Journal of Korea Trade Vol. 23, No. 6, October 2019, 113-130
https://doi.org/10.35611/jkt.2019.23.6.113
ISSN 1229-828X

Applicability of Blockchain based Bill of Lading under the Rotterdam Rules and UNCITRAL Model Law on Electronic Transferable Records

JKT 23(6)

Received 4 September 2019
Revised 1 October 2019
Accepted 22 October 2019

Jung-Ho Yang†
Department of International Logistics and Trade, Jeonju University, South Korea

Abstract

Purpose – This paper investigates applicability of blockchain based bill of lading under the current legal environment. Legal requirements of electronic bill of lading will be analyzed based on the Rotterdam Rules and recently enacted UNCITRAL Model Law on Electronic Transferable Records. Using comparative analysis with the previous registry model for electronic bill of lading, this paper examines the advantages of blockchain based bill of lading.

Design/methodology – This research reviewed previous efforts for dematerializing bill of lading with its limitation. Main features of blockchain technology which can make up for deficiencies of registry model also be investigated to analyze whether these features can satisfy the requirements for the legal validity of the negotiable electronic transport record or electronic transferable records under the Rotterdam Rules and the MLETR.

Findings – Main findings of this research can be summarized as follows: Blockchain system operated in an open platform can improve transparency and scalability in transfer of electronic bill of lading by assuring easy access for transaction. Distributed ledger technology of blockchain makes it more difficult to forge or tamper with transactions because all participants equally shares identical transaction records. Consensus mechanism and timestamp in a blockchain transaction guarantee the integrity and uniqueness of a transaction. These features are enough to satisfy the requirements of electronic transferable records under the Rotterdam Rules and MLTER.

Originality/value – This study has significance in that it provided implications for the introduction of electronic bill of lading by analyzing whether the blockchain based electronic bill of lading model meets the legal requirements under the current legal system prepared prior to the introduction of blockchain technology, and by presenting the advantages of the blockchain based bill of lading model through comparative analysis with the existing registry model.

Keywords: Blockchain, Electronic Bill of Lading, Electronic Transferable Records, Rotterdam Rules, UNCITRAL Model Law
JEL Classifications: K15, K22, K33, O33

1. Introduction

The recent increase in e-commerce due to advances in IT technology has improved the speed and efficiency of international transactions through changes in communication and transaction methods. However, paper based inefficient transactions still be continued in the shipping industry. The bill of lading, which is one of the most important documents used in international transactions today, is an paper document that still has to be physically delivered along with the shipped goods. The main reason is that the negotiable paper bill of lading, which has long been recognized its legal effect as transferable paper document, plays a key

†**First and Corresponding author:** y4381@jj.ac.kr

role in the international shipping. The practical problem with paper bill could be solved by technical solutions that digitalize the transaction process performed by bill of lading. However, over the past few decades, there has been various efforts to dematerialize bill of lading, but it has not been successful. Lack of legal basis to support the use of electronic bill of lading, and controversy over the registration system model to identity the holder of electronic bill of lading caused uncertainty to the use of electronic bill of lading. Blockchain based electronic bill of lading models also have considerable legal uncertainty.

This paper examines whether the application of new solution based on blockchain technology could provide new possibilities for the digitalization of bill of lading under the current legal environment. To this end, the applicability of blockchain based electronic bill of lading will be analyzed based on the legal requirements under the Rotterdam Rules and recently enacted UNCITRAL Model Law on Electronic Transferable Records along with the limit of the existing electronic bill of lading model operated by central registry.

Blockchain technology has recently begun to be discussed but is acceptable for transactions in electronic bill of lading if it meets the basic requirements of the previously enacted Rotterdam rules and the UNCITRAL Model Law on transferable electronic records. In this regard, we will review whether blockchain based bill of lading could be a functional equivalence which recognize the same legal effect as traditional paper bill of lading.

2. Previous Attempts for Dematerializing Bill of Lading

2.1. Closed System based on Registry Model

So far, attempts to dematerialize the bill of lading have been operated in a closed system based on central registry managed by trusted third party. It require users to obtain access to the registry through a contract not only with service provider but also with other users in advance.

The bolero system, for example, supplement the legal gap through a multilateral contract called the Bolero Rule Book. This provides a set of rules necessary for the BBL to be recognized as having the same effect as a paper bill of lading. The Bolero Rule Book has legal effect between the parties to the contract to the extent that its contents do not violate the enforceable laws. The legal effect of the Bolero Regulation is limited to users of the bolero system. In other words, the rights of the paper bill of lading holder are granted by law or custom, whereas the rights of the BBL holder are recognized by contract between users of the bolero system (Yang Jung-Ho, 2002).

Under the registry model, the identity of the owner of the electronic transferable record is contained in a separate independent third-party registry. Electronic transferable records managed in the registry system contain only reference to the location of the registry where the information to identify the controlling party can be found. It cannot be possessed and is not recognized as a symbol such as the key to open the warehouse. Instead, it uses the control concept to identify the holder. This approach involves identifying the person who can exercise the rights embodied in the electronic transferable record. In this kind of system, the concept of control and the associated concerns regarding security focus primarily on the registry rather than the transferable record itself (UNCITRAL, 2011).

2.2. Limitations of Registry Model

2.2.1. The Scope of Negotiability

The registry model has limitations in that the scope of negotiability of the electronic bill of

lading is limited to members who subscribe to the system. All parties involved in the transaction should be a member in order for the seamless transaction to be made by such a system. If a person who does not join the system as a member participates in a transaction, the electronic bill of lading procedure needs to be converted to a tangible paper bill of lading. Therefore, the scope of the electronic bill of lading is extremely limited. The closed system, which operates limited to registered members, is barrier in the practical use of electronic bill of lading to the extent that the lack of readiness of trading partners pointed out among the biggest obstacles to electronic bill of lading in the UNCTAD survey (UNCTAD, 2003). The main concern of international shipping industry about a central registry system seems whether such a system could work on a large scale as well (Underhill and Bibby, 2016).

Table 1. Obstacles to the Use of electronic Alternative

Obstacles to the use of electronic alternative (more than one answer possible)	**(% of respondents)**
Infrastructure/market/trading partners not yet ready	51
Legal framework is not clear enough or is not adequate	44
Electronic equivalents are not sufficiently secure	25
Technology and/or switch to electronic environment is too costly	12
Confidentiality concerns	10
Other reasons	2

Source: UNCTAD (2003).

