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RESEARCH ARTICLE

The nature of property in cryptoassets

Timothy Chan*†

Faculty of Law, National University of Singapore, Singapore
*Author e-mail: chanwxt@nus.edu.sg

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Abstract

Disputes relating to cryptoassets have proliferated in recent years, along with the rise of the cryptoasset market. Some of these can be resolved using traditional principles of contract, tort or trust law, but proprietary issues raise particular conundrums. While cryptoassets have generally been accepted to be property, that is merely the starting point. To properly resolve proprietary disputes, it is necessary to provide a reasoned and robust explanation for why particular rules of title originally developed in the context of tangible property should apply. In turn, two foundational questions must be answered. First, what is the subject-matter of the property right in cryptoassets? And secondly, what is the proprietary effect of a blockchain transaction? These issues have received relatively little attention in the literature, which has focused on whether cryptoassets are property at all, and existing contributions (including the Law Commission's recent Consultation Paper on Digital Assets) which do engage these issues are far from reaching consensus. This paper critically examines those views and puts forward its own reasoned approach for the application of traditional rules of title to cryptoassets.

Keywords: property and trusts; digital assets; cryptoassets

Introduction

There has been much discussion in recent years over the question of whether cryptoassets[1] constitute property for the purpose of the common law, which has important implications for whether such assets can be held on trust, devolve by will, and vest on bankruptcy or insolvency. It has generally been answered in the affirmative by various Commonwealth courts (recognising that cryptoassets can be held on trust[2] and are susceptible to interlocutory proprietary injunctions),[3] the Law Commission[4] (largely affirming the earlier view of the UK Jurisdictional Taskforce),[5] and various

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[1]This term is used to embrace assets styled as 'cryptocurrencies' (such as Bitcoin and Ethereum), sub-tokens, and so-called non-fungible tokens (NFTs). See for a similar usage M Bridge et al (eds) *The Law of Personal Property* (London: Sweet and Maxwell, 3rd edn, 2022) ch 8.

[2]*Ruscoe v Cryptopia Ltd (in liq)* [2020] 2 NZLR 809; *B2C2 Ltd v Quoine Pte Ltd* [2019] 4 SLR 17.

[3]*Sally Jane Danisz v Persons Unknown and Others* [2022] EWHC 280 (QB), *AA v Persons Unknown* [2019] EWHC 3556 (Comm) (England); *Chen v Blockchain Global Ltd* [2022] VSC 92 (Australia); *CLM v CLN and Others* [2022] SGHC 46 (Singapore); *Yan Yu Ying v Leung Wing Hei* [2021] HKCFI 3160 (Hong Kong).

[4]Law Commission *Consultation Paper on Digital Assets* Law Com No 256, 28 July 2022.

[5]UK Jurisdictional Taskforce *Legal Statement on Cryptoassets and Smart Contracts*, November 2019.

legal scholars.[6] Yet, relatively little attention has been given to the nature of property in such assets and how property rules operate in relation to them. Discussions of the 'nature' of property in cryptoassets usually focus on whether cryptoassets are choses in action (since they are clearly not choses in possession).[7] But that issue is not really about how property in cryptoassets behaves; it goes instead to the question of whether cryptoassets can be regarded as property to begin with. It should be said at the outset that this paper does not deal with that issue; it follows the consensus above in assuming that cryptoassets are properly regarded as objects of property in English law, and therefore does not address the so-called '*tertium quid*'[8] debate (or the Law Commission's recent proposal to introduce a 'third category' of personal property).[9] Instead, this paper focuses on several foundational questions which must be answered to determine how property rights in such assets operate, namely: (i) what is the subject-matter of the property right; (ii) what is the legal characterisation of blockchain transactions which purport to 'transfer' such assets; and (iii) when and how title does title pass?

There is growing recognition of the importance of these issues, which occupy several chapters in the Law Commission's recent Consultation Paper on Digital Assets,[10] but little consensus about them. Yet, they are fundamental to resolving even the simplest of property disputes. For example, in a case involving the unauthorised misappropriation of Bitcoins, the question whether legal and/or equitable title has passed will determine whether the claimant brings an action to vindicate her proprietary rights,[11] to reverse the recipient's unjust enrichment,[12] and/or mount an equitable claim built on the doctrine that property in the hands of a thief is subject to a constructive trust.[13] This is no mere hypothetical. Indeed, disputes of this nature are bound to increase in number given the widespread misappropriation of blockchain assets[14] now being reported following the sudden growth of the cryptoasset market,[15] and various reported interlocutory judgments already involve disputes featuring the loss of valuable cryptoassets such as Bitcoin and Ethereum.[16]

It must be emphasised that in searching for rules governing the transfer of title to cryptoassets, a straightforward analogy with tangible property does not suffice. An example of such analogical reasoning can be found in a Bloomberg Law report suggesting that the victim of a phishing attack who lost a cryptoasset known as a non-fungible token (NFT) might retain ownership of the token,

[6]See for example Bridge et al, above n 1, para 8-050; J Marinotti 'Tangibility as technology' (2021) 37(3) Georgia State University Law Review 671; D Fox 'Cryptocurrencies in the common law of property' in D Fox and S Green (eds) *Cryptocurrencies in Public and Private Law* (Oxford: Oxford University Press, 2019); KFK Low and E Teo 'Bitcoins and other cryptocurrencies as property?' (2017) 9(2) Law, Innovation and Technology 235; L Chambers 'Misappropriation of cryptocurrency: propelling English private law into the digital age?' (2016) 5 Journal of International Banking and Financial Law 263.

[7]See *AA v Persons Unknown* [2019] EWHC 3556 (Comm).

[8]Per Fry LJ in *Colonial Bank v Whinney* (1885) 30 Ch D 261: '[a]ll personal things are either in possession or action. The law knows no *tertium quid* between the two'.

[9]Law Commission, above n 4, ch 4.

[10]See chs 10, 12 and 13 of the Law Commission *Consultation Paper on Digital Assets*, above n 4.

[11]See *Armstrong DLW GmbH v Winnington Networks Ltd* [2013] Ch 156 at [85]–[94]; Law Commission, above n 4, para 19.73; Fox, above n 6, para 6-103; Chambers, above n 6, at 264–265.

[12]The unjust factor here potentially being ignorance or lack of consent: see the recent developments in Singapore in *Esben Finance Ltd and Others v Neil Wong Hou-Lianq* [2022] SGCA(I) 1. But, if title has not passed see W Swadling 'Ignorance and unjust enrichment: the problem of title' (2008) 28(4) Oxford Journal of Legal Studies 627.

[13]*Chase Manhattan Bank NA v Israel-British Bank (London) Ltd* [1981] Ch 105; *Westdeutsche Landesbank Girozentrale v Islington LBC* [1996] AC 669 at 714–715; cf *Shalson v Russo* [2005] Ch 281 and J Tarrant 'Property rights to stolen money' (2005) 32(2) University of Western Australia Law Review 234 at 245.

[14]See for example the Federal Trade Commission 'Cryptocurrency buzz drives record investment scam losses' *Data Spotlight* (17 May 2021), available at https://www.ftc.gov/news-events/data-visualizations/data-spotlight/2021/05/cryptocurrency-buzz-drives-record-investment-scam-losses.

[15]Which reached a total market capitalisation of $3 trillion in November 2021 (see J Ossinger 'Crypto World Hits $3 trillion market cap as Ether, Bitcoin gain' (*Bloomberg*, 8 November 2021), available at https://www.bloomberg.com/news/articles/2021-11-08/crypto-world-hits-3-trillion-market-cap-as-ether-bitcoin-gain#xj4y7vzkg), although this value has dropped dramatically in recent months.

[16]Such as *Danisz*, above n 3 (transfer of Bitcoin procured by fraud); *AA v Persons Unknown*, n 7 above (a ransomware attack); *CLM*, above n 3 (loss of a private key held in a safe).

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notwithstanding its subsequent sale to a third party.[17] This was because 'a thief never obtains ownership, "and because the thief didn't get good title, you can't sell more rights than you actually have"'.[18] But, as McFarlane and Douglas have recently cautioned, it is a mistake to equate the theft of a chattel (a tangible asset) with the misappropriation of cryptoassets (which are intangible).[19] In the specific context of cryptoassets, Low warns against the use of a 'broken' metaphor with conversion, since physical interferences are simply impossible in relation to intangible assets.[20] As McFarlane and Douglas explain, to develop the law in a principled manner, we must examine the similarities and differences between the specific type of intangible asset in question and existing tangible assets, and ask whether they affect how the law should protect the rights of property owners.[21]

This paper seeks, by undertaking that process, to make a robustly reasoned case for the application of (most) traditional rules of title transfer by analogy. The argument begins in Section 1 by introducing the key technological concepts necessary to investigate the nature of property in cryptoassets. Section 2 examines the first of two foundational questions on which hinge the application of title rules: what is the *res*? Here, it will be argued that the *res* should be framed as a 'transactional ability' to effect a valid blockchain transfer. Section 3 examines the second foundational question: what is the legal characterisation of a blockchain transaction? Specifically, is the *res* (as defined) actually transferred, or is a new item of property created? It is contended that whether or not a legal transfer occurs is a normative rather than a factual question, and that therefore even though a blockchain transaction may factually extinguish the original item and create a new item, the law should treat this as a true transfer. With these answers in place, Section 4 offers a brief sketch of how various title transfer rules may properly be applied to cryptoassets by analogy.

