Blockchain Whitepaper For Cross-border Trade

Prepared by

Shenzhen OneConnect Smart Technology Co.,Ltd.

PingAn Blockchain Research Institute

February 2019

Table of Contents

Preface

The Trade Facilitation Agreement (TFA) drafted by World Trade Organization entered into force in February 2017, aiming to drive modernization of customs governance, improve business environment, accelerate trade facilitation and promote economic growth. Trade facilitation has become an important goal of development for governments and institutions worldwide, and innovative and cutting-edge technologies are actively tested and utilized to improve trade efficiency and reduce costs.

China has positively responded to the call of WTO and has been exploring the application of emerging technologies such as blockchain technology in cross-border trade. Blockchain is a distributed ledger technology that combines P2P communication, cryptography, consensus mechanism and other technologies. It has several major characteristics: weak centralization, strong data consistency, traceability, immutability and high security, all of which give blockchain strong disruptive potential.

In the past few years, blockchain technology has attracted great attention from countries all over the world: 7 large banks in Europe collaborated to build a blockchain based trade platform we.trade to improve trade efficiency; led by Hong Kong Monetary Authority, several international banks in Hong Kong launched a blockchain trade finance network to solve the pain points in trade finance, lower financial risk and drive trade development; Korea initiated a blockchain based Customs Shipping Logistics Alliance in order to achieve "sense-less" customs clearance, intelligent logistics and paperless office.

Ping An's exploration and research on blockchain started as early as 2015. In 2016, the founder and chairman of Ping An group announced on its executive committee meeting that blockchain will be the focus of Ping An's future expansion. In April of the same year, Ping An officially joined R3 Distributed Ledger Group, and became the first ever Chinese financial institution to join this alliance. Starting from the "seed" of blockchain sown in 2015, Ping An has been continuously honing and developing the technology with practice. By year 2019, more than 3,500 blockchain-related patents are publicized and more than 5,000 applications are filed around the globe, half of which are from Chinese enterprises. Among them, Ping An's blockchain patent applications has reached 441, taking the lead over domestic tech companies.

Under the guidance of the General Administration of China Customs, with the support from Tianjin Municipal government and Tianjin Customs, the Tianjin Port Blockchain Validation Pilot Project officially launched in In August 2018. The project was constructed by Ping An's FinTech subsidiary, Shenzhen OneConnect Smart Technology Co.,LTD, and is the national and even world's leading blockchain application in cross-border trade finance field. A consortium chain was designed for this project to connect the "business circle, logistics circle, financial circle, service circle and regulation circle". In this project, Blockchain technology realizes data rights confirmation and data sharing on the premise of data privacy protection, which eventually breaks the data silo and connects different business data flow in trade finance. Cross-checking of data is made possible, and thus trade fraud can be easily prevented; Supervision is carried out more effectively, and thus overall customs clearance is more efficient. This project aims to achieve the goal of "improving efficiency, raising economic benefits, controlling risk and reducing costs". It will contribute to the ecosystem of cross-border trade, and promote the development of trade facilitation.

Taking this blockchain pilot project as a starting point and combining relevant blockchain application experience, Shenzhen OneConnect Smart Technology Co.,LTD took the lead in the composition of this blockchain cross-border trade whitepaper. This whitepaper proceeds from the pain points in trade finance, showcases the value added by utilizing blockchain solutions, and explores more possibilities when blockchain is combined with other emerging technologies such as AI, big data, etc.

Special thanks shall be given to the World Trade Organization, the General Administration of Customs of China, the Asia-Pacific Model E-Port Network, the Port Service office of Tianjin and Samsung SDS (China) for their great support in the writing of this white paper. This white paper hopes to provide reference for the application of blockchain technology in cross-border trade, and to contribute to the establishment of a trusted global trade connectivity network.

co-CEO, executive vice president, chief information officer and chief operating officer of Ping An

Jessica Tan

1.Background

1.1.Trend in division and cooperation of global trade

The concept of globalization has become widely known since the 1980s due to the in-depth exchange in information, trade, culture and ideas around the world under the drive of the development of science and technology and the improvement of transportation conditions. The authorities led by the International Standardization Organization (ISO) have formulated common global standards, and countries have worked together and formed a multilateral trading system, and trade barriers have been decreasing. The developing and emerging countries play important roles in the global trade and geographically participate in the global trade in diversified manners. Transnational corporations emerge continuously with a rising share in the global trade, driving the globally optimized allocation of factors of production such as land and labor. The process of globalization changes the pattern of world economy and trade visibly, and the international trade network is gradually formed.

The cross-border trade is huge in volume and the global value network is improving. According to the statistical data released by WTO, the global merchandise trade grew at an annual rate of about 7% from the 1980s to 2011, with the total volume of trade reaching $18 trillion in 2011. Impacted by the financial crisis, the global merchandise trade experienced a brief depression, and recovered in 2017, with a small recovery in total volume of trade to $17.4 trillion, and maintained a solid growth trend in 2018. With a huge international trade volume, closely dependent trade between countries, and an increasingly-improved global value network, how to improve the division efficiency and cooperation level of global value chain and maximize the economic welfare of countries also becomes the focus of research in various sectors around the world.

The international supply chain has further subdivided functions, with numerous participants and high specialization. The international trade network covers a wide range of countries, geography and economies. Every single supply chain is being furthered. Under the traditional trade scenario, the importers/exporters undertake a wide range of functions, taking charge of such duties as freight transport, customs clearance, and financing. With a mature international supply chain, the industries in the entire chain continue to subdivide; various types of intermediary institutions have emerged, which serve in the flow of supply chains, such as freight forwarder, customs broker, and commission agent. There are more and more participants undertaking their respective roles with a high degree of specialization. The efficiency of each part of the process has been significantly improved. In addition, in consideration of the numerous participants, it is foreseeable that more emphasis will be placed on multi-party cooperation, coordination and information sharing in the international supply chain in the future so as to improve the overall efficiency of entire chain.