Goldby (2013), citing this survey, comment that 'even once membership is obtained, the user may be trading with non-members, which would prevent the user from benefiting from the investment.' While such a conversion may be necessary to clearly satisfy the legal concept of negotiable bill of lading, if the scope of negotiability is broad enough to all or most of the participants in the relevant transaction to be members, the likelihood of having switch electronic bill of lading into paper bill of lading will be decreased. However, none of the existing platforms for electronic bill of lading seem to have succeeded in reaching a critical mass in their membership, with paper bill of lading still prevalent in world trade (Takahashi, 2016).

2.2.2. Possession Requirement

Ong (2018) argue that the registry model is not compatible with transferable documents such as bill of lading in that the transfer of control of an electronic record between the parties is made not by delivering an electronic record but by changing the identity of the controlling party in the registry. The claim delivery of the shipment at the destination and the claim damages against the carrier is granted under the possession of the bill of lading and the transport contract. Thus, a person who has control of electronic records in the registry model cannot claim delivery of the shipment or claim damages under the contract of carriage. The claim delivery of the shipment at the destination and the claim damages against the carrier is granted under the possession of the bill of lading and the transport contract. Thus, a person who has control of electronic records in the registry model cannot claim delivery of the shipment or claim damages under the contract of carriage.

The title to the cargo shipped represented by documents of title such as bill of lading are generally allowed by the physical possession of a paper documents. Electronic bill of lading under the registry model grants the rights to the goods by the control of the electronic record maintained in the registry. A universal solution to give legal effect to electronic bill of lading

operated by a registry model is that the control over the electronic bill of lading is considered to have the same effect as the possession of paper bill of lading. This solution has been adopted by a number of legal regimes such as the Rotterdam Rules, and more recently, the UNCITRAL Model Law on Electronic Transferable Records. The technology of maintaining electronic transport records is based on the basic purpose and main function of paper bill of lading to recognize the electronic bill of lading same as a paper bill of lading. However, this approach could unintentionally interrupt existing legal concepts and approaches underlying the primary paper bill of lading although it was inevitable choice because there was no way to technically implement physical possession of paper documents (UNCITRAL, 2011).

The failure of previous efforts to digitalize bill of lading relates to the fact that such attempts have simply intended to replicate a paper bill in an electronic form. The controversy about new electronic bill of lading system continued because they attempt to replicate paper based processes that does not easily allow itself to a legitimate electronic form (Bury, 2016).

2.2.3. Unilateral System Operations

The registry model identifies the controlling party to the electronic bill of lading in a registry system managed by an independent third party. The creation, issue and transfer of electronic bill of lading is based on the information sent to and recorded in the central registry. This requires careful management of the system to verify the integrity of electronic records stored in the registry. The transfer of title under the CMI rules is only possible through the cancellation of the previous private key and the issuance of new private key to the new holder by the carrier who act as the central registry. This structure leads to unreasonable results to the carrier because the carrier have to assume liabilities in connection with a breakdown and failure of the system irrelevant to obligations under the contract of carriage. In other words, the registry model place a disproportionate burden on carriers. Thus, it is understandable that carriers reluctant to agree to be bound contractually to CMI Rules. In addition, commodity traders concerned about the potential for the competitors and tax authorities to access their transaction information in that trusted third party authorized by government operates registry models (Bury, 2016).

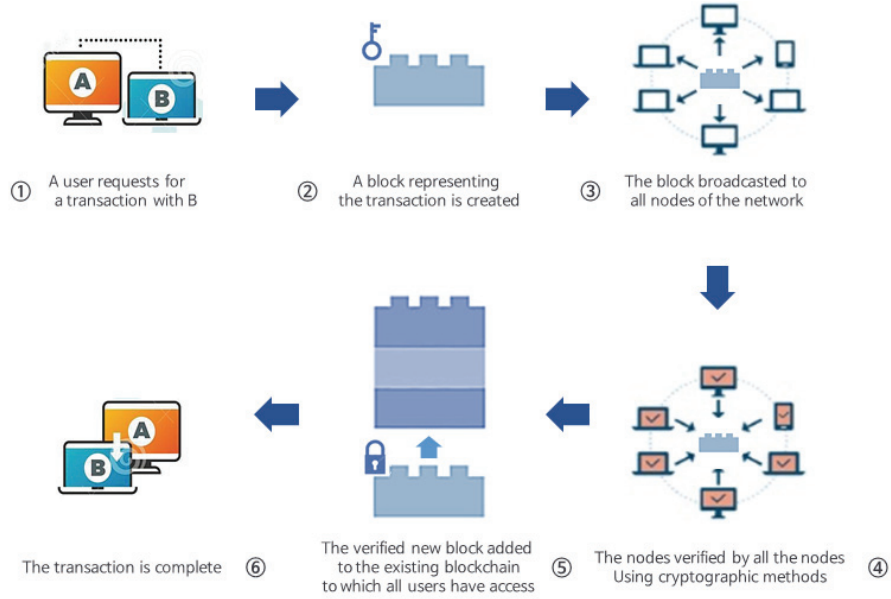
3. Blockchain Technology

3.1. Principle of Blockchain System

Blockchain technology, which started to draw attention with virtual currency such as bitcoin, bitcoin, is a distributed transaction record management system that simultaneously shares information and manages transaction records by multiple participants to supplement shortcomings of centralized system. A blockchain consists of a chain of a blocks in which a series of transactions are recorded. Transaction history confirmed on a block-by-block basis. Block refers to individual transaction records that are combined into a single group. Blockchain record large numbers of transactions. They achieve this by grouping individual transaction records together into a block (Bacon et al., 2017).

The way in which blockchain generates transaction information and maintains transaction records can be described as shown in Fig. 1. If A and B enter into a transaction, the transaction information is stored in the block and sent to the entire participant of the network. After that all participants mutually agree that the transaction records are reliable through a procedure to verify the validity of the transaction. The transaction is complete by the approved blocks added to the existing blockchain.

Fig. 1. Blockchain Transaction Process



Source: Recomposition by Author from various source.

