Chapter 3

Can permissionless blockchains be regulated and resolve some of the problems of copyright law?

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Introduction

In October 2018, the European Parliament passed a resolution (European Parliament resolution of 3 October 2018 on distributed ledger technologies and blockchains: building trust with disintermediation (2017/2772(RSP))) on distributed ledger technologies that recognised blockchains' potential to disrupt copyright. The aim of this chapter is to examine blockchain technologies and provide an assessment of their disruptive potential upon the legal sphere of intellectual property, and in particular copyright in the music industry. In order to do so, this chapter will start off by clarifying that *the* blockchain does not exist, because there are several different types of blockchains and, accordingly, different legal and regulatory issues. After identifying the type of permissionless blockchain that is analysed in this chapter, we move on to identify the definitional and non-definitional features of blockchain technologies. For the blockchain to unleash its disruptive potential, it must be clarified whether it complies with existing laws and whether new regulations are needed. Should existing regulations be found insufficient, only then could a serious discussion around new regulations be started, and it should take into account the necessity not to stifle innovation, the level of development of the relevant technologies, the importance of involving all the stakeholders, and the placement of the discussion at a supranational level. The focus of the chapter is to critically assess whether public permissionless blockchains can be used to disrupt intellectual property law by resolving some of the problems in copyright law, with particular regard to the issues of copyright registration and infringement. It will be shown how blockchains can resolve the registration issues by allowing forms of tamper-resistant, censorship-resistant, user-friendly, and privacy-friendly copyright registration. As to infringement, blockchains can prevent it by making it easier for copyright owners to track the use of their works and for music consumers to identify the owners, seek a license, and pay the royalties. It is perhaps too soon to conclude that a 10-year-old technology will ultimately disrupt copyright, but there already seem to have emerged some indications that the blockchains' features of being permissionless, distributed, transparent, without

a single point of failure, tamper resistant, and peer to peer will radically change copyright by fixing some of its more urgent problems.

Does *the* blockchain exist?

Arguably, *the* blockchain does not exist; there are several different types of blockchains, each with different legal issues.

This said, a good starting point is the technological overview presented by the US National Institute of Standards and Technology (NIST) in October 2018 (Yaga et al., 2018). Blockchains are defined as 'distributed digital ledgers of cryptographically signed transactions that are grouped into blocks'. After an agreement is reached on the validation of a new block, the latter is added to the chain and cryptographically linked to the previous one. The participants will notice if someone tries to tamper with a transaction inscribed in a block (tamper evidence), and the older a block is the more difficult it is to tamper with it (tamper resistance). The distributed character of the blockchains derives from the fact that every participant has a full copy of the chain, and 'new blocks' are replicated across copies of the ledger. However, not all blockchains are fully distributed. Indeed, a major distinction in this field is between permissionless blockchains and permissioned ones. The main example of the former is Bitcoin, where every user can view all the transactions, has a full copy of the chain, and in principle has the same power as the other participants (peer to peer). Permissioned blockchains, in turn, are not peer to peer, disintermediated, and fully transparent because there are administrators or consortia granting user permissions.

This chapter focuses on a permissionless blockchain that is open, distributed, peer to peer, transparent, tamper resistant and censorship resistant. The resistance to censorship derives from the lack of a central point of failure: being distributed, it is virtually impossible to take down content, because even if a node goes down, the rest of the network still stands (Sermpinis, 2018). The blockchain whose legal issues we are exploring is not, however, a Bitcoin-type blockchain. Indeed, even though we are referring to a permissionless technology, since we want to apply it to be multipurpose, we have in mind an Ethereum-type blockchain (Popper, 2017). The latter is Turing complete and therefore more versatile than the Bitcoin, which can be used only for simple transactions and does not allow users to build smart contracts – protocols to automatically execute actual contracts (Mik, 2017) – on top of it (Brent, 2018).

Core and non-definitional components of blockchain technologies

It is important to note that there are differing opinions as to which features of blockchain technology are strictly definitional and not subject to change (Fairfield, 2015). However, this chapter is of the opinion that 'blockchain technology' is actually an umbrella term for three distinct technologies combined, not

all of which will remain apparent in every deployment of blockchain-based applications (Maas, 2018).

