the bank receives the order and verifies the information given such as bank account number, bank code, liquidity, the bank account of the receiving person and the number of transaction (TAN). After successful verification, in a *third* step, the transaction will

be carried further within the internal systems of the bank and finally initiates the transfer and thereby transmits the transaction information to the financial institution of the receiving person. As a *fourth* step, the recipient's financial institution receives the transaction and finally credits his/her account.

Figure 1: The Four Steps of the SEPA-Transaction Process *(based on European Payments Council)*



4.2.1 The Process of Clearing within the SEPA-Area

The previous paragraph shortly mentioned the validation of certain transaction information. Since the focus of the thesis lies on cross-border transactions, the following abstract will not explain all existing clearing possibilities, but instead, focus on the primary system for fast clearing and Settlement of transactions (TARGET2) of the European Central banks and further on other clearing and settlement systems that the European Central Banks offer. This abstract has the aim to enhance the understanding of a domestic transaction process.

In the Euro-zone, it is either possible to use the SEPA-clearer or other clearing institutions for the clearing process (Deutsche Bundesbank, 2019). By using the SEPA-Clearer, *non-urgent* domestic and cross-border transactions within the Euro-zone are "cleared and settled through the electronic mass traffic (EMT)" (Deutsche Bundesbank, 2019). "The SEPA-clearer handles initiated SEPA-transactions, SEPA by direct debit, SEPA Card Clearing (SCC)" (Deutsche Bundesbank, 2019).

When transactions within the Euro-zone are urgent, the European central banks are offering the transaction system "TARGET2". The system settles more than 350.000 transactions per day and is in the leading position with "90% processing of the total value settled by large-value payment systems in euro" (European Central Bank, 2019, p. 6). The ECB is

focusing on three objectives by providing TARGET2 as clearing system: (1) Provision of a mechanism, which is safe and reliable for settlements of euro payments on a real-time gross settlement basis, (2) An efficiency increase of inter-Member State payments within the euro-area and (3) Serve the needs of monetary policy of the Eurosystem. In order to access the system, the options (a) Direct Participation, (b) Indirect Participation (c) Multi addressee access, or (4) Addressable Bank Identifier Codes are possible.

4.2.2 TARGET Instant Payment Settlement

The TARGET Instant Payment Settlement (TIPS) is an answer of the ECB towards the highly competitive landscape of payment services and the increasing expectations of customers and consumers. In the last years, innovations disrupted the payment system and helped to develop more efficient and faster payment processes. Since November 2018, the ECB is offering a new market infrastructure service. Thereby, "it enables payment service providers to offer fund transfers to their customers in real-time and around the clock, every day of the year" (European Central Bank, 2019). This affects not only B2B but also B2C, C2C, and C2B transactions, thus, the whole European transaction traffic. The sole purpose of TIPS lies in the settlement process. Therefore, the clearing process is not executed by TIPS.

4.3 Cost and Pace of SEPA Transactions

Clearing and settlement service provider demand a fee for their services. This fee is not equal and differentiates between the amount transferred or the rate the specific financial institution agreed on with the clearing institutions for using their clearing services (SEPA-Clearer, TARGET2). Furthermore, it differentiated between non-urgent SEPA transactions, SEPA by Core Direct Debit or SEPA Card Clearing. The usual rate charged for the SEPA-Clearer by the German Central Bank is EUR 0.0025 per transaction (Deutsche Bundesbank, 2016, p. 10). The services of TARGET2 offer different fee-models. One model asks for a monthly fixed fee of EUR 150 and EUR 0.80 per transaction. A second option asks for a fixed fee of EUR 1,875 and transaction fees from EUR 0.60 to EUR 0.125 per transaction. The exact fee per transaction depends on the monthly volume of transactions (European Central Bank, 2018). Moreover, TIPS as an extension of TARGET2 asks for a fee of EUR 0.002 as the only fee per transaction. The issue at this moment is that not all banks are using TIPS, which leads the customer to use TARGET2.

Especially in a business context, liquidity is a critical and distinguishing factor of sustainable success. Therefore, the pace of transaction clearings is decisive for businesses. In

the EU, the pace can vary between the different clearing methods. However, by European law, it is compulsory to process a usual electronic transaction within the EMT within one day. Therefore, the transaction has to be processed within 24 hours from the moment an electronic submission of a transaction order was made. Within each day, six process cycles of transactions are happening. However, non-urgent transactions are not instantly credited to the recipient's account (Deutsche Bundesbank, 2016). In contrast to the SEPA-Clearer, does TARGET2, as a system for urgent euro payments, use a Real-Time Gross Settlement system in which payments instantly get cleared. Nonetheless, this does not translate in a direct crediting of the recipient´s account.

In November 2017, the European Payment Council introduced the SEPA Instant Credit Transfer (SCT Inst), which provides its services 24 hours per day on 365 days a year and is limited to a transfer amount of EUR 15,000 per single transaction. Furthermore, it expects a maximum processing time of 10 seconds per transaction. During these 10 seconds, the payer's payment service provider (PSP) has to report whether that liquidity is given, and the transaction can be either processed or gets rejected. In individual cases, in which the execution time of 10 seconds cannot be kept due to exceptional processing circumstances, the rules of the SCT Inst keeps the maximum processing time at 20 seconds. The Beneficiary Bank is only able to make funds available for the beneficiary if it has the confirmation from the Clearing & Settlement Mechanisms, which requires positive notification from the payer´s bank first (European Payments Council, 2018, p. 23).

Additionally, all the participating institutions commit themselves to payment transfers every day of the year, including weekends and holidays. However, not each participating bank can process each transaction instantly. Therefore, participants are obliged to provide collateral in order to settle transactions if instant processing is not possible.

In comparison to the classical approach of a transaction, the SCT Inst is a viable option that improves the pace of transaction by far. Classically, financial institutions bundled transaction orders and processed them step by step (European Payments Council, 2018). Furthermore, transactions are processed on all seven days of the week. The change towards the possibility to process transactions on each calendar day a year improves the transaction pace. The number of banks that offer the service of an instant payment to its clients is increasing.

TIPS can be seen as an extension of TARGET2, it decreases processing time to five seconds and assures a direct crediting to the recipient's account, which was not possible with TARGET2 (European Central Bank, 2019).

The following chapter will discuss the process of cross-border transactions. Thereby, it will draw a comparison between the classical SWIFT-based bank transfer and other available options to transfer money across borders.

5 Cross-Border Transactions

As discussed in the last abstract, trust plays a central role in transactions. Therefore, financial intermediaries are focused on a transparent transaction process in order to gain and keep the trust of different acting parties. The SEPA-area was focused and discussed. It could be seen that the ongoing development of transaction flexibility and technology is forced within the European Union. However, in the following abstracts, an overview of current trends within the payment industry will be given, and the process of cross-border transactions will be explained and illustrated by an example of a transaction from Germany to Japan. Thereby, aspects of costs, pace as well as the general transaction process will be discussed. Furthermore, a comparison will be drawn between a classical cross-border transaction via SWIFT and different money transfer service providers.

5.1 Current Trends in the World of Payment

The field of payments is still one of the most lucrative areas within the financial service industry. In 2017, financial institutions earned more than USD 125 billion from cross-border transactions. With a positive macroeconomic outlook, further developments of technology, the modernization of suitable infrastructure, in order to process electronic transactions rapidly and the increased usage of digital cash mechanism, led to total growth of 11% year over year, which translates into a total amount of $1.9 trillion in payment revenues in the year of 2017 (McKinsey, 2018; BCG, 2018). Until 2022, payment revenues are expected to increase on average at 9% per year with the region of Asia-Pacific being the biggest driver of growth. In payment, revenues are fees included for domestic and cross-border transactions as well as for net interest income on current accounts and overdrafts. In the following abstracts, the focus lies on cross-border transactions. Thereby, the general definition of the cross-border transaction, the current prevalent trends and different kinds of transaction systems will be discussed with a focus on classical B2B payments as well as C2C and C2B payments.

5.1.1tg Consumer-to-Consumer Transactions

The term “Consumer-to-Consumer (C2C) transactions” describes the cash-to-cash remittance of two individuals. It currently has a size between 400 and 500 Billion, with a CAGR of 5% (McKinsey, 2018, p. 13). The majority of users of cash-to-cash remittances are migrants of the low-middle income class, and those are currently charged the most. The mean fee that is charged for the cash-to-cash services is 6%. The exact fee to be paid is dependent on the distance and amount transferred. In abstract 5.5, different fee structures and money transfer processes will be discussed.

5.1.2 Consumer-to-Business Transactions

Besides the two traditional ways of cross-border payment flows, the area of Consumer-to-Business (C2B) payments is increasing as well. It is defined as payment flows, which are initiated by the consumer towards a business, which is not situated within the same currency. Therefore, cross-border transaction fees are occurring. The payment flow in this segment is currently at a size of USD 1.5 trillion and grew 20% in 2017. McKinsey is expecting it to grow by roughly 10% per year until 2021. The biggest driver of those expectations is the growth of global online eCommerce. Retail cross-border eCommerce sales are expected to reach USD 900 billion in 2020. A second driver is international bill payments such as tuition, subscriptions, or rent since it remains laborious to open an “in-country” bank account (McKinsey, 2018).

As already mentioned, the trend of” electronification”, which describes the increasing tendency of consumers using electronic payment methods instead of banknotes, is observable. Therefore, consumers use new payment methods and money transfer providers in order to conduct a cross-border transaction. 2017 was following the trend of 2016, in which more payments were made by card than by cash. Consumers merely demand that businesses offer different payment possibilities. Therefore, internationally operating companies have to offer certain flexibility in payment options. Moreover, it is expected that cross-border flows will increase over the years due to the globalization and adjustment of regulatory frameworks (Newman & Denecker, 2018, p. 4). The international Forex-trading is expected to increase by roughly 6% until 2020.

Overall, the cross-border payments flow increased, and the trend towards electronification and the use of different payment methods accompany a further increase. Globalization is shaping the world of payment and challenges established payment systems. Therefore, the next abstract discusses a classical cross-border transaction, which is merely used

for business-to-business transactions and additionally, explains systems which are used by consumers. The aim thereby is to present the current systems, its cost, and pain points.

5.2 Status of Financial Exclusion

Besides the different classes of transactions, it has to be pointed out that over 1.7 billion people worldwide did not have access to a bank account or digital payments and therefore, lack the access to financial services, which could enhance investments in education, business and the health of the people (World Bank, 2018). Within the Findex Report of the World Bank, studies could be found that showed that "mobile money services, which allow users to store and transfer funds through a mobile phone can help improve people´s income-earning potential and thus reduce poverty" (World Bank, 2018, p. 1). Furthermore, the report shows that between 2014 and 2017 over "515 million adults opened a bank account at a financial institution or a mobile phone provider" (World Bank, 2018, p. 2). Moreover, it has been reported that within high-income economies, over 94% of the adult citizens have access to digital payments and a bank account, compared to only 63% in developing economies (World Bank, 2018, p. 2).

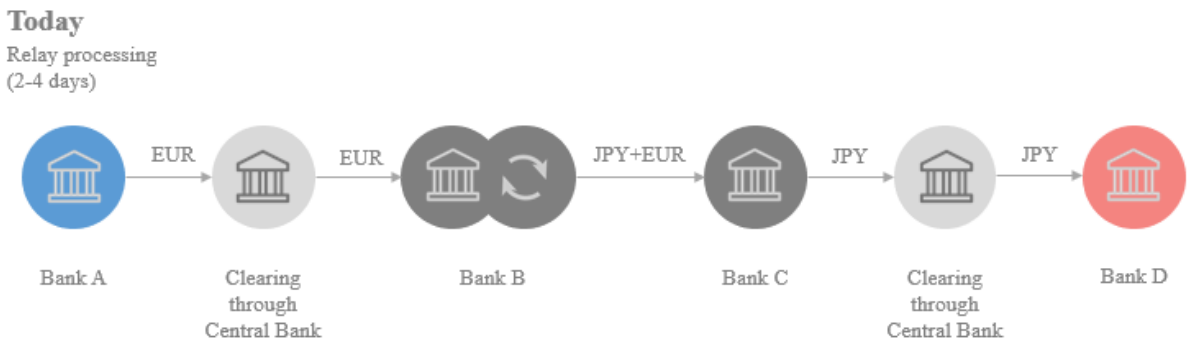
After the world of payments and the status of financial exclusion has been discussed, the next abstract focuses on the definition of cross-border transactions.

5.3 Definition of Cross-Border Transactions

Cross-border transactions are not comparable to the SEPA-area transactions. Since currency risk and a further distance between both parties exist, security is more expensive to guarantee, and processes of clearing and settlement involve more parties than a domestic transaction (Pakcan, 2012). In order to demonstrate a cross-border transaction (outside of the SEPA), a classical transaction from Germany to Japan will be demonstrated. The sender X is situated in Germany an and the receiver Y in Japan. The seller is ordering the transfer of funds at its bank A. In order to send the requested funds from Bank A to Bank D, corresponding banks are needed since Bank A, and Bank D do not hold accounts with each other (BIS, 2016). Therefore, Bank A contacts its corresponding Bank B. Correspondent banking can be seen as a "provision of current or other liability account and related services to another financial institution" (BIS, 2016, p. 9). This financial institution is located internationally and therefore, a correspondence bank that provides "access to the foreign financial systems" (BIS, 2016, p. 9) and handles a transaction in foreign currency is needed. Bank A needs to have a mirror account in order to operate the transactions effectively. These mirror accounts are known as Nostro/vostro accounts. A Nostro account defines an account Bank B holds as a correspondent bank for Bank

A in a foreign currency (Wandhöfer & Casu, 2018). For a transaction from bank A to bank B, clearing and settlement are needed. After Bank B received the funds, it transfers them to Bank C, the corresponding bank from Bank D. In order to finally transfer the funds from Bank C to Bank D, a second clearing and settlement process is needed. After Bank D received the transfer, it deposits the funds into the account of Y. In this process, fees for clearing and settlement occurred twice, which translates in less pace and higher transaction costs. In the exemplified transaction, a total number of 6 parties were involved in the cross-border transaction from X to Y.

Figure 2: Payment Flow of Cross-Border Transactions (Based on Ripple, 2015)



5.4 SWIFT as Widely Used Cross-Border Transaction System

After discussing the general definition of a cross-border transaction process, this abstract will focus on the explanation of the SWIFT-network, on which cross-border transactions mainly rely on as infrastructure.

5.4.1 Definition of SWIFT

The Society for Worldwide Interbank Financial Telecommunication (SWIFT) provides the dominant systems behind the payment flow of cross-border transactions. SWIFT is defined as a “global member-owned cooperative and the world´s leading provider of secure financial messaging services” (SWIFT, 2019). The system is a messaging platform that more than 11,000 financial institutions in more than 200 countries are using. It is used as a unified cross-border transaction language. The standardization of global financial messaging was an essential step in order to create a cost-efficient way of transaction in the past. Furthermore, it was the goal to create a system, which is unambiguous, risk-mitigating, machine friendly, and facilitating in the area of atomization (SWIFT, 2019). SWIFT is responsible for the transfer of data from bank A to bank B. To do so; it uses identification codes and specific messaging standards. Those

standards include specific security and identification procedures in order to authenticate the customer's bank. Thereby, it assures that messages arrive at the receiving party. Furthermore, the system encrypts messages until they are delivered to the receiver. To conclude, SWIFT is the biggest messaging system provider in the world of payments. However, it is not responsible for settling but rather for translating between financial institutions. The following paragraph will explain the SWIFT global payment innovation.

5.4.2 SWIFT Global Payment Innovation

SWIFT global payments innovation (SWIFT gpi) is an advancement from the previously described SWIFT system. The goal thereby is to address the main pain points of its predecessor and therefore, increase pace and transparency and introduce an end-to-end payment tracking, since an in-progress payment could not be tracked and investigations for delays were difficult to conduct (Faden, 2019). Transparency is not only established by the end-to-end tracking but also by clear communication of fees. In order to use the SWIFT gpi, financial institutions have to agree to a new service level agreement (SLA) with SWIFT. By agreeing, the financial institutions agree to (1) an end-to-end, same-day processing of payments and a same-day crediting of the beneficiary bank account and the condition that the beneficiary bank receives the payment before the banks cut-off time; (2) complete transfer of the payment amount without deducting any charges from this amount; transparent indication of FX and transaction fees; (3) up to 140 characters of unaltered additional payment information and (4) an end-to-end tracking of payments. SWIFT gpi uses a cloud-based tracker, which is comparable to a tracker of parcels. The tracker updates the status of payments starting from the moment the payment is passed to the correspondent bank. Therefore, (Bellin, 2018) banks can track the progress of the payments, which is essential for many of its clients (Faden, 2019). Overall, SWIFT gpi is a solution that solves some pain points under the condition that banks can adapt its technology towards the system requirements. The next paragraph will provide an overview of cost and pace for cross-border transactions using SWIFT and those, which use SWIFT gpi.

