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Research on the Comparative Advantage of Blockchain Payment Systems

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Abstract The Blockchain technology is a decentralized information communication technology which is with a huge potential application in the field of cross border payment, investment and all other financial transactions. This paper is to study the huge advantage of Blockchain decentralized point to point payment technology over traditional SWIFT systems. All aspects of the comparison are investigated comprehensively include the mechanism, cost, supervision, currency, and transaction speed and all others which is trying to provide some insights for the future development of blockchain payment system and its all-other applications.

Keywords Blockchain; Payment system; SWIFT; decentralization

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1. Introduction

Since the advent of blockchain technology, a large number of blockchain payment systems have emerged, such as Bitcoin, Ripple, Litecoin, Libra, etc [1]. world famous traditional financial institutions and industry giants have also begun to study blockchain technology to promote their cross-border payment business [2]. Among many blockchain cross-border payment systems, Ripple, as the earliest blockchain cross-border payment enterprise, is representative of its cross-border payment system in terms of technology scalability, compatibility and business processing mode [3]. It is the benchmark of cross-border payment systems, and its business model has been applied in a large range. For the above considerations, this paper selects Ripple as the case study object to elaborate and explore the application characteristics and internal mechanism of blockchain in the field of cross-border payment.

1.1 The emergence and development of Ripple

Ripple, founded in 2012, is an American company focusing on blockchain technology and digital cryptocurrency [4]. Headquartered in San Francisco, it is a private financial technology company. Ripple cross border payment system is an open-source payment agreement developed by Ripple company. Its goal is to establish a fast, effective and low-cost global payment system to help customers of banks and other financial institutions make global payments faster, more reliable and cheaper [5,6,7]. Ripple cross-border payment system has a large market share in the field of blockchain payment. As of May 2023, more than 200 financial institutions around the world have established cooperative relations with Ripple. Banking institutions and remittance institutions such as Bank of America (BOA), Santander Bank of Spain, Standard Chartered Bank, SCB, express fund are all major customers of Ripple. In June, 2023, Ripple recently reached a cooperation with Banco de La Rep ú blica, the Central Bank of Colombia, to jointly explore the use cases of blockchain technology. As the leader of enterprise blockchain and digital cryptocurrency solutions, Ripple has a good development prospect in the field of blockchain payment. In Forbes' 2022 selection of the most valuable private financial technology companies in the United States, Ripple ranked fifth with a valuation of $15billion, and 2023 Ripple was selected into the 2023 Hurun global Unicorn list with a valuation of 105billion yuan, ranking 23rd.

1.2 classification of Ripple cross border payment operation mode

Ripple is a cross-border payment system. Its goal is to connect banks, payment service providers and digital asset transactions, so as to achieve faster and more economical global payments worldwide. Ripple has three solutions, xcurrent, xrapid and xvia. Each solution has its own professional skill direction, which can help solve the difficulties faced by financial institutions and payment service providers in global payment transactions. For example, xcurrent focuses on assisting large banks in handling cross-border payment business; Xrapid focuses on using XRP to solve liquidity problems; Xvia focuses on providing communication network integration services to non-bank institutions and enterprises. From the perspective of whether to use XPR, Ripple cross-border payment solutions can be divided into two categories.

1) Solution based on non-digital cryptocurrency

Xcurrent is a cross-border payment solution optimized by blockchain. It does not involve the use of encrypted digital currency XRP or the conversion with legal tender. It can be installed into the existing payment system of financial institutions in the form of external plug-ins, and will not interfere with the original rights and obligations of all parties in the system. The cost and scope of transformation are small. Therefore, Xcurrent is popular among financial institutions. Financial institutions can optimize the infrastructure of traditional payment system through this solution. At present, most of the financial institutions cooperating with Ripple use Xcurrent.

2) Solution based on digital cryptocurrency

Xrapid and Xvia solutions are based on digital cryptocurrency XRP to provide services. Among them, xrapid is a solution to provide liquidity for payment service providers and build a global currency bridge for on-demand liquidity. Xrapid is based on the use of XRP digital cryptocurrency. Through XRP and XRP consistent ledger technology, transactions can be faster and cheaper. Xvia is a XRP digital cryptocurrency service based on xrapid, which can better help ordinary companies access Ripple for payment. Xvia focuses more on an API standardized interface that allows banks and other financial service providers to interact within the same structure without relying on multi payment network integration. Its purpose is to promote integration and communication between Ripple participants, help financial service providers and ordinary enterprises, and help small and medium-sized

business needs (such as invoices, delivery tracking and payment tracking). At present, the solution based on XRP digital cryptocurrency is rarely used in financial institutions cooperating with Ripple. On the one hand, financial institutions are still cautious about digital cryptocurrency. The main reason is that digital currency is still in the regulatory blind spot in many countries. On the other hand, the commercial implementation cost of this solution is huge.

