# BLOCKCHAIN BILLS OF LADING: A NEW GENERATION OF ELECTRONIC TRANSPORT DOCUMENTS*

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*Recently, great attention has been paid to blockchain technology for creating new opportunities in international trade. Parties involved in international trade can now enter into transactions more securely thanks to immutable, distributed ledgers without necessarily relying on a third-party system provider while benefiting from the improved speed and cost of transactions. Blockchain technology has a decisive impact on the development of electronic transport documents. Pre-existing electronic bills of lading have relied on a system provider of "registry" whose nature has restricted them from being widely used in practice. Blockchain bills of lading are expected to address the shortcomings of their preceding generation by allowing anyone to use them and achieving a mechanism of transferring their control in a similar way to transferring the possession of paper bills of lading. At the same time, however, there are a number of practical and legal issues that might slow down the full application of blockchain bills of lading. To examine the potential issues in their use, this paper aims first to introduce blockchain bills of lading and how they carry out the functions of traditional bills of lading; secondly, the paper seeks to identify what the challenges are and how they may impede the use of blockchain bills of lading; and lastly, it investigates whether the proposed legal instruments could provide legal recognition of the use of blockchain bills of lading. These questions will determine the*

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*prospects for blockchain bills of lading: could they eventually render paper bills of lading a relic, or will they simply remain just another type of electronic bill of lading that has to coexist with paper bills of lading?*

***Keywords:*** *blockchain bills of lading; distributed ledger; registry; token; public blockchain; private blockchain; functional equivalence.*

## 1. INTRODUCTION

Blockchain bills of lading have been in the spotlight for the last few years, drawing the attention of both scholars and practitioners. They introduced a new stage in the development of transport documentation, having the potential to be more successful than former attempts to create electronic bills of lading. Blockchain bills of lading may be able to replace not only paper bills of lading, which remain dominant in international trade but also the preceding generation of electronic bills of lading based on registry systems.

International trade is considered to be one of the most important areas of application of blockchain technology. The new technology is designed to enable trade data to be recorded in a secure, immutable, and distributed format by providing the real-time exchange of information and verifying the validity of transactions between various parties. What it brings to bills of lading is not limited to the general benefits of digitalisation such as the reduced time and cost of paper use and increased efficiency and security. Blockchain technology may also have crucial relevance to a bill of lading as a document of title. Several system providers have rapidly been launching documentation services based on blockchain technology for the last few years.[1] Following this development in practice, many scholars are

[1] System providers include Global Share SA edoxOnline platform (2019), WAVE network (2020), CargoX (2020), and TradeLens eBL (2021). (The years indicate the year of approval by International P&I Clubs.) They commonly apply different types of blockchain technology – for example, CargoX is based on the Euthereum, a public-blockchain platform, whereas TradeLens eBL is based on the Hyperledger Fabric solution, a private network where validators (Trust Anchors) are known to the network based on cryptographic identities. Another striking characteristic is the strong involvement of a carrier, the issuer of a bill of lading, in the development of a blockchain B/L. For instance, IBM and Maersk have jointly developed TradeLens, later joined by the world's major shipping carriers such as CMA-CGM, MSC, and Hapag-Lloyd. Other than the P&I approved platforms, COSCO and Alibaba are working on constructing a blockchain platform in China, while TradeWaltz launched by Japanese NTT Data involves not only carriers but also major banks, shippers, insurers, and telecommunication companies building a trade information platform using blockchain technology.

exploring the legal issues arising from the use of blockchain bills of lading and the pressing need for their legal regulation.[2] This calls for the creation and implementation of a legal regime to sufficiently recognise the use of blockchain bills of lading while removing obstacles to their widespread use in practice.

The main questions to be addressed in this paper are thus as follows. Whether and how a blockchain bill of lading can retain and carry out the functions of a traditional bill of lading. What legal or technical challenges may impede the use of blockchain bills of lading. Whether the proposed legal instruments for e-commerce would be able to provide legal recognition for the use of blockchain bills of lading. The answers to these questions will determine whether blockchain bills of lading remain a new type coexisting with paper bills of lading or whether they will transform transport documentation to eventually render bills of lading a relic of the past.

After a brief introduction to blockchain technology, this paper attempts to identify the potential problems or challenges that may hinder the use of blockchain bills of lading in practice. Particular attention will be given to the function of the document of title to be replicated by blockchain bills of lading. The paper will examine the core issues related to the function of the document of title, such as possession and control, and the feasibility of blockchain bills of lading to perform the same functions as paper bills of lading in the process from issuance, through transfer, leading to the final point of delivery. The paper will give due attention to the legal regulation of blockchain bills of lading to enable their legal recognition, leading to their possible takeover of the role presently played by paper bills of lading in international trade.

[2] See in general Todd, P., Electronic Bills of Lading, Blockchains and Smart Contracts, *International Journal of Law & Information Technology*, vol. 27 (2019), no. 4, pp. 339-371; Chetrit, N.; Danor, M.; Shavit, A.; Yona B.; Greenbaum, D., 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*, vol. 22 (2018), no. 2, pp. 59-106; Albrecht, C., Blockchain Bills of Lading: The End of History? Overcoming Paper-Based Transport Documents in Sea Carriage Through New Technologies, *Tulane Maritime Law Journal*, vol. 43 (2019) no. 2, pp. 251-288; Ong, E., Blockchain Bills of Lading and the UNCITRAL Model Law on Electronic Transferable Records, *Journal of Business Law*, 2020, pp. 202-218; Liu, H., Blockchain and Bills of Lading: Legal Issues in Perspective, in Mukherjee, P.; Mejia, Jr., M.; Xu, J. (eds.), *Maritime Law in Motion, WMU Studies in Maritime Affairs*, vol. 8., Springer, Cham, 2020, pp. 413-435; and Takahashi, K., Blockchain Technology and Electronic Bills of Lading, *Journal of International Maritime Law*, vol. 22 (2016), no. 3, pp. 202-211.

## 2. BACKGROUND: THE DEVELOPMENT OF ELECTRONIC TRANSPORT DOCUMENTS

Electronic transport documents have existed for several decades. Still, their adoption in practice has been slow, and, so far, they have not been able to replace the traditional paper bills of lading except for a rather small volume of trade covered by registry-based electronic transport documents. Most scholars argue that the cause of the relatively slow adoption of electronic transport documents lies in inadequate legal regulation. Therefore, questions are raised regarding the legal validity and recognition of such documents.[3] In particular, the lack of legal recognition hinders the recognition of electronic transport documents as documents of title. This uncertainty is due to the lack of a legal infrastructure to support electronic bills of lading,[4] controversy surrounding the registry-based approach of identifying the holder of an electronic bill of lading, and the lack of suitable technology to facilitate the token model approach.

Most of the attempts thus far have been based on the registry model. One of the key problems standing in the way to the broader and faster adoption of electronic transport documents has been the fact that the registry model is by definition a closed model which contravenes the nature of bills of lading as one of the most widely used documents in international trade. More recently, the token model has attracted considerable attention, particularly in the context of the feasibility of its use as an open system.

### 2.1. Registry Model

In the first stage of development, electronic transport documents were based on a closed system, where shipping data were accessed through a central registry operated by a trusted third party. The registry model constitutes "the first generation" as the most widely used model to operate electronic transport documents.