3.2. Structure and Characteristics of Blockchain Technology

3.2.1. Distributed Ledger

Whereas conventional electronic transactions are based on a centralized systems that record all transactions in a single ledger, the blockchain can be defined as a distributed ledger system in which all participants jointly record and manage transaction information by distributing the ledger that records transaction information over a peer-to-peer network rather than a central server of a particular agency (Yang Jae-Hoon, 2018).

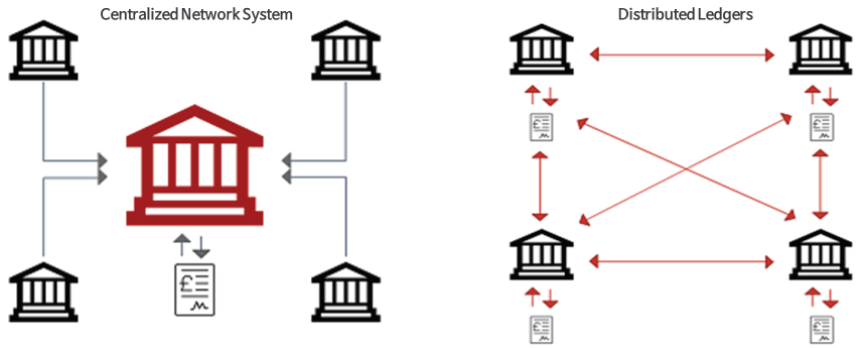
Blockchain technology makes the central registry system unnecessary by creating "digital property" in which rights are recorded in a distributed digital ledger while previous electronic bill of lading model generally required a central registry managed by a trusted third party to track the person who has rights to bill of lading (Bury, 2016). Under the distributed system based on blockchain, transactions are made between individuals on an open platform that does not require membership in advance. This would therefore be a significant advantage in that this ensures easy access for various trading partners around the world.

The registry model can be an efficient way where there are not many trading participants. However, it is difficult for a particular authority to manage the complex transaction process in international logistics involving various stakeholders, such as forwarder, insurer, customs, shipping company. Instead, the blockchain platform which connects all members of the international supply chain to a distributed network could be more effective in that it can contribute to enhancing the real-time visibility and security of international logistics by allowing members to exchange documents directly, including bill of lading without an intermediary (Song Sang-Hwa, 2018). Moreover, distributed systems can reduce human errors that might be committed by registry administrators who manage the central registry. In addition, concerns about censorship by registry administrators or government agencies

can also be reduced (Takahashi, 2016).

A centralized network is vulnerable to accidents or hacking attacks if a hacker effectively targets a central server. On the other hand, blockchain operating on a distributed network is designed to be managed jointly by members with identical transaction records copied to their computers in the system without independent servers. Since all participants equally shares transaction records, it requires simultaneous penetration into the entire participant's computer rather than the central server in order to forge or hack into a particular transaction. Thus, the bigger the network, the harder it becomes to forge or tamper with transactions.

Fig. 2. Centralized and Distributed Ledger Approaches



Source: Santander (2015).

3.2.2. Consensus Algorithm

Until recently, it had been considered impossible to synchronize the ledgers maintained by all participants under an open distributed system. Because there was belief that to reach a consensus among unspecified individuals on the priority of the transaction is difficult (Takahashi, 2016).

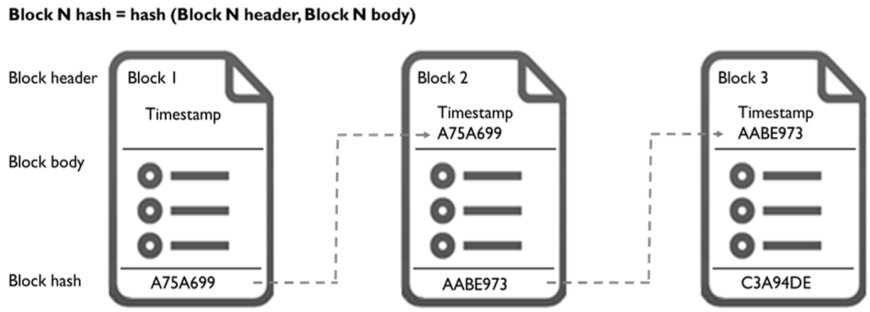
Blockchain technology has significance in that it has made it possible to reach a consensus on data integrity in an open network system. The blockchain system secures the reliability of the transaction by verifying the validity of the individual transaction by all members involved in the transaction although it does not have a single entity to verify the transaction. The consensus algorithm is an algorithm that ensures the integrity of the system by cross verifying the mathematically calculated result values subject to a specifically defined procedure by nodes that are not mutually reliable in the distributed network. Computers on the network must reach an agreement on the validity of the transaction before new data blocks are added to the end of the blockchain. Deleting or changing the information stored in the block is almost impossible after a new block is added to the blockchain as it requires approval from the members who approved the block. It becomes a permanent record that all of the computers on the network can use to coordinate an action or verify an event (Chetrit et al., 2018). Under the blockchain system each transaction can be validated by all participants although it can be said trustless in that no single party validates a transaction (McDermott et al., 2017).

3.2.3. Time Stamping

A block chain consists of a chain of blocks. Each block records a series of transactions that

have been identified on a block-by-block basis. Each transaction also forms part of the chain in the sense that the output of one transaction becomes the input of the next transaction (Takahashi, 2016). Blockchain groups individual transaction records into a block and links blocks using hash to record large numbers of transactions. A block consists of two parts, 'block body' and 'block header'. The 'block body' contains the transactions that the block records. The 'block header' includes the hash of the previous block and some metadata such as a timestamp. The header and the body are used as input data for the hash function. A block's hash value is created from data that includes the hash of the previous block. Blocks are chained by these block hash pointers, creating a 'blockchain', as shown in Fig. 3 (Bacon, 2017).

Fig. 3. A Simple Blockchain Representation Showing Three Chained Blocks



Source: Bacon et al. (2017).

In blockchain technology, every transaction has a timestamp that determines exactly when the transaction was made (Nakamoto, 2008). Timestamping on blockchain use hash algorithms to create a digest, or a cryptographic string that is representative of a piece of data. The cryptographic digest is attached to a blockchain transaction linked to the time the document is submitted. The digest generated by the hash function depends on the characteristics of the document. The cryptographic digest generated by the hash function is attached to a blockchain transaction linked to the time when the document is submitted.