1. A primer on blockchain technology

Cryptoassets are a unique form of property, being a creature of the blockchain technology that allows them to exist. While various detailed accounts of blockchain technology have been presented elsewhere,[22] this section seeks to draw out the key terms and concepts relevant to how property in cryptoassets behaves, many of which have not been emphasised in accounts of the technology in legal writing to date.

(a) Basic components of the blockchain

Cryptoassets come into existence and are transacted on their respective blockchains, which are decentralised ledgers recording entitlements and transactions. Blockchains are maintained by a network of individual computers running the relevant software, known as 'nodes',[23] which are able to earn

[17]R Setty 'Seth Green's stolen "bored ape" muddles NFT legal ownership' (*Bloomberg Law*, 8 June 2022), available at https://news.bloomberglaw.com/ip-law/seth-greens-stolen-bored-ape-muddles-nft-legal-ownership.

[18]Ibid.

[19]B McFarlane and S Douglas 'Property, analogy and variety' (2020) Oxford Journal of Legal Studies 1.

[20]KFK Low 'Quoines in cryptopia: when (if ever) are cryptoasset exchanges trustees?' (2020) The Conveyancer and Property Lawyer 70 at 80.

[21]McFarlane and Douglas, above n 19, at 26.

[22]For the technical perspective, this paper draws on A Summers *Understanding Blockchain and Cryptocurrencies* (Oxford: CRC Press, 2022); H Arslanian *The Book of Crypto – The Complete Guide to Understanding Bitcoin, Cryptocurrencies and Digital Assets* (Cham: Springer, 2022), T Gayvoronskaya and C Meinel *Blockchain – Hype or Innovation?* (Cham: Springer, 2021), C Dannen *Introducing Ethereum and Solidity: Foundations of Cryptocurrency and Blockchain Programming for Beginners* (Berkeley: Apress, 2017), A Narayanan et al *Bitcoin and Cryptocurrency Technologies* (Princeton: Princeton University Press, 2016), and P Franco *Understanding Bitcoin – Cryptography, Engineering and Economics* (West Sussex: Wiley, 2015). It also makes reference to open source resources made available for Bitcoin and Ethereum developers, accessible at https://developer.bitcoin.org/devguide/index.html and https://developer.bitcoin.org/devguide/index.html and https://ethereum.org/en/developers/docs/ respectively. For accounts of the technology in legal texts, see inter alia S Green 'Cryptocurrencies: the underlying technology' in Fox and Green, above n 6; Bridge et al, above n 1, ch 8; Low and Teo, above n 6, at 236–241.

[23]Franco, above n 22, p 110; Summers, above n 22, p 25.

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cryptoassets through a process called 'mining'. There are various approaches to mining.[24] Bitcoin functions on a 'proof-of-work' model, which requires nodes to compete to solve a difficult mathematical problem to receive a reward.[25] In the process of solving that problem, nodes must verify transactions which are sent to the network by users.[26] A successful miner will be allowed to add a group of verified transactions to the blockchain in the form of a new 'block', and will receive a cryptoasset reward.[27] Ethereum previously functioned on a 'proof-of-work' mechanism as well[28] but in a recent and highly publicised transition[29] has shifted to a 'proof-of-stake' mechanism, under which nodes will be able to validate transactions by staking coins they already own.[30] In the event that two blocks are successfully mined at the same time (an event known as a 'fork'), the network protocol provides that the longest chain is valid, which is determined by majority consensus.[31]

If a user does not wish to mine but simply wishes to purchase and transact cryptoassets, it is not necessary to run a full node. All that is required is something known as a 'public-private keypair'. A keypair is made up of a 'public address' and a 'private key', which both typically consist of a string of letters and/or numbers, and can be generated easily using various types of wallet generation software.[32] The blockchain will maintain a record of the cryptoasset entitlements associated with the 'public address', which can also be used to send and receive cryptoassets on the relevant network. Any such transaction must be validated by a 'signature' which can only be generated using the 'private key'. By virtue of the algorithmic relationship between the private key and the public address, the 'signature' generated is extremely easy for all other users to verify,[33] but the private key is itself extremely difficult to reverse-engineer.[34]

(b) Blockchain transactions

The manner in which blockchain technology allows cryptoassets to be transferred from one public address to another must be examined in slightly greater detail, because it is fundamental to how the asset is to be characterised as property. In this regard, there are two different methods used by blockchains to record transactions: the 'unspent transaction output' (UTXO) model, used by Bitcoin and Litecoin,[35] and the 'account balance' model, used by Ethereum.[36]

In the UTXO model, the software maintains a database known as the 'UTXO cache', which contains a list of all existing UTXOs and their corresponding addresses.[37] UTXOs, as their name suggests, are 'unspent' outputs (denominated in Bitcoin) which are available to be spent via a blockchain transaction. UTXOs are created when a block is successfully mined. For example, a Bitcoin miner which successfully mines a block will be rewarded with an UTXO in the sum of 6.25 Bitcoins,[38]

[24]For a broad overview, see Summers, above n 22, ch 7. See also KFK Low and E Mik 'Pause the blockchain legal revolution' (2020) 69 International and Comparative Law Quarterly 135 at 141–142.

[25]For more detail on mining see Franco, above n 22, ch 7.

[26]Franco, above n 22, pp 105–108; Dannen, above n 22, p 112.

[27]Franco, above n 22, pp 105–108; Narayanan et al, above n 22, p 39.

[28]Dannen, above n 22, ch 6.

[29]See eg L Wintermeyer 'The ethereum merge is over. Now what?' (*Forbes*, 22 September 2022), available at https://www.forbes.com/sites/lawrencewintermeyer/2022/09/22/the-ethereum-merge-is-over-now-what/?sh=79c6e53f4b0b.

[30]See Summers, above n 22, pp 102–103 for a brief overview of the proof-of-stake mechanism.

[31]Franco, above n 22, p 108; Dannen, above n 22, p 124.

[32]Franco, above n 22, p 17; Gayvoronskaya and Meinel, above n 22, p 19; Low and Teo, above n 6, at 38. For more on wallets, see Bitcoin Developer 'Wallets' at https://developer.bitcoin.org/devguide/wallets.html.

[33]Gayvoronskaya and Meinel, above n 22, pp 18–19; Bitcoin Developer 'Transactions' at https://developer.bitcoin.org/devguide/transactions.html; Ethereum Developer Resources 'Ethereum accounts' (updated 3 November 2022) at https://ethereum.org/en/developers/docs/accounts/. For more detail on the algorithm, see Franco, above n 22, ch 5.

[34]Arslanian, above n 22, p 47; Gayvoronskaya and Meinel, above n 22, p 18; Franco, above n 22, p 63.

[35]C Perez-Sola et al 'Another coin bites the dust: an analysis of dust in UTXO-based cryptocurrencies' (2019) 6(1) Royal Society Open Science 180817, 2.

[36]Summers, above n 22, p 79.

[37]Narayanan, above n 22, p 52; Franco, above n 22, p 79; Bitcoin Developer 'Transactions', above n 33.

[38]The current Bitcoin mining reward: Gayvoronskaya and Meinel, above n 22, p 45.

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which will be associated with that miner's public address on the blockchain. If the miner subsequently sends these Bitcoins to another address, the original UTXO will be referenced by the network as a 'transaction input' and a new UTXO in the same denomination will be generated on the recipient's end. So, Bitcoin transactions do not involve the notional tracking of individual Bitcoins, but rather the tracking of UTXOs and their associated addresses. In contrast, Blockchains that use the 'account balance' model, such as Ethereum, do not maintain a UTXO cache. Instead, each Ethereum account contains a data field recording its Ether balance.[39] When Ether is sent from one account to another, the value representing the account balance of each account is simply adjusted accordingly.[40] Unlike Bitcoin, an Ether transfer therefore involves no traceable tokens or transaction outputs and takes effect purely as a notional transfer of value from one account to another. For this reason, cryptoassets using the account balance model have been described as more 'fungible'[41] than cryptoassets using the UTXO model.[42]

As already mentioned, any such transactions must be 'signed' using the private key associated with the originating public address. Once a transaction is sent to the network, the first mining node that receives it will verify: (i) that the signature was generated using the correct private key; and (ii) that the sending wallet contains sufficient cryptoassets to be transferred.[43] The node will then broadcast the transaction to the rest of the network, where it will be stored in a pool of transactions to be mined.[44] Once a transaction is included in a successfully mined block, it forms part of the blockchain and is regarded as 'confirmed'.[45] With each subsequent block confirmation, the probability that a transaction in a particular block will be reversed diminishes exponentially.[46] It is for this reason that blockchain transactions are touted as immutable.

