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The Bill of Lading on the Blockchain: An Analysis of its Compatibility with International Rules on Commercial Transactions

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ABSTRACT

This article examines the legal compatibility of a blockchain bill of lading under the following UNCITRAL works: the Model Law on Electronic Commerce, the Model Law on Electronic Signatures, the Convention on the Use of Electronic Communications in International Contracts, the Rotterdam Rules, and the Model Law on Electronic Transferable Records. The bill of lading has been around for centuries, shaping the cross-border sales landscape while at the same time being shaped by it. Blockchain technology is providing an opportunity to assess how various industries are conducting business, including the cross-border sales landscape. The compatibility of blockchain with bills of lading may seem unusual, since the former may be perceived as a new, disruptive technology originally used to trade cryptocurrency and the latter may be perceived as a centuries old, outdated solution that has resisted change. This article attempts to show that these two systems can in fact be compatible with each other and be compatible with international rules on commercial transactions, specifically as they relate to the bill of lading. Blockchain could be the technology that will put an end to the drawbacks of paper bills of lading, and the bill of lading system, if fully adopted, could be the application that develops blockchain technology to its full potential in the shipping industry.

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I. INTRODUCTION

This article provides an introduction to the international legal aspects of the bill of lading on the blockchain.[1] It begins with

1. **Standard Blockchain Disclaimer**: 1. The development of Blockchain technology and its enterprise level implementation is ongoing. There are characteristics of blockchain that will not fully develop for years, if at all. Fully enterprise-ready blockchain-complete solutions still need time. *See* Marco Iansiti & Karim R. Lakhani, *The Truth About Blockchain*, HARV. BUS. REV., Jan.–Feb. 2017, https://hbr.org/2017/01/the-truth-about-blockchain ("True blockchain-led transformation of business and government, we believe, is still many years

a brief explanation of the bill of lading and how blockchain technology works. It then examines the legal issues arising from blockchain technology under existing United Nations Commission on International Trade Law (UNCITRAL) works such as the Model Law on Electronic Commerce, the Model Law on Electronic Signatures, the Convention on the Use of Electronic Communications in International Contracts, the Rotterdam Rules, and the Model Law on Electronic Transferable Records. It ends with a brief discussion of current market solutions relating to the blockchain bill of lading and concluding remarks about challenges, opportunities, and suggestions about the future of bills of lading on the blockchain. To be clear, this article focuses solely on whether a blockchain bill of lading is compatible with international commercial instruments. It does not discuss whether the bill of lading should be on the blockchain.

II. THE BILL OF LADING AND ITS CHALLENGES

The bill of lading is a transport document issued by a carrier to a shipper covering the carriage of goods by sea.[2] Traditionally,

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away.") [https://perma.cc/YL25-CBHF]. 2. Sometimes blockchain is not the answer to a given problem. Sometimes a cloud-based ledger database will do the job better and more efficiently. *See* Chris Baraniuk, *Blockchain: The Revolution that Hasn't Quite Happened*, BBC (Feb. 11, 2020), https://www.bbc.com/news/business-51281233 ("[A] similar system [to blockchain] could be achieved with other technologies such as cloud-based ledger databases that encrypt data and control who can access what information.") [https://perma.cc/6BCG-224N]. I encourage readers to substitute "more costly and less speedy database" whenever they see "blockchain" in this article, because currently this is state of affairs for some, if not most, blockchain applications. *See* Carolynn Look, *Blockchain Settlement Was Slow, Costly in Trial, Weidmann Says*, BLOOMBERG (May 29, 2019, 4:07 AM), https://www.bloomberg.com/news/articles/2019-05-29/blockchain-settlement-was-slow-costly-in-trial-weidmann-says (describing how "[a] trial project using blockchain to transfer and settle securities and cash proved more costly and less speedy than" traditional means) [https://perma.cc/LD6B-3MP5]. 3. Blockchain technology and our understanding of its potential are constantly evolving. Efficient and meaningful ways of implementing the technology are also evolving. 4. The blockchain movement has provided us an opportunity to reflect on how we interact and transact in multiple situations, privacy, decentralization, immutability, and verifiability, among others, which is positive for growth in a number of transactional situations. To this end, the author encourages scholarly focus on a) prioritizing the analysis of practical blockchain use cases, and b) focusing on blockchain as a potentially useful set of technologies, not an ideology.

2. *See generally* RALPH H. FOLSOM ET AL., INTERNATIONAL BUSINESS TRANSACTIONS: A PROBLEM-ORIENTED COURSEBOOK 193–210 (13th ed. 2019) [hereinafter IBT COURSEBOOK] (providing extensive background material on

the bill of lading has three functions: (1) it operates as a receipt that confirms the placement of goods on board a vessel for delivery; (2) it is evidence of a contract of carriage between the shipper and carrier; and (3) it is a "document of title," meaning, the carrier must deliver the goods to the proper person as defined by the bill.[3]

If the bill of lading identifies the consignee as "to order of shipper," then this creates a negotiable bill of lading.[4] In this situation, delivery of the goods is proper only to a person in possession of a negotiable bill of lading that has been properly endorsed (through the chain of endorsements) to that person.[5] A non-negotiable (or straight) bill of lading only identifies a specific person to which the carrier must deliver the goods.[6] A non-negotiable bill of lading is (obviously) not negotiable (and thus not transferrable).[7] The negotiable nature of a negotiable bill of lading makes it slightly more complex than a non-negotiable bill of lading.[8] This article focuses largely on the negotiable bill of lading, but other types of bills of lading are not excluded.

There are a number of shortcomings to paper bills of lading.[9] Paper bills of lading could be forged: a seller could contract with a buyer requiring a letter of credit guaranteeing payment for the goods, then create a fraudulent bill of lading that a carrier never issued, and present it to a bank along with a draft for payment.[10]

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bills of lading); RALPH H. FOLSOM ET AL., PRINCIPLES OF INTERNATIONAL BUSINESS TRANSACTIONS 201–44 (4th ed. 2017) [hereinafter IBT PRINCIPLES] (providing condensed background material on bills of lading).

3. IBT PRINCIPLES, *supra* note 2, at 201–02.

4. *Id.* at 214.

5. *Id.* at 215. A less common situation is when a bill of lading is made out to "bearer." In this case, the bill is only transferred by delivery (as opposed to delivery and endorsement). 7B ANDERSON U.C.C. § 7-501:8 (3d. ed.).

6. IBT PRINCIPLES, *supra* note 2, at 218.

7. *See* 22 RICHARD A. LORD, WILLISTON ON CONTRACTS § 59:10 (4th ed. 1990) ("A negotiable bill of lading is a document of title, while a non-negotiable bill functions more like a receipt.").

8. *See* Conte C. Cicala, *A Punic Web: Statutes and Contracts Affecting the Container Trade*, 25 U.S.F. MAR. L.J. 153, 165 (2013) (explaining the purpose of negotiable bills of lading).

9. *See* David A. Bury, *Electronic Bills of Lading: A Never-Ending Story?*, 41 TUL. MAR. L.J. 197, 212 (2016) ("[C]ontemporary commercial and shipping realities have ironically rendered the paper bill of lading increasingly obsolete.").

10. *See* IBT PRINCIPLES, *supra* note 2, at 235–36 (discussing how banks deal with bill of lading fraud).

Paper bills of lading could be stolen: A person could steal or otherwise obtain the bill of lading and draft, forge the buyer's indorsement, and then present the documents to the carrier to obtain the goods. In addition, disputes relating to the bill of lading could arise, including (a) "misdescribing"[11] the goods; or (b) "misdelivery"[12] of the goods. Bills of lading could also simply arrive late, creating problems for delivery at the arrival port.[13] The following will discuss the development of electronic records in the supply chain and how blockchain and similar technologies could prevent these shortcomings.

III. BLOCKCHAIN

The blockchain is a distributed, decentralized, persistent, and tamper-resistant digital ledger of transactions that can be programmed to record a variety of interactions.[14] It is generally accepted that an individual (or a group of individuals) known as Satoshi Nakamoto "developed" blockchain in 2008.[15]

In simple terms, blockchain could be described as follows: Imagine that your computer (a "node") has an Excel file containing the history of certain transactions (a "ledger"). Ten other people ("miners"), living in ten separate countries (making it "distributed"), have the same file on their respective nodes, each of which is an iteration of an original (making it "decentralized"). When you initiate a transaction, your node sends a message to each miner to inform them of the proposed transaction. Each

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11. *See id.* at 203 (explaining that "misdelivery" and "misdescribing" are "common disputes over bills of lading").

12. *See id*.

13. *See* Elson Ong, *Blockchain Bills of Lading* 2–3 (Nat'l Univ. Sing. Law, Working Paper No. 2018/020, 2018), https://ssrn.com/abstract=3225520 ("It is no longer a certainty that original paper bills of lading will reach the consignee or indorsee before the goods arrive at the port of destination.") [https://perma.cc/EJD9-TVRS].

14. *See generally* SATOSHI NAKAMOTO, BITCOIN: A PEER-TO-PEER ELECTRONIC CASH SYSTEM, https://bitcoin.org/bitcoin.pdf (explaining the concept of the blockchain technology, Bitcoin) [https://perma.cc/Q8GV-DX9T].

15. *See* Jean Bacon et al., *Blockchain Demystified: An Introduction to Blockchain Technology and Its Legal Implications* 43 (Queen Mary Univ. of London, Sch. of Law, Legal Studies Research Paper No. 268/2017, 2017), https://ssrn.com/abstract=3091218 ("It is generally accepted that these purposes and means were originally envisaged by a person (or persons) known as 'Satoshi Nakamoto.'") [https://perma.cc/55S3-AV76]. To say that blockchain was "developed" by one person or group of persons is a misnomer. Blockchain technology contains a variety of technologies that have existed for decades.

miner rushes to check the validity of the transaction, attaching their logic ("proof of work"). If the other miners agree with the logic, the transaction gets executed, and everyone updates their ledger.[16]

Hash functions create a tamper-evident data structure and can prove the integrity of the data in a blockchain.[17] Hashing is the process of generating a value from a string of text using an algorithm.[18] Practically speaking, it is almost impossible for two input strings to have the same hash value.[19]

The "block" in a blockchain can, in general, be differentiated into the head of the block (block header) and its body (block body).[20] The block body contains the transaction input and the block header includes the hash of the previous block along with certain metadata, the content of which depends on the blockchain platform (sometimes a block number, nonce, and timestamp).[21] The first block does not have a hash for the previous block because it is the so-called genesis block.[22] The block body could contain any string of text, including the entire contents of a bill of lading.[23] Indeed, a number of different supply

16. *See generally Blockchain Explained... in Under 100 Words*, DELOITTE, https://www2.deloitte.com/ch/en/pages/strategy-operations/articles/blockchain-explained.html (explaining blockchain with a simple analogy) [https://perma.cc/8G5U-47F7].

17. *See* Jean Bacon et al., *Blockchain Demystified: A Technical and Legal Introduction to Distributed and Centralised Ledgers*, 25 RICH. J.L. & TECH. 1, ¶ 15, at 11 (2018) (explaining how "[h]ash values" can be used to "make a data structure . . . tamper-evident").

18. *See* Bacon et al., *supra* note 15, at 6 ("Hashing involves putting the contents of a data item (e.g. a document), through a 'hash function.' This function creates a string of digits of a fixed length which are unique to the input data item.").