Thus, the same digest does not exist unless the same data is used to compute the digest as it depends on the nature of the document. Time stamp proves that electronic documents existed at a certain point in time (proof of existence) as well as the data did not change after that time (proof of contents). This can be said as a crypto notarization proving that some transactional data existed at a certain point in time. A timestamp can be referred to as proof of existence. The role of time stamp is to prove the existence of a particular transaction by recording the date and time when a transaction occurred and identifying the context. To prevent double spending, it is necessary to determine which transactions occurred first. For this purpose, time stamp servers record time and reinforce it in the form of a chain, making forgery difficult. This is an important feature of blockchain technology in the sense that ordinary disputes can be solved easily. Use of timestamp will certainly create a uniqueness of transaction that has been executed in a certain time.

3.2.4. Trade Asset Tokenization

Blockchain technology not only allows creating ledgers, but also allows trading tokens online on a peer-to-peer (P2P) basis and holding them without the involvement of

intermediary. The tokens are either cryptocurrency units of self-anchored value or asset-backed tokens, i.e. tokens for which there exists the underlying asset they represent (Takahashi, 2017). Thus, transaction assets can be digitalized by using crypto tokens to indicate the control or ownership of the bearer under a blockchain network. By tokenizing transaction assets, the transfer of token between trading participants on a blockchain network can be performed in parallel with the movement of physical assets, and a clear chain of asset proof can be established, establishing a clear chain of asset provenance (Varghese and Goyal, 2018).

The registry model uses the control concept instead of possession to ensure the uniqueness because it could not technically replicate the possession of electronic records. As mentioned above, electronic transferable records under the registry model only contain reference to the location of the registry where the information to identify the controlling party can be found. These electronic records therefore could not be transferred as unique tokens as it does not exist digitally as a token to be traded. However, unlike the registry model electronic forms of tokens are said to be available for possession (Ong, 2018). Legal possession of digital tokens has important implications for identifying the person with title or the possession right. Ong (2018) has a view that it is reasonable to base basic framework of an electronic bill of lading on a token model, in the sense that the electronic form of token can be immediately and visually verified on-site like a paper document.

4. Legal Validity of Electronic Transferable Record

4.1. Current Legal Framework Supporting Electronic Bill of Lading

Sufficient support of legal framework is essential for the successful settlement of electronic bill of lading. Traditional paper bill of lading would also only be a piece of paper if there is no legal foundation recognizing its legal effects. For example, if the parties to the contract of carriage agree to use electronic bill of lading, the transaction process by electronic bill of lading between the parties will be performed under the agreement. However, the agreement between the parties will have no effect on the rights of third-party holder unless there is an applicable legal framework.

Until recently, despite various efforts to dematerialize the bill of lading, it has been difficult to be widely accepted in the industry due to the absence of a legal framework to support the use of electronic bill of lading. Blockchain based electronic bill of lading will also be as difficult to establish successfully without sufficient support from the applicable legal system as the projects so far have been on electronic bill of lading.

The reason why preparing the legal foundation to dematerialize transport documents has not been sufficient so far, in spite of worldwide efforts to facilitate electronic transactions, is that digitalizing transport documents is not a simple matter which can be solved by acknowledging that electronic documents have the same effect as paper documents, but a unified regulation is required to ensure reliable procedures for international negotiation of electronic documents.

The adoption of the Rotterdam Rules in 2008 and the UNCITRAL Model Law on Electronic Transferable Records in 2017 is the result of international efforts to ensure the stability and reliability of transactions based on electronic bill of lading by eliminating legal uncertainties regarding electronic bill of lading. Although new international laws may be introduced in the future, the Rotterdam Rules and the UNCITRAL Model Laws provide the legal framework necessary for the utilization of blockchain technology by stipulating requirements for electronic transport records or electronic transferable records to have legal

effects as well as procedures for securing the reliability of the transaction.

4.1.1. The Rotterdam Rules

The Rotterdam Rules has underlying purpose to provide a modern and uniform law concerning the international carriage of goods by sea in order to reduce transaction costs, increase predictability and stability, and promote confidence in international maritime commerce.

One of notable features of the Rotterdam rules is that it attempts harmonization of international transport laws and customs regarding international transport documents by stipulating comprehensive provisions on various forms of transport documents which had not been covered under the previous international transport convention such as the Hague-Visby Rules or Hamburg Rules.

In particular, it provides the requirements for the issuance, transfer, and disposition of electronic transport records in addition to acknowledging electronic transport records as functional equivalent of paper transport documents so that transactions by transport documents accompanying the transport of goods can be carried out seamlessly in an electronic environment.

Rotterdam rules were adopted in 2008 before blockchain technology was introduced. If the Rotterdam rule applies as a legal framework for electronic bill of lading, though not yet in force, whether blockchain based bill of lading can be considered as a negotiable electronic transport record will be a question.

4.1.2. UNCITRAL Model Law on Electronic Transferable Records

The UNCITRAL Model Law on Electronic Transferable Records (MLETR) was designed to be used as a neutral and uniform text for the international distribution of electronic transferable records in international trade. There were several discussions on whether the legislation on electronic transferable records would be made in the form of a convention or a model law during the UNCITRAL working group meeting. After discussion UNCITRAL Working Group decided to take the form of a model law in that it may be difficult to ratify the Convention because the electronic transferable records is unfamiliar concept except in some countries at present (UNCITRAL, 2015). Under this model law electronic transferable records can be used as functional equivalence to transferable documents or instruments.

According to the MLETR, electronic transferable records are defined as an electronic record that satisfy the requirements for being considered as transferable documents or instruments (Article 2). Transferable documents or instruments are described as a paper documents that entitles the holder to claim the performance of the obligation indicated in the document or instrument and to transfer the right to performance of the obligation indicated in the document or instrument through the transfer of that document or instrument. It also provides the requirements that should be met for an electronic record to be treated as a transferable document (Article 10). Electronic transferable records under the MLETR mainly covers a bill of lading or promissory notes (Takahashi, 2016).

4.2. Basic Principles

4.2.1. The Principle of Technology Neutrality

One of the guiding principles in the UNCITRAL works on electronic commerce is the principle of technology neutrality. This means that laws should not require or assume the use of certain technologies in communicating or storing information electronically. The purpose

of technology neutrality is important from the point of view that it does not suppress the development of any technology or unfairly favors one technology over another (UNCITRAL, 2011). This principle contributes to accommodating possible future technological developments by establishing a framework that can grant legal effect if certain requirements are met, regardless of which technology or media is used to electronic records. In this respect, blockchain technology which did not exist when the Rotterdam Rules and MLETR was enacted can be covered by those Rules.

4.2.2. The Principle of Functional Equivalence

It should be noted that the principle of technical neutrality does not mean that any technology can produce data messages which meet paper based requirements (Takahashi, 2017). Only the technology that fulfills the essential functions of a paper document can create data messages that replace paper document. This is so-called the principle of functional equivalence, another guiding principle underlying the UNCITRAL works on electronic commerce (UNCITRAL, 2016).

There are legal and technical limitations in replacing paper documents with electronic records because electronic records are inherently different from paper documents. In other words, even if the purpose or function fulfilled by electronic records is nothing different from paper documents, the laws and customs applied to paper documents are difficult to apply to electronic records without any restriction because the characteristics of the medium or the technical operation methods are inherently different from paper documents.

The principle of functional equivalence has intent to recognize the same legal effect on electronic records as paper documents if electronic records can technically implement the essential purpose and function of a paper document even though there are fundamental differences between electronic records and paper documents (UNCITRAL, 1996).

This approach is designed to enable electronic transactions to execute in accordance with existing laws instead of eliminating all requirements of paper document itself or infringing legal concepts underlying those requirements (UNCITRAL, 2007). Therefore, an electronic transferable record can be regarded as a transferable document or instrument if certain requirements are met. In this regard, the Rotterdam Rules provide minimum requirements necessary for recognizing a negotiable electronic transferable records as negotiable bill of lading as follows.[1] The use of a negotiable electronic transport record is subject to the procedure referred to in the contract of carriage, which must provide for: (a) the method for the issuance and the transfer of the record to an intended holder (b) an assurance that the record retains its integrity (c) the manner in which the holder is able to demonstrate that it is the holder and (d) the manner of providing confirmation that delivery to the holder has been effected or that the record has ceased to have any effect or validity.

MLETR also provides a functional equivalence rule for the use of transferable documents or instruments by setting forth the requirements to be met by an electronic record.[2] It reads as follows. Where the law requires a transferable document or instrument, that requirement is met by an electronic record if (a) The electronic record contains the information that would be required to be contained in a transferable document or instrument; and (b) A reliable method is used (i) to identify that electronic record as the electronic transferable record; (ii) to render that electronic record capable of being subject to control from its creation until it ceases to have any effect or validity; and (iii) to retain the integrity of that electronic record.

---

[1] The Rotterdam Rules, Art. 9 (a)-(d).

[2] UNCITRAL Model Law on Electronic Transferable Records, Art. 10

4.3. Legal Recognition of Electronic Bill of Lading

4.3.1. Guarantee of Singularity (Uniqueness)

The Rotterdam Rules and the MLETR specify the conditions which electronic records must satisfy in order to implement the purpose and essential functions of transferable documents.[3] However, the negotiability of document of title in which embody the rights of title to the goods is a difficult issue to resolve simply by recognizing electronic records as a functional equivalence and granting the same legal effect of paper documents. For this reason, the main legal and technical obstacles that arise in utilizing electronic bill of lading almost have relation with the negotiation of the bill of lading as a document of title.

The possession of the document of title constitutes constructive possession and control over the goods. The document may be used to transfer title and to provide security over the goods to financial institutions (Dubovec, 2006). Therefore, it should be a unique throughout the entire process of transfer of title to ensure that only the holder can exercise his right to claim the performance of the obligation in the document.

It is necessary for bill of lading to be secure uniqueness and singularity because the bill of lading is a document of title which embodies the right of title to the goods shipped. The holder of the bill of lading, by possession of the original bill of lading, can be assured that the rights in the bill of lading can only be exercised by himself. However, it is difficult to ensure the uniqueness of electronic records under the electronic environment in the sense that electronic messages can easily produce duplicates which are difficult to distinguish and identical records to remain in the computer even after the transfer of rights. This would disrupt negotiability of the document of title in that such a problem may cause a risk of double transfer (Jung Gyung-Young, 2017). Guarantee of uniqueness is essential requirement for electronic bill of lading to be recognized as paper bill of lading in that it is necessary to prevent multiple claims from being made on the same obligation.

4.3.2. Possession vs. Exclusive Control

A bill of lading is a document of title which embodies the right to claim delivery for the goods shipped. Therefore, the possession and delivery of bill of lading is required for the exercise or disposition of the title under the bill of lading. In other words, the negotiability of bill of lading cannot be discussed separately from the physical possession of the original bill of lading, so long as the physical possession of the original document is a prerequisite to obtain the right under the current legal system on a document of title (Benaw, 1995).

However, electronic bill of lading is distinguished from paper bill of lading in the sense that it consists of an intangible electronic record as well as the contents of the electronic record and the exercise or disposal of the right are operated separately without any combination. As above mentioned, the lawful holder who has obtained bill of lading in due course can assume that no one but himself can exercise the rights in the bill of lading. A paper bill of lading as a document of title is recognized as the only means to transfer the right in the document. On the other hand, if electronic bill of lading is used reliable methods and procedures must be established for the exercise or disposal of rights since it is not a document of title under the current legal regime.

The Rotterdam rules and MLETR introduce the approach of exclusive control instead of physical possession of original documents to secure the negotiability of electronic bill of lading. Both of them regard the exclusive control of an electronic record as functional

[3] The Rotterdam Rules, Art. 9; UNCITRAL Model Law on Electronic Transferable Records, Art. 10

equivalence to the possession of a transferable document, on the ground that they both guarantee uniqueness.