The first of those three technologies is the blockchain itself, as a way to structure data. What makes a blockchain unique is its use of cryptography. By utilising certain cryptographic functions, a blockchain is able to create a persistent, tamper-evident record of any item of data and authenticate the identity of the parties involved in each transaction (UK Government Chief Scientific Adviser, 2017). Unsurprisingly, a blockchain is a definitional feature of blockchain technology that will be apparent in each and every blockchain application (Maas, 2017).

The second element is the network. Early applications of blockchain technology such as Bitcoin and Ethereum operate on a publicly visible, permissionless blockchain that is distributed across a peer-to-peer network (Bacon, 2018). In that, anything that happens on a blockchain is a function of the network as a whole. A network of computers known as 'nodes'[2] manage the network jointly, meaning that there is no central authority (Rosic, 2018). In this type of blockchain, anyone can become a node, and the entire contents of the blockchain are publicly visible. However, this is not to say that every application of blockchain technology will be this way. Distributed peer-to-peer networks or those that are public or permissionless may not be necessary or even permissible in certain circumstances. Alternative applications include networks that are 'private' or 'permissioned', where participation is limited to a certain group of users and can only be viewed by specified parties. It is often predicated that the blockchain is a trustless system[3] in that participants can transact without necessarily trusting each other and without intermediaries (e.g., banks). However, this can be said only with regards to permissionless blockchains. In permissioned blockchains, conversely, there is likely to be an aspect of trust among the users required as there will be some element of 'centralisation' (Bacon, 2018). Venture capital-backed Ripple is one example of a blockchain application that has amended the underlying technology to operate in an environment where a degree of trust is required for transactions to be validated (UK Government Chief Scientific Adviser, 2017). Governments are also exploring the idea of blockchains using a centralised trusted third party. Estonia, for example, has utilised blockchain technology since 2012 to help maintain the integrity of data across health, judicial, and legislative areas ('E-Estonia, 2018). For these reasons, this chapter considers public, permissionless distributed peer-to-peer networks to be a fundamental characteristic of early blockchain-based applications rather than a definitional feature that is apparent in all versions of blockchain technology. Nonetheless, when we do not specify otherwise, a reference to the blockchain must be understood as a reference to a permissionless distributed peer-to-peer network, since these characteristics have the potential to disrupt, or at least profoundly affect, the law, and copyright in particular.

The final component is the consensus mechanism, i.e., a 'process to achieve agreement within a distributed system on the valid state (the main consensus

mechanisms are proof of work, round robin, and proof of stake". The latter is used in Ethereum and can be either Byzantine fault-tolerant proof or chain-based).

Consensus is what enables the nodes in a distributed peer-to-peer network to work together without having to know or trust each other. The consensus mechanism is a set of rules that are agreed upon by the network of nodes running the software in which the rules regulate the addition of new blocks (Maas, 2018). These rules ensure consistency across the network and that participant/system behaviour is valid and appropriate (Bacon, 2018). Given that consensus mechanisms solve problems of trust in distributed peer-to-peer networks,[4] it follows that if the deployment of a blockchain application is anything other than distributed, such a consensus mechanism may not be required. Therefore, this chapter considers consensus mechanisms to be a fundamental characteristic of early applications that may change dependent on the purposes for which the technology is adopted, rather than a definitional feature apparent in all blockchain-based applications. Nonetheless, since the distributed character of the blockchain is likely to have a disruptive impact on the law and on copyright in particular, we will refer to blockchains using a consensus mechanism, unless stated otherwise.

To regulate or not to regulate: that is the question?

For the blockchains to unleash their potential in the music industry and beyond, the regulatory conundrum must be untangled. Overly restrictive regulation may stifle innovation, but the lack of any regulation may lead to legal uncertainty, which in turn would slow down the adoption of the blockchains (Telpner, 2018). The regulatory treatment of blockchain or of some of its aspects and applications will be a major factor in determining the level of success the technology will have regarding all its use cases. Given the importance of blockchains' regulation and music copyright being highly regulated, it is necessary to dig deeper and explore the regulatory treatment of blockchain in general.