The registry model relies on a trusted third party who can securely control a particular record and identify the person entitled to take delivery of the goods. The central registry, acting as an agent for managing an electronic record, ensures exclusive access to the record using a private key whose holder

[3] Goldby, M., The CMI Rules for Electronic Bills of Lading Reassessed in the Light of Current Practices, *Lloyd's Maritime and Commercial Law Quarterly*, Part 1 (2008), pp. 66-67.

[4] In a 2003 UNCTAD survey targeting professionals involved in the international trade industry, 44% of respondents stated that the "legal framework is not clear enough or is not adequate" as an obstacle to the use of electronic B/Ls. UNCTAD, The Use of Transport Documents in International Trade, *UNCTAD/SDTE/TLB/2003/3*, 2003, p. 27.

can exercise control over the goods. Instead of a "unique document" that would entitle its holder to the right of control, the central registry securely manages a "unique person" entitled to exercise the right of control. Thus, there is no document whose possession would give the right of direct control. Still, there is a kind of indirect control exercised through the central registry, which is designed to provide the same legal effect as possessing a paper bill of lading.

Unlike the process of transferring documents of title, the registry-based transfer of the control over an electronic record identifies the person in control rather than transferring the record.[5] Control is transferred by the communication of authenticated messages between the registry and the parties who have an interest in the goods. The registry is responsible for the transfer of title from one party to another by removing the previous party's control when the control is transferred to a new holder. As a result, the registry system can electronically simulate the negotiability of a paper bill of lading.

Registry-based systems are based on contractual arrangements where users agree to a common set of private rules and systems designed to transfer their control of the electronic record, which ensures that the results of the electronic documentation process contractually and legally mirror those of paper bills of lading. Bolero and essDOCS, the best-known examples of the registry model,[6] are operated by their own contractual rules and procedures: the Bolero Rulebook and Databridge Services and Users Agreement (DSUA). To give legal effect to electronic bills of lading under the registry model, the control of an electronic transport document is granted the same effect as the possession of a paper bill of lading.

The fundamental problem of the registry model is that electronic trading systems are only able to function among their members. The registry system essentially requires its users to subscribe to the system and to be subject to contractual effects and system control. This means that electronic bills of lading cannot be employed when the users of a registry system enter into a transaction with a non-member.

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5 Ong, E., Blockchain Bills…, p. 205.

6 Bolero manages title to the goods through the Bolero Title Registry (BTR). It manages rights and liabilities over the carriage of goods by keeping a record of transfer and the identity of the holder of the BBL. Similarly, essDOCS relies on CargoDocs that limits users' access to an original electronic B/L record. As a result, only one user has access to that record and exercises his rights as agreed upon by DSUA. In particular, essDOCS achieved significant growth from around 500 in 2012 to over 52,000 across 203 countries in 2020. See Demetriou, N., Electronic Bills of Lading: Why it's Different This Time, *Baltic Exchange Member News and Events* (4 March 2015), available at www.balticexchange.com/en/news-and-events/news/guest-column/2015/electronic-billsofladingwhyitsdifferent-thistime. See also ESS-Databridge, Customers, available at https://essdocs.com/network/customers.

In this case, a paper bill of lading must be issued. This problem has constrained the growth of electronic bills of lading. Electronic trading systems are effective only when they are used by a large number of people involved in international trade; it may be neither cost-effective nor convenient for traders to join or use them.

### 2.2. Token Model

An alternative to the registry system is to set up a token-based system. A technologically secure record is used to grant the party holding it exclusive control at the relevant time.[7] The token model is distinguished from the registry model in that it identifies the holder of an electronic record through the record itself.[8] The token model may rely on technological and security safeguards, without a third party's assistance, to ensure that the electronic record is unique: this is similar to how an original bill of lading is transferred. Unlike the registry model, an electronic token grants its holder possession (or control) of the record, including the rights deriving from such possession. While some token-based systems, such as blockchain technology, may not rely on an intermediary and can be operated merely by the transfer of tokens among participants, other systems may rely on a trusted third party to ensure the security and reliability of the transfer.[9] Either way, the token model is more comparable to replicating a paper bill of lading since an electronic token can be virtually possessed.

Until recently, the token model has neither been adopted by international instruments nor been implemented in practice, mainly because of the inadequate technology to enable the use of the electronic token in practice. This is changing through blockchain technology.

## 3. BLOCKCHAIN BILLS OF LADING

In recent years, Distributed Ledger Technology (DLT), often referred to as "blockchain",[10] has been promoted as the way forward in the digitalisation of international trade and trade finance.[11] Blockchain technology enables business

[7] Goldby, M., *Electronic Documents in Maritime Trade: Law and Practice*, 2nd edn., Oxford University Press, Oxford, 2019, pp. 328-329.

[8] Ong, E., Blockchain Bills…, p. 205.

[9] Goldby, M., *Electronic Documents…*, p. 329.

[10] Blockchain and DLT are often used interchangeably but they are not the same. Blockchain is a type of DLT where all transactions are recorded and grouped in blocks with an immutable cryptographic signature.

[11] See in general Zetzsche, D. A.; Buckley, R. P.; Arner, D. W., The Distributed Liability of Distributed Ledgers: Legal Risks of Blockchain, *University of Illinois Law Review*, vol. 2018,

transactions to be carried out quickly, securely, and inexpensively. The significant potential advantage of blockchain bills of lading is that they are based on a decentralised system that does not require a registry or third-party intermediary's control and can be used by anyone, presumably inexpensively.[12] Since blockchain technology also involves new terminologies, some technical aspects need explanations to better understand blockchain bills of lading.[13]

### 3.1. Blockchain: Technological Aspects

Blockchain is a distributed online ledger,[14] a database that essentially operates as a decentralised digital logbook or bookkeeping system in which a certain amount of transaction history is collected as a block.[15] The database contains a continuous and complete record of transactions, and each block is chained to the next block using a cryptographic signature called hashing.[16] For new transactions to be added to the blockchain, a participant in the network must solve a complex mathematical problem known as proof-of-work (POW).[17] This process is called mining, aimed at verifying whether the transactions are legitimate and, if so, grouping them into a newly generated block.[18] Once the problem is solved,

no. 4, p. 1361; Saive, D., Das Blockchain-Traditionspapiere, *Transportrecht*, vol. 41 (2018), no. 6, p. 234; and Takahashi, K., Blockchain Technology..., *op. cit.*

12 Takahashi, K., Blockchain Technology…, pp. 205-206.

13 Some of the essential terms associated with blockchain technologies are explained in the glossary at the end of this text. However, the language and terminology regarding this whole technology remain unsettled.

14 Each computer on a particular blockchain is called a "node", and all nodes operate under the same set of rules; they are connected via the internet and therefore communicate directly without a third party. Each node has access to a copy of the blockchain data.

15 Takahashi, K., Blockchain Technology…, p. 202.

16 McKinlay, J.; Pithouse, D.; McGonagle, J.; Sanders, J., Blockchain: Background, Challenges and Legal Issues, 2 February 2018, available at https://www.dlapiper.com/en/uk/insights/publications/2017/06/blockchain-background-challenges-legal-issues/.

17 Apart from the proof-of-work algorithm, proof-of-stake has also been developed as another validation algorithm, mainly to overcome the disadvantages of the former. The main difference is that the proof-of-stake algorithm allows the blockchain system to choose some nodes offering large stakes to validate transactions rather than letting all the nodes compete, and mine blocks, which helps reduce energy consumption. See European Parliamentary Research Service, Scientific Foresight Unit (STOA), *Blockchain for Supply Chains and International Trade: Report on Key Features, Impacts and Policy Options,* Brussels, PE 641.544, May 2020, p. 7.

18 When a new block is created, each node in the network participates in verifying the block before broadcasting it to other nodes. The selected transactions form a block, and it remains unconfirmed until it is added to the blockchain for confirmation. See, Crosby, M.; Nachiappan, Pattanayak, P.; Verma, S.; Kalyanaraman, V., Blockchain Technology:

the new block information is announced to the other miners of the network for its validation, after which the valid block is added to their distributed ledger.

The previous block and the new block can be linked together by adding the hash value of the previous block to the new one, by which the transaction can be cryptographically confirmed. In this process, a node wanting to enter into a transaction needs a specific key, which is created by solving the complex mathematical problem, to add the transaction to the blockchain.[19] Public key cryptography plays an important role where public key and private key work together for the completion of a transaction. The private key, which is known only to the user who has generated the digital signature,[20] is used to digitally sign transactions. The public key, known to all participants, is used to verify that the transaction was signed by the owner of that private key. As a result, a great level of transaction integrity can be achieved.

### 3.2. Main Features of Blockchain Technology

The key features of blockchain technology are decentralisation, pseudonymity, and immutability.[21]

*(a) Decentralised System*

A blockchain may be a public ("permissionless") or a private ("permissioned")[22] digital network used for recording transactions.[23] Private blockchain networks

Beyond Bitcoin, *Applied Innovation Review*, 2016, no. 2, pp. 1-16, available at https://j2-capital.com/wp-content/uploads/2017/11/AIR-2016-Blockchain.pdf.

[19] Herd, J., Blocks of Lading: Distributed Ledger Technology and the Disruption of Sea Carriage Regulation, *Queensland University of Technology Law Review*, vol. 18 (2018), no. 2, p. 310.

[20] Bashir, I., *Mastering Blockchain*, Packt Publishing, Birmingham, 2020, p. 70.

[21] In general, see Zheng, Z.; Xie, S.; Dai, H.; Chen, X.; Wang, H., Blockchain Challenges and Opportunities: A Survey, *International Journal of Web and Grid Services*, vol. 14 (2018), no. 4, p. 352; Tapscott, D.; Tapscott, A., *Blockchain Revolution: How the Technology Behind Bitcoin Is Changing Money, Business, and the World*, Portfolio/Penguin, New York, 2016. See also Li, M.; Weng J.; Yang, A.; Lu, W.; Zhang, Y.; Hou, L.; Liu, J.; Xiang, Y.; and Deng, R., Crowd BC: A Blockchain-based Decentralized Framework for Crowdsourcing, *IEEE Transactions on Parallel and Distributed System*, vol. 30 (2019), no. 6, p. 1251.

[22] Permissionless/public or permissioned/private are interchangeably used, but there is a slight difference. The distinction between permissionless and permissioned blockchain is mainly related to the issue of access to the platform: a permissionless blockchain is open to anyone with a computer (software), whereas a permissioned blockchain restricts access. The distinction between public and private blockchains lies in the management of (who manages) the platform and user authentication. See Ganne, E., *Can Blockchain Revolutionize International Trade?*, WTO Publications, Geneva, 2018, pp. 8-9.

[23] Some authors also speak of consortium or hybrid blockchains as a third (middle-ground) type of network.

involve a number of participants whose identities are revealed by their public key, leading to factual anonymity.[24] A public system is a kind of self-maintained database, and the information regarding transactions is stored automatically and traced without the participation of a third party. Thus, it is not designed to shut down, block or limit access only to certain members; it is an open system. Everyone in a public blockchain has the same permission to read, send transactions and participate in the consensus mechanism. Blockchain records are also transparent and traceable – anyone with access to the internet can view the records and record history.[25]

On the other hand, a private blockchain system, which is preferred by some parties such as banks, involves a third party acting as a central administrator who may restrict members' access. The access control mechanism of the private blockchain could vary depending on the system, but new members need to obtain an invitation or permission based on a set of rules to join the system. Members may be known within the network, but transactions remain secret.

*(b) Pseudonymity*

To ensure the security of transactions using blockchain technology, confidentiality is of essential importance. Pseudonymity does not mean that the counterpart of a transaction is unknown. Transactions are conducted through a publicly available address or key, whose identity is not known or recorded on the blockchain, though it might be possible to trace the identity of the user with the address information as long as there is sufficient time and resources.

Public blockchain may not be able to sufficiently protect the confidentiality and privacy of its contents, because it is designed to be universally transparent. Though encrypted, the blockchain contents are distributed and open to everyone in the world, through which double-spending can be watched; combined with the timestamping function that allows only the chronologically first transaction to be recorded, double-spending is technologically impossible. Still, a public blockchain system can be set up in a way to guarantee anonymity by making it almost impossible to link a transaction to its individual address.

On the other hand, private blockchains are designed in such a way that one entity controls the permissions to validate and write data onto the blockchain, while, unlike public blockchains, participants are identified. Considering the ability of private blockchains to restrict users from reading certain data or adding

[24] Takahashi, K., Blockchain Technology…, p. 209.

[25] Vlačič, P.; Čekrlič, B., The Time Is Now: Widespread Adoption of the Electronic Bill of Lading, *Il Diritto Marittimo*, vol. CXXII (2020), no. 3, p. 709.

new transactions, private blockchains can provide a greater level of privacy and confidentiality, which is an advantage compared to public blockchains.

*(c) Immutability*

Immutability or tamper resistance is another essential feature of blockchain technology. Cryptography technology is designed to create secure and immutable records by making it virtually impossible to tamper with data in the blockchain blocks.[26] Blockchain records could be modified in theory; for example, a group of miners controlling more than 50% of the network's computing power could prevent new transactions from gaining confirmation, suspend payments between users, or reverse completed transactions (51% attack). However, older blocks would be more difficult to rewrite due to the higher level of computation power required.

The feature of immutability is attributed to the mechanism of hashing that protects the data and of the timestamp server that is responsible for the chronological connection between the blocks. The ledger records back-linked sequences of blocks that contain transactions in an orderly manner. This means that each block contains data that refer to its predecessor in the chain. Blocks are identified by a "hash" contained in the header of each block. Each block header also contains a reference to its parent block, which is the hash of the previous block. Since each block is linked to its parent, a sequence of blocks, or a "blockchain", is created, tracing all the way back to the genesis block.

### 3.3. Blockchain Bill of Lading as a Functional Equivalent of Bill of Lading

The replacement of paper bills of lading with blockchain ones raises several legal issues. A blockchain bill of lading does not simply mean that it is a computer-generated one containing the same data as a paper bill of lading. From a practical aspect, blockchain bills of lading do not have to be a replica of paper bills. What is important is whether blockchain bills can perform the same functions as paper bills of lading.

A blockchain bill of lading is supposed to perform the same functions as its paper equivalent, with the only difference being in the manner of performance.

As a reminder, the functions of a bill of lading are:

(a) Evidence of goods received for carriage;

(b) Evidence of the contract of carriage and its conditions; and

[26] Kinthaert, L., Could Blockchain Be the Shipping Industry's Life Jacket? *Innovation & Digital Shipping*, 22 December 2016, Informaconnect, available at https://informaconnect.com/could-blockchain-be-the-shipping-industrys-life-jacket/.

(c) Document of title.

As long as a proper security system is in place, the performance of the functions of receipt and evidence of contract should not be problematic. The problems arise concerning the third function: document of title. It should be noted that this issue is not relevant in the case of a sea waybill and is limited to negotiable documents of title.

### 3.4. Blockchain Bills of Lading as Documents of Title

Transactions using blockchain may involve a variety of tangible and intangible values, including cryptocurrencies and goods. The original purpose of blockchain technology was related to using the cryptocurrency known as "Bitcoin". What connects bitcoin and a blockchain bill of lading is the same technology and their similar nature which represents certain values. Yet, bitcoin represents the right to a monetary value[27] while a blockchain bill of lading represents the right to particular goods.

The bill of lading has the character of a document of title. It gives its holder the right to claim the goods from the carrier once they arrive at the port of destination. It also enables its holder to dispose of the goods in transit. Can a blockchain bill of lading perform these functions in the same or in a similar way?

A paper bill of lading plays its role as a negotiable document not because it is paper, but because of what can be done with it.[28] What counts is not whether or not it is in tangible form, but what it represents and what it is capable of doing.[29]

Blockchain bills of lading, being intangible electronic data, cannot be physically possessed. This creates a problem in performing the document of title function, where the physical possession of a paper bill of lading is a prerequisite for performing the function. That is, intangible data cannot be produced on delivery nor endorsed to a new holder. To compensate for this handicap, it is necessary to find an alternative way to embody the physical possession of an electronic document so that the negotiability of documents of title can be simulated. To overcome this difficulty, there is a need for a new intangible concept that enables the transfer of rights in the goods without relying on physical possession of a piece of paper.

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[27] Of course, this is valid only in jurisdictions that accept Bitcoin, such as El Salvador.

[28] Clarke, M., Transport Documents: Their Transferability as Documents of Title; Electronic Documents, *Lloyd's Maritime and Commercial Law Quarterly*, Part 3 (2002), p. 363.

[29] Chandler, G. F., Maritime Electronic Commerce for the Twenty-First Century, *European Transport Law*, vol. 32 (1997), pp. 654-655.

Blockchain has the potential to solve the problems concerning the function of documents of title. Blockchain technology allows tokenisation of physical assets which can be used to create blockchain bills of lading as tokens acting as an asset. The node with such a token has the right of possession and disposal of the token. Private keys enable the user to access the wallets and grant him the exclusive right to execute transactions on the wallet.[30] This is of essential importance for the function of the blockchain bill of lading as a document of title, since only the holder of the private key can transfer a document of title.[31]

The private key and digital signature secure possession of the token. Possession of a blockchain bill of lading can be transferred thanks to hashing, which prevents the bill of lading from being tampered with and the transfer of the bill of lading from being reversed.[32] Blockchain bills of lading can achieve the endorsement function because the token is in the form of a chain of digital signatures whose order is established[33] and cannot be reversed. This is possible thanks to the security of hashing that transforms the data into a hash value; it is impossible to trace the original data through a hash value, so once the possession of a token is transferred, the transfer is irreversible. The holder of a blockchain bill is in virtually the same position as the holder of a paper bill of lading.

### 3.5. Possession and Exclusive Control

The objective of blockchain bills of lading is to achieve functional equivalence. This means that blockchain bills do not have to perform the functions of paper documents in the same way as paper documents. Still, they should be able to achieve the same effects, so that the holder of the token under a blockchain bill of lading is in the same position as the holder of a paper bill of lading. The essential element of functional equivalence is to ensure the uniqueness of the blockchain bill, the ability to "possess" the bill, and the ability to pass on the right by transferring the bill onto another party.

30 Wallet basically means the software that holds secret keys. It is used to access and control Ethereum accounts and interact with smart contracts. Keys need not be stored in a wallet and can instead be retrieved from offline storage (e.g., a memory card or paper) for improved security. Despite the name, wallets never store the actual coins or tokens.

31 Vlačič, P.; Čekrlič, B., The Time Is Now…, p. 709.

32 Ong, E., Blockchain Bills…, p. 214.

33 Abdellatif, N.-P., An Ethereum Bill of Lading under the UNCITRAL MLETR, *Maastricht Journal of European and Comparative Law*, vol. 27 (2020), no. 2, p. 269.

The holder can possess, or control, a blockchain bill of lading, and through the digital identity, exclude others from accessing the blockchain bill.[34] In this way, the holder can have the right of possession as in the case of a paper bill. Public Key Infrastructure (PKI) technology enables the blockchain bill of lading to identify a holder, but pseudonymously.[35] The transfer of exclusive control to a transferee and the transferor's loss of control through cryptographic one-way hashing is comparable to the transfer mechanism of legal possession. Controlling goods through blockchain bills of lading is enabled by the act of transfer, and the new holder can evidence its possessory rights by holding the private key that represents the control of the blockchain bill.

Electronic procedures used to transfer rights should ensure that the rights are transferred to a specific person and that no one can interfere with the rights. Of course, electronic procedures must be acceptable from both security and legality aspects.

The blockchain acts as a depository for data while allowing the transfer of title from one party to another, and cancelling the first party's title at the moment the title is transferred to the new holder. Since blockchain technology allows the functional equivalence of possession through the token, despite its digital environment, transferring the token of blockchain bills of lading would enable transferring control over the goods in a very similar way as paper bills of lading do. From a technical perspective, transferring the blockchain token can electronically simulate the way a paper bill of lading is transferred. The problem is how to implement this concept in practice and how to give it legal validity.

### 3.6. A Public or Private System

Blockchain bills of lading may operate in either public or private (or hybrid) systems. A kind of private system already functions in practice.[36] Some parties, such as banks or trading partners with long-term relationships, may prefer a private system. The private blockchain system is distinguished from the current registry model in terms of how the transaction relationship is evidenced and the

[34] Ong, E., Blockchain Bills…, p. 214.

[35] See Bacon, J.; Michels, J. D.; Millard, C.; Singh, J., Blockchain Demystified: A Technical and Legal Introduction to Distributed and Centralised Ledgers, *Richmond Journal of Law & Technology*, vol. 25 (2018), no. 1, p. 103. While the use of a pseudonym may protect the confidentiality of a transaction, since the flow of transactions is recorded on the blockchain, there is the possibility that the party can be identified by comparing it with information outside the blockchain.

[36] See footnote 1.

level of reliance on the third-party intermediary. Still, a private blockchain system similarly requires a certain level of control or involvement by a third-party system provider due to registration and access control in a closed setting. This creates the same problem as a registry-based system; it would be difficult for a member of a private blockchain network to execute a transaction with a non-member, so in such a case the blockchain bill would have to be substituted with a paper bill of lading. Nevertheless, if private blockchain systems prove to be cost-effective and speedy while guaranteeing a higher level of transparency and privacy, they may in the near future replace the currently used registry systems.

One of the critical advantages of the public blockchain is that it is open and transparent – it enables anyone to join a transaction, which is similar to the current paper bill of lading system. The public system may be more suitable in the case of commodity trade where the goods are resold many times. Public blockchain bills of lading would heighten the uptake of trade of goods in transit, benefiting traders who want to make the trade information public for the chance of better transactions during the carriage. In that case, the issue of the anonymity of the parties arises as well. As companies could participate in the transfer of title without revealing their identities, and as one company could hold multiple addresses, the nature of the public blockchain can be misused by, for example, intentionally distorting the market price of certain commodities. On the other hand, if the identity of pseudonymous addresses should be traceable, which would be possible depending on the policy of blockchain analysis, companies would be reluctant to use the network due to concerns about their privacy and the confidentiality of their trade information.

The problem with a public blockchain system is that the data contents, which are not intended to be shared with those who remain outside a certain group, could be exposed to anyone. This poses a problem to the blockchain replication of a paper bill of lading, where the identity of the parties and their trade history are known only among the parties involved in the transfers of title.

Perhaps there is a need to depart from the traditional rules that apply to the paper bill of lading and create new rules based on the blockchain technology to verify the identity of the parties in a different way. Alternatively, there may be no need for verification (as in the case of a bill of lading to the bearer). As an idea, to identify the party that has the right of control under blockchain bills of lading, the term "lawful holder of the bill of lading" may be replaced by "authorised holder of the private key of the blockchain bill of lading" (this term may sound a bit clumsy), or simply "authorised/controlling party". New terminology may be necessary to reflect more precisely the new ways of operation, even if the substance of the character of control remains the same.

The public blockchain system could be a double-edged sword: on one hand, it provides trade information for those who are interested in taking part in the sale of goods in transit, while the seller can benefit from a potentially higher price of the goods. On the other hand, it might unnecessarily expose trade information, as well as information concerning the parties involved in the sale of goods in transit. In addition to the problems related to legal recognition of blockchain bills of lading, the risk of privacy and confidentiality may be the main reason why the current blockchain bill of lading system is limited to private systems.

The public blockchain system promises a number of benefits, and it may eventually become the dominant blockchain bill of lading system in the future. The goal of replicating paper bills of lading can be achieved only by an open system. Yet, permissioned or hybrid blockchain has been at the centre of the latest growth of blockchain applications in response to commercial needs. Thus, it is unlikely that a public-type blockchain bill of lading will be widely used any time soon.

### 3.7. Way of Operating Blockchain Bills of Lading

Members in trade transactions usually include merchants, buyers, sellers, carriers, and banks. They can conduct secure transactions through their digital signatures. In a blockchain system, there is no trusted third party in charge of validating a transaction, but the members validate it collectively.

Blockchain technology applied to a bill of lading is an example of the token model, which may achieve the same purpose as the registry model. The token is used to access the electronic record that grants exclusive control over the goods.[37] Blockchain has made it possible to transfer rights online without the intervention of a third party. The shipper can transfer an electronic record by using its private key to digitally sign the hash in the record and send it to the consignee with a public key. Since the public key is available in the public directory of the certification authority, other related parties can view the document. Still, only the shipper or a subsequent transferor can transfer. Once the data are transferred, the control moves from the shipper to the transferee or to the consignee, who becomes the only party controlling these data in the blockchain.

Blockchain bills of lading can follow the same stages as paper bills of lading – issuance, transfer, and delivery – but in a different manner.

[37] Goldby, M., *Electronic Documents…*, pp. 328-329.

### *3.7.1. Issuance*

In practice, issuing a blockchain bill of lading starts when the shipper delivers the goods to the carrier. After receiving the goods in charge, the carrier will verify the data provided by the shipper. The carrier can create a "genesis" block as part of issuing a blockchain bill of lading signed by the carrier's private key, the hash, and the shipper's public key. The carrier can record in the block the data that are usually also contained in a paper bill of lading, such as the description of the goods, the name of the vessel, port of loading and discharge, the names of the shipper and the consignee (or notify party), possible reservations regarding the defective condition or shortage of the goods, etc. The carrier can then use its digital signature to verify the data in the block. On a blockchain, a carrier may issue an encrypted message using its private key and the intended receiver's (shipper's) public key. The shipper, using the carrier's public key, can verify that the message originated from the carrier and has not been altered during transmission, and safely decrypt the message using his private key to prove the possession of the tokenised bill of lading.

At this point, the transaction is recorded on the distributed ledger. The token representing the right to the goods is issued to the shipper, who then acquires possession of the token – which plays the same functions as a paper bill of lading. Once a record has been issued, only one person can control the record in the blockchain. Initially, that party is the shipper. The shipper can rely on the integrity of the record as hash functions create a tamper-evident data structure to prove the integrity of the data.[38]

### *3.7.2. Transfer*

The shipper is entitled to transfer the rights in the goods by transferring tokens to a new buyer, which would in this way acquire the rights under the contract of carriage, including the right to the delivery of the goods, and the rights against the carrier if the goods are lost or damaged during carriage. The shipper can transfer the blockchain bill of lading by signing it with its private key, the hash, and the public key of the transferee. The holder of the private key can easily access and transfer blockchain bills of lading by transferring a token to another user, so that the holder of the private key deposits the document in another wallet, or, in the terminology of paper bills of lading, transfers the document to a new lawful holder of the bill of lading (transferee).

The token transfer is carried out by hashing the token using the public key and digitally signing the token using its private key. PKI technology enables the

[38] Bacon, J. *et al.*, Blockchain Demystified…, p. 11.

blockchain bill of lading to identify the holder. A transferee of a blockchain bill of lading can verify the chain of previous holders of the rights to the goods. In this way, the blockchain can be transferred as many times as a paper bill of lading can be transferred by endorsement.

The pseudonymous character of blockchain transactions does not represent a problem to the transfer of blockchain bills of lading. While the actual names of the parties may not be known, there is no problem in transferring blockchain bills of lading to an intended transferee/consignee even in the setting of the public blockchain. Still, a potential risk remains as to whether or not the identity of the parties involved in a certain trade, or their transaction information, would be traced and exposed.

### *3.7.3. Delivery*

At the port of destination, the carrier is obliged to deliver the goods to the person whose public key matches the private key of the last recipient of the tokens on the blockchain. The carrier will deliver the goods to the last holder of the token, similar to the way, in the case of a paper bill of lading, the goods are delivered to the last lawful holder of the bill of lading. The use of public and private keys, a signing algorithm, and a validation function ensure that the holder of a blockchain bill of lading can show that he is entitled to take delivery of the goods based on the blockchain bill. At the moment of delivery of the goods, the consignee transfers control over the token in favour of the carrier, imitating the way the goods are delivered against a paper bill of lading.

### *3.7.4. Integrity and Security*

One of the key aspects of a document of title is "uniqueness". A document of title must not only be "original" but also "unique", which assures the parties that its holder is the only person entitled to take delivery of the goods it represents. "Original" means that statements contained in the document have not been changed since the document was issued; this is a matter of ensuring the integrity of the information contained in a blockchain bill of lading.

The "uniqueness" requirement may not be suitable for electronic records, which are by nature intangible and easy to duplicate. To prevent the risk of unauthorised duplication, it is sufficient to keep a particular record unaltered while preventing unauthorised users from accessing the record.[39] To replace its

[39] An electronic equivalent to possession of a paper document can be achieved by effective access to and control of a particular electronic record, not necessarily because the electronic

paper equivalent, the blockchain bill of lading must be a unique document meeting the requirement of originality. Digital signatures can achieve this as a substitution for handwritten signatures used to authenticate paper bills of lading.

One of the most important features of blockchain technology is that once data are recorded on the blockchain, it is impossible to change them – blockchain records are immutable, which protects the holder of the right against alterations of the records. Blockchain bills of lading are encrypted on the blockchain network, and only nodes which have a private key can access them. Once the token has been transferred to another and the transferred data are recorded, there is no turning back – no one is able to modify the data. In this regard, if a mistake in one of the transfers leads to the misdelivery of the goods, it is questionable whether the transfer order can be recovered. It might be possible to reactivate the retrieved blockchain bill of lading so the final transferee of the token can transfer back to the point where the mistaken transfer occurred, which involves many uncertainties. Blockchain technology includes several technological devices that can guarantee the integrity of a blockchain bill of lading. The use of PKI and authentication by unique digital signatures are far more secure than handwritten signatures (which can be easily imitated). The hash value of the previous blocks that are used to sign future blocks represents a guarantee of the integrity of the transaction whose contents cannot be modified after a block is created.

### *3.7.5. Liability*

The blockchain system is not free from technical challenges such as liability for system errors, communication failure, and system breakdowns.[40] The issue is who should bear the risk of malfunctioning blockchain technology. In the case of the registry model, that issue is clearer and the party operating the registry should assume liability in such a case. On the other hand, in the case of a decentralised system, the issue remains open. It depends on whether the malfunctioning derives from the error of some of the parties in the chain or whether the error occurs without any party in the chain being responsible for it.

The liability issue will have to be addressed once the system causes problems in practice, but it would be better to try to regulate pre-emptively. Prevention is usually less costly than cure.

record itself cannot be duplicated. Today's computer security has been developed to the extent that an electronic record can be distinguished from other records and cannot be accessed by unauthorised users.

[40] Yang, J., Applicability of Blockchain Based Bill of Lading under the Rotterdam Rules and UNCITRAL Model Law on Electronic Transferable Records, *Journal of Korea Trade*, vol. 23 (2019), no. 6, p. 128; and Liu, H., Blockchain and Bills..., *op. cit.*

## 4. LEGAL FRAMEWORK

Blockchain bills of lading can potentially play an important role in international trade, but they still face various challenges regarding their legal value.[41] They are not yet legally recognised due to the absence of a legal regime. Their validity is supposed to derive from substantive law, which has failed to provide legal recognition of electronic transport documents.

There is no international framework that properly regulates blockchain bills of lading, which creates legal uncertainty regarding the rights of the parties under blockchain bills. While blockchain technology may have a strong impact on the way business will be conducted in the future, there are still many legal issues that need to be addressed.

Blockchain bills of lading would not be covered by international conventions governing the carriage of goods by sea, such as the Hague-Visby Rules as the most widely applied convention, which were drafted in the period that preceded the development of electronic commerce and IT technology. Blockchain bills are not recognised as documents of title to which this international convention applies.

The lack of an adequate legal framework applicable to blockchain bills of lading represents a serious deficiency. Some attempts have been made at both international and national levels. At the international level, of particular importance are the attempts made by UNCITRAL, such as the Rotterdam Rules (2008) and the Model Law on Electronic Transferrable Records (2017). At the national level, several countries have adopted laws that might be applicable to blockchain bills of lading.

### 4.1. The Rotterdam Rules

The UN Convention on the International Contracts for Carriage of Goods Wholly or Partly by Sea, 2008 (the Rotterdam Rules) was the very first attempt to regulate electronic transport documents by an international convention. Article 1(18) contains a definition of the term "electronic transport record" as "information in one or more messages issued by electronic communication under a contract of carriage by a carrier… that: (a) Evidences the carrier's or a performing party's receipt of goods under a contract of carriage; and (b) Evidences or contains a contract of carriage". Article 1(19) further defines a negotiable electronic transport record as fulfilling the requirements of Article 9(1) while indicating

[41] See in general Ong, E., Blockchain Bills..., *op. cit.*

that "the goods have been consigned to the order of the shipper or to the order of the consignee and is not explicitly stated as being 'non-negotiable' or 'not negotiable'".

Article 8(b) of the Rotterdam Rules provides that "The issuance, exclusive control, or transfer of an electronic transport record has the same effect as the issuance, possession, or transfer of a transport document", which is based on a functional equivalence principle. This provision suggests that "exclusive control" of electronic transport records is equivalent to possession of transport documents. An electronic transport record must be subject to exclusive control from its creation until it ceases to have any effect[42] to fulfil the objective that only one person is entitled to have control over the goods. The reliance on control indicates that the Rotterdam Rules are mainly based on the registry model, but their application may be extended to the control of blockchain bills of lading. The Rotterdam Rules contain separate and parallel rules for paper versus electronic commerce practices.[43] Each rule applicable to paper bills of lading has an electronic equivalent applicable to electronic bills of lading. However, the Rotterdam Rules face an uncertain future since, so far, only a few countries have ratified this convention.[44]

### 4.2. The MLETR

A more recent approach is found in the Model Law on Electronic Transferrable Records (MLETR), which was adopted in 2017. From the aspect of applying to blockchain bills of lading, the timing of the adoption of the MLETR was not very good, since at that time blockchain bills of lading were not yet in use and the MLETR was drafted with the main focus on the registry system. However, there seems to be little difficulty in applying the MLETR to the blockchain as its explanatory note specifically mentions "token-based and distributed ledger-based systems".[45]

[42] Article 1(21); to ensure this, the use of an electronic transport record must meet substantive and procedural requirements under Article 9 of the Rotterdam Rules. Article 9(1) requires an electronic transport record to be subjected to procedures in which: (a) a transferor can transfer the record to an intended holder; (b) integrity of the record can be retained; (c) the holder can demonstrate that it is the genuine holder; and (d) the carrier can provide confirmation on the validity of the record (substantive requirements). These conditions may be operated by a particular electronic bill of lading system, which must be referred to in that record and readily ascertainable (procedural requirements).

[43] For example, Articles 4, 33 and 35.

[44] Currently, only five States – Spain (2011), The Republic of the Congo (2012), Togo (2014), Cameroon (2017), and Benin (2019) – have ratified the Rotterdam Rules.

[45] UNCITRAL Secretariat, Explanatory Note to the UNCITRAL Model Law on Electronic Transferable Records, in the United Nations, UNCITRAL Model Law on Electronic Transferable Records, 2018, para. 34.

The MLETR is based on two principles that may be relevant to blockchain bills of lading: (a) the principle of technological neutrality and (b) the principle of functional equivalence. For blockchain bills of lading, a particularly important aspect is the right of control.

*(a) Principle of Technological Neutrality*

The MLETR does not favour or exclude any particular technology. "Technological neutrality" enables the use of an electronic transferable record regardless of its underlying technology, thus providing a fair and objective environment for e-commerce without hampering the future development of technologies. The idea behind this is that the legal framework should be technology-neutral because technology is developing rapidly in this area.

The MLETR provides consistency with the technologies available for electronic transferable records; this effectively upholds the principle of neutrality. The system-neutral approach of the MLETR aims to enable "the use of various models whether based on the registry, token, distributed ledger or other technology".[46] The principle of technological neutrality allows the acceptance of blockchain technology, and the Explanatory Note refers to DLT.[47]

*(b) Principle of Functional Equivalence*

The MLETR applies to electronic transferable records that are functionally equivalent to transferable documents. The principle of functional equivalence means replicating the functions performed by paper documents in electronic form. This principle allows member states to regulate electronic transactions under existing laws without necessitating the wholesale elimination of paper-based requirements or changing the legal concepts and approaches underlying those requirements. This principle finds expression in Article 10, which treats an electronic transferable record as a transferable document or instrument if certain requirements are met.

*(c) Control*

Another relevant part of the MLETR relates to "control" which plays a key role in enabling an electronic transport document to perform the function of a document of title. Article 11 provides a functional equivalence rule for the possession of a transferable document; with this, the person in control of an electronic transferable record is in the same position as the entitled holder of a paper bill of lading.[48] The control focuses on the use of a reliable method to identify the person in control of the electronic transferable record.

[46] UNCITRAL Secretariat, 2018, para. 18.

[47] UNCITRAL Secretariat, 2018, paras. 18, 66, 78, 117, 143 and 197.

[48] UNCITRAL Secretariat, 2018, para. 109.

There might be slight confusion due to the equation of "control" and "possession" under the MLETR, as both categories traditionally refer to distinct legal constructs. On the one hand, the term "possession" may be preferable as it refers to settled legal principles, which may also be more compatible with the possession of a blockchain token. On the other hand, the term "control" might be more suitable to cover various kinds of documents or technologies. Either of the terms may be applied to blockchain bills of lading.

### 4.3. National Legislation

Most of the existing laws require a document of title to be in tangible form and to be signed. This raises doubts about whether blockchain bills of lading can have the status of a document of title. Since blockchain bills are a recent invention, and they are still not recognised as documents of title by merchant custom, the easiest way they can achieve the status of documents of title would be for existing legislation to be amended in a way that explicitly provides for such recognition.

At the national level, an increasing number of national law-making bodies have been engaged in reviewing national laws to accommodate the requirements of electronic commerce. As a result of these efforts, some existing laws have been amended. Most of these changes are aimed at removing legal barriers to electronic commerce such as form requirements for writing and signature and rules of evidence that might exclude computer-generated records. Some jurisdictions have adopted regulations aimed at enabling the use of electronic documents, particularly by revising civil procedure rules on evidence, and a number of countries have adopted specific laws on electronic commerce.

One possibility to recognise the validity of electronic transport documents lies in the adoption of a national law based on the MLETR which may serve as a template for unified national legislation or, at least, as a method of triggering discussions to reform domestic law. There are some encouraging signs regarding the success of the MLETR. Legislation based on or influenced by the MLETR has been adopted in seven jurisdictions – more than half of these acceptances have been made in the last two years.[49] While blockchain bills of lading may be recognised in those jurisdictions, most of the other national legislations have not yet addressed the issue of recognition.

[49] https://uncitral.un.org/en/texts/ecommerce/modellaw/electronic_transferable_records/status.

Under English law, electronic transport documents are not recognised as negotiable documents of title under the COGSA 1992. This means that rules governing the transfer of title and the right to sue are not applicable to blockchain bills of lading. Reform of the English COGSA would be welcome, as this is not the only issue that would require intervention in the current COGSA 1992.[50] Insufficient legislation backing the use of electronic transport documents has been identified as the dominant reason for the lack of progress.[51]

In the US, an important step was made by the 2003 revision of the Uniform Commercial Code (UCC). Revised Section 7 introduced comprehensive rules on electronic documents of title into US law.[52] Section 7-106 of the UCC provides that a person can be in control once the system is employed to identify the person to whom the rights in the goods have been transferred through the passing of an electronic record. This provision clarifies control in the case of electronic transport records as the functional equivalent of possession through the creation of a framework by which it can be established who has possession of the goods. A rule based on the concept of "control" has been established for the negotiation and transfer of electronic documents of title. Under this rule, a person has control of an electronic document of title if the method used to transfer interests in the electronic document reliably establishes that person as the person to which the electronic document was issued or transferred.

The German Commercial Code recently introduced a provision stating that an electronic transport record "having the same functions as a bill of lading shall be deemed equivalent to a bill of lading, provided that the authenticity and integrity of the record are assured".[53] Thus, the realisation of an electronic transport record serving the same functions as a bill of lading would *ipso iure* deem this electronic record equivalent to a paper bill under German law (i.e., the "functional equivalence" approach).[54] The new German Commercial Code

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50 Straight bills of lading need to be recognised as a document of title following the *Rafaela S* case.

51 Goldby, M., *Electronic Documents…*, pp. 129-130.

52 See UCC § 7, American Law Institute & Uniform Law Commission 2003; see also Goldby, M., *Electronic Documents…*, p. 145.

53 Handelsgesetzbuch [HGB] [Commercial Code], as amended by Article 5 of the Act of July 5, 2016, § 516, para. 2, available at http://www.gesetze-im-internet.de/englisch_hgb/englisch_hgb.html#p0977(Ger.) and https://dserver.bundestag.de/btd/17/103/1710309.pdf; see also Saive, D., Blockchain Documents of Title – Negotiable Electronic Bills of Lading Under German Law, (23 January 2019), available at https://ssrn.com/abstract=3321368.

54 See German Bundestag [Parliament], Bundestagsdrucksache [Parliament Paper], Deutscher Bundestag: Drucksache [BT] 17/10309, 93.

allows for electronic bills of lading to be issued, although the details thereof remain to be determined by government regulation.[55] So far, no such regulations have been adopted, so electronic bills of lading are not granted legal recognition under the current German law.

In Korea, electronic bills of lading were introduced in the 2007 revision of the Commercial Code, in which they are treated as having the same effect as paper bills of lading.[56] The revision relies on a registry operated by the Korea Trade Net (KTNET), which is selected and supervised by the Ministry of Justice, so it is not applicable to blockchain bills of lading.

## 5. FUTURE

To achieve wide implementation of blockchain bills of lading in practice, all parties should be familiar with blockchain technology, as coordination and cooperation are required among the carrier, the shipper, the consignee, and other potential holders of blockchain bills of lading. At this stage, it is not realistic to have wide use of blockchain technology in the case of smaller companies. The present situation confirms that at the moment only some large companies take part in the process of implementing blockchain bills of lading. Time is needed, and with the fast development of technology that requires the quick adjustment

[55] Section 516(3) provides that the Ministry of Justice is empowered to determine by regulation the details of issuing, presenting, and transferring electronic bills of lading.

[56] Article 862 of the Commercial Code (Electronic Bill of Lading) provides that:

1. Instead of issuing a bill of lading pursuant to Article 852, n20 or 855, n21, the carrier may issue an electronic bill of lading by way of registering it in the title registry designated by the Minister of Justice upon assent of the shipper or charterer. The electronic bill of lading issued thereon has the same effect as the bill of lading issued pursuant to Article 852 or 855.

2. The electronic bill of lading should include information stated in Article 853(1). Only after the carrier includes an electronic signature and sends it to the shipper or the charterer and they have received it, does the electronic bill of lading become effective.

3. The holder of an electronic bill of lading can assign its rights to an assignee through an electronic document with information of indorsement and by sending this with the electronic bill of lading to the assignee through the designated registry.

4. When the assignee receives the above electronic document with the information of the indorsement according to par. 3, the electronic bill of lading has the same effect as if the assignor had made written indorsement and delivered the bill of lading to the assignee pursuant to Articles 852 and 855. The assignee of the electronic bill of lading acquires the same rights as the assignee who obtains the bill of lading pursuant to Articles 852 and 855.

of businesses, blockchain bills of lading have good prospects of being widely used in the future.

To achieve their objectives, blockchain bills of lading have to be able to perform both in practice and in law. To perform in practice, they must win the confidence of users. To do so, they should ensure reliability and security. Users are reluctant to adopt practices that increase risks regarding security and the unauthorised transfer of control. To perform in law, there is the need for a legal framework that recognises that blockchain bills have the same legal effect as paper bills of lading. Performance in practice and performance in law are closely related; success in practice facilitates performance in law. Successful implementation of blockchain bills in practice may prepare the ground for their legal recognition.

The discussion in this paper is under a disclaimer: blockchain technology is still "under construction", being subject to the structure of various protocols or algorithms, and full implementation of this technology will require some time.[57] We are witnessing the "acceleration of history" that started with the "information revolution", and blockchain technology is just one piece of this large, evolving process. Several projects based on blockchain technology that have been launched in recent years may pave the way for the future. However, there is still a long way to go before the use of blockchain bills of lading becomes widespread. Both legal and technical issues have to be resolved.