2. The subject-matter of property in cryptoassets

With the above view of the technology in mind, we turn to the first foundational question that must be answered to analyse the nature of property rights in cryptoassets. It is often said that a property right is a 'right in respect of a *res*, a thing'.[47] Therefore, 'whenever and wherever there is ownership, there is an owner, there is a thing that is owned, and there are non-owners'.[48] The question that this section seeks to answer is: What is the *res*? This exercise is crucial because it is impossible otherwise to 'examine the similarities and differences between rights to intangible and tangible assets', as McFarlane and Douglas exhort us to do.[49] Moreover, to understand how property rights in intangibles operate, it is necessary to precisely define the asset according to the rules that create it. For example, in order to understand property rights in carbon credits,[50] it is necessary to examine the underlying legislative framework that brings the asset into existence.[51] In the case of cryptoassets, the relevant rules are the technological ones.

[39]Dannen, above n 22, p 23; Gayvoronskaya and Meinel, above n 22, p 38.

[40]Summers, above n 22, pp 90–92.

[41]The term here simply meaning 'interchangeable' rather than bearing its legal definition: cf R Goode 'Are intangible assets fungible?' (2003) Lloyd's Maritime and Commercial Law Quarterly 379.

[42]Summers, above n 22, p 90.

[43]Franco, above n 22, pp 79–80; Dannen, above n 22, pp 57–58.

[44]Franco, above n 22, p 110; Summers, above n 22, pp 95–96.

[45]Ibid.

[46]Dannen; above n 22, pp 33–35; Ethereum Developer Resources 'Transactions' (updated 22 November 2022) at https://ethereum.org/en/developers/docs/transactions/.

[47]JE Penner *The Idea of Property in Law* (Oxford: Oxford University Press, 1997) p 23. See also for example K Gray and SF Gray *Elements of Land Law* (Oxford: Oxford University Press, 5th edn, 2009) p 8; S Munzer 'Property and disagreement' in JE Penner (ed) *Philosophical Foundations of Property Law* (Oxford: Oxford University Press, 2014) p 289 at p 290.

[48]L Rostill *Possession, Relative Title, and Ownership in English Law* (Oxford: Oxford University Press, 2021) p 156.

[49]McFarlane and Douglas, above n 19, at 26.

[50]*Armstrong*, above n 11.

[51]KFK Low and J Lin 'Carbon credits as EU like it: property, immunity, tragiCO_2medy?' (2015) 27 Journal of Environmental Law 377 at 391–394; B Holligan 'Commodity or propriety? Unauthorised transfer of intangible entitlements in the EU emissions trading system' (2020) 83(5) Modern Law Review 979.

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As will be developed below, this paper takes the view that the subject-matter of property rights in cryptoassets is a 'transactional ability': the practical ability to effect a blockchain transaction that will be recognised as valid by all other nodes on the blockchain. To the knowledge of this author, a similar conception of property in cryptoassets was first proposed in 2019 by Sarra and Gullifer, who suggested that '[w]hat the "owner" of bitcoin has is the ability to generate a transfer, in return for which the transferee is prepared to transfer valuable consideration, which is likely to be fiat or cryptocurrency, or a real-world asset'.[52] They argued that so conceived, the subject-matter of the property right fulfils the criteria of transferability, excludability and exigibility.[53] However, while this may explain why a cryptoasset, conceived as such, should be regarded as property, it does not explain why this particular characterisation of the *res* should be preferred over other characterisations. The latter is a separate question which must be carefully considered in view of the fundamentally different alternatives which have been advanced by other leading writers in the field. This section adds to the debate by proposing a normative justification for viewing cryptoassets as a 'transactional ability'. It then reviews and explains the difficulties with the main alternative conceptions in the literature, notably those proposed by Fox (whose views have been substantially adopted by the Law Commission) and Low.

(a) The normative justification for property in a 'transactional ability'

To explain how the *res* in a novel species of property is defined, it is necessary to return to the first principles of what makes a property right a property right. In this regard, '[i]n seeking to identify the hallmark of a property right modern property theory emphasises the notion of excludability', that is, the 'power of a person to either exclude or permit access to or recourse by other persons to a particular asset'.[54] Therefore, excludability (or the lack thereof) tells us when something *cannot* be property, as demonstrated by the seminal case of *Victoria Park Racing & Recreation Grounds Co Ltd v Taylor*,[55] known for Latham CJ's comment that there can be no 'property in a spectacle'.[56] Excludability is also central to the scope of the property torts, in that torts give legal compunction to the owner's right not to have his exclusory possessory rights impinged upon. So, in conducting the relatively unusual exercise of identifying the subject-matter of a property right in a cryptoasset, we must inquire what is that 'thing' or resource from which holders of cryptoassets seek to exclude others. This aligns with the basic and intuitive notion that the subject-matter of a property right is that of which it is sought to be said 'that is mine'.

What then is that 'thing'? At first glance, it may appear to be the string of letters or numbers which makes up the private key. But this cannot be correct because the private key is not transferred when a cryptoasset is transacted on the blockchain. Metaphorically speaking, the private key is the key that unlocks the safe containing the cryptoasset. I do not typically give the key to someone if I wish to give them the diamonds in my safe. In the same way, when a cryptoasset is transferred on the blockchain, the private key does not change hands.[57] But if the private key is the key to the safe, the treasure in the safe is best understood as the *ability to effect a blockchain transaction (with the specific assets held at that public address) that will be recognised as valid under the relevant consensus algorithm*. In other words, if I say 'I own a Bitcoin', what I mean is that I have the ability to cause all other blockchain participants, within the rules of the system, to recognise a transaction spending that Bitcoin as valid. Conceiving the *res* as such a 'transactional ability' is faithful to the exclusionary focus of property law, for this ability is precisely the 'thing' that must be safeguarded by its holder by keeping the private key secure, and is traded for value on a regular basis in the market.

[52]J Sarra and L Gullifer 'Crypto-claimants and Bitcoin bankruptcy: challenges for recognition and realization' (2019) 28 International Insolvency Review 233 at 243.

[53]Ibid.

[54]Bridge et al, above n 1, para 1-006.

[55]*Victoria Park Racing and Recreation Grounds Co Ltd v Taylor* (1937) 58 CLR 479.

[56]Ibid, at 496–497.

[57]A point made in Low and Teo, above n 6, at 248.

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The term 'transactional ability' is to be preferred over the term 'power' to avoid giving the impression that the ability in question amounts to a *legal* power rather than a *factual* ability. While the ability indeed arises in the context of the relevant system rules and might be thought at first blush to be contractual in origin,[58] it is clear that individual node operators do not expect to undertake liability to cryptoasset holders in the course of mining,[59] which is a fundamentally self-interested process: nodes may select any transactions from the transaction pool to be included in a block, and typically select the ones that offer the largest 'tip' to the miner.[60] In the absence of a corresponding liability, the transactional ability here cannot be a legal power in the Hohfeldian sense.[61] Rather, it must be understood as a factual ability to send a transaction altering a state of recognition within the given set of system rules. So conceived, this transactional ability is clearly distinct from other factual abilities (say the ability to give a haircut),[62] which clearly would not constitute an object of property.[63] It is instead closely akin to goodwill,[64] which is the 'benefit and advantage of the good name, reputation, and connection of a business', or the 'attractive force which brings in custom'.[65] In similar vein, 'owning' a cryptoasset is to 'own' the ability to alter a state of recognition amongst the participating community of nodes. As we have seen above, consensus and validation are at the forefront in the processes of mining, transacting and validation on blockchain ledgers. Since the blockchain itself is a creature of consensus, it stands to reason that the subject-matter of the property right in cryptoassets should be closely tied to that consensus.

A potential objection to this thesis is the argument that some narrower conceptions of property limit the permissible category of 'things' strictly to physical things only (even to the exclusion of debts, company shares and intellectual property rights).[66] But these views do not seem to accommodate the weight of doctrinal recognition that debts[67] and company shares[68] are property, as well as the express statutory provisions conferring proprietary status upon various intellectual property rights.[69] They are therefore disputed by other writers.[70] Alternatively, it might be claimed that all forms of

[58]With gratitude to James Penner for raising this point.

[59]See the exclusion clause in the MIT licence under which the Bitcoin software is provided: Open Source Initiative 'The MIT license', available at https://opensource.org/licenses/mit-license.php; see also *Tulip Trading Limited v Bitcoin Association for BSV* [2022] EWHC 667 (Ch), where the alleged victim of a hack failed to establish a good arguable case that fiduciary and/or tortious duties were owed to it by Bitcoin developers (now on appeal: M Cross 'Court of Appeal to consider crypto 'duty of care'' (*Law Society Gazette*, 15 August 2022), available at https://www.lawgazette.co.uk/law/court-of-appeal-to-consider-crypto-duty-of-care/5113426.article).

[60]See Summers, above n 22, pp 95–96.

[61]See WN Hohfeld 'Some fundamental legal conceptions as applied in judicial reasoning' (1913) 23(1) Yale Law Journal 16 at 44.

[62]With thanks to Kelvin Low for suggesting this example.

[63]Such an ability would likely also be personal in character and incapable of assignment. See *Don King Productions Inc v Warren* [2000] Ch 291.