5.4.3 Cost & Pace of Cross-Border Transactions using SWIFT & SWIFT GPI

In contrast to the “domestic clearing”, a cross-border transaction needs international settlement with several intermediaries. Inefficiencies are mainly due to the location of the initiator and the recipient of a transaction and different currencies involved. Furthermore, the diversity of regulatory and technical standards increases the time needed for a transaction.

Besides, treasurer of companies is not able to efficiently manage the company's liquidity since no clear indication of the timing when payments arrive is available. Swift gpi tackles some pain points of transparency and overall time needed. Through SWIFT gpi, it was possible to decrease the needed time towards a time frame of 30 minutes – 24 hours.

Additionally, the recipient is credited within 24 hours of transaction initiation, and banks can track the payment, which gives companies the opportunity to increase efficiency in liquidity planning. However, in order to do so, banks have to adapt their technological systems towards the new expectations of SWIFT gpi. This is expected to be merely done at the end of 2020 (SWIFT; Citi, 2018, p. 8). As could be seen, the problem of pace decreases through SWIFT gpi, nonetheless is it a question of technological readiness, which is decisive for the success and further global adaption of gpi. The system upgrade is difficult and expensive, which makes it more appealing to banks to stick with the current systems than refreshing those. In an interview with Christopher May conducted for this thesis, Mr. May emphasized on the weak IT-infrastructure banks have and that the "technological turnaround will take time and cost money, which banks are not easily ready to deduct from their balance sheets." Fees are developing through the number of intermediaries and the degree of complexity.

In the area of trade finance, more than 20 billion points of data are accessed and further transmitted to at least 20 participants for each transaction (BCG, 2017, p. 18). The consulting company "Deloitte" reported that a transaction from a German company to a company settled in Japan would cost around 8% of the total amount of the transaction. In general, transaction costs for cross-border transactions are expected to vary between 5 to 10% of the total amount transferred. In order to compare the different transfer methods in abstract 5.6 of this thesis, an example transfer of EUR 10,000 from Germany to Japan will be exercised. In general, the financial institution can vary, but this example uses the fees list of Commerzbank AG in Germany and the Japan Post Bank. Commerzbank is asking for a general fee of 1.5% or at least EUR 12.5 per transfer. Additionally, fees are occurring due to the payment in foreign currencies. In the case of Commerzbank, all transfers below EUR 12,500 are charged with a fee of EUR 7.5 and all transfers above EUR 12,500 are charged with 1% of the total amount. The Japan Post Bank charges a general fee of JPY 2,500 for incoming transfers, which translates into EUR 20.50 (exchange course JPY/EUR at 11th of July 2019) and an additional EUR 5 for each transfer which is over EUR 100.

Furthermore, a fee of EUR 10 for intermediary services has to be paid according to Japan´s Post bank list of fees. In addition to the different fees mentioned, banks are charging

an exchange rate mark-up of 4-6% (TransferWise Ltd, 2018). In total, transfer fees, without consideration of the exchange rate mark-up, are adding up to EUR 192.9, which equals 1.93% of the transaction amount. Therefore, as could be seen in the example above, transferring money across borders is expensive and represents a substantial cost hurdle for companies.

The next paragraph will focus on the alternative of SWIFT-based transactions and focus on money transfer service providers.

5.5 Money Transfer Service Providers for Cross-Border Transactions

Besides the traditional bank as a cross-border transaction provider, money transfer service providers are enabling private persons and business to do so as well. This abstract discusses three of the big players in the field of C2C and C2B transactions in terms of the transaction process, fee structure, and pace. An exemplified transaction of EUR 10,000 will provide the basis for a comparison of fees and pace of C2B and C2C transactions.

5.5.1 PayPal

PayPal is one of the leading platforms in the digital and mobile payments landscape for consumers and merchants. In its annual report of 2018, PayPal counted over 267 million customers and over 9.9 billion payment transactions with a total payment volume of USD 578 billion in 2018. The service enables customers to send and receive payments under the condition that both have a PayPal account. PayPal understands itself not only as a connector to a trusted third party but more as an opener for the usage of a variety of sources to fund a transaction. This includes a PayPal account balance, a PayPal Credit account, credit or debit card as well as gift cards or coupons. The transaction process starts with the customer paying for the service or product. As a second step, PayPal is encrypting the bank account information, and the amount transacted and authenticates the transaction through its payment gateway and processor to detect fraud. The process only takes seconds until the sale is authorized and the funds are sent to the PayPal account of the merchant. The whole process of clearing and settling only takes a few seconds. Nonetheless, the money is not in the merchants' bank account within these seconds. The crediting of the merchants' account takes 1-2 days (PayPal Holdings Inc, 2018). Therefore, the whole process of buying and settling takes in total around 1-2. Furthermore, it enables PayPal merchants to increase their reach by facilitating the payment process. It offers an end-to-end payments solution that includes the clearing and settlement process and provides instant access to funds. Fees charged for a completed transaction generate revenues. The transaction fee structure divides into two main parts: Private payments and business payments.

Private payments are occurring when a private person transfers money to another private person. To indicate the payment as a private transaction the person who is initiating the payment has to confirm that the payment has the sole purpose of being transferred to another private person such as a family member or a friend. The fees are dependent on the currency, location of the sender and recipient, and the classification of the payment. If the receiving and initiating person are in the same country or currency zone, such as the euro-zone, the transaction is classified as "domestic transaction," and the transaction costs are at zero, whereas if the person is settled in the same country and currency, additional costs are occurring. PayPal charges a fee of 5% of the transaction amount with a minimum of EUR 0.99 and a maximum of EUR 3.99. Additionally, it charges a fee for the currency exchange service this fee is ranging between 3.75-4.00% (Appendix 2). Besides private transactions, there is a business transaction. It is defined as a "transaction which is related to a purchase or a sale of products or services" (PayPal Holdings, Inc, 2019). PayPal is charging a variable transaction fee of 2.49% of the total transaction amount plus a fixed fee for transactions in euro of EUR 0.35. Under the condition that PayPal grants the merchant a so-called "merchant rate", the variable fee can decrease. This rate decreases with the increase in monthly transaction volume (Appendix 3). The fixed fee is varying between transaction currencies. The different fees are charged solely to the merchant and not the purchaser. In Appendix 4, all the different fixed fees are shown. In the case of a cross-border business transaction, PayPal is charging a variable transaction fee mark up between 1.80 and 3.30%. The level of mark-up charged is dependent on the region the receiver lives in. The FX exchange rate is equal to the FX fees charged in a private transaction. Converting this information into an example of a transfer of EUR 10,000 to Japan, differences between a private C2B and a C2C transaction occur. The C2C transaction consists of a fixed fee of EUR 0.35, a variable fee of EUR 3.99 and a 4% currency exchange mark-up which translates into EUR 400. The transaction fee amounts to EUR 404.34 in total, translating into 4.04% of transaction costs. Under the condition that PayPal does not grant merchant rates, the C2B option consists of a fee of 2.49% of the principal amount plus the fixed fee 0.35€ and the 4% currency exchange mark-up. Therefore, C2B transaction costs are 6.49% of the transferred amount, which translates into EUR 649.35. Year by year, PayPal increases the number of users. Nonetheless, it is not possible to send money in every currency. Therefore, the possibility to send money with PayPal in every country is not given, which limits its usability to persons and business which are not using the 24 offered currencies of PayPal.

5.5.2 The Western Union Company

The Western Union Company (WU) is a leading company in the area of global money and payment services by providing ways to facilitate the process of transferring money around the world. At the end of 2018, it counted more than 550,000 agent locations and representation in more than 200 different countries around the world. WU aims to provide a service which facilitates payment with a focus on cross-border and cross-currency transactions. The customer focus lies on small and medium-sized businesses as well as individuals. WU major source of business is the currency exchange at respective spot rates in order to enable their customers to make cross-border payments (The Western Union Company, 2019). The focus of WU lies on C2C transaction since it made 80% of their business in 2018. Fees paid by the customers for the transfer of money are the source of revenue. The level of fee depends on the channel through which the money is sent, the send and receive location, the principal amount sent if a currency-exchange is necessary, the exchange rate set by WU and the current spot rate in the foreign exchange market and as of last speed of service. The transfer process starts with the consumer entering a WU agent location and provides the agent with the necessary information such as name and additional identifying information of the recipient. At last, the consumer deposits the principal amount plus the transaction fee in the agent's office (The Western Union Company, 2019). In the next step, the agent enters the given information into the internal money transfer system of WU. After doing so, the agent receives a unique identification number (UIN), which he/she passes to the consumer. Thereafter, the consumer must give the UIN to the recipient. Otherwise, the recipient cannot obtain the principal amount. In order to receive the principal amount, the recipient has to enter an agent location of WU, present his/her identification information and the UIN. The recipient usually does not have to pay any fee and receives the principal after the agent confirms the identification information and UIN. Besides the classical cash withdrawal at a WU agent´s location, it is also possible to transfer the amount on a bank account indicated by the consumer who sends the money. In selected markets, it is possible to send the principal amount to a prepaid card that is WU branded in order to send money to a mobile wallet. This depends on the destination of the money since it is common that in some less emerged regions, the mobile wallet takes the additional role of a bank account. The pace of transfers varies. The classic pickup of cash at an agent’s office takes a few minutes. Additionally, it is the crediting of a mobile phone or the WU prepaid card done within minutes. The option of a transfer to a bank account takes between one and three days to be available for the recipient. The fee structure of WU depends on the sectors above. For example, for a transfer

of EUR10,000 from Germany to Japan, WU deducts a fixed fee of 3%, if a deposit happened at the agent´s location, which would translate in EUR 300 to pay for the transfer service (The Western Union Company, 2019). Additionally, is the difference in currency exchange spot rates and the rate WU is applying to the customer. By conducting various tests with different currencies on the WU-website, it was found that on average, the difference between the spot rate and applied exchange rate varies at the 2% level. In the example, this additional costs of € 200. It could be seen that about 5% of the principal amount is necessary to pay in order to initiate a transfer over WU.

5.5.3 TransferWise

TransferWise is a start-up in the matured stage with the mission to make international money transfers instant and less expensive due to fewer differences of spot and applied rate. Today, TransferWise is counting over five million customers, which amounts to a total transfer of more than four billion euros each month. It offers different models of transfers which are the “fast transfer”, in which the money gets directly transferred from the credit or debit card, the “low-cost transfer”, which sends the money from the customer's bank account, or the “easy transfer”, which sends money from a bank account via online payment. In all three options, it is possible to track the transfer and to see the current status. The pace of the three methods is different. The fast transfer allows the recipient to have the transferred amount available in seconds, whereas the low-cost transfer, as well as the easy transfer, takes two days to process the transaction and credit it to the recipient’s bank account. Besides the different transaction possibilities, it is also possible to choose different kind of account options: (1) the general account, which focuses on the P2P money sending process; (2) the “borderless account”, a multicurrency account, therefore the user can hold all currencies he/she needs. Furthermore, the user gets a debit card, which allows him/her to pay in any currency he wants for a low exchange rate mark up between 0.35 and 2%. Besides that, it is also possible to withdraw any foreign currency of a value of GPD 200 each month with no charge; (3) it is possible to open a business account. This allows the user to pay salaries and bills in different currencies. Furthermore, receiving a payment from abroad is free of charge. Last, it is also possible to use a debit card given by TransferWise, which facilitates the payment across borders for the user. The difference between a classical bank transfer and TransferWise lies in the transfer process. Instead of transferring the sender´s money directly to the recipients, the system is matching amounts with other users of TransferWise who are transferring money in the opposite direction (Kauflin, 2018). Therefore, TransferWise reroutes the money a customer wants to transfer to some other user of

TransferWise, who sends a similar amount to someone across borders (Rubini, 2018). Destination of the money and the amount transferred determine the transaction fees. The minimum fee is 0.5%, whereas it can be 1% as well depending on the country and the type of transfer used. In our example of a EUR 10,000 transfer from Germany to Japan, it would lead to a total fee of EUR 64.88, which translates into 0.64%. For this transfer, it was only possible to use the "low-cost transfer" option, whereby the processing time is two days. However, through the usage of the mid-market exchange rates, no additional fees for forex exchange are occurring.

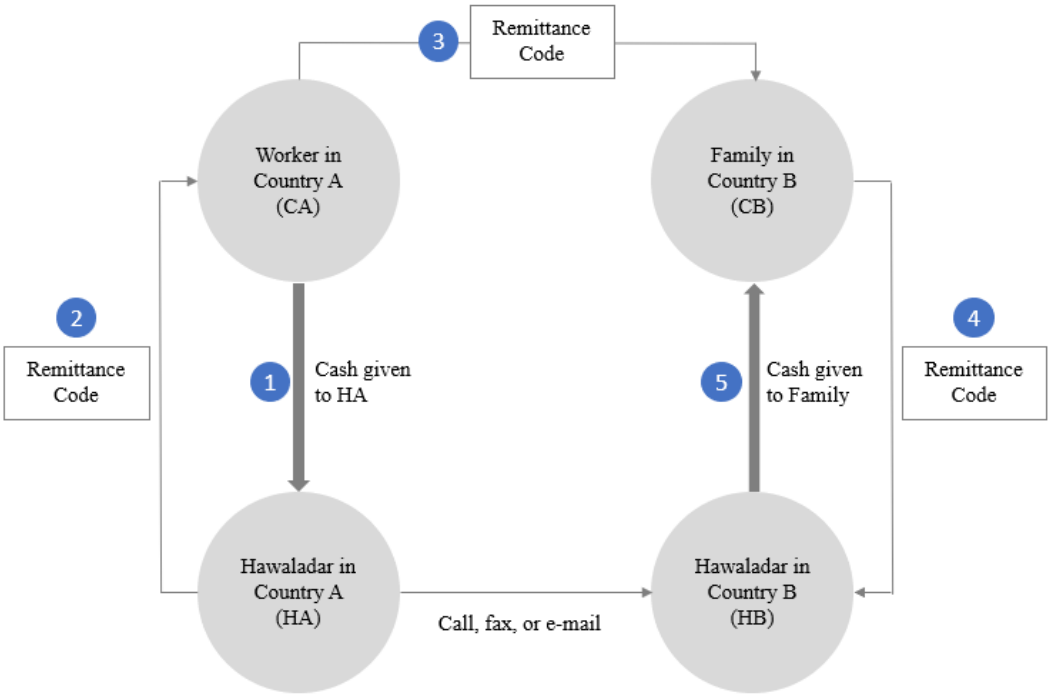
Besides the beforementioned money transfer providers, the next abstract will explain a very old-fashioned and merely prevalent method in developing countries "hawala".

5.6 Hawala as Alternative Transaction Method for Cross-Border Transactions

An alternative to the beforementioned money transfer service providers is the possibility to send money via the "hawala" system. The hawala system, is a "money transfer mechanism which exists in the absence of or parallel to, conventional banking channels" (El Qorchi, Maimbo, & Wilson, 2003, p. 12). The system consists of a worker who is working outside a country in which he/she wants to send money, the receiver of the money and to hawaladars (HA & HB) which are arranging the payment. A usual transaction follows a definite pattern, which is that worker A gives hawaladar HA money to transfer to B. A counterpart of Hawaladar A in the respective country is contacted, in this example we call him/her HB. HB is preparing the remittance to B in their local currency. When A gives HA the money to transfer, he/she gets a code, which he/she tells B so that HB can identify the eligible receiver of the money. For this service, the agents charge a fee of usually 2-5% per transaction, and a transaction process takes 6-12 hours across cities and up to 24 hours across borders (El Qorchi, Maimbo, & Wilson, 2003, p. 16). Figure 3 shows the typical transaction logic. The hawala system especially helps the 1.7 billion unbanked people, as no bank account is needed. Therefore, particularly in developing countries, in which "formal banking is expensive, heavily regulated, or simply absent" (The Economist, 2015), it is an efficient and essential alternative to the formal money transfer into the country. Furthermore, Hawala is an alternative for countries that are banned from international trade and banking, for example, Iran. However, besides the possibility to send money into developing countries, it is also known as a mean to fund terrorist attacks. Therefore, regulators increase their suspicion on such money streams, which increases the risk for Hawaladars as the countries they live in, are merely focusing on complying merely with western regulators in order to expand their trade and business activities. Due to that, it is expectable that

hawala transfer possibilities decrease over time, which leaves the users who are reliant on the system with fewer choices to send money to unbanked family members, as countries, in which the money is sent to usually underly strict international controls or banishment from the international banking world.