1.2.Main participants in cross-border trade

The international supply chain process is divided by the Buy-Ship-Pay Model, as defined by the United Nations Center for Trade Facilitation and Electronic Business (UN/CEFACT), into three parts: Buy, Ship and Pay. Among them, the Buy process determines the business contract relationship between both parties of a trade, and clarifies the flowing directions of funds and goods. The Ship process is subdivided into five processes, including prepare for export, export, transport, prepare for import, and import. First of all, exporters are required to declare to and obtain export licenses from the customs of the exporting countries, and inspect and count the goods. The Ship process, namely the actual flow of goods, may be entered after all documents are prepared well, which mainly involves various services such as international transport and insurance of goods. It is also required to declare to and obtain licenses from the customs of importing countries before the goods arrive in the importing countries, and the goods can only be released after they are inspected again. The final Pay process mainly involves financial procedures, namely payment for goods, tax payment, insurance claim etc. This process determines the end point of goods flow and drives the actual flow of funds.
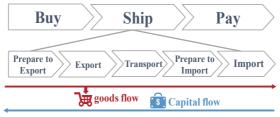

Fig. 1 Buy-Ship-Pay Model

According to the key processes of international supply chain, major participants in cross-border trade may be divided as follows:

- **Buyer:** Importer, payer and consignee as the end point of goods flow and the starting point of capital flow.
- **Supplier:** Exporter, consignor and payee as the end point of capital flow and the starting point of goods flow.
- **Government:** Mainly customs authority, border control, port administrative, Ministry of Commerce, State Administration of Foreign Exchange, State Tax Administration, State Council and other related departments. The government departments are mainly responsible for verifying the authenticity and legality of import and export goods, reducing risks and ensuring that the interests of the state are not infringed.
- **Intermediary:** Transportation service provider and freight forwarder, customs broker, commission agent, etc. serving convenient customs clearance that serves the entire process of the international supply chain. In case that financing is required, such financial institutions as banks and factoring companies will also participate in. Intermediaries play a key role in promoting the operation of information flow, goods flow and capital flow.

The international supply chain is featured by a complex process, numerous documents, numerous participants, longer overall time of customs clearance and high costs. The statistical data of UN/CEFACT show that the average cost of international trade documents accounts for about 5-10% of the value of international trade goods. Each shipment averagely involves 27 trade participants, 40 kinds of documents and 400 copies. As the World Bank's statistical data on customs, in the over 100 countries surveyed, the average time needed for export customs clearance is 7.53 days in 2017. To improve the efficiency of customs clearance and promote cross-border trade facilitation has become the primary goal of customs in all countries.

1.3. Development and status quo of China's cross-border trade

Since China's entry into WTO in 2001, China's foreign trade relationship has been gradually improved, showing a diversified trend of development. According to data released by the Ministry of Commerce, the structure of China's export commodities has gradually shifted from light industry, low value-added raw materials and products to high-value-added, high-tech and finely processed goods and China's position in the global trade pattern is also gradually rising. In accordance with the statistics of General Administration of Customs, P.R. China, the total value of imports and exports of China's trade in goods was over RMB 30 trillion yuan in 2018, with an increase of 9.7% over 2017, reaching a record high. Among them, the general trade import and export grew rapidly, with overall growth in import and export with the major trading partners. The potentials for trade cooperation along the Belt and Road are gradually released, bringing new power for trade development and a better overall trade momentum.

In terms of total trade volume and growth rate, China's trade scale has reached the level of large countries. However, in the Doing Business 2019: Training for Reform released by the World Bank, the index of cross-border trade of China is 82.59 (out of 100 points), ranking 65th in the world, and in the report of Connecting to Compete 2018: Trade Logistics in the Global Economy, the efficiency index of the China's Customs clearance process is only 3.29 (1 point for the lowest efficiency and 5 points for the highest), ranking 31st in the world. This shows that there is still more room of growth for China's cross-border trade. Promoting trade facilitation and improving the business environment on the basis of efficient regulation will have a positive impact on China's import and export trade, thus enhancing China's influence in international trade and energizing China's economic development.

2.Purpose

2.1.Goals and orientations of WTO and WCO

According to WTO's statistics, the global trade growth rate in 2017 was 4.7%, reaching the highest level since 2011. In the context of the slow recovery of the global economy, how to optimize the business environment and cooperate to reduce the global trade friction and promote the further economic growth has become the goal of the major authorities and national governments.

The first of WCO strategic goals is to promote the security and facilitation of international trade, including the simplification and coordination of customs processes. WCO is working with its members (183 members, including China), in enhancing the economic competitiveness so as to ensure a growing economy. Trade security and facilitation is one of the key factors for economic development of nations and is closely tied into national agendas on social wellbeing, poverty reduction and economic development of countries and their citizens.

The WTO is also actively promoting the realization of trade facilitation. The Trade Facilitation Agreement drafted by WTO entered into force on February 22, 2017. The Agreement aims to simplify the documentation required for the customs clearance of goods, coordinate trade procedures and facilitate the cross-border flow of elements. The reduction of time and cost in the course of trade may drive a country to be an important part of the global integrated production chain. Moreover, in the context of global trade slowdown, simplifying trade processes may forcefully promote the development of international trade and the global economy.

2.2.Advanced measures and enlightenment from other customs

To promote trade facilitation has become the mainstream for governments of all countries, and many countries, jurisdictions and organizations are actively cooperating to achieve this goal:

In June 2017, the Directorate-General for Taxation and Customs Union (DG TAXUD) and the International Chamber of Commerce of the World Chamber of Commerce (ICC WCF) jointly launched a blockchain proof-of-concept project. Taking advantage of blockchain technology's immutability and traceability, the project aims to ensure that in the electronic ATA system, all trade documents are authentic and businesses are trackable, which eventually add to the system's credibility.

In November 2017, the Monetary Authority of Singapore (MAS) and the Hong Kong Monetary Authority (HKMA) exchanged a Memorandum of Understanding (MoU) to jointly develop the Global Trade Connectivity Network (GTCN), a cross-border infrastructure based on blockchain technology, to digitalize cross-border trade and improve the transparency, integrity and security of the trade process. The system will also reinforce the interaction between regulators and participants of cross-border trade.

In March 2018, under the support of Inter-American Development Bank (IDB), Costa Rican, Mexican and Peruvian customs have undertaken a pilot project that will modernize their customs operations through Blockchain technology. By exploiting the strong consistency and traceability features of blockchain, the three customs are able to automatically and securely verify their Mutual Recognition Agreements (MRAs), and thus guarantee the efficient execution of the Authorized Economic Operator (AEO) programs.

In 2005, the South Korean Customs successfully developed and applied UNI-PASS, covering seven systems related to customs supervision, namely Export Customs Clearance System, Import Customs Clearance System, Tariff Collection and Management System, Inbound Cargo Supervision System, Outbound Cargo Supervision System, Tax Rebating System and "Single Window" Customs Clearance System. These seven systems are interrelated and coordinated with each other, playing a core role in South Korea's import and export electronic customs clearance. In May 2018, the South Korean Customs initiated a test on a Blockchain-based clearing system, to help over 50 domestic companies validate data and shipments in the import and export processes and improve the efficiency of import and export operations. In September 2018, the South Korean Customs and Samsung SDS planned to jointly set up a Blockchain-based Customs Shipping Logistics Alliance, which provides Blockchain logistics solutions for 38 logistics leaders. By introducing exporters, logistics companies, buyers, shipping companies and air shippers, the Alliance has established a customs service platform, and realized sense-less customs clearance, intelligent logistics, paperless office etc. In the future, financial services such as loan financing will be introduced to the system in the future.

Different countries, customs and organizations actively utilize emerging technologies to improve customs efficiency and reduce labor costs and errors, which gives referential significance to other countries and customs.