[64]An analogy with goodwill is also drawn to support treating cryptoassets as property in English conflict of laws rules by A Dickinson 'Cryptocurrencies and the conflict of laws' in Fox and Green, above n 6, para 5.107. But it should be noted that analogies with other forms of intellectual property are less apt for they involve the propertisation of *legal rights* to monopolise particular forms of information. The distinctions between rights in cryptoassets and common law copyright in particular is explored further below at the text to n 111.

[65]*Commissioners of Inland Revenue v Muller and Co's Margarine Ltd* [1901] AC 217 at 223–224.

[66]See W Swadling 'Property: general principles' in A Burrows (ed) *English Private Law* (Oxford: Oxford University Press, 2000) para 4.20; B McFarlane *The Structure of Property Law* (Oxford: Hart Publishing, 2008) pp 132–153; S Douglas and B McFarlane 'Defining property rights' in JE Penner and HE Smith (eds) *Philosophical Foundations of Property Law* (Oxford: Oxford University Press, 2013) p 219 at p 239; M Crawford *An Expressive Theory of Possession* (Oxford: Hart Publishing, 2020) pp 15–20.

[67]*Torkington v Magee* [1902] 2 KB 427 at 430.

[68]Companies Act 2006, s 541; Bridge et al, above n 1, para 6-001.

[69]Copyright, Designs and Patents Act 1988, s 90(1); Trade Marks Act 1994, s 22; Patents Act 1977, s 30(1).

[70]Bridge et al, above n 1, para 9-003; Low and Teo, above n 6, at 244; JE Penner 'The (true) nature of a beneficiary's equitable proprietary interest under a trust' (2014) 27 Canadian Journal of Law and Jurisprudence 473 at 488–489; Marinotti, above n 6.

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intangible property recognised thus far can be characterised as a type of Hohfeldian claim-right,[71] or at least a Hohfeldian immunity (in the case of carbon credits[72] and other statutory licences),[73] and the proposed 'transactional ability' is neither. But in fact the idea that a form of factual consensus can be 'propertised' is not unknown to English law, for goodwill has been judicially described on numerous occasions as a species of property. So, the tort of passing off prevents the 'wrongful invasion of a right of property',[74] that property being the 'goodwill and reputation of [the plaintiff's] business which is likely to be harmed by the defendant's misrepresentation'.[75] In view of these authorities, the leading practitioner's text on passing off states categorically that goodwill in England is personal property,[76] and various other texts agree.[77] But, defined as 'reputation' or as 'attractive force',[78] goodwill is simply a factual state of recognition that cannot be characterised as a Hohfeldian claim-right or immunity, which draws the teeth from the argument that intangible property must take the form of one or the other of these. As explained above, goodwill resembles the proposed subject-matter of property in cryptoassets, for the latter (given its focus on the ability to alter the consensus among nodes) amounts to a very specific type of recognition within a defined class. This paper contends that the courts can and should recognise this 'transactional ability' as a species of property by analogy with goodwill. This would, in the absence of legislative intervention, be a permissible incremental development of property doctrine.

Viewed in this way, the 'transactional ability' theory of property in cryptoassets can explain the legal position where the owner of a cryptoasset irretrievably loses access to his or her private key: since the owner has irretrievably lost the ability to effect transactions with the cryptoassets at the associated public address, those assets should be deemed to have been lost or destroyed.[79] The theory also accommodates not only 'first-layer' cryptoassets like Bitcoin and Ethereum, but also 'second-layer' assets such as sub-tokens and NFTs.[80] But it must be noted that this 'transactional ability' describes only the factual subject-matter of the property right; the person who can exercise the 'transactional ability' from time to time may not necessarily have legal title to the asset.[81] This is because the blockchain ledger is not a legally definitive record of title, in the same way that land registries provide conclusive evidence of title[82] – as Fox puts it, the recipient's title 'may be defeasible for reasons external to the Bitcoin system'.[83] So, while a third party may be able to exercise

[71]Such as the classic chose in action, the contractual right. See WN Hohfeld 'Some fundamental legal conceptions as applied in judicial reasoning' (1913) 23(1) Yale Law Journal 16.

[72]*Armstrong*, above n 11.

[73]*In re Celtic Extraction* [2001] Ch 475 (waste management licences); *Swift v Dairywise Farms Ltd (No 1)* [2000] 1 WLR 1177 (milk quotas).

[74]See for example *Harrods Ltd v Harrovian School Ltd* [1996] RPC 697 at 711 per Millett LJ, following *Spalding (AG) and Bros v AW Gamage Ltd* (1915) 32 RPC 273 (HL) at 284 per Lord Parker; *Star Industrial v Yap Kwee Kor* [1976] FSR 256 (PC) at 269 per Lord Diplock.

[75]Ibid.

[76]C Wadlow *The Law of Passing Off: Unfair Competition by Misrepresentation* (London: Sweet and Maxwell, 5th edn, 2016) ch 3.

[77]J Mellor et al *Kerly's Law of Trade Marks and Trade Names* (Sweet and Maxwell, 16th edn, 2018) paras [15-044], [20-024]; Bridge et al, above n 1, para 10-015; M Bridge *Personal Property Law* (Oxford: Oxford University Press, 4th edn, 2015) p 17; FH Lawson and B Rudden *The Law of Property* (Oxford: Oxford University Press, 3rd edn, 2002) pp 42–43. But *contra* Penner (1997), above n 47, p 109, fn 18.

[78]Note that Bridge et al, above n 1, at para 10–015 characterise goodwill as the 'right to prevent passing off' but it is suggested that this definition ought to be treated with care because the cases describe the tort of passing off as a tort design to prevent the invasion of a right of property; if goodwill is precisely the subject-matter of that right of property, to define goodwill as the right to prevent passing off would appear circular.

[79]See *Chen v Blockchain Global Ltd*, above n 3, at [9].

[80]Ie assets which exist on top of a first-layer blockchain, such as NFTs created on the Ethereum blockchain. For more detail on these types of cryptoassets, see Summers, above n 22, ch 9.

[81]And even though more than one person may have access to the private key (which, as information, is not rivalrous), the transactional ability itself is rivalrous for the system rules of the blockchain allow it only to be exercised once.

[82]See Low and Mik, above n 24, at 146–152; Fox, above n 6, para 6.49; Law Commission, above n 4, para 13.8.

[83]Fox, above n 6, para 6.49.

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control[84] over the asset (such as by gaining access to the owner's private key), whether or not legal title passes depends on the rules of derivative title transfer, which are explored in the penultimate section below.

(b) Data-centric formulations

It is suggested that the thesis presented here is reinforced by considering the difficulties posed by the main alternative characterisations of property in cryptoassets. The first of these is a characterisation of the *res* as a 'data string',[85] either independently, or as a composite 'thing' comprising both a 'data string' (or, as the Law Commission puts it, a 'data structure') and a 'set of transactional functionalities'.[86] In some ways these theories are inspired by the idea contained in the Bitcoin White Paper that a cryptoasset is a 'chain of digital signatures'.[87] Because these conceptions identify the external manifestation of the 'thing' in the 'data string' or 'data structure' recorded on the blockchain, they are referred to here as 'data-centric formulations'.

Fox first put forward such a conception in his chapter in *Cryptocurrencies in Public and Private Law*:

> A crypto-coin takes its form from the recording of transactions on a cryptocurrency system. Stripped to its elements, the coin consists of a string of data, manifested as a readable sequence of characters, which has been generated by a transaction on the system. The transaction might have been the original one where the coin was first mined or a later one where a user transferred a coin already in existence. The data string records a transactional output of value at the public key of the person who now has the power to transact with it by using his or her private key. For this reason, the coin is often called 'an unspent transaction output' ('UTXO').[88]

He regards these individual 'data strings' as a type of information, saying that '[it] is that primary information which … has to be [the] object of any property right'.[89] While he acknowledges the law's 'general reluctance' to recognise property in information, an exception may be made because the 'data string' here is 'more than the information itself' in view of the excludability of cryptoassets within the blockchain system.[90]

The idea that a cryptoasset is more than the 'data string' alone has been developed by Fox and others to include a superadded functional requirement. In Fox's words, a cryptoasset is an 'ideational thing containing different components'.[91] The 'data string' is simply its 'outward manifestation' but it must be seen as a 'set of transactional functionalities', the most important of which is the ability to effect new transactions on the blockchain.[92] Fox's views have been adopted by Liu[93] and more recently the Law Commission, which has said that crypto-tokens are 'data structures', or 'sets of linked or associated data', which have both 'technical and social dimensions' by virtue of being 'instantiated' within a crypto-token system.[94] The Law Commission therefore considers that 'the law is capable of treating a

[84]Whether or not 'control' ought to be developed or recognised as a proprietary concept, as suggested by the Law Commission, is beyond the scope of this paper: see the Law Commission Consultation Paper, above n 4, ch 11.

[85]Fox, above n 6, para 6.13.

[86]Law Commission, above n 4, para 10.25; D Fox 'Digital assets as transactional power' (2022) 1 Journal of International Banking and Financial Law 3.

[87]S Nakamoto 'Bitcoin: a peer-to-peer electronic cash system' (2009), available at https://bitcoin.org/bitcoin.pdf.

[88]Fox, above n 6, para 6.13.

[89]Ibid, para 6.16.

[90]Ibid, paras 6.43–6.44.

[91]Fox, above n 86; also proposed by Fox in a lecture delivered at the National University of Singapore on 25 January 2022.

[92]Fox, above n 86. Similar views have also been advanced in Marinotti, above n 6, at 722.

[93]H Liu 'Title, control and possession in the digital asset world' (2022) Modern Studies in Property Law Conference, available at SSRN: https://ssrn.com/abstract=4079185, p 2.

[94]Law Commission, above n 4, para 10.25.

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crypto-token, being a composite of a specific data structure and commonly-understood process or functionality, as a thing'.[95]

The difficulties with these views, it is submitted, arise because of their focus on the underlying data. Preliminarily, it is not clear how they would apply to account-based systems, since Fox's view was originally conceptualised in the context of the UTXO system and makes reference to the UTXO as the 'data string'. Similarly, while the Law Commission states that 'the law should be capable of characterising cryptotokens as things whether they are created through UTXO-based implementations, [a]ccount-based implementations or token-based implementations',[96] it does not identify what data makes up the 'data structure' in account-based systems. In account-based blockchain ecosystems, unlike UTXO-based systems, no outputs are tracked and there therefore seems to be no 'data string' at all to be identified as the subject-matter of property. A model of property rights in cryptoassets must be able to account for the dominant 'strains' of cryptoassets circulating today. It would create untenable inconsistency if, for example, Bitcoin and Ethereum were subject to differing proprietary analyses, since a single dispute may involve both types of cryptoassets.[97]

Leaving this aside, even in the context of UTXO-based systems, it is difficult to conceive of the 'data string' as property when it is not the 'thing' that cryptoasset owners seek to exclude others from. The 'data string' refers to the specific lines of code included in a block effecting a transaction that assigns a particular UTXO or account balance to a particular public key, which are publicly accessible on the blockchain – the whole world is at liberty to view and even copy[98] the relevant data, which indeed the concept of blockchain validation requires. It cannot even be said that owners seek to enforce a particular *type* of exclusion by excluding others from making transactions that would cause a change to the state of the relevant data within the blockchain record, since subsequent transactions do not change the state of prior blocks (which are immutable) but rather change their significance (in that what was previously an unspent output is henceforth regarded as spent). Any such notion of exclusion therefore does not comport with the usual notion of property in information, which is concerned with restricting access to that information.[99]

Moreover, it is difficult to understand what happens to a 'data string' after a blockchain transaction occurs. Either the data string is property, or it is not. With respect, it does not seem correct that the data string is 'destroyed' with every transaction, as Fox and the Law Commission suggest, just because its 'functional attributes' are 'exhausted'.[100] An analogy may be drawn with cheques, which are recognised as property because they are physical objects, but recognised as carrying a particular value because of their status as negotiable instruments. The fact that the issuer of a cheque may refuse to honour it for any reason does not change the fact that the cheque still exists as property, being a piece of paper, although of course its value will be negligible. In the case of a cryptoasset, the block that contains the original string of data is immutable. Upon a subsequent transaction with that UTXO, the blockchain is updated to reflect that the original UTXO is spent and a new UTXO is created. The original 'data string' remains in its block, forever recorded on the blockchain. So the logical conclusion of the analysis is that each output ever created, being a string of code that immutably exists on the blockchain, is an individual item of property that continues to exist, but it only has value if it is unspent. This not only unduly complicates the analysis but reveals that the true argument must be that the 'data string' itself is property independently of its functionality, which is inconsistent with established principles of English law.[101]

[95]Ibid, para 10.62.
[96]Ibid, para 10.38, fn 744.
[97]See for example the Singapore case of *CLM*, above n 3.
[98]See the Law Commission, above n 4, paras 10.31–10.32.
[99]For example, consider the facts of the well-known case of *Victoria Park Racing v Taylor*, above n 55.
[100]Law Commission, above n 4, para 10.122.
[101]*Your Response v Datateam* [2014] EWCA Civ 281.

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(c) A 'right to a registry entry'

The second important characterisation of cryptoassets as property was first advanced by Low and Teo in 2017.[102] While this model lies functionally very close to the view proposed in this paper, it differs in a subtle but material way. These authors contended that cryptoassets are encapsulated by an abstract legal right, which is a right of holders to 'have their bitcoins, or more accurately their unspent transaction output or UTXO, locked to their chosen public bitcoin address on the blockchain'.[103] Put another way, cryptoassets 'take the form of a right to a registry entry'.[104] Low has since expanded upon the analysis in a number of subsequent papers[105] as well as in the practitioner's text, *The Law of Personal Property*.[106] In their 2017 article, Low and Teo arrived at their conclusion largely by a process of elimination, having identified that cryptoassets cannot be classified as choses in possession and ruling out the subject-matter of the property right being the private cryptographic key. On this view, if a third party dishonestly transfers a cryptoasset holder's assets to another, the third party will be liable for interference with a property right.[107] The difference between this view and the view presented here is that Low and Teo see the *legal* right to have particular UTXOs associated with a public address as itself being the subject-matter of the property right. In other words, that legal right stands in the same position as contractual rights or intellectual property rights which are recognised as proprietary – as Low wrote in relation to carbon credits and he says again in this context, the 'right is the *res*'.[108] On the other hand, as described above, this paper frames the subject-matter of the property right as a *practical* transactional ability.

The main difficulty with Low's view is identifying a basis for the proposed right. Legal rights do not come into existence *in vacuo*. The right contemplated here clearly does not arise under a statute (as with statutory intellectual property rights, for example) or pursuant to contractual agreement, since a holder of Bitcoin enters into no bilateral contract with any particular counterparty and, as explained above, individual nodes do not expect to undertake liability to cryptoasset holders in the course of mining.[109] The right cannot be conceived of as a bundle of data protection rights either, as not all blockchain participants are identifiable by publicly accessible information on the blockchain.[110] A more plausible basis upon which to found the posited 'right to a registry entry' would be to draw an analogy with common law copyright, recognised in *Millar v Taylor*, where Willes J said that 'the sole right of printing, publishing and selling' was a species of property 'long known' that 'existed in fact and usage, as long as the name'.[111] It is, however, questionable whether cryptoassets have achieved sufficient vintage to say that there is a long-established practice recognising that cryptoasset holders enjoy the right to have their assets reflected on the ledger. More importantly, the proposed 'right' differs in a fundamental way from intellectual property rights. On a deeper analysis, if a 'right to a registry entry' is to be recognised, what is the corresponding duty? The 'right to a registry entry' cannot be a right to compel individual nodes to recognise the owner's entitlement through the mining process since, as seen above, nodes do not owe a right to specific holders to validate particular transactions. Rather, it must be a right against everyone in the world *not to send a valid transaction that will spend the owner's UTXO as an input*: indeed, that is the only way the owner's 'right to a registry

[102]Low and Teo, above n 6, at 253.

[103]Low, above n 20, at 81.

[104]Bridge et al, above n 1, para 8-050.

[105]See KFK Low 'Trusts of cryptoassets' (2021) 34(4) Trust Law International 191 at 196; Low, above n 20; KFK Low 'Bitcoins as property: welcome clarity?' (2020) 136 Law Quarterly Review 345; KFK Low and M Hara 'Cryptoassets and property' in S van Erp and K Zimmermann *Edward Elgar Research Handbook on EU Property Law* (forthcoming), available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4103870.

[106]Bridge et al, above n 1, para 8-050.

[107]Although the precise claim is not made clear: Bridge et al, above n 1, para 8-050.

[108]Low and Mik, above n 24, at 148.

[109]See text to n 59 above.

[110]Cf N Walters 'Privacy law issues in public blockchains' (2019) 17 Canadian Journal of Law and Technology 276.

[111]*Millar v Taylor* (1769) 4 Burr 2301 at 2311.

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entry' can be interfered with. But this sounds very much like an exclusionary right protecting a rivalrous asset, being the UTXO or, as this paper proposes, the transactional ability that it represents. That is the kind of right generally regarded as being an *erga omnes* property right. In this way, the right differs from the content of copyright, which is a right to prevent particular forms of non-rivalrous exploitation, central to which is the act of reproduction.[112]

To this extent, the analogy between cryptoassets and copyright is unstable. It is suggested that the better view is to regard the right described by Low as one of the *property rights* enjoyed by an owner of property, rather than as itself being the *subject-matter* of those property rights. In other words, the legal right not to have the ability to transact interfered with is an incident of property in the cryptoasset, much like the right to possession is regarded as an incident of property in chattels.[113] It comes into existence not by established practice (as with common law copyright), but rather because of the prior characterisation of the cryptoassets as property. This avoids a problem of circularity: as Grantham and Rickett said, 'a proprietary right to a particular asset cannot be the event that generated that proprietary right in that asset'.[114] It should be emphasised that this paper does not disagree that cryptoasset owners enjoy a legal right to exclude interferences with their assets. But if that right arises as a consequence of the fact that the law has classified cryptoassets as property in the first place, then the existence of that right does not tell us what the subject-matter of the property right is. On the view advanced in this paper, that is a holder's 'transactional ability', which is given legal protection by its classification as property. In practical terms, little will turn on the difference between these two views, since an owner seeking to vindicate his or her proprietary rights will be primarily concerned with whether or not such legal protection exists (as opposed to the basis on which such rights arise). But analytically, the distinction has consequences for the inquiry that follows below.

3. The legal characterisation of blockchain transactions

Having set out this paper's proposed approach to framing the *res* in a cryptoasset, the next foundational issue to be investigated is whether that *res* is truly transferred in a blockchain transaction. While that may appear intuitively to be the case, there is an important alternative characterisation, on which each and every transaction – rather than effecting a true transfer – creates a new and distinct asset. The discussion below seeks to achieve two objectives. First, it demonstrates the significance of this question and how, on certain models of the *res*, it causes conceptual difficulties in the application of conventional title transfer rules. It then proposes that a blockchain transaction can nevertheless properly be understood as a true transfer, because whether or not a 'transfer' has occurred is a normative rather than a factual question.

(a) The significance of classification as a 'transfer'

The main significance of the present inquiry is that if a blockchain transaction is a '*res*-transferring' event, it is possible to proceed to the next stage of the inquiry, which is whether conventional rules of title transfer such as *nemo dat* and the currency exception apply.[115] Conversely, if a new asset is instead created upon every blockchain transaction, it is far harder to say that those conventional rules should apply. In that case, property in the asset would usually vest in the 'transferee' according to the rules of the system that created the asset. For example, the conventional position is that bank transfers create new items of property.[116] In consequence, even an avowedly void transaction is effective to vest legal

[112]See G Davies et al (eds) *Copinger and Skone James on Copyright* (Sweet & Maxwell, 17th edn, 2016) para 5-88.

[113]See AM Honoré 'Ownership' in AG Guest (ed) *Oxford Essays in Jurisprudence* (Oxford: Oxford University Press, 1961) pp 113–114.

[114]RB Grantham and CEF Rickett 'Property rights as a legally significant event' (2003) 62(3) Cambridge Law Journal 717 at 726.

[115]This is discussed in the next section.

[116]*R v Preddy* [1996] AC 815; D Fox *Property Rights in Money* (Oxford: Oxford University Press, 2008) para 5.22. The same is thought to be the case in a transfer of certificated or intermediated securities: see for example L Gullifer and J Payne *Corporate Finance Law: Principles and Policy* (Oxford: Hart Publishing, 3rd edn, 2020) para 9.2.6.2.

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title in the resulting bank debt in the recipient.[117] This stands in stark contrast to a void transaction under which ownership of a chattel is purportedly transferred, in which case title generally remains with the original owner.[118] If, therefore, blockchain transactions are characterised as *res*-creating rather than *res*-transferring events, legal title would presumptively vest in the recipient in any transaction. This led the UK Jurisdictional Taskforce to conclude that the traditional *nemo dat* rule would not apply to the sale of a 'stolen' cryptoasset.[119] On this view, blockchain transactions offer absolute dynamic security (albeit subject to equitable interests such as those generated by misrepresentation and fraud), a position which has been described as both unlikely and undesirable.[120]

As will be recalled, this paper contends that the subject-matter of the property right is an owner's 'transactional ability' to effect recognised transfers on the blockchain. With this in mind, the argument that a blockchain transaction extinguishes an existing asset and creates a new one appears persuasive at first glance. When a transaction is sent and validated on the blockchain, the fact of the transaction suggests that the original item of property (that very ability to transfer) is exhausted or 'spent' and a new item of property is created, which is the recipient's *new* ability to execute transfers in respect of that *new* cryptoasset. These difficulties do not arise on Low's conception of the *res* as a 'right to a registry entry', since the rules governing the transfer of a legal right need not take reference from the factual mechanism of a blockchain transaction.[121] On the other hand, Fox and the Law Commission regard blockchain transactions as *res*-creating events notwithstanding their data-centric formulation of the *res*.[122] The Law Commission, endorsing the views of the UK Jurisdictional Taskforce,[123] stated that the 'crypto-tokens prior to and following a transaction are … distinct and different data objects' because the 'functional or operational attribute of that manifested data is exhausted'.[124] For reasons given previously, this paper considers that on data-centric formulations of the *res*, it is incorrect to say that a blockchain transaction causes the original asset to be destroyed and a new asset to be created. Nonetheless, the Law Commission's views are illustrative of the attraction of the *res*-creating argument.

The Law Commission's subsequent reasoning also illustrates the thorny issues that consequentially arise. As explained above, the UK Jurisdictional Taskforce had earlier taken the view that since a blockchain transaction is a *res*-creating event, conventional rules of title transfer such as *nemo dat* should not apply to cryptoassets. The Law Commission disagreed. In its view, conventional title transfer rules could still apply to cryptoassets. To reach this conclusion, the Law Commission relied on a passage in Fox's *Property Rights in Money* saying that it would be 'justifiable to treat the incorporeal transfer [of money by means of an inter-bank payment] as involving a derivative means of acquiring title' to give 'full effect to the principle that the law should aim for functionally equivalent outcomes regardless of whether money is paid in corporeal or incorporeal form'.[125] But, as Fox explains in a later paragraph, these statements were simply meant to support the classification of bank transfers as derivative rather than original means of acquiring title.[126] In fact, Fox was at pains to emphasise that the 'originator's title is not transferred'[127] and that the 'beneficiary always takes the primary

[117]As held in *Trustee of the Property of FC Jones and Sons v Jones* [1997] Ch 159; see Fox, above n 116, para 5.102. The same conclusion is reached by numerous other writers: see B McFarlane and R Stevens 'The nature of equitable property' (2010) 4 Journal of Equity 1 at 22; L Smith 'Simplifying claims to traceable proceeds' (2009) 125 LQR 338 at 347.

[118]*Cundy v Lindsay* (1878) 3 App Cas 459. Cf M Smith and N Leslie *The Law of Assignment* (Oxford: Oxford University Press, 3rd edn, 2018) para 29.77.

[119]See the conclusion of the UK Jurisdictional Taskforce, above n 5, para 47.

[120]KFK Low 'Confronting cryptomania: Can equity tame the blockchain?' (2020) 14 Journal of Equity 240 at 254.

[121]See Low and Teo, above n 6, at 253.

[122]Fox, above n 6, para 6.18.

[123]UK Jurisdictional Taskforce, above n 5, paras 44–45.

[124]Law Commission, above n 4, para 12.14.

[125]Law Commission, above n 4, para 13.19 citing Fox, above n 116, paras 1.101, 1.106.

[126]Fox, ibid, para 5.05.

[127]Ibid, para 5.46.

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legal title to incorporeal money'.[128] Thus, unlike in respect of chattels, '[a] defect in the transaction between the originator and the beneficiary cannot prevent the beneficiary from taking the primary legal title to the money if the credit to his or her account is irrevocable'.[129] It is true that where the transaction is defective, the originator may still have a proprietary claim to those monies as the traceable product of the originator's funds.[130] However, such claims are generally equitable,[131] and in fact depend on legal title passing, which inquiry is wholly distinct from the former.[132] This simply underscores the point made here: traditional rules of title transfer applicable to property interests at common law do *not* apply to bank transfers. So the Law Commission's reasoning that those rules can apply to crypto-tokens even though it regards a blockchain transaction as a *res*-creating event must be regarded as suspect.

(b) Normative, rather than factual, transfers

This paper proposes a different solution to the problem. In accepting that a blockchain transaction creates a 'new' item of property, it has been assumed that whether something is 'new' or the 'same' for the purposes of property law is a factual question. But (and this is the key to the argument that follows) this is really a normative question. As Penner has explained, there are particular essential features that make a 'thing' what it is for the purposes of the law.[133] It is those essential features, according to Penner, that explain 'why the steak that [he] cooked and ate was the same steak [he] bought raw at the butcher's'.[134] Intuitively, some transformations should be regarded as sufficiently fundamental such that the old is destroyed and something new is created, while others are not. For example, 'if someone steals a painting from my wall and throws it into a fire, no legal system can pretend that, despite the immolation, the pile of ashes in the grate remains a Matisse'.[135] But whether or not the pile of ashes is the same *legal thing* as the Matisse is not a factual question but a normative one, the crux of which is whether the replacement has the essential features that make it the same 'thing'.

This point has been appreciated in relation to chattels through the law of *specificatio*, but hitherto escaped emphasis in the context of intangible property. This is probably explicable on the basis that many types of intangible property simply cannot be factually transferred without a concomitant conveyance of legal title. In the simple case of a debt or other contractual obligation, it usually follows from the provisions of the contract that only the obligee can give a good discharge.[136] Were a fraudster to effect a purported assignment of the debt without the obligee's knowledge, the would-be assignee would gain no rights against the obligor, and neither would the obligor gain a good discharge by rendering performance to the same.[137] It is said, therefore, that a debt cannot be 'stolen'.[138] This applies

[128]Ibid, para 5.74.

[129]Ibid, para 5.74.

[130]Ibid, paras 5.91–5.106.

[131]The decision in *Trustee of the Property of FC Jones and Sons v Jones* [1997] Ch 159 causes particular difficulty but even there Fox suggests that Mrs Jones there obtained 'primary legal title' to her balance at Raphaels while the trustee obtained a form of 'secondary title': see above n 116, para 5.103.

[132]For this reason, this paper focuses on the rules relating to legal title rather than the circumstances in which an equitable interest might arise over cryptoassets. For more detail on that subject, see Fox, above n 6, paras 6.58, 6.105; Tarrant, above n 13.

[133]See JE Penner 'On the very idea of transmissible rights' in JE Penner and HE Smith (eds) *Philosophical Foundations of Property Law* (Oxford: Oxford University Press, 2014) p 244 at p 252; JE Penner *Property Rights – A Re-Examination* (Oxford, Oxford University Press, 2020) pp 122–124.

[134]Penner (2020), ibid.

[135]Crawford, above n 66, p 15.

[136]S Douglas 'The scope of conversion: property and contract' (2011) 74(3) Modern Law Review 329 at 339–340.

[137]*Tai Hing Cotton Mill Ltd v Liu Chong Hing Bank Ltd* [1986] AC 80.

[138]AP Bell *Modern Law of Personal Property in England and Ireland* (London: Butterworths, 1989) p 8. So, for example, Crawford argues that in *OBG v Allan*, the purported settlements of liabilities owing to OBG by its invalidly appointed receivers were not binding on OBG, and should not have been accepted as valid by OBG's liquidator: Crawford, above n 66, p 14.

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likewise to certificated shares,[139] carbon credits[140] and other forms of statutory intellectual property rights.[141] In all of these cases, the effect of *nemo dat* is achieved by the rules which give the relevant intangible property legal existence: unauthorised transfers (regardless of whether they operate to transfer or extinguish the owner's original rights) are invalid because a third party simply cannot interfere with the owner's rights. Since there *cannot* be a factual transfer divorced from a legal transfer, there has been no reason for the law to analyse the effect of a factual transfer as distinct from its legal result. Further, the position in some instances is governed by express statutory language providing that the relevant assets are 'transmissible' (copyright)[142] or may be 'transferred' (as with statutory assignments and carbon credits).[143] But no such external rules govern cryptoassets, which are not, as Penner described conventional intangibles, 'inherently "exclusive"'.[144] To the contrary, the technological design of the system makes it entirely possible for a third party to achieve a factual transfer of cryptoassets regardless of the owner's corresponding intention. Moreover, where effected via blockchain transactions, such transfers factually operate to extinguish the owner's original cryptoasset and create a new cryptoasset at the recipient's address.

To determine whether the new cryptoasset is the same 'thing' as the original, in the absence of guidance in the context of intangible property, we must look to the doctrine of *specificatio*. This doctrine seeks to identify the essential characteristics of a 'thing' that persist through transformations such that it remains the same, rather than a new, 'thing', which is precisely the same endeavour now undertaken in relation to cryptoassets.[145] The Romans, from whom the doctrine of *specificatio* originated,[146] used a test of 'reducibility' or 'reversibility': if the new item could be reduced to its raw materials, property would remain with the owner of the materials; otherwise, property vested in the operator (the manufacturer).[147] But this approach is plainly ill-suited for modern conditions, since modern engineering makes it theoretically possible to reverse almost any type of transformation.[148] More recent authorities, although some still refer to the language of reversibility,[149] have resorted to asking whether the original materials remain 'separate and identifiable'[150] and looking at the 'obvious identity'[151] of the goods. Therefore, for example, plastic pellets had lost their original identity when converted into plastic containers, and it did not matter that they could theoretically be converted back into pellets.[152] According to Webb, '[w]hat appears to have evolved is a test that looks to a number of factors'.[153] In this multi-factorial test, '[t]he question is whether the goods have undergone a transformation'.[154] The court ultimately looks at whether the goods have become a 'qualitatively different thing', which inquiry is 'underpinned by economic realities'.[155]

This test is apt to be applied to determine whether the transformation of intangibles creates a new asset. The traditional reversibility test may be eliminated from consideration – already criticised in the

[139]*Davis v Bank of England* (1824) 2 Bingham 393 at 402.

[140]Low and Lin, above n 51, at 391, although *contra Armstrong*, above n 11.

[141]Low and Lin, above n 51, at 388.

[142]Copyright, Designs and Patents Act 1988, s 90(1).

[143]Law of Property Act 1925, s 136(1)(a); Low and Lin, above n 51, at 393.

[144]Penner (2020), above n 133, p 14.

[145]Indeed, Smith and Leslie, above n 118, suggest that the combination of two debts to create a single, larger debt is in fact a true case of *specificatio* and imply that it would be governed by the relevant rules: para 28.106.

[146]A Plisecka 'Accessio and specificatio reconsidered' (2006) 74 The Legal History Review 45.

[147]D Webb 'Title and transformation: who owns manufactured goods?' (2000) Journal of Business Law 513 at 523. Note, however, that property may not vest in the operator who is a wrongdoer: see Smith and Leslie, above n 118, para 28.99 ff.

[148]P Matthews '"Specificatio" in the common law' (1981) 1 Anglo-American Law Review 121; Webb, above n 147, at 523.

[149]See *Borden (UK) Ltd v Scottish Timber Products* [1981] Ch 25 at 46 per Buckley LJ: 'The manufacture had amalgamated the resin and the other ingredients into a new product by an irreversible process'.

[150]*Clough Mill Ltd v Martin* [1984] 3 All ER 982 at 994.

[151]*ICI New Zealand Ltd v Agnew* [1998] 2 NZLR 129.

[152]Ibid, at 134.

[153]Webb, above n 147, at 525.

[154]Ibid.

[155]Ibid.

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context of chattels, it becomes nonsensical in the context of intangibles, since every type of transformation would be reversible by effecting the equal and opposite transfer.[156] On the other hand, Webb's 'economic reality' test is particularly suitable for intangible assets. Such assets, being incapable of possession, cannot be physically enjoyed and are chiefly exploited for their economic value, to the extent that Merrill described the exchange value of property rights in intangibles as their only value.[157] Penner, who likewise acknowledges the importance of exchange value, argues that intangibles also have value in the inherent right of enforcement[158] – but no underlying right can be identified in the case of cryptoassets. It is natural, then, that the 'essential feature' which determines whether an intangible asset remains legally the same thing should be its economic nature. A crucial point is that this test successfully explains why bank transfers create new items of property.[159] Following a bank transfer from Alice to Bob, the original debt owed to Alice by her bank may have the same denomination as the new debt owed to Bob, but that is all they have in common. They are otherwise economically distinct because they are governed by the different terms and conditions that apply to Alice's and Bob's relationships with their respective banks. Moreover, the extinction and creation of those debts are not necessarily simultaneous: the new chose in action belonging to Bob comes into existence, not at the moment that Alice's account is debited, but at the moment that Bob has an 'unconditional and irrevocable right' against his bank to draw on the funds.[160]

The 'economic reality' test also provides the explanation for why a blockchain transaction involving cryptoassets is to be treated as a true *res*-transferring event. Where Alice transfers a UTXO in the sum of one Bitcoin to Bob, although the new UTXO at Bob's public address may technically be a new output, it has the same Bitcoin value and is economically and qualitatively identical to the original UTXO at Alice's public address. There is no backdrop of contractual relations between Alice or Bob and any third party; the blockchain regards cryptoassets as identical regardless of whether they emanate from Alice's or Bob's address. To this, one might object that cryptoassets are not in fact always fungible; 'tainted' coins, which are traceable to the proceeds of criminal conduct, pass at less than full market value.[161] So, if Alice's Bitcoin or Ethereum is mixed with 'tainted' coins at Bob's public address, the resulting asset is not economically identical to hers. But this is not a problem, since the change in economic value is a result not of the transfer but of the mixture of the Bitcoin or Ethereum at Bob's public address. In the result, it is suggested that the economic value in controlling the relevant 'transactional ability' (as reflected in the demand for these assets in the financial markets), which persists through the blockchain transaction, is the 'essential feature' that allows the law to treat the transferred asset as the same 'thing' as the original asset.

4. Title transfers

The preceding section has argued that a blockchain transaction effects the true transfer of the *res* in a cryptoasset. But, as previously explained, it does not necessarily follow that title in that *res* is transferred. Just as there are multiple situations where possession of a chattel may pass from one party to another without a transfer of ownership (as in the case of theft)[162] there may be situations where a cryptoasset is transferred via a blockchain transaction even though title does not pass to the transferee. Of course, if a blockchain transaction is a *res*-transferring event, the analogy between cryptoasset transfers and transfers of chattels becomes stronger. In particular, the characteristics of transferability and excludability programmed into the blockchain render the control over a cryptoasset exercised by the holder of a private key functionally similar to the control over a tangible asset

[156]For example, any transfer of bank money can easily be reversed by the participating banks.
[157]See TW Merrill 'Property and the right to exclude' (1998) 77 Nebraska Law Review 730.
[158]Penner (2020), above n 133, p 14.
[159]*R v Preddy*, above n 116.
[160]See eg *Momm v Barclays Bank International Ltd* [1977] QB 790.
[161]Fox, above n 6, para 6.20.
[162]Bridge et al, above n 1, para 31-002.