Figure 3: Hawala Transaction Flow (Based on El Quorchi, Maibo & Wilson, 2003)



Following the discussion of cross-border transactions via SWIFT, SWIFT gpi, different money transfer service providers and Hawala, the next abstract will establish a comparison between the different options for a transaction across borders.

5.7 Comparison of Different Cross-Border Transaction Providers

After explaining the classical domestic and cross-border transaction methods as well as the most used cross-border money transfer provider and Hawala, this abstract has the aim to compare the different methods and provider by pace and cost.

In this chapter, it has been made clear that a difference between domestic and cross-border payments is prevalent and additionally to that, other viable options are available for the consumer to transfer money across borders. By comparing the classical “domestic” and cross-border transaction, the difference in pace and cost is still prevalent. While the classical SEPA-transaction takes one day, SWIFT needs 3-7 days to settle a transaction due to a higher number of involved parties within each transaction process. Through SWIFT gpi, the pace of a

transaction decreased sharply from 3-7 days to one day. However, the costs of bank transfers using SWIFT gpi are equal to SWIFT, since SWIFT or SWIFT gpi is only a messaging system that does not overtake the roles of clearer and settler. Therefore, the costs for the intermediaries are still prevalent. The current disadvantages of SWIFT strain the small and medium enterprises (SME) more than the multinational companies. The reason for this is that SMEs do not have different subsidiaries within the region they are transferring money to and therefore do not have an advantage, as corresponding banks will probably be different, which will cost time and money.

Furthermore, not all financial institutions use SWIFT gpi. Additionally, it limits each transaction to EUR 15,000, which translates into several transactions for any amount above EUR 15,000. Therefore, companies must use the standard SWIFT model, which leads to a low pace and high costs. In the core, it does not matter whether a consumer or a company is using SWIFT in order to transfer money across borders. Therefore, this thesis will compare SWIFT and SWIFT gpi with the beforementioned money transfer service providers and Hawala by pace and cost.

Generally, money transfer providers aim for pace. All three presented transfer providers advertise with instant transfers. Furthermore, all three providers have a different fee structure and different target group. PayPal, on the one hand, has a clear focus on C2B business transaction, since this is the most significant source of revenue. Western Union, on the other hand, has a clear focus on the C2C cross-border transactions, since C2C transactions make 80% of the revenues. Users of WU merely focus on the fact that cash pick up is available, which gives people without bank accounts in emerging countries the possibility to have cash available directly. This advantage leads to the readiness of customers to pay on average a 5% transaction fee (dependent on the principal amount). TransferWise can be categorized in the middle of the two beforementioned service providers since it has a focus on both B2C and C2C. It advertises with low fees, which are mainly due to the little to no mark-up they charge.

Furthermore, Hawala focuses on the quick remittance into countries without any conditions except a fee. Table 1 shows that hawala outpaces the classical transfer via SWIFT but still takes 24 hours for a transfer across borders, which implicates that it falls behind all money transfer service provider except TransferWise. In terms of cost, Hawala is estimated to be cheaper than all the presented options except for TransferWise. However, the most crucial advantage of Hawala is the possibility to use it without having a bank account or any form of identity. This, however, bears the risk of terror-financing, for instance.

Additionally, table 1 shows a tradeoff between pace or cost. A classical bank transfer, using SWIFT, takes most of the time and charges the highest transaction fees. Even with SWIFT gpi transaction fees are equal only the pace increased. Here, it has to be remarked that SWIFT gpi could only be used because the payment was below EUR 15,000. Furthermore, table 1 shows that PayPal is cheaper than the WU in the C2C segment but not in the C2B segment. Additionally, PayPal does not offer the possibility to pick up the amount transferred in cash, as WU does.

In comparison to WU and PayPal, TransferWise is offering the lowest transaction fees by far. With transaction fees of only 0.65% of the transferred amount, it beats all the different cross-border provider in the category “cost.” However, TransferWise takes two days to credit the recipient's account. Moreover, the most significant component of the respective transaction fees is the exchange rate mark-up. Except for TransferWise, all the other providers are charging a mark-up, which represents the primary source of revenues concerning cross-border transactions. Overall, it can be said that the method used for a cross-border transaction is dependent on the purpose of the transaction and the recipient’s ability to have an own bank account. Due to the high number of people in emerging countries without a bank account, WU is the only option to transfer money from the more emerged country into those regions.

To conclude, cheaper alternatives to the system of SWIFT exist. Those possibilities are only usable when both parties are using an account at the respective money transfer provider. Under the condition that parties from different countries use the same money transfer service, correspondence banks would be obsolete. However, it seems unlikely to assume that different parties from different countries are using the same money service provider, which leads to the only viable option, which is SWIFT.

		SWIFT	SWIFT gpi	PayPal	Wester Union	Transferwise	Hawala
C2B	Cost	693	693	649.35	500	64.88	200-500
	Pace	3-7 days	30 min -1 day	1 minute	24 hours	1-2 days	6-24 hours
	Prerequisites	Bank account	Bank account	Bank account + PayPal account	Bank account	Bank account + TransferWise account	Cash to remit, has to be given to hawaladar
C2C	Cost	693	693	404.34	500	64.88	200-500
	Pace	3-7 days	30 min -1 day	1-10 seconds	1 minute	1-2 days	6-24 hours
	Prerequisites	Bank account	Bank account	Bank account + PayPal account	UIF	Bank account + TransferWise account	Cash to remit, has to be given to hawaladar

T ble reports the differences in transaction pace and transaction costs of an exemplified transaction from Germany t
ir R. By "SWIFT" and SWIFT gpi is a traditional bank transfer meant, whereby the only difference lies in the t
a t" indicates a general bank account at any official financial institution. The fees in total can vary by using a dif
e le has the only purpose of illustrating the differences in transaction fees as well as transaction pace. All the data f
ransaction possibilities based on a transfer from Germany to Japan
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N at for hawala, it has not been possible to retrieve exact information for a transfer from Germany to Japan, the g
b ` comparison

6 Basics of Blockchain

After discussing the central role of trust of intermediaries and the general process of a domestic and cross-border transaction, this abstract will build the technological basis for further research in this thesis. In order to evaluate the effects of blockchain on cross-border transactions, it is crucial to understand the underlying technological procedure behind blockchain. Therefore, chapter five focuses on the technological components of a blockchain and the mechanism behind a transaction via blockchain. The aim thereby is to understand the fundamentals of its functionality in order to evaluate possible use cases, pain points, and technical limitations.

6.1 Main Idea of Blockchain

This abstract will focus on the problem that Satoshi Nakamoto (2008), the founder of Bitcoin, aims to solve by using the blockchain technology.

When Satoshi Nakamoto presented his white paper about Bitcoin, he remarked the weakness of the payment system due to the “strong trust-based model” (Nakamoto, 2008). Thereby, he expressed his critic on the transaction costs, which are occurring due to intermediaries. Furthermore, Nakamoto criticizes that through the occurrence of mediation cost, the transaction size minimum is limited, which cuts off the possibility of small cross-border transactions. Additionally, he remarks that “there is a broader cost in the loss of ability to make non-reversible payments for non-reversible services” (Nakamoto, 2008). Thereby, he indicates that due to the nature of reversible payments, a transaction of non-reversible services is not safe. This comes from the fact that in today’s world of payments, transactions, made through PayPal or credit cards, are reversible. The aim of Nakamoto (2008) was to create a mechanism that allows the user to “make payments over a communication channel without a trusted party” (p. 1). Digital networks are transmitting data by copying data from one location to another. The verification process, the validity check of information, is crucial. In today's digital payment system, a third trusted party is verifying the information of the transaction data. However, without such a party, the two parties must interact with each other directly. This is not possible as it would bear a high risk. Therefore, companies are willing to pay the intermediary for trust and a decrease in fraud. The willingness to pay translates into an increase in transaction cost. Transaction cost occurs not only from monetary nature but also from timely nature, since the” involvement of intermediaries verification and authorization takes longer”, as Mr. May indicated. The transfer of information is the core of a transaction process. Information such as

the name, cash available, location, and time are all included in the data transmitted and validated through the trusted party, as it is the same with every bank or credit card transaction. Information gets exchanged in order to verify a transaction. The data itself is written in binary code, which translates text in zeros and ones. The binary system consists of a string of consecutive zeros and ones and represents the binary code. The machine language uses the binary system, and furthermore represents the smallest amount of data flowing through the hardware and software systems. Each zero or one represents a bit. The mentioned strings become data interpreted by the computer system. This simple code structure allows easy copies of different data sets, which opens the door for double-spending. As electronic transactions are data sets, which are copied from one party to another, they are vulnerable to be copied wrongly or digitally counterfeited. Thereby, money that is not existent can be spent, which is defined as "double-spending".

In order to erase that flaw, Nakamoto proposed an electronic payment system, which is based on cryptographic proof instead of a trusted third party. To do so, he proposed the usage of a ledger. A ledger, known from accounting, can be defined as a database that holds all the different transactions made in an entity (Wischmann, 2019). The ledger proposed to close the security gap holds all units of issued currencies. This would lead to the possibility of instant tracking of current holdings of different users and furthermore, enables an update of the ledger and the holdings of the different user after the digital property changed. However, the ledger itself would lead to the same security problems as mentioned before, since the ledger is still only a data source consisting out of zeros and ones. Therefore, to securely use the proposed ledger, it would still be necessary to have a third party validating the data and to protect from counterfeits of data. Thus, the danger of counterfeiting or wrong digital information would still be prevalent. In this case, a trusted third party has to practice the same actions as it has to in today's world of payment, which translates in identity and liquidity validation.

After discussing the idea of a centralized digital ledger as a solution for the current flaws in the transmission and data storage, it could be seen that this idea would still lead to the previously observed flaws. Consequently, a trusted third party would be necessary. In his white paper, Nakamoto (2008) proposes a "peer-to-peer electronic payment system based on cryptographic proof instead of trust" (p. 1). He elaborates that cryptographic proof would allow a "direct transaction between two parties without the need of a trusted third party" (p. 1). Therefore, with the procedure of blockchain, Nakamoto aims to cut off the intermediaries and enables direct peer-to-peer transactions without the predominant cost of risk via the renowned

"chain of blocks." After superficially explaining the idea of Nakamoto, the next abstracts will focus on the definition of the proposed chain of blocks also knows as "blockchain" and on the technical functionality of Nakamoto´s solution proposal in order to build a digital network, which enables transactions without the need of any intermediaries.

6.2 Essential Elements of a Blockchain

Nakamoto did not use the term "blockchain" in 2008; it was after he published his white paper that the term "blockchain" got merely used and stemmed from his idea of a "chain of blocks" (Nakamoto, 2008, p. 7). A clear definition of blockchain is still missing as the technology is still at the beginning of its evolution. In 2015, Walport defined the blockchain as a kind of database, in which data entries are grouped in blocks. These blocks follow a chronological order and are connected via a cryptographic signature (Schlatt, Schweizer, Urbach, & Fridgen, 2016, p. 8). Each block contains past information; in the case of blockchain, these are processed transactions. The moment a record is added into the block, it cannot be modified and is very difficult to falsify. This is called "persistence." If an entry has to be updated, a new record has to be attached to the already existing one. Any member of the public can view each record, which allows any person to verify the authenticity of every transaction, which is why it is called a "public ledger" (Subramanian, 2018). However, this also implicates that malicious parties can be part of the network, as any member can add information to the block. Therefore, it is inevitable to verify each entry into the blockchain in advance. This system defines a decentral consensus network by Glazer and Bezzenberger (2015), which is based on cryptography and peer-to-peer principles. In core, this means that no central authority is in charge, but rather a decentralized "network-wide verification by consensus" (Glaser & Bezzenberger, 2015, p. 2). The consensus system will be explained in more depth in abstract 6.3. After this abstract explained the essential elements of the blockchain, the following abstract will focus on the technological concept of blockchain.

6.3 Technical Concept of Blockchain Exemplified by Bitcoin

This thesis has a strong focus on the role of intermediaries in the process of a cross-border transaction. The aim of Nakamoto (2008) was to make intermediaries obsolete by introducing the blockchain. Therefore, it is crucial to understand the technical concept of blockchain, which includes its different possible network architectures. Thereby, the roles of intermediaries can be clarified. For the explanation of the technical concept of blockchain, the "Bitcoin-blockchain" will be used.

As Nakomoto (2008) pointed out, Bitcoin is a P2P based currency system in which transactions do not need a trusted third party. As already explained, blockchain serves as a chronological ledger with all past transactions on the Bitcoin-blockchain. Before describing the technical specifics in more detail, it is crucial to explain the aspects of centralized, decentralized, and distributed network architectures.

Figure 4: The Different Network Architectures (Based on Jayasinghe, 2016)

A centralized network architecture works with one central server, which is used by all users of a network. This central server is responsible for the majority of processing. The users of the network request the central server for information and do not perform a request directly. Network administrators are necessary in order to maintain and organize the network. In terms of security, this system has its flaws, as only central servers store the data. If this server breaks down, the whole network is not functional anymore (McGew, 2019). Therefore, centralized networks are highly vulnerable to server failures since it affects the whole network.

A decentralized network does not use a central server to store all the data. Thereby, nodes in the network interoperate as well as collaborate. The main difference is that the nodes can interact with each other without any central source (Schlatt, Schweizer, Urbach, & Fridgen, 2016).

Blockchain is not based on one of the two network architectures as it is a “distributed network” (Shrier, Wu, & Pentland, 2016). This implies that the public ledger is distributed among all members of the network. Thus, all members of the network can view all the transactions. Therefore, the distributed ledger is not in one hand or fragmented in the hands of different members. This leads to an advantage in comparison to centralized or decentralized networks. Due to the distributed network structure, it is not necessary to use third parties’ services in order to keep the system running. Therefore, no intermediaries are needed.

Furthermore, from a security point of view, the probability of a system breakdown is decreasing massively, due to the distributive characteristic of the network. The system is complicated to hack since no central code exists. Therefore, a central attack point does not exist. In the case of an attack on one server, the other servers in the distributed network are still working, which allows the system to continue running.

6.4 Fundamentals of Cryptography

The blockchain technology is acknowledged as a breakthrough because it eliminates the problem of "double-spending" and "enables for the first time unrelated people to reach consensus on the occurrence of a particular transaction or event without the need for a controlling authority" (Trautman, 2018). The key to the consensus is the cryptography. Therefore, this abstract will explain the fundamentals of cryptography in order to build the basis for the further explanation of the mechanisms within a transaction of Bitcoin (BTC).

Two fundamental concepts of cryptography are the building blocks for the blockchain systematic. These are the "Public-Key cryptography" and the "cryptographic hash functions". The Public-Key cryptography is using a mathematically connected pair of keys. It consists of a private and a public key. This pair of keys enables the usage of digital signatures. The sender of a message is combining the public and the private key and sends the "signed" message to the recipient. "The recipient can verify the authenticity of the message (if the private and public key is corresponding) by using the public key of the sender" (Schlatt, Schweizer, Urbach, & Fridgen, 2016, p. 10). Thereby, the digital signature aims for three effects: (1) *Authentication* can be reached since only the sender knows the private key; (2) *Non- Repudiation* - It is not possible for the sender to deny sending the message or reverse a transaction (non-reversal); (3) *Integrity* - Since the cryptographic encryption makes it impossible to change a message without being noticed (Schlatt, Schweizer, Urbach, & Fridgen, 2016).