19. *See id*.

20. *See* Bacon et al., *supra* note 17, ¶ 19, at 12–13 ("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.").

21. *See* Bacon et al., *supra* note 15, at 8 (explaining the distinction between the "block body" and "block header").

22. Nicolas Wenker, *Online Currencies, Real-World Chaos: The Struggle to Regulate the Rise of Bitcoin*, 19 TEX. REV. L. & POL. 145, 153 (2014) ("[E]ach approved block forms a link in a chain that traces back chronologically to the very first 'Genesis block' . . . .").

23. Bacon et al., *supra* note 17, ¶ 12, at 9 ("Hashing involves putting a data item (e.g. the contents of a document) through a hash function.").

chain documents could be input into the block body of a blockchain.[24]

Hashing is one of two core technologies that are characteristic of the blockchain.[25] Importantly, blockchain technology needs to authenticate the parties to any transaction to prevent fraudsters from posing as other parties.[26] To ensure that the parties to a transaction are who they say they are, blockchain technology uses public key infrastructure, which is the second of the two core technologies that are characteristic of the blockchain.[27] Public key infrastructure generates a public and a private key that work together to authenticate parties and information.[28]

Public key infrastructure, in general, consists of a public and a private key, a signing algorithm, and a validation function.[29] A transferee of a blockchain bill of lading can verify the chain of ownership of the bill of lading.[30] In a shipping scenario, a carrier can create a blockchain bill of lading (in a "genesis" block) and issue it to a shipper, signing it with the carrier's private key, the hash, and the shipper's public key.[31] The shipper can then transfer the blockchain bill of lading by signing it with the shipper's private key, the hash, and the public key of the receiver.[32] In theory, a blockchain multi-signature design[33] could

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24. Eleanor Wragg, *IGP&I Approves a Fifth Electronic Bill of Lading System for Its Members*, GLOBAL TRADE REV. (Jan. 14, 2020) https://www.gtreview.com/news/fintech/igpi-approves-a-fifth-electronic-bill-of-lading-system-for-its-members/ ("[Wave's] distributed ledger network uses blockchain technology to enable parties to issue, exchange and sign a variety of supply chain encrypted documents with no need for a central server or registry.") [https://perma.cc/L4DM-H885].

25. Bacon et. al., *supra* note 17, ¶ 207, at 101 ("Blockchain technology utilizes two core technologies to create a persistent, tamper-evident record of transactions between parties whose identity has been authenticated.").

26. Bacon et al., *supra* note 15, at 10 ("[U]sers should be confident that nobody can spend their coins without access to their private key.").

27. Bacon et al., *supra* note 17, ¶ 207, at 101.

28. *Id*., ¶ 21, at 14 ("Public key infrastructure (PKI) allows users to generate a key pair consisting of a public and a private key to sign a data item, and to validate whether a digital signature is correct.").

29. Bacon et al., *supra* note 15, at 9.

30. NAKAMOTO, *supra* note 14, at 2.

31. Ong, *supra* note 13, at 8.

32. *Id.* at 9.

33. *See* Gregory Maxwell et al., *Simple Schnorr Multi-Signatures with Applications to Bitcoin*, 87 DESIGNS, CODES & CRYPTOGRAPHY 2139, 2140 (2019), https://eprint.iacr.org/2018/068.pdf ("Multi-signature protocols . . . allow a group of signers (each possessing its own private/public key pair) to produce a

be used for delivering, transacting, and inspecting goods in, for example, the drug supply or in goods that are patented, including trade secrets, or otherwise need some sort of third-party or multi-party validation.[34]

Apart from the security and transferability of the negotiable bill of lading, a negotiable bill of lading must, in general, be a unique document—a feature known as the "guarantee of uniqueness" or "guarantee of singularity."[35] The following attempts to analyze whether blockchain technology could mimic the particular features required of a paper bill of lading, and track blockchain technology's strengths and weakness with regard to the requirements of international rules on commerce.

IV. THE LEGAL INFRASTRUCTURE FOR BILLS OF LADING ON THE BLOCKCHAIN

A. THE UNCITRAL MODEL LAW ON ELECTRONIC COMMERCE (1996), THE UNCITRAL MODEL LAW ON ELECTRONIC SIGNATURES (2001), AND THE UNITED NATIONS CONVENTION ON THE USE OF ELECTRONIC COMMUNICATIONS IN INTERNATIONAL CONTRACTS (2005)

The UNCITRAL Model Law on Electronic Commerce of 1996 (EC Model Law) with its Guide to Enactment (EC Guide)[36] was published to give national legislators a set of rules relating

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single signature σ on a message m. Verification of the validity of a purported signature σ can be publicly performed given the message and the set of public keys of all signers.") [https://perma.cc/NV2F-79FP].

34. Jen-Hung Tseng et al., *Governance on the Drug Supply Chain via Gcoin Blockchain*, 15 INT'L J. ENV'T RSCH. & PUB. HEALTH 1, 2 (2018) (citing Yang Li et al., *Blockchain Technology in Business Organizations: A Scoping Review* [https://perma.cc/GH9F-3YYN])) ("When it comes to preventing counterfeit drugs in the drug supply chain, blockchain technology stands out as a way to ensure an immutable chain of transaction ledger, tracking each step of the supply chain at the individual drug level.").

35. Koji Takahashi, *Blockchain Technology and Electronic Bills of Lading*, 22 J. INT'L MAR. L. 202, 204–05 (2016); *see also* Jung-Ho Yang, *Applicability of Blockchain Based Bill of Lading Under the Rotterdam Rules and UNCITRAL Model Law on Electronic Transferable Records*, 23 J. KOREA TRADE 113, 113 (2019).

36. U.N. COMM. INT'L TRADE L., UNCITRAL MODEL LAW ON ELECTRONIC COMMERCE WITH GUIDE TO ENACTMENT 1996 WITH ADDITIONAL ARTICLE 5 *BIZ* AS ADOPTED IN 1998, U.N. Sales No. E.99.V.4 (1999) [hereinafter EC MODEL LAW].

to "paperless messages" and to provide a more secure legal environment for electronic commerce.[37] A guiding principle in the EC Model Law was to cover all situations where information is generated, stored, or communicated, thus providing "media-neutral" rules.[38] The EC Model Law expresses the principle that there should be no disparity of treatment between data messages and paper documents.[39] These principles are sometimes called the principles of functional equivalence and technological neutrality, both of which are embodied in UNCITRAL works in electronic commerce.[40] With regard to contracting under the EC Model Law, "an offer and the acceptance of an offer may be expressed by means of data messages."[41] Therefore, blockchain technology, though not yet fully developed at its time of adoption, would arguably be included in the scope of application of the EC Model Law.[42]

The UNCITRAL Model Law on Electronic Signatures (2001) (ES Model Law) with its Guide to Enactment (ES Guide)[43] builds on the EC Model Law with respect to the signature requirement

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37. *Id.* ¶ 2, at 16.

38. *Id.* ¶ 24, at 23–24.

39. *Id.* art. 5, at 5 ("Information shall not be denied legal effect, validity or enforceability solely on the grounds that it is in the form of a data message."); *see also id.* ¶ 46, at 31–32 ("[T]here should be no disparity of treatment between data messages and paper documents.").

40. *Id.* art. 6(1), at 5 ("Where the law requires information to be in writing, that requirement is met by a data message if the information contained therein is accessible so as to be usable for subsequent reference."); *see also id.* art. 7(1), at 5–6 ("Where the law requires a signature of a person, that requirement is met in relation to a data message if: (a) a method is used to identify that person and to indicate that person's approval of the information contained in the data message; and (b) that method is as reliable as was appropriate for the purpose for which the data message was generated or communicated, in the light of all the circumstances, including any relevant agreement.").

41. *Id.* art. 11(1), at 8 ("In the context of contract formation, unless otherwise agreed by the parties, an offer and the acceptance of an offer may be expressed by means of data messages. Where a data message is used in the formation of a contract, that contract shall not be denied validity or enforceability on the sole ground that a data message was used for that purpose.").

42. The technology was "not yet fully developed" in that, for example, some of the technology involved in blockchain, like time-stamping digital documents and public key cryptosystems, did exist at the time but were not fully utilized as a blockchain system.

43. U.N. COMM. INT'L TRADE L., UNCITRAL MODEL LAW ON ELECTRONIC SIGNATURES WITH GUIDE TO ENACTMENT, U.N. Sales No. E.02.V.8 (2002) [hereinafter ES MODEL LAW].

in the electronic environment, stating that an "electronic signature" may be used as appropriate.[44] The ES Model Law also reflects the principle of technology neutrality in electronic commerce.[45] Thus, signing with a private key, hash, and recipient's public key in a blockchain should be deemed to meet the requirements of a signature under the ES Model Law.[46]

The United Nations Convention on the Use of Electronic Communications in International Contracts (2005) (EC Convention) provides further solutions for issues related to electronic communications in international contracts.[47] The Preamble of the EC Convention reiterates the two guiding principles of UNCITRAL in the area of electronic commerce: technological neutrality and functional equivalence.[48] The EC Convention affirms the principle contained in the EC Model Law that contracts should not be denied validity or enforceability by using electronic communications.[49] The EC Convention reiterates the rules in

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44. *Id.* ¶ 4, at 8.

45. *Id.* ¶ 5, at 9 ("The words 'a media-neutral environment', as used in the UNCITRAL Model Law on Electronic Commerce, reflect the principle of non-discrimination between information supported by a paper medium and information communicated or stored electronically."); *see also id.* art. 6(1), at 2 ("Where the law requires a signature of a person, that requirement is met in relation to a data message if an electronic signature is used that is as reliable as was appropriate for the purpose for which the data message was generated or communicated, in the light of all the circumstances, including any relevant agreement.").

46. National legislatures have in some cases enacted laws that are *supportive* of the use of blockchain technology in connection with certain digital assets and contractual obligations. The Chamber of Digital Commerce has published its Blockchain Report Card summarizing the status of state blockchain laws in the United States. *See Blockchain Report Card (2019)*, CHAMBER OF DIGITAL COMMERCE, https://blockchainlawguide.com/resources/2019-05-16—-State-Legislature-Blockchain-Report-Card.pdf [https://perma.cc/S4H4-M28Y]; *see also Legislator's Toolkit for Blockchain Technology (2018)*, CHAMBER OF DIGITAL COMMERCE, https://digitalchamber.org/state-legislators-toolkit/ [https://perma.cc/8SXZ-EP58].

47. U.N. COMM. INT'L TRADE L., EXPLANATORY NOTE BY THE UNCITRAL SECRETARIAT ON THE UNITED NATIONS CONVENTION ON THE USE OF ELECTRONIC COMMUNICATIONS IN INTERNATIONAL CONTRACTS, ¶ 3, at 13 U.N. Sales No. E.07.V.2 (2007) [hereinafter EC CONVENTION EXPLANATORY NOTE].

48. U.N. COMM. INT'L TRADE L., UNITED NATIONS CONVENTION ON THE USE OF ELECTRONIC COMMUNICATIONS IN INTERNATIONAL CONTRACTS, at 1, U.N. Sales No. E.07.V.2 (2007) [hereinafter EC CONVENTION] (stating that "uniform rules should respect . . . the principles of technological neutrality and functional equivalence").

49. EC CONVENTION EXPLANATORY NOTE, *supra* note 47, ¶ 10, at 15; *see also* EC CONVENTION, *supra* note 48, art. 8. ¶ 1 ("A communication or a contract

the EC Model Law concerning form requirements as well as electronic authentication techniques as substitutes for handwritten signatures.[50] However, the EC Convention does not apply to "bills of exchange, promissory notes, consignment notes, bills of lading, warehouse receipts or any transferable document or instrument that entitles the bearer or beneficiary to claim the delivery of goods or the payment of a sum of money."[51] The reason for this exclusion is likely because "the potential consequences of unauthorized duplication of documents of title and negotiable instruments . . . make it necessary to develop mechanisms to ensure the singularity of those instruments."[52] This exclusion and the author's not-fully-formed arguments and conclusory remarks regarding the application of the ES Model Law and EC Model Law provide a starting point for defining the scope of the UNCITRAL Model Law on Electronic Transferable Records (ETR Model Law) relating to blockchain bills of lading.[53] It also provides a starting point for an analysis of the more modern United Nations Convention on Contracts for the International Carriage of Goods Wholly or Partly by Sea (Rotterdam Rules).[54]

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shall not be denied validity or enforceability on the sole ground that it is in the form of an electronic communication."); *cf.* EC MODEL LAW, *supra* note 36, art. 11, at 8 ("Where a data message is used in the formation of a contract, that contract shall not be denied validity or enforceability on the sole ground that a data message was used for that purpose.").

50. EC CONVENTION EXPLANATORY NOTE, *supra* note 47, ¶ 13, at 15–16; *see also* EC CONVENTION, *supra* note 48, art. 9 ¶ 3 (prescribing that parties use a method "to identify the party and to indicate that party's intention in respect of the information contained in the electronic communication" so long as the method the parties use is reliable or proven to identify the party and the party's intention); *cf.* EC MODEL LAW, *supra* note 36, art. 7, at 5–6 (declaring that a data message satisfies a signature requirement if "a method is used to identify that person and to indicate that person's approval of the information contained in the data message" and the method is a reliable way to make that determination).

51. EC CONVENTION, *supra* note 48, art. 2, ¶ 2; *see also* EC CONVENTION EXPLANATORY NOTE, *supra* note 47, ¶ 80, at 35 (categorizing the excluded documents as "negotiable instruments and similar documents").

52. EC CONVENTION EXPLANATORY NOTE, *supra* note 47, ¶ 80, at 35.

53. U.N. COMM. INT'L TRADE L., EXPLANATORY NOTE TO THE UNCITRAL MODEL LAW ON ELECTRONIC TRANSFERABLE RECORDS, ¶ 19, at 23, U.N. Sales No. E.1.V.5 (2017) [hereinafter ETR MODEL LAW EXPLANATORY NOTE] (citing EC CONVENTION EXPLANATORY NOTE, *supra* note 47, ¶ 81, at 35).

54. G.A. Res. U.N. Doc. A/Res/63/122, preamble, United Nations Convention on Contracts for the International Carriage of Goods Wholly or Partly by Sea (Feb. 2, 2009) [hereinafter Rotterdam Rules].

B. THE ROTTERDAM RULES

The Rotterdam Rules provide a more modern approach to earlier conventions relating to the international carriage of goods by sea, to wit: the Hague Rules, the Hague-Visby Rules, and the Hamburg Rules.[55] The Rotterdam Rules take into account technological and commercial developments including the development of electronic transport documents[56] and electronic bills of lading, which refer to them as "negotiable electronic transport records."[57] Under Article 1(18) of the Rotterdam Rules, an electronic transport record refers to 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."[58] Recall that the bill of lading, as a transport document issued by a carrier to a shipper covering the carriage of goods by sea,[59] traditionally: (1) operates as a receipt that confirms the goods have been placed on board a vessel for delivery; (2) is evidence of a contract of carriage between the shipper and carrier; and (3) is a "document of title," thus, the carrier must deliver the goods to the proper person as defined by the bill.[60] Although Article 1(18) of the Rotterdam Rules does not specifically address title, Article 47 states that "[w]hen a negotiable transport document or a negotiable electronic transport record has been issued: [the] holder of the negotiable transport document or negotiable electronic transport record is entitled to claim delivery of the goods from the carrier."[61] This is the functional equivalent of title under the Rotterdam Rules, and together illustrates that a bill of lading (if

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55. Michael F. Sturley, *Modernizing and Reforming U.S. Maritime Law: The Impact of the Rotterdam Rules in the United States*, 44 TEX. INT'L L.J. 427, 429–30 (2009).

56. Rotterdam Rules, *supra* note 54, pmbl. ("*The General Assembly*, . . . *[c]oncerned* that the current legal regime governing the international carriage of goods by sea lacks uniformity and fails to adequately take into account modern transport practices, including containerization, door-to-door transport contracts and the use of electronic transport documents.").

57. *Id*. art. 9.

58. *Id*. art. 1(18).

59. *See generally* IBT PRINCIPLES, *supra* note 2, at 193–210; *see also* IBT PRINCIPLES, *supra* note 2, at 201–44.

60. IBT PRINCIPLES, *supra* note 2, at 201–02.

61. Rotterdam Rules, *supra* note 54, art. 47(1)(a).

electronic) is included as a negotiable electronic transport record in the Rotterdam Rules.

i. Form and Consent Requirements

Article 3 of the Rotterdam Rules discusses the form requirements for electronic communications.[62] That article states, "[e]lectronic communications may be used for [notices, confirmation, consent, agreement, declaration, and other communications], provided that the use of such means is with the consent of the person by which it is communicated and of the person to which it is communicated."[63] The parties, therefore, need to agree to use electronic communications and if blockchain technology is used, would need to agree to use such technology. Specific consent requirements are not discussed, but consent could be inferred from the use of electronic communications by the issuer and a response by the recipient that is not a direct rejection of the use of such means.[64] Evidence of consent could also be determined by the use of public key infrastructure and authentication by unique digital signatures by the parties.[65]

ii. Electronic Transport Records

Chapter 3 of the Rotterdam Rules lists the information necessary to be included in an electronic transport record.[66] Article 8 defines "use and effect of electronic transport records," and states that "anything that is to be in or on a transport document . . . may be recorded in an electronic transport record, provided the issuance and subsequent use of an electronic transport record is with the consent of the carrier and the shipper . . . ."[67] It further provides that "issuance, exclusive control, or transfer

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62. *Id.* art. 3.

63. *Id.*

64. YVONNE BAATZ, ET AL., THE ROTTERDAM RULES: A PRACTICAL ANNOTATION 11 (2009).

65. *See generally* Scott L. Schmookler & Katherine Musbach, *Modernizing Loan Fraud: The Proliferation and Evolution of Digital Loan Transactions*, 24 FIDELITY L.J. 85 (2018) (summarizing what is needed for electronic signatures to have legal effect).

66. Rotterdam Rules, *supra* note 54, arts. 8–10. A "[n]egotiable electronic transport record" means an electronic transport record that uses "to order," or "negotiable," or other appropriate wording. *Id.* art. 1(19).

67. *Id.* art. 8(a).

of an electronic transport record has the same effect as the issuance, possession, or transfer of a transport document."[68]

By permitting "[a]nything that is to be in or on a transport document" to be recorded electronically, subject to the parties' consent, this article underscores the principle of technological neutrality and a functional equivalence.[69] It also makes clear "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."[70] The parallel quality of "issuance, exclusive control, or transfer" with "issuance, possession, or transfer" indicates that exclusive control is equivalent to possession under the Rotterdam Rules with regard to electronic transport records.[71] Possession of documents includes various legal consequences, which, along with exclusive control, are not fully discussed in the Rotterdam Rules. However, definitions of "issuance" and "transfer" referred to in Article 8 of the Rotterdam Rules are defined in Article 1, which provides that "*issuance* of a negotiable electronic transport record" must "ensure that the record is subject to *exclusive control* from its creation until it ceases to have any effect or validity."[72] Furthermore, the "*transfer* of a negotiable electronic transport record means the transfer of *exclusive control* over the record."[73]

The concepts of issuance, exclusive control, and transfer laid out in Article 8 are important vis-à-vis the procedures for use of negotiable electronic transport records enshrined in Article 9 of the Rotterdam Rules.[74] This article states that procedures for use of negotiable electronic transport records must provide for:

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68. *Id.* art. 8(b).

69. *Id.* art. 8(a).

70. Theodora Nikaki & Baris Soyer, *A New International Regime for Carriage of Goods by Sea: Contemporary, Certain, Inclusive and Efficient, or Just Another One for the Shelves?*, 30 BERKELEY J. INT'L L. 303, 322 (2012) (quoting Rotterdam Rules, *supra* note 54, art. 8).

71. Rotterdam Rules, *supra* note 54, art. 8(b).

72. *Id.* art. 1(21) (emphasis added).

73. *Id.* art. 1(22) (emphasis added).

74. Sabena Hashmi, *The Rotterdam Rules: A Blessing?*, 10 LOY. MAR. L.J. 227, 237–38 (2012) ("The objective of the Rotterdam Rules is, inter alia, to facilitate the use of electronic transport records."). The rules accomplish this objective by establishing provisions related to exercise of the right of control for electronic transport records of any kind, as well as the "use" and "effect" of electronic transport documents, and finally by "introducing a statutory framework for the usage of both negotiable and non-negotiable transport records." *Id.*

> (a) The method for the *issuance* and the *transfer* of that record to an intended holder;
>
> (b) An assurance that the negotiable electronic transport 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 electronic transport record has ceased to have any effect or validity.[75]

Paragraphs (a)–(d) will be examined separately to determine whether a blockchain bill of lading satisfies these requirements.

Paragraph (a) requires provisions for both issuance and transfer of electronic transfer records.[76] The holder of a private key is the only person[77] with exclusive[78] control of the particular address where an electronic bill of lading is kept, and it is almost impossible for two input strings to have the same hash value.[79] In a blockchain bill of lading situation, the issuer would create a negotiable electronic transport document (bill of lading) in a genesis block and could transfer it to a transferee by signing it with the issuer's private key, the hash, and the transferee's public key.[80] The transferee could verify the record and transfer the negotiable electronic transport document by signing it with the transferee's private key, the hash, and the public key of the new

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75. Rotterdam Rules, *supra* note 54, art. 9(1) (emphasis added).

76. *Id*.

77. ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 115 ("[T]he 'person in control' may be a natural or legal person, or other entity able to possess a transferable document under substantive law.").

78. The term "exclusive" is not defined in the Rotterdam Rules. The ETR Model Law also refers to "exclusive," but its explanatory notes clarify that "[article 11 of the ETR Model Law] refers to 'exclusive' control for reasons of clarity, since the notion of 'control', similarly to that of 'possession', implies exclusivity in its exercise. Yet, control, like possession, could be exercised concurrently *by more than one person*." ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 111 (emphasis added). In this sense, there could be more than one holder of a private key, but they still together retain exclusive control over the particular address at which an electronic bill of lading is kept.

79. Bacon et al., *supra* note 15, at 6.

80. Ong, *supra* note 13, at 8–9, 11–12 (explaining that "[b]lockchain bills of lading will share the same token model as electronic bills of lading" while using timestamping and cryptographic techniques to ensure the bills of lading are unique). The electronic bill of lading token model is a process where "a shipper can transfer an electronic bill of lading to a receiver by using the shipper's private key to digitally sign the hash of the shipper's bill of lading and the public key of the receiver." *Id*.

transferee.[81] Both the issuance and transfer of an electronic bill of lading on the blockchain is therefore provided for, thus fulfilling the requirements of paragraph (a).

Paragraph (b) safeguards the integrity of the record.[82] There are a number of technological devices built into blockchain technology that guarantee the integrity of a blockchain bill of lading (meaning that the blockchain records are tamper-resistant and cannot be easily altered).[83] One guarantee is the public key infrastructure and authentication by unique digital signatures (which are arguably more secure than any handwritten signature).[84] Another guarantee is the immutable nature of the blockchain (the hash value of previous blocks is used to sign future blocks, guaranteeing that its state cannot be modified after a block is created).[85] Therefore, a blockchain bill of lading would be able to provide for an assurance of record integrity required by paragraph (b).

Paragraph (c) requires procedures that provide for "the manner in which the holder [of a negotiable electronic transport record] is able to demonstrate that it is [in fact] the holder."[86]

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81. *Id*.

82. Rotterdam Rules, *supra* note 54, art. 9(1).

83. Phillip Shaverdian, Comment, *Start with Trust: Utilizing Blockchain to Resolve the Third-Party Data Breach Problem*, 66 UCLA L. REV. 1242, 1277 (2019) ("Blockchain's innate characteristics of immutability and decentralization ensure data integrity . . . . The cryptographic validation mechanism, consensus model, and decentralized nature make it very challenging for any party to tamper with the data stored on a blockchain."). *But see* Rebecca M. Bratspies, *Cryptocurrency and the Myth of the Trustless Transaction*, 25 MICH. TECH. L. REV. 1, 25 (2018) ("[F]rom the genesis block onward, it has been clear that the blockchain is secure only so long as honest miners control more computational power than a group of cooperating attackers.").

84. Randy V. Sabett, *International Harmonization in Electronic Commerce and Electronic Data Interchange: A Proposed First Step Toward Signing on the Digital Dotted Line*, 46 AM. U. L. REV. 511, 521 (1996) ("Due to the binding between each signed message and the signer, however, a digital signature actually provides even stronger authentication than a handwritten signature.").

85. Marc Pilkington, *Blockchain Technology: Principles & Applications*, *in* RESEARCH HANDBOOK ON DIGITAL TRANSFORMATIONS 225, 233 (F. Xavier Olleros & Majlinda Zhegu eds., 2016) ("Immutability is a characteristic of blockchain technology."). *But see* Angela Walch, *Blockchain's Treacherous Vocabulary: One More Challenge for Regulators*, 21 J. INTERNET L. 1, 1 (2017) ("'[I]mmutability' of blockchain records is a matter of debate . . . ."); A.J. Bosco, *Blockchain and the Uniform Electronic Transactions Act*, 74 BUS. LAW. 243, 249 (2019) ("The description of blockchains as 'immutable' may not be entirely accurate.").

86. Rotterdam Rules, *supra* note 54, art. 9(c).

The Rotterdam Rules do not specifically define the method of demonstration, and the ETR Model Law suggests that it is not necessary to name the person in control,[87] which implies that anonymity or pseudo-anonymity is acceptable (as in the blockchain).[88] The blockchain infrastructure by its nature authenticates the parties to a transaction to prevent fraudsters from posing as other parties.[89] To ensure that the parties to a transaction are who they say they are, blockchain technology uses public key infrastructure comprised of "a public and a private key, a signing algorithm, and a validation function."[90] This ensures that a holder of a blockchain bill of lading is able to demonstrate that they are the rightful holder, fulfilling the requirements of paragraph (c).

Paragraph (d) concerns the end of the record's validity.[91] The requirement of paragraph (d) would be satisfied by configuring the blockchain system to confirm that a transaction is "complete" when the blockchain bill of lading is transmitted to the carrier upon the delivery of the goods. A buyer can transfer the blockchain bill of lading to a carrier by signing it with the buyer's private key, the hash, and the carrier's public key.[92] The carrier can then verify the blockchain bill of lading by a validation function and release the goods.[93] In the situation where an electronic transport record ceases to have any effect or validity, an ending block could be created to memorialize such termination.

Article 10 of the Rotterdam Rules discusses the replacement of a negotiable transport document with a negotiable electronic transport record, and *vice versa*.[94] If a hard-copy document has

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87. *See* ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 116 ("The requirement to identify the person in control does not imply that an electronic transferable record in itself should contain the information relating to identification of the person in control.").

88. *See* Adam Ludwin, *How Anonymous is Bitcoin*, COIN CENTER (Jan. 20, 2015), https://coincenter.org/entry/how-anonymous-is-bitcoin (discussing the degree of anonymity provided by bitcoin and its implications for general transactions and regulation) [https://perma.cc/K7LC-ATCG].

89. Bacon et al., *supra* note 15, at 9.

90. *Id*.

91. Rotterdam Rules, *supra* note 54, art. 9(1).

92. Ong, *supra* note 13, at 9 ("[A] shipper can transfer an electronic lading to a receiver by using the shipper's private key to digitally sign the hash of the shipper's bill of lading and the public key of the receiver.")

93. Bacon et al., *supra* note 15, at 9.

94. Rotterdam Rules, *supra* note 54, art. 10.

been issued and the carrier and the holder agree to replace that document by a negotiable electronic transport record, the holder needs to surrender the hard-copy document, and then the carrier needs to issue a negotiable electronic transport record that includes a statement that it replaces the hard-copy document.[95] And *vice versa*, if a negotiable electronic transport record has been issued and the carrier and the holder agree to replace that electronic transport record by a hard-copy document, the carrier needs to issue a hard-copy document that includes a statement that it replaces the negotiable electronic transport record.[96]

Article 10 provides for switching between an electronic transport record and a negotiable transport document.[97] Of note, the switch needs to happen between a holder and the carrier. Since the holder of the private key is the only person/entity with exclusive control of that particular block address at which an electronic bill of lading is kept, both the issuance and transfer of an electronic bill of lading on the blockchain is provided for by this public/private key system.[98] The detailed requirements of Article 10 could in theory be satisfied by configuring the blockchain system to recognize when the bill of lading is switched from an electronic transport record to a negotiable transport document and *vice versa*.[99] In the situation where an electronic transport record is switched to a negotiable transport document, an ending block could be created to memorialize such transformation. This type of ending block, however, should be different from the ending block that is created due to delivery of the goods, because the parties could agree to switch back to an electronic transport record. Similarly, a genesis block could be created when a negotiable transport document is switched to an electronic transport record on the blockchain, subject to the negotiable transport document being destroyed or otherwise held void

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95. *Id*.

96. *Id*.

97. *Id*.

98. *See* Bacon et al., *supra* note 17, at 21 (explaining users' ability to propose new transfers with Bitcoin).

99. Alan Cohn et al., *Smart After All: Blockchain, Smart Contracts, Parametric Insurance, and Smart Energy Grids*, 1 GEO. L. TECH. REV. 273, 283 (2017) ("Using an oracle or other triggering mechanisms, smart contracts will only execute upon the occurrence of agreed-upon events, based on agreed-upon sources of information. In this way, smart contracts have the potential to simplify administration of a range of commercial contracts.").

and the other requirements of the Rotterdam Rules (like consent of the parties).[100]

iii. Transport Documents and Electronic Transport Records

Article 35 of the Rotterdam Rules discusses *issuance* of the transport document or the electronic transport record.[101] If the shipper and the carrier have agreed to use a blockchain electronic transport record (or have otherwise remained silent), upon delivery of the goods for carriage, the shipper would be entitled to the blockchain bill of lading.[102] In this situation, a carrier would create a blockchain bill of lading (in a genesis block) and issue it to a shipper signing it with the carrier's private key, the hash, and the shipper's public key.[103] The shipper could verify the record and transfer the blockchain bill of lading to, for example, a bank, by signing it with the shipper's private key, the hash, and the public key of the receiver.[104] If shipper and the carrier have agreed *not* to use a transport document or an electronic transport record, or it is the custom, usage, or practice of the trade not to use one, then the carrier would not need to issue one.

Article 36 of the Rotterdam Rules discusses contract particulars necessary in the transport document or electronic transport record.[105] These particulars are standard in most bills

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100. *See* David C. Donald & Mahdi H. Miraz, *Multilateral Transparency for Securities Markets Through DLT*, 25 FORDHAM J. CORP. & FIN. L. 97, 120 (2019) ("Each chain has a 'genesis block' marking the start of the chain. The genesis block may contain instructions and procedures for the operation of the chain, which could be rules on the creation of new assets and establishing consensus, code for a smart contracts [sic], or policy statements.").

101. Rotterdam Rules, *supra* note 54, art. 35.

102. *Id*.

103. *See generally* Eric D. Chason, *How Bitcoin Functions as Property Law*, 49 SETON HALL L. REV. 129 (2018) (describing the processes of Bitcoin transactions as similar in protocol and procedure to typical real estate transactions).

104. Ong, *supra* note 13, at 12.

105. Rotterdam Rules, *supra* note 54, art. 36. The contract particulars, in general, include items like a description of the goods, the leading marks necessary for identification of the goods, the number of packages or pieces, or the quantity of goods, the weight of the goods, a statement of the apparent order and condition of the goods, the name and address of the carrier, the date on which the carrier or a performing party received the goods, or on which the goods were loaded on board the ship, or on which the transport document or electronic transport record was issued, the number of originals of the negotiable transport document, the name and address of the consignee, the name of a ship,

of lading. To fulfill the requirements of this article in the blockchain bill of lading scenario requires some coordination between the shipper, carrier, and any other third party involved in the process (like a party performing an independent inspection).[106] It also requires consultation with system designers so they understand the requirements of Article 36 and the players involved.[107] Communications and negotiations between the parties could be accomplished on or off the blockchain prior to the bill of lading's genesis block, or the parties could choose to use a blockchain populated form.[108] A blockchain multisignature design could be used when parties other than the shipper and carrier are involved, for example, when third-party validation or inspection is necessary.[109] Multisignature technology helps when there are more than two parties that need to validate a certain transaction, like customs, local food and drug bureaus, intellectual property bureaus, or other government entities.[110]

Article 37 of the Rotterdam Rules discusses the identity of the carrier.[111] If the shipper and the carrier have agreed to use an electronic transport record, then the public keys of both parties should be indicated in the blockchain bill of lading.[112] The relevant parties, if identified by name in the contract particulars, would need to include their public keys to avoid a situation where an electronic transport record contains information (like the public key) "relating to the identity of the carrier" that would

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the place of receipt and the place of delivery, and the port of loading and the port of discharge. *Id.*

106. *Id*.

107. *See generally* Dirk A. Zetzsche et al., *The Distributed Liability of Distributed Ledgers: Legal Risks of Blockchain*, 2018 U. ILL. L. REV. 1361 (2018) (discussing the fundamental aspects of the design of blockchain systems and various forms of potential liability for distributed ledger technology participants).

108. Dakota A. Larson, *Mitigating Risky Business: Modernizing Letters of Credit with Blockchain, Smart Contracts, and the Internet of Things*, 2018 MICH. ST. L. REV. 929, 973 (2018).

109. *See* Tseng et al., *supra* note 34, at 3 (recommending multisignature design for personnel responsible for inspecting drugs in a drug supply chain).

110. *Id*.; Larson, *supra* note 108, at 973 ("[B]lockchain is particularly useful for transactions that involve multiple parties and communications.").

111. Rotterdam Rules, *supra* note 54, art. 37.

112. *Id*.

be inconsistent with the contract particulars.[113] The blockchain bill of lading system could be configured to require the identity of the carrier and its public key.[114] This would avoid the situation where no person is identified in the contract particulars, but the contract particulars indicate that the goods have been loaded on board a named ship. Unequivocal statements as to the carrier and its key(s) are necessary, and any *ad hoc* carrier definitions or demise clauses (if accepted in a particular jurisdiction) should be eliminated or disregarded in a blockchain bill of lading.

Article 38 of the Rotterdam Rules relates to signature formalities of the carrier.[115] It states that an "electronic transport record shall include the electronic signature of the carrier or a person acting on its behalf. Such electronic signature shall identify the signatory in relation to the electronic transport record and indicate the carrier's authorization of the electronic transport record."[116] Public key infrastructure in a blockchain consists of a public and a private key, a signing algorithm, and a validation function.[117] This infrastructure can provide the electronic signature required in Article 38.[118] A carrier would need to provide its public key, then a transferee can verify the validity of the electronic signature of the carrier (or any subsequent transferee).[119] The shipper "signs" an electronic document with the shipper's private key, the hash, and the public key of the receiver.[120] This would fulfill the requirement of a signature under Article 38.

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113. Reade Ryan & Mayme Donohue, *Securities on Blockchain*, 73 BUS. LAW. 85, 97 (2018) (explaining that, in the securities context, "a blockchain that registers securities could be programmed to enable the issuer of blockchain securities, any transfer agent, and any intermediary holding such securities for others to identify the owners of such blockchain securities").

114. *Id*.

115. Rotterdam Rules, *supra* note 54, art. 38.

116. *Id*.

117. Bacon et al., *supra* note 15, at 9.

118. Riley T. Svikhart, *Blockchain's Big Hurdle*, 70 STAN. L. REV. ONLINE 100, 107 (2017) ("[T]he Arizona amendment [of its Uniform Electronic Transactions Act (UETA)] legitimizes blockchain-based records by declaring that '[a] signature that is secured through blockchain technology is considered to be in an electronic form and to be an electronic signature.' This amendment places blockchain-based records on par with preexisting forms of electronic records and signatures and requires parties and courts to grant blockchain-secured information full legal effect in spite of its nonwritten form.").

119. NAKAMOTO, *supra* note 14, at 2.

120. *Id*.

Article 39 of the Rotterdam Rules discusses deficiencies in the contract particulars.[121] Article 40 of the Rotterdam Rules discusses qualifying the information relating to the goods in the contract particulars.[122] Article 41 of the Rotterdam Rules discusses the evidentiary effect of the contract particulars.[123] Article 42 of the Rotterdam Rules discusses freight prepaid.[124] These articles relate to an electronic transport record in that the system configuration of a blockchain bill of lading could address deficiencies in the contract.[125] For example, if the contract particulars include the date but fail to indicate its significance, and the contract particulars indicate that the goods have been loaded on board a ship, the system could automatically populate the contract to reflect that the date is "[t]he date on which all of the goods indicated in the . . . electronic transport record were loaded on board the ship."[126] Similarly, if the contract particulars include the date but fail to indicate its significance, and the contract particulars indicate that the goods have not been loaded on board a ship, the system could automatically populate the contract to reflect that the date is "[t]he date on which the carrier or a performing party received the goods."[127]

The blockchain system could also allow the carrier to qualify information in the electronic record to indicate that the carrier does not assume responsibility for the accuracy of the information furnished by the shipper if it has "actual knowledge that any material statement in the . . . electronic transport record is false or misleading [or] has reasonable grounds to believe that a

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121. Rotterdam Rules, *supra* note 54, art. 39. Deficiencies include particulars about the date and its significance and the apparent order and condition of the goods at the time the carrier receives them. *Id.*

122. *Id.* art. 40. Qualifying language includes carrier knowledge about any material statement in the electronic transport record that is false or misleading. It also includes qualifying language that relates to when goods are in a closed container or the carrier did not inspect the goods. *Id.*

123. *Id.* art. 41. For example, an electronic transport record is *prima facie* evidence of the carrier's receipt of the goods, and proof to the contrary by the carrier in respect of any contract particulars is not admissible. *Id.*

124. *Id*. art. 42. For example, the statement "freight prepaid" means just that, and the carrier cannot assert against the holder otherwise. *Id.*

125. Morgan N. Temte, *Blockchain Challenges Traditional Contract Law: Just How Smart Are Smart Contracts?*, 19 WYO. L. REV. 87, 96 (2019) ("[U]sers can program the [blockchain] platform to take specific action once parties meet certain conditions.").

126. Rotterdam Rules, *supra* note 54, art. 39(2).

127. *Id*.

material statement in the . . . electronic transport record is false or misleading" as allowable under Article 40.[128] The blockchain system could also account for qualifications under Article 40, and update the electronic transport record accordingly.[129] For example, if no qualification is made as to receipt of the goods, the electronic transport record system could automatically update to reflect the carrier's receipt of the goods.[130]

This could all be accomplished by a so-called smart contract, persistent script, or other self-enforcing agreement embedded in code housed on the blockchain (a "Smart Contract").[131] The Smart Contract could contain a set of rules that satisfy the Rotterdam Rules.[132] When certain situations are met, the agreement could be updated accordingly or automatically enforced.[133]

iv. Delivery of the Goods

Chapter 9 of the Rotterdam Rules deals with delivery of the goods. In particular, Article 47 deals with delivery when a negotiable transport document or negotiable electronic transport record is issued.[134] Article 47(1) holds that when "a negotiable electronic transport record has been issued [the] holder . . . is entitled to claim delivery of the goods from the carrier after they have arrived at the place of destination."[135] The carrier must then deliver the goods "[u]pon demonstration by the holder . . . that it is the holder of the negotiable electronic transport record."[136] Finally, if the parties used a negotiable

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128. *Id.* art. 40.

129. Temte, *supra* note 125, at 96.

130. *Id.*

131. Carla L. Reyes, *Cryptolaw for Distributed Ledger Technologies: A Jurisprudential Framework*, 58 JURIMETRICS J. 283, 286–87 (2018) (defining the concept of a smart contract as a script that can perform a function upon the fulfillment of certain conditions).

132. Allison Skopec, *PIN Chagrin: The Glencore Heist and EDI Through the Lens of Delivery Orders*, 42 TUL. MAR. L.J. 221, 243–44 (2017) ("[S]mart contracts are used in four main ways: (1) government enforcement; (2) business management; (3) case precedent; and (4) within the supply chain. For purposes of maritime-related supply chain happenings, all four different contract types can apply depending on the parties involved.").

133. *Id.*

134. Rotterdam Rules, *supra* note 54, art. 47.

135. *Id.* art. 47(1).

136. *Id.*

electronic transport record, it "ceases to have any effect or validity upon delivery to the holder."[137]

To demonstrate that the holder is *the* holder of the negotiable electronic transport record, the carrier could verify ownership of the bill of lading through a validation function[138] to verify the chain of ownership.[139] When a blockchain negotiable electronic transport record has been used to obtain the goods, the blockchain could be configured to recognize that the electronic transport record ceases to have any effect or validity upon delivery to the holder.[140] This could be accomplished by including unique identifiers to the "delivery" block to identify it as an ending block.

Article 47(2) allows a carrier to deliver the goods without the surrender of a negotiable document.[141] In these circumstances, delivery is often made in exchange for a letter of indemnity.[142] The letter of indemnity hedges the risk of maritime fraud. There is an ongoing debate in the academic community about Article 47(2), but it is the author's view that blockchain technology would remedy this situation because the blockchain is (essentially) always available and immutable.[143] For example, any transferee of the negotiable electronic transport record would be recorded on a decentralized blockchain that cannot be lost like a paper document.[144] In theory, there could always be "surrender" with regard to a blockchain bill of lading since the blockchain will always record transfers. Therefore, transferees could in theory always be found. One problem would be that a holder could have misplaced its public or private key, thus holder status could

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137. *Id*.

138. Bacon et al., *supra* note 15, at 9.

139. NAKAMOTO, *supra* note 14, at 2.

140. Rotterdam Rules, *supra* note 54, art. 47(1).

141. *Id*. art. 47(2) (explaining that if "the goods are not deliverable" because the holder cannot be found, the carrier may seek advice from the shipper and request instructions on delivery of the goods, and that upon delivery, after consulting with the shipper, the carrier is "discharged from its obligation to deliver the goods" to the holder).

142. Nikaki & Soyer, *supra* note 70, at 334.

143. *See* Pilkington, *supra* note 85 ("Immutability is a characteristic of blockchain technology.").

144. *But see* Walch, *supra* note 85, at 1 ("'[I]mmutability' of blockchain records is a matter of debate . . . ."); Bosco, *supra* note 85, at 249 ("The description of blockchains as 'immutable' may not be entirely accurate.").

not be verified.[145] In these situations, a recovery seed or recovery phrase, a list of twelve, eighteen, or twenty-four words, could be used to recover a key, but this could also be misplaced or stolen.[146]

v. Rights of the Controlling Party

Chapter 10 of the Rotterdam Rules addresses the rights of the controlling party.[147] In particular, Article 51 addresses the identity of the controlling party and transfer of the right of control of a negotiable electronic transport record.[148] It states, that when a negotiable electronic transport record is issued, the "holder is the controlling party."[149] Furthermore, the "holder may transfer the right of control to another person by transferring the negotiable electronic transport record" to a subsequent holder.[150]

To demonstrate that the holder is *the* holder (and thus the controlling party and possessing rights of the controlling party), the holder could verify ownership of the bill of lading through a validation function[151] to verify the chain of ownership.[152] The holder can then transfer the blockchain bill of lading by signing it with the holder's private key, the hash, and the public key of the receiver.[153] In Article 1(10), a holder "means: (a) A person that is in possession of a negotiable transport document . . . or (b) The person to which a negotiable electronic transport record has been issued or transferred in accordance with the procedures referred to in Article 9, paragraph 1."[154] Recall that Article 9 paragraph 1 (with its requirements (a)-(d)) discusses the procedures

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145. Neal B. Christiansen & Julia E. Jarrett, *Forfeiting Cryptocurrency: Decrypting the Challenges of A Modern Asset*, 67 DEP'T OF JUST. J. FED. L. & PRAC. 155, 158–59 (2019) (explaining that if "wallets," which are tools used "to manage public and private keys," are misplaced, then the public and private keys inside the "wallet" may be irretrievable).

146. *Id*. at 174.

147. Rotterdam Rules, *supra* note 54, at ch. 10.

148. *Id.* art. 51.

149. *Id*. The right of control is limited to the right to give or modify instructions, the right to obtain delivery of the goods, and the right to replace the consignee. *Id*. art. 50.

150. *Id*. art. 51(4)(b).

151. Bacon, *supra* note 15, at 9.

152. NAKAMOTO, *supra* note 14, at 2.

153. Ong, *supra* note 13, at 8–9.

154. Rotterdam Rules, *supra* note 54, at art 1(10).

for use of negotiable electronic transport records, stating the method and requirements for use of negotiable electronic transport records.[155] Recall also that the blockchain bill of lading would fulfill all the requirements under Article 9(a)–(d).

vi. Transfer of Rights

Chapter 11 of the Rotterdam Rules deals with transfer of rights.[156] In particular, Article 57 deals with when a negotiable electronic transport record is issued.[157] It states:

> [w]hen a negotiable electronic transport record is issued, its holder may transfer the rights incorporated in it, whether it be made out to order or to the order of a named person, by transferring the electronic transport record in accordance with the procedures referred to in article 9, paragraph 1.[158]

Transferring the electronic transport record can be accomplished by signing the record with the holder's private key, the hash, and the public key of the receiver.[159] Again, recall the discussion of Article 9(1) above and how the blockchain bill of lading would fulfill all the requirements under its sub-paragraphs (a)–(d).[160] In theory, the blockchain bill of lading would need to be made out to the order of a named person (with a named public key) in order to transfer the rights incorporated in it.

This section illustrates how blockchain bills of lading (correctly configured) would be compatible with the Rotterdam Rules, but there is still work to be done to fully realize blockchain bills of lading within this legal framework.[161] One significant detail is that the Rotterdam Rules will only enter into force when

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155. Requirements include: "(a) The method for the issuance and the transfer of that record to an intended holder; (b) An assurance that the negotiable electronic transport 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 electronic transport record has ceased to have any effect or validity." *Id*. art. 9(1).

156. *Id*. ch.11.

157. *Id*. art. 57.

158. *Id*. art. 57(2).

159. Ong, *supra* note 13, at 8–9.

160. Rotterdam Rules, *supra* note 54, art. 9(1).

161. Christian Albrecht, *Blockchain Bills of Lading: The End of History? Overcoming Paper-Based Transport Documents in Sea Carriage Through New Technologies*, 43 TUL. MAR. L.J. 251, 273 (2019) ("The Rotterdam Rules . . . merely provide for a first step in the direction of a fully functional legal framework. Nonetheless, this primary step may be considered the most significant one.").

twenty countries have ratified, accepted, approved, or acceded to that treaty.[162] As of October 2020, there were twenty-five signatories to the treaty, but only five countries have ratified or acceded to it.[163]

C. UNCITRAL MODEL LAW ON ELECTRONIC TRANSFERABLE RECORDS

The EC Convention provides a starting point for defining the scope of application of the ETR Model Law because the EC Convention excludes from its application "bills of exchange, promissory notes, consignment notes, bills of lading, [or] warehouse receipts"[164] because the drafters claimed that "finding a solution for this problem [of the legal treatment of electronic transferable records] required a combination of legal, technological and business solutions, which had not yet been fully developed and tested."[165] This section will discuss the relevant provisions of the ETR Model Law as they relate to blockchain bills of lading.

i. General Provisions

Article 1 of the ETR Model Law addresses the scope of application of the model law, stating that the ETR Model Law "applies to electronic transferable records" and that nothing in the ETR Model Law "affects the application to an electronic transferable record of any rule of law governing a transferable docu-

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162. *See* United Nations Treaty Collection, Chapter XI D 8 (Dec. 11, 2008), https://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XI-D-8&chapter=11&clang=_en (quoting Rotterdam Rules, *supra* note 54, art. 94(1)) ("This Convention enters into force on the first day of the month following the expiration of one year after the date of deposit of the twentieth instrument of ratification, acceptance, approval or accession.") [https://perma.cc/JCQ6-Q2L8].

163. *Id*. (showing that, as of October 25, 2020, four countries have ratified and one country has acceded to the treaty).

164. ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 19, (quoting EC CONVENTION EXPLANATORY NOTE, *supra* note 47, ¶ 81); *see also* EC CONVENTION, *supra* note 48, art. 2(2) ("This Convention does not apply to bills of exchange, promissory notes, consignment notes, bills of lading, warehouse receipts or any transferable document or instrument that entitles the bearer or beneficiary to claim the delivery of goods or the payment of a sum of money.").

165. ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 19.

ment or instrument including any rule of law applicable to consumer protection."[166] The third paragraph in Article 1 allows enacting jurisdictions to define items outside the scope of the ETR Model Law.[167] The ETR Model Law provides rules that "may apply to various types of electronic transferable records based on the principle of *technological neutrality* and a *functional equivalence* approach," and further explains that "[t]he principle of technological neutrality entails adopting a system-neutral approach, enabling the use of various models whether based on registry, token, *distributed ledger* or other technology."[168] This illustrates that the ETR Model Law contemplates using technologies like blockchain, which embodies these characteristics.[169] Importantly, the ETR Model Law focuses on transferability and not negotiability.[170]

For the purposes of the ETR Model Law, an electronic record includes information "generated, communicated, received or stored by electronic means, including, where appropriate, all information logically associated with or otherwise linked together so as to become part of the record, whether generated contemporaneously or not."[171] An electronic *transferable* record is an "electronic record that complies with the requirements of article 10,"[172] which is similar to Article 9 paragraph 1 of the Rotterdam Rules and will be discussed below. A transferable document or instrument means a "document or instrument issued on paper 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

166. U.N. COMM'N ON INT'L TRADE LAW, UNCITRAL MODEL LAW ON ELECTRONIC TRANSFERABLE RECORDS, at 7, U.N. Sales No. E.17.V.5 (2018) [hereinafter ETR Model Law].

167. *Id.* art. 1(3); *id.* art. 1(3) n.1 (suggesting categories of documents that enacting jurisdictions may want to exclude).

168. ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 18 (emphasis added).

169. *See* NAKAMOTO, *supra* note 14, at 1 (explaining the functional equivalence of online blockchain transactions to traditional banking systems and the distributed nature of blockchain transactions).

170. ETR MODEL LAW, *supra* note 166, art. 1; ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 20 ("The [ETR] Model Law focuses on the transferability of the record and not on its negotiability on the understanding that negotiability relates to the underlying rights of the holder of the instrument, which fall under substantive law.").

171. ETR MODEL LAW, *supra* note 166, art. 2.

172. *Id.*

or instrument through the transfer of that document or instrument."[173] The ETR Model Law distinguishes between an electronic transferrable record and a transferable document or instrument simply by the latter being "on paper."[174] For the purposes of this article, a blockchain bill of lading would likely fall under, and will be analyzed as, an electronic transferable record.[175]

Article 6 of the ETR Model Law allows for additional information to be included in electronic transferable records.[176] The ETR Model Law does not prevent the inclusion of additional information in an electronic record simply due to the different nature of the media.[177] This includes "information necessary for technical reasons, such as metadata or a unique identifier" and "dynamic information, i.e. information that may change periodically or continuously, based on an external source, which may be included in an electronic transferable record due to its nature but not in a transferable document or instrument."[178] Such information could include, for example, the price of a publicly traded commodity and the position of a vessel.[179] A blockchain bill of lading would contain certain metadata due to its nature (such as information in the block head: nonce, block number, etc.).[180] A blockchain bill of lading could also include dynamic information relating to container information, cargo container temperature, and other information relating to any interrelated

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173. *Id*.; *see also* ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 38 (including bills of lading in list of "transferable documents or instruments, inspired by article 2, paragraph 2, of the [EC] Convention").

174. ETR MODEL LAW, *supra* note 166, art. 2.

175. Articles 3–5 do not directly implicate blockchain bills of lading. Article 3 emphasizes that the ETR Model Law should be interpreted with reference to its international origin. ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 40. Article 4 of the Model Law allows for derogation by agreement. *Id*. ¶ 50. Article 5 relates to complying with possible disclosure obligations. *Id*. ¶ 53.

176. ETR MODEL LAW, *supra* note 166, art. 6.

177. ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 57.

178. *Id*. ¶ 58.

179. *Id*.

180. *See generally* Nicolas Courtois et al., *The Evolution of Embedding Metadata in Blockchain Transactions* (2018 Int'l Joint Conference on Neural Networks, Digital Object Identifier No. 10.1109/IJCNN.2018.8489377, July 2018), https://arxiv.org/pdf/1806.06738.pdf (explaining the use of metadata in blockchain transactions) [https://perma.cc/TH3B-TRDR].

device[181] or Smart Contract information programmed into the block.

The principle of *technological neutrality* is manifested in Article 7 of the ETR Model Law.[182] Article 7 states that "an electronic transferable record shall not be denied legal effect, validity or enforceability on the sole ground that it is in electronic form,"[183] restating the same general principle that is set forth in the EC Model Law[184] and EC Convention.[185] Article 7 manifests the philosophy that the ETR Model Law does not require a person to use an electronic transferable record without that person's consent, but that the "consent of a person to use an electronic transferable record may be inferred from the person's conduct."[186] Of note, the Explanatory Note to the UNCITRAL Model Law on Electronic Transferable Records ("ETR Model Law Guide") emphasizes that "consent to the use of an electronic transferable record . . . [in] token-based and distributed ledger-based systems, may be implicit and inferred by circumstances such as exercise of control of the record or performance of the obligation contained in the record."[187]

ii. Provisions on Functional Equivalence

The principle of functional equivalence is manifest in Chapter II of the ETR Model Law.[188] Articles 8 and 9 of the ETR Model Law discuss form and signature requirements.[189] Article 8 states that "[w]here the law requires that information should be in writing, that requirement is met with respect to an electronic

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181. Sometimes referred to as Internet of Things ("IoT") information. *See* Margaret Rouse, *What Is IoT (Internet of Things) and How Does It Work?*, IOT AGENDA, https://internetofthingsagenda.techtarget.com/definition/Internet-of-Things-IoT (last visited Oct. 25, 2020) ("The internet of things, or IoT, is a system of interrelated computing devices . . . that are provided with unique identifiers . . . and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.") [https://perma.cc/M57G-2ZAV].

182. ETR MODEL LAW, *supra* note 166, art. 7.

183. *Id.*

184. EC MODEL LAW, *supra* note 36, ¶ 46 ("[T]here should be no disparity of treatment between data messages and paper documents.").

185. EC CONVENTION EXPLANATORY NOTE, *supra* note 47, ¶ 129.

186. ETR MODEL LAW, *supra* note 166, art. 7.

187. ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 66.

188. ETR MODEL LAW, *supra* note 166, arts. 8–11.

189. *Id.* arts. 8–9.

transferable record if the information contained therein is accessible so as to be usable for subsequent reference."[190] Article 9 states that "[w]here the law requires or permits a signature of a person, that requirement is met by an electronic transferable record if a reliable method is used to identify that person and to indicate that person's intention in respect of the information contained in the electronic transferable record."[191] "The requirements for functional equivalence of . . . 'writing' and 'signature' in an electronic environment" are crucial given the specifics of the media.[192] Public key infrastructure consisting of a public and a private key, a signing algorithm, and a validation function meet the requirement for a signature in a blockchain system.[193] A holder and transferee can verify the block and the chain of ownership, thus satisfying the writing requirement.[194]

Another principle of *functional equivalence* is manifested in Article 10 of the ETR Model Law.[195] It states that:

> Where the law requires a transferable document or instrument, that requirement is met by an electronic record if (a) the electronic record contains the [same] information that would be required to be contained in a transferable document or instrument; and (b) a reliable method is used: (i) [t]o identify that electronic record as the electronic transferable record; (ii) [t]o render that electronic record capable of being subject to control from its creation until it ceases to have any effect or validity; and (iii) [t]o retain the integrity[196] of that electronic record.[197]

The requirements in paragraphs (i)–(iii) will be examined to determine whether they could be satisfied by a blockchain bill of lading.

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190. *Id*. art. 8.

191. *Id*. art. 9.

192. ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 68.

193. *See* Bacon et al,, *supra* note 15, at 9 ("PKI can be used to create digital signatures, which establish that a transaction emanated from a certain user").

194. *See* NAKAMOTO, *supra* note 14, at 2 (describing the significance of individually identifiable and publicly verifiable "signatures" to each Bitcoin transaction).

195. ETR MODEL LAW, *supra* note 166, art. 10.

196. "The criterion for assessing integrity shall be whether information contained in the electronic transferable record, including any authorized change that arises from its creation until it ceases to have any effect or validity, has remained complete and unaltered apart from any change which arises in the normal course of communication, storage and display." *Id*. art. 10(2).

197. *Id*. art. 10(1).

Paragraph (i) establishes the requirement to identify an electronic record as *the* electronic transferable record.[198] According to the ETR Model Law Explanatory Note, this requirement implements the so-called singularity approach.[199] As described above, hash functions prove the integrity of the data in a blockchain.[200] This hashing creates a unique record because the inherently unique hash value cannot be easily duplicated, thus fulfilling paragraph (i).[201]

Paragraph (ii) establishes the requirement that the electronic record be capable of being subject to control from its creation until it "ceases to have any effect or validity."[202] According to the ETR Model Law Explanatory Note, this requirement implements the so-called control approach.[203] The holder of the private key is the only person with control of that particular address at which an electronic bill of lading is kept (because of the unique quality afforded by blockchain technology).[204] The control of an electronic bill of lading on the blockchain is therefore provided for, thus fulfilling paragraph (ii).

Paragraph (iii) sets forth the requirement that the electronic record retain its integrity.[205] As explained above, there are a number of technological devices built into blockchain technology which would guarantee the integrity of a blockchain bill of lading (meaning that the blockchain records are tamper-resistant and

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198. ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 94.

199. *Id*.; *see also id*. ¶ 95 ("The purpose of the provision is to identify the electronic transferable record that is the functional equivalent of the transferable document or instrument."); *id*. ¶ 96 ("The combination of the article 'the' and singular noun in the Arabic, English, French and Spanish language versions of the Model Law suffices to point at the singularity approach.").

200. *See* Scott J. Shackelford & Steve Myers, *Block-by-Block: Leveraging the Power of Blockchain Technology to Build Trust and Promote Cyber Peace*, 19 YALE J. L. & TECH. 334, 355–56 (2017) (describing the "tamper-proof power of blockchain").

201. *See also* Bacon et al., *supra* note 15, at 6 (describing hash values as unique with the probability of a duplicate being one in 10^{60}).

202. ETR Model Law Explanatory Note, *supra* note 53, ¶ 98.

203. *Id*.

204. *Cf*. Andrew M. Hinkes, *Throw Away the Key, or the Key Holder? Coercive Contempt for Lost or Forgotten Cryptocurrency Private Keys, or Obstinate Holders*, 16 NW. J. TECH. & INTELL. PROP. 225, 231 (2019) ("Any person who controls a private key can access and control the assets associated therewith[, however] a thief who steals a private key may immediately transfer the assets controlled by that private key to another wallet.").

205. ETR MODEL LAW, *supra* note 166, art. 10(1).

cannot be easily altered). One guarantee is the public key infrastructure and authentication by unique digital signatures (which are arguably more secure than any handwritten signature).[206] Another guarantee is the immutable nature of the blockchain (recall that the hash value of previous blocks is used to sign future blocks, guaranteeing that its state cannot be modified after a block is created).[207] Therefore, a blockchain bill of lading would be able to provide for an assurance of record integrity required by paragraph (iii).

Finally, the ETR Model Law Article 11 addresses situations

> where the law requires or permits 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: (a) [t]o establish exclusive control of that electronic transferable record by a person; and (b) [t]o identify that person as the person in control.[208]

As explained above, to ensure that the parties to a transaction are who they say they are, blockchain technology uses public key infrastructure (a public/private key, a signing algorithm, and a validation function).[209] This ensures that a holder of a blockchain bill of lading is able to demonstrate that it is the rightful holder, fulfilling this requirement.[210]

iii. Use of Electronic Transferable Records

Chapter III of the ETR Model law addresses the use of electronic transferable records. Article 12 provides a standard on reliability that applies whenever the ETR Model Law requires the use of a "reliable method."[211] In particular, the "method" referred

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206. *See* Bacon et al., *supra* note 15, at 9 (describing how public key infrastructure can use a challenge-response interaction to confirm a digital identity).

207. *See* Shackelford & Myers, *supra* note 200 at 351 (describing how distributed consensus creates an immutable public-ledger).

208. ETR MODEL LAW, *supra* note 166, art. 11(1). The ETR Model Law Guide emphasizes that identification is not to be understood as an obligation to *name* the person in control and instead only requires "method or system", thus leaving the possibility of using keys. ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 116.

209. *See* Bacon et al., *supra* note 15, at 9.

210. *See also* ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 111 ("[Article 11] refers to 'exclusive' control for reasons of clarity, since the notion of 'control', similarly to that of 'possession', implies exclusivity in its exercise. Yet, control, like possession, could be exercised concurrently *by more than one person*.") (emphasis added).

211. *Id*. ¶ 122 ("The concept of reliability refers to the reliability of the method used. In turn, reference to the method implies reference to any system used to implement that method.").

to should be "[a]s reliable as appropriate for the fulfilment of the function for which the method is being used, in the light of all relevant circumstances."[212] It should be proven in fact to have fulfilled the function "by itself or together with further evidence."[213] Article 12 provides a list of examples that include reliable methods, but this list is illustrative and not exhaustive, and it does not prevent the parties from allocating liability contractually.[214] It does, however, point out the need for a uniform approach to blockchain bill of lading infrastructure and quality controls.[215] As of the writing of this article, such an approach does not exist.

Article 13 allows for a time indication in electronic transferable records. "In the case of endorsements, this is particularly important given that the dematerialized nature of electronic transferable records does not make their temporal sequence apparent as in transferable documents or instruments."[216] In blockchain headings, the time is one of the elements, so this will be recorded each time a new block is created, thus recording the time of "endorsement."[217]

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212. ETR MODEL LAW, *supra* note 166, art. 12(a) (stating that this may include: "(i) Any operational rules relevant to the assessment of reliability; (ii) The assurance of data integrity; (iii) The ability to prevent unauthorized access to and use of the system; (iv) The security of hardware and software; (v) The regularity and extent of audit by an independent body; (vi) The existence of a declaration by a supervisory body, an accreditation body or a voluntary scheme regarding the reliability of the method; [or] (vii) Any applicable industry standard").

213. *Id*. art. 12(b).

214. ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 123.

215. Albrecht, *supra* note 161, at 287 ("Currently, the law can only adapt to a commercial practice on the condition that the latter is sufficiently settled. As the bedrock of common law rulemaking, this principle should be interpreted in a modern way, encompassing the inclusion of new technologies to the extent that they are able to perform the same functions as traditional practices. Until this is recognized, the blockchain bill [of lading] cannot be used as a document of title.").

216. ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 140.

217. *See, e.g.,* JAMES CONDOS ET AL., VT. GENERAL ASSEMB., BLOCKCHAIN TECHNOLOGY: OPPORTUNITIES AND RISKS 19 (2016), http://legislature.vermont.gov/assets/Legislative-Reports/blockchain-technology-report-final.pdf (noting that blockchain "provides a reliable way of confirming . . . the time and date of its submission, . . . eliminating the need for third-party intermediaries in certain situations") [https://perma.cc/987R-X92E].

Article 14 clarifies that the location of an "information system" is not an indicator of a place of business.[218] This is particularly useful for blockchain systems in that the management of electronic transferable records is decentralized and will use technology located in various jurisdictions that may change regularly.[219]

Article 15 identifies the requirements that need to be complied with in order to achieve functional equivalence of endorsement, and provides for "the use of different models for electronic transferable records management systems in line with the principle of technological neutrality."[220] In a blockchain bill of lading scenario, a holder can "endorse" the blockchain bill of lading to a transferee by signing it with the holder's private key, the hash, and the transferee's public key. The transferee can then verify the blockchain bill of lading by a validation function.[221]

Another principle of *functional equivalence* is manifested in Article 16, which provides for situations where an electronic transferable record may be amended.[222] "[A]rticle 16 aims to provide evidence of and trace all amended information. The article is in line with the general obligation to preserve the integrity of the electronic transferable record[s]."[223] Of note, the "amended information should not only be recorded, but also identified as such and therefore be recognizable."[224] Recall the immutable nature of the blockchain (the hash value of previous blocks is used to sign future blocks, guaranteeing that its state cannot be modified after a block is created). A blockchain bill of lading not only

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218. ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 146.

219. *Cf. Id*. ("That clarification may be particularly useful in light of the likelihood that third parties providing services relating to the management of electronic transferable records will use equipment and technology located in various jurisdictions, or whose location may change regularly, such as in the case of use of cloud computing.").

220. *Id*. ¶ 154.

221. *See, e.g.*, Huang-Chih Sung, *When Open Source Software Encounters Patents: Blockchain As an Example to Explore the Dilemma and Solutions*, 18 J. MARSHALL REV. INTELL. PROP. L. 55, 59 (2018) ("[T]he hash value can be used to maintain the confidentiality and prove the identity of the information directed into the blockchain by operating the Hash Function on the information again, and checking whether the same hash value is generated. The transparency, untamperability, and undeniability of the information can thereby be confirmed.").

222. ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 155.

223. *Id*. ¶ 158.

224. *Id*.

provides for a high assurance of record integrity (including preservation of all amendments to the blockchain), but it also provides for amendments only if the parties have signed and authorized a new block.[225]

Articles 17 and 18 aim at satisfying two main goals: (a) enabling change of medium between an electronic transferable record and a transferable document or instrument; and (b) ensuring that the replaced document will not further circulate.[226] The holder of the private key is the only person with control of that particular address at which an electronic bill of lading is kept. Both the issuance and transfer of an electronic bill of lading on the blockchain is provided for by this public/private key system.[227] The requirements of Articles 17–18 could in theory be satisfied by configuring the blockchain system to recognize when the bill of lading is switched to an electronic transport record to a negotiable transport document and *vice versa.*[228] In the situation where an electronic transport record is converted to a negotiable transport document, an ending block could be created to memorialize such transformation. Similarly, a genesis block could be created when a negotiable transport document is switched to an electronic transport record on the blockchain,

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225. Marina Fyrigou-Koulouri, *Blockchain Technology: An Interconnected Legal Framework for an Interconnected System*, 9 CASE W. RES. J.L. TECH. & INTERNET 1, 3 (2018) (explaining that "[a] new block will only be added to the ledger if the network verifies that its transactions are legitimate and valid, and do not contradict previous transactions" and that all computers on the network must reach a consensus).

226. ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 163. An electronic transferable record may replace a transferable document or *vice versa*. A statement indicating a change of medium must be inserted in the new instrument, and upon issuance of the new instrument, the old instrument must be made inoperative. ETR MODEL LAW, *supra* note 166, arts. 17–18.

227. *But see* Emmanuel T. Laryea, *Paperless Shipping Documents: An Australian Perspective*, 25 TUL. MAR. L.J. 255, 286 (2000) ("For holders of bills of lading to realise the full benefits conferred by statutes affecting bills of lading, it is important that the receipt message and the Private Key are recognised as constituting a bill of lading under those laws. It is doubtful whether the receipt message and the Private Key qualify as a bill of lading under the laws in many jurisdictions.").

228. Cohn et al., *supra* note 99, at 283 (showing that triggering mechanisms can be used with numerous blockchains to execute smart contracts only "upon the occurrence of agreed-upon events").

subject to the negotiable transport document being destroyed or otherwise held void.[229]

iv. Cross-border Recognition of Electronic Transferable Records

Article 19 aims at addressing issues relating to "cross-border recognition of an electronic transferable record" when that record was "issued or used" abroad.[230] The need for an international regime to facilitate the cross-border use of electronic transferable records is recognized in the preamble to the ETR Model Law.[231] The preamble appeals to "relevant international and regional organizations to coordinate their legal activities in the area of electronic commerce . . . to avoid duplication of efforts and to promote efficiency, consistency and coherence in the modernization and harmonization of legislation on electronic commerce."[232] The words "issued or used" cover the entire life cycle of an electronic transferable record, including endorsement and amendment.[233] Given the specific use of blockchain bill of lading technology in international commerce, and the fact that blockchain technology is decentralized, this article prevents parties from challenging records that were issued or used abroad.[234]

In summary, it follows that a blockchain bill of lading could be an electronic record falling under the ETR Model Law as drafted (if not otherwise excluded by a jurisdiction), but there is still work to be done to fully realize blockchain bills of lading within this legal framework. One significant detail is that the ETR Model Law has only been enacted in one jurisdiction.[235]

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229. Donald & Miraz, *supra* note 100, at 120 ("The genesis block may contain instructions and procedures for the operation of the chain, which could be rules on the creation of new assets and establishing consensus, code for a smart contracts [sic], or policy statements.").

230. ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 180.

231. *Id.* ¶ 181 (noting that the need was "recognized at the outset of the work" and was also "emphasized by the commission at its forty-fifth session").

232. ETR MODEL LAW, *supra* note 166, pmbl.

233. ETR MODEL LAW EXPLANATORY NOTE, *supra* note 53, ¶ 184.

234. Jonathan Rohr & Aaron Wright, *Blockchain-Based Token Sales, Initial Coin Offerings, and the Democratization of Public Capital Markets*, 70 HASTINGS L.J. 463, 470 (2019) (noting that "[l]arge public blockchains are redundantly stored on computers scattered throughout the globe").

235. *UNCITRAL Model Law on Electronic Transferable Records (2017) - Status*, UNITED NATIONS COMMISSION ON INTERNATIONAL TRADE LAW, https://uncitral.un.org/en/texts/ecommerce/modellaw/electronic_transferable_records/status [https://perma.cc/5QNK-S5GD].

Only a small number of jurisdictions have conducted public consultations on its adoption.

V. CONCLUSION

A fully functional legal framework for blockchain bills of lading, as of the writing of this article, has not been realized yet.[236] But the legal frameworks discussed in this article can be seen as a significant step towards realizing a fully functional legal framework.[237]

There are numerous solutions on the market attempting to "digitize" bills of lading.[238] One solution relating to a "digital" bill of lading is the Telex release. A "Telex release" is an industry term that refers to the release of cargo at one port when the bill of lading was presented somewhere else.[239] However, users of this solution still need to issue an original physical bill of lading.[240] Bolero[241] and essDocs[242] also provide solutions relating to

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236. Albrecht, *supra* note 161, at 273 ("The Rotterdam Rules . . . merely provide for a first step in the direction of a fully functional legal framework. Nonetheless, this primary step may be considered the most significant one.").

237. *Id*.

238. AltexSoft Inc., *Electronic Bill of Lading: How to Go Paperless with Bolero, essDOCS, e-title, and edoxOnline*, MEDIUM (Feb. 11, 2020), https://medium.com/@AltexSoft/electronic-bill-of-lading-how-to-go-paperless-with-bolero-essdocs-e-title-and-edoxonline-ea6b11bcb7 (explaining that some of these solutions are actually being utilized in the market, while others are still in the design and prototype phase) [https://perma.cc/P6VK-9PBE].

239. Hariesh Manaadiar, *What Is a Telex Release..??*, SHIPPING & FREIGHT RES. (Aug. 8, 2011), http://shippingandfreightresource.com/what-is-a-telex-release/ [https://perma.cc/4KTN-VARZ].

240. Hariesh Manaadiar, *Difference Between Telex Release and Express Release*, SHIPPING & FREIGHT RES. (Mar. 1, 2017), https://shippingandfreightresource.com/difference-between-telex-release-and-express-release/ [https://perma.cc/R7QT-8NN9].

241. *Bolero Insights: Electronic Bill of Lading for Carriers Overview*, BOLERO 4–5 ("The Bolero eBL is based on this construct of a legal solution closely integrated with a technology implementation but adds some important and unique elements to both the legal rulebook and the technical solution.").

242. ESSDOCS LIMITED, https://www.essdocs.com/solutions/cargodocs/docex/electronic-bills-of-lading ("The electronic Bill of Lading finally became a reality with the operational launch of CargoDocs DocEx, which enables users to create, issue and transfer eDocs – including an electronic bill of lading (eB/L) – through the trade chain.") [https://perma.cc/F4DC-3QSU]; ESSDOCS LIMITED, https://www.essdocs.com/solutions/cargodocs/docex ("CargoDocs eDoc Exchange (DocEx) is a secure, cloud-based solution that enables the electronic signing, exchange and legal transfer of title documents. Data from the original eDocs in DocEx can be combined with data from IoT devices and key events to

the "digital" bill of lading and electronic documents. These solutions are not without challenges, including security and confidentiality of messages.[243] TradeLens is a blockchain supply chain platform jointly developed by IBM and Maersk GTD.[244] TradeLens is based on Hyperledger Fabric, an open-source permissioned blockchain.[245] Since the blockchain is permissioned, it appears that it is not totally open in the sense that nodes are specifically assigned.[246] TradeLens claims that members are "Trust Anchors" having cryptographic identities, and it is not clear how these anchors are chosen.[247] CargoX is a company developing blockchain based bill of lading solutions.[248] Its solution

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minimize the risk and cost of financing and trade.") [https://perma.cc/E8J6-VVR9].

243. Naomi Chetrit et al., *Not Just for Illicit Trade in Contraband Anymore: Using Blockchain to Solve A Millennial-Long Problem with Bills of Lading*, 22 VA. J.L. & TECH. 56, 77 (2018) ("The main issue with the Bolero system is that it lacks closure and confidentiality of messages exchanged between users. For example, messages in the system are visible to all the parties using Bolero. Further, encryption for documents and messages is optional, creating differing and inconsistent levels of security across the platform, depending on the particular transaction. It is important to note that Bolero (and ESS documents) is still commercially used today but in very few cases.").

244. *TradeLens Blockchain-Enabled Digital Shipping Platform Continues Expansion With Addition of Major Ocean Carriers Hapag-Lloyd and Ocean Network Express*, MAERSK (July 2, 2019), https://www.maersk.com/news/articles/2019/07/02/hapag-lloyd-and-ocean-network-express-join-tradelens.

245. TRADELENS, https://www.tradelens.com/platform ("Powered by IBM Cloud and IBM Blockchain, the TradeLens Platform provides every entity involved in global trade with the digital tools to share information and collaborate securely.") [https://perma.cc/H6KA-QYRL].

246. Press Release, TRADELENS, TradeLens Adds Major Ocean Carriers Hapag-Lloyd and Ocean Network Express (July 2, 2019), https://www.tradelens.com/press-releases/hapag-lloyd-and-ocean-network-express ("Hapag-Lloyd and ONE will each operate a blockchain node, participate in consensus to validate transactions, host data, and assume a critical role of acting as Trust Anchors, or validators, for the network. Both companies will be represented on the TradeLens Advisory Board, which will include members across the supply chain to advise on standards for neutrality and openness.") [https://perma.cc/28ME-HYGW].

247. *Id.*

248. CARGOX, RESHAPING THE FUTURE OF GLOBAL TRADE WITH WORLD'S FIRST BLOCKCHAIN-BASED BILL OF LADING 8, https://cargox.io/CargoX-Business-Overview-Technology-Bluepaper.pdf ("The blockchain-based Bill of Lading developed by CargoX preserves all paper B/L legacy features and enhances them with benefits offered by the decentralised ecosystem, including speed, security, and transparency. Additionally, it provides a base for further integration of value-added features such as smart contract Letter of Credit (L/C), insurance, etc.") [https://perma.cc/53K9-PHMY].

utilizes the CXO token.[249] Its first shipment in 2018 was processed with its blockchain-based CargoX Smart Bill of Lading™ solution.[250] The cargo was released successfully in the Port of Koper, Slovenia on August 19, 2018, completing its journey from Shanghai, China.[251] These solutions, as well as other similar solutions, face various challenges relating to centralization, trust, and lack of widespread use by the shipping industry.[252]

The bill of lading has been around for centuries, shaping the cross-border sales landscape while at the same time being shaped by it. Blockchain technology is disrupting various industries, including the cross-border sales landscape. The compatibility of blockchain with bills of lading may seem unusual, since the former may be perceived as a new, disruptive technology originally used to trade cryptocurrency and the latter may be perceived as a centuries old, outdated solution that has resisted change. The above analysis, however, has shown that these two systems can in fact be compatible with each other under UNCITRAL works related to international commerce. Blockchain could be the technology that will put an end to the drawbacks of paper bills of lading, and the bill of lading system, if fully adopted, could be the application that develops blockchain technology to its full potential in the supply chain industry.

An open blockchain platform requiring no subscription to membership would be ideal, since the membership requirement could be an obstacle to the widespread adoption of blockchain bills of lading. A blockchain bill of lading calls for a globally unified solution, and in this respect, UNCITRAL, with its rich experience in areas of relevance to international commerce, is an

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249. *Id*. ("CargoX token (ticker symbol CXO) is an ERC20 Ethereum-based utility token used as a core part of CargoX's digitized business model. Users will need to spend CXO tokens to utilize CargoX Smart B/L smart contracts and issue a Smart B/L. CXO tokens will be used for all CargoX services, as well as for a payment solution for logistic services offered by other selected logistic partners.").

250. Press Release, CARGOX, A day to remember: The First Ever Blockchain-Based CargoX Smart B/L™ has Successfully Completed its Historic Mission During a Trial Shipment from China to Europe, (Aug. 23, 2018), https://cargox.io/press-releases/full/first-ever-blockchain-based-cargox-smart-bl-has-successfully-completed-its-historic-mission/ [https://perma.cc/Y6D9-G22Z].

251. *Id*.

252. CryptoWeekly named CargoX as one of 250 crypto companies to watch in 2020. *See 250 Crypto Companies to Watch in 2020*, CRYPTOWEEKLY, https://cryptoweekly.co/250/ (discussing the top 250 crypto firms that are using blockchain solutions) [https://perma.cc/538H-YFMA].

ideal forum for providing a globally unified solution. However, a blockchain bill of lading must be sufficiently supported by local legal systems. In this respect, the ETR Model Law should be consulted while shaping the law of individual countries. This will facilitate the consistent implementation of blockchain bill of lading technology across differing legal systems and encourage the replacement of paper bills of lading.

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