2.3.Orientation and goals of Chinese government

Minimization, optimization, improvement, and reduction to promote cross-border trade facilitation

To cope with the trend of international trade facilitation, the Standing Committee of the State Council of P.R. China issued the Work Plan to Optimize the Business Environment for Cross-border Trade at Ports on October 13, 2018, deepen the reform of "Hands-off, Management and Service", further optimize the business environment at ports, and implement more advanced facilitation measures for cross-border trade, so as to promote the sound and healthy development of foreign trade. The key goal of the Work Plan is "Reduction, Optimization, Improvement and Lowering":

- **"Minimization"** is to minimize the number of documents needed for customs clearance. Nowadays, the number of documents required for import and export trade is 86 and 19 departments are involved. It will become the focus of work to reduce the number of documents, promote the electronization of document information, and realize networking comparison and cross-verification.

- **"Optimization"** is to optimize the process. The State Council pointed out the need to deepen the reform of national customs clearance integration, promote one-time joint inspection of customs, border control and maritime, and promote to realize "five-unification": unifying declaration documents, unifying operation system, unifying risk review, unifying instruction issuing, and unifying on-site law enforcement.

- **"Improvement"** is to improve the timeliness. According to the World Bank's statistical data, the average customs clearance time of China Customs is 7.6 days, which is slightly longer than the global average clearance time of 7.53 days. Improving the efficiency of customs inspection and developing multimodal transport, classification and grading customs clearance will become the focus of work for improving the timeliness of customs clearance.

- **"Reduction"** is to reduce costs, that is, reducing the compliance costs at import and export links and promote a more open and transparent business environment at ports.

The Work Plan points out specially that customs ports need to vigorously promote the application of science and technology, improve the electronization of port logistics information, verify the intelligence level, and initially realize the modernization of the port governance system and governance capacity so as to create a more dynamic, more efficient, more open, and more convenient port business environment.

3.Major Issues of Cross-border Trade

In the international cross-border trade, data and information are undoubtedly important elements throughout the business process, and the connection of data flow is essential for the international cross-border trade. However, it is a private and important business asset for all participants because of its important role played in the business, and participants are unable and unwilling to share the data publicly, leading to the formation of data silos.

The data silos in the international cross-border trade separate the data flow in the business process, further resulting in the lack of trust and inefficient process collaboration among the parties due to the lack of information.
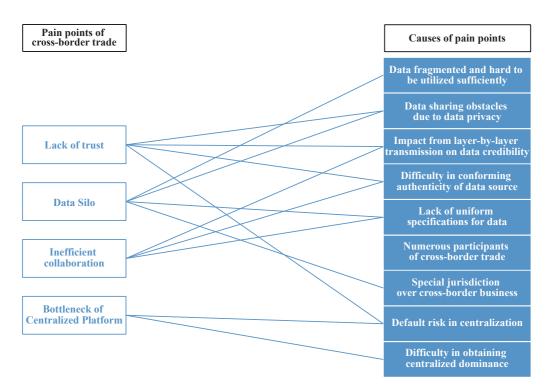

Fig. 2 Major Issues of Cross-border Trade

On the other hand, the large number and complex natures of participants in the international cross-border trade make it difficult for a common database-style centralized platform initiated and operated by an institution or organization to dispel the concerns of participants about data breaches and attribution of ownership, as well as the lack of sufficient dominance and coercive measures for large-scale replication in the traditional mode.

These problems also hamper customs regulation. As a regulator, the customs investigation focuses on the authenticity of the transaction and the legal compliance of the transaction. The lack of data sources and the difficulty in integrating data make the customs supervision difficult and time-consuming, thus reducing the efficiency of international trade and forming a vicious circle.

3.1.Data silo

The international cross-border trade and the corresponding regulatory work are veritable "data-intensive industry", only taking the Chinese Customs as an example, Chinese customs handled a total of 78.14 million inbound and outbound customs declarations in 2017, supervised 4.273 billion tons of inbound and outbound goods, 38.92 million transport vehicles (ships, airplane), 1.37 billion postal express, investigated 3,260 smuggling crime cases. However, the large number of international cross-border trade participants, complex business processes and a wide variety of business characteristics resulted in fragmented data sources, private and sensitive data content, lack of standardization of data formats, resulting in international cross-border trade business data fragmentation and the formation of data silos, which led to data cannot be fully utilized despite its significant values.

Data fragmented and hard to be utilized sufficiently. The data in cross-border trade is generated from different participants in different business

segments, and some of the data is transferred and processed through one or more other links. According to statistical data and calculations by the United Nations Commission on Trade and Development (UNCTAD) and UN/CEFACT, every shipment involves an average of 27 trade participants, 40 kinds of documents and the copies of nearly 400 documents, resulting in a large number of data production sources, complex data flow, traditional data platform facing serious technical challenges in the data collection, aggregation and reconciliation. Taking the port office as an example, the local port offices cannot obtain all the detailed information of customs clearance, only get the statistical average of overall customs clearance time, it is difficult to make targeted improvements to specific data. In addition, the system is closed and not interoperable, the participation subjects involve different countries and regions and other complex factors, leading to a serious data fragmentation, difficult to be utilized sufficiently.

Data sharing obstacle due to data privacy. The data generated and owned by participants in the cross-border trade are generally highly commercially confidential. Therefore, considering information security and their own commercial interests, participants cannot and do not have the will to share data with any third party, especially direct or indirect competitors; thus, it is difficult for data to log on to the platform system, and a block of data silos are formed.

Lack of uniform specifications for data. Although the structured data, such as orders, invoices and declarations, remain an important part of the data field in current cross-border trade, with the application of technologies such as the IoT, the increasing digitization of business is bound to lead to more unstructured, non-standardized data that will pose huge challenges to data connectivity and collaborative utilization.

3.2. Lack of trust

Trust is a pivotal element in the cross-border trade. Logistics, capital flow and data flow in the business need to be sustained by trust. However, in the current cross-border trade environment, relatively few technologies may be used to support trust, but a large number of traditional paper documents, handwritten signatures, third-party custody and other modes, not only cannot effectively reduce the risk of fraud, but also affect the efficiency of cross-border trade processing to a certain extent.

Difficulty in conforming authenticity of data source. In the cross-border trade, data sources, that is, a large number of participants, are distributed in different countries and regional jurisdiction because of cross-border business characteristics, in the absence of a reliable electronic process system, enormous challenges exist if any party in the business chain wants to confirm the authenticity of the identity of the participants in the other links in order to avoid the risk of trade fraud.

Impact from layer-by-layer transmission on data credibility. In the current cross-border trade business, the data sources of a single link in the business chain are often relatively single. Taking customs as an example, most of the data required for its supervision usually comes from trade service providers such as customs brokers, or authorized economic operators (AEOs). However, the data of these enterprises are not obtained once and the data is transmitted layer by layer; thus, the data credibility is bound to be greatly reduced, resulting in information verification links in cross-border trade process needing a lot of time and labor costs.