The second fundamental concept is "hash function." The hash function can be defined as an algorithm which changes an input of arbitrary length into an input of fixed length and is called "hash value" (Preneel, 2003, p. 15). A hash function has the characteristic that it is deterministic as the same input results in the same output. Furthermore, even a small change of the input would lead to a significant change of the hash-value, which makes it unlikely for anyone to extract the messages´ content from the hash (Badev & Chen, 2014). The hash function has three main characteristics: (1) *Pre-image resistance* – It is difficult to find a particular message by knowing the hash-value; (2) *Second pre-image resistance* – It is tough to

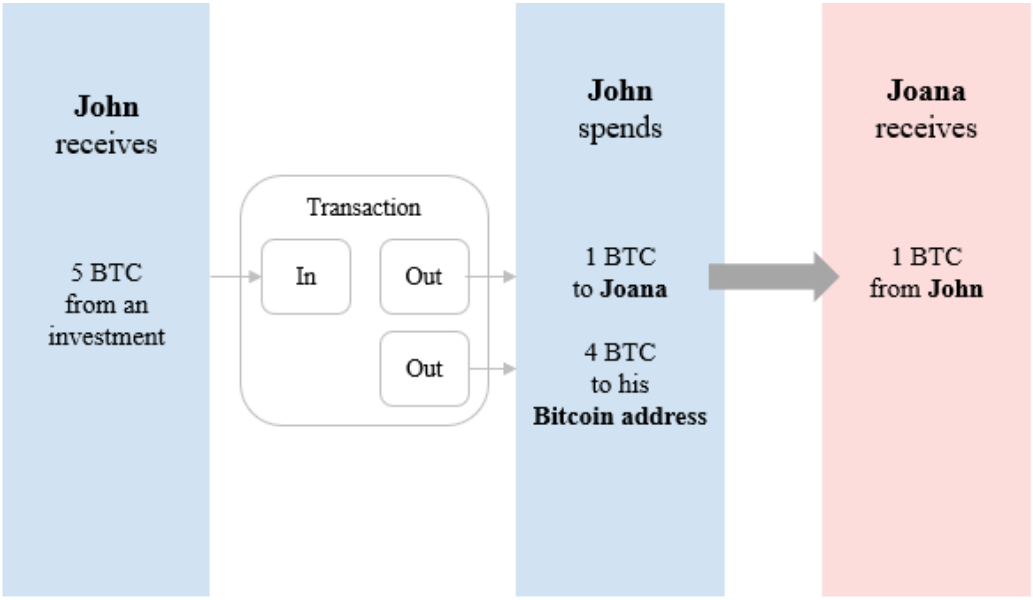
find a second input with the same hash-value; (3) *Collision resistance* – It is very challenging to find two different messages with the same hash-value (Badev & Chen, 2014). Therefore, by using the hash-function in the blockchain, it is used to add a reference and a timestamp to the transaction in the block. Therefore, it is essential for the cryptographic integrity. After discussing the technical and cryptographical fundament, the following abstract will exemplify a transaction with Bitcoin.

6.5 Exemplified Transaction with Bitcoin

The last abstract had the goal to enrich this thesis by building a fundament of the technological concept blockchain underlies. After discussing the two critical cryptographic concepts for blockchain as well as the underlying technical mechanism, which is happening within the blockchain, this abstract focuses on the whole process of an exemplified transaction of one bitcoin. The aim thereby is to give a detailed overview of each step within the transaction process as this thesis focuses on the effect of blockchain, it is essential to understand the procedure of a transaction based on blockchain. This thesis chose Bitcoin as it is the most renowned cryptocurrency and the one with the highest market capitalization (Coinmarketcap.com, 2019).

The scenario is based on Schlatt, Schweizer, and Urbach (2016). John wants to send Joana one BTC. In order to do so, John needs a "wallet," which is software that secures Joana's BTCs (Bamert, Wattenhofer, & Welten, 2014).

Figure 5: Exemplified Bitcoin Transaction



6.5.1 Initiation of a Transaction

As the first step, a message with the details of the transaction is generated, for instance, “John wants to transfer one BTC to Joana”. Since no real accounts or account balances are existent in the Bitcoin network, there is only the public ledger that records all transactions of BTC. As no accounts are existent, only the bitcoin address is available and used to receive bitcoins. Only the owner of the private key can use the funds of BTCs. John sent the message for the transaction, which consists of the amount to be transferred and the Bitcoin address of the recipient Joana. Furthermore, the message contains information about Joana´s transaction history. The moment John sent the messages, he signed it with his private key and broadcasted it on the Bitcoin network. This way, each member of the Bitcoin network can verify that John was the one who sent the message and that the message has not been falsified (Badev & Chen, 2014). Therefore, the effect of “non-repudiation” through digital signatures disables John to deny that he has “signed” the message with his digital signature.

6.5.2 Verification

As this thesis focusses on the effect of blockchain on cross-border transactions, it is crucial to explain the verification process of a transaction via blockchain as the central part of today's intermediaries is the verification of transactions.

The objective of the Bitcoin protocol is to verify two aspects of the transaction message: (1) Whether John broadcasted the transaction message into the bitcoin-network and (2) whether the sending address has enough funds to guarantee a successful completion of the transaction. In order to ensure that John sent the message (1), the digital signature will be used, as only the owner of the private key of the respective address can sign the message. For (2), it is more complex. In the concept of Bitcoin, each input needs to be fully spent in a transaction (Turner & Irwin, 2018). This implicates that when John starts to initiate a transaction, his input would be all BTCs, which are deposited at his Bitcoin address, therefore, five BTCs. The following output, which would be transferred to Joana, is one. The “unspent transaction output” (UTXO) would be transferred to the new Bitcoin address, also called “change address” of John. The UTXO-database contains all transaction outputs which are not yet used for a *new* transaction. For instance, the remainder of four BTC is not yet used for new transactions as it is still in the wallet of John.

Continuing in the process of validation, each node will now check whether John’s inputs are not yet used for the other transactions, which happens via the UTXO. Besides this, it is also

checked whether enough funds are available; therefore, if the input is bigger or equal to the outputs. Additionally, the legitimacy of the digital signature is also done within the process of validation. If these three criteria are fulfilled, the node sends the transaction to as many as possible other nodes, which are reviewing the transaction under for the same three criteria as the first node did. After this is done, the nodes are entering the data into the UTXO database. The next step of the transaction process follows as the blockchain gets updated.

6.5.3 The Consensus Mechanism and the Update of the Blockchain

There are two types of nodes prevalent within the Bitcoin-network. The first is a passive node, and the second is the mining node. Both kinds of nodes are eligible to verify and forward a transaction, but only the mining nodes can enter the transaction data into a new block and therefore, in the blockchain (Nakamoto, 2008). Any node can choose to be a miner and start to mine new blocks in order to add new blocks to the blockchain. Therefore, they are collecting a certain number of not finally verified transactions and put it in a block this block.

Until this point, the network is vulnerable, as a sender with harmful intentions could send merely transactions at the same time with the same transaction outputs and transfer these to different Bitcoin addresses. This is also known as the previously mentioned “double spending problem”. The already explained innovation of the consensus mechanism solves the issue of double-spending.

Lamport (1982) described the byzant generals’ problem, in which the Byzantine army is encircling a city. It divides into different divisions with each having one general. The generals only communicate via messengers. In this scenario, all of the generals have to find a consensus to one of the two plans of action, either attacking all together or if the resistance of the city is too strong, retreat altogether. If the army is not attacking at once or retreating at once, the battle ends in a defeat. Under the condition that all messengers and generals are trustworthy, the solution would be simple. However, within the generals and messengers are traitors, which means that they would not follow instructions or forward the wrong message. The Bitcoin-blockchain uses a consensus algorithm to choose a leader who will determine the next block. Before a miner can be a leader, he/she has to find a solution to one particular mathematical problem, which has the goal to find a specific number, also called nonce (number only once). The mathematical problem is generally defined as “ given data X, find a number n such as that the hash of n appended to given data X results is a number less than Y” (Konstantopoulos, 2017).

As already mentioned, the only possibility to solve for the hash function is trying all possible combinations. Therefore, computing power (CPU power) of miners are determent who can broadcast the new block in the blockchain. After the miner broadcasted the new block, it gets verified by other nodes through checking that the hash data of the block is less than the preset number Y. Miners receive rewards when a block is successfully implemented into the blockchain (Konstantopoulos, 2017). This concept is called "Proof-of-Work" (PoW) (Nakamoto, 2008). After every 210.000 blocks, mined the reward bisects. It started with 50 BTC per solution and is now at 12.5 BTC per each new block added.

As the solving process of the mathematical problem requires a high amount of computational power, of which the supply is limited miners are incentivized not to falsify blocks. Through the PoW, a record is formed and cannot be altered without resolving the PoW of past blocks. This, however, is only possible when the majority of CPU power is in the control of nodes to attack the network. As long as nodes, who do not want to attack the network, control the majority of CPU, traitors can be outpaced (Nakamoto, 2008). Therefore, falsifying blocks is not lucrative as it needs a high amount of CPU power and is risky as other miners could be faster in solving the problem.

The following abstract will focus on the one hand, on the costs, which occur for a transaction with Bitcoin, and on the other hand, on the pace of transactions.

6.5.4 Cost and Pace of a Bitcoin Transaction

As Nakamoto (2008) indicated, the goal of the Bitcoin-Blockchain was to eliminate the intermediaries within a transaction and consequently decrease the cost and increase the pace of transactions.

The costs per transaction are dependent on the urgency of a transaction as the space within one block is limited to one Megabyte. Therefore, it depends whether a user wants to have the transaction included in the next block, in the next three blocks or the next six blocks. The transaction within the next block requires a transaction fee on average of USD 0.81, whereas a transaction in the next three blocks would require an averaged transaction fee of USD 0.76 and within the next six blocks of USD 0.41[1].

The pace depends on the block, which the particular transaction includes. As the validation of one block takes on average ten minutes (Schlatt, Schweizer, Urbach, & Fridgen, 2016), a

[1] The data were extracted from www.bitcoinfees.info on the 28th of August 2019. These figures are variable and can change daily.

transaction takes at least ten minutes until it is verified and included in the blockchain. Furthermore, the Bitcoin-blockchain able to verify seven transactions per second, which indicates a lack of pace and scalability in order to be a viable option for a world-wide used payment option as in comparison Visa verifies >50,000 transactions per second (Floyd, 2017). Therefore, the Bitcoin-blockchain has to be able to process more transaction than it initially does. In order to do so, Poon and Dryja (2016) introduced the "Bitcoin Lightning Network", which will be explained the next abstract.

6.6 Lightning Network as Gate to Scalability

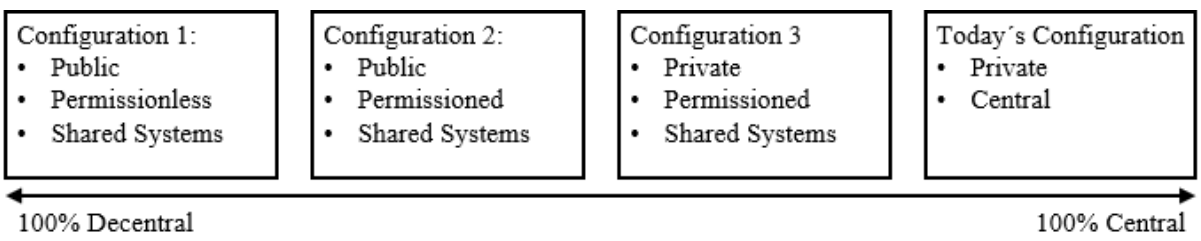
The lightning network for Bitcoin is a second-layer protocol, which enables transactions to be processed for neglectable fees and high pace and allows an instant settlement. The lightning network adds a layer to the Bitcoins-blockchain and allows users to create payment channels between two parties (Seres, Gulyas, Nagy, & Burcsi, 2019). The newly created payment channel allows transactions to be processed instantly and demands neglectable fees. In order to use the option of the payment channel, a multi-signature wallet (a wallet that both parties can access with private keys) has to be created. After the successful creation of the payment channel, as the next step, both parties place a deposit into it. After this, both parties can make numerous transactions with each other. The main difference thereby is that the transactions are not written in the blocks of the Bitcoin blockchain. The final balance of the payment channel only appears on the blockchain after the payment channel closed.

The next abstract will present the different characteristics of blockchain systems and discuss the level decentralization and centralization of the respective system.

6.7 Assorted Characteristics of Blockchain

After discussing the transaction process of the Bitcoin-blockchain and explaining the technological concept of the blockchain, this abstract has the goal to explain the three main configurations of blockchain. The understanding of the assorted characteristics will be helpful in chapter 7, where this thesis focuses on different consortia.

Figure 6: Degree of Centralization of Different Blockchain Systems (following *Schlatt, Schweizer, Urbach, & Fridgen, 2016)*



In order to discuss the different characteristics of blockchain, a distinction between private and public blockchains is necessary. Thereby, it is essential to determine who has access to the data (Schlatt, Schweizer, Urbach, & Fridgen, 2016). If all users are allowed to access the data, it is a *public* system and presented by *configuration 1* in Figure 6. Therefore, every user is allowed to check and verify transactions as well as participate in the process of reaching consensus (Lin & Liao, 2017). Thus, the network does not exclude any users, which implicates that the ledger has no central holder. Bitcoin, for instance, is based on the principals of a public blockchain. The combination of the public network and Bitcoin is advantageous as it processes transactions in a fast manner with low transaction fees (Nakamoto, 2008, p. 4). The *public* character of this type of blockchain allows transparency in the transaction history and leads to all users of the network having access to all past transactions (Schlatt, Schweizer, Urbach, & Fridgen, 2016). If not every user can act as a validation node, it is defined as permissioned blockchain. The permissioned architecture accepts only specific nodes for validation of the block. The idea behind it is that by knowing the participants in the network, honest validation results. The decentralized nature, as well as the permissioned access, could lead to faster internal exchange of information. Thus, by granting, only trusted members access to the network, a more cost-efficient and faster solution can be achieved. However, this kind of network relies on the chosen trusted validators, if those validators are "traitors", the security of the network is endangered.

After the discussion of blockchain´s assorted characteristics, the focus of this thesis will drift towards the current developments of blockchain within the economy. Thereby, the next chapter will focus on blockchain-consortia within the field of transactions and the importance of the fulfillment of Schupmann´s standards, which will be explained in detail.

7 An Application of Blockchain to the Field of Cross-Border Transactions

Chapter 3 explained the role of intermediaries as a trusted third party. Thereby, it was made clear that due to the distrust of two interacting parties, a financial institution usually takes the role of an intermediary and "trusted third party". Furthermore, SWIFT, as most used messaging system between banks, increased its pace. However, due to the outdated technology of financial institutions as well as the high number of parties involved in the transaction process, a transaction still takes three to seven days on average until funds are in the recipients´ account. Furthermore, *chapter 6* explained the fundamental concept of blockchain, as Satoshi Nakamoto

(2008), the founder of blockchain, aims to erase the intermediaries of a transaction. As the financial industry and governments increase their attention to blockchain, consortia were established. As this thesis focusses on the effect of blockchain on cross-border transactions, this chapter has the aim to give an overview of the current status quo in the evolvement of the financial industry in the blockchain technology. Furthermore, the goal is to establish a general understanding of the reason behind the building of consortia and determine what standards they should fulfill in order to unfold the full potential of the technology.

7.1 The Rise of Blockchain Consortia

The area of cross-border transactions has been neglected and only slowly increased its efficiency within the past decade. SWIFT decreased its time to process transactions, but as already mentioned still has limitations, as a transfer of EUR 15,000 is the maximum transferrable amount at a time, and fees still occur as the number intermediaries involved in a transaction does not decrease. Furthermore, as Mr. Belz indicated in a conducted expert interview for this thesis, “as long as the interest rates are as low as they are now, banks need such cross-border transaction revenues more than ever as it represents a strong revenue driver”. Therefore, DLT threatens financial institutions as a further involvement of transacting parties with blockchain pressures the fee models of financial intermediaries. However, as financial institutions noticed the development within the blockchain scene and additionally, the potential for its operations in trade finance or cross-border transactions (Hawser, 2018), they are increasing its engagement and involvement. The next abstract aims to explain the reasoning behind the trend of collaboration, in which financial institutions jointly develop blockchain-based transaction systems.

7.1.1 The Three Types of Blockchain Consortia

Consortia have the aim to build a platform for cooperation. Thereby, consortia have different types with different focusses. Gratzke (2017) defined these three different types as *business-focused*, *technology-focused, and hybrids*. A business-focused consortium focusses on specific business problems (Dalton, Leonowicz, Scanlon, & Burke, 2019), whereas technology-focused consortia aim to build a technological infrastructure. The technological infrastructure aims to set a technological standard on which future products base. The hybrids combine the characteristics of both types. Thereby, it builds a technological infrastructure to solve a specific problem within a particular industry (Dalton, Leonowicz, Scanlon, & Burke, 2019).