Under the Rotterdam Rules[4] the 'issuance' of a negotiable electronic transport record means the issuance of the record in accordance with procedures that ensure that the record is subject to exclusive control from its creation until it ceases to have any effect or validity. The 'transfer' of a negotiable electronic transport record means the transfer of exclusive control over the record. Also, the MLETR provides that where the law requires the possession of a transferable document or instrument, that requirement is met with respect to an electronic transferable record if a reliable method is used to establish exclusive control of that electronic transferable record by a person and to identify that person as the person in control.[5]

It can be understood that the possibility of multiple claims are ruled out in a prescriptive way by which not only ensure uniqueness by identifying electronic transferable record representing a certain right but also secure exclusiveness by allowing it to be subject to control, although it is difficult to guarantee uniqueness technically (Jung Gyung-Young, 2017). In line with the general principle that the Model Law does not affect substantive law, the notion of control does not affect or limit the legal consequences arising from possession. Consequently, parties may agree on the modalities for the exercise of possession but may not modify the notion of possession itself (UNCITRAL, 2016).

5. Feasibility of the Blockchain Bill of Lading under the Current Legal Regime

5.1. Significance of Blockchain based Electronic Bill of Lading

Blockchain technology has the potential to resolve the technical and operational limitations of unsuccessful electronic bill of lading model. A blockchain system build up trust through consensus process among independent members without central registry. It enhances transparency and scalability of transactions because it operates in a decentralized open system. Moreover, blockchain technology is very useful to transferable instrument such as bill of lading in terms that it guarantees uniqueness by confirming and verifying transaction history connected in a chronological order by block.

Blockchain technology not only replace paper documents with electronic records in international transactions, but also enables the implementation of smart contracts which allows contractual obligations evidenced by bill of lading are automatically fulfilled when certain conditions are met. For example, if blockchain technology were used to synchronize transaction records between the parties to an international carriage of goods by sea, smart contracts can automatically change and record title to the goods upon the buyer's payments to the seller

5.2. Guarantee of Uniqueness

5.2.1. Avoidance of Double Spending

The Rotterdam Rules and the MLETR require electronic records to be unique in order to recognize an electronic transferable record as the functional equivalence of transferable

[4] The Rotterdam Rules, Art. 21-22.

[5] UNCITRAL Model Law on Electronic Transferable Records, Art. 11.

instrument such as bill of lading. This is to ensure that no one but himself can exercise the title in the electronic transferable records.

To prevent double transfer, it is necessary to decide on the priority of the transactions by which the same token has been used multiple times. Until recently it had been thought that, in an electronic environment, the only possible way to guarantee uniqueness was by means of a central registry administered by a trusted entity. This is because it had been believed that it is hard to reach a consensus among unspecified participants on the priority of the transactions under an open decentralized system.

However, at present, the consensus mechanism under the blockchain system makes it possible to prevent from fraud or double spending by synchronizing distributed ledgers without a trusted intermediary (Takahashi, 2016). Blockchain technology has made that possible by way of confirming a set of transactions on a block-by-block basis, with each block added through solving a computationally difficult puzzle. Blockchain technology can, using timestamping and cryptographic techniques, single out the earliest transfer of a blockchain as the authorized transfer and void later unauthorized transfers in the process, enabling blockchain bill of lading to be unique (Nakamoto, 2008).

5.2.2. Exclusive Control

Until recently, the administrator managing an central registry has been required to assure that the relevant electronic records are subject to the exclusive control of their holders. In this regards, Angelo (2011) pointed out that, "at least in theory, the guarantee of uniqueness could be possible if computer technology were able to create a unique electronic record that could be exclusively held by a holder and transferred to another without replication at some point down the negotiating chain." He also explained that it is possible to rely on technical devices to ensure the uniqueness of electronic records that they are transmitted across a continuous distribution chain. Nevertheless, it had no choice but to rely on electronic registry systems since there was no computer technology to create a unique electronic record at the time.

However, the blockchain technology is now able to replace such a central registry with algorithm which ensures that there exist a unique distributed ledger and guarantees that the tokens recorded in the distributed ledger are subject to the exclusive control of their holders (Takahashi, 2017). The blockchain protocol ensures that transactions are valid and are recorded only once, allowing members to adjust each transaction in a distributed network without relying on trusted authority to validate and clarify all transactions (Chetrit et al., 2018). More precisely, it can be explained as preventing the continuous circulation of copies by allowing them to come up with an agreement on priorities among competing transactions rather than creating a unique transaction record.

Under the Rotterdam Rules and the MLETR, the exclusive control of an electronic record is regarded as functional equivalence to the possession of a paper bill of lading. A blockchain based token is considered to be subject to the exclusive control of the holder of the private key corresponding to the address at which the token is kept. In this respect, it can be said that the holder of the private key corresponding to the address where an electronic bill of lading is kept would be deemed to have possession of it.

5.3. Identification of the Controlling Party

The person who has title under a bill of lading depends on the type of the bill of lading. In the straight bill of lading a specific person is designated as entitled person while someone to whom the specific person endorse shall be recognized as the entitled person under the order

bill of lading. The holder is simply recognized as entitled person without stating certain person where the bearer bill of lading is issued. A bill of lading is transferred by endorsement and by delivery or by mere delivery. The last person who has been identified in the continuation of endorsement has the title to under the bill of lading.

The Rotterdam Rules[6] require that the use of a negotiable electronic transport record shall to be subject to the procedure referred to in the contract of carriage which provide for the manner in which the holder is able to demonstrate that it is the holder. This purport is consistent with the MLETR which stipulates that the requirement for the possession of transferable documents under the law is met by electronic transferable record where a reliable methods to identify a particular person as the person in control is used, along with establishing exclusive control of electronic transferable record by a person.

As can be seen in official document on the Model Law project, the UNCITRAL Secretariat conceived two approaches to establish the identity of the person in control of the electronic transferable record, the token model and the registry model (UNCITRAL, 2011). The official document described the token model as a model which identifies the person in control in the electronic record itself, while the registry model is described as a model which identifies the person in a separate independent third-party registry. It also states that if an authoritative copy of an electronic transferable record is stored in a specific secure computer system protected by appropriate security and access controls, the person in control may also be defined itself as the single person authorized to access to the electronic transferable record, in which case the transfer of control would require a transfer of exclusive means of security access, such as a unique access token.

Blockchain system authenticate identity of users based on PKI. Encrypted data by the public key can be decrypted only by using the private key and vice versa. Certain data set can be decrypted by using public key proves that the data was encrypted by and transferred from the holder of the private key (Bacon et al., 2017).

A blockchain ledger corresponds to the addresses where tokens are kept. A private key creates the corresponding public key and the public key creates an address. In this way, the holder of the private key corresponding to the address where the token is kept can control a blockchain based token. Thus, the addresses are cryptographic identities of the holders of the tokens (Takahashi, 2016). The private keys corresponding to the addresses are kept secret while the public key is published. Disclosing the public key does not need exposing the true identity of the person concerned (Nakamoto, 2008). As a result, the identity of the holder appears anonymously, not by their real names. However, it does not mean that the holder cannot prove his or her identity.

UNCITRAL Secretariat implies that the holder of an electronic record may be identified in a way other than by real name. It says that: "…identification should not be understood as implying an obligation to name the person in control, as the draft Model Law allows for the issuance of electronic transferable records to bearer, which implies anonymity" (UNCITRAL, 2015). Similarly, the Rotterdam Rules do not separate the negotiable electronic transport records into order bill of lading and bearer bill of lading. Moreover, it does not specifically stipulate methods for identification. Thus, it could be understood that method of demonstration is not confined to identification by name. In this regard, a blockchain based bill of lading can be considered as functional equivalence of a bearer bill of lading.

[6] The Rotterdam Rules, Art. 9 (1) (c).

5.4. Indication of Time and Place in Electronic Transferable Records

MLETR stipulates[7] that where the law requires or permits the indication of time or place with respect to a transferable document or instrument, that requirement is met if a reliable method is used to indicate that time or place with respect to an electronic transferable record. Available methods to indicate time and place in electronic transferable records may compatible with systems based on registry, token, distributed ledger or other technology. Explanatory note refers to a time stamping[8] as a reliable method in indicating time (UNCITRAL Explanatory Note, 2018)

Distributed ledger technology depends on the operational rules of a time stamping server which automatically record all transactions as a document, and time stamps to each transaction. Participants of the blockchain bill of lading system decide on a single history in the order of which they were received to determine which blockchain bill of lading to be referenced amongst competing transfers of blockchain bill of lading (Nakamoto, 2008).

5.5. Integrity of Blockchain Bill of Lading

A blockchain based bill of lading which is equivalent to a 'negotiable electronic transport record' under the Rotterdam Rules must be able to provide for 'an assurance that the record retains its integrity'.[9] MLETR suggests a provision for assessing the concept of integrity. It implies that an electronic transferable record retains integrity when any set of information related to authorized changes remains complete and unaltered from the time of the creation of the electronic transferable record until it ceases to have any effect or validity (UNCITRAL Explanatory Note, 2018).

A blockchain based bill of lading is more excellent than a paper bill of lading in assuring data integrity. Once a transaction is made, various processes are carried out to ensure the security of the transaction on a blockchain system as follows (Ganne, 2018). First, the sender creates key pairs of public key and private key which are mathematically related. The public key is available to the receiver. Then, the sender hashes the data to be sent and encrypt the data with the sender's private key to ensure integrity. In other words, the sender converts the data into a new digital string of fixed lengths using a hash, a mathematical function. The encrypted hash constitutes the digital signature of the electronic record. It guarantees that the message was created and sent by the sender as well as not altered in transit. The receiver can verify the integrity of the electronic record by comparing its calculated hash value with the hash value sent by the sender when applying the same hash algorithm to the plain data transmitted by the sender. The receiver can be assured that the data has not been altered during the transmission where the two-hash values match.

In addition, the blockchain network is designed to validate new transactions and not to invalidate former transactions recorded in previous ledgers to ensure that only legitimate transactions are recorded on the block. The possibility of the data being forged is remote because adding a new verified block to blockchain requires not only considerable computing power but also consensus on the validity of a transaction recorded in the ledger among independent nodes on the network.

---

[7] UNCITRAL Model Law on Electronic Transferable Records, Art. 13.

[8] Time stamp is an international technical standard based on Public Key Infrastructure for the verification of time electronic record were generated (proof of existence) and authenticity (proof of content). It also proves that electronic records existed at a certain time and that data did not change after that time (Timestamping, 2010).

[9] The Rotterdam Rules, Art. 9 (1) (b).

6. Conclusion

It is true that previous efforts to dematerialize bill of lading, which plays a essential role in international trade, have not been successful due to lack of legal basis and controversy over the registration system. Recently, however, the growing interest in blockchain, a core technology in the 4th Industrial Revolution, has accelerated the development of platforms for commercializing blockchain based electronic bill of lading in the shipping industry. Moreover, international efforts to establish legal foundation on electronic transport records have also paid off with the enactment of the Rotterdam Rules and UNCITRAL Model Law on Electronic Transferable Records.

This paper analyzed the advantages of blockchain based electronic bill of lading in comparison with existing registry models. Furthermore, whether the main features of blockchain technology meet the requirements for the legal validity of the negotiable electronic transport record or electronic transferable records under the Rotterdam Rules and the MLETR also be analyzed.

Blockchain technology has features that can make up for the deficiency of registry models as follows. First of all, blockchain technology in which transactions are made under an open platform can improve transparency and expandability of transactions of electronic bill of lading, which were pointed out as the limits of the registry model, by ensuring easy access for transaction participants. Secondly, under the distributed network of the blockchain, it becomes more difficult to forge or tamper with transactions as the scale of network grow because the transaction records are shared and jointly managed by all participants. Thirdly, the timestamp that records the date and time when the transaction occurred in a blockchain transaction to demonstrate the existence of a particular transaction prevents double payments, making it easier to resolve ordinary disputes. Last but not least, blockchain technology makes it possible to holding digital tokens and trading them online on a peer to peer basis.

In addition, blockchain technology also has elements such as distributed ledger technology, timestamps, and consensus mechanism that can more efficiently meet the requirements of the negotiable electronic transport record or electronic transferable records under the Rotterdam Rules and the MLETR which provide the legal basis for blockchain based bill of lading.

There are some obstacles to the successful settlement of blockchain bill of lading. For example, the introduction of a blockchain technology brings about concerns regarding liability for system errors, communication failure, or system breakdowns. Nevertheless, considering the benefits of using blockchain technology, the prospect for introducing blockchain bill of lading is promising.