The more blockchain becomes widespread, the more lawmakers develop an interest in regulating it. Most existing regulations, policies, and case law take a top-down approach and focus on Bitcoin and, accordingly, on evidence and tax issues.

For example, the EU Court of Justice exempted Bitcoin transactions from VAT because they regard only 'currency, bank notes and coins used as legal tender' (*Skatteverket v David Hedqvist Skatteverket v David Hedqvist*, Case C-264/14). For the focus on evidence, see Arizona Revised Statutes, 44–7061.

The most common approach, however, is to assess whether and how existing laws apply to the blockchains[5] and avoid the introduction of new regulations 'given that the technology is still evolving and practical applications are limited both in number and scope' (European Securities and Markets Authority, *Report The Distributed Ledger Technology Applied to Securities Markets* (ESMA, 2017) 4).

In the US, a similar 'wait-and-see' approach has been taken by the Federal Reserve Board, as well as the Federal Reserve Banks of New York and Chicago (see Mills, David, Kathy Wang, Brendan Malone, Anjana Ravi, Jeff Marquardt, Clinton Chen, Anton Badev, Timothy Brezinski, Linda Fahy, Kimberley Liao, Vanessa Kargenian, Max Ellithorpe, Wendy Ng, and Maria Baird (2016). 'Distributed ledger technology in payments, clearing, and settlement,' Finance and Economics Discussion Series 2016–095. Washington: Board of Governors of the Federal Reserve System, https://doi.org/10.17016/FEDS.2016.095. Cf., similarly, Financial Industry Regulatory Authority, *Distributed Ledger Technology: Implications of Blockchain for the Securities Industry* (FINRA, 2017)). Contrary to popular belief, blockchains are not a lawless technology; recent research underlined that we should abandon the naivety whereby blockchain transactions would be 'free from the travails of conventional law, thus offering the promise of grassroots democratic governance without the need for third-party intermediaries' (Yeung, 2019). Most of existing laws apply to the blockchains, but should new regulations be introduced, a participatory and holistic approach would be preferable. Indeed, it is important to involve all the stakeholders and keep in mind all the potential socio-legal issues if one wants to ensure that the blockchain unleashes its full potential and benefits all the players involved.

Bitcoin, the first and most widely used blockchain, set out to remove state institutions' influence on currency. Permissioned blockchains inherited the features of being intrinsically transnational and (potentially) state free, which begs the fundamental questions on whether it is at all possible to regulate them and, if so, how. These problems, however, are not new, since the Internet is transnational and yet is highly regulated. Recent research has showed that most of the physical world rules can be applied in cyberspace, though there is a clear problem concerning which authority can legitimately regulate it (Chris Reed and Andrew Murray, *Rethinking the Jurisprudence of Cyberspace* (Elgar 2018)). Bitcoin and blockchain have moved on from the cypherpunk days (Lopp, 2016), where the community using Bitcoin and the like were mostly made up of individuals with libertarian and anti-establishment political stances (Stankovic, 2018). Nowadays, Bitcoin has entered the mainstream, even becoming a legal payment method in Japan (Garber, 2017). Blockchain, in turn, has stepped out of Bitcoin's shadow and now offers a wide variety of potential use cases, some of which promise to be revolutionary (Swan, 2015). However, for blockchain to realise its full disruptive potential, it will need to appease the legal and regulatory environments in which it will operate ('Blockchain – Key Legal and Regulatory Issues' *Lexis PSL TMT*). Indeed, beyond cryptocurrency, blockchain has potential application across a number of heavily regulated industries, which have been designed without blockchain in mind. This may ultimately mean that the use of blockchain could be found to be incompatible with the current regulatory framework (Finck, 2017). If so, the uncertainty that this incompatibility inevitably creates will no doubt restrict innovation and ultimately prevent