7.1.2 Reasons for Consortia in Blockchain

The area of blockchain was a topic, which was observed by financial institutions for a long time. However, this changed as the industry discovered different potential application fields. Therefore, engaging in a consortium was led by four factors:

(1) Creating network effects: SWIFT became a key player in the area of cross-border transactions because a high number of financial institutions used its service, which translated into a worldwide standard of messaging between financial institutions. Thereby, the value of a standardized messaging system improved by an increasing number of users. This is also known as "network effect". Therefore, financial institutions are engaging in a consortium in order to build a blockchain-technology based infrastructure for cross-border transactions, which has the potential to experience high adoption rate by the target-user, in the case of cross-border transactions by any individual which intends to transfer monetary funds across borders (Vadgama, 2018).
(2) The pooling of expertise: The pooling of expertise leads to a new source of knowledge on for future projects. Thus, being part of a consortium would bring any participant close to status quo of knowledge within the area of financial services.
(3) Lowering risk exposure: By cooperating, the parties share investment costs for the establishment of the consortium, which translates into lower individual risk for each participant and lower cost for staying in the loop of direct and indirect competitors (Vadgama, 2018).
(4) Common Standards: As already mentioned, a high adoption rate is important in order to create network effects. A basis for such network effects is the agreement on common standards. The standard setting is very crucial for the success of a consortium as it gives each participant an incentive because the broader the acceptance of certain standards, the more participants will take part in the consortium, which increases the benefit from network effects.

7.1.3 Exemplified Consortia

This section of the thesis presents the three main consortia within the industry of blockchain-based cross-border payments.

7.1.3.1 R3 as Most Established Consortia in the Area of Payments

R3 is a consortium that was founded in 2016 with 42 founding members as a response to the rising worldwide awareness of blockchain technology and its potential. R3 had the goal to

provide an open-source blockchain software called “Corda” (R3, 2019). The consortium aims to increase transparency within a transaction and shows which party transacted. Thereby it wants to “[reduce transaction and record-keeping costs and streamlining business operations]” (R3, 2019). When R3 launched, mainly financial services companies with a focus on peer-to-peer networks with smart contracts as a mechanism to process the transaction used it. The beforementioned process of “mining” and “tokenization” is not prevalent in R3s concept and is aimed to replace by smart contracts. Smart contracts can be defined as “a computer program that directly controls the transfer of digital currencies and assets between parties under certain conditions. [It does not only define] the rules and penalties related to an agreement in the same way a traditional contract does, but it can also automatically enforce those obligations” (Sales & Cole, 2018). Thereby, it aimed to reduce the mentioned inefficiencies, such as costs of intermediaries and book-keeping. Furthermore, by forming such a consortium, the goal was to provide a trusted blockchain technology-based platform, which is interoperable. Within the last three years, the consortium grew and expanded its applicability from solely the financial services sector towards different industries. Nowadays, its network spans over more than 300 companies, such as Credit Suisse, UBS, the Colombian central bank “Banco de la República”, Microsoft or Amazon (Castillo, 2016; O´Leary, 2017). Today, the focus of Corda lies on the enablement of companies from different sectors to use the Corda platform as “technological basis for their [individual] needs while ensuring security of the participant's data and still benefiting from the network” (Rutter, 2019). Besides the already established R3 consortium, a new consortium called “Libra Association” was introduced. The following abstract has the aim to provide an overview of libra and its goals.

7.1.3.2 Libra as the New Trial to Create A Worldwide Standard

R3 as consortium had the goal to provide a blockchain technology-based platform for peer-to-peer transactions to decrease cost and increase transparency. Libra is a consortium of more than 25 independent companies with Facebook as its leader. Its members are leading players in technology, telecommunication, and payment industries, such as Mastercard, Visa, PayPal, Vodafone, eBay Spotify AB, and more. The consortium built an independent company called “Libra Association”. Its mission is to “introduce a global currency and to provide a simple financial infrastructure to millions of people to simplify the day-to-day life” (Libra Association, 2019, p. 1). Furthermore, and in comparison to other blockchain-based transaction systems, Libra aims to provide a coin with low volatility. To do so, it wants to create an intrinsic value behind Libra by deposing treasury bills of the most developed economies. Within the last

month, it created different discussions and was on the main agenda of the Federal Reserve Bank or the European Central Bank. Through Facebook's leading role within the development of Libra, it is also able to provide more than 2 Billion users an opportunity to use Libra as currency in the social network. As Facebook mentioned the already discussed issue of citizens from emerging countries having no access to bank accounts, it would enable especially those and the rest of users to transfer money to each other. However, Libra as a currency is currently in many discussions, which is why this thesis discusses the potential functionality of Libra in chapter 8.2 and furthermore, if its current version fulfills the standards needed for effective usage of the blockchain-technology.

7.1.3.3 Ripple Labs Inc and its Role as Blockchain-Based Payment Provider

Besides the very young initiative from the Libra Association in revolutionizing the payment industry and the system of cross-border transactions, it was Ripple Labs Inc (Ripple), which was working since its establishment in 2012, at inefficiencies in the area of cross-border transactions. Thereby, it aims to tackle the beforementioned cross-border transaction pain points. It wants to establish a low-cost, fast-paced, and transparent system. Within the payment industry, Ripple is earning a high amount of attention as it has successfully demonstrated its effect on cross-border transactions by using the self-developed and decentralized network-based “Ripple protocol (RTXP)”. It can be used for the transfer of values such as cash and assets. Furthermore, and due to the decentralized network characteristic, it is an open-source software.

Today, cross-border transactions of financial institutions and other payment providers are already processed by the ripple-owned transaction network “RippleNet”. As Ripple already has a proven track record, the thesis compares it with the beforementioned money transfer provider SWIFT, Bitcoin, and Libra in chapter 9. As the goal of this thesis is to explain the current effects of blockchain on cross-border transactions, it is crucial for the information value of this thesis to compare the different options. Before going deeper into the comparison and into the assessment of the different blockchain-based platforms, it is important to discuss necessary standards that are essential for a successful establishment of any of the given blockchain-based payment solutions.

7.2 The Need of Standards as Main Adoption Determinants for Blockchain Technology

As already mentioned, the principle of blockchain has the potential of disrupting the payments industry (Holotiuk, Pisani, & Moormann, 2019). Blockchain can increase the pace, decrease costs of the transaction, and provides more efficiency within the process of validation and securitization. However, in order to do so, it is inevitable to be accepted globally and politically. Consequently, certain standards and regulations have to be created. This section of the thesis has the aim to discuss Schupmann's (2017) discussed three dimensions of standards and provides certain guidance of what must be made possible in order to see a global adaption of blockchain.

7.2.1 The Technological Standards

As blockchain is based on a harmonized technological system, it is essential to embrace and fulfill certain technological standards. In order to realize the potential of the technology, it is important to implement "standards [which] enable interoperability" (Schupmann, 2017, p. 8). Therefore, the usability of the technology across different IT-platforms and users is a key element that enables the unfolding of blockchain´s potential. One of them is the possibility of eliminating intermediaries. However, common technical standards are needed, which include "data sovereignty, privacy or lack of consensus" (Meguerditchian, 2016, p. 3). If this is not guaranteed, "independent and incompatible blockchains will be adopted by different institutions that will be unable to directly transact with each other" (Schupmann, 2017, p. 9). As already mentioned, interoperability is the key element for success within cross-border transactions, otherwise incompatible procedures for cross-border transactions will be used and thus, the promised efficiencies and effects of blockchain on cross-border transactions cannot be realized and would lead to the further use of intermediaries in a transaction. In order to reach interoperability, it is necessary that key stakeholders, such as industry and politics, agree with the particular standards. Therefore, consortia can have the power to set standards as it combines technical expertise and experience, which creates certain credibility. If no agreement upon a set of standard can be made, big players will try to establish technological standards as financial institutions, such as Bank of America Corporation and JPMorgan Chase Bank already patented blockchain solutions for cross-border payments (US Patent No. US 2019 / 0172059 A1, 2019; US Patent No. US 2018 / 0121911 A1, 2018). Therefore, it is essential for the full unfolding of blockchain´s potential to create global technological standards as "[SWIFT did for messaging, or XML did for data streams]" (Schupmann, 2017, p. 9) and to jointly work on those. Otherwise,

the status of fragmentation of solutions will remain, network effects have difficulties to be reached, and consequently, no disruption within the cross-border transaction process will be seen.

7.2.2 Governance and Liability Standards

Libertarians argue that due to the principles of blockchain, no intermediaries, and therefore, no state, which regulates financial affairs, is needed anymore (Atzori, 2017). Dr. Jens Zimmermann, a member of the German Parliament and responsible for the topic of blockchain and electronic cash systems within Germany, argues that "[At some point an intermediary will be needed since smart contracts and KI are not far enough to confirm if a machine is build up and ready to use or not. Therefore, at some point, a trusted third party will be needed, especially when the transaction volume is high.]" When focusing on governance and liability standards, it is important to discuss not only the role of the state but also challenge the general necessity of a third party. From the technological point of view, there is no need for a third party in the cross-border transaction process. However, considering the example of Dr. Zimmermann, it should be differentiated between the level of trust between the two interacting parties. He indicated that "if the two parties deeply know each other and have a deep level of trust, blockchain can be efficient". When A, for instance, transfers funds to B in a private context (family or friends), a relationship between both is preexisting, which would eliminate any need for a third party. However, for effective management of the blockchain in a business context, it is still important to establish governance and liability standards, thus which party is responsible for "[the access, input, and correction of data]" (Schupmann, 2017, p. 10). Besides the fact of efficiency, Schupmann (2017) also states that due to the amount of data collected, it has been made clear "how records on individuals are kept on distributed ledgers, who owns this data, under what circumstances, if any, it may be integrated to a single distributed ledger and the procedures for correcting errors and removing data" (p. 11). If different governance structures are prevalent, a deacceleration of the adoption of blockchain and the uncertainty of potential users will increase. Therefore, it is also important as a general standard. By joining the expertise of financial institutions and technology developers, the resulting expertise, which can be seen in R3, Libra and Ripple, has the credibility to propose and develop certain standards under the condition that it reaches a certain market dominance (Schupmann, 2017).

7.2.3 Current Regulatory and Legal Standards

With the announcement of Libra, different public institutions such as the US FED, the European Central Bank and many other indicated their skepticism about the idea, as it is not clear whether Libra complies with different jurisdictions. Therefore, in order to reach a broad adoption of blockchain for cross-border transactions, standards of compliance have to exist. It is especially important to comply with international financial regulations which are

(1) Know Your Customer (KYC): The verification of the identity of the client. The policies are important as it "validates that their customers are not or have been involved in illegal activities such as fraud, money laundering or organized crime" (Arasa & Ottichilo, 2015, p. 1)
(2) Anti-Money Laundering (AML): Internal controls that are made by financial institutions in order to "protect themselves from exposure to money laundering and the financing of terrorism" (Hernández-Coss & Egwuagu, 2005, p. 1)

Therefore, institutions who want to use blockchain have to either integrate the technology within their current compliance structure or build new systems. An essential part is the concern of data handling, consequently "how are [data from individuals stored], protected and used" (Schupmann, 2017, p. 11). Besides financial regulations and data privacy laws, it is critical to comply with other and various regulations within different jurisdictions. Mrs. Dr. Tillick, an expert interviewed for this thesis, indicated that "it is vital that we keep each regulator very close in the loop because otherwise the fear of the unknown can rise and lead to actions by the regulator". Furthermore, Mr. Belz indicated that "without the global adaption of standards which are agreed by each state in which blockchain solutions should be legal, it is challenging to comply with all the different jurisdictions and regulations". Furthermore, the inclusion of blockchain would lead to a drastic change within the global payments system. Thus, self-regulation by private parties would be very risky. It would instead need the public regulator, which focuses on the financial stability of the global payment system and the blocking of terrorism financing. Therefore, it is crucial to reach an agreement of standards which lead to stability within the payment system and further to a consent with a majority of regulators and jurisdictions. As SWIFT arrived at an international standard, it is essential to aim for such an internationally agreed set of standards. Again, consortia can play a decisive role in the development and acceleration of broad adoption.

Therefore, a broad adaption of the blockchain technology within the field of cross-border transactions needs fulfillment of a specific set of standards. The next chapter will focus on Ripple Labs Inc. and Libra Association. The chapter aims to explain the two different solutions in detail. Afterwards, it assesses the fulfillment of standards as well as what effects those solutions have and could have on cross-border transactions.

8 A Discussion of Ripple and Libra

Blockchain triggered the building of consortia and with it the question of standards. Furthermore, blockchain showed specific potential to pain points such as time, pace, and transparency. However, as discussed in the previous section, the fulfillment of standards is crucial for a globally accepted solution. This chapter focuses on the beforementioned consortia Ripple and Libra. Ripple is relevant because financial institutions started to use Ripple´s service, RippleNet, already and implemented it in patent applications. Furthermore, Libra is a topic of high relevance nowadays, as its hypothetical launch would potentially have a substantial impact on the field of cross-border payments as well as on central bank politics.

8.1 Ripple Labs Inc and its Possible Effects on Cross-Border Transactions

Ripple focuses on cross-border as well as on inter-bank commercial payments. Usually, these payment types are made through the beforementioned correspondent banks. As explained in chapter 5, cross-border payments might take 3 to 7 days to be settled and accounted for the beneficiary account. This is often the case because of the mentioned “cut-off times” and the involvement of several correspondent banks. Additionally, transparency of exchange rates and other occurring transaction fees is missing in most of the transaction possibilities. Furthermore, Accenture (2016) found out that within the cross-border payment system, no clear and centralized clearing system is given, which leads to the need of corresponding banks as intermediaries. Ripple wants to enable banks to interact directly with each other without needing the intermediaries for the transfer anymore. To do so, it provides a blockchain solution that focuses on the elimination of high transaction fees, the increase of pace and transparency. Ripple has propelled almost entirely independent from Bitcoin (Andoulaki & Karame, 2016). Besides the offered currency “Ripple” (XRP) it focuses on the payment industry as it has the goal to “facilitate the exchange between currencies within its network” (Andoulaki & Karame, 2016, p. 193). Today it counts more than 200 different customers, which are financial institutions and money transfer service provider. Customers of renowned companies such as

American Express, Santander, or Moneygram Inc, can send money across borders via XRP for a reduced set of fees in comparison to the standard options (Nikolaev, 2019).

In the following abstracts, the aim of this thesis is to gain more profound knowledge about the beforementioned Ripple protocol and its network architecture. Additionally, transaction costs for a cross-border payment via XRP, and the pace of a transaction will be discussed.

8.1.1 Overview of Ripple

Ripple is as a "decentralized payment system [which] is based on credit networks " (Andoulaki & Karame, 2016, p. 192). Ripple made its code available for the public and is, therefore, fulfilling the open-source characteristics. Thus, it is like Bitcoin, as anyone can be a node. Within the Ripple network, a node can have three different roles:

(1) A *user* who receives and initiates payments
(2) A *market maker*, which act as trade enablers in the system. They "[provide liquidity and support in order to keep the spreads low which adds utility and reduces the cost for entities transacting on the Ripple protocol]" (Liu, 2015)
(3) A validating server that executes the consensus protocol of Ripple, that checks and also validates all transactions initiated in the system

Similar to Bitcoin, a user has a private and public key. The same concept of functionality applies to Ripple as it does to Bitcoin. Therefore, when a user wants to initiate a payment with XRP to another user, he/she signs the transfer with his/her digital signature, thus his/her private key. For payments that are not made in XRP, Ripple has "no way to enforce payments, and only records the amounts owed by one entity to the other. In this case, Ripple implements a distributed credit network system" (Andoulaki & Karame, 2016, p. 194). However, this thesis focuses on the general functionality of the Ripple protocol. The system design of Ripple focuses on the ability to integrate RippleNet with the existing banking systems in order to work together with financial institutions to build an alternative to the corresponding banking system. Ripple offers three different services in order to achieve a reduction of cost and an increase of pace within the cross-border transaction process.

XVia

"XVia was created for not only banks but also corporates and payment providers which are aiming to send payments across various networks using a standard interface" (Ripple Labs Inc, 2019). XVia does not require specific software or any other technical requirements except a

functioning internet connection. Users can transfer money globally while each transfer is transparently tracked and confirmed when successfully sent. Furthermore, XVia has the aim to increase capital efficiency as it eliminates the need for foreign currency transaction accounts.

XCurrent

XCurrent is an enterprise software solution created by Ripple, which "enables banks to instantly settle cross-border payments with end-to-end tracking" (Ripple Labs Inc., 2019). By using XCurrent, banks can send messages to each other and confirm payment details before the initiation of the payment and the transfer delivery once it got settled (Ripple Labs Inc., 2019). By this application, the focus is to improve the efficiency in the settlement process as it increases transparency and pace of the settlement process in comparison to SWIFT.