2 Analysis on the operation mode of traditional cross-border payment system SWIFT

2.1 overview of traditional cross-border payment system SWIFT

SWIFT (Global Interbank Financial Telecommunication Association) was established in 1973. It mainly provides file transmission for financial institutions around the world and provides secure, standardized and automated communication services for payments [8]. As the most mainstream cross-border payment system in the world, SWIFT has played an active role in promoting currency circulation, international financial payments and risk prevention worldwide. Most of the international banks have joined the SWIFT organization, and the global cross-border remittance between countries around the world mainly uses the SWIFT system.

SWIFT system mainly deals with information, which is transmitted among financial institutions through standard messages, and the information flow and capital flow are separated. Each financial institution connects with its own internal capital account system through the information received, and then completes the final capital transfer through the local clearing system. In the process of fund transfer, the financial institution initiating the business generally needs to open an account in the overseas agent bank to deposit a certain amount of reserves, and rely on the reserves account of the overseas agent bank for information flow and fund payment. After all the information flows and capital flows are completely matched and consistent, the fund settlement can be finally completed. If there are more complex remittance paths, multiple agent banks will be involved in the process.

SWIFT system mainly realizes message exchange with peers through standardized messages, so as to complete the information transmission of the entire financial transaction. SWIFT mainly has ten types of messages, including payment message, query message and specific foreign exchange trading, collection and other business messages

2.2 Analysis of SWIFT operation mode

Suppose that company C needs to remit us $1000 from China to customer company D in the United States, company C has a RMB account in Bank C in China, company D has a US dollar account in bank D in the United States, and Bank C and bank d also have a US dollar account in Bank E in the United States, Bank E is the intermediary bank for the business processing of Bank C and bank D, and Bank C, bank D and Bank E are all members of SWIFT organization. The following will elaborate on the traditional cross-border payment business model of SWIFT from the three stages of payment preparation, information interaction and payment settlement.

i) Payment preparation stage

In the payment preparation stage, company C needs to keep enough RMB funds in Bank C in China, and Bank C needs to keep enough USD funds in the account of Bank E in the United States. The specific business operation mode is as follows:

(1) Assume that company C has 8000 yuan in Bank C and company D has 100 dollars in bank D in the United States. Assume that the exchange rate of US dollars against RMB on the day of company C's remittance is usd/cny=7.1540.

(2) Bank C has $10000 in Bank E in the United States, and bank D has $2000 in bank E.

In this payment preparation stage, the account funds of company C and company D are reflected in their respective bank books, and the account funds of Bank C and bank D deposited in Bank E are also reflected in their respective bank books. At the same time, the account books of Bank E will also record the account funds of Bank C and bank D.

ii) Information exchange and payment settlement

Company C officially sent a request to Bank C to remit us $1000 to company D of bank D. the specific business operation mode is as follows:

(1) After receiving the remittance request from company C, Bank C will calculate the RMB required for 1000 US dollars according to the foreign exchange rate on that day, plus the remittance handling fee of Bank C and the

handling fee required by the agent bank in the process of remittance. Generally speaking, SWIFT's cross-border remittance fees are borne by our (remitter), Sha (both parties jointly) and Ben (payee). Assuming that in this case, the remittance service charge is borne by the remitter in the form of our, the bank will charge a fixed service charge, which can basically cover the relevant service charge in the whole process of remittance. Assuming that bank C charges customers 200 yuan for remittance service charge, and the exchange rate is usd/cny=7.1540, a total of 7354 yuan will be deducted from the customer's remittance principal and service charge.

(2) After the deduction of company C, Bank C will send an MT103 message to the agent bank D through the SWIFT system. According to the message format requirements, the receipt and payment information will be completely input into the SWIFT message, in which the agent bank e will be indicated in the message. At the same time, Bank C sent an mt202 message to Bank E, instructing Bank E to transfer $1000 from Bank C's account to bank D. the sender's reference number field of the mt202 message is consistent with the sender's reference number of MT103 to ensure that the two messages correspond to the same business. Generally speaking, Bank C will find the best remittance path according to the deposit bank of the payee. If the agency relationship of the payee bank cannot be determined, the overseas agent bank of Bank C will generally find the best remittance path to reduce intermediate links.

(3) After receiving mt202 from Bank C, Bank E deducted $1000 and $10 commission from Bank C's account and added $1000 to bank D's account.

(4) After Bank E completes the relevant processing, Bank E, as the account bank of Bank C and bank D, will send bills to Bank C and bank D respectively (mt940 or mt950, whether to send mt940 or mt950 messages depends on the services opened by Bank C and bank D. generally, the mt940 bill will carry more information than mt950, and the charging standard of messages will also be higher than mt950). The bill will record each receipt and payment record of the account. For example, the bill received by Bank C will show that $1000 has been deducted from the bill and $10 has been charged. The bill received by Bank E to Bank D will show that a record of $1000 has been received.

(5) After receiving the bill from Bank E on the next day, Bank C will deduct the deposit balance in Bank E according to the billing records and relevant numbers, and deduct the handling charge of $10 (at the exchange rate of usd/cny=7.1540, the conversion handling charge is about 72 yuan), so as to complete all the capital and accounting processing of bank C.

After bank D received the MT103 from Bank C, because bank D and Bank C did not have a direct bank capital relationship, from a risk perspective, bank D could not directly account for company d by virtue of the MT103 sent by bank C. instead, bank D waited until Bank E, the account bank of bank D, matched the information of the bill with the information of MT103, and then accounted for the customer, thus completing all the capital and accounting processing of bank D.

From the above operation mode of SWIFT cross-border business, we can find that the operation mode of SWIFT is serial, and the information flow and capital flow are completely separated in the whole process of business operation. This payment mode of SWIFT is similar to that of Ripple's xcurrent mode. Both of them realize the transmission of payment information through information flow interaction, but the accounting processing is still kept within the financial institutions.

3 Comparative analysis of Ripple and SWIFT

Ripple's cross-border payment mode based on non-digital cryptocurrency is most similar to the SWIFT processing mode of the traditional cross-border payment system. By comparing the differences between the two in business process, account processing mode, compliance supervision and risk control, we can clearly compare their characteristics, advantages and disadvantages.

3.1 comparative analysis of business process

1) Comparison in payment information verification

In the traditional SWIFT mode, when the remitter initiates a remittance, the remitting bank verifies the identity, account and compliance of the remitter, and charges the remitter for the remittance after confirming that it is correct. At this stage, the verification of identity information is usually done manually, and the acquisition and review of customer information is limited to the information stored in the remitting bank's system. On the one hand, the ability of manual screening is limited, on the other hand, the amount of customer related information is also limited, so

there are problems such as low efficiency and unreliable authentication of identity information. In terms of remittance fees, the remitting bank can only specify the fees of the bank, but it cannot accurately judge the receiving bank and the fees involved in the process one by one, especially for the cross-border remittance business that needs to be completed through multiple agencies, the remitting bank can only estimate the total amount of fees, which may or may not cover the fees in the whole process of remittance. When there are additional charges in the middle of the agent bank, which exceed the total fees paid in advance by the customer, it needs to claim from the remitting customer. Under the traditional mode, there are many intermediary banks and links for remittance, and the cost is not transparent, which leads to higher communication costs, reconciliation costs and remittance handling fees of cross-border remittance, and also affects the remittance experience of customers. In Ripple mode, because the receiving and paying banks are all on the same blockchain, the customer information collected and verified by the system exists in the blockchain. The receiving and paying banks have a unified information base for the customer information on the chain, whether it is their own customers or the customers of the other bank, and the information is open and transparent. Both parties can call to verify the customer information at the same time and at any time. In terms of information verification, it can significantly improve the efficiency, avoid the problems of incomplete information and asymmetric information, further improve the security of remittance and reduce the risk of remittance. Due to the point-to-point payment in Ripple mode, there is no intermediary agency of the intermediate agent bank, so the two-point and one-line process is very simple. For the remittance fees of the receiving and paying parties, in the information verification stage, the banks of the receiving and paying parties calculate the corresponding fees and interact at the first time, so that the remitter can know his remittance fees and exchange rate at the first time. The simplification of the process and the openness and transparency of customer information and transaction information have reduced the time and cost of information verification and effectively improved the efficiency of cross-border remittance.