3.3. Inefficient process collaboration

The entire cross-border trade process involves not only a large number of participants and complex businesses but also cumbersome cooperation in participants and inter-process collaboration. Taking the models developed by UN/CEFACT as a reference, the cross-border trade can be divided into at least 27 major links in the processes of Buy, Ship and Pay. Most of these links involve multiple participants from different countries, and even cooperation between regulatory bodies in different countries. Due to the business particularity of cross-border trade, the absence or problem of any link in logistics, capital flow and information flow may lead to inefficient collaboration of the whole business process, which will directly affect the trade and the efficiency of customs clearance. A system that covers all major links and is capable of achieving a high degree of digitization and automation, together with sound collaboration mechanisms, will contribute significantly to the efficiency gains of cross-border trade.

3.4. Bottleneck of centralized platform

Under the premise that Blockchain Technology is not currently used, almost all technical solutions that enable the digitization of cross-border trade offer centralized services or platforms. Such systems are highly centralized at both technical and governance levels, with each user connected to the center, which have rights and obligations much higher than those of the general party. Moreover, such systems are still featured by low central

ransparency and strong central dependence, and the entire systems will suffer great damages once the center breaks contracts, loses or loses connection. The establishment of the center is also one of the largest challenges that such centralized systems face in their applications. In general business, the role of a system center is usually performed by a regulatory body with coercive means and powers, out of a competitive relationship between ordinary business institutions and their consideration of their respective interests. However, because of the characteristics of cross-border trade, goods flow, capital flow and data flow are bound to involve the jurisdiction of at least two different countries or regions; it is almost impossible for any jurisdiction to refer its own control and ownership of the data flow to other subjects. In addition, the subjects crossing different transactions have very strong diversity and non-regularity, so that the solutions like local protocol or consortium can hardly be realized. The pressures and constraints from business and politics make it almost impossible for any centralized platform, which tries to integrate cross-border trade data streams, to have the corresponding dominance needed to achieve their goals.

4.Possible Technical Solution - Blockchain

4.1.Trend of Blockchain Technology

Since the birth of Bitcoin, discussions around digital money and Blockchain are proliferating. As the underlying technology of Bitcoin, Blockchain has been concerned by academia and the public for its characteristics of de-trust, transparency and security, and many technology companies have also taken Blockchain Technology as its core development technology. In 2016, the State Council of P.R. China first included Blockchain Technology in the "13th Five-Year" Information Planning, marking China's affirmation of Blockchain Technology, encouraging the layout of emerging technologies. Blockchain Technology is developed to the stage of deep exploration.

4.1.1.Blockchain events from 2017 to 2018

- In February 2017, the United States Congress launched the Blockchain caucus to advance favorable public policies based on Blockchain Technology and digital money.
- In April 2017, a Japanese legislation on Bitcoin entered into force. The legislation stated that Bitcoin transactions were subject to anti-money laundering laws, while also classified Bitcoin as a paid payment tool.
- In June 2017, the World Economic Forum published the Realizing the Potential of Blockchain, which analogized Blockchain with the Internet and pointed out that Blockchain is a "brand-new global resource", which will break the original business models and industry rules.
- In June 2017, DG TAXUD and ICC WCF jointly launched a proof-of-concept project to base its electronic ATA system on blockchain in order to increase the system's credibility.
- In November 2017, the MAS and the HKMA exchanged an MoU to jointly develop the Global Trade Connectivity Network (GTCN), a cross-border infrastructure based on blockchain technology, to digitalize cross-border trade and improve the transparency, integrity and security of the trade process.
- In December 2017, the Commonwealth Bank of Australia said it planned to issue bonds on Blockchain systems next year to transfer and disburse operations on a system basis of Blockchain, and has now completed 25 PoC validations and tests to solve actual business problems.

In March 2018, under the support of Inter-American Development Bank (IDB), Costa Rican, Mexican and Peruvian customs have undertaken a pilot project to build an AEO data sharing platform, and the three customs are able to automatically and securely share verified information.

- In May 2018, the Korea Customs Service (KCS) signed a Memorandum of Understanding (MoU) with a number of e-commerce companies to develop, test and conduct transactions on the Blockchain customs platform. The project will test the e-commerce customs clearance platform driven by Blockchain Technology.
- In June 2018, UN/CEFACT, as an agency of the United Nations for global trade development, was testing Blockchain and smart contracts to test the roles they can play. UN/CEFACT recently published a white paper on research into emerging technologies in Blockchain, describing the benefits and impact that Blockchain can bring to the work of businesses and organizations.
- In July 2018, we.trade, a Blockchain trading platform made up of 7 large European banks (Deutsche Bank, HSBC, the Union Bank of Belgium, the French Foreign Trade Bank, the Dutch Cooperative Bank, Société Générale and the United Credit Bank of Italy), was tested for the first time.
- In September 2018, guided by the Hong Kong Monetary Authority (HKMA) and led by a number of international banks, eTradeConnect, a Hong Kong trade financing network was officially launched based on Blockchain Technology, to address real problems in trade finance and reduce financial risks.
- In September 2018, KCS and Samsung SDS plan to establish the Customs Maritime Logistics Alliance to provide Blockchain logistics solutions for 38 logistics leaders. By introducing exporters, logistics companies, buyers, shipping companies and air shippers, the Alliance has established a customs service platform, and realized sense-less customs clearance, intelligent logistics, paperless office etc.

The governments and authoritative organizations around the world not only acknowledge Blockchain Technology, but also continue to invest in and develop Blockchain Technology, so as to promote the real applications and bring real values. In November 2018, the WTO hosted a workshop Blockchain and International Trade: Opportunities, Challenges, and Implications for International Trade Cooperation. Its subsequent report Can Blockchain Revolutionize International Trade? clearly distinguishes Blockchain Technology from Bitcoin and points out that Blockchain has great potential and can be closely integrated with international trade business, not only to promote the transformation of international trade, improve the

operational efficiency of customs-related business, but also to bring new development opportunities for micro and small enterprises in developing countries. According to the forecast of the World Economic Forum, in the coming 10 years, the application of Blockchain will greatly reduce international trade barriers, expand the international trade domain, and bring more than 1 trillion dollars of brand-new markets.

The Chinese government and customs are also actively seeking Blockchain as an effective means of improving the trade business environment and enhancing the efficiency of customs supervision. The application of Blockchain Technology to obtain more source data on transactions and to cross-check data from all parties may help the customs enhance the credibility of the judgment of transaction authenticity, help the customs balance trade facilitation and customs clearance risk control, so as to achieve the goal of "effective supervision, convenient service". On the premise of ensuring the current policy principles, the introduction of new technologies may lead to changes in the way policies and systems are implemented, allowing regulatory processes to be optimized, thereby reducing the institutional costs of enterprises.

4.1.2.Characteristics of Blockchain

The Blockchain is a distributed data structure essentially. Each full node on blockchain contains a full copy of data on chain. When new (trade) data are written to the chain, nodes validate the new data through a consensus mechanism; the data verified to be true is packaged into the block, and each block contains the hash value of the previous block after encryption, forming an "end-to-end" chain structure, hence the name of "Blockchain". The design features of Blockchain endow it with the following characteristics:

Weak centralization. Any node in a distributed ledger system has a copy of all records, and new data written onto chain are verified through an effective consensus mechanism. Therefore, two parties can complete peer-to-peer transactions without the need for trusting each other or third party endorsement. In a Blockchain scenario, there is no strong center to control all the data, and each participant is equal to share the risks while sharing the benefits.

Tamper-proof. Blockchain is append-only, and newly generated blocks are attached to the longest chain and do not affect previous blocks. Because each block contains the hash value of the previous block, if any previous block is forcibly tampered, all the blocks since the tampered block should be replaced to satisfy the hash value change; thus, the possibility of data tampering is almost zero.

Data. There is a timestamp server running on Blockchain that timestamps a block of items and stores the timestamp in a hash value. In the chain structure, each block timestamp includes the timestamp of the previous block, and the time information increases with the height of the block. Combining with the characteristic of tamper proof, the order of the transaction occurrence can be traced. An individual may easily query the transaction time, block generation time, block confirmation time and other information by using the block explorer, making transactions open and transparent.

Cryptography-guaranteed security. An asymmetric encryption method is employed to complete the encryption and decryption process of the public/private key. Only the matching of public/private key may unlock the account value; the private key is saved by the user, and the hacker cannot attack the account as long as the private key is not disclosed. At the same time, redundancy can be used to resist attacks because each node stores all the data in a distributed manner.

4.2.Advantages in application of Blockchain Technology

Since the birth of Bitcoin, discussions around digital money and Blockchain are proliferating. As the underlying technology of Bitcoin, Blockchain has been concerned by academia and the public for its characteristics of de-trust, transparency and security, and many technology companies have also taken Blockchain Technology as its core development technology. In 2016, the State Council of P.R. China first included Blockchain Technology in the "13th Five-Year" Information Planning, marking China's affirmation of Blockchain Technology, encouraging the layout of emerging technologies. Blockchain Technology is developed to the stage of deep exploration.
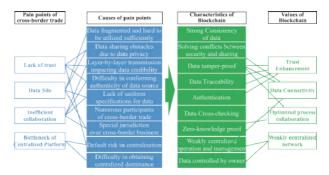

Fig. 3 Values of Blockchain in Cross-border Trade

4.2.1.Data connectivity

The strong consistency of data integrates fragmented data. Blockchain guarantees strong consistency, making it possible for most business participants in cross-border trade processes to participate in the system as data sources. Unlike traditional solutions, data is uploaded by participants on the Blockchain system, validated by a consensus mechanism, and recorded in the "ledger" shared by everyone in the system, eliminating the link between the "respective ledger" data of different participants, greatly improving the efficiency of the consolidation of fragmented data aggregation, and making it possible to systematize the whole process of data. As for customs-oriented regulators, it will greatly enrich the information sources during regulation so as to solve existing problems of single source, layer-by-layer transmission of regulation information and long-distance between regulators and information sources. And on the basis of obtaining additional information sources, we should think about the current regulation ideas mainly based on "points", and explore other more effective regulation modes.

Privacy solutions address the contradiction between data security and sharing. The cryptographic property of Blockchain enables it to provide a wealth of privacy solutions, such as information encryption, decryption authorization and zero-knowledge proof. Compared with the traditional database solution, Blockchain Technology can solve the long-standing contradiction between commercial data privacy secret and commercial data sharing value by technical means.

The information encryption and decryption authorization solutions ensure that all data is encrypted by its owner and that the decryption rights are authorized only to its accredited participants, such as trading partners and regulatory bodies of customs; the zero-knowledge proof solutions may go further, provided that third parties do not need to decrypt the ciphertext on chain and that the data owner does not disclose sensitive information, to realize the verification and judgment of the information on some links, such as the total value of goods, the place of origin, to make full use of the values brought by trade data sharing, and to improve the efficiency of the whole process.

4.2.2.Trust enhancement

The de-trust mechanism provided by Blockchain does not depend on the authentication and credit endorsement of the authority, but only the algorithm commonly recognized by the participants in the chain of trust, and establishes the trust network between the machines by technical means, which changes the way of traditional credit creation.

The information on the chain is tamper-proof and traceable. The Blockchain is tamper-proof, and the traceability of information records makes it impossible for all data, which have been successfully uploaded through consensus validation, to be modified without the knowledge of the individual participants. Even if the information is transmitted layer by layer, trade participants or customs will be able to efficiently verify the authenticity of the data through the Blockchain system, effectively replacing the traditional paper documents, handwritten signatures and other methods, which are relatively easy to forge, but also more attuned to the demands for digital trends in the cross-border trade.

Identity authentication and information cross-checking. While the increase of data providers may enrich the data sources of participants and regulators and reduce the intermediate links in data transmission, it also presents new challenges to party certification and data validation. The introduction of identity authentication and information cross-verification cannot only solve this issue, but also automatically identify the different points in uploading information and trigger early warning through the combination with smart contracts, turn passive detection into active attack, eliminate the risk of fraud from the source, and further improve the efficiency of supervision.

4.2.3.Optimized process collaboration

As mentioned above, Blockchain Technology is featured by strong data consistency, so that the Blockchain system is able to cover the cross-border trade process of all aspects of the participants, open up the trade data flow, and provide the most important foundation for in-depth cooperation of various participants.

In addition, the introduction of smart contract application in some standardized links automatically triggers the implementation of subsequent related businesses when the pre-order data meet the conditions, while improving the degree of automation and increasing efficiency, as well as avoiding the risk of credit fraud and operational risks to a certain extent. It has very broad application scenarios for the establishment of cross-border trade between participants, between the participants and the customs, and even the mechanism of collaboration and communication within the customs.

4.2.4.Weakly centralized network

Due to the complex business and political factors, the cross-border trade system is bound to be a centralized platform, which cannot be initiated, owned and managed only by individual participants. Due to its distributed data structure, data encryption and other technical characteristics, Blockchain has the ability to build a weakly centralized system jointly constructed by the participants. The system should not only be a single platform, but also a system that attracts "heavyweight" participants and has a certain degree of connectivity.

System operation and management. The cross-border trade Blockchain network should adopt a mode that participants jointly participate in recording information and validating on-chain information through a consensus mechanism. Due to the distributed data structure of Blockchain, the system will not be affected on stability and functionality due to default, loss, or loss of connectivity of an individual participant. Some of the necessary operational work, such as the access of consortium chain participants, the update and adjustment of consensus mechanism, can be used for some of the existing Blockchain network adopted by the committee mode; the necessary and transparent management not involving specific data flow should be carried out by the UN/CEFACT and other third party organizations.

Data ownership and use rights. All data on the cross-border trade Blockchain network system should be encrypted and uploaded, and the data owner has the authority to decrypt and authorize other participants to decrypt it. The zero-knowledge proof technology shall be combined to maximize data values through data sharing, optimize cross-border trade facilitation and regulation efficiency, while ensuring ownership and corresponding benefits for data owners to encourage more participants in cross-border trade to join the system.