XRapid

As the costs of liquidity are not neglectable, Ripple provides a solution for payment providers and other financial institutions. Since money transfers in emerging markets require pre-funded local currency accounts, costs of liquidity are high. By XRapid using XRP, it offers on-demand liquidity, which lowers cost since no pre-funded local currency accounts are needed anymore (Ripple Labs Inc., 2019).

8.1.2 Distributed Ledger Technology of Ripple

Ripple also uses decentralized ledger technology. "Every few seconds a new block is built and includes transaction records which have to be approved by the validating servers. The consensus protocol of Ripple is contrary to the Bitcoin protocol not using the "Byzantine fault tolerance but rather the crash-tolerant consensus protocol, which mainly assumes the presence of rational validating servers. This is achieved by Ripple using a closed system of validating servers that are not anonymous. Consequently, it can be seen a difference to Bitcoin and its validating procedure as it does not allow any entity to validate but only a fixed set which is known and allowed by Ripple" (Andoulaki & Karame, 2016, p. 194). Furthermore, it is assumed that rational servers are not misusing its role as validators because it would harm themselves. For the case of fraud, Ripple has the right and autonomy to ban and sue the wrong acting parties. Therefore, Ripple uses a permissionless blockchain while being a "quasi-intermediary".

8.1.3 Inter-Ledger-Protocol as Gate for Interoperability

By using an inter-ledger protocol (ILP), it is possible to "keep track of credit, debits and liquidity across the different transacting parties" (Zhang, 2019, p. 433). Schwartz & Thomas

(2016) defined the ILP as a network of networks and added that the ILP could be seen as a "shared protocol [that] could connect networks to one another". Therefore, the ILP is an open-source ledger, which can connect to different operating systems of banks or payment providers. Therefore, the ILP allows the usage and connection of the prevalent system architecture. Furthermore, banks have to be connected via the open-source ledger from Ripple, which is also outlined by the patent of the Bank of America ((US Patent No. US 2019 / 0172059 A1, 2019, p. 7). Therefore, the ILP can connect to different ledgers of banks and money transfer service providers and thus, provides interoperability. The only condition for banks in order to use the ILP is a one-time connection with the ILP.

8.1.4 Cost & Pace of Transactions with Ripple

As already mentioned, the goal from Ripple is to decrease costs and increase pace of transactions as it eliminates the needs of different correspondent banks and enables the direct interaction between banks across borders. However, costs of the transaction are still prevalent in order to "protect the XRP ledger from being disrupted by spam and denial-of-service attacks". Therefore, a neglectable amount of XRP destroyed within each transaction. Transaction costs increase "along with the load on the network" (XRP Ledger, 2019). Consequently, costs can vary. However, the minimal transaction costs for a usual transaction of XRP are at 0.00001 XRP when taking into account a today´s price of one XRP of EUR 0.274020 a transaction would cost close to zero. These fees are only applicable if no crypto exchange service is used for the transaction and instead the XRPs are transferred out of a crypto wallet, which allows "users to store and retrieve their digital assets" (Bankrate, LLC, 2016).

Besides the decrease in costs, RippleNet increases the pace, as it does not use intermediaries. As Ripple offers an "instant, on-demand settlement" (Ripple Labs Inc, 2019) a transaction settles within seconds. The system can process 1500 transactions and also is further able to scale and compete with VISA, which is processing 50.000 transactions per second. A use case demonstrated with ReiseBank, and ATB Financial showed that a cross-border transaction from Canada to Germany took in total 8 seconds until the payment was received and the beneficiary was notified (Ripple Labs Inc., 2016). Therefore, costs highly decrease, and the pace of a transaction outperforms SWIFT. However, SWIFT benefits from its global network and thus, reach, it has. The following abstract will discuss the reach of Ripple.

8.1.5 A Global Network as Key for Ripples´ Success

As beforementioned, Ripple counts over 200 different banks and money transfer service provider as customers and users of RippleNet (Ripple Labs Inc., 2019). Thereby Ripple spans a global network. However, as already mentioned, SWIFT is mainly used due to its significant number of financial institutions accepting and using its standard. Consequently, cross-border transactions are made through SWIFT, as the standard of messaging and process via correspondent banks is accepted almost in every region of the world. Therefore, even with the high cost and low pace involved the interconnection between the different banks all over the world is an advantage, banks are appreciating highly. The global network of banks and money transfer service provider is a critical element of Ripple's success and currently a protection for SWIFT. However, if banks are deciding to change their current systems, it would lead to switching costs in the form of risk and monetary resources. Banks have to change its internal procedure, and as Mr. May also remarked, “Banks have to change their technical infrastructure in order to be ready for future technological challenges. Furthermore, do banks have a risk in order to change its technological structure in the form of a loss of highly sensitive data and additionally, are those technological adjustments costly which is why banks are hesitant in adjusting”. Ripple provides a way around a substantial change in technology by allowing banks and money transfer service provider to use their established systems further and only integrate RippleNet via the ILP. Thereby, it allows banks to use the function of Ripple but mitigates the risk of those to the lowest. However, Ripple has to increase its reach of banks and money transfer service provider in order to be a strong alternative to SWIFT as the global network is essential to banks processing cross-border transactions.

8.1.6 Assessment of Ripple and its Fulfillment of Schupmanns´ Standards

As already discussed in section 7.2, Schupmann (2017) made clear that specific standards must be fulfilled in order to effectively use the full potential of blockchain technology. The fulfillment of the different standards is crucial as it paves the way for the success of the respective blockchain-based solution. Therefore, this section has the aim to assess Ripple and its fulfillment of the three beforementioned standards: (1) Technological Standards, (2) Governance and Liability Standards and (3) Regulatory and Legal Standards.

8.1.6.1 Ripple and its Fulfillment of Technological Standards

Section 7.2.1 discussed how essential the prevalence of technical standards is for successful positioning of a consortium and therefore of a blockchain-based solution. Interoperability is

one of the critical elements of success as it enables companies and consumers to mainly use a particular platform. Without interoperability, it is very unprobeable that a solution will globally be adopted.

Ripple´s ILP, enables all using institutions to connect their network with RippleNet and therefore, to interact with banks using different networks. It is the interface of different networks and allows interaction between each other. RippleNet allows integrating different financial institutions and money transfer service providers to integrate different ledgers. Consequently, Ripple fulfills the need for interoperability. Therefore, RippleNet does not need any non-prevalent technical standards in order to enable different users to use it.

Furthermore, it is also not a condition to use XRP to process a transaction as the currency exchange happens without further action of the initiator or the recipient of the transaction (Andoulaki & Karame, 2016). The only condition for both transaction parties is that their financial institutions are both connected with RippleNet. To do the financial institutions have to connect their ledgers once with the RippleNet as deeper explained in section 8.1.3. Therefore, a parallel line can be drawn between SWIFT and Ripple as when a financial institution wants to interact with another financial institution both have to be connected to the SWIFT network.

To conclude, it can be said that interoperability is given and that Ripple complies with Schupmanns (2017) condition of technological standards, as current financial institutions systems are enough to enable the usage of RippleNet.

8.1.6.2 Ripple and its Fulfillment of Governance and Liability Standards

This abstract has the aim to further focus on the compliance of Ripple with Schupmann´s requirements (2017) of setting clear governance and liability standards for an effective solution of blockchain-based cross-border transactions. Without implemented governance standards, it can be seen as challenging to define the party who has to provide solutions to possible upcoming problems. Therefore, as Schupmann (2017) said, it must be clear who holds primary responsibilities over the provided technology.

In section 6.7, the different possible characteristics of blockchain have been discussed. Thereby it was distinguished between permissionless and permissioned ledgers. When talking about Bitcoin, it was explained that it is a permissionless network with no governing intermediating party as there is no consortium, company, or any other organization behind it. Solely the validators, which can be anyone without further validation of another party whereas

Ripple can decide which nodes are allowed to validate and which are not. Furthermore, it cannot be seen as genuinely permissionless as Ripple provides the opportunity to gateways, which allow the user to store their cryptocurrencies, to freeze accounts. In 2014 Ripple introduced the usage of the" freeze feature" (Ripple Labs Inc., 2014). Thereby, made clear that the protocol extension "gives gateways the ability to either globally freeze all their issued funds, or to freeze funds of a particular user" (Ripple Labs Inc., 2014, p. 1). Global freeze describes the ability of a financial institution to freeze its actions on the XRP ledger.

Consequently, all currencies traded on the issuing address are frozen, and no funds can flow anymore. Ripple argues that this would help the gateways, which for example are financial institutions to "prevent [successful] attacks on the network" (Ledger, 2018), as it is not possible to further initiate payments or transactions. An individual freeze only focusses on certain individual accounts and has the aim to "comply with regulatory requirements… while it allows gateways to freeze individual [accounts] in order to investigate suspicious activity" (Ripple Labs Inc., 2014, p. 1). It has to be mentioned that Ripple gives this power to the gateways and has no authority to initiate such a freeze itself but opens the collaboration with state authorities in any case of suspicion.

The effect of such commitments to the demand of state authorities allows financial institutions to be confident about the usage of RippleNet, as Ripple establishes trust through the collaboration with regulating authorities. Therefore, it can be said that the requirement of a governance standard is not yet fully worked out, but Ripple strongly signals its readiness to work closely with authorities and therefore, establish a certain governance standard within Ripple Labs Inc.

8.1.6.3 Ripple and its Fulfillment of Existent Regulatory and Legal Standards

As Schupmann (2017) explained, a consortium must comply with current regulatory and legal standards. Therefore, this abstract will examine whether Ripple fulfills current regulatory and legal standards.

As already mentioned, Ripple's main focus lies on the facilitation of cross-border payments and therefore, it works closely together with financial institutions and money transfer service provider. Thereby, Ripple aims to provide support by RippleNet, whereby XRP is seen as a vehicle to facilitate transactions but not as inevitable mean to do so, as it is also possible to use other currencies on the RippleNet. Furthermore, and as already mentioned, Ripple is already used for transactions, as examples from Reisebank, American Express, and Santander show.

Thus, Ripple already has to comply with current regulatory and legal requirements as the financial institutions using Ripple's applications as the players mentioned above and other partners have to be compliant with banking regulations. Furthermore, Ripple focuses on the compliance of its applications with regulatory and legal standards as it publicly emphasizes the importance of regulation as the CEO of Ripple Brad Garlinghouse emphasizes on the importance of regulatory by saying that "for the industry to succeed, we need to work with regulators and within policies" (2019). It is seen as given that Ripple and its applications are in line with regulatory and legal standards within the payment and transaction area. Consequently, it fulfills regulatory and legal standards.

8.2 Libra Association and its Possible Effects on Cross-Border Transactions

Concerning globalization and the global use of the internet and the further digitization of products, Libra has the aim to go one step further by focusing on the economic empowerment. As already discussed, several emerging countries are relying on remittances from outside their borders because access to the financial ecosystem is denied to more than 1.7 billion people worldwide (World Bank, 2018). Hence, Libra wants to change this situation by including those unbanked people through the usage of Libra. Furthermore, and besides providing access to the financial ecosystem, Libra wants to decrease cost, increase pace, simplify the process of cross-border transactions, and provide a "platform for innovative financial services" (Libra Association, 2019, p. 2), which in the long-run should lead to an ecosystem of products and services that allows people to use the currency in their day-to-day business. To do so, it introduced the beforementioned "Libra Coin" (Libra Association, 2019) which serves as the currency used on the Libra blockchain. As already mentioned, the Libra Association consists of 25 companies. Each company had to show its commitment by providing USD 10 million in order to support research and development of the Libra Blockchain and has to carry the annual cost of running the validator nodes. One exception is prevalent for NGOs, social impact partners, and universities, because those institutions do not have to invest the initial USD 10 million. Companies such as Mastercard, eBay, Andreesen Horowitz, or Vodafone are partners in the Libra Association (Libra Association, 2019).

The next abstracts will explain the procedure of the Libra Blockchain and how partners are involved in the Libra Blockchain[2].

[2] It must be remarked that Libra is a newly introduced approach. Therefore, only facts until the end of July 2019 were considered for the assessment of Libra.

8.2.1 Overview of the Libra Blockchain

The Libra Blockchain is a "cryptographically authenticated distributed database" (Libra Association, 2019), and a public online ledger and "consists of a [number] of validators which are together responsible for the processing and the maintenance of it]" (Libra Association, 2019, p. 2). It is open-source as its primary goal is it to build "an open and interoperable ecosystem for financial services" (Libra Association, 2019, p. 3). The beforementioned partners are acting as validators. Therefore, Libra is a form of a permissioned blockchain, as only the member can function a node that validates and processes transactions. As already explained, Bitcoin and Ripple require a private, as well as public key, in order to initiate a transaction. Libra is using a new programming language which is called "move". It enables a simpler form of writing and to fulfill the intention of the coder. Thereby, it wants to assure to eliminate the risk that code has unintended commands in it, which could lead to security problems. Furthermore, the Libra Coin is the vehicle for transactions. The Libra Association has the aim to keep the Libra coin stable in order to ensure reliability and usage and less speculation as it is the case with Bitcoin, for instance. Furthermore, Libra is not "mined" but rather backed by reserves (Placeholder2). The reserve is a collection of different assets with low volatility. Therefore, the main difference between Libra and other cryptocurrencies is its intrinsic value based on the collection of the assets. Additionally, it has to be remarked that the exchange course of Libra is dependent on the development of the reserves. (Libra Association, 2019)

8.2.2 Distributed Ledger Technology of Libra

As already mentioned, Libra is an open-source platform with a permissioned blockchain. Only members of the Libra Association are allowed to validate transactions. Similar to the Bitcoin-blockchain, it uses the Byzantine Fault Tolerance consensus model (BFT). Therefore, two-thirds of the nodes have to confirm the legitimacy of the transaction. In the case of fraud in which over one third of the different validator nodes are compromised, the blockchain would diverge, also known as "fork" and the Libra Association would "would temporarily halt transactions, figure out the extent of the damage and recommend software updates to resolve the fork" (Constine, 2019). The data are not saved in the classical blocks as explained before but rather in a "single versioned database". The version number is an "unsigned 64-bit integer that corresponds to the number of transactions the system has executed" (Libra Association, 2019, p. 1). Therefore, blocks are more a logical construct for the different validating nodes in order to coordinate the "confirmed snapshots of the system state" (Lopp, 2019) and each transaction with Libra is permanently written into the Libra Blockchain.

8.2.3 Interoperability of Libra

As already discussed before, it is crucial to provide interoperability as a gate for global adoption. Regarding Libra, David Marcus (2019) remarked in a note that "[the user] will be able to use a range of custodial and non-custodial wallets that will have a full interoperability with one another, meaning [the user] will be able to pay and receive payments across wallets from different companies". Custodial wallets are wallets in which a third party is storing the private keys of a user whereas a non-custodial wallet allows a user the full control over his/her private keys and therefore over his/her funds (Guarda Wallet, 2018). Therefore, what Marcus (2019) described is existing interoperability of exchanges such as *Binance* and private wallets, which can be, for instance, stored on physical devices (Guarda Wallet, 2018). This would also implicate that companies accepting Libra as a mean to pay for services or products would not have problems to receive Libra. However, it is still not published how companies and banks might integrate the Libra Blockchain into their current systems.

8.2.4 Cost & Pace of Transactions with Libra

As Libra stated in its mission statement, one main goal is the decrease in cost and thereby the inclusion of 1.7 unbanked billion people. Similar to Ripple, it wants to do so by cutting correspondence banks. Nonetheless, transaction costs are occurring, and transactions are not entirely for free. Each user has to pay "gas", which is the transaction fee occurring. One unit of "gas" is equal to a fraction of a penny. Furthermore, the user can indicate how much gas he/she wants to pay. Indicating a higher amount of "gas" would lead to faster processing of transactions (Libra Association, 2019). The fee intends "[to cover] cost of processing the transfer of funds" (Constine, 2019). Furthermore and similar to Ripple it is a mean to "deter fraudulent actions from creating millions of transactions to power spam and denial-of service attacks" (Constine, 2019) as the transaction fee accumulates to a high amount when millions of transactions are created, which would harm the fraudster.

Besides the argument of the decreased cost, Libra is also improving the pace the transaction process as it can process around 1000 transactions per second and a transaction would finally be settled within 10 seconds upon initiation of the transaction (Libra Association, 2019). However, it has not been made clear yet by the Libra Association how and if it would be able to scale the number of transactions up to the level of Visa, for instance.