2) Comparison in payment and settlement

In the traditional SWIFT mode, information flow and capital flow are handled separately. Because there are intermediate links of multiple agent banks, the information flow needs to be carried out in series, from the remitting bank to the intermediate bank, and then from the intermediate bank to the final receiving bank, which is a long process. At the stage of fund transfer, the remitter's funds have been deducted at the time of remittance. For the payee, after receiving the bill from the intermediate agent bank, the payee needs to transfer the funds against the debit note to receive the payment. If the intermediate involves multiple agents, the payee's time to receive the funds will be longer. In the traditional mode, there are many links that need to be coordinated and communicated, and the direct impact is high cost, low efficiency and error prone. In Ripple mode, the settlement process is optimized, without the participation of third-party financial institutions. Through point-to-point information flow, the actual remittance cost can be determined when remitting. All transaction settlements are checked online, and the payment is either successful or failed. The information flow is confirmed in parallel. There is no serial confirmation layer by layer. The payment and settlement process is simple and the cost is clear. The reduction of intermediary agencies has reduced the process, reduced the cost and greatly improved the efficiency of payment and settlement.

3.2 Comparative analysis of accounting treatment modes

Under the traditional SWIFT mode, accounting processing is completed within each financial institution. After deducting the customer's funds, the remitting bank will transfer the information flow, and then write off the accounts according to the statement of the agent bank. At least 24 hours will elapse between them. If the account is not issued for a long time, it needs to communicate with the agent bank and then carry out accounting treatment such as account reversal according to the situation. In this mode, the account structure is not unified, there are many intermediate links, and the information is not transparent. For example, only the financial institution has the right to view the relevant accounting treatment, the final transaction information and customer information. Both parties to the transaction do not know the actual information. The accounting treatment is completely subject to the account book issued by the agent bank, and there is the possibility of manual accounting treatment errors and tampering. In the actual business work of the bank, due to the information of each agent bank is not synchronized, the account reversal processing of deduction and cancellation often occurs, and the root cause is that the relevant information is not transparent and public. In Ripple mode, a distributed ledger is used. Through the above payment process and capital flow diagram, it is clear that the transaction information of both parties is synchronized, and the success or failure of the transaction can be confirmed immediately when remitting. All transactions and accounting processing are completed synchronously, and there is no message lag, asynchrony and non-disclosure. Under Ripple mode, on

the one hand, it will greatly reduce the workload of manual reconciliation and improve the efficiency of accounting processing; on the other hand, it will also help reduce the risk of operational risk and accounting data tampering.

3.3 Comparative analysis of compliance supervision effect

Under the traditional SWIFT mode, during and after the capital transaction, it is necessary to submit relevant business information to the company's internal compliance department or external regulatory authority in advance or afterwards, including but not limited to the identity information, remittance information, remittance time, etc. of both parties to the transaction. In the traditional mode, the sources of information are diverse and there are barriers to information, which makes it impossible for regulators to verify the true situation of cross-border transactions and the true information of both parties. In addition, different countries and departments have different requirements and standards for submission, which makes financial institutions need to spend higher time and labor costs in data submission and data storage.

In Ripple mode, all transaction information is online. Blockchain technology, with its characteristics of decentralization, data disclosure, traceability, and tamper resistance, as well as the unique advantages of distributed ledgers, enables regulatory authorities to query and review relevant information at any time, and can automatically screen and execute by setting automated compliance processing conditions and procedures in advance, which can effectively improve regulatory efficiency, reduce regulatory execution costs, and achieve a better regulatory effect.

3.4 Comparative analysis of risk control capability

Under the traditional SWIFT mode, the agent bank has a large amount of customer account information, transaction information and other privacy information, which is relatively easy to become the target of hacker attacks. From the perspective of previous cases, centralized institutions such as agent banks and SWIFT, once the transaction records are tampered with by hackers, are difficult to detect and repair at the first time, and are prone to money laundering, illegal transfer of funds and other risks. In addition, due to the centralized institutional nodes, once the system is attacked, it will face a huge risk of paralysis.

In Ripple mode, Ripple adopts a set of complex and effective methods to ensure network security. First, Ripple is a decentralized system based on distributed ledger, which makes it difficult for hackers to attack. Even if a node is attacked, the synchronization mechanism of distributed ledger will not affect all users; Secondly, Ripple designed a new key system based on the principle of asymmetric cryptography, which can realize the secure communication of data between different institutions; Third, at the transaction level, Ripple uses geometric multiple growth to consume Ruibo coins for malicious attackers to prevent network malicious attacks. These network security technologies effectively ensure the security of Ripple cross-border payment system and improve the risk prevention and control ability of the system.