large-scale adoption of blockchain into these areas. In order to successfully navigate these heavily regulated industries, it would seem necessary that regulation is seen as a tool to provide certainty for those involved in blockchain's development and encourage innovation rather than one used by the regulators to stifle it (where not otherwise specified, the term 'regulators' is used generically to refer to any lawmakers and regulators across jurisdictions, whether they operate a transnational, supranational, national or subnational level; 'Blockchain – Key Legal and Regulatory Issues' (n 35)). The problem does not apply, however, only to regulated industries but to all sectors where personal data is processed. Indeed, the EU General Data Protection Regulation (GDPR), which came into force in May 2018, introduces principles, obligations, and rights whose implementation can be difficult if at all possible in a blockchain context (Berberich, 2016; Herian, 2018). For example, data subjects have the right to rectify their personal data, but once the data is in the blockchain, it is virtually impossible to change it (Ibáñez, 2018; CNIL, *Blockchain*, *2018*).

Part of the literature is of the opinion that regulation of blockchain is inevitable, and in the end the community of developers will in fact welcome such regulation. According to this view, regulators will win the developers around by accepting creative solutions to achieve the right balance between protecting the relevant public interest objectives and stimulating innovation (Kevin, 2017). The rationale behind said opinion is based on the fact that the same scenario happened twenty years ago at the early stages of the Internet. The more recent phenomenon of the platform economy (Kenney, 2017) has also reinforced how this scenario plays out (Noto La Diega, 2016). Uber, for example, who were once notoriously reluctant to cooperate with regulators (Arvelo, 2018), have now actively sought regulatory intervention regarding insurance legislation that applies unanimously across the United States (Uber, 'Insurance Aligned', 2018), and as of March 2018, they have instructed insurance companies in order to comply with those requirements (Uber, 'An Update on Insurance', 2018).

If regulation is inevitable, the next question is how to regulate. Going forward, it would seem that successful regulation is dependent on a number of factors. First of all, the regulators need to learn from their past mistakes regarding other emerging technologies and be sure not to repeat them. Although blockchains remain an immature technology with evolving use cases, it is arguable that early regulatory acknowledgment and interest should be seen as positive, as it is important to be mindful of the negative impact that delayed interest in an emerging technology can have (as noted by Finck, (Finck, 2017), the early stages of the Internet's development suffered the negative impact of a delayed interest).

Second, successful regulation is not only dependent on the regulators themselves. Rather, the industry and those involved with the development of blockchain should also actively collaborate with each other and the regulators to tackle the complex challenges at hand (Finck, 2017). If those involved in the development of blockchain do decide to resist regulatory attempts, it is

suggested that '[i]f anything, the innovators stand to lose the most by delaying government involvement in adopting reasonable solutions' (Werbach, 2017).

The third factor concerns the level at which blockchain is regulated. Generally, regulators regulate the use of a technology as opposed to regulating the technology itself. However, blockchain's ever-growing use cases mean that regulators are finding it difficult to regulate ('Blockchain – Key Legal and Regulatory Issues' (n 35)). Yet some scholars suggest that this remains the best approach and claim that a use-case-focused approach is supported by the experience with other emerging technologies such as the Internet (Maupin, 2017). If such an approach is to be successfully adopted, the aforementioned collaborative effort of all the parties involved in that specific use case will be key. Not only that, the unpredictability of blockchain will require a flexible, open approach to each use case that will allow the law to develop as and when the technology does (Finck, 2017).

That being said, even if flexible, agile, use-specific regulation is developed, if that regulatory model is only applicable in one country, its positive impact may be limited. The distributed potential of blockchain, coupled with its intangibility, means that its application could operate simultaneously over multiple jurisdictions. This may mean that it is unclear who is performing the regulated activity. If this proves to be the case, regulators may struggle to determine whether or not a particular blockchain's activities need to be regulated, and if so, under which jurisdiction. Further, if something goes wrong, it may prove difficult to determine the precise location and identity of the culprit who is responsible for said breach or failure ('Blockchain – Key Legal and Regulatory Issues' (n 35)). Therefore, successful regulation will also require regulators to engage in transnational conversation and cooperation in an attempt to formulate some sort of consistent collaborative governance.[6] Although international conventions would appