

## BLOCKCHAIN REAL ESTATE AND NFTS

JULIET M. MORINGIELLO\* & CHRISTOPHER K. ODINET\*\*

### ABSTRACT

*Non-fungible tokens (popularly known as NFTs) and blockchains are frequently promoted as the solution to a multitude of property ownership problems. The promise of an immutable blockchain is often touted as a mechanism to resolve disputes over intangible rights, notably intellectual property rights, and even to facilitate quicker and easier real estate transactions.*

*In this Symposium Article, we question the use of distributed ledger technologies as a method of facilitating and verifying the transfer of physical assets. As our example of an existing transfer method, we use real property law, which is characterized by centuries-old common law rules regarding fractionalized ownership and local land records that still, in many jurisdictions, rely on paper. We explain the history of real property title protection and then identify the problems with the existing system. We then compare the extant system (and its problems) with what blockchain could offer, concluding that a blockchain system would provide few, if any, benefits.*

---

\* Associate Dean for Academic Affairs and Professor of Law, Widener University Commonwealth Law School.

\*\* Professor of Law and Michael & Brenda Sandler Fellow in Corporate Law, Professor of Finance (*secondary*), University of Iowa. The authors thank Kate Sablosky Elengold, Todd Pettys, Josephine Gittler, Hilary Allen, Shawn Bayern, Eric Chason, Joshua Fairfield, Carla Reyes, Kevin Werbach, Jason Windawi, James Grimmelmann, Del Wright, Laura Heymann, and all the participants of the *William & Mary Law Review* Cryptocurrency Symposium for their helpful comments and critiques. The authors also thank Richard Berner, Michael Kohn, Harper Beasley, Evan McKay, Nick Yost, Madison Hall, and Martin Kiernan for their helpful research support. All errors belong to the authors alone.

*That said, we concede that tracking and transferring ownership of certain rights—specifically, purely intangible rights—is a long-standing legal problem that begs for resolution. We focus on ownership signals and contrast ownership of physical assets—which is broadcast in part by manual possession in addition to, in the real estate realm, recording—with ownership of intangible assets, which cannot be possessed in a way that easily gives a signal to the entire world that the possessor is the owner. Because of that difference, we conclude that the true use case for NFTs and distributed ledgers is in tracking and verifying ownership of intangibles.*

## TABLE OF CONTENTS

INTRODUCTION . . . . .	1135
I. RECORDING SYSTEMS: OLD AND NEW . . . . .	1138
A. <i>The Traditional Real Estate Recording System</i> . . . . .	1139
1. <i>Historical View</i> . . . . .	1140
2. <i>Modern View</i> . . . . .	1143
B. <i>Distributed Ledger Technology Recording Systems</i> . . . . .	1147
1. <i>Introduction to Blockchain</i> . . . . .	1148
2. <i>Ethereum's Open-Ended Blockchain</i> . . . . .	1150
3. <i>The Fuel of Ethereum: Ether</i> . . . . .	1153
4. <i>Smart Contracts and Decentralized Apps</i> . . . . .	1154
5. <i>Cryptographic Keys</i> . . . . .	1157
6. <i>Crypto Intermediaries</i> . . . . .	1159
7. <i>Non-Fungible Tokens (NFTs)</i> . . . . .	1160
II. DO BLOCKCHAIN AND CRYPTO ASSETS HAVE A ROLE IN REAL ESTATE TRANSACTIONS? . . . . .	1164
A. <i>The Hype</i> . . . . .	1164
B. <i>Crypto- and Blockchain-Enabled Real Estate Transactions:         The Practice</i> . . . . .	1166
1. <i>Land Transfers by NFT</i> . . . . .	1167
2. <i>Crypto-Enabled Loans</i> . . . . .	1169
3. <i>Moving Recording to the Blockchain</i> . . . . .	1171
C. <i>Crypto, Blockchain, and Real Estate Transactions:         The Reality</i> . . . . .	1172
III. PROBLEMATIZING CRYPTO IN PROPERTY & COMMERCIAL LAW . . . . .	1174
A. <i>Impediment # 1: Overhauling the Law</i> . . . . .	1175
1. <i>The U.C.C. Today and Tomorrow</i> . . . . .	1176
2. <i>Real Estate Law</i> . . . . .	1178
B. <i>Impediment # 2: Overhauling the System</i> . . . . .	1181
1. <i>The Problems of Cost and Trust</i> . . . . .	1181
2. <i>The Delaware Corporations Example</i> . . . . .	1183
3. <i>Back to Vermont</i> . . . . .	1185
C. <i>The Problem of the Recording System as a         Repository of a Variety of Interests in Land</i> . . . . .	1185

IV. THE INTANGIBLE CASE FOR BLOCKCHAIN PROPERTY	
REGISTRIES . . . . .	1186
<i>A. Signals, Recording Systems, and Property Rights</i> . . . . .	1186
<i>B. The Intangible Case(s) for Tokenizing Property</i> <i>Rights and Tracking Them on a Blockchain:</i> <i>The Case of Visual Art</i> . . . . .	1189
CONCLUSION . . . . .	1191

## INTRODUCTION

For over a decade now,<sup>1</sup> the promise of distributed ledger technologies (often referred to as “blockchains”) have filled the minds of policymakers, politicians, investors, corporate giants, and even the general public.<sup>2</sup> Headlines proclaim that “blockchain will transform business”<sup>3</sup> and will “revolutionize the world economy.”<sup>4</sup> Of late, the rise of non-fungible tokens (NFTs) has added fuel to the fire, further enhancing the rhetoric around what crypto can do to change the world.<sup>5</sup> And perhaps nowhere have these promises had more resonance than in the case of property rights.<sup>6</sup> Blockchain technologies have been touted as a mechanism to track and resolve disputes over property, ranging from intellectual property to personalty to even real estate.<sup>7</sup> It is with this final asset class—*real*

---

1. Wayne Duggan, *The History of Bitcoin, the First Cryptocurrency*, U.S. NEWS: MONEY (Aug. 31, 2022, 3:21 PM), <https://money.usnews.com/investing/articles/the-history-of-bitcoin> [<https://perma.cc/CN9P-BZ9T>] (“The Bitcoin blockchain was officially launched when the first Bitcoin block, the genesis block, was created on Jan. 3, 2009.”).

2. See, e.g., BOBBY C. LEE, *THE PROMISE OF BITCOIN: THE FUTURE OF MONEY AND HOW IT CAN WORK FOR YOU* (2021) (ebook); *Harnessing the Promise of Blockchain to Change Lives*, UNITED NATIONS CONF. ON TRADE & DEV. (Mar. 2, 2021), <https://unctad.org/news/harnessing-promise-blockchain-change-lives> [<https://perma.cc/D2ZW-KDVY>]; Press Release, U.S. Dep’t of the Treasury, Fact Sheet: Framework for International Engagement on Digital Assets (July 7, 2022), <https://home.treasury.gov/news/press-releases/Jy0854> [<https://perma.cc/363Y-YH3X>].

3. *Time for Trust: How Blockchain Will Transform Business and the Economy*, PRICE-WATERHOUSECOOPERS, <https://www.pwc.com/gx/en/industries/technology/publications/blockchain-report-transform-business-economy.html> [<https://perma.cc/4SZH-PXNB>].

4. *How Blockchains Could Change the World*, MCKINSEY & CO. (May 6, 2016), <https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/how-blockchains-could-change-the-world> [<https://perma.cc/83CU-NSYA>].

5. Clive Thompson, *The Untold Story of the NFT Boom*, N.Y. TIMES (Aug. 12, 2021), <https://www.nytimes.com/2021/05/12/magazine/nft-art-crypto.html> [<https://perma.cc/7PS4-QXKL>].

6. Desiree Daniel & Chinwe Ifejika Speranza, *The Role of Blockchain in Documenting Land Users’ Rights: The Canonical Case of Farmers in the Vernacular Land Market*, 3 FRONTIERS BLOCKCHAIN 1 (2020), <https://www.frontiersin.org/articles/10.3389/fbloc.2020.00019/full> [<https://perma.cc/K7AN-HFL4>]; Rosa M. Garcia-Teruel & Héctor Simón-Moreno, *The Digital Tokenization of Property Rights. A Comparative Perspective*, 41 COMPUT. L. & SEC. REV. 1, 2, 11 (2021).

7. See Gabriel Khoury & Jared A. Wachtler, *Blockchain Technology Is Changing the Real Estate Industry*, NAT’L L. REV. (Feb. 24, 2022), <https://www.natlawreview.com/article/blockchain-technology-changing-real-estate-industry> [<https://perma.cc/DH3T-9KV8>]; *Blockchain and Property Rights*, NEW AM., <https://www.newamerica.org/future-land-housing/reports/>

*property*—that this Symposium Article concerns itself. In these pages, we question the use of blockchain networks and NFTs in real property transactions by interrogating how the existing technologies work against the backdrop of the realities of real property transfers. Moving beyond the hype, we explain that a blockchain system would provide few if any benefits to our system of real estate transactions.

The recording system in the United States is quite old and has, at least historically, been based on paper records.<sup>8</sup> Additionally, the system is almost exclusively one of notice, which aims to convey information to parties that may or may not be accurate.<sup>9</sup> Rather than being definitive, recording information serves as a basis for further investigation.<sup>10</sup> One may find a cloud on title to property, only to then discover that the basis for the ostensible claim is invalid.<sup>11</sup> In other cases, the claim revealed in the record may require additional acts to cure the title.<sup>12</sup> All of this, plus the very paper-based nature of the system, has given rise to numerous objections over the years—primarily that the system is antiquated and inefficient.<sup>13</sup> Surely blockchain systems, with their distributed networks and immutable recordkeeping all operating seamlessly through smart contracts and token-based assets rather than through paper deeds and filings, would vastly improve land transfers.<sup>14</sup>

But we are incredulous as to these claims. While many aspects of the existing land-recording system are old and, at least in many parts of the country, still paper-based, not all components are bad. Indeed, for all its inefficiency, land transactions abound in the United States—and have done so even during the COVID-19 pandemic.<sup>15</sup> In other words, for all its flaws and ripe old age, the U.S. land-recording system seems to be working quite fine.

---

proprightstech-primers/blockchain-and-property-rights/ [https://perma.cc/S3YD-S95G].

8. *See infra* Part I.A.

9. *See infra* Part I.A.

10. *See infra* Part I.A.

11. *See infra* Part I.A.

12. *See infra* Part I.A.

13. *See infra* Part II.A.

14. *See infra* Part II.B.

15. Peter Grant, *Covid-19 Fuels Best-Ever Commercial Real-Estate Sales*, WALL ST. J. (Jan. 25, 2022, 3:35 PM), <https://www.wsj.com/articles/covid-19-fuels-best-ever-commercial-real-estate-sales-11643115601> [https://perma.cc/E6WE-DTDG].

Moreover, moving to a blockchain-based system would be a significant undertaking.<sup>16</sup> Not only would it involve changes to numerous laws—indeed, it would involve fundamentally moving to a land registration system<sup>17</sup> and leaving the notice recording system behind—but it would also require that changes be made to property law itself.<sup>18</sup> Specifically, current law does not allow one to tokenize rights in real property.<sup>19</sup> In other words, one cannot merely, through contract or some other private law mechanism, create a digital asset (an NFT) and have it embody ownership or any other rights in real estate.<sup>20</sup>

But putting aside the legal obstacles, there are also systemic barriers—some of which are bound up in basic political economy. First, to change the system of recording from the way it is now to one that involves blockchain as contemporarily conceived would be expensive and present issues of public trust, as it would seem to require the introduction of private firms as central nodes in the system to substitute for accountable government officials.<sup>21</sup> As we explain below, efforts in at least two states to use blockchain technology in corporate record keeping and in land transfers have largely come to nothing.<sup>22</sup>

Yet, we think there is indeed a potential case for using blockchains and crypto technology when it comes to property rights. But it is not in the world of real property—which our existing system has largely shown itself to be sufficient—but rather for *intangible* property.<sup>23</sup> American law was developed to deal with tangible assets, whether personal or real. This makes sense because these asset types represented the primary forms of wealth for most of history.<sup>24</sup>

---

16. See *infra* Part III.B.

17. 66 AM. JUR. 2D *Registration of Land Titles* § 1 (2021) (describing the Torrens system of land registration, rather than recordation).

18. See *infra* Part III.A.

19. See Juliet M. Moringiello & Christopher K. Oinet, *The Property Law of Tokens*, 74 FLA. L. REV. 607, 640-43 (2022).

20. See *id.*

21. See *infra* Part III.B.

22. See *infra* Part III.B.

23. See *infra* Part IV.

24. See Arjan Zuiderhoek, *Introduction: Land and Natural Resources in the Roman World in Historiographical and Theoretical Perspective*, in OWNERSHIP AND EXPLOITATION OF LAND AND NATURAL RESOURCES IN THE ROMAN WORLD 1, 7 (Paul Erdkamp et al. eds., 2015) (ebook); CLAIRE PRIEST, CREDIT NATION: PROPERTY LAWS AND LEGAL INSTITUTIONS IN EARLY AMERICA

But tracking and transferring rights in intangible property—particularly *purely intangible personal property*—have always been underdeveloped.<sup>25</sup> It is here, so we argue, that blockchain technology and NFTs might have the highest utility.

In order to make all of these arguments, this Symposium Article proceeds in four parts. First, we explain how the existing system of land recordation works in the United States, paying specific attention to its most salient aspects. We then describe and compare it to the recording system that is the blockchain. We aim here to give a primer on blockchains, using the Ethereum network as the centerpiece, with a focus on the aspects that offer the best points of comparison to the traditional land recording system. In Part II, we question whether the hype around blockchains and crypto has a meaningfully useful role to play in real estate transactions. We do this by describing the various uses proffered by crypto enthusiasts and the companies experimenting with various crypto offerings—ranging from NFT land transfers to crypto mortgages and more. Our main contribution comes to the fore in Part III, in which we problematize the use of blockchains and NFTs in real property transactions to show how current property and commercial law, as well as considerations of political economy and pure costs, make the crypto promise quite hollow. Part IV concludes, however, with some crypto optimism, arguing that blockchains and attendant technologies can play a useful role in how we deal with rights in certain kinds of intangible property.

## I. RECORDING SYSTEMS: OLD AND NEW

One can ascribe various definitions to blockchains, but at their core, they are digital ledgers that contain various kinds of information.<sup>26</sup> In turn, this information is meant to convey rights or claims,

---

166-68 (2021); H.W. BRANDS, *THE AGE OF GOLD: THE CALIFORNIA GOLD RUSH AND THE NEW AMERICAN DREAM* 23-24 (2002).

25. See generally Juliet M. Moringiello, *False Categories in Commercial Law: The (Ir)relevance of (In)tangibility*, 35 FLA. ST. U. L. REV. 119, 121 (2007); Christopher K. Odinet, *BitProperty and Commercial Credit*, 94 WASH. U. L. REV. 649, 654 (2017); Joshua A.T. Fairfield, *Bitproperty*, 88 S. CAL. L. REV. 805, 826 (2015); Christopher K. Odinet, *Data and the Social Obligation Norm of Property*, 29 CORNELL J.L. & PUB. POL'Y 643, 651-53 (2020).

26. See U.S. Sec. & Exch. Comm'n v. Kik Interactive Inc., 492 F. Supp. 3d 169, 173



sometimes to things internal to the blockchain system itself (such as native cryptocurrencies<sup>27</sup>) and sometimes to things external to it (such as tokens that represent virtual or physical assets<sup>28</sup>). But in truth, public ledgers that contain information giving rise to or evidencing rights and claims have been around for quite a long time.<sup>29</sup> While not originally digital in nature, they have played an important—in fact, essential—role in moderating conflicts between parties claiming interests of one kind or another in the same thing, be it property or otherwise.

To understand the promise of blockchains and what they can (and cannot) do to solve the issues that are often said to plague real property transactions, one must first understand the real property public ledger system that already exists. The following provides a tour of the real property recording system in the United States and then gives a nuts and bolts summary of the dominantly distributed ledger technology—that run by Ethereum—and the smart contracts and tokens that are attendant to it.

### A. *The Traditional Real Estate Recording System*

To understand the extant recording system, one must understand the concept of title. As Rufford and Carroll Patton's seminal treatise on land titles defines it: "[T]itle' means the right to or ownership of property."<sup>30</sup> More recently, Heather Way described title as "a legal construct that defines" the rights held by someone in a particular asset.<sup>31</sup> Donald Kochan has written, "title is meaningless if it is not

---

(S.D.N.Y. 2020) ("As planned by Kik, Kin was to be a cryptocurrency stored, transferred, and recorded on a digital ledger called a blockchain. On a blockchain, each transaction is recorded in a block, which is linked to a prior block through cryptographic code. This results in the chain of blocks making up the ledger, or blockchain. Blockchains are decentralized because they rely on the combined computing power of different networks of computers to process and verify transactions." (citations omitted)).

27. See *In re Bibox Grp. Holdings Ltd. Sec. Litig.*, 534 F. Supp. 3d 326, 329-30 (S.D.N.Y. 2021) ("A blockchain is a decentralized electronic ledger that allows for secure and reliable tracking of the ownership and transfer of each individual unit of the crypto-asset."), *reconsideration denied in part*, No. 20cv2807, 2021 WL 2188177 (May 28, 2021).

28. See Moringiello & Odinet, *supra* note 19, at 635.

29. See *id.* at 618-21; see also Fairfield, *supra* note 25, at 816-20.

30. 1 JOYCE D. PALOMAR & RUFFORD G. PATTON, PATTON & PALOMAR ON LAND TITLES § 1 (3d ed. 2011).

31. Heather K. Way, *Informal Homeownership in the United States and the Law*, 29 ST.

recognized and nearly meaningless if there is not some method to prove title with certainty.”<sup>32</sup>

This is when the laws governing assurance of title come into play. These laws are a mix of common law doctrines and statutory regimes that impart legal recognition of title in real property and make such information readily available for public inspection.<sup>33</sup> In doing so, as the history below chronicles, title is made relatively certain, and certain rights are given priority vis-à-vis other interests in the same property.

### 1. *Historical View*

During the early common law period in England,<sup>34</sup> a formal system of recording land titles was not really needed.<sup>35</sup> Land transferred between persons seldomly because it was usually tied up in the hands of aristocratic families<sup>36</sup> or otherwise insulated from seizing creditors.<sup>37</sup> The same was true in many civil law jurisdictions in which the lack of a market for frequent transfers of

---

LOUIS U. PUB. L. REV. 113, 120 (2009).

32. Donald J. Kochan, *Certainty of Title: Perspectives After the Mortgage Foreclosure Crisis on the Essential Role of Effective Recording Systems*, 66 ARK. L. REV. 267, 272 (2013).

33. Gerald Korngold, *Resolving the Intergenerational Conflicts of Real Property Law: Preserving Free Markets and Personal Autonomy for Future Generations*, 56 AM. U. L. REV. 1525, 1564 (2007).

34. The common law emerged in the late 1100s. See JOHN H. LANGBEIN, RENÉE LETTOW LERNE, & BRUCE P. SMITH, *HISTORY OF THE COMMON LAW: THE DEVELOPMENT OF ANGLO-AMERICAN LEGAL INSTITUTIONS* 77 (2009). One exception would be the Domesday Book of 1086, which was a kind of land record, although its purpose was less about creating a definitive source for land titles and more about helping William the Conqueror settle tax accounts due to the Crown. See THEODORE F.T. PLUCKNETT, *A CONCISE HISTORY OF THE COMMON LAW* 10-11 (1929).

35. It should be noted that prior to the Roman Empire, there was little concern for recording land interests because states were often not stable enough for long enough to merit such a system, particularly when possession was deemed sufficient to convey information about who owned what. See P.H. Marshall, *A Historical Sketch of the American Recording Acts*, 4 CLEV.-MARSHALL L. REV. 56, 56-57 (1955).

36. See EILEEN SPRING, *LAW, LAND, AND FAMILY: ARISTOCRATIC INHERITANCE IN ENGLAND, 1300 TO 1800*, at 4-5 (1993); DAVID CANNADINE, *THE DECLINE AND FALL OF THE BRITISH ARISTOCRACY* 89 (1990); David Spring, *English Landed Society in the Eighteenth and the Nineteenth Century*, in 17 *THE ECONOMIC HISTORY REVIEW NEW SERIES* 146-47 (1964).

37. See 14 MICHAEL ALLAN WOLF, *POWELL ON REAL PROPERTY* § 146,82.01 (2022); see also PRIEST, *supra* note 24, at 62.

land made a recording system commercially unnecessary.<sup>38</sup> Also, the populace was largely illiterate, so a written record of land titles would have been of little utility.<sup>39</sup> In place of a system of paper recording, parties to a transfer of realty undertook a solemn ceremony known as *enfeoffment*.<sup>40</sup> This typically involved the symbolic handing over of a twig, some dirt, or a similar token, accompanied by words spoken by the grantor evidencing the intent to transfer, with the whole ritual being observed by a number of witnesses.<sup>41</sup> From this point onward, any subsequent attempts by the grantor to transfer the same property to someone else would be ineffective because the rule was that the first transfer prevailed over any subsequent ones (or, said another way, “first in time, first in right”).<sup>42</sup>

However, with changes in attitudes and markets for real property—specifically, more frequent transfers of real estate for business purposes, a more robust mortgage finance market, and a growing merchant class—the law began to move away from the twig and turf ceremony.<sup>43</sup> Indeed, in 1535, the English Parliament passed the Statute of Uses, which allowed people to convey title to real property without the *enfeoffment* ceremony.<sup>44</sup> The Statute of Enrolments was passed alongside the Statute of Uses also in an effort to combat secret transfers of property, which allowed for the avoidance of taxation to the Crown.<sup>45</sup> It became necessary to actually make a filing to indicate the conveyance of particular kinds of estates in land.<sup>46</sup> Finally, the passage of the Statute of Frauds in 1677 required a written document to effectuate a transfer of title to real property.<sup>47</sup> Yet even with this legislation, a system of recording

---

38. See Marshall, *supra* note 35, at 57. That is not to say that the civil law countries did not eventually adopt various kinds of land record systems. See 1 PALOMAR & PATTON, *supra* note 30, § 4.

39. See 14 WOLF, *supra* note 37, § 82.01; see also Marshall, *supra* note 35, at 56-57.

40. See 14 WOLF, *supra* note 37, § 82.01.

41. SHELDON F. KURTZ, HERBERT HOVENKAMP, CAROL NECOLE BROWN & CHRISTOPHER K. ODINET, CASES AND MATERIALS ON AMERICAN PROPERTY LAW 1307 (7th ed. 2019).

42. 14 WOLF, *supra* note 37, § 82.01; 3 HARRY D. MILLER & MARVIN B. STARR, CALIFORNIA REAL ESTATE DIGEST § 9 (3d ed. 2022).

43. See 14 WOLF, *supra* note 37, § 82.01.

44. 27 Hen. 8, c. 10.

45. See *id.* at c. 16.

46. *Id.*

47. 29 Car. 2, c. 3, § 1. For a more complete discussion of the statute and its background,

land titles was hardly robust. The Statute of Enrolments only reached a narrow set of land transfers—the bargain and sale transfer of only freehold title, but not, for example, the more common leasehold interest.<sup>48</sup> In sum, landowners who wished to avoid making their land transactions public were easily able to do so.<sup>49</sup>

It would not be until the American colonists usurped native lands<sup>50</sup> that a more significant recording system, similar to the one we know today, began to develop.<sup>51</sup> In the 1600s, a number of colonies began experimenting with requiring a written record of land ownership recorded in a local court's official records.<sup>52</sup> In what some historians believe to be the fountainhead of the modern recording acts, the General Court of Massachusetts Bay, likely influenced by so many colonists coming from Holland where land recording was becoming more common, enacted an ordinance aimed at preventing fraudulent conveyances in October 1640.<sup>53</sup> To do so, and in the interest of creating a system such that “every man may know what estate or interest other men may have in any houses, lands, or other hereditaments they are to deale [sic] in,”<sup>54</sup> the new law required that certain transfers of interests in real property be recorded in the records of the court.<sup>55</sup> These instruments had to be first acknowledged by some kind of public officer, and once recorded, they created

---

see LORD WRIGHT, LEGAL ESSAYS AND ADDRESSES 225-26 (1939).

48. See SHELDON F. KURTZ, MOYNIHAN'S INTRODUCTION TO THE LAW OF REAL PROPERTY, §§ 4-5, at 256-57 (7th ed. 2020).

49. DALE A. WHITMAN, ANN M. BURKHART, R. WILSON FREYERMUTH & TROY A. RULE, THE LAW OF PROPERTY 701 (4th ed. 2019).

50. See COHEN'S HANDBOOK OF FEDERAL INDIAN LAW § 1.02, at 13-16 (Nell Jessup Newton ed., 2012).

51. For a discussion of the connection between manorial records and transfers of copyholder (also called unfree tenant) interests and the rise of a recording system in the new American colonies, see Marshall, *supra* note 35, at 59; see also George L. Haskins, *The Beginnings of the Recording System in Massachusetts*, 21 B.U. L. REV. 281, 281-83 (1941).

52. See 14 WOLF, *supra* note 37, § 82.01. Prior to 1640, Virginia, Plymouth, Rhode Island, and Connecticut all enacted legislation dealing with land recording. See Haskins, *supra* note 51, at 284; PALOMAR & PATTON, *supra* note 30, § 4. In fact, the European colonial powers had already introduced some colonies to it (such as in New York, thanks to Dutch influence). See Haskins, *supra* note 51, at 291, 295.

53. See Haskins, *supra* note 51, at 282-83; 1 PALOMAR & PATTON, *supra* note 30, § 4.

54. 1 RECORDS OF THE GOVERNOR AND COMPANY OF THE MASSACHUSETTS BAY IN NEW ENGLAND 306 (Nathaniel B. Shurtleff ed., Boston, William White 1853).

55. Haskins, *supra* note 51, at 282-83.

an order of priority of rights in the same property among multiple grantees.<sup>56</sup> Numerous other colonies, ranging from Pennsylvania to Georgia, enacted similar statutes in the years that followed.<sup>57</sup> By the time of the American Revolution, all the English colonies had some form of recording system for conveying rights in realty.<sup>58</sup>

## 2. Modern View

The gradual westward expansion of the United States caused the influence (or imposition) of these early colonial recording acts to grow.<sup>59</sup> Eventually a pattern developed, which today has coalesced around three different forms of recording systems—the race, the race-notice, and the notice systems.<sup>60</sup> In the latter two forms, the “first in time, first in right” rule prevails unless a subsequent acquirer of an interest in the same property pays value and acquires the interest in good faith without notice of the first acquirer’s rights (and in the case of race-notice, also records the act giving rise to their interest).<sup>61</sup> In the former type, the race jurisdiction, the prevailing party is simply the one who records the instrument giving rise to their interest first as well as pays value for it.<sup>62</sup>

Whichever the system adopted in a given jurisdiction, the principles of title assurance embodied in these recording systems are generally the same.<sup>63</sup> They are systems of information that, through the law, make property, as the famous Peruvian economist Hernando DeSoto described, “standardized ... accountable ... [and]

---

56. *Id.* at 282.

57. See Haskins, *supra* note 51, at 282-88; 14 WOLF, *supra* note 37, § 82.01 (citing V. NICHOLSON, PENNSYLVANIA LAW OF REAL PROPERTY 288 (1924); 1 SMITH’S LAWS 94 & 422; Act of March 7, 1755, reprinted in T.R. COBB, DIGEST OF THE STATUTE LAW OF GEORGIA 159 (1851).

58. See 1 PALOMAR & PATTON, *supra* note 30, § 4.

59. 14 WOLF, *supra* note 37, § 82.01.

60. KURTZ ET AL., *supra* note 41, § 15.3.1, at 1370-71.

61. See *id.* § 15.3.1, at 1370-71, 1378-80 for a discussion with examples.

62. See *id.* § 15.3.1, at 1370; see also JAMES CHARLES SMITH, EDWARD J. LARSON, JOHN COPELAND NAGLE & JOHN A. KIDWELL, PROPERTY LAW 583 (3d ed. 2013); JOHN G. SPRANKLING & RAYMOND R. COLETTA, PROPERTY: A CONTEMPORARY APPROACH 629 (3d ed. 2015); GRANT S. NELSON, DALE A. WHITMAN, COLLEEN E. MEDILL & SHELLEY ROSS SAXER, CONTEMPORARY PROPERTY 742-43 (4th ed. 2013); JOSEPH WILLIAM SINGER, BETHANY R. BERGER, NESTOR M. DAVIDSON & EDUARDO MOISES PENALVER, PROPERTY LAW: RULES, POLICIES, AND PRACTICES 990 (6th ed. 2014).

63. See KURTZ ET AL., *supra* note 41, § 15.3.1, at 1370-71.

fungible.”<sup>64</sup> They are, in short, “public memory systems” that take the form of “rule-bound ... and publicly accessible registries.”<sup>65</sup>

More concretely, the aim of the recording act is not only to “favor the creation of clear and reliable property interests, while disfavoring ambiguous or contested ownership interests,” but also to “facilitate[] the creation of secure title interests by insuring a property owner from third party claims to the property.”<sup>66</sup> Joseph Singer explains while recording is not necessary for the transaction to be effective between the parties to it, recordation “is essential both to provide an official record of the state of the title” as well as “to protect the buyer against any competing claims that may be created by the grantor in others.”<sup>67</sup> The act of recording, combined with the public nature of the registry itself, puts “buyers on notice of prior claims or limits on land use rights.”<sup>68</sup>

But it is not merely buyers who rely upon the recording system. The system has a number of constituencies, such as borrowers, lenders, those with leasehold interests, title insurance firms,<sup>69</sup> government entities, judgment creditors, those entitled to statutory liens, and many more.<sup>70</sup> For example, before one leases property from or extends capital to the owner of real estate, one would want

---

64. Institute for Liberty & Democracy, *Hernando de Soto's Speech at the IBA 2008 (Part 3)*, YOUTUBE (June 29, 2010), <https://www.youtube.com/watch?v=gcwX7Kts3Us> [<https://perma.cc/S9WS-AJPU>].

65. Hernando de Soto, *The Destruction of Economic Facts*, INST. FOR LIBERTY & DEMOCRACY (Apr. 28, 2011), <https://www.ild.org.pe/ildnews/2012/858-building-a-nation-of-owners> [<https://perma.cc/933X-QBUS>].

66. Way, *supra* note 31, at 121.

67. JOSEPH WILLIAM SINGER, PROPERTY § 11.4.5, at 542 (4th ed. 2014).

68. *Id.*

69. For a discussion of the role of abstracts, title opinions, and title insurance companies, see 1 PALOMAR & PATTON, *supra* note 30, §§ 41-54. For an overview of Iowa's unique title guaranty program, see IOWA CODE ANN. § 515.48(10) (West 2021). See also Deborah J. Cook, Note, *Iowa's Prohibition of Title Insurance—Leadership or Folly?*, 33 DRAKE L. REV. 683, 684, 689-90 (1984).

70. Kochan, *supra* note 32, at 275-76. For an overview of the vendor's lien and the recording system, see *Lavin v. Lynch*, 168 N.W. 1024, 1024 (Mich. 1918); *Wilson v. Plutus Mining Co.*, 174 F. 317, 317 (8th Cir. 1909); *Finnell v. Finnell*, 105 P. 740, 740 (Cal. 1909); *Blomstrom v. Dux*, 51 N.E. 755, 757 (Ill. 1898). For discussions of the judgment lien and the recording system, see *Jeffrey v. Moran*, 101 U.S. 285, 287 (1879); *Hertweck v. Fearon*, 179 P. 190, 190 (Cal. 1919); *Curry v. Lehman*, 47 So. 18, 19 (Fla. 1908); *Ives v. Beecher*, 54 A. 207, 207 (Conn. 1903). For a summary of the mechanic's lien and the recording system, see 56 C.J.S. *Mechanics' Liens* § 13 (2022).

to know the state of title.<sup>71</sup> Does the individual actually own the property, either alone or with others?<sup>72</sup> Are there other interests in the property, either granted by the owner (such as easements, covenants, or leaseholds) or imposed on the owner's property by law (like judgement or statutory liens)?<sup>73</sup>

Aside from the variety of constituencies, there is great variety in the types of instruments that can (and should) be filed. It may be a document that conveys legal or equitable title, such as a purchase agreement or a deed.<sup>74</sup> It can also be an instrument that modifies, transfers, or releases an interest in the property.<sup>75</sup> But an important aspect of most modern recording acts in the United States is that the filings convey notice of *potential* interests in the property, but they are not necessarily definitive as to those interests. Rather, the recording system "simply invites searchers to inspect" the records and draw their own conclusions, after conducting due diligence, as to whether they are correct.<sup>76</sup>

For example, one might file a lien against property, claiming falsely that they are entitled to a right against the real estate because they were not fully paid for work performed.<sup>77</sup> Under law, that lien filing has no effect because it relates to a false claim.<sup>78</sup> Nevertheless, it creates a cloud on the property's title.<sup>79</sup> A searcher would find the lien statement in the record.<sup>80</sup> From there, the searcher would need to conduct an additional study to determine whether the lien was valid.<sup>81</sup> If the lien was valid and the searcher

---

71. See 3 PALOMAR & PATTON, *supra* note 30, § 561 (describing encumbrances generally).

72. See LAWRENCE M. FRIEDMAN, *A HISTORY OF AMERICAN LAW 173-75* (3d ed. 2005) (describing how the recording system gave confidence to buyers in paying the purchase price for contracted real property).

73. See PRIEST, *supra* note 24, at 46; Kochan, *supra* note 32, at 273.

74. See KURTZ ET AL., *supra* note 41, § 13.4.1, at 1250.

75. See PALOMAR & PATTON, *supra* note 30, § 5.

76. See WHITMAN ET AL., *supra* note 49, § 11.15, at 819.

77. See Lawrence M. Dudek, *Common Issues Regarding the Validity, Enforcement and Priority of Construction Liens*, 47 MICH. REAL PROP. REV. 32, 32 (2020).

78. See 3 PALOMAR & PATTON, *supra* note 30, § 604.

79. See *id.* ("A cloud on the title consists of an adverse title, right or lien which appears to be good so far as disclosed by the records, but which in fact is invalid, released or barred by reason of facts that have to be proven by extrinsic evidence.").

80. See Julie Ryan Evans, *Is There a Lien on My House? How to Do a Property Lien Search by Address*, REALTOR.COM (Jan. 31, 2023), <https://www.realtor.com/advice/finance/how-are-liens-handled-when-a-home-is-sold> [<https://perma.cc/KKX6-5XBW>].

81. See generally *Taxpayers Should Beware of Property Lien Scam*, IRS (Sept. 26, 2019),

acquired the property, then they would take it subject to the encumbrance.<sup>82</sup> If the lien was deserved but not recorded, then the searcher could generally acquire the property free and clear of the lien, provided an otherwise lack of notice.<sup>83</sup> In this way, as Louisiana scholars have noted, the recording act system is a negative system: the law does not attest to the validity of recorded documents but it does deny effect as to third persons for those interests that are valid but not recorded.<sup>84</sup>

This is compared to a registration system (often called a Torrens system).<sup>85</sup> In a registration system, interests in real property only transfer upon registration.<sup>86</sup> In this sense, registration (the filing of the transfer in a public office) is the act that matters. Execution of an instrument (such as the deed) does not effectuate a transfer.<sup>87</sup> Any interests in that property, such as liens or other encumbrances, must be noted on the registered title.<sup>88</sup> They do not and cannot exist otherwise.<sup>89</sup> Lastly, notice (even actual knowledge) of the purported interest of another does not affect the interests of a person who acquires the property from the registered owner.<sup>90</sup> Combined, these attributes mean that title searches are extremely simple because if it is not noted on the single, authoritative certificate in the registry, there are no other interests to be concerned about.<sup>91</sup>

---

<https://www.irs.gov/newsroom/taxpayers-should-beware-of-property-lien-scam> [<https://perma.cc/28QZ-V6ZJ>] (discussing fraudulent property lien scheme).

82. See generally Caroline McCarthy, *What to Know About Buying a House with a Lien?*, OWNUP (Apr. 19, 2021), <https://resources.ownup.com/buy-a-house-with-lien> [<https://perma.cc/J4V2-J5GF>].

83. KURTZ ET AL., *supra* note 41, § 15.3.1, at 1370-71.

84. MELISSA T. LONEGRASS, SANDI VARNADO & CHRISTOPHER K. ODINET, *SALE, LEASE, AND ADVANCED OBLIGATIONS: CASES AND READINGS* 117-79 (2019).

85. See BLAIR C. SHICK & IRVING H. PLOTKIN, *TORRENS IN THE UNITED STATES: A LEGAL AND ECONOMIC HISTORY AND ANALYSIS OF AMERICAN LAND-REGISTRATION SYSTEMS* 20-21 (1978).

86. See *Re Land Titles Act*, *Ferguson v. Registrar of Land Titles*, [1953] D.L.R. 36, 36 (Can. Sask. 1952).

87. *Id.*; see also Dale A. Whitman, *Optimizing Land Title Assurance Systems*, 42 GEO. WASH. L. REV. 40, 62 (1973).

88. See *Wells Fargo Bank, N.A. v. Omiya*, 420 P.3d 370, 377-78 (Haw. 2018); *Ferguson*, [1953] D.L.R. at 40.

89. See *Ferguson*, [1953] D.L.R. at 40; John E. Cribbet, *Conveyancing Reform*, 35 N.Y.U. L. REV. 1291, 1302-03 (1960).

90. *Ferguson*, [1953] D.L.R. at 41.

91. WHITMAN ET AL., *supra* note 49, § 11.15, at 820-21; see also KURTZ, *supra* note 48, at 235 n.28.



The United States largely uses a recording system. Eight states, Puerto Rico, and Guam technically have some form of a Torrens registration system.<sup>92</sup> But even in those places, use of the system is voluntary (and not widely used at that).<sup>93</sup> Over time, statutes allowing for registration of property interests (rather than recordation) have been repealed.<sup>94</sup> Today, the only places that still see registration activity are Cook County in Illinois, Hawaii, some Minnesota counties, and parts of Ohio and Massachusetts.<sup>95</sup>

We mention the Torrens system here only to point out the ways in which it is different from the dominant system in the United States and how its implementation would be integral to a blockchain system for land transactions. Many people have spilled ink over why the Torrens system would be theoretically superior to our current land title infrastructure, but the tremendous cost, and the attendant pathology, in moving from the current recording system to one of registration has prevented such a thing from ever coming close to being adopted.<sup>96</sup> This is perhaps nowhere more evident than in the waning and presently very small number of places where such a system operates in the United States at all.<sup>97</sup> But we note that it is important to keep the registration system in mind, as the next Part of this Article discusses blockchain ledgers.

### *B. Distributed Ledger Technology Recording Systems*

Having described our current system of land recordation, we turn to, for comparison, the architecture of distributed ledger technologies or, as they are more commonly known, blockchain networks. In this Section, we give an overview of distributed ledgers using the Ethereum blockchain system and, to a lesser degree, Bitcoin's Blockchain system (which we will refer to as the Blockchain (capitalized) to distinguish from when we mean distributed ledger technologies more generally (uncapitalized)). We do this for two

---

92. WHITMAN ET AL., *supra* note 49, § 11.15, at 819.

93. *Id.* § 11.15, at 819-20.

94. *See, e.g.*, 765 ILL. COMP. STAT. 40/3 (1992).

95. WHITMAN ET AL., *supra* note 49, § 11.15, at 819-20.

96. For a more complete discussion, see *id.* at 790-823.

97. Barry Goldner, Comment, *The Torrens System of Title Registration: A New Proposal for Effective Implementation*, 29 UCLA L. REV. 661, 662 (1982).

reasons. First, the Blockchain was the first distributed ledger technology,<sup>98</sup> so an understanding of its workings builds the foundation to then understand the Ethereum blockchain, which is the network upon which today's NFTs and other crypto assets are created and transferred.<sup>99</sup> We also describe the concepts and role of smart contracts and NFTs in distributed ledger systems. This discussion and comparison of systems is necessary in order to interrogate, as we do in Part II, whether this new system can not only replicate but also enhance our extant system of land recording.

### 1. *Introduction to Blockchain*

One can ascribe various definitions to blockchains, but at their core, they are digital ledgers that contain various kinds of information.<sup>100</sup> They are, as Aaron Wright and Primavera De Filippi note, “powerful decentralized database[s]” that serve as “irreversible and incorruptible public repositor[ies] of information.”<sup>101</sup> The information contained in these databases is meant to convey rights

---

98. Robert Sheldon, *A Timeline and History of Blockchain Technology*, TECHTARGET (Aug. 9, 2021), <https://www.techtarget.com/whatis/feature/A-timeline-and-history-of-blockchain-technology> [<https://perma.cc/9H95-BEQE>].

99. See *Non-Fungible Tokens (NFT)*, ETHEREUM, <https://ethereum.org/en/nft> [<https://perma.cc/EJ28-XU9H>].

100. See *Blockchain*, BLACK'S LAW DICTIONARY (11th ed. 2019); *Luma v. Dib Funding, Inc.*, No. 20-2504, 2022 WL 181156, at \*16 n.4 (D. Md. Jan. 19, 2022) (“A blockchain is a ‘distributed ledger enforced by a disparate network of computers.’” (quoting Jake Frankenfield, *Cryptocurrency*, INVESTOPEDIA, <https://www.investopedia.com/terms/c/cryptocurrency.asp>)); *Magill v. Elysian Glob. Corp.*, No. 20-cv-06742-NLH-AMD, 2021 WL 1221064, at \*7 n.3 (D.N.J. Apr. 1, 2021) (“A blockchain is an electronic distributed ledger or list of entries—much like a stock ledger—that is maintained by various participants in a network of computers.” (quoting *Investor Bulletin: Initial Coin Offerings*, SEC (July 25, 2017), [https://www.sec.gov/oiea/investor-alerts-and-bulletins/ib\\_coinofferings](https://www.sec.gov/oiea/investor-alerts-and-bulletins/ib_coinofferings))); see also *Shin v. ICON Found.*, 553 F.3d 724, 727 (N.D. Cal. 2021); *Zamfir v. Casperlabs, LLC*, 528 F. Supp. 3d 1136, 1140 (S.D. Cal. 2021) (“A blockchain is a distributed protocol that stores transactional records as a chain of ‘blocks,’ and each block cannot be retroactively altered without leaving evidence of the alteration.”); *Commodity Futures Trading Comm’n v. Thompson*, No. 19-CV-9052, 2020 WL 7122013, at \*3 (S.D.N.Y. Oct. 1, 2020) (“A blockchain is a public, distributed electronic ledger. Whenever someone transfers cryptocurrency between wallet addresses, it is recorded on a blockchain.”); *U.S. Sec. & Exch. Comm’n v. Kik Interactive Inc.*, 492 F. Supp. 3d 169, 173 (S.D.N.Y. 2020).

101. Aaron Wright & Primavera De Filippi, *Decentralized Blockchain Technology and the Rise of Lex Cryptographia* 2, 8 (July 25, 2017) (unpublished manuscript), [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2580664](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2580664) [<https://perma.cc/LC5E-ZB28>].

or claims, sometimes to things internal to the blockchain system itself (such as native crypto assets) and sometimes to things external to it (such as virtual or physical assets).<sup>102</sup> Carla Reyes explains that distributed ledger technology is “computer software that is distributed, runs on peer-to-peer networks, and offers a transparent, verifiable, tamper-resistant transaction-management system” that is “maintained through a consensus mechanism rather than by a trusted third-party intermediary that guarantees execution.”<sup>103</sup>

An important aspect of these various definitions is the peer-to-peer distribution component. Paul Vigna and Michael Casey observe that the ledger does not exist on a single computer server. Instead, it “is shared around [a] community of computer owners, or *nodes*.”<sup>104</sup> This means that many individual but connected computers contain identical copies of the same ledger.<sup>105</sup> As such, no single individual has control of the database and the information contained in it.<sup>106</sup> This is compared to a system where an official ledger is kept only by a single individual (a single intermediary).<sup>107</sup> In a blockchain, each time a change is needed in the information contained in the ledger, all of the nodes must agree to make the change, and having done so, all will update their copy of the database accordingly. This is what makes the system distributed.<sup>108</sup>

The most popular and oldest type of distributed ledger technology is Bitcoin’s Blockchain.<sup>109</sup> Indeed, the term “distributed ledger

---

102. Moringiello & Odinet, *supra* note 19, at 611; *In re Bibox Grp. Holdings Ltd. Sec. Litig.*, 534 F. Supp. 3d 326, 329-30 (S.D.N.Y. 2021) (“A blockchain is a decentralized electronic ledger that allows for secure and reliable tracking of the ownership and transfer of each individual unit of the crypto-asset.”).

103. Carla L. Reyes, *Conceptualizing Cryptolaw*, 96 NEB. L. REV. 384, 390-91 (2017) (footnotes omitted).

104. PAUL VIGNA & MICHAEL J. CASEY, *THE AGE OF CRYPTOCURRENCY: HOW BITCOIN AND DIGITAL MONEY ARE CHALLENGING THE GLOBAL ECONOMIC ORDER* 124 (2015).

105. *See Reyes, supra* note 103, at 391.

106. *See id.*

107. VIGNA & CASEY, *supra* note 104, at 123-24.

108. *See id.*; Reyes, *supra* note 103, at 391.

109. SATOSHI NAKAMOTO, *BITCOIN: A PEER-TO-PEER ELECTRONIC CASH SYSTEM* 3 (2009), <https://bitcoin.org/bitcoin.pdf> [<https://perma.cc/49F7-QE3Q>]; Vinay Gupta, *A Brief History of Blockchain*, HARV. BUS. REV. (Feb. 28, 2017), <https://hbr.org/2017/02/a-brief-history-of-block-chain> [<https://perma.cc/N3RG-6DTJ>]. To download the blockchain, see *Support Bitcoin*, BITCOIN, <https://bitcoin.org/en/support-bitcoin> [<https://perma.cc/NZ3Q-NU38>].

technology” is often used interchangeably with the word “blockchain,” and we do so throughout this Article (uncapitalized).

Because a blockchain is a ledger, it is helpful to remember at the start that it is information that is stored in the ledger.<sup>110</sup> The information comes in the form of single units (which are, in reality, strings of letters and numbers).<sup>111</sup> These individual units are called Bitcoins on the Blockchain, which were originally conceived of as a form of currency or, more precisely, a medium of exchange.<sup>112</sup> A blockchain’s central roles are to both operationalize and memorialize the transfer of these units from one person to another.<sup>113</sup>

## 2. *Ethereum’s Open-Ended Blockchain*

While Bitcoin’s Blockchain was the first of its kind with regard to distributed ledger technology, Ethereum’s blockchain has added features to Bitcoin’s technology that made it more applicable to things unrelated to buying and trading crypto assets, including efforts to track and transact in real property rights.<sup>114</sup> The versatility of Ethereum is why most of the current crypto market activity is now happening on Ethereum’s blockchain rather than on Bitcoin’s Blockchain, which only functions as a platform for trading the native coin of the same name.<sup>115</sup>

Ethereum did not initially intend to compete with Bitcoin’s Blockchain; rather, Ethereum was simply trying to build upon the

---

110. Adam Hayes, *Blockchain Facts: What Is It, How It Works, and How It Can Be Used*, INVESTOPEDIA (Sept. 27, 2022), <https://www.investopedia.com/terms/b/blockchain.asp> [<https://perma.cc/LR3Z-R24M>].

111. Carlos Bueno, *What a Bitcoin Looks Like*, CARLOS BUENO, <https://carlos.bueno.org/2012/07/paper-bitcoins.html> [<https://perma.cc/PYM8-RMSW>] (depicting the code for one bitcoin).

112. Parthajit Kayal & Purnima Rohilla, *Bitcoin in the Economics and Finance Literature: A Survey*, 1 SN BUS. & ECON., June 2021, at 1, 8, 10.

113. Reyes, *supra* note 103, at 391; Gupta, *supra* note 109.

114. See *What Is Ethereum and How Does It Work?*, COINTELEGRAPH, <https://cointelegraph.com/ethereum-for-beginners/what-is-ethereum-a-beginners-guide-to-eth-cryptocurrency> [<https://perma.cc/G2GB-5N53>]; *Blockchain in Real Estate*, CONSENSYS, <https://consensys.net/blockchain-use-cases/real-estate/> [<https://perma.cc/892P-F7V9>]; Adam Redolfi, *The Future of Real Estate Transactions on the Blockchain*, FORBES (Oct. 27, 2021, 6:45 AM), <https://www.forbes.com/sites/forbesbizcouncil/2021/10/27/the-future-of-real-estate-transactions-on-the-blockchain/?sh=7a53e8464938> [<https://perma.cc/8BWN-4BXL>].

115. *What Is Ethereum and How Does It Work?*, *supra* note 114.

distributed ledger technology that Bitcoin's Blockchain created to make it more open-ended.<sup>116</sup> Nevertheless, Ethereum is now Bitcoin's top competitor.<sup>117</sup> The goal of Ethereum is "to create an alternative protocol for building decentralized applications, providing a different set of tradeoffs that ... will be very useful for a large class of decentralized applications."<sup>118</sup> Ethereum achieves this goal "by building ... a blockchain with a built-in Turing-complete programming language, allowing anyone to write smart contracts and decentralized applications where they can create their own arbitrary rules for ownership, transaction formats and state transition functions."<sup>119</sup> With the addition of smart contracts and the ability to create decentralized apps, Ethereum is open-ended, unlike Bitcoin's Blockchain, and "extremely well-suited to serving as a foundational layer for a very large number of both financial and non-financial protocols."<sup>120</sup>

Similar to Bitcoin's Blockchain, Ethereum's network is decentralized and, thus, does not exist on a single server; rather, it exists on thousands of computers across the globe, thanks to users who participate as "nodes" or "miners."<sup>121</sup> Essentially, each node holds a copy of a single decentralized ledger—in this case, Ethereum's blockchain—and any interactions must be verified so that every node can update their copy of the ledger.<sup>122</sup> As mentioned earlier, this is what makes the system distributed and decentralized.<sup>123</sup> Because the system is decentralized in this way, it is nearly impossible to forge, alter, or hack the Ethereum network.<sup>124</sup> While

---

116. See Nathan Reiff, *Bitcoin vs. Ethereum: What's the Difference?*, INVESTOPEDIA (Oct. 4, 2022), <https://www.investopedia.com/articles/investing/031416/bitcoin-vs-ethereum-driven-different-purposes.asp> [<https://perma.cc/Y38G-R8H9>].

117. See *id.*; *Ethereum Explained: A Guide to the World Supercomputer*, CRYPTOPEDIA (June 28, 2022), <https://www.gemini.com/cryptopedia/ethereum-blockchain-smart-contracts-dapps> [<https://perma.cc/2K2U-R4TT>] [hereinafter *Ethereum Explained*].

118. ETHEREUM, *ETHEREUM WHITEPAPER* (2023), <https://ethereum.org/en/whitepaper/#messages-and-transactions> [<https://perma.cc/QDB3-YFGX>].

119. *Id.*

120. *Id.*

121. *What Is Ethereum and How Does It Work?*, *supra* note 114.

122. *Id.*

123. See Reyes, *supra* note 103, at 391.

124. Crypto Casey, *What Is Ethereum? (Ultimate Beginner's Guide—How It Works & Why It's Undervalued)*, YOUTUBE (Feb. 29, 2020), <https://www.youtube.com/watch?v=DhoRtGCp4JI> [<https://perma.cc/U4PH-2EUP>].

Bitcoin and Ethereum both have their own types of distributed ledger technologies, Bitcoin's Blockchain only functions to trade or hold the cryptocurrency known as Bitcoin.<sup>125</sup> Ethereum, on the other hand, is a *programmable* blockchain, meaning “people can build software on [Ethereum] to create valuable products and services” —or create things just for fun, such as games.<sup>126</sup> The software built on Ethereum is referred to as decentralized applications, or “dApps” for short.<sup>127</sup> Some common examples of dApps include games, such as *CryptoKitties*, as well as decentralized finance (DeFi) platforms—such as token exchange platforms like Uniswap.<sup>128</sup> In sum, Ethereum is a “marketplace of financial services, games, social networks, and other apps” that all operate through crypto assets that exist and are moved around through Ethereum's blockchain.<sup>129</sup>

Miners (or nodes) are the ones who complete network processes on the Ethereum blockchain, and they do so through a process called a proof-of-work protocol.<sup>130</sup> Proof-of-work “involves performing computational work on computer hardware to complete transactions.”<sup>131</sup> Mining is the “lifeblood” of the proof-of-work system, and it is the process through which a new block of transactions is created and added to the Ethereum blockchain ledger.<sup>132</sup> Ethereum miners (which is the term used to describe the computers running Ethereum's software) use their time and power to process transactions, produce blocks, and thus secure the Ethereum network.<sup>133</sup>

---

125. *Id.*

126. *Id.*

127. *See Decentralized Applications (DAPPS)*, ETHEREUM, <https://ethereum.org/en/dapps/> [<https://perma.cc/AD9J-3EWW>].

128. *See id.*; *Decentralized Finance (DeFi)*, ETHEREUM, <https://ethereum.org/en/defi/#bitcoin> [<https://perma.cc/439Y-3ADB>]; *About*, CRYPTOKITTIES, <https://www.cryptokitties.co/about> [<https://perma.cc/FPN9-KWGM>].

129. *What Is Ethereum?*, ETHEREUM, <https://ethereum.org/en/what-is-ethereum/> [<https://perma.cc/WB6Y-57DZ>].

130. Crypto Casey, *supra* note 124.

131. *Id.*

132. *Mining*, ETHEREUM (Feb. 16, 2023), <https://ethereum.org/en/developers/docs/consensus-mechanisms/pow/mining/> [<https://perma.cc/NPV6-MRAE>].

133. *Id.* Ethereum was set to launch Ethereum 2.0 in 2022 but has not done so as of early 2023; under 2.0, Ethereum's blockchain will move away from this proof-of-work model into the more energy-efficient proof-of-stake model. Wayne Duggan, *What is Ethereum 2.0? Understanding the Merge*, FORBES: ADVISOR (Sept. 15, 2022, 6:53 AM), <https://www.forbes.com/advisor/investing/cryptocurrency/what-is-ethereum-2-merge/> [<https://perma.cc/3JGT-PU NM>].

The transactions mentioned above are the network interactions that occur on Ethereum's blockchain.<sup>134</sup> These transactions are stored in blocks within the Ethereum blockchain.<sup>135</sup> Miners are the ones who "validate these blocks before committing them to [Ethereum's] network," on which they act as a "transaction history or a digital ledger."<sup>136</sup> "Each block [on the blockchain] has a unique 64-digit code identifying it," and "[m]iners commit their computer power to find[ing] that code, proving that [it is] unique."<sup>137</sup> The computer power is proof of the work the miners do—hence "proof-of-work."<sup>138</sup> Also similar to Bitcoin, all of the transactions on Ethereum are completely public.<sup>139</sup>

### 3. *The Fuel of Ethereum: Ether*

In reading this background, a natural question that might arise is how and why people build upon Ethereum's blockchain through smart contracts and dApps. The *how* is discussed below, but the answer to *why* is found in Ethereum's native token: Ether. Ether is to Ethereum what Bitcoin is to Bitcoin's Blockchain, but Ether has a more important role in the Ethereum Blockchain than Bitcoin does in its distributed ledger. Instead of simply being a unit of value, a certain amount of Ether is required to perform any action on the Ethereum network.<sup>140</sup> One can think of Ether as the oil of Ethereum because it is necessary to fuel Ethereum's technology.<sup>141</sup> Not only do transactions cost Ether but miners are also rewarded with Ether for creating new blocks for the Ethereum blockchain.<sup>142</sup> Thus, Ether incentivizes people to host and maintain the data on Ethereum's blockchain—which further illustrates Ethereum's goal to decentralize the internet because providing this type of incentive

---

134. See *What Is Ethereum and How Does It Work?*, *supra* note 114.

135. *Id.*

136. *Id.*

137. *Id.*

138. *Id.*

139. *Id.* Anyone can look at all the transactions on Ethereum by accessing the Ethereum Blockchain Explorer. See *The Ethereum Blockchain Explorer*, ETHERSCAN, <https://etherscan.io> [<https://perma.cc/29EX-LVBV>].

140. Crypto Casey, *supra* note 124.

141. *Id.*

142. *What Is Ethereum and How Does It Work?*, *supra* note 114.

may push more people to develop on Ethereum's network versus others.<sup>143</sup>

The amount of Ether required for a certain transaction is determined by a built-in pricing system known as GAS.<sup>144</sup> "GAS considers the bandwidth and space requirements as well as computational difficulty of each transaction to determine the fee it will require to complete."<sup>145</sup> The term GAS was created to differentiate between the actual value of Ether and the cost of performing a transaction on the Ethereum blockchain.<sup>146</sup> Because transactions cost Ether—and because Ethereum's ultimate goal is to have as many people using its network as possible—there is not a fixed supply of Ether, like one finds with other coins, such as Bitcoin.<sup>147</sup> Ether is still traded as a digital currency in the same fashion as other cryptocurrencies, but it is also a necessary component of using the Ethereum network.<sup>148</sup>

#### 4. *Smart Contracts and Decentralized Apps*

The reason Ethereum is so buildable is due to the addition of customizable *smart contracts* on the Ethereum network—something that does not exist on Bitcoin's Blockchain.<sup>149</sup> Smart contracts are "lines of [computer] code that dictate the terms of a contract and control the execution of [that] contract."<sup>150</sup> The founder of the concept, computer scientist and legal scholar Nick Szabo, described smart contracts as computer code that contains "a set of promises, specified in digital form, including protocols within which the parties perform on these promises."<sup>151</sup> He uses a vending machine

---

143. Crypto Casey, *supra* note 124.

144. *Id.*

145. *Id.*

146. *Id.*

147. *Id.* As of September 2, 2022, at 4:55 PM Eastern Time, there were 19,139,543.75 Bitcoins outstanding, with another 1,860,456.3 left to be mined. See *How Many Bitcoins Are There?*, BUY BITCOIN WORLDWIDE, <https://www.buybitcoinworldwide.com/how-many-bitcoins-are-there/> [<https://perma.cc/CT2N-GMFG>]. The total available, therefore, is roughly 21 million, after which no future Bitcoin will be created. *Id.*

148. See Reiff, *supra* note 116.

149. *Id.*

150. Crypto Casey, *supra* note 124.

151. Nick Szabo, *Smart Contracts: Building Blocks for Digital Markets*, <https://www.fon.hum.uva.nl/rob/Courses/InformationInSpeech/CDROM/Literature/LOTwinterschool2006/s>



as a simple example: one inserts coins, makes a selection, and the mechanism in the machine dispenses the item.<sup>152</sup> Carla Reyes explains that “[m]ore complex smart contracts can be created by embedding additional code into the underlying protocol.”<sup>153</sup> Even more concisely (and sufficient for our purposes), Eric Chason states that “a smart contract is a computer program.”<sup>154</sup>

The major characteristic of smart contracts is that they are “autonomous, self-sufficient, [and] distributed [in] nature.”<sup>155</sup> This means that once the software is launched, it can operate self-sufficiently.<sup>156</sup> The code of a smart contract works to execute the parties’ instructions without the need for an intermediary.<sup>157</sup> The code is typically designed such that if *X* happens, then the smart contract should execute step *Y*.<sup>158</sup>

To be sure, to say something is a smart contract does not mean that it necessarily constitutes a legally binding contract.<sup>159</sup> Rather, it is merely a term for self-executing code that is typically related to the fulfillment of obligations that parties agree to in a legally binding contract.<sup>160</sup> As Eric Chason describes, one potential use of a smart contract would be to execute the obligations of parties to an interest rate swap agreement whereby certain market events trigger a payment obligation for one of the parties.<sup>161</sup> Because the parties intend for a certain event to give rise to an obligation, the smart contract function alleviates the need for an intermediary to inform or otherwise give notice to the parties.<sup>162</sup>

---

zabo.best.vwh.net/smart\_contracts\_2.html [https://perma.cc/FX8V-TKT3].

152. *Id.*

153. Reyes, *supra* note 103, at 397.

154. Eric D. Chason, *Smart Contracts and the Limits of Computerized Commerce*, 99 NEB. L. REV. 330, 349 (2020).

155. Reyes, *supra* note 103, at 398.

156. *See id.*

157. *See* Stuart D. Levi & Alex B. Lipton, *An Introduction to Smart Contracts and Their Potential and Inherent Limitations*, HARV. L. SCH. F. ON CORP. GOVERNANCE (May 26, 2018), <https://corpov.law.harvard.edu/2018/05/26/an-introduction-to-smart-contracts-and-their-potential-and-inherent-limitations/#3b> [https://perma.cc/6SMC-KA3L].

158. *Id.*

159. *See* SHAWN S. AMUAL, JOSIAS N. DEWEY & JEFFREY R. SEUL, *THE BLOCKCHAIN: A GUIDE FOR LEGAL & BUSINESS PROFESSIONALS* §§ 2:1, 2:18, 2:20 (2016); Chason, *supra* note 154, at 342.

160. *See* Chason, *supra* note 154, at 356.

161. *Id.* at 354-56.

162. *Id.* at 356.

However, smart contracts are limited in their ability to fully accommodate legally binding contracts.<sup>163</sup> Specifically, while smart contract code can effectuate contract provisions, it cannot construe contract provisions that are inherently subjective.<sup>164</sup> For example, a smart contract might be designed to automatically shut off a vehicle if a car loan payment is not received timely.<sup>165</sup> The smart contract will execute the provision in the contract that allows the automobile lender to do such a thing, but whether the payment was really due, such as if the borrower had a legally valid reason for not making payment, is not an issue that the smart contract can or is meant to deal with.<sup>166</sup>

Another way to see the value of smart contracts is in their versatility in terms of what they can allow one to do with and on a blockchain. Smart contracts that run atop blockchain systems have been used in a number of ways, ranging from the trading of crypto-securities to file storage to gaming to executing financial contracts.<sup>167</sup> Today, about half of smart contract applications are run through Ethereum's blockchain (hence the focus on that system in this Article).<sup>168</sup>

Developers can build and run distributed applications due to Ethereum's own programming smart contract language that runs on the Ethereum blockchain.<sup>169</sup> The relationship between smart contracts and dApps is that the "decentralized application (dapp) is an application built on a decentralized network that combines a smart contract and a frontend user interface."<sup>170</sup> In effect, developers use smart contracts to create decentralized applications on Ethereum's blockchain.<sup>171</sup>

---

163. See Levi & Lipton, *supra* note 157; Reyes, *supra* note 103, at 396.

164. See Levi & Lipton, *supra* note 157.

165. David Z. Morris, *Bitcoin Is Not Just Digital Currency. It's Napster for Finance.*, FORTUNE (Jan. 21, 2014, 10:00 AM), <https://fortune.com/2014/01/21/bitcoin-is-not-just-digital-currency-its-napster-for-finance/> [<https://perma.cc/8CKW-A2QU>].

166. See Levi & Lipton, *supra* note 157.

167. See Reyes, *supra* note 103, at 398; *Real-World Use Cases for Smart Contracts and dApps*, CRYPTOPEDIA (Dec. 23, 2021), <https://www.gemini.com/cryptopedia/smart-contract-examples-smart-contract-use-cases> [<https://perma.cc/WX72-N5VE>].

168. *Ethereum Explained*, *supra* note 117.

169. Reiff, *supra* note 116.

170. *Decentralized Applications (DAPPS)*, *supra* note 127.

171. *Ethereum Explained*, *supra* note 117.

While anyone can create smart contracts and dApps on Ethereum, it is a complicated process, and there are several prerequisites. First, one must be connected to the Ethereum network; this can be done by creating an account on a blockchain developer platform, such as Alchemy.<sup>172</sup> One must also generate an application programming interface (API) key by creating an application on Alchemy.<sup>173</sup> Finally, one must also create an Ethereum account to send and retrieve transactions in order to pay the Ether required for the transactions performed to be executed on the Ethereum blockchain.<sup>174</sup> These are just the initial steps before being able to program on the Ethereum network. Afterwards, there are several other development software platforms to be downloaded and lines of code to be written.<sup>175</sup> The extent of these additional steps depends on the goal of the developer and the complexity of what is being constructed.<sup>176</sup>

### 5. Cryptographic Keys

An important concept to understand about blockchain usage is that, unlike a traditional ledger that might keep track of who owns a particular thing, the holder of a claim to a crypto asset (that is, a unit on the ledger) is not indicated by actually having the holder's name listed on the ledger.<sup>177</sup> Instead, blockchain systems such as Ethereum's and Bitcoin's are pseudonymous.<sup>178</sup> Next to each unit on the ledger is a string of letters and numbers called a cryptographic key.<sup>179</sup> This key is public in that it is listed next to the unit(s) on the

---

172. See *Hello World Smart Contract for Beginners*, ETHEREUM (Mar. 30, 2021), <https://ethereum.org/en/developers/tutorials/hello-world-smart-contract/#step-1> [<https://perma.cc/9F36-6DZB>].

173. See *id.*; Andreas Antonopoulos, *Bitcoin Is a Money Platform with Many APIs*, O'REILLY RADAR (May 29, 2013), <http://radar.oreilly.com/2013/05/bitcoin-is-a-money-platform-with-many-apis.html> [<https://perma.cc/C644-SR6H>].

174. See *Hello World Smart Contract for Beginners*, *supra* note 172.

175. See *id.*

176. See Michele D'Aliessi, *How Does the Blockchain Work?*, MEDIUM (June 1, 2016), <https://onezero.medium.com/how-does-the-blockchain-work-98c8cd01d2ae> [<https://perma.cc/D43W-3BQ5>].

177. Benjamin Fabian, Tatiana Ermakova & Ulrike Sander, *Anonymity in Bitcoin—The Users' Perspective 1-2* (Int'l Conf. on Info. Sys., Conference Paper, 2016).

178. *Id.*

179. See ANDREAS M. ANTONOPOULOS & GAVIN WOOD, *MASTERING ETHEREUM: BUILDING*

ledger.<sup>180</sup> The public cryptographic key has a sibling, which is another string of letters and numbers called the private cryptographic key.<sup>181</sup> The private key is what the claimant uses to authorize the ledger system to transfer a unit (that is, Ether or some other crypto asset) from the claimant to another person.<sup>182</sup> The public key is needed to generate an Ethereum address, which, in turn, is needed to receive the crypto asset at issue.<sup>183</sup> The transfer is complete when the claimant's identifying cryptographic information is replaced with the recipient's identifying cryptographic information on the ledger.<sup>184</sup> One might think of the public key as one's bank account number and the private key as the account's personal identification number (PIN), which is needed to authorize account activity.<sup>185</sup> It is fine for the bank account number to be public, but the PIN should remain private.<sup>186</sup> As an example:

[Private Key:]

f8f8a2f43c8376ccb0871305060d7b27b0554d2cc72bccf41b27056  
08452f315

....

[Public Key:]

046e145ccef1033dea239875dd00dfb4fee6e3348b84985c92f103  
444683bae07b83b5c38e5e2b0\c8529d7fa3f64d46daa1ece2d9ac  
14cab9477d042c84c32ccd0<sup>187</sup>

---

SMART CONTRACTS AND DAPPS 61-64 (2019) (ebook); Sheping Zhai, Yuanyuan Yang, Jing Li, Cheng Qiu & Jiangming Zhao, *Research on the Application of Cryptography on the Blockchain*, 1168 J. PHYSICS: CONF. SERIES 1, 5 (2019), <https://iopscience.iop.org/article/10.1088/1742-6596/1168/3/032077/pdf> [<https://perma.cc/2U8N-WX9H>]; Francisco José de Haro-Olmo, Ángel Jesús Varela-Vaca & José Antonio Álvarez-Bermejo, *Blockchain from the Perspective of Privacy and Anonymisation: A Systematic Literature Review*, 20 SENSORS 7171, 7175 (2021).

180. See Reyes, *supra* note 103, at 392.

181. ANTONOPOULOS & WOOD, *supra* note 179, at 60-62.

182. *Id.* at 62.

183. *Id.* at 61-62.

184. See *id.* at 60; ETHEREUM, *supra* note 118.

185. ANTONOPOULOS & WOOD, *supra* note 179, at 60.

186. See *id.*

187. *Id.* at 64, 70.

## 6. *Crypto Intermediaries*

Ironically, although major proponents of blockchains extol their disintermediated nature, there are actually powerful intermediaries that largely dominate the crypto market because millions of crypto assets holders keep their cryptographic keys stored in a digital account with certain online firms called “crypto wallet” companies.<sup>188</sup> The name, however, is misleading. Nothing is actually stored in the wallet.<sup>189</sup> As explained above, the actual unit (the Ether, Bitcoin, or other crypto asset) exists only on the ledger (the blockchain).<sup>190</sup> What is stored in the wallet (that is, the digital account) are the public and private keys.<sup>191</sup> To transact using these keys, individuals typically use another kind of online firm known as a “crypto exchange” company.<sup>192</sup> Here again, one sets up an online account and then links that exchange account with a wallet account.<sup>193</sup> Some exchange companies also operate wallet companies, making them one-stop shops.<sup>194</sup> The exchange company’s software allows it to interact with and send orders and instructions to a given blockchain network.<sup>195</sup>

In all of this, one will quickly notice that a person does not hold a crypto asset like Bitcoin or Ether (or any other kind of crypto asset) in one’s crypto wallet account or on an exchange.<sup>196</sup> Instead, one only holds a copy of the keys and information about the

---

188. Ameer Rosic, *Cryptocurrency Wallet Guide: A Step-by-Step Tutorial*, BLOCKGEEKS (Aug. 19, 2020), <https://blockgeeks.com/guides/cryptocurrency-wallet-guide/> [<https://perma.cc/55AF-EZG5>].

189. *Id.*

190. *See* D’Aliessi, *supra* note 176.

191. Rosic, *supra* note 188.

192. *See Cryptocurrency Exchanges*, CORP. FIN. INST. (Dec. 4, 2022), <https://corporatefinanceinstitute.com/resources/knowledge/other/cryptocurrency-exchanges/> [<https://perma.cc/MR3U-MZS4>].

193. *See What Are Crypto Exchange Wallets?*, CRYPTOPEDIA (Apr. 29, 2021), <https://www.gemini.com/cryptopedia/crypto-wallets-crypto-exchanges> [<https://perma.cc/U47J-26WB>].

194. *See id.*; DELOITTE, A MARKET OVERVIEW OF CUSTODY FOR DIGITAL ASSETS 1, 12 (2020), [https://www2.deloitte.com/content/dam/Deloitte/xs/Documents/finance/me\\_Digital-Custodian-Whitepaper.pdf](https://www2.deloitte.com/content/dam/Deloitte/xs/Documents/finance/me_Digital-Custodian-Whitepaper.pdf) [<https://perma.cc/D6K5-TLCP>]. Examples of one-stop shops include Coinbase and Kraken. *See* Barbara Friedberg & David Rodeck, *Kraken vs. Coinbase*, FORBES ADVISOR (Dec. 9, 2022, 10:27 AM), <https://www.forbes.com/advisor/investing/cryptocurrency/kraken-vs-coinbase/> [<https://perma.cc/G53H-EDAY>].

195. *See* Rosic, *supra* note 188.

196. *Id.*

associated units in the wallet, with the exchange company then facilitating orders to the applicable blockchain ledger using the keys.<sup>197</sup> Also, there are different kinds of wallets.<sup>198</sup> The one described above is an *online* wallet, in which the wallet account is controlled by a third party and can be accessed from anywhere using the internet, much like an email account.<sup>199</sup> These wallets are typically offered by wallet-exchange combo companies, and they are considered custodial wallets because a third-party custodian is keeping the key information.<sup>200</sup> One can also have a *desktop* wallet in which the keys and the information about associated units are on a single computer. Of course, to interact with a blockchain network to conduct a transaction, one would need to connect to the internet.<sup>201</sup> This kind of wallet is called noncustodial because there is no third-person custodian.<sup>202</sup>

There are also *hardware* wallets, in which the information is stored on a device, such as a USB drive, and *paper* wallets, in which there is a printed out, physical copy of the public and private keys. Again, to transact with Ether or another crypto asset, one would have to upload the keys to some kind of wallet or machine that could connect to the internet.<sup>203</sup> Wallets that are in some way regularly connected to the internet are called *hot* wallets while those that are not are called *cold* wallets.<sup>204</sup>

### 7. Non-Fungible Tokens (NFTs)

The final component of the blockchain and token system that merits mention for purposes of this Article—and indeed, it is the culmination of the lengthy but necessary discussion above—is the non-fungible token (NFT).<sup>205</sup> These are digital assets, similar to the

---

197. *What Are Crypto Exchange Wallets?*, *supra* note 193; DELOITTE, *supra* note 194, at 6.

198. *See* Rosic, *supra* note 188.

199. *See id.*; DELOITTE, *supra* note 194, at 7.

200. *See What Are Crypto Exchange Wallets?*, *supra* note 193; DELOITTE, *supra* note 194, at 7.

201. *See* Rosic, *supra* note 188.

202. *See id.*; *What Are Crypto Exchange Wallets?*, *supra* note 193.

203. Rosic, *supra* note 188; DELOITTE, *supra* note 194, at 7.

204. Rosic, *supra* note 188; DELOITTE, *supra* note 194, at 7.

205. *See* Moringiello & Odinet, *supra* note 19, at 607; *see also* Joshua A.T. Fairfield, *Tokenized: The Law of Non-Fungible Tokens and Unique Digital Property*, 97 IND. L.J. 1261,

tokens that can be created using smart contracts on various blockchains<sup>206</sup> as described above, except that the coding protocol (the smart contract) used to create the token renders it unique and indivisible.<sup>207</sup> This is comparable to regular, fungible tokens (like Bitcoin, Ether, and other similar crypto assets), which are exchanged interchangeably.<sup>208</sup> One way to understand the difference between a fungible and non-fungible token is the information stored in the metadata of the token.<sup>209</sup> A fungible token has similar metadata to other tokens that it is fungible with. For example, a single Ether is the same as any other single Ether, even though it has a unique identifying code. Similarly, a one dollar bill is the same as any other one dollar bill, but each has its own serial number.<sup>210</sup> On the other hand, a non-fungible token's metadata contains specific information that makes that token unique.<sup>211</sup>

As we explain in other work, the most prominent use of NFTs is in the digital art market.<sup>212</sup> A piece of digital art (or rather, the code that is the art) or a pointer that links to the digital art is embedded

---

1269-73 (2022).

206. The dominant code standard for creating NFTs is Ethereum's ERC-721. See *ERC-721 Non-Fungible Token Standard*, ETHEREUM (Jan. 20, 2023), <https://ethereum.org/en/developers/docs/standards/tokens/erc-721/> [<https://perma.cc/K9M8-YGPG>].

207. Moringiello & Odinet, *supra* note 19, at 633; *Fungible vs Nonfungible Tokens: What Is the Difference?*, COINTELEGRAPH, <https://cointelegraph.com/nonfungible-tokens-for-beginners/fungible-vs-nonfungible-tokens-what-is-the-difference> [<https://perma.cc/9AEC-LK78>] [hereinafter *Fungible vs Nonfungible Tokens*].

208. See Moringiello & Odinet, *supra* note 19, at 637-38; *Fungible vs Nonfungible Tokens*, *supra* note 207.

209. See Moringiello & Odinet, *supra* note 19, at 630-32; *Fungible vs Nonfungible Tokens*, *supra* note 207.

210. See Eli Cole, *Cryptocurrency and the § 1031 Like Kind Exchange*, 10 HASTINGS SCI. & TECH. L.J. 75, 77 (2019) (“[C]ryptocurrency is fungible and divisible.”).

211. See Moringiello & Odinet, *supra* note 19, at 630-32; Gwyneth Iredale, *The Difference Between Fungible and Non-Fungible Tokens*, 101 BLOCKCHAINS (Mar. 24, 2021), <https://101blockchains.com/fungible-vs-non-fungible-tokens/> [<https://perma.cc/XXQ6-5A9N>].

212. See Moringiello & Odinet, *supra* note 19, at 628; see also Katya Fisher, *Once Upon a Time in NFT: Blockchain, Copyright, and the Right of First Sale Doctrine*, 37 CARDOZO ARTS & ENT. L.J. 629, 629-31 (2019) (discussing the use of NFTs in intellectual property rights relative to the auctioning off of a unique, new album by the Wu-Tang Clan). For a discussion of other uses of NFTs, see Fairfield, *supra* note 205, at 1284; Brian L. Frye, *After Copyright: Pwning NFTs in a Clout Economy*, 45 COLUM. J.L. & ARTS 341, 346-50 (2022); Brian L. Frye, *NFTs & the Death of Art* 3-6 (Apr. 19, 2021) (unpublished manuscript), [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3829399](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3829399) [<https://perma.cc/V93T-896G>]; Brian L. Frye, *How to Sell NFTs Without Really Trying*, 13 HARV. J. SPORTS & ENT. L. 113, 128-29 (2022). See generally Moringiello & Odinet, *supra* note 19.

within the NFT.<sup>213</sup> Thus, whomever has the right to access the NFT has the right to view the art.<sup>214</sup> While it is true that the actual digital art itself can be replicated (for example, if the art consists of a graphic, then a sophisticated screen capture can essentially replicate the item), rights to the NFT serve as a form of province or authenticity of rights to the digital art.<sup>215</sup> One might have a replica of the graphic, but only the holder of the NFT to that graphic can have the *original*.<sup>216</sup> Similarly, one may have a copy of a painting by Monet—even if it is a copy so good as to look identical—but only one person can have the original.

Another critical feature of NFTs is that unlike regular tokens, values do not rise and fall in a correlated fashion.<sup>217</sup> For example, if the trading price of a single Ether goes from \$36,000 to \$29,000, then all Ethers go from \$36,000 to \$29,000 because all Ethers are fungible.<sup>218</sup> But an NFT of digital art *A* can hold its value even if the value of NFT of digital art *B* falls.<sup>219</sup> That is because the two NFTs are inherently different or, said another way, the things they are tied to are different.<sup>220</sup>

The fact that crypto assets can be made unique is a critical part of their use in current crypto real estate projects. As we explain fully in Part II, the NFT is meant to represent a unique piece of real estate or an entity that owns real estate, which can then be transferred on a blockchain in a purchase and sale transaction.

\* \* \*

Due to its versatility, the Ethereum blockchain, replete with its smart contracts and dApp capabilities, is the situs for many of the current projects aimed at moving real estate transactions to the

---

213. Moringiello & Odinet, *supra* note 19, at 646; Fairfield, *supra* note 205, at 1282-84.

214. *See* Moringiello & Odinet, *supra* note 19, at 646.

215. *See id.*

216. *See id.*

217. Fairfield, *supra* note 205, at 1272.

218. *Fungible vs. Nonfungible Tokens*, *supra* note 207.

219. *See* Fairfield, *supra* note 205, at 1272.

220. Brandon Vigliarolo, *NFTs Cheat Sheet: Everything You Need to Know About Non-Fungible Tokens*, TECHREPUBLIC (May 14, 2021, 9:26 AM), <https://www.techrepublic.com/article/nfts-cheat-sheet-everything-you-need-to-know-about-non-fungible-tokens/> [https://perma.cc/S2JN-HJWD].



blockchain—specifically, Ethereum’s blockchain.<sup>221</sup> But before exploring these contemporary attempts, a few points of comparison bear mentioning. Unlike the current real estate recording system, the Ethereum blockchain is decentralized.<sup>222</sup> Rather than being operated by a government entity, such as a local government or county recorder, it is operated by various nodes (miners) who, with their high-powered computers, operate the network to verify transactions and keep custody of the distributed ledger.<sup>223</sup> This means, of course, that the blockchain system operates in a more opaque way than the real estate records. One can easily know the name and inner workings of the recording office because they are typically subject to public records request laws.<sup>224</sup> In contrast, with the blockchain, in-depth information about the miners is not available or similarly discernable.<sup>225</sup>

Also, from a user’s perspective, there are a number of intermediaries involved in a blockchain transaction compared to one involving the land records.<sup>226</sup> In other words, between the user and the blockchain there are many more middlemen, be they the miners operating the system, the wallet platform holding the cryptographic keys, or the exchange company facilitating transfers on the Ethereum network.<sup>227</sup> With the extant property recording system, filings typically happen in-person, are faxed, or are transmitted using software licensed to the recorder.<sup>228</sup> Naturally, however, no

---

221. See REALT, LEGALLY COMPLIANT OWNERSHIP OF TOKENIZED REAL ESTATE 2, [https://realt.co/wp-content/uploads/2019/04/RealToken\\_White\\_Paper\\_US\\_v01.pdf](https://realt.co/wp-content/uploads/2019/04/RealToken_White_Paper_US_v01.pdf) [<https://perma.cc/F9LC-T49X>].

222. See *id.* at 7-8.

223. See *How to Mine Ethereum: A Beginner’s Guide to ETH Mining*, COINTELEGRAPH, <https://coingecko.com/ethereum-for-beginners/how-to-mine-ethereum-a-beginners-guide-to-eth-mining> [<https://perma.cc/AP2E-TULW>].

224. See, e.g., *Recording/Official Records*, KEVIN C. KARNES, CLERK OF THE CT. & CONTROLLER, LEE CNTY., FLA., <https://www.leeclerk.org/departments/recording-official-records> [<https://perma.cc/8ZQS-DYMN>].

225. David Canellis, *Anonymous Bitcoin Miners Are Taking Over the Network*, NEXT WEB (Jan. 15, 2019, 4:46 PM), <https://thenextweb.com/news/unknown-bitcoin-miners-cryptocurrency> [<https://perma.cc/VPR5-RJN2>].

226. See Edzo Botjes, *Pulling the Blockchain Apart. The Transaction Life-Cycle*, ITNEXT (Sept. 15, 2017), <https://itnext.io/pulling-the-blockchain-apart-the-transaction-life-cycle-381b76842c6> [<https://perma.cc/7FNG-BTFF>] (illustrating the digital steps involved in a blockchain transaction).

227. See *id.*

228. See *id.*

paper changes hands in a blockchain transaction, because the transfer occurs when the crypto asset changes on the blockchain from being currently associated with one cryptographic key to another.<sup>229</sup>

Lastly, the information contained in both types of ledgers is open for public inspection, but the actual information itself is quite different.<sup>230</sup> While one can see the names of the transferee and transferor of interests in real property on the face of documents recorded in the land records (usually in residential transactions, these will be the legal names of natural persons), the only identifying information on the blockchain will be the users' public cryptographic keys.<sup>231</sup> In Part II, we explain how all of these points of comparison reveal the weaknesses in what blockchains can do in and for real estate transactions.

## II. DO BLOCKCHAIN AND CRYPTO ASSETS HAVE A ROLE IN REAL ESTATE TRANSACTIONS?

In this Part of the Article, we discuss the hype surrounding crypto-enabled land transactions. We then explain several models that companies are promoting. In doing so, we discuss possible roles for the blockchain in land transfers.

### A. *The Hype*

The promise of faster, cheaper, inclusive, and reliable real estate transactions has lured numerous companies into the world of blockchain and crypto-enabled land transfers.<sup>232</sup> In this Section, we discuss products whose promoters claim to improve the real estate closing process by transacting on a blockchain as well as products

---

229. *See id.*

230. *See What Is Ethereum and How Does It Work?*, *supra* note 114.

231. Howard Poston, *Public-Key Cryptography in Blockchain*, INFOSEC (Sept. 29, 2020), <https://resources.infosecinstitute.com/topic/public-key-cryptography-in-blockchain/> [<https://perma.cc/3THG-5KZU>].

232. *See* Natalia Karayaneva, *Real Estate NFTs: How It Began*, FORBES: DIGIT. ASSETS (Nov. 24, 2021, 7:22 PM), <https://www.forbes.com/sites/nataliakarayaneva/2021/11/24/real-estate-nfts-how-it-be-gan/> [<https://perma.cc/YZ75-MDD8>].

that enable crypto holders to buy land without liquidating their crypto asset holdings.

Speed is an oft-promoted benefit of both blockchain and crypto-enabled real estate closings.<sup>233</sup> The CEO of Propy, which offers “[a]utomate[d] ... real estate transaction[s],”<sup>234</sup> claims that it took only twenty-two minutes to transfer a studio apartment using an NFT.<sup>235</sup> This speed is cited as particularly desirable to members of certain demographic groups, such as millennials and Gen-Zers, who “are already purchasing high-value assets ... online [and] expect the same ease and transparency when buying real estate.”<sup>236</sup> A blockchain entrepreneur who auctioned her Florida home as an NFT lauded the ability of NFTs to consummate real estate transactions as quickly as Venmo transactions.<sup>237</sup> The platforms’ consumer-facing websites claim to take the boredom out of real estate transactions, with the crypto mortgage company Milo explicitly stating, “we deal with the boring stuff like title, insurance, appraisals all behind the scenes.”<sup>238</sup>

In addition to marketing their products as more desirable to young people, the companies also promote their transaction structure as the gateway to wealth-building for those who have been denied access to traditional financial products. Milo promotes its Crypto Mortgage product in access-to-credit terms, justifying its high interest rates for loans with a goal of “expand[ing] access to those with crypto wealth who are currently ‘unbanked’ in regards to

---

233. *See id.*

234. *See* PROPY, <https://propy.com/browse/> [<https://perma.cc/2PAM-8XH3>].

235. Karayaneva, *supra* note 232.

236. *Id.* The author also claims that the buyer in the twenty-two-minute transaction had never bought a home in the Bay Area because traditional real estate transactions were far too complicated. *Id.*

237. Bernadette Berdychowski, *This Tampa Bay Home Is Being Sold as an NFT*, TAMPA BAYTIMES (Feb. 5, 2022), <https://www.tampabay.com/news/real-estate/2022/02/04/this-tampa-bay-home-is-being-sold-as-an-nft/> [<https://perma.cc/5TZ4-5LAC>].

238. *Crypto Mortgage*, MILO, <https://www.milocredit.com/crypto/> [<https://perma.cc/R8AQ-VUNQ>]. We note that describing legal necessities as “boring” was also a hallmark of “Web 1.0” transactions, when companies offered their online terms of use behind cleverly labeled links. *See* Walter A. Effross, *The Legal Architecture of Virtual Stores: World Wide Web Sites and the Uniform Commercial Code*, 34 SAN DIEGO L. REV. 1263, 1378-79 (1997) (describing the Simon & Schuster SuperStore, which presented its terms with the link “Our lawyers made us put this here,” and Kraft’s Interactive Kitchens, whose terms were behind a link labeled “A message from our lawyers”).

mortgage loans.”<sup>239</sup> RealT, which offers investors the opportunity to buy fractionalized, token-based interests in rental properties, promotes its product as one that allows “the average person” to make “sound real estate investments without any additional financing.”<sup>240</sup>

Another type of accessibility might be described as access parity. Many sellers might be wary of taking Bitcoin or any other crypto asset as payment for real estate.<sup>241</sup> Yet those with large crypto holdings tend not to want to liquidate them because of the tax consequences of doing so.<sup>242</sup> These buyers desire the ability to use their crypto holdings as collateral for loans in the same way that those with large tax portfolios can do so.<sup>243</sup> The central idea behind all these crypto real estate efforts is to upend traditional market practices using crypto technologies in an effort to, at least nominally, expand access and democratize both finance and ownership.

### *B. Crypto- and Blockchain-Enabled Real Estate Transactions: The Practice*

Actual efforts to implement these crypto real property strategies are still nascent, but that is not to say they do not exist. To better understand how the promise of the hype is being put into practice, the following divides the crypto real property market into three

---

239. Maxwell Strachan, *VC-Backed Startup Promises Bitcoiners Way to Bypass Taxes While Buying Home*, VICE (Feb. 1, 2022, 10:27 AM), <https://www.vice.com/en/article/y3vn85/vc-backed-startup-promises-bitcoiners-way-to-bypass-taxes-while-buying-home> [<https://perma.cc/TJ4P-SWAE>]. This promoter also noted the large percentage of nonwhite crypto traders, a statistic, coupled with the high percentage of crypto market participants without a college degree, used by *New York Times* columnist Paul Krugman to christen crypto as the “[n]ew [s]ubprime.” Paul Krugman, Opinion, *How Crypto Became the New Subprime*, N.Y. TIMES (Jan. 27, 2022), <https://www.nytimes.com/2022/01/27/opinion/cryptocurrency-subprime-vulnerable.html> [<https://perma.cc/8W5T-YPQM>].

240. See REALT, *supra* note 221, at 10.

241. Sarah Cumming, *Sellers Allow Homebuyers to Pay in Bitcoin but Experts Warn of ‘Highly Volatile’ Currency*, ABC GOLD COAST (May 26, 2021, 5:16 PM), <https://www.abc.net.au/news/2021-05-27/buying-property-with-bitcoin/100155992> [<https://perma.cc/H89V-JSKE>] (explaining disadvantages to sellers accepting Bitcoin as payment for real estate).

242. See *Tax Tips for Bitcoin and Virtual Currency*, TURBOTAX (Dec. 1, 2022, 8:26 AM), <https://turbotax.intuit.com/tax-tips/tax-payments/tax-tips-for-bitcoin-and-virtual-currency/L1ZOgU00q> [<https://perma.cc/C9VU-5X4R>].

243. See Strachan, *supra* note 239.

categories with examples: property transfers, property financing, and property recording.

### 1. *Land Transfers by NFT*

At the time of this writing, companies are offering several different types of crypto- and blockchain-enabled real property transactions. Propy's product purports to speed up real estate transactions by using blockchain technology from the execution of the contract through the closing.<sup>244</sup> Propy has been experimenting with the use of blockchain since late 2017, when it enabled a buyer in Kyiv, Ukraine to purchase an apartment with crypto and record the transaction on a blockchain ledger.<sup>245</sup> The transaction was not solely on the blockchain but it was also recorded in Ukraine's paper land records system.<sup>246</sup> We note that it is not clear what blockchain added to that transaction, and in a *Wall Street Journal* article, the promoter explained that because Ukraine had adopted regulations that integrated the online and offline title-recording processes, the paper deed contained the blockchain address of the digital transaction.<sup>247</sup> Four years later, Propy facilitated the sale of that same property, this time in a transaction that used the paper and online systems in a successive rather than a parallel fashion.<sup>248</sup> To facilitate the 2021 transaction, the real property was transferred to a United States limited liability company (LLC), and the NFT purportedly transferred ownership in the LLC.<sup>249</sup> This structure eliminates the need for recording each successive sale; the LLC is recorded as the owner of the real estate in the paper land records, and the ownership of the LLC changes through the transfer of the NFT on the applicable blockchain.<sup>250</sup>

---

244. See *Propy Title Agency*, PROPY, <https://propy.com/browse/propytitle/> [https://perma.cc/X3QF-BZPC].

245. Peter Grant, *An Entire Real Estate Deal Takes Place Online, Using Cryptocurrency Technology*, WALL ST. J. (Sept. 26, 2017, 5:49 PM), <https://www.wsj.com/articles/an-entire-real-estate-deal-takes-place-online-using-cryptocurrency-technology-1506462545> [https://perma.cc/4CSR-D5B3].

246. See *id.*

247. *Id.*

248. See Karayaneva, *supra* note 232.

249. See *id.*

250. *Id.*

Propy moved its product stateside, conducting an auction of a home in Florida via an NFT.<sup>251</sup> As it did in the Ukraine sale, Propy first facilitated the transfer of the real estate to an LLC.<sup>252</sup> Then, Propy “minted” the property rights into an NFT.<sup>253</sup> According to the Propy website, the NFT equals ownership rights in the home valued at \$650,000, and the NFT is “a DeFi asset[] that can be borrowed against.”<sup>254</sup> The NFT includes “[a]ccess to [the] ownership transferred paperwork,” a picture of the house, and an “NFT mural by [a] local artist.”<sup>255</sup> The NFT business appears to be a miniscule part of Propy’s overall operations; the remainder of the business provides a platform for online real estate transactions.<sup>256</sup> For these more traditional transactions, Propy provides a platform for storing the transaction documents on the blockchain.<sup>257</sup> As was the case in the original Ukrainian transaction, the blockchain address is on the recorded deed, now as a quick response (QR) code.<sup>258</sup>

RealT offers investors the opportunity to buy interests in rental property.<sup>259</sup> RealT’s hook is democratization; by using Ethereum tokens to represent fractional interests in real estate, it allows smaller investors to access the market.<sup>260</sup> As is the case in Propy’s structure, the tokens do not actually represent interests in real estate; the tokens represent interests in a business entity.<sup>261</sup> RealT has structured its entity as a Delaware Series LLC, and each series owns one real property asset.<sup>262</sup> Each deed evidencing the transfer of the real estate to the series is recorded in the county in which the

---

251. See Berdychowski, *supra* note 237.

252. See *id.*

253. See *id.*

254. *Florida—The Home of the First US Real Estate NFT*, PROPY, <https://propy.com/browse/first-us-real-estate-nft/> [<https://perma.cc/BU6R-ZU6A>].

255. *Id.* A news report on the transaction clarifies that the NFT art is a mural that will be painted on a wall of the house. See Berdychowski, *supra* note 237 (solidifying the fact that the NFT is in there just for marketing purposes).

256. See PROPY, *supra* note 234.

257. See *FAQ*, PROPY, <https://propy.com/browse/faq/> [<https://perma.cc/4A4J-8YJ3>].

258. See *id.*

259. See REALT, *supra* note 221, at 10.

260. See *id.*

261. *Id.* at 9.

262. See *id.* at 11.

real estate is located.<sup>263</sup> Investors then buy tokens, known as Real Tokens, that represent units of the series.<sup>264</sup>

One benefit of this token structure is the mechanism for disbursing rental payments. The management company collects rent from the tenants and exchanges the rent for stablecoins, which are then distributed to the rent contract associated with each property.<sup>265</sup> The rent contract then automatically disburses the rental payments, pro rata, to the digital wallets that hold the Real Tokens.<sup>266</sup> The RealT white paper available on the company's website gives a balanced view of the pros and cons of token-based real estate ownership, recognizing, for example, that while a homeowner might tokenize her house on the RealT platform, the possibility of using that token as collateral for a loan is "purely hypothetical."<sup>267</sup> RealT also recognizes the importance of real-world conditions that affect real estate and intends to use Ethereum's Interplanetary File System (IPFS) to give token holders access to their property's inspection reports, maintenance histories, and repair and renovation histories.<sup>268</sup>

## 2. *Crypto-Enabled Loans*

Two companies, Milo and LoanSnap, are offering crypto mortgage loans.<sup>269</sup> Both are claiming to offer the world's first crypto mortgage,

---

263. *See id.*

264. *Id.* at 19. Stablecoins are designed to behave similarly to traditional currencies, combining their price stability with the flexibility offered by cryptocurrencies. *See What Are Stablecoins?*, CRYPTOPEDIA (June 28, 2022), <https://www.gemini.com/cryptopedia/what-are-stablecoins-how-do-they-work> [<https://perma.cc/HK3X-W49P>].

265. *See* REALT, *supra* note 221, at 19.

266. *See id.*

267. *Id.* at 20.

268. *Id.* at 23.

269. *See World's 1st Crypto Mortgage Only at Milo!*, MILO, <https://www.milo.io/crypto/> [<https://perma.cc/GB7S-QF62>]; Kamran Rosen, *This Company Wants to Turn Your Mortgage into an NFT*, FORBES (Nov. 18, 2021, 1:30 AM), <https://www.forbes.com/sites/kamranrosen/2021/11/18/this-company-wants-to-turn-your-mortgage-into-an-nft/?sh=370754837feb> [<https://perma.cc/8SVW-9Z5R>].

using different structures.<sup>270</sup> Milo makes loans to customers who hold Bitcoin, which they must transfer to a third-party wallet custodian for Milo's benefit.<sup>271</sup> Milo then advances the purchase price (in U.S. dollars) to the seller, and the customer pays the purchase price over time.<sup>272</sup> If the customer misses a payment, Milo withdraws the customer's crypto and liquidates it to make the payment (ostensibly, by selling it on the open market).<sup>273</sup> The benefit of the Milo loan is that the borrower does not have to liquidate the Bitcoin to buy the house.<sup>274</sup> It is not clear from the Milo website how their loans are structured, but they do not appear to be mortgage loans. That said, the founder of Milo told one news outlet that customers have an incentive to pay because he (the lender) has a lien on the house and the buyer's Bitcoin.<sup>275</sup>

LoanSnap's product is more clearly a mortgage. LoanSnap is a mortgage lender, and it claims to have minted the first NFT mortgages using its Bacon Protocol.<sup>276</sup> According to LoanSnap, NFTs can improve the mortgage lending process because the blockchain can permanently record information that lenders take into account in making lending decisions, such as the applicant's credit score.<sup>277</sup> On the other end, through the Bacon Protocol, LoanSnap enables anyone with a wallet to act as a lender by purchasing LoanSnap's stablecoin, which will be backed by the NFT mortgages.<sup>278</sup> Like the other projects that involve real estate transfers, this one begins with a signed mortgage recorded in the county in which the land is located.<sup>279</sup> The "wrap" works as follows: a loan originator (who must be a licensed lender) enters into a traditional mortgage transaction with the property owner.<sup>280</sup> The originator then mints an "Egg" NFT

---

270. See *World's 1st Crypto Mortgage Only at Milo!*, *supra* note 269; Rosen, *supra* note 269.

271. See Strachan, *supra* note 239.

272. See *id.*

273. See *id.*

274. See *id.*

275. See *id.*; CNBC Television, *Milo CEO on Using Crypto for Home Mortgages*, YOUTUBE (Mar. 25, 2022), <https://www.youtube.com/watch?v=LjJskQqcRzw> [<https://perma.cc/48TM-4ZPF>].

276. See Rosen, *supra* note 269.

277. See *id.*

278. ALLAN CARROLL & KARL JACOB, HOME COIN WHITEPAPER 4 (2022), <https://files.baconcoin.finance/bacon-protocol-whitepaper.pdf> [<https://perma.cc/B2FV-2BDY>].

279. See *id.* at 7.

280. See *id.*



and transfers the Egg to the mortgagor.<sup>281</sup> From that point, the originator acts as a loan servicer, and the mortgagor uses the Egg to borrow money from the Pan (staying with breakfast), which is a smart contract that pools funds, mints the stablecoin, and funds the loans.<sup>282</sup> Like the proponents of other crypto-enabled real estate transactions, LoanSnap claims that its product will make real estate transactions (in this case, mortgages) “cheaper, faster, and more flexible for homeowners.”<sup>283</sup> In reality, LoanSnap’s Bacon-enabled loans cannot exist without the traditional real estate transfer and recording system, and the value added by the Bacon, Egg, and Pan seems to be that it gives homeowners the ability to quickly borrow money secured by their homes.<sup>284</sup>

### 3. *Moving Recording to the Blockchain*

Some companies have proposed transferring local land records to a blockchain. Propy has entered a partnership with the city of South Burlington, Vermont, to test blockchain as a recording system.<sup>285</sup> Propy’s goal is to become South Burlington’s recording system, but it will take several steps to get there.<sup>286</sup> The city received its first “blockchain deed” in early 2018,<sup>287</sup> which was a paper deed, recorded in the city’s land records, that contained a blockchain address and QR code identifying the deed’s location on the public Ethereum blockchain.<sup>288</sup> This is according to plan; in the next level of the Propy-South Burlington collaboration, the recording office would enter into the blockchain an acknowledgment that it has received

---

281. *See id.* at 7-8.

282. *See id.* at 8.

283. *Id.* at 2.

284. The quick money aspects of the transaction are reminiscent of the period prior to the 2008 financial crisis. *See* CHRISTOPHER K. ODINET, *FORECLOSED: MORTGAGE SERVICING AND THE HIDDEN ARCHITECTURE OF HOMEOWNERSHIP IN AMERICA* 26 (2019).

285. Ben Miller, *Vermont City, Real Estate Startup Try Out Blockchain for Recording Property Transactions*, GOVTECH., <https://www.govtech.com/biz/vermont-city-real-estate-startup-try-out-blockchain-for-recording-property-transactions.html> [<https://perma.cc/CY4R-TPZU>].

286. *See id.*

287. Jonathan Wolf, *Will Blockchain Technology Really Ever Supplant the Humble Title Search?*, ABOVE THE L. (Feb. 2, 2022, 6:18 PM), <https://abovethelaw.com/2022/02/will-blockchain-technology-really-ever-supplant-the-humble-title-search/> [<https://perma.cc/HJJ4-5UAX>].

288. *Id.*; Miller, *supra* note 285.

the deed and the necessary fees.<sup>289</sup> Level three would require the city recording office to link its records with Propy's system to enable Propy to record deeds within the city's system electronically, and the last level—level four—would be achieved when Propy becomes South Burlington's land records software.<sup>290</sup> In late 2019, Propy and the city launched a six-week trial during which Propy's blockchain registry system ran in parallel to the city's recording office.<sup>291</sup> As of this writing in 2023, the project has not progressed any further than the six-week trial.<sup>292</sup>

### *C. Crypto, Blockchain, and Real Estate Transactions: The Reality*

The debates over the role of electronic technologies in real estate transactions are not new. Our description in Part I of the paper-based land recording system exposes some flaws that might be solved by a system in which records are created and stored electronically.<sup>293</sup> Even before the emergence of electronic technologies, critics of the existing system proposed title registration, such as the Torrens system, as a solution for flaws in the recording system.<sup>294</sup> As legislation developed and enabled various transactional technologies, such as electronic signatures, commentators proposed technology-enabled improvements to the land transfer system.<sup>295</sup>

The difference between today's crypto transaction promoters and the commentators of the past is that the former advocate for transforming the land transfer system in its entirety, and the latter

---

289. See Miller, *supra* note 285.

290. See *id.*

291. *Propy Trials Blockchain for Land Registry in Vermont*, LEDGER INSIGHTS (Jan. 8, 2020), <https://www.ledgerinsights.com/propy-blockchain-real-estate-title-registry-vermont/> [<https://perma.cc/RD34-LCZX>].

292. See Wolf, *supra* note 287.

293. See *supra* Part I.A.

294. See generally Ted J. Fiftis, *Land Transfer Improvement: The Basic Facts and Two Hypotheses for Reform*, 38 U. COLO. L. REV. 431, 435 (1966).

295. See, e.g., Tanya Marsh, *Foreclosures and the Failure of the American Land Title Recording System*, 111 COLUM. L. REV. SIDEBAR 19, 24-25 (2011) (advocating for a state or federal recording system that incorporates completely searchable documents); Dale A. Whitman, *Digital Recording of Real Estate Conveyances*, 32 J. MARSHALL L. REV. 227, 228 (1999) (suggesting that digitization will make the recording system "much easier, faster, and less costly"); Arthur R. Gaudio, *Electronic Real Estate Records: A Model for Action*, 24 W. NEW ENG. L. REV. 271, 271 (2002) (promoting a "truly uniform electronic recording system").

proposed targeted improvements that might harness emerging technologies.<sup>296</sup> We take a more targeted approach in the discussion that follows, recognizing both the flaws and strengths of the existing system. We discuss problems that electronic recording might solve and then explain impediments to the implementation of a blockchain-based system. We end this Part by discussing off-record claims to land and noting that ownership interests in land, which straddle the border between the tangible and intangible, are already signaled by existing practices and institutions that the blockchain will not likely replace. It is no surprise that a recording system that was developed more than three hundred years ago would adapt imperfectly to today's society.

Calls to modernize real estate transactions and the systems that enable them are not new. These calls peaked at two points in the past twenty-five years: after the promulgation and enactment of the Uniform Electronic Transactions Act (UETA) and its federal counterpart, the Electronic Signature in Global and National Commerce Act (E-Sign), and after the 2008 mortgage crisis wreaked havoc.<sup>297</sup> Several authors identified indexing as a problem with a system in which humans deliver paper documents to other humans who are responsible for ensuring that those documents can be found by anyone searching for information about real property.<sup>298</sup> In 1999, Dale Whitman proposed that preparing electronic documents with standard fields could make real estate documents “self-indexing,” thus removing the problem of human error from the indexing system.<sup>299</sup> Tanya Marsh suggested more than ten years later that recording offices could harness more sophisticated technology to

---

296. See, e.g., Grant, *supra* note 245; Marsh, *supra* note 295; Whitman, *supra* note 295; Gaudio, *supra* note 295, at 274.

297. See, e.g., Marsh, *supra* note 295, at 19 (observing that participants in the mortgage market developed a parallel system to the outdated recording system and that both systems failed to meet the goals of recording); Gaudio, *supra* note 295, at 273-74 (explaining that although the electronic transactions acts facilitated electronic real estate transaction documents, the benefits of electronic transactions would not be fully realized until there was an electronic recording system).

298. See Marsh, *supra* note 295, at 21-22 (noting that misspelled names and minor variations of names can make documents impossible to locate); Whitman, *supra* note 295, at 240 (“[E]xpecting the recorder’s personnel to perform indexing is fundamentally inefficient and unnecessary.”).

299. Whitman, *supra* note 295, at 240.

create completely searchable documents that could include what she described as “limitless data,” including tax records, prior conveyances, and subdivision plats.<sup>300</sup>

To be sure, electronic recording has made some progress. Thirty-nine U.S. jurisdictions have enacted the Uniform Real Property Electronic Recording Act, which the Uniform Law Commission promulgated in 2004.<sup>301</sup> The Act establishes that any legal requirement that a document be original or on paper and manually signed can be satisfied by an electronic document.<sup>302</sup> It also gives enacting states the choice of establishing an Electronic Recording Commission to set statewide electronic recording standards or designating an existing state agency to do so.<sup>303</sup> It further gives local recording offices the authority to automate certain recording procedures.<sup>304</sup>

The takeaway is that most, if not all, of the problems that real estate experts have identified with the current land recording (and related transfer) system can be solved by any number of secure electronic systems, managed by a government entity.<sup>305</sup> Making a blockchain network the secure electronic system of choice is not the way, however. As we describe in Part III, the impediments to implementing a blockchain system for real estate transactions likely outweigh any benefits that such technology might offer.

### III. PROBLEMATIZING CRYPTO IN PROPERTY & COMMERCIAL LAW

To better understand the barriers to blockchain’s promise, this Part identifies the major obstacles standing in the way—namely, existing law and systems. We argue that these difficulties are not merely theoretical nor easily solved. Thus, recent efforts to effectuate blockchain’s promise have fallen short. Additionally, we describe

---

300. Marsh, *supra* note 295, at 24-25.

301. See *Real Property Electronic Recording Act*, UNIF. L. COMM’N (2004), <https://www.uniformlaws.org/committees/community-home?communitykey=643c99ad-6abf-4046-9da4-0a6367da00cc> [<https://perma.cc/7BRP-U9QC>].

302. UNIF. L. COMM’N, THE UNIFORM REAL PROPERTY ELECTRONIC RECORDING ACT: A SUMMARY 2, <https://www.uniformlaws.org/HigherLogic/System/DownloadDocumentFile.ashx?DocumentFileKey=3be821b4-d463-170c-000d-ae0bd9ee5e6d&forceDialog=1> [<https://perma.cc/L2RX-45EU>].

303. UNIF. REAL PROP. ELEC. RECORDING ACT § 5 (UNIF. L. COMM’N 2003).

304. *Id.* § 4.

305. See UNIF. L. COMM’N, *supra* note 302, at 1-2.

how the speed promoted by those developing crypto-enabled real estate transactions is undesirable, given the uses to which buyers put land. We close this Part by discussing off-record claims to land and noting that existing practices and institutions already signal ownership interests in land, which straddle the border between the tangible and intangible, and the blockchain will likely not replace them.

### *A. Impediment # 1: Overhauling the Law*

Crypto-enabled land transaction promoters tend to overestimate the utility of blockchain tokens in facilitating real estate transactions. For example, the CEO of Propy wrote that when real property becomes an NFT, “the NFT will become collateral in the crypto world which unlocks crypto-enabled mortgages.”<sup>306</sup> There is just one problem: both the Uniform Commercial Code (U.C.C.) and real property law stand in the way of that prediction.

As explained above, the Propy model of crypto real estate transactions requires that the real property first be transferred to an LLC.<sup>307</sup> The LLC rights are represented by an NFT to the degree such a tokenization is even legally possible.<sup>308</sup> In the sales transactions described above, the crypto asset transfers an interest in a business entity, not an interest in land.<sup>309</sup> The crypto-enabled mortgage that Propy claims to be made possible by NFTs is not a real estate mortgage at all; it is a loan secured by an interest in a business entity that is the owner of real estate.<sup>310</sup> In the case of Milo, its mortgage may not be a mortgage at all, and LoanSnap’s mortgage lending scheme seems to be a complicated way to fund

---

306. Karayaneva, *supra* note 232.

307. *See supra* Part II.

308. We do not address in this Article whether it is legal to tokenize an interest in an LLC such that the holder of the NFT is the holder of the interest with the NFT and the interest being one and the same. Whether this is possible depends upon the limited liability company laws of the applicable jurisdiction. *See* R. Wilson Freyermuth, Christopher K. Odiinet & Andrea Tostato, *Predatory Crypto in Real Estate* 8 (Univ. of Miss. Sch. of L. Legal Stud. Rsch. Paper, Paper No. 2002-13, 2022) (unpublished manuscript), [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=4268587](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4268587) [<https://perma.cc/Y6V7-F875>].

309. *See id.* at 9.

310. *See id.* at 8.

mortgages.<sup>311</sup> Current commercial and real estate law explains some of the complexity because nothing in either set of laws enables an NFT real estate transaction.<sup>312</sup> The open question that we address in this Article is whether the law should enable such transactions. Below we explain what the law is now and for the foreseeable future.

### *1. The U.C.C. Today and Tomorrow*

The current U.C.C. does not facilitate the transactions that the crypto land transfer companies are promoting. Under Article 9, both cryptocurrency and NFTs fall into the category of “[g]eneral intangibles.”<sup>313</sup> This classification produces several undesirable results for companies that promote blockchain- and cryptocurrency-enabled real estate transactions.

One problem is that a person with a security interest in a general intangible can perfect that interest only by filing a financing statement.<sup>314</sup> This is significant because the proponents of crypto real estate transactions purport to perfect their interests in crypto collateral by taking possession or control of it.<sup>315</sup> This method is preferable for those who deal in crypto because it allows them to liquidate the collateral easily, which is something that they cannot do if their security interest in the crypto collateral is non-possessory.<sup>316</sup>

The other problem for the crypto community is that transferees of neither crypto assets broadly nor NFTs specifically benefit from the same “take free” rules that the U.C.C. grants other financial instruments. For example, although a creditor can perfect a security interest in a promissory note by filing a financing statement, the U.C.C. makes such perfection less desirable than perfection by

---

311. See Alcynda Lloyd, *Why You Shouldn't Get Your Mortgage in Bitcoin*, BUS. INSIDER (Feb. 19, 2022, 6:00 AM), <https://www.businessinsider.com/crypto-mortgage-analysis-bitcoin-pros-cons-milo-trouble-getting-financing-2022-2> [<https://perma.cc/CK6D-4SES>].

312. See Megan Jones & David Wright, *NFT Use Cases in Real Estate*, JD SUPRA (May 5, 2022), <https://www.jdsupra.com/legalnews/nft-use-cases-in-real-estate-9505741/> [<https://perma.cc/W2EX-98WH>].

313. U.C.C. § 9-102(a)(42) (AM. L. INST. & UNIF. L. COMM'N 2010).

314. U.C.C. § 9-310(a) (AM. L. INST. & UNIF. L. COMM'N 2022).

315. See Freyermuth & Odinet, *supra* note 308, at 23.

316. *See id.*

possession.<sup>317</sup> A transferee who takes possession of a promissory note takes it free of all competing property claims of which it has no knowledge.<sup>318</sup> Recognizing that promissory notes are routinely transferred in commerce by negotiation, which includes the transfer of possession, the U.C.C. provides that a filed financing statement does not give knowledge of a competing property claim to a promissory note.<sup>319</sup> The absence of such a rule for crypto assets, including NFTs, means that anyone who takes a transfer of these digital assets would take them subject to a blanket security interest that encumbers all “general intangibles.”<sup>320</sup>

The crypto industry has pushed for laws to remove the barriers described above to using crypto assets in commerce. Some states, notably Wyoming, have passed laws to facilitate such use, and others have followed Wyoming’s lead.<sup>321</sup> However, even in these “crypto-forward” statutes, NFTs do not transfer interests in other assets in the way that those promoting the use of NFTs in real estate transactions would like.<sup>322</sup>

The sponsoring bodies of the U.C.C., the Uniform Law Commission and the American Law Institute, recognizing the growing use of crypto assets in commerce and the desire for crypto-friendly legislation, have revised the U.C.C. to facilitate and clarify the rules regarding transactions in these assets.<sup>323</sup> But even when enacted in the states, those amendments will not facilitate transactions that purport to transfer real estate by an NFT representing the real

---

317. See U.C.C. § 9-310(a), (b)(6) (AM L. INST. & UNIF. L. COMM’N 2022) (providing that all security interests must be perfected by filing except those perfected by possession); *id.* § 9-313(a) (allowing a secured party to perfect its interest in instruments by possession).

318. See *id.* § 9-317(d).

319. See *id.* § 9-330(f).

320. See Freyermuth & Odinet, *supra* note 308, at 23.

321. See, e.g., WYO. STAT. ANN. §§ 34-29-101 to 34-29-106 (2021); IDAHO CODE §§ 23-5301 to 23-5306 (2022) (amending the Uniform Commercial Code by adding a definition of “digital asset,” allowing a secured creditor to perfect its security interest in a digital asset by possession or control, and providing that perfection by possession or control is a better method of perfection than filing a financing statement); TEX. BUS. & COM. CODE §§ 9.314, 9.331, 12.001-004 (2021) (amending the Uniform Commercial Code to provide for perfection by control of virtual currency and providing that a person with control over virtual currency takes the virtual currency free of competing property claims).

322. See Moringiello & Odinet, *supra* note 19, at 660.

323. See *UCC, 2022 Amendments to*, UNIF. L. COMM’N (2022), <https://www.uniformlaws.org/committees/community-home?CommunityKey=1457c422-ddb7-40b0-8c76-39a1991651ac> [<https://perma.cc/B8LE-LAD9>].

estate because non-U.C.C. law does not recognize a link between an NFT and any underlying real or personal property.<sup>324</sup> In other words, a transfer of an NFT transfers only the NFT, not the underlying asset.<sup>325</sup>

## 2. Real Estate Law

One might say that real property is already tokenized and has been for centuries. As explained above, property law requires the delivery of a deed to transfer ownership of the land.<sup>326</sup> The deed delivery requirement, as noted in Part I, evolved from the requirement in preliterate England that a transferor of land show intent to transfer by handing a clod of dirt to the grantee.<sup>327</sup> Dirt gave way to paper, and it may be desirable that paper give way to documents that are electronically created and stored.<sup>328</sup> Indeed, a system that enables the electronic creation, transfer, and storage of deeds might eliminate disputes over lost deeds, misrecording, and failures to deliver.<sup>329</sup>

Deed transfer requirements should not be an impediment to electronic real estate transactions. Just as the paper deed delivery requirement emerged from preliterate practices, an electronic substitute for a deed could certainly emerge.<sup>330</sup> As we explained in an earlier work, deeds serve a tokenization function and could be replaced or supplemented by electronic deeds if the law supported

---

324. Moringiello & Odiinet, *supra* note 19, at 662.

325. The amendments make an exception for tokens that represent certain payment rights, treating those tokens as the equivalent of electronic negotiable instruments. *See* U.C.C. § 12-04 (AM. L. INST., Tentative Draft No. 1, 2022).

326. *See supra* Part I.

327. Amanda Farrell, *The History and Value of Land Records*, PROPROLOGIX (2021), <https://www.proplogix.com/blog/the-history-and-value-of-land-records> [<https://perma.cc/2EJR-Z82Z>].

328. Contract law is far ahead in this respect, with the UETA and E-Sign granting validity to electronically created and signed contracts for statute of frauds purposes. *See UETA and E-SIGN Act*, DOCUSIGN, <https://www.docusign.com/learn/esign-act-ueta> [<https://perma.cc/ZUX2-P9SX>].

329. *Benefits of eRecording*, ERECORDING PARTNERS NETWORK, <https://goepn.com/benefits-of-erecording/#:~:text=The%20Benefits%20of%20eRecording%20for%20Submitters%20and%20Recorders&text=Electronic%20recording%20significantly%20improves%20efficiency,and%20other%20real%20estate%20documents> [<https://perma.cc/A28V-LX9X>].

330. *See* UNIF. REAL PROP. ELEC. RECORDING ACT § 5 (UNIF. L. COMM'N 2003).



such a practice.<sup>331</sup> A deed serves several functions: it facilitates the transfer of land, describes the land and the state of title to the land, and serves as a document that can be placed on the public record to establish a chain of title.<sup>332</sup> An electronic equivalent could perform all of the same functions.

Current real estate financing practices and law do not enable NFT real estate transactions, however. Real estate financing is effectuated by the use of mortgage documents that grant the lender an interest in the land as security for a loan.<sup>333</sup> When the buyer misses a payment or otherwise defaults on a mortgage obligation, the mortgage document and state law provide the procedures for foreclosing on the land to satisfy the debt.<sup>334</sup> Substituting this document with an interest in an NFT raises a host of issues, including the right of redemption, foreclosure waiting periods, notice requirements, and sundry equitable principles that have long guided mortgage law.<sup>335</sup>

Various consumer laws protect individuals when they finance their homes using a mortgage. Such protections may be lost if the financing used does not qualify as mortgage financing under the relevant laws, such as when the collateral is an NFT and not the home.<sup>336</sup> For example, in a residential mortgage transaction, federal laws, such as the Truth in Lending Act (TILA)<sup>337</sup> and the Real Estate Settlement Procedures Act (RESPA)<sup>338</sup> provide a host of special protections for home buyers. Lenders cannot even make a residential mortgage loan without first assessing whether the

---

331. See Moringiello & Odinet, *supra* note 19, at 622.

332. *See id.* at 622-23.

333. See CONSUMER FIN. PROT. BUREAU, GUIDE TO CLOSING FORMS 2, [https://files.consumerfinance.gov/f/documents/cfpb\\_buying-a-house\\_closing-forms\\_guide.pdf](https://files.consumerfinance.gov/f/documents/cfpb_buying-a-house_closing-forms_guide.pdf) [<https://perma.cc/DTD3-NQYE>].

334. *See id.*

335. *See* Freyermuth & Odinet, *supra* note 308, at 1.

336. Notably, federal law ties various residential mortgage borrower protections to there being a “residential mortgage loan[.]” *See, e.g.*, 15 U.S.C. § 1639b(4)(e)(2). The definition of a residential mortgage loan requires that there be “a mortgage, deed of trust, or other equivalent consensual security interest on a dwelling or on residential real property that includes a dwelling.” *Id.* § 1602(dd)(5). If the lien is on the NFT, rather than on real property, then the credit transaction would not be one involving a residential mortgage loan. *See id.*

337. *Id.* §§ 1601-1616.

338. 12 U.S.C. §§ 2601-2617.

borrower has the ability to repay it.<sup>339</sup> Additionally, the TILA-RESPA Integrated Disclosure provisions require that consumers be given a preliminary, and then a final, statement of information about the loan's key terms, including pricing.<sup>340</sup>

TILA also allows mortgage borrowers to rescind the entire financing transaction during the three business days after it is consummated.<sup>341</sup> This right is often referred to as a “cooling off” period, affording the borrower some time to think through whether the deal was in their best interest without the pressures of a mortgage lender's sales pitch.<sup>342</sup> But even after the mortgage loan is made and the “cooling off” period expires, federal mortgage law continues to furnish the borrower with special protections and benefits. This is particularly true in the context of mortgage servicing, in which, for instance, servicers are obligated to help borrowers work through loan defaults<sup>343</sup> and to answer qualified written requests within certain set deadlines.<sup>344</sup> Indeed, federal mortgage law even requires that lenders give borrowers a fifteen-day grace period to make late payments without a penalty and another fifteen days before the loan is considered delinquent.<sup>345</sup> There is also likely no individual tax advantage more cherished than the mortgage interest tax deduction, which also may be lost if the financing is not considered mortgage financing.<sup>346</sup> Again, all of

---

339. 15 U.S.C. § 1639c(a)(1) (applying that requirement only to residential mortgage loans).

340. See 12 C.F.R. §§ 1024.5(d), 1026.19(e), 1026.37, 1026.38 (2021). Notably, these provisions only apply only to loans secured by real property.

341. See 15 U.S.C. § 1635(a).

342. ADAM J. LEVITIN, CONSUMER FINANCE: MARKETS AND REGULATION 603 (2018).

343. See 12 C.F.R. §§ 1024.39(a)-(b), 1024.40, 1024.41(b)(2)(i); see also *id.* § 1024.41(a).

344. See 12 U.S.C. § 2605(e).

345. See Kevin Graham, *The Hidden Costs of Late Mortgage Payments*, ROCKET MORTGAGE (Jan. 23, 2023), <https://www.rocketmortgage.com/learn/cost-of-making-late-payment-on-mortgage#:~:text=The%20amount%20of%20time%20varies,payment%20without%20incurring%20a%20penalty> [<https://perma.cc/E9N6-5DQS>] (discussing how “a lender usually permits a borrower 15 days from the due date” to make a payment); Kevin Graham, *Mortgage Delinquency: What It Is and What It Means*, QUICKEN LOANS (Apr. 25, 2022), <https://www.quickenloans.com/learn/mortgage-delinquency#:~:text=A%20mortgage%20is%20not%20considered,report%20to%20the%20credit%20bureaus> [<https://perma.cc/388Q-3AZ3>] (“A mortgage is not considered ... delinquent until you have been behind on your payment for 30 days or more.”).

346. See Lauren Nowacki, *The 2022 Mortgage Interest Deduction: Your Guide to Limits and Qualifications*, ROCKET MORTGAGE (Feb. 18, 2023), <https://www.rocketmortgage.com/learn/mortgage-interest-deduction> [<https://perma.cc/GXJ3-V4K5>].

these protections depend upon the transaction involving a mortgage over real property—not taking a security interest in an NFT that forms the basis of an interest in a real estate holding company.<sup>347</sup>

### *B. Impediment # 2: Overhauling the System*

The other major roadblock concerns the realities of changing the system of land recording itself. Setting aside changes to the law, changes to the system pose their own unique set of considerations and these may be the most significant challenge of them all. These problems involve factors tied to any governmental change: the expense of the change and the public's trust in what the change brings.<sup>348</sup> And then there is always the chance that the overhaul will be half-hearted, with the partial implantation of a new system and concurrent maintenance of the old creating more complexity and inefficiency in real property transactions.<sup>349</sup>

#### *1. The Problems of Cost and Trust*

More than twenty years ago, commentators recognized the substantial financial costs that would be involved in moving real estate records to an electronic system. In 2002, Sam Stonefield wrote that the cost of moving one county in Iowa to an electronic system would cost the local government \$75,000.<sup>350</sup> Relatedly, Arthur Gaudio recognized that the realities of state and local government financing would likely delay the goal of implementing electronic recording systems nationwide.<sup>351</sup>

In addition to the cost of moving systems, another challenge is the threat of lost revenue. Counties rely on recording fees generated by their Recorder of Deeds offices.<sup>352</sup> The controversies over the

---

347. *See id.*

348. *See* Fiflis, *supra* note 294, at 474.

349. *See* Gaudio, *supra* note 295, at 299.

350. Sam Stonefield, *Electronic Real Estate Documents: Context, Unresolved Cost-Benefit Issues and a Recommended Decisional Process*, 24 W. NEW ENG. L. REV. 205, 232 (2002).

351. Gaudio, *supra* note 295, at 299; *see also* Stonefield, *supra* note 350, at 237 (noting the political impediments to allocating funds to move recording systems from a paper format to an electronic system).

352. *See, e.g.,* Montgomery County v. MERSCORP Inc., 795 F.3d 372, 374 (3d Cir. 2015) (“The Recorder sought to recover millions of dollars in unpaid recording fees.”); *Recording Fees*

Mortgage Electronic Registration System (MERS) illustrate how jealously the counties guard those fees.<sup>353</sup> MERS established an independent system for tracking mortgage assignments.<sup>354</sup> There have been myriad complaints about the effect of MERS on the property recording system, but the counties had a specific concern: the loss of recording fees.<sup>355</sup> As a result, several counties sued MERS to recover unpaid recording fees, claiming that the failure to pay such fees upon the assignment of a mortgage violated state law.<sup>356</sup> Although every county that challenged MERS ultimately lost because no statute requires mortgage recording, the litigation illustrates how fervently counties protect their fees, which, in turn, introduces yet another political economy barrier.<sup>357</sup>

Issues of trust compound the cost problem. Twenty years ago, there was low consumer trust when it came to electronic transactions.<sup>358</sup> To maintain trust in the recording system, it must be transparent and public. Tanya Marsh emphasized that for these reasons, establishing and maintaining land records must remain an essential government function.<sup>359</sup> It is hard to imagine that the average person trusts a blockchain system whereby anonymous nodes and related parties maintain the ledger through incentives and mechanisms that often mystify the public.<sup>360</sup> The examples

---

*and Taxes*, Md. CTS., <https://mdcourts.gov/clerks/cecil/recordingfees> [<https://perma.cc/QHW8-S54U>] (publicizing the price of recording mortgages in Maryland as up to seventy-five dollars per instrument recorded).

353. MERS is a national database that tracks the holders of mortgage servicing rights and beneficial ownership interests in loans secured by real estate mortgages. *See MERS System*, MERS, <https://www.mersinc.org/products-services/mers-system> [<https://perma.cc/W6UM-GDKR>]. To participate in the system, the borrower and lender agree to name MERS as the mortgagee on the mortgage. *Id.* MERS records the initial instrument in the applicable county land records but bypasses additional recording fees for secondary mortgage transactions by allowing lender-members to transfer the right to be repaid among one another, recording such transfers in the MERS, rather than local government, databases. *Id.*

354. *Id.*

355. *See, e.g., MERSCORP Inc.*, 795 F.3d at 374.

356. *Id.*

357. Some trial courts sided with the counties but were reversed on appeal. *See, e.g., id.* at 378-79 (reversing the lower court ruling and ruling in favor of MERS because Pennsylvania law, similar to the laws of other states, does not require land transfers to be recorded).

358. Stonefield, *supra* note 350, at 221.

359. *See* Marsh, *supra* note 295, at 24.

360. Dawn Allcot, *Crypto Comprehension Study: 98% of People Don't Grasp Basics of Bitcoin, Stablecoins or NFTs*, YAHOO! (Nov. 2, 2021), <https://www.yahoo.com/video/crypto-comprehension-study-98-people-190349019.html> [<https://perma.cc/BV2W-TFAV>].

below suggest that the mainstream trust of blockchain system has yet to surface.

## 2. *The Delaware Corporations Example*

Before blockchain was promoted as the answer to problems in the real estate world, it was touted as a better way to maintain corporate records. And Delaware, the paper home of 68 percent of Forbes 500 companies, took the bait.<sup>361</sup> Delaware's story provides an example of some of the practical impediments to replacing a well-established, but sometimes creaky, system with a new one.

Blockchain promoters went to Delaware raising a host of issues that could be solved by an automated system housed on a blockchain.<sup>362</sup> According to the proponents, blockchains could solve issues with the secured loan filing system and disputes over corporate share ownership.<sup>363</sup> Delaware responded positively to the blockchain lobbyists.<sup>364</sup> The state established the Delaware Blockchain Initiative and appointed a state blockchain ombudsman.<sup>365</sup> Even the legislature moved to recognize blockchain as a method of maintaining corporate records, passing a law that allowed corporate records to be maintained on “[one] or more electronic networks or databases (including [one] or more distributed electronic networks or databases)” so long as the records can be converted to paper records within a reasonable time.<sup>366</sup>

---

361. Holly Quinn, *What Ever Happened to the Delaware Blockchain Initiative?*, TECHNICAL.LY (Mar. 31, 2022, 3:21 PM), <https://technical.ly/civic-news/delaware-blockchain-initiative/> [https://perma.cc/J8ZJ-RA93].

362. See Karl Baker, *Delaware Eases Off Early Blockchain Zeal After Concerns over Disruption to Business*, DEL. ONLINE (Feb. 2, 2018, 9:19 PM), <https://www.delawareonline.com/story/news/2018/02/02/delaware-eases-off-early-blockchain-zeal-after-concerns-over-disruption-business/1082536001/> [https://perma.cc/743Z-8PUV].

363. See *id.* The Delaware blockchain ombudsman and the president of the software company working with Delaware to develop its blockchain promoted the idea of a smart Uniform Commercial Code filing system, which would, in theory, lower the costs of searches and filings and reduce mistakes and fraud. See Andrea Tinianow & Caitlin Long, *Delaware Blockchain Initiative: Transforming the Foundational Infrastructure of Corporate Finance*, HARV. L. SCH. F. ON CORP. GOVERNANCE (Mar. 16, 2017), <https://corpgov.law.harvard.edu/2017/03/16/delaware-blockchain-initiative-transforming-the-foundational-infrastructure-of-corporate-finance/> [https://perma.cc/N2EF-H8VJ].

364. See Baker, *supra* note 362; Tinianow & Long, *supra* note 363.

365. Quinn, *supra* note 361.

366. DEL. CODE ANN. tit. 8, § 224 (2017).

Even with legislative facilitation, the Delaware Blockchain Initiative went nowhere.<sup>367</sup> We believe the lessons from Delaware are instructive for those who promote blockchain for real estate transactions. Most importantly, despite the Delaware law allowing blockchain corporate records and the state's support of the Delaware Blockchain Initiative, the state itself never developed any blockchain infrastructure.<sup>368</sup> Traditionally, corporations maintain physical ledgers of stock ownership.<sup>369</sup> The blockchain initiative envisioned a state-sponsored blockchain to replace such ledgers.<sup>370</sup> Yet, in the absence of this blockchain, it is unclear how many companies even took advantage of the new law allowing them to maintain stock ledgers on the blockchain.

One explanation is that companies did not find an unregulated blockchain to be an attractive place to maintain corporate records; said another way, they did not trust it.<sup>371</sup> Another is that there is already an established corporate registration and record-keeping business in Delaware.<sup>372</sup> Even though a physical location for a corporate agent may seem antiquated to some, people who deal with Delaware corporations are comfortable with the existing system.<sup>373</sup> Moreover, the current system creates jobs in Delaware—for registered corporate agents, for lawyers, and for other service providers—and the state did not want to risk losing those jobs by implementing a public blockchain.<sup>374</sup> The jobs concern is closely related to the revenue concern generally. Although blockchain advocates claimed that adoption of a public blockchain for corporate records could bring more money into the state, the Secretary of State's office was concerned about the impact of a move to the blockchain on other revenue sources.<sup>375</sup>

---

367. See generally Quinn, *supra* note 361.

368. See *id.*

369. See Moringiello & Odinet, *supra* note 19, at 619-20.

370. See Tinianow & Long, *supra* note 363.

371. Quinn, *supra* note 361.

372. See *Department of State: Division of Corporations*, STATE OF DEL., <https://icis.corp.delaware.gov/ecorp/Entitysearch/namesearch.aspx> [<https://perma.cc/9G9M-YXVZ>].

373. See Quinn, *supra* note 361.

374. See Baker, *supra* note 362.

375. See *id.*

### 3. *Back to Vermont*

We described South Burlington's experiment with Propy above.<sup>376</sup> Last anyone heard of it, the city and Propy were maintaining parallel systems for recording.<sup>377</sup> That is the worst possible outcome—for all its failures, county land records provide some level of certainty in that everyone knows where to find information about land located in that county. Two places to search means the possibility of errors and mismatches in information, not to mention adding additional information gathering to the transaction's due diligence.

#### *C. The Problem of the Recording System as a Repository of a Variety of Interests in Land*

Lastly, the proponents of blockchain-based real estate transactions seem to assume that all interests in land are created in consensual transactions involving one person conveying the entire interest in the land to another. Real estate transactions are messier than that.

For example, judgment liens can attach to real property.<sup>378</sup> It is unclear how a judgment lien creditor can add its interest to a blockchain-based system.<sup>379</sup> There is also the issue of materialmen's and mechanics' liens, which sometimes require a claimant to make a filing into the land records.<sup>380</sup> We wonder what would happen when these filings need to be canceled, such as when they create an invalid cloud on title. Additionally, land often transfers by will or intestacy.<sup>381</sup> Again, it is not clear how to integrate those facts into

---

376. See *supra* Part II.B.3.

377. See *supra* Part II.B.3.

378. See, e.g., Thomas J. Mitchell, Comment, *Perpetuating the Force of Judgments and Judgment Liens in Texas*, 29 TEX. L. REV. 530, 534 (1951).

379. See, e.g., 5AP2 NICHOLS CYCLOPEDIA LEGAL FORMS ANNOTATED § 113:37, Westlaw (database updated November 2022) (providing municipalities with a sample form that creditors can use to document changed interests in real property in their jurisdictions, with no mention of updating such information in blockchain-based systems).

380. See *Bob DeGeorge Assocs., Inc. v. Hawthorn Bank*, 377 S.W.3d 592, 598 (Mo. 2012) (describing the lien and the filing requirements in Missouri); MO. REV. STAT. § 429.010 (2013).

381. See generally *Introduction to Wills*, AM. BAR. ASS'N, [https://www.americanbar.org/groups/real\\_property\\_trust\\_estate/resources/estate\\_planning/an\\_introduction\\_to\\_wills/](https://www.americanbar.org/groups/real_property_trust_estate/resources/estate_planning/an_introduction_to_wills/)

the smart contracts that are said to so seamlessly guide these transactions.

#### IV. THE INTANGIBLE CASE FOR BLOCKCHAIN PROPERTY REGISTRIES

Above we described the existing system for verifying rights in real estate.<sup>382</sup> Real estate rights straddle the line between the intangible and the tangible.<sup>383</sup> Title is an intangible concept because no one can determine the title rights in a parcel of land solely by looking at it.<sup>384</sup> A parcel of land can be physically possessed, and possession is a fact that is visually verifiable.<sup>385</sup> In this final Part, we provide our final analysis of why the attributes of contemporary blockchain technology do not actually address all the facets of real property transactions, but we conclude on a high note by offering a way that crypto and its attendant technologies can serve a useful purpose when it comes to tracking and verifying rights in purely intangible property.

##### *A. Signals, Recording Systems, and Property Rights*

The real estate system signals ownership rights in two ways. First, the recording system provides signals regarding the intangible rights, or title.<sup>386</sup> However imperfect, it is a system that would be difficult to dismantle, and dismantling the system would require time-consuming law reform.<sup>387</sup> The recording system provides a method of publicizing tokens representing rights to real estate, such

---

[<https://perma.cc/T8WP-WWHT>] (discussing the methods by which property can transfer at death depending on whether a person dies with or without a will).

382. See Part I.A.2.

383. See HERNANDO DE SOTO, *THE MYSTERY OF CAPITAL: WHY CAPITALISM TRIUMPHS IN THE WEST AND FAILS EVERYWHERE ELSE* 157 (2000) (“[P]roperty is not a physical thing that can be photographed or mapped.... [T]he law is less concerned with representing the physical reality of buildings or real estate than with providing a process or rules that will allow society to extract potential surplus value from those assets. Property is not the assets themselves but a consensus between people as to how those assets should be held, used, and exchanged.”); Jason Gordon, *Tangible vs Intangible Property—Explained*, BUS. PROFESSOR (Sept. 24, 2021), [https://thebusinessprofessor.com/en\\_US/property-law/tangible-vs-intangible-property](https://thebusinessprofessor.com/en_US/property-law/tangible-vs-intangible-property) [<https://perma.cc/A7Q7-4JQL>] (discussing how real estate can be “physically touched”).

384. See DE SOTO, *supra* note 383, at 157.

385. See Gordon, *supra* note 383.

386. See DE SOTO, *supra* note 383, at 157.

387. See *supra* Part III.B.



as deeds, mortgages, and easements, and finding a benefit in replacing today's system for tracking rights with one that incorporates NFTs and blockchain is difficult.<sup>388</sup>

Second, because real estate is tangible, physical possession can also signal title in the same way possession signals title in all other tangible assets.<sup>389</sup> Possession by someone who did not initially have rights in the real or personal property can ripen into title if the possession persists uninterrupted for a long enough time.<sup>390</sup> Moreover, certain conditions on a parcel of land might provide inquiry notice of a competing title claim, such as an easement.<sup>391</sup> For these reasons, a real estate buyer's title due diligence includes not only a record search but also a visual search of the land.<sup>392</sup> As a result, even if all a buyer cared about was the title to real estate, a search of the real estate records, without a visual inspection of the property, would be inadequate title due diligence.<sup>393</sup>

It is important to note that title is only part of what makes a house or any other unit of real estate attractive to a buyer. A buyer of real estate will want to know the condition of the real estate before buying it, and many buyers insist that their obligation to buy be contingent on a satisfactory physical inspection of the premises.<sup>394</sup> A frictionless real estate transaction that is as quick as a Venmo payment would not allow the inspections that buyers and their lenders view as critical. In addition to an inspection showing whether the roof is leakproof and that the heating system works, a

---

388. See *supra* Parts III.A-B.

389. See Henry Winthrop Ballentine, *Claim of Title in Adverse Possession*, 28 YALE L.J. 219, 220 (1919) (discussing how possession implies a claim to title at least in some capacity).

390. See generally John Lovett, *Disseisin, Doubt, and Debate: Adverse Possession Scholarship in the United States (1881-1986)*, 5 TEX. A&M L. REV. 1 (2017) (providing an exhaustive discussion of the theories of adverse possession).

391. See, e.g., *Purchaser Had Constructive Notice of Easement Even Though Easement Was Not Indexed to Lot*, SCHLAM STONE & DOLAN LLP (Sept. 4, 2019), <https://www.schlamstone.com/blogs/commercial/2019-09-04-purchaser-had-constructive-notice-of-easement-even-though-easement-was-not-indexed-to-lot/> [<https://perma.cc/N9BF-4S66>].

392. See Sebastian Alvarado, *Due Diligence: Inspections and Appraisals*, OUTLIER LEGAL SERVS. (Apr. 30, 2021, 7:30 PM), <https://news.outlierlegal.com/2021/04/30/due-diligence-inspections-and-appraisals/> [<https://perma.cc/YFV3-5RPX>].

393. See *id.*

394. See KURTZ ET AL., *supra* note 41, at 1226 (providing case law about real estate buyers who assume that a comprehensive in-person inspection occurred and who otherwise would not have finalized their purchase).

buyer will want to know whether a home suits her personal preferences and needs. A buyer of a four-bedroom house will want to see the house to assess whether the size and placement of the four bedrooms matches her family's needs. This physical assessment is part of why the Venmo analogy is inapposite. No one needs to inspect funds before accepting a Venmo payment.<sup>395</sup> But a physical inspection of real estate is an important part of the purchasing process.

We also note that frictionless transactions are not always good. This is especially true when individuals enter into sales and financing transactions. The law recognizes the importance of friction by, as we described above, mandating a three-day "cooling off" period in certain consumer credit transactions.<sup>396</sup> As we noted, the effect of this rule is to give an individual three days after receiving required disclosures to rescind a loan transaction.<sup>397</sup> The goal of these consumer protection laws is to encourage consumers to compare loan products and to promote informed decision-making.<sup>398</sup> This is because consumers can make hasty decisions.<sup>399</sup> Real estate is typically someone's most valuable asset, so having some friction in such a major transaction can be a good thing. This rationale is what underpins the idea of forcing mortgage creditors to wait before foreclosing on residential property. Friction in foreclosure is good because it can save a home if the borrower can refinance, allow them to or make up missed payments, or give the borrower more time for negotiation.<sup>400</sup>

---

395. See Frank Gogol, *How to Use Venmo*, STILT (Sept. 7, 2022), <https://www.stilt.com/blog/2021/05/how-to-use-venmo/> [<https://perma.cc/BET7-3DGM>] (discussing how payments over Venmo occur instantly).

396. See *supra* Part III.A.2.

397. See *supra* Part III.A.2.

398. See Christopher L. Peterson, *Predatory Structured Finance*, 28 CARDOZO L. REV. 2185, 2225-32 (2007).

399. See LEVITIN, *supra* note 342, at 247 (discussing behavioral economics in consumer finance).

400. *How Long Do I Have to Rescind? When Does the Right of Rescission Start?*, CONSUMER FIN. PROT. BUREAU (Sept. 9, 2020), <https://www.consumerfinance.gov/ask-cfpb/how-long-do-i-have-to-rescind-when-does-the-right-of-rescission-start-en-187/> [<https://perma.cc/AN6K-PQ8R>].

*B. The Intangible Case(s) for Tokenizing Property Rights and Tracking Them on a Blockchain: The Case of Visual Art*

Although moving real property title to a blockchain might be impractical and expensive and would provide little improvement to real estate transactions, the use case for blockchain as a property registry is more compelling for tracking *purely* intangible property rights. Commentators writing about intellectual property, specifically as applied to fine art, have explored this use case, and we summarize some of their arguments below, concluding that if there is a use case for tracking property rights on a blockchain and through the use of NFTs, that use case is to track property rights for which there is no clear signal of possessory rights to an original.

As we discussed above, changes in technology that enabled electronic creation and storage of legal documents created benefits in commercial transactions, including real estate transactions.<sup>401</sup> The opposite holds true for rights in digital creative works; the internet enabled the perfect copying of such works, and such perfect copying is anathema to copyright holders.<sup>402</sup>

That said, there are some who argue that copyright is an imperfect mechanism for protecting the rights of creators. Amy Adler wrote that rather than encouraging creativity on the part of creators of visual art, copyright may do the opposite.<sup>403</sup> According to Adler, it is the “norm of authenticity” that protects the rights of artists because authenticity provides the foundation for the art market.<sup>404</sup> Where visual art is concerned, the main value is not in

---

401. See *supra* Part II.C.

402. See Tonya M. Evans, *Cryptokitties, Cryptography, and Copyright*, 47 AIPLA Q.J. 219, 228 (2019) (explaining that because digital technology allowed for easy and cheap copying, “the sharp line that divided professional counterfeiters and low-level copyists began to blur”). The internet was not the first technology to raise concerns about perfect copying. Almost one hundred years ago, commentators expressed the same concerns about photography. See Stefan Bechtold & Christopher Jon Sprigman, *Intellectual Property and the Manufacture of Aura* 9-10 (N.Y. Univ. of L. Pub. L. Rsch., Working Paper No. 22-09, 2022), [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=4002717](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4002717) [<https://perma.cc/5XYK-SHGC>] (discussing Walter Benjamin’s 1931 essay in which he observed that unlike earlier technologies, photography could precisely reproduce images, thus erasing the visual difference between the original and reproductions).

403. See Amy Adler, *Why Art Does Not Need Copyright*, 86 GEO. WASH. L. REV. 313, 323 (2018).

404. *Id.*

the tangible—the sculpture, painting, or photograph—but in the intangible quality of authenticity.<sup>405</sup> A work by a known artist will sell for far more than an exact copy by someone else.<sup>406</sup>

Art law scholars have observed that ownership stripped of possessory rights might be sufficient for participants in the art market. Stefan Bechtold and Christopher Sprigman have explained how many creators develop an “aura” around their work and that it is the aura that is valuable to buyers.<sup>407</sup> This aura is valuable despite the fact that the works to which the aura pertains are not unique originals; rather, they are identical copies of works.<sup>408</sup> Bechtold and Sprigman use Thomas Kinkadee as an example of an artist whose manufactured aura provided his mass-produced works with an air of provenance and authenticity.<sup>409</sup> Brian Frye also promotes the idea of “bare” ownership, arguing that authenticity is merely a proxy for the clout that accompanies ownership.<sup>410</sup> If the intangible ideas of ownership, aura, and authenticity drive the art market, then perhaps NFTs and blockchain registries have a place in the digital art world.

Others have promoted blockchain as a method of providing scarcity for digital works of art. According to Tonya Evans, blockchain technology enables ownership of digitally scarce assets.<sup>411</sup> Evans analyzes blockchain’s benefits from a creator’s point of view and posits that, not only does blockchain technology protect an artist against counterfeiting, but that it also grants creators new ways to monetize and enforce their copyrights.<sup>412</sup> As an example of the latter benefit, she explains that NFTs, combined with smart contracts, might enable an artist to profit from each transfer of a digital work of art.<sup>413</sup>

---

405. *Id.* at 331-32 (“The supreme value placed on authenticity—and the utter distinction it draws between original and copy, and between one artist’s authorship and another’s—makes copyright law superfluous.”).

406. *Id.* at 346 (explaining that the designation of a work as inauthentic is “the equivalent of an economic death sentence”).

407. *See* Bechtold & Sprigman, *supra* note 402, at 21-24.

408. *See id.*

409. *See id.*

410. Frye, *supra* note 212, at 348.

411. Evans, *supra* note 402, at 249.

412. *See id.* at 254, 265.

413. *See id.*

We explain in another paper that an NFT grants no property rights in an underlying asset.<sup>414</sup> Yet as the discussion above illustrates, in the art market the proof of ownership represented by the NFT might be more important than any exclusive rights to a digital work of art.<sup>415</sup> The status granted by a verifiable claim of ownership is what matters, and a blockchain registry can enable such a status.<sup>416</sup> NFTs might provide an aura of exclusive ownership even though they grant no exclusive ownership rights in any work of art.<sup>417</sup> Doing so would protect both the creator of the work—who, by bestowing authenticity, could earn more for the work—and the buyer—who, by proving authenticity, could maximize her investment.

### CONCLUSION

The American system for transferring and recording interests in real estate is far from perfect. However, the fix is not an automated system that facilitates speedy transactions. Real estate straddles the line between tangibility and intangibility. The recording system tracks the intangible aspect, that of title, and that system could benefit from the certainty technological innovations provide. The tangible aspects of real estate will remain crucial to buyers and sellers, and those aspects, both with respect to the physical condition of the property and to conditions on the land that might indicate title claims, are verified by robust signals such as physical possession.

Blockchain technology's promise is its ability to track rights that are not verifiable by existing recording systems or physical signals. This promise makes the intangible case for the technology. The technology's promise in the physical world, so we have argued, is limited.

---

414. See Moringiello & Odinet, *supra* note 19, at 670; see also Frye, *supra* note 212, at 346 (“[T]here’s no necessary relationship between an NFT and the work it purports to represent. An NFT is an NFT ‘of’ a work only because the creator of the NFT says it is.”).

415. Cf. Bechtold & Sprigman, *supra* note 402, at 21-24.

416. Cf. Evans, *supra* note 402.

417. Cf. Bechtold & Sprigman, *supra* note 402, at 21-24.