3.5 Comparative analysis and summary of Ripple and SWIFT cross-border payment modes

1) Ripple's comparative advantages

From the comparison of the cross-border payment operation modes of Ripple and SWIFT, we can find that Ripple has obvious comparative advantages over SWIFT in terms of payment efficiency, payment cost and payment security. In addition to the intuitive comparison of the above payment business processing modes, this paper further comprehensively and deeply analyzes the two modes based on the three major economic theories of the ternary paradox theory, the free currency theory and the transaction cost theory, as shown in the following table:

Table 3-1 comparison between Ripple mode and SWIFT mode

Compare items	Ripple mode	SWIFT mode
verification speed of payment information	fast, the accuracy rate is high	the speed is slow, and the error rate is high
Payment and settlement i	in seconds, 7*24-hour service	1-3 days, non-7*24-hour service
Accounting treatment	Distributed ledger with consistent information and high efficiency	Centralized account, asymmetric information, low efficiency

Compare items		**Ripple mode**	**SWIFT mode**
Compliance regulation		Open and transparent information, low regulatory cost and high efficiency	Information barriers, high regulatory costs and low efficiency
transaction cost	Remittance expenses	Bank charges are low, and blockchain payment is nearly free	Bank service charge + SWIFT telecommunication charge, at least 200-yuan, higher cost
	Search information cost	low	high
	Negotiation decision cost	Information sharing, transparent transaction, low negotiation and decision-making costs	Opaque information and transaction, high negotiation and decision-making costs
	Regulatory costs	Information disclosure cannot be tampered with, and the supervision cost is low	Information and transaction barriers, high regulatory costs
	Execution costs	Compliance and regulatory conditions can be set and implemented automatically with low implementation cost	Manual verification and execution are required, and the execution cost is high
	Trust cost	Decentralized, open and transparent information, build a trust environment and low trust cost	Information barriers exist and trust costs are high
	Join organization cost	Low cost	There are initial installation fees and annual membership fees, which are high
	System maintenance cost	As an open-source protocol, the system maintenance cost is low	There are fixed system maintenance and upgrade costs every year, and the system maintenance cost is high
Ternary paradox		Security and scalability are chosen at the expense of decentralization. It is a multi-centralized alliance chain system	Security and efficiency are lower than those of blockchain, and the system is highly centralized
Free monetization		With XRP digital cryptocurrency	No digital currency
Remittance time		4-5 seconds	24 hours or more
System running time		7*24 hours	Non 7*24 hours
System scalability		It has strong extensibility, and the financial system can be quickly connected with a little transformation	Poor scalability and must be handled according to its rules
Stability of the system		high	higher
System security		Multi center, distributed ledger, high security	Centralized, vulnerable to hacker attacks, resulting in system collapse and low security
Security and privacy measures		Asymmetric encryption technology	Secure login, identity recognition, message encryption
Whether digital currency is supported		support	Not supported
exchange rate risk		There are market makers with short	Long transaction cycle, many links

Compare items	Ripple mode	SWIFT mode
	trading time and low exchange rate risk	and high exchange rate risk
Market share	Low occupancy	High occupancy

4. Conclusions

Although Ripple is superior to SWIFT in many aspects, the market share of SWIFT is still much larger than Ripple. Although Ripple has actually carried out relevant business with major financial institutions and individual users worldwide, there many obstacles which hurdle the fast development of Ripple system. The main barriers restricting Ripple's promotion in the world are as follows [3,9,10]:

First of all, Ripple's entry threshold is relatively low, and it lacks sufficient qualification review. In the face of the existence of false gateways, once users choose the wrong gateway, it will cause large financial losses. In view of the previous situation of frequent and disorderly risks in the development of Internet finance, many countries in the world are making special governance in the financial field, and this part is under strict supervision, especially for issues related to capital security.

Secondly, Ripple payment is separated from the bank account system and has not been audited under the real name system, which is very easy to cause the risk of money laundering. The anonymity and multi-currency exchange of Ripple increase the difficulty of monitoring and is not easy to monitor.

Thirdly, the digital cryptocurrency XRP used by Ripple has not been popularized around the world. XRP plays a major role in Ripple payment, which is cheap and convenient for currency conversion. It is a key part of Ripple payment agreement. However, at present, many nations's regulatory authorities have relatively strict control over the use of digital cryptocurrency, and there are still some regulatory risks in the use of XRP in China's existing market.

Finally, the technology barrier is huge due to the Ripple payment system consumes enormous computing power and storage for a realistic world payment system application which is beyond current information technology of the world and point to the quantum computing and storage technology.

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