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exercised by the person in possession. For this reason, Fox suggests that ideas 'analogous to physical possession' have relevance in the context of the blockchain.[163] This analogy features prominently in the discussion below, which explores two key issues surrounding how conventional rules of title transfer might apply to cryptoassets: first, when does title pass at all? And secondly, to what extent do the *nemo dat* rule and its exceptions apply?

(a) When does title pass?

The fundamental rule of title transfer governs when title passes. In this regard, the intention of the transferor is always crucial. While contractual rights can be assigned in equity merely by the assignor expressing a 'final and settled intention to transfer the chose immediately to the assignee',[164] it is unlikely that a mere communication of this sort will suffice to transfer title in a cryptoasset. As Fox has said, a transfer via a blockchain transaction in the cryptoasset context is closely akin to the delivery of possession of chattels, where title is generally transferred only where there is an intention to transfer title coupled with delivery of possession.[165] Consequently, the general rule should be that title in a cryptoasset passes when a confirmed blockchain transfer is executed, such that the asset becomes associated with the transferee's public address, with the intention that title should pass. This conclusion is in line with Fox's view that if 'Bob had wrongfully used Alice's private key to activate the transfer to himself, then his title would be void at law and in equity'.[166] Other writers are similarly of the view that where cryptoassets are transferred in circumstances where the transferor does not intend title to pass, the transferor would retain the proprietary interest in the asset.[167] A further interesting extension of this issue is whether the general rule should be varied in the event of a sale of a cryptoasset. Under the Sale of Goods Act 1979, title passes when the parties to the contract intend it to pass, notwithstanding that delivery may have yet to be effected.[168] Obviously, the Act does not apply to cryptoassets, which are not 'goods'.[169] However, since the statutory presumptions were a codification of the common law,[170] there appears to be no reason why the courts cannot develop analogous principles in the context of intangibles like cryptoassets which are routinely bought and sold for money consideration.

(b) Nemo dat and its exceptions

The first rule discussed above tells us how title transfers work in two-party scenarios. When a third party is added, the second rule of title transfer becomes crucial: *nemo dat quod non habet* – no one can give what they do not have. This has been described as a rule that is 'applicable to all legally transferable rights'[171] and the 'basic rule' that underpins all forms of transfers of personal property'.[172] Given its universality, there is no reason the *nemo dat* rule should not apply to transfers of cryptoassets, and commentators have not suggested otherwise.[173] Consequently, in the event that Bob accesses

[163]Fox, above n 6, para 6.50.

[164]YK Liew *Guest on the Law of Assignment* (London: Sweet and Maxwell, 4th edn, 2021) para 3-13.

[165]Bridge et al, above n 1, para 30-001.

[166]Fox, above n 6, para 6.49.

[167]Law Commission, above n 4, paras 13.33–13.34; Chambers, above n 6, at 265.

[168]Sale of Goods Act 1979, s 17(1).

[169]Sale of Goods Act 1979, s 61(1): '"goods" includes all personal chattels other than things in action and money'. See Law Commission, above n 4, para 13.36.

[170]See Bridge et al, above n 1, para 19-037.

[171]Low and Teo, above n 6, at 244.

[172]Bridge et al, above n 1, para 31-002; S Worthington *Personal Property Law* (Oxford: Hart Publishing, 2000) p 220; ELG Tyler and NE Palmer *Crossley Vaines' Personal Property* (London: Butterworths, 5th edn, 1973) p 159.

[173]Fox, above n 6, para 6.48; Chambers, above n 6, at 265; KFK Low and E Teo 'Legal risks of owning cryptocurrencies' in D Lee and R Deng (eds) *Handbook of Blockchain, Digital Finance, and Inclusion: Cryptocurrency, FinTech, InsurTech, and Regulation* (London: Academic Press, 2017) p 225 at p 240.

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Alice's private key without her knowledge and transfers her Bitcoins to himself, Bob not only does not gain legal title (this follows from the first rule above), but he is unable to pass legal title to Carol, even if he subsequently transfers those Bitcoins to Carol via a valid blockchain transaction.

The more interesting and complex issue is the extent to which exceptions to the *nemo dat* rule operate. While numerous exceptions exist, they cannot be covered in detail here. This paper will therefore confine itself to two observations. First, the exception that is most obviously relevant in the context of cryptoassets is the currency rule, which provides that title in money is 'renewed whenever the money passes to a person who receives it in good faith and in return for a valuable consideration'.[174] With the exception of the Law Commission, which advocates the introduction of a general defence of good faith purchaser for value without notice to cryptoasset transactions,[175] commentators are generally agreed that the exception is unlikely to apply to cryptoassets. This is because, notwithstanding their styling as 'cryptocurrencies', cryptoassets have yet to become 'commonly accepted as alternative payment media alongside traditional currencies' (which is the view of both legal commentators[176] and industry players[177]). Further, the currency rule applies only where the money in question passes as currency,[178] which will not be the case insofar as cryptoassets like Bitcoin and Ethereum are traded as speculative assets.[179] These objections are weighty, and it is doubtful that a sufficient market practice has emerged to justify extending the defence to cryptoassets generally. However, the case for the exception to apply may be stronger in relation to so-called 'stablecoins' such as Tether and USDC. These cryptoassets are second-layer tokens which exist on blockchains with smart contract functionality such as Ethereum, and are designed to be pegged to the US dollar.[180] They are frequently used as an 'on-ramp' to purchase other cryptoassets such as Ethereum and Bitcoin.[181] Given that their denominations are pegged to the US dollar and they are often used to purchase other cryptoassets as speculative investments,[182] it is plausible that the application of the currency exception is warranted.

Secondly, many of the other exceptions to the *nemo dat* rule[183] find their basis in statutes dealing with tangible goods and therefore cannot be applied directly to cryptoassets. On this basis, the Law Commission assumes that the statutory exceptions to *nemo dat* would not apply.[184] However, that conclusion might be premature, since those statutes are generally accepted to represent a codification of the common law position at the time: as Bridge et al explain, the 'exceptions to the [*nemo dat*] rule grew up, firstly at common law and then, when the common law did not move fast or radically enough for the mercantile community, by statute'.[185] While there is no obvious single principle that runs through the exceptions, various themes can be identified, such as estoppel.[186] In view of this, it

[174]D Fox 'Bona fide purchase and the currency of money' (1996) 55 Cambridge Law Journal 547.

[175]Law Commission, above n 4, para 13.84.

[176]Fox, above n 6, para 6.61; Low and Teo, above n 173, p 241; for the rarer, contrarian view, see Chambers, above n 6, at 265, although the author does not discuss the issue in any depth.

[177]See L Abramowicz 'Mastercard sees crypto and data among ways to move beyond plastic' (*Bloomberg Finance*, 2 August 2022), available at https://www.bloomberg.com/news/articles/2022-08-02/mastercard-sees-crypto-and-data-businesses-as-growth-sectors, quoting Sachin Mehra, CFO of Mastercard Inc as saying that 'we view crypto more as an asset class'.

[178]*Moss v Hancock* [1899] 2 QB 111.

[179]Low and Teo, above n 173, p 241.

[180]See Tether 'Understanding Tether's peg and reserves' (23 May 2022), available at https://tether.to/en/understanding-tethers-peg-and-reserves/; Circle 'What is USDC?' (updated May 2022), available at https://developers.circle.com/developer/docs/what-is-usdc.

[181]See Abramowicz, above n 177; C Hicks 'What is Tether? How does it work?' (*Forbes*, 16 May 2022), available at https://www.forbes.com/advisor/investing/cryptocurrency/what-is-tether-usdt/.

[182]It is sometimes alleged that stablecoins are used to inflate the cryptoasset market: see S Reynolds 'Stablecoin issuer Tether ordered to produce documents showing backing of USDT' (*CoinDesk*, 21 September 2022), available at https://www.coindesk.com/markets/2022/09/21/stablecoin-issuer-tether-ordered-to-produce-documents-showing-backing-of-usdt/.

[183]Such as the mercantile agent exception and the buyer- and seller-in-possession exceptions. See generally Bridge et al, above n 1, ch 31.

[184]See the Law Commission, above n 4, para 13.36.

[185]Bridge et al, above n 1, para 31-002.

[186]Ibid, paras 31-013–31-014.

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does not seem that there is anything in principle preventing the common law from formulating analogous rules in the context of the sale of cryptoassets. One point that must be noted is that insofar as some of these exceptions are predicated upon a buyer or seller remaining in 'possession',[187] their applicability depends upon the law recognising some notion of quasi-possession or 'control' (as the Law Commission advocates)[188] in relation to cryptoassets, which issue lies beyond the remit of this paper.

Conclusion

This paper has sought to present a principled and robust case for the application of traditional title transfer rules to cryptoassets by incremental judicial reasoning. The issues canvassed, however, are but the foundational issues on which further debate may be built. This includes considerations of precisely what claims and remedies are available to vindicate the misappropriation of cryptoassets, the types of security that can be taken over cryptoassets, and the means by which judgments may be enforced in the face of the immutability and anonymity of the blockchain. It remains to await with excitement the legislative and judicial clarification that will ultimately determine how title disputes relating to cryptoassets are to be resolved.

[187]Sale of Goods Act 1979, s 24.
[188]Law Commission, above n 4, ch 11.

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