8.2.5 Network Effects of Libra

As already discussed, a critical factor of success of a blockchain solution for cross-border transactions is the global adoption of the product. As Facebook Inc. is one of the leading actors in Libra, it announced that it has the aim to integrate Libra and Libra wallets within its core product platforms, Instagram, Facebook, Messenger, and WhatsApp. Thereby, it opens the gate to the global adoption of Libra, as over 2.7 billion people are active users of at least one of Facebook´s core products (Statista, 2019). Thereby, it would reach the beforementioned network effects, as people who are having an account on one of the platforms can send and receive Libra Coins. Therefore, it can be said, by using Libra Coin, Facebook could compete with SWIFT, for instance, as it also has a global network of people using it. As a result of this location and distance get neglectable.

8.2.6 Assessment of Libra and its Fulfillment of Schupmann´s Standards

This section assesses the fulfillment of Libra with Schupmann´s standards (2017). The assessment has the aim to provide a status quo whether Libra can exploit the full potential of its blockchain-technology. Therefore, as in section 8.1.6, it will be assessed whether Libra fulfills (1) Technological Standards, (2) Governance and Liability Standards, and (3) Regulatory and Legal Standards.

8.2.6.1 Libra and its Fulfillment of Technological Standards

As already discussed in the case of Ripple, interoperability is a key element for a system or an application in order to be globally adopted. As Marcus (2019) indicated, Libra is fulfilling the condition of interoperability. Libra is usable with non-custodial as well as custodial wallets. The only condition for the usage as an individual party is the owner of one of the two mentioned wallet options. Furthermore, a difference between Libra and Ripples lies in the target group of for their products. Libra is merely focused on the individual as it has the necessary reach by the usage of Facebook´s core platforms whereas Ripple focusses on the institutions behind a transactions, banks and money transfer service provider to reach more individuals. It has to be seen in the future how Libra can include such parties, as from today's point of view, those players are neglected because they are not needed to create network effects. However, within the time frame this thesis was written in, it can be said that Libra allows interoperability between the interacting parties due to the usage of any of the two beforementioned types of wallets. To conclude, Libra complies with Schupmann´s condition of Technological Standards, the moment companies and private user once registered for the usage of Libra.

8.2.6.2 Libra and its Fulfillment of Governance and Liability Standards

The fulfillment of governance and liability standards is essential in order to provide a sustainable blockchain solution with the potential of global adaption (Schupmann, 2017). As Libra is a permissioned network in which only partners can act as a node and validate transactions. Furthermore, it is the Libra Association, which is the administrative body of the Libra Blockchain and its reserve (Libra Association, 2019). The Libra Association is governed by the Libra Association Council, which makes "decision on the governance of the network and reserve [… and is comprised by one representative per node]" (Berenzon, 2019). Votes are only granted to founding members which therefore fulfill two criteria: (1) Meet a set of predefined eligibility criteria and (2) own Libra investment token, which is the initial investment of USD 10 million USD (Libra Association, 2019). Furthermore, no founding member is allowed to have more than "one vote or 1% of the total votes in the council" (Berenzon, 2019). Furthermore, Libra arguments that the "established reputations [of the involved companies make it unlikely for them to act in any malicious way]" (Libra Association, 2019, p. 24) as the Libra Investment Token would only yield returns from interests gaining on the beforementioned reserves. Due to the fact of the reserves' low-risk profile and therefore low yields, a materialization of the investment will only be seen when the size of the reserves grow. Therefore, any malicious action on the Libra Blockchain would negatively affect the acting party of the founding members, as well as Libra, would lose credibility and therefore, trust from potential users. Furthermore, the Libra Association has the authority to temporarily put all ongoing transactions on hold, if any fraudulent or suspicious actions were discovered. Thereby, it provides the possibility to control the network, which could further translate into the possibility of regulating bodies cooperating with the Libra Association like it is the case for Ripple, as it allows to "freeze" accounts within a time frame of an investigation. However, so far, it has not yet been made clear how and if individual accounts under suspicion can be frozen without harming the global transaction flow. Any further specific governing rules in the time when this thesis was written are not yet public. However, the beforementioned validation rules are in place, and furthermore, the Libra Association states how decisions are made and who is eligible to vote as well as how the voting power is divided. Hence, it fulfills the criteria of Schupmann (2017) of "clear government structures that provide for who may access, input and correct data" (Schupmann, 2017, p. 12). Consequently, a governance structure is in place, but, the broader IT laws and the clear liability regulations by the states are missing. Therefore the expected governance is given, but the liability standards are not, since national lawmakers are

needed and mechanisms for dispute resolutions, for instance, clear liability standards, would help to "reduce uncertainty and manage risk" (Schupmann, 2017, p. 12).

8.2.6.3 Libra and its Fulfillment of Existent Regulatory and Legal Standards

Within the last few months, central banks and other regulatory institutions have deeply discussed Libra, its possible role within the world and furthermore its compliance with regulatory and requirements. Thereby, the U.S. Senate Banking Committee was raising concerns regarding privacy and data protection. Furthermore, a general concern is that states could lose their power over money, which would mean a loss of a critical mean for the steering of the country. Today, it cannot be said whether Libra fulfills regulatory and legal standards as it not fully launched so far. What has to be said is that Libra drifts away from the decentralized factor and drifts more towards a centralized action from which lawmakers are afraid of as it would mainly translate into a private consortium having "control over a public good", as Mrs. Alexandria Ocasio-Cortez complaints. Furthermore, the Senate Banking Committee fears that the power of the Libra Association by steering a worldwide used currency could end-up in a deep conflict of public and private interests. David Marcus, the leader of Calibra, addresses this fear at the hearing in front of the U.S. Senate Banking Committee by saying:

> The Libra Association, which will manage the Reserve, has no intention of competing with any sovereign currencies or entering the monetary policy arena. It will work with the Federal Reserve and other central banks to make sure Libra does not compete with sovereign currencies or interfere with monetary policy. Monetary policy is properly the province of central banks. (2019)

Furthermore, Marcus ensures to work with regulatory bodies, for instance, with the Swiss Financial Markets Supervisory Authority and expects to "engage with them on an appropriate regulatory framework for the Libra Association" (2019).

Thus, Libra cannot get around its compliance with regulatory and legal requirements. However, at this moment, it is also important to urge the regulatory and legal bodies to build up a legal framework which encompasses the regulatory and legal standards for the blockchain technology and digital currencies.

In summary, it can be said that so far, it is not possible to evaluate Libras' current fulfillment of legal and regulatory standards, as it not finally launched yet. However, what can be said is that Libra is willing to work with regulatory and legal bodies in order to ensure its compliance with legal and regulatory frameworks.

9 Comparison of SWIFT, Bitcoin, Ripple, Libra, and Money Transfer Service Provider

After discussing the concept of a transaction via SWIFT, the fundamentals of Blockchain and chosen cryptocurrencies and consortiums, this abstract has the aim to compare the different presented solutions to transfer money across borders. Within the evaluation of each of the possible and prevalent solutions, the thesis has focused on the cost, pace, and transparency of cross-border transactions and further assessed possible solutions such as Libra and Ripple. Therefore, this chapter has the aim to make a comparison between the presented solutions for cross-border transactions and further add hypotheses in order to make blockchain solutions applicable in the future.

	Bank Tranfer	Bitcoin	Ripple	Libra	PayPal	Western Union	Transferwise
Cost	5-7% of transaction volume	Next Block: $0.81 3 Blocks Fee: $0.76 6 Blocks Fee: $0.41	At least 0.00001 XRP, but dependent on the gateway used, "Binance" charges $0.25 for a transaction of any amount	User has to pay "gas". No clear indication of fee structure, however an estimate could end up at the level of Ripple	Ca. 6% of the transaction volume	Ca. 5% of transaction volume	0.65% of transaction, dependent on destination and type of transaction
Pace	3-7 days	10 minutes when in next block Lightning network allows transactions within 1-10 seconds	1-10 seconds	1-10 seconds	1-10 seconds	1 minute	2 days
Transparency	Fees and tracking of transaction rarely possible	Payment can be tracked, and all transaction records can be seen by all parties	Technology of Ripple allows to track each step of transaction. However, level of transparency dependent on using entity of Ripples' services	Only validators see full transaction history. It is unclear how users are able to track transaction and get informed about fees	Shows fees that appear for transaction. Allows user to track payments	Fees are communicated before transaction is initiated. Tracking of payment is possible	Fees are communicated before transaction is initiated. Tracking of money is possible
Network	> 11,000 institutions	No clear statement possible	Increasing network but still small with > 200 customers	Through Facebooks´ core products, more than 2.7 billion individual users can be adressed	Work together with most e-commerce platforms in Europe and counts over 289 million users	Reachable in > 200 countries and > 500,000 Western Union agents	> 4 million users
Security	Centrally stored data. Security dependent on individual bank institute	Decentral Ledger Technology assures strong security. Consensus mechanism make Blockchain very difficult to attack	Validation is secure through consensus mechanism	Only trusted parties are allowed to validate transaction records kept in single versioned database, which is centrally stored	Central servers make PayPal more vulnerable to cyber attacks	Data stored centrally which leaves Western Union vulnerable to cyber attacks	Data centrally stored, therefore vulnerable to cyber attacks
Compliance with Schupman's Standards	Yes	Not clear statement possible	Yes	Not yet compliant with regulatory & legal framworks	Yes	Yes	Yes

saction Application with Selected Money Transfer Service Providers and the Usual Bank Transfer

This table reports the difference between a classical bank transfer, the usage of a money transfer servic
remarked that the prices for a transaction via the Bitcoin-blockchain are denominated in USD. Additiona
the whitepaper and the developer platform of Libra served as a basis for the comparison as it is a very ne

9.1 Comparison of Cost and Pace

As already discussed within the thesis, one main pain point of cross-border transactions was the high costs occurring per transaction. When comparing the different possible and future options, Table 2 shows that blockchain-based payments are showing a potential of cost reduction as the majority of intermediaries and in the case of blockchain all intermediaries could be cut out. Furthermore, the exchange rate fee is another reason for high transaction cost, which is charged from the banks when using SWIFT and from the money transfer service providers. In comparison to banks using SWIFT and money transfer service providers, it could be seen that the cost-saving potential for a cross-border transaction is demonstrated by Ripple, Bitcoin, and hypothetically by Libra.

When focusing on the pace, it has to be said that SWIFT, PayPal, and other money transfer service providers improved over time, and therefore, their number of transactions processed per second. However, Table 2 shows that Ripple and Libra, under the condition that Libra will be implemented in the way it was presented in the two published white papers, can outpace SWIFT and even money transfer service providers, as transactions are processed within a second. It is a different story with Bitcoin since the Lightning network helps Bitcoin to increase the pace of processing transactions as it does not directly use the verification mechanism of the Bitcoin-blockchain for each transaction but more for a summary of transactions within a particular payment channel. The improvement through the lightning network enabled the Bitcoin blockchain to compete with current Ripple solutions and hypothetically Libra as well. Therefore, if Bitcoin is only compared with its basic setup, it is outperformed by SWIFT and all the presented money transfer service providers, as it only processes seven transactions per second. However, if the usage of the lightning network on the Bitcoin-blockchain is included in the comparison, Bitcoin is outpacing SWIFT as well as the mentioned money transfer service providers.

In summary, when focusing on the cost and pace of a cross-border transaction, blockchain-based solutions are outperforming SWIFT-based solutions and solutions offered by money transfer service providers. However, the beforementioned network effects are crucial in order to profit from such a performance in terms of cost and pace, which is why this thesis will compare the current solutions concerning network effects in its following section.

9.2 Comparison of Network Effects

When explaining the current situation of consortia, the importance of network effects was discussed. By doing so, it has been made clear that for a global adaption, network effects are inevitable. SWIFT, for example, is one of the most used solutions, as it has the most significant reach since more than 11,000 financial institutions are using its messaging standards. Therefore, financial institutions are well aware of the transaction process and furthermore, to the standards of a transaction. When comparing SWIFT and Ripple, it can be said that from today's point of view, this is the main point of weakness of Ripple. However, it could be seen that patents from institutions such as Bank of America include Ripple as a crucial technology for their blockchain-based transaction processes. Under the hypothesis that other high ranked institutions adapt to new blockchain-based transaction processes, it could be the case that Ripple gets up on speed and increases its network in a fast manner and therefore, could transform within the next years to a serious competitor of SWIFT within the market for cross-border transactions. For money transfer service providers, it can be said that in the current setup they still have a strong network through its branches, but as could be seen, the industry is also increasing its focus on alternative and blockchain-based solutions such as Ripple, as Moneygram and Ripple have a partnership to improve the money transfer process of Moneygram. Furthermore, as long as the financial inclusion does not reach the more than 1.7 billion unbanked people, money transfer services providers such as Western Union or Moneygram will have its business opportunity and through the usage of Ripple, it could either increase their margin or increase their customer base by offering lower fees. When comparing Bitcoin to the different solutions, it has to be said that it is difficult as some researchers believe that because Bitcoin is also seen as a store of value, network effects are not as strong as in cases when Bitcoin is only used as currency and less seen as a store of value. Therefore, under the condition of Bitcoin being a store of value, network effects are not as strong for instance for Ripple as RippleNet can work with fiat currencies and is only shortly used as a vehicle for the transaction. Whereas under the condition Bitcoin owner would see Bitcoin only as a transaction currency, it has the biggest network within the crypto world. When comparing Libra to the mentioned solutions, it has been made clear that the reach of Libra is substantial, as more than 2.7 billion people are using at least one of Facebook´s core products and are therefore a potential user who can use Libra. Consequently, it will be an alternative for unbanked people and people who are using Western Union in regions where SWIFT, for instance, is not allowed. Furthermore, it is not clear yet how unbanked people will get enabled to exchange their local

currency with Libra. Therefore, Libras strong network effects are also underlying the hypotheses of all the unbanked people having the possibility to exchange their currency with Libra. Besides the beforementioned points, certain regions such as China, South Korea, and others have to allow the usage of cryptocurrency in order to create fair competition. Under the hypothesis of having cryptocurrencies worldwide allowed, it is possible that solutions such as Ripple increase its worldwide network fast through the banks and Libra through the network of Facebook´s core products' users. Therefore, it can be summarized that under the hypothesis, that the introduction of legal frameworks happens, the further eager of big corporations to invest in the usage of blockchain-based transaction channels and the further legalization in critical regions such as APAC, the network for blockchain-based solutions could grow strongly over the next years and possibly reach the network strength of SWIFT within the next decade.

In the next abstract will compare the fulfillment of Schupmann´s standards by the different solutions.

9.3 Comparison of Fulfillment of Schupmann´s Standards

When comparing the different options with Schupmann´s standard, it must be mentioned that Schupmann´s standards only discuss standards for practical usage of the blockchain technology. When this thesis discussed Ripple´s and Libra´s fulfillment of technology, governance, and liability and regulatory and legal standards, it could be seen that Ripple already fulfills all three kinds of standards, as it is already used by regulated financial institutions. Furthermore, when discussing Libra, it has been made clear, that Libra is in a very early stage of development and therefore, the question of the fulfillment of the different standards cannot be answered clearly. What stood out when both options were analyzed, is that with the introduction of Libra, a legal framework has to be created soon. Currently, legal and regulatory bodies are discussing different ways of regulating Libra. Ripple, on the other side, is already widely used, as it is not the cryptocurrency, which is the main product of Ripple, but rather the blockchain technology, that is easy to implement for banks, as no new systems are needed and the current ledger system of financial institutions can be connected to RippleNet. Therefore, it allows a smooth transition into blockchain-based cross-border transactions. Furthermore, it is challenging to compare Bitcoin as no real consortium is behind Bitcoin. However, as Dr. Zimmermann already mentioned "certain transactions need an intermediary", it is questionable whether Bitcoin will be able to establish the regulatory and legal acceptance to act as a globally acknowledged vehicle for a transaction. Furthermore, Nathaniel Popper, a journalist from the New York Times, defined Bitcoin as "digital gold". Bitcoin is merely seen as a store of value, what is

supported by recent studies from Bloomberg, which show that Bitcoin is merely seen as a digital asset, as its correlation with the gold price increased to 0.837 and volatility decreases. Therefore, Bitcoin moves into the direction of being a digital asset. However, when comparing Bitcoin to Ripple or Libra, for instance, it can be said that Bitcoin is less used as a transaction vehicle but merely as an asset. Therefore, it seems less realistic, that Bitcoin plays a significant role in the future area of cross-border transactions and instead remains a digital asset to invest in.

When comparing the solutions to money transfer service provider that are already acting on the market or SWIFT-based transactions, Table 2 shows that all of the mentioned players fulfill the different standards as they are acting around the globe, which clearly signals the fulfillment of standards. In summary, it is inevitable to introduce a clear legal framework for blockchain and digital currency because only then it is possible for the different solutions to compete with the current ones.

The next abstract will focus on the comparison of transparency provided by the different solutions.

9.4 Comparison of Transparency

Clear transparency of fee structures was missing when focusing on SWIFT. However, SWIFT started to improve this matter by introducing SWIFT gpi. Due to that, a customer can see how much fees a transaction will cost and furthermore, what the current status of the transaction is. Nonetheless, open source recordkeeping has not yet been introduced. With this, the question would be if data privacy and protection laws would allow such a new feature to SWIFT-based transactions. The money-transfer service providers provide transparency as the status of a transaction for the user of WU or PayPal is visible, and fees are clearly stated before the user finally initiates a transaction. When comparing both SWIFT and money transfer service providers with the presented Blockchain solutions, it can be said that transparency is one of the main issues Ripple, Bitcoin, or Libra wants to solve. When looking at Bitcoin, it can be said that each transaction record is visible. Therefore, every party who is interested in historical transactions has access to it. Furthermore, it is clear how fees a user has to pay in order to make a transaction with Bitcoin. The only weak point is that a user has to put in a transaction fee, which is an incentive for the validators to favor a transaction of a user. Additionally, comparing Ripple to the current predominant SWIFT and money transfer service providers, it can be seen that Ripple acts with full transparency, as its system allows for tracking the status of a

transaction and furthermore, it is indicated how much of a transfer fee is occurring. However, as Ripple is not directly the institution the transaction is made with, the users of the system, therefore the financial institutions and money transfer service provider are asked to show the expected transfer fees. Therefore, Ripple offers the possibility to notify both actors in a transaction and hence acts transparently. When comparing Libra to all the beforementioned solutions, it is not clear how Libra is approaching the transparency issue as, on the one hand, it is an open-source network, but on the other hand, only partners can validate, and therefore only those have the full transaction history and enjoy full transparency. Within the time frame of writing this thesis, it not clear yet how users are getting notified about status and fees (if occurring). In summary, it can be said that except Libra all the different solutions provide a certain degree of transparency. However, SWIFT improves its level of transparency but is still behind Bitcoin or Ripple, as it does not maintain an open-source record which would be accessible for every interested party.

As the security of systems is a topic with increased attention, the next abstract will draw a comparison between the different systems, and their level of security.

9.5 Comparison of Security

When discussing Blockchain technology, security is another central point of the benefits of its strategy. SWIFT is only a messaging system, and the financial institutions using SWIFT are responsible for their systems and the security of their SWIFT keys. What can be said is that financial institutions are using a centralized network architecture which leads to vulnerability as all relevant data are stored centrally (Bearingpoint, 2017). When the assorted characteristics of Blockchain were discussed, it was distinguished between permissioned and open systems. Permissioned networks have the advantage that they are potentially more comfortable to fit into legal or regulatory frameworks (World Bank, 2017). Additionally, it is seen as easier for a permissioned network to "[resolve] issues related to identity and data privacy" (World Bank, 2017, p. 12). In contrast, Ripple only has the right to remove validator nodes and is not able to ban them from the beginning and further secures validation by the beforementioned consensus mechanism. However, by keeping a central entity in the control of regulating access, a higher vulnerability for cyber-attacks is given. This diminishes some advantages of the DLT as "security and system integrity of open, permissionless DLs is achieved through cryptographic and algorithmic solutions which ensure that anonymous network participants are incentivized to enforce accuracy of the ledger, without the need for barriers to entry or trust among participants" (World Bank, 2017, p. 12). Therefore, money transfer service providers and

financial institutions, who keep data stored on a centralized database, are potentially an easier target for fraud and cyber-attacks than services, which rely on distributed and permissionless networks.

10 Conclusion

This thesis focused on the effects of blockchain on cross-border transactions. Therefore, it started with an explanation of the role of financial intermediaries as a trusted third party within the transaction process.

Thereafter, the thesis discussed differences between domestic transactions within the SEPA area and cross-border transactions and compares it to money transfer service provider in chapter 5. Thereby, it has been made clear that the degree of complexity of cross-border transactions is higher than for domestic transactions. This is the case as more parties are involved compared to domestic transactions. Within the thesis, an example of a transaction of EUR 10,000 to Japan in Japanese Yen had been established in order to illustrate a cross-border transaction process and the parties involved. Thereby, it could be explained how the difference in currency and financial institution requires correspondence banks and clearinghouses to step in. Thus, the inclusion of intermediaries deaccelerates the process of the transaction and requires more time and costs occurring for services increase.

At this point, the blockchain-technology has the potential to increase the efficiency within the process of cross-border transactions. The thesis discussed the fundamentals of the technology and showed the disruptive power it could potentially have on the payment industry and the way cross-border transactions are processed (Holotiuk, Pisani, & Moormann, 2019). Thereby, it was shown that transactions are possible to be processed without a trusted third party, as the double-spending problem could be solved by the consensus algorithm. The blockchain-technology and its exact way of solving the double-spend problem were explained in chapter 6. Furthermore, it was illustrated how a transaction process on the Bitcoin-Blockchain works in order to compare the ordinary cross-border transaction via a financial institution and blockchain. It was also explained what different characteristics of blockchain are existent to build a basis for the discussion of different consortia in chapter 6.

Chapter 7 focuses on the observed creation of consortia, within the adaption of blockchain and cross-border transactions. Different consortia were presented and standards for efficient use of the blockchain technology, proposed by Schupmann (2017), were explained. Thereby, the importance of the fulfillment of technology, governance, and liability, as well as

regulatory and legal standards, was discussed in order to assess selected consortia in chapter 8. In chapter 8, the consortia Ripple and Libra were analysed in detail in order to provide a statement towards the fulfillment of requirements for a future influence in the field of cross-border transactions of the two consortia. Thereby, both consortia were chosen in order to, on the hand, show what requirements consortia or companies within the field of blockchain need to fulfill for an efficient and globally adaptable solution and, on the other hand, also provide an analysis of a very new and relevant topic by analyzing Libra.

In chapter 9, a comparison of the assessed consortia as well as Bitcoin and ordinary transactions via a financial institution was made. The effects, which blockchain, had or could have will be explained in the following abstract.

10.1 Discussion of Effects of Blockchain on Cross-Border Transaction

By explaining the different transaction processes of blockchain-based, the thesis exposed the most significant flaws within the cross-border transaction process and how blockchain could solve those.

When revising different literature towards the topic of blockchain and the payment industry, it has been made clear that especially pace, cost, and transparency are issues that need to be solved in order to increase efficiency within this area. By analyzing the blockchain technology and the different solutions for the cross-border transaction process, it could be found that due to the consensus algorithm the validation of transactions can be accelerated, which would lead to a high increase in pace. Additionally, the reliance on the validation nodes leads to the possibility of transactions within every day of the week and not only business days. Furthermore, it could be seen that due to further improvement and development of the established blockchain solutions, scalability has also been improved over time and will improve further in the future. Besides pace, costs could be decreased as the number of intermediaries could be at least massively decreased or in the case of Bitcoin, eliminated.

Furthermore, blockchain increases transparency, as it permanently records transactions made in a public ledger in the case of Bitcoin, which makes it possible for everyone to comprehend all the transactions and additionally shows the transaction fees to be paid before the transaction had been initiated. Moreover, the distributed ledger technology ensures that data are not stored centrally and therefore decreases the chances of a cyber-attack. In contrast, financial institutions and money transfer service providers maintain centralized storage of data.

Furthermore, there are also soft effects observable. The financial service industry merely increases its efforts to improve the cross-border transaction process and therefore starts to challenge itself. It could be seen that companies such as JP Morgan, Goldman Sachs or Bank of America increased their efforts to have a technological edge in their industry and another argument for existing and potential customers to work with them as the revenue stream from will decrease and therefore the institutions and the payment industry itself will face new business models (Holotiuk, Pisani, & Moormann, 2017). Furthermore, the market leader, SWIFT, increased its efforts to innovate the process of cross-border transactions by introducing SWIFT gpi. Besides, the industry brought legal and regulatory authorities to move their focus on the regulation. This is of high importance as it is crucial for companies and consortia to have a clear legal and regulatory framework to comply with in order to live up by the full potential of the blockchain technology.

Moreover, the implementation of blockchain-based transactions benefit people in the developing world as the cost of transactions decreases, which affect especially small remittances, as transaction cost "disincentivize the transaction altogether" (Dierksmeier & Seele, 2018). Furthermore, internet access, as well as the payment of a neglectable fee, are required in order to do a transaction of cryptocurrency. Consequently, it would enable unbanked people to gain access to liquidity by the possibility of the receipt of micropayments or loans and furthermore a new degree of convenience and security (Dierksmeier & Seele, 2018). Furthermore, and due to the low cost of transaction increase, the ease of spending for people and could enhance the growth of the economy (Van Alstyne, 2014).

However, in the analyses drawn from Ripple and Libra, it could be seen that legal and regulatory frameworks have to harmonize with the technology, and therefore, especially the liability standards are welcomed by the regulating authorities. From today's perspective, it seems relatively unlikely that the legal and regulating authorities will allow a system without a responsible party behind it. Ripple, for instance, realized this fact and still acts as a kind of intermediary. Nonetheless, governments try to step in and already propose a shift towards a blockchain-based digital currency. This indicates that the usage of blockchain technology is a severe point of discussion. Nevertheless, it can be seen as questionable and unlikely that the governments will allow consortia, such as the Libra Association, to be responsible for a global currency.

Therefore, in summary, it can be said that blockchain-based solutions for the cross-border transaction process are evolving. Consequently, blockchain already affects cross-border

transactions, which will continue in the future due to numerous reasons mentioned above. However, it must be assured that future solutions comply and work together with regulatory and legal authorities in order to ensure that the full potential of the technology within the area of cross-border transactions can unfold.

10.2 Limitations and Possible Future Research

There are several limitations to the results of this thesis. First, research within the topic of a cross-border transaction and the effect of blockchain is scarce. Thus, it was not possible to use a vast amount of high-class literature. Therefore, also web sources and white paper were used in order to establish a clear understanding of the respective technology.

Second, as the creators write white papers of the technology, it can be expected to have a biased way of describing facts. This could be, for example, the case for the governance description of Libra. Therefore, within the assessment of the different consortia and the comparison of those with SWIFT based cross-border transactions, it cannot be ruled out that this bias is also reflected within the results presented.

Third, as the topic of blockchain within the financial services industry evolves very fast, it can be the case that current developments are not fully included in this thesis, as the time frame for inclusion closed at the beginning of July 2019.

Fourth, the thesis would be even further enriched if more people had been found as an interviewee. Especially, representatives of money transfer service providers or credit card issuers would have rounded up the expert interviews and led to more insights presentable within this thesis.

In future studies, it would be suggestible to focus more in-depth on the possible effects of the implementation of blockchain within the process of cross-border transactions instead of the payments industry. However, additionally, further research within the change of business-models within the payment industry but also in the field of eCommerce would be desirable as it would decrease hurdles of expansion. Furthermore, it would be very interesting to research about a clear step-by-step roadmap for companies to adapt to the blockchain. Another interesting topic to research about would be the area of financial inclusion since as of now it is said to help for the inclusion of currently unbanked people, but a clear path to the inclusion of unbanked people is not given yet. Thereby, it would be interesting to see alternative approaches to Libra. Furthermore, it would be interesting to research a global digital currency and its consequences for the world economy, as Libra triggered discussions about such an approach.

At last, future research could investigate the consequences of a blockchain-based world-wide transaction system, as energy consumption will increase by a full shift towards digital currencies.

Table of Appendix

Appendix 1: Overview of Experts Interviewed

Nr.	Name of Expert	Date of the Interview	Occupation	Experience
1	Markus Belz	06-28-2019	Financial Advisor for international corporates	Over 25 years experience in financial advisory of internationally acting corporates
2	Christopher May	07.08.2019	Founder of Finoa.io	Former McKinsey Consultant and currently building a startup within the area of blockchain
3	Dr. Jens Zimmermann	07.11.2019	Member of the German Parliament	Responsible for the topic "blockchain" within the Financial Commitee" of the German Parliament
4	Dr. Natalie Tillack	07-18-2019	Founder of Denkfabrik.io	Former McKinsey Consultant and currently helping startups to handle new technologies, for instance blockchain

Appendix 2: Expert Interview Questions

Could you provide me with some information about your background and explain to what extent you have been in touch with the topics of transactions or Blockchain so far?

1. *Background information:* In the last year, cross-border transactions in the amount of more than $135 trillion were carried out. Hereby, payment revenues in terms of total fees of around $125 billion were generated.

   Question: What is your opinion on the topic of cross-border transactions? (General opinion and thoughts about the topic)
2. What is your opinion on the topic of Correspondent Banking?
3. Blockchain and Cryptocurrency are terms, which are getting more attention from the financial sector. What do you think about this?
4. Which weaknesses do you see in the current cross-border transaction process?
5. Would you endorse the Blockchain tehchnology as core technology for the transaction process? If yes/no, why?
6. Where do you see the main weaknesses in the global adaption of the Blockchain technology as the technology for the transaction process?

Appendix 3: Foreign Exchange Fees per Currency

Foreign Exchange Fees per Currency

Transaction Currency	ISO-4217-Code	Foreign Exchange Fee
Australian Dollar	AUD	4.00%
Brasilian Real	BRL	4.00%
British Pound	GBP	3.75%
Danish krone	DKK	3.75%
Euro	EUR	3.75%
Hong Kong Dollar	HKD	4.00%
Israeli Schekel	ILS	4.00%
Japanese Yen	JPY	4.00%
Candadian Dollar	CAD	3.75%
Malaysian ringgit	MYR	4.00%
Mexican Peso	MXN	4.00%
New Taiwan Dollar	TWD	4.00%
New Zealand Dollar	NZD	4.00%
Norwegian Krone	NOK	3.75%
Philippine Peso	PHP	4.00%
Polish Zloty	PLN	3.75%
Russian Ruble	RUB	3.75%
Swedish Krona	SEK	3.75%
Swiss Franc	CHF	3.75%
Singapore Dollar	SGD	4.00%
Thai Baht	THB	4.00%
Czech Koruna	CZK	3.75%
Hungarian Forint	HUF	3.75%
US Dollar	USD	3.75%

Appendix 4: Overview of Merchant Rates

Merchant Rate

Monthly Trannsaction Volume via PayPal Account in EUR	Variable Fee
less than 2,000.00 EUR	2.49%
2,000.01 EUR to 5,000.00 EUR	2.19%
5,000.01 EUR to 25,000.00 EUR	1.99%
25,000.01 EUR to 100,000.00 EUR	1.79%
more than 100,000.00 EUR	1.49%

Appendix 5: Fixed Fee in Transaction Currency

Fixed Fee in Transaction Curreny

Currency that is changed	Fixed Fee
Australian Dollar	0.30 AUD
Brasilian Real	0.60 BRL
British Pound	0.20 GBP
Danish krone	2.60 DKK
Euro	0.35 EUR
Hong Kong Dollar	2.35 HKD
Israeli Schekel	1.20 ILS
Japanese Yen	40.00 JPY
Candadian Dollar	0.30 CAD
Malaysian ringgit	2.00 MYR
Mexican Peso	4.00 MXN
New Taiwan Dollar	10.00 TWD
New Zealand Dollar	0.45 NZD
Norwegian Krone	2.80 NOK
Philippine Peso	15.00 PHP
Polish Zloty	1.35 PLN
Russian Ruble	10.00 RUB
Swedish Krona	3.25 SEK
Swiss Franc	0.55 CHF
Singapore Dollar	0.50 SGD
Thai Baht	11.00 THB
Czech Koruna	10.00 CZK
Hungarian Forint	90.00 HUF
US Dollar	0.30 USD

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Declaration of Honor

I hereby declare that I have written this thesis on my own and with no other help than the literature and other supportive material listed in the appendix. Citations of sentences and parts of sentences are declared as such, while other imitations are clearly marked and linked to original sources with regard to extent and intention of the statements made. This thesis has never been handed in to any examination authority before and it is also not yet published.

Vallendar, 09.09.2019 _____

Julien Maximilian Habeeb