5.Overall Design of Blockchain Technology Applications

With the gradual emergence of the values of Blockchain Technology, the regulators, financial institutions and commercial companies of all countries and regions have increased the applications of Blockchain. However, there are some limitations in the various applications, both in the business field and in the regional coverage. If existing and future Blockchain networks are able to integrate with each other in a framework of uniform standards, the total value that a converged network can create is much greater than the sum of the values created by the networks alone. Under this premise, it will be meaningful to put forward the overall design model of the applications of international trade Blockchain Technology. After continuous iteration and improvement, the model may also be used as a reference for the overall design of Blockchain Technology applications in other business areas.
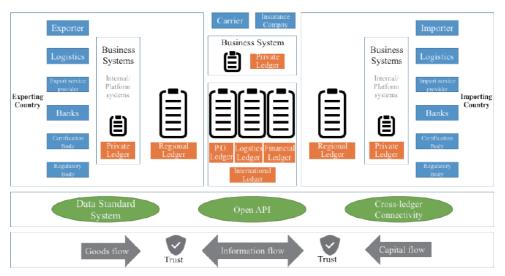

Fig. 4 Blockchain Application Model

5.1.Overall architecture

Fig. 4 depicts the overall framework for applying Blockchain distributed ledger technology to international trade services. This figure is based on all business participants and the business relationship between them, and overlays the distributed ledger of the Blockchain, to demonstrate the help that Blockchain Technology may bring in the transmission of information, the establishment of trust, and the collaboration of processes. Some of the instructions related to this framework diagram are as follows:

All participants in this example use one or more systems to do their business; the systems may refer to the internal ones (such as ERP systems and TMS systems) of a single organization, or to the Internet online platform system provided by others.

Through the establishment of passages between various layers of networks and cross-layer networks, data may be agreed upon and synchronized in the ledgers of these networks, resulting in the data flow between different systems and different participants.

Participants are provided with identification by various identity authentication providers when participating in the Blockchain network to clarify the credibility of the trust carrier and single-source data in the Blockchain network. In addition, after cross-checking of data from multi-parties has been completed in a certain business (such as the three-flow (the full set of goods flow, capital flow and information flow) touch in a cross-border trade business), the credibility of the relevant data may be enhanced as a whole.

The systems may automatically drive business processes or notify relevant participants to participate in driving business processes based on specific business logic within the application, according to the data obtained from the ledgers at all levels. All participants may also drive business processes by embedding smart contracts in regional Blockchain networks or international Blockchain networks that trigger smart contracts by updating data in the ledger or related status. Either system assistance of these methods helps switch business processes from a concatenated manual propulsion mode to an automated, parallel business collaboration mode, and then improves process efficiency and reduces operating costs and operational risks.

The construction of the overall architecture and the smooth operation of the business based on this architecture depend on the support from the following three aspects: the establishment of a data standard system, the creation of open interface, and the support of cross-ledger connectivity.

5.2.Data standard system

In the business area of cross-border trade financing, whether it is the paper document used before informationization or the use of EDI or Internet-based electronic documents after informationization, there are data standard systems in different levels, such as:

  • The international data standard system, such as 35 proposals, 7 sets of standards and 5 sets of technical specifications issued by UN/CEFACT so far from 1981;

  • The regional data standard systems, such as China's international trade document standard system, which is composed of the standards for general information, data meta-class standards, as well as document format and data meta layout;

  • As the link between business and data, the enterprise internal data standard systems help enterprises open up the data between internal departments, improve the efficiency of enterprise production and operation, and even fully realize the Big Data strategy.

The application of Blockchain network hopes to break the data silos between different systems through distributed ledger technologies. However, if the data is presented in a non-standard and non-uniform form in different Blockchain networks, these more refined data will only pose a greater challenge to other participants' understanding in the actual business.

Therefore, the data standards of own ledgers shall be established for the Blockchain network at all levels according to the data standard systems of the above-mentioned different levels from top to bottom.

5.3.Open interface

The data is stored in the various ledgers of the Blockchain network, so the two major issues below need to be considered:

How to write data into the ledger under the data standard system

Standardized API may be considered as a way for each level of ledger to execute a data standard system, so designers of Blockchain networks at all levels of the architecture need to complete the design of the interface according to the data standard system to ensure the understanding and usability of the data in the ledger.

How to use the data in the ledgers

The use of data involves two ways: one is to fetch data in the ledger into the application system through API, and the data is used by the application System program; another is to invoke Blockchain network smart contracts through API, such as combining with the zero-knowledge proof technology to verify data in the ciphertext state, and the data is used by logic on the Blockchain.

5.4.Cross-ledger connectivity

Based on the study on existing Blockchain application networks, ledgers may generally be categorized from two dimensions:

1）Categorized based on the geographic scope covered, such as:
  • Private ledger;
  • Regional ledger; and
  • International ledger.

2）Categorized based on the business segments focused, such as:
  • Orders and commercial invoices may be recorded in the trade financing business ledger;
  • The waybills and shipping data may be recorded in the logistics business ledger; and
  • All types of licenses and declaration documents may be recorded in the ledger of administrative and supervisory business.

Therefore, each sub-process data of cross-border trade are likely to be fragmented across all categories of ledgers at all levels in its initial state. All the trade or service participants who wish to use data to advance business processes and financial or regulation participants who wish to use data to validate transactions all hope to find a way to integrate data across the ledgers, so that the data from each level and in each segment may be integrated with each other, thus bringing more and more application values.

5.5. Information security

In the context of cross-border trade, cross-ledger connectivity usually means that information flows across borders. However, information security is an important part for safeguarding national security in the era of rapid development of information technology. Therefore, in the overall design of Blockchain Technology applications, how to deal with the relationship between privacy and sharing of information, closure and opening, application and protection, security and development, is a common challenge to all countries.

The challenge of information security may be addressed in the following 3 aspects:

- To develop cross-border regional or international information security standards and codes of conducts;
- To develop cross-border regional or international information security laws, regulations or international conventions; and
- To meet five major characteristics of information security, namely confidentiality, integrity, usability, controllability and non-repudiation, in the selection of Blockchain Technology.

5.6. Applications

Designed according to the Blockchain Technology solution, ideally, a Blockchain-based trade customs clearance system is a distributed database network; the core participants (such as importers, exporters, government agencies, banks, and logistics) join the network as nodes; they encrypt and upload their own data based on unified data standards, and possess ownership and control rights over the data. The data of each business link is recorded in the form of ciphertext in distributed ledgers at all levels, and when any of the network participants request to view the relevant business data based on reasonable business requirements, the data owner may authorize the decryption to enable data sharing. For example, in factoring business, exporters may authorize banks to view relevant order information for faster financing approvals. For information no decryption authorization may be obtained for, the Blockchain network may also provide zero-knowledge proof algorithm technology to verify data authenticity.