Probably the most significant obstacle is the legal uncertainty surrounding the blockchain technology. In this regard, the Rotterdam Rule and the UNCITRAL Model Law on Electronic Transferable Records which includes the feasible rules on electronic bill of lading have important implications. It may not be enough to resolve legal issues regarding electronic bill of lading at the moment since few countries have ratified Rotterdam rules[10] and the UNICTRAL Model Law is nothing more than a mere recommendation. However, it is believed to contribute to suggesting a legislative model on electronic bill of lading and reducing legal uncertainty.

[10] The situation of the Rotterdam Rules remains almost the same since the Genoa Assembly in 2017 except the Cameroon's ratification on October 11, 2017. Twenty-five States have signed, and four have ratified, the Rotterdam Rules (See Tomotaka Fujita (2018), Report of the Standing Committee on Carriage of Goods (including Rotterdam Rules).

References

Benaw, K. (1995), "Current Developments Concerning the Form of Bills of Lading – Belgium". In A. N. Yiannopolous (Ed.), *Ocean Bills of Lading: Traditional Forms, Substitutes, and EDI Systems*, Hague, Netherlands: Kluwer Law International, 87-125.

CMI (2018), "Report of the Standing Committee on Carriage of Goods (including Rotterdam Rules)". Available from https://comitemaritime.org/wp-content/uploads/2018/11/Attachment-21.pdf (accessed July 16, 2019)

David, B. A. (2016), "Electronic Bills of Lading: A Never-Ending Story?", *Tulane Maritime Law Journal*, 14, 197-238.

Elson, O. (2018), *Blockchain Bill of Lading* (Working Paper No. 2018/020), Singapore: National University of Singapore, 1-31.

Jean, B., M. J. David, M. Christopher and S. Jatinder (2017), *Blockchain Demystified: An Introduction to Blockchain Technology and its Legal Implications* (Legal Studies Research Paper, No. 268/2017), London: Queen Mary University, 1-53.

Jung, Gyung-Young (2017), "A Study on the UNCITRAL Model Law on Electronic Transferable Records", *Comparative Law*, 24(4), 1597-1664.

Kim, Hyoung-Cheol and Kwang-Hyun Yu (2014), "A Study on Connection of e-B/L for Improving the Efficiency of International Logistics and e-Nego", *Journal of International Trade & Commerce*, 10(3), 349-364.

Koji, T. (2016), "Blockchain Technology and Electronic Bills of Lading", *Journal of International Maritime Law*, 22, 202-211.

Koji, T. (2017), "Implications of the Blockchain Technology for the UNCITRAL Works", Proceedings of the Congress of the United Nations Commission on International Trade Law: Modernizing International Trade Law to Support Innovation and Sustainable Development, Vienna, 81-94.

Lata, V. and R. Goyal (2018), "Blockchain for Trade Finance: Trade Asset Tokenization (Part 3)", *Digital Business*, 1-12.

Law 360 (2017), "From Bills of Lading To Blockchain Structures". Available from https://www.cadwalader.com/uploads/books/85a389ea712b15e94fa5b94fe3dcf892.pdf (accessed August 14, 2019)

Marek, D. (2006), "The Problems and Possibilities for using Electronic Bills of Lading as Collateral", *Arizona Journal of International & Comparative Law*, 23(2), 437-466.

Mariano, B., R. Emmet and A. Veitch (2015), *The Fintech 2.0 Paper: Rebooting Financial Services*, London: Santander, 1-19.

Miriam, G. (2013), *Electronic Documents in Maritime Trade: Law and Practice*, Oxford, UK: Oxford University Press.

Naomi, C., D. Mayrav, S. Angelic, Y. Boaz and G. Dov (2018), "Not Just for Illicit Trade in Contraband Anymore: Using Blockchain to Solve a Millennial-long Problem with Bills of Lading", *Virginia Journal of Law & Technology*, 22(2), 59-106.

Satoshi Nakamoto (2008), *Bitcoin: A Peer-to-Peer Electronic Cash System*. Available from https://bitcoin.org/en/bitcoin-paper (accessed July 16, 2019)

Ship Law Log (2016), "Electronic Bills of Lading". Available from https://www.shiplawlog.com/2016/01/14/electronic-bills-of-lading/ (accessed August 14, 2019)

Song, Sang-Hwa (2018), "The Future of Blockchain and Logistics", *Logistics Insight*, 1, 1-36.

UNCITRAL (1996), *Electronic Data Interchange* (UNCITRAL Working Paper, No. A/CN.9/W.69), Vienna: Author, 32-40.

UNCITRAL (2007), *Explanatory note by the UNCITRAL secretariat on the United Nations Convention*

on the Use of Electronic Communications in International Contracts (United Nations Publication, No. E.07.V.2), Vienna: Author, 13-100.

UNCITRAL (2011), *Legal Issues Relating to the Use of Electronic Transferable Records* (UNCITRAL Working Paper, No. A/CN.9/WG.IV/WP.115), Vienna: Author, 1-19.

UNCITRAL (2015), *Draft Model Law on Electronic Transferable Records* (UNCITRAL Working Paper, No. A/CN.9/W.GⅣ/WP.135), Vienna: Author, 1-17.

UNCITRAL (2016), *Report of Working Group IV (Electronic Commerce) on the work of its fifty-second session* (UNCITRAL Working Paper, A/CN.9/863), Vienna: Author, 1-18.

UNCITRAL (2018), *Explanatory Note to the UNCITRAL Model Law on Electronic Transferable Records* (United Nations Publication, No. E.17.V.5), Vienna: Author, 15-64.

UNCTAD (2003), *The use of transport documents in international trade* (UNCTAD Report, No. UNCTAD/SDTE /TLB/2003/3), Geneva, Switzerland: Author, 1-42.

Yang, Jae-Hoon (2018), "A Study on the Effect of Block Chain Application and Legal Issue in Logistics Industry", *Journal of Convergence for Information Technology,* 8(1), 187-189.

Yang, Jung-Ho (2002), *Comparative Study on the Electronic Bill of Lading and Paper Bill of Lading* (Doctoral Dissertation), Seoul: Sungkyunkwan University.