It is unrealistic to create a centralised system adopted by all traders around the world, at least in the foreseeable future. Without solving legal obstacles, the use of blockchain bills of lading will face serious difficulties in practical implementation. Despite all the challenges, it is beyond doubt that in the future all paper transport documents will be replaced by data interchanged through computerised networks connecting shipowners, charterers, freight forwarders, shippers, consignees, sellers, buyers, and bankers.

## 6. CONCLUSION

Blockchain technology has great potential to transform the global logistics industry. Blockchain is not just an abstract concept, but has started its practical implementation in several pioneering projects. Blockchain technology is still in the process of development, so it may be premature to make definite conclusions on its impact on various areas of business. One of the areas where blockchain

[57] Baraniuk, C., Blockchain: The Revolution that Hasn't quite Happened, 11 February 2020, *BBC*, available at https://www.bbc.com/news/business-51281233.

technology has the potential to find a solution relates to the replacement of paper bills of lading by blockchain bills of lading. However, at the moment practical implementation is still at an early stage, being limited to several projects promoted by shipping companies and related businesses.

Commercial implementation of blockchain bills of lading still faces many challenges. At present, one of the main obstacles is the fact that electronic documents still do not satisfy certain legal requirements, including requirements pertaining to negotiable documents. The legal infrastructure is also not fully compatible with e-commerce. Most of the existing legal frameworks are still based on paper documents, which is inappropriate for dealing with electronic records.

Despite technological advances that have been followed by adjustments in the law, progress in the use of electronic transport documents has been rather slow. One of the main reasons is legal uncertainty deriving from the fact that electronic transport documents are not given the same legal recognition as paper documents. As long as electronic transport documents are not afforded the same legal status and protection as paper documents, their effectiveness will be limited and made dependent on alternative instruments that are typically contract based.

Law has made important steps to accommodate technological developments in the area of electronic transport documents, such as technological neutrality and functional equivalence principles adopted by several UNCITRAL instruments. This certainly helps in the implementation of blockchain bills of lading. However, as technology develops, new legal issues emerge that will also require the attention of legislators.

The fact that many legal issues relating to electronic commerce have still not been resolved has not prevented electronic commerce from being practised. It can be assumed that initially paper bills of lading will be used in combination with electronic transport documents so that existing form requirements can still be accommodated. In the long run, however, the use of electronic transport documents will increase, leading to a reduction in the use of traditional bills of lading and to their eventual demise.

Should law wait for practice to develop, or should law "facilitate" the development of practice? Would it be better for the law to change first, as businesses are currently reluctant to undertake electronic transactions due to the lack of legal certainty? Law reform is necessary. This does not mean that practice should wait for law reforms. Law and practice working in parallel is the best solution.

## GLOSSARY (SELECTED TERMS ONLY)

| | |
|---|---|
| **Block** | A group of transactions entered into a blockchain analogous to a page of a ledger or record book. A difference can be made between the head of the block ("block header") which includes the hash of the previous block, and its body ("body block") which contains the transaction input and may include the contents of a bill of lading. |
| **Blockchain** | Blockchain is a public digital ledger of past transactions in order. Blockchain is a decentralised system for storing information among its members that operates without the involvement of a third party. Blockchain is called thus because it is a chain of blocks. |
| **Blockchain (Private a.k.a. Permissioned)** | Existing members must admit participants in the blockchain, and the general public do not have access. Members would include the merchants buying and selling the goods, the carriers, and the banks. |
| **Blockchain (Public a.k.a. Permissionless)** | A blockchain that resides on a network of computers worldwide that is accessible to everyone who has the necessary software. |
| **Decentralisation/ Decentralised** | A system with no single point where decisions are made. |
| **Distributed** | Unlike a decentralised system, a distributed system shares processing and/or data across multiple nodes, but the decisions may still be centralised and may use complete system knowledge. |
| **Distributed Ledger Technology (DLT)** | The larger class of technology of which blockchain is a subset. A digital system in which the transactions and their details are recorded in multiple identical copies at the same time with no central data store or administration. |

| | |
|---|---|
| **Ethereum** | A public blockchain that supports smart contracts. Ethereum provides a platform where anyone can create applications to securely change data and value. |
| **Genesis Block** | The first or first few blocks of a blockchain that do not have a hash for the previous block. |
| **Hashing** | The process of translating a given key into a code. A hash function is used to generate new value according to a mathematical algorithm. |
| **Immutable/Immutability** | The property of being unchangeable. Once a transaction has been added to a block and written to a blockchain, it cannot be changed and is immutable. |
| **Miners** | Participants have the same file on their respective nodes, each of which is an iteration of an original (making it "decentralised"). Mining means adding transaction records to the blockchain ledger after confirming the validity of the transactions. |
| **Node** | Participants within the network. Their computers have a file containing the history of certain transactions. A computer that holds a copy of the blockchain ledger. |
| **Public Key Infrastructure (PKI)** | A technique where two sets of "keys" are generated: the public key and the private key. These two keys are used to authenticate parties and information. |
| **Token** | Cryptographic tokens represent programmable assets or access rights, managed by a smart contract and an underlying distributed ledger. They are accessible only by the person who has the private key for that address and can only be signed using this private key. |

| | |
|---|---|
| **Wallet** | Software that holds secret keys. Used to access and control Ethereum accounts and interact with smart contracts. The wallet also has a blockchain address to which transactions can be sent. Despite the name, wallets never store actual coins or tokens. |

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***Sažetak:***

**BLOCKCHAIN *TERETNICE – NOVA GENERACIJA ELEKTRONSKIH PRIJEVOZNIH ISPRAVA***

*U posljednje vrijeme, blockchain tehnologiji posvećuje se velika pozornost kao novini u međunarodnoj trgovini. Stranke u međunarodnoj trgovini sada mogu sigurnije ulaziti u transakcije zahvaljujući blockchain tehnologiji, bez potrebe da se oslanjaju na usluge treće stranke, a istodobno da iskorištavaju prednosti veće brzine i niže cijene transakcija. Blockchain tehnologija, također, ima presudan utjecaj na razvoj elektronskih prijevoznih dokumenata. Prethodno postojeće elektronske teretnice oslanjale su se na pružatelja sustava »registra«, čija je priroda ograničila njihovu široku upotrebu u praksi. Očekuje se kako će blockchain teretnice riješiti nedostatke prethodne generacije elektronskih dokumenata, omogućavajući svim stranama da ih koriste putem mehanizma prijenosa prava kontrole na sličan način kao i prijenos papirnatih teretnica. Međutim, postoji niz praktičnih i pravnih pitanja koja bi mogla usporiti punu primjenu blockchain teretnica. Kako bi se ispitali potencijalni problemi u korištenju blockchain teretnica, ovaj će rad najprije objasniti koncept blockchain teretnice i kako one mogu obavljati funkcije tradicionalnih teretnica; zatim identificirati izazove koji mogu ometati korištenje blockchain teretnica; te na kraju ispitati mogu li predloženi pravni instrumenti osigurati pravno priznanje za korištenje blockchain teretnica. Ova će pitanja odrediti izglede za uspjeh blockchain teretnica: hoće li one na kraju označiti kraj tradicionalne teretnice ili će ostati samo još jedna vrsta elektronske teretnice koja postoji zajedno s papirnim teretnicama.*

***Ključne riječi:*** *blockchain teretnica; distribuirana glavna knjiga; registar; token; javni blockchain; privatni blockchain; funkcionalna ekvivalencija.*