When the data and status of each business sub-process are connected through, all participants may respond to the business process timely, and even automate the processing with the help of their own business systems and smart contracts on the Blockchain network. For example, logistics companies may automatically generate export declarations based on consolidated information of waybills, information of authorized invoices, information of authorized certificate of origin, and so on, so as to simplify the original complex process and improve overall business efficiency.

Since the Blockchain networks at all levels and the distributed ledgers they generate are shared by the participating subjects, any participant may delegate the data at their disposal to the targeted authorization according to their own needs and wishes. Although the data flow and the way data are used reflect regulatory and regulated and other similar power relationships, it does not mean that the subject with higher power in the business has higher power over any Blockchain network, its ledger and the data on the ledger at the technical or operational level. The characteristics of weak centralization may not only help the participants reduce the barriers to participation, but also bring about a relationship of mutual trust to attract more participants to join, thus contributing to the formation of the scale of network.

Please see the Appendix for more detailed case explanation so as to help understand the overall framework design of Blockchain Technology applications and the values that Blockchain Technology may bring to cross-border trade.

6.Prospect

6.1.Combination of Blockchain and other technologies

6.1.1.IoT and edge computing

The Internet of Things (IoT) is the network of physical objects—devices, vehicles, buildings and other items—embedded with electronics, software, sensors, and network connectivity that enables these objects to collect and exchange data. Edge computing refers to technologies that are physically close to the data generation end and provide data processing and services nearby for faster response. The introduction of IoT and Edge Computing technologies, combined with Blockchain Technology, will bring a wider range of technical application space for cross-border trade and corresponding regulation.

Combination with Blockchain Technology. While the IoT technology and applications are growing rapidly, the following four major bottlenecks remain:

- Device security: The IoT is of a large scale with many devices, presenting new challenges to network security, and network security incidents like "Zombie IoT" are emerging;

- Data privacy: At present, there is a lack of a perfect encryption solution for IoT data, and it is difficult for central managers to self-certify their innocence and the security concern occurs when data are leaked;

- Structural rigidity: The number of devices on the network will grow geometrically along with the evolution of the IoT technology, and it is unaffordable for the centralized management architecture;

- Multiple-party collaboration: At present, IoT data are mainly stored in internal systems, and the cost of establishing credit to achieve connectivity between systems is relatively high.

The introduction of edge computing may effectively solve the bottleneck of architectural rigidity. Edge computing may compute and process data and information at the local or edge end, greatly reducing bandwidth pressure; meanwhile, the flexible edge computing architecture enables rapid on-demand scaling.

However, while the introduction of edge computing solves the architecture problem faced by IoT, the security, privacy, and collaboration of the system still need to be addressed through a combination with Blockchain Technology:

- Identity authentication: Blockchain, especially the access verification and consensus mechanism of the consortium chain system, will help avoid the access of malicious nodes;

- Privacy protection: Blockchain may provide a complete encryption and sharing solution, and the ownership and use rights of all data in the system may be guaranteed on demand;

- Weakly centralized architecture: The distributed database characteristic of Blockchain makes the network do not need to set up an independent center for data processing, improving the maximum scale of the network;

- Inter-system collaboration: The Blockchain solution may solve the contradiction between data privacy and sharing, breaking the data silos between systems, and maximizing the values of data.

Optimization of data flow of cross-border trade. The combination of IoT and edge computing with Blockchain Technology will enable data flow of cross-border trade to be fully optimized from a variety of perspectives, including scale, quality, and acquisition efficiency.

In terms of data scale, in the horizontal dimension, the introduction of the IoT and edge computing may digitize information (such as the presence and displacement of goods in the customs supervision areas), which was previously difficult to be digitized, enrich the breadth of the data flow; in the longitudinal dimension, the real-time monitoring capability of IoT sensors and the fast processing capability of edge computing may also improve the accuracy of data flow by turning data previously recorded only by "points" (such as ship-to-port records) into "real-time" data such as (ship trajectory and state records).

In terms of data quality, it may increase the difficulty and cost of counterfeiting to a certain extent and reduce the risk of fraud because it is collected directly into the Blockchain system through the IoT sensor, and the data become tamper-proof.

In terms of data collection efficiency, the data of each link are directly collected and uploaded by the sensor device of the Internet of thing, which replaces the traditional manual input, greatly improves the efficiency and reduces the possible risk of input error, and may be combined with the smart contract for realizing dynamic supervision and active collection of abnormal information. The application of edge computing may complete some high-timeliness data processing at the edge end, significantly reducing the delay caused by centralized processing and bandwidth problems (such as

the electronic seine system in the customs supervision area, which may dynamically supervise the trajectory of the goods, and actively collect the conditions, under which goods deviate from the designated route).

6.1.2. Big Data and AI

Big Data and AI are often mentioned at the same time. Big Data is a massive data set with multiple forms and complex sources, and the traditional data processing mode cannot completely digest its huge amount of information, while AI provides a flexible and intelligent data processing and analysis solution for Big Data, which fully excavates the value of data and frees up the potential of data. Moreover, the evolution of AI also requires a large amount of data input, as it may become more and more "intelligent" through the analysis of huge data. Big Data and AI complement each other and are considered to be the future of data development.

The "Big Data + AI" mode will play an important role in the international supply chain and customs-related data-intensive industries. The combination of the two and Blockchain may not only solve the existing defects, but also stimulate a strong collaborative effect:

Blockchain + Big Data

Big Data is essentially a set of multiple types of data; the number and quality of data sources determine the values of Big Data; it is difficult to produce Big Data with values in case of single data source and poor data type. As for the application of Blockchain in the customs scenario, the characteristics of its distributed database may integrate the trade participants' multiple fragmented data, solve the problem of data fragmentation, and ensure the diversification and high quality of Big Data. Its strong consistency may ensure the timeliness of data integration and improve the efficiency of data analysis.

Blockchain + AI

The combination of Blockchain and AI also offers space of imagination. An important technology in Blockchain is named as a smart contract, which means that developers want technology to intelligently analyze the business and automate the overall process. At present, the smart contract technology remains in the early stage and can only handle the business logic with simple conditions and cannot be applied practically. If AI and Blockchain are integrated organically, or may further empower the customs business scenario, deeply optimize existing processes, free up the workforce and bring more values.

Application Scenarios

With the combination of Blockchain, Big Data and AI Technology, the following application scenarios in the future are expected:

- Intelligent Customs Clearance. Applied to optimize the customs import and export processes, improve the timeliness and accuracy of detection on illegal customs clearance items through intelligent analysis, and then improve the efficiency of import and export goods inspection;

- Intelligent Risk Control. Applied to establish enterprise portraits for different import and export enterprises with massive data, organically combine with the current enterprise credit grading system of the Customs, set up a predictive enterprise credit evaluation model and a risk analysis model, and provide more comprehensive information and more reasonable means of evaluation.

- Industry Signpost. Applied to provide the industry with the signpost of future development, and provide references for the country to formulate corresponding policies by dynamically monitoring quantities, types and amounts of imported and exported goods and collecting the information and intelligence related to the commodity industry and enterprises.

6.2. Globally-connected trusted trade network

Necessity for Network Connectivity. In the context that Blockchain Technology is maturing and applied, more and more participants, whether they are between different longitudinal links within the cross-border trade process or between different horizontal participants /consortiums in a segment, have begun to try to build a Blockchain system dominated by themselves. Although Blockchain has a characteristic of weak centralization and is more open than traditional platforms, it is still difficult to develop a single Blockchain system, which can cover all cross-border trade operations around the world due to commercial competition and political complexity.

Meanwhile, a system initiated by a participant or a consortium is usually relatively closed and difficult to attract participants of the same volume as the system's dominant party, resulting in the fragmentation of the overall data flow and the inability to realize the full values of the data. Therefore, it is extremely important to facilitate the global cross-border trade by realizing the connectivity between Blockchain systems and the connectivity between Blockchain systems and traditional non-Blockchain systems.

Trend of Network Connectivity. The governments around the world are actively seeking the possibilities for combining with Blockchain Technology.

- The Singapore Government is working with the HKMA to jointly develop a Global Trade Connectivity Network (GTCN) to link the National Trade Platform (NTP) of Singapore and the Hong Kong Trade Finance Platform (HKTFP), apply Blockchain Technology to facilitate the cross-border flow of trade data and achieve the three-flow integration of international trade network.

- China Customs promotes the development of Blockchain pilot projects, explore Blockchain in view of the general cargo import business of airport and Class B express import business scenario, and makes effort to enhance the transparency and efficiency of the supply chain and improve the overall business environment at the port. China Customs also plans to exchange with other customs platforms in the future, so as to bring collaborative effects to all participants.

Predictably, the global trade network is covering a wider and wider range, the network participants will become more and more closely connected, a number of different Blockchain platforms will gradually be connected, and all countries' customs, financial institutions and other government departments will jointly promote this process and jointly build a trusted Blockchain network of connectivity.

Appendix: Case Study on a Hypothetical Business

A complete business process based on Blockchain customs clearance is described below, describing how milk powder is exported from Germany to China. The names of the companies in the case are fictitious and do not represent any real organization.

- Milchpulver GmbH, a milk powder manufacturer, is a company registered in Germany.

- Milchpulver and Tianjin Fangxin Milk Power, a Chinese milk powder importer registered in the Tianjin Administration for Industry and Commerce, reached a trade agreement by negotiation. Milchpulver wrote the electronic information of above-mentioned trade agreement to the international cross-border trade Blockchain network ledger based on the data standard system (hereinafter, similar information writing processes are simply referred to as the "information upload"; the information may be written directly to the international ledger by the enterprise through the system it uses, and also may be "integrated" into the upper level of the international ledger through the regional ledger in the way of cross-ledger), and authorized Tianjin Fangxin Milk Power at the same time (the information written to the ledger is encrypted by default and only data owners and authorized principals may decrypt and read the plaintext); Tianjin Fangxin Milk Powder completed electronic signature and the information was stored on the Blockchain in order to prevent tampering by either party.

- Milchpulver produced a batch of milk powder on October 20, 2018, 1,000 cans in total. Milchpulver applied to and obtained the certificate of origin from the IHK Chamber of Commerce in Germany. The IHK Chamber of Commerce uploaded the electronic information of the certificate of origin and authorized to Milchpulver GmbH. The IHK Chamber of Commerce has a CA certificate issued by an international certified company in the international cross-border trade Blockchain network, and any entity authorized to inquire may identify the official attributes of that certificate of origin through a check-up.

- Tianjin Fangxin Milk Power issued a purchase order to Milchpulver on October 21, 2018, intending to order the above-mentioned batch of milk powder. Tianjin Fangxin Milk Power uploaded the electronic information of the purchase order, and authorized to Milchpulver GmbH.

- Milchpulver made a sales order in its internal ERP system based on the purchase order, and completed the shipment, and then generated a commercial invoice and a packing list. Milchpulver uploaded the information of the commercial invoice and the packing list, and authorized it together with the certificate of origin to the freight forwarder MRT Logistics.

- MRT Logistics completed a series of logistics arrangements based on the information of the commercial invoice and the packing list, such as booking, and generated a waybill. MRT Logistics uploaded the information of the waybill and authorized to Milchpulver.

- Milchpulver purchased insurance for cargo transport from an insurance company, and obtained the authorization of policy information.

- Tianjin Fangxin Milk Power obtained the authorization of a full set of electronic trade documents from Milchpulver, and reauthorized to Tianjin Customs and freight forwarding provider Suto Logistics.

- MRT Logistics automatically generated an export declaration form based on the information of authorized invoice, packing list, certificate of origin and self-owned waybill, and completed the declaration through the German Customs Declaration System, while authorized the electronic information of all the documents mentioned above to the German Customs.

- The German Customs audited the export declaration based on the accompanying electronic documents and released the business.

- After the cross-border carrier updated the departure status, the smart contract in the Blockchain network was triggered, and the smart contract automatically generated an import declaration form based on the electronic information of full set of trade documents obtained by Suto Logistics; meanwhile, it notified Suto Logistics the current logistics status of goods, and prompted to prepare for the import declaration.

- After Suto Logistics completed the import declaration through a single window, the automatic audit procedure of Tianjin Customs completed a multi-dimensional cross-verification on the information of the import declaration form according to the information of accompanying electronic documents, confirmed the trade authenticity of the business and judged it as a low-risk business, and finally gave a pre-clearance suggestion.

- Customs clearance was quickly completed after goods arrival and cargo handling.

- Tianjin Fangxin Milk Power authorized a full set of electronic trade documents together with the customs clearance certificate authorized by Tianjin Customs to the Bank of China, and put forward financing applications for trade payment. The Bank of China invoked the preset zero-knowledge proof algorithm and confirmed that Tianjin Fangxin Milk Power had not obtained trade financing services (other banks would not disclose any customer's information and related financial business information to the Bank of China in the principle of protecting business interests) through other banks based on the trade business in the Blockchain network. At the same time, based on the complete trade information above, the Risk Control System of the Bank of China gave a low-risk rating results on the financing application and eventually the Bank of China released the trade financing funds on very favorable terms rapidly.

Crypto-controlled data sharing

Milchpulver	IHK Chamber of Commerce	MRT Logistics	Insurance Company	German Customs	Carrier	Customs-bonded Warehouse	China Customs	Suto Logistics	Fangxin Milk Powder	Bank of China
P.O. Invoice Packing List	Certificate of Origin	Waybill	Insurance certificate	Customs clearance receipt	Waybill	Tallying information	Customs clearance receipt	Logistics information	P.O.	Payment info Financing info

Blockchain Network

Fig. 5 Relationships of Businesses on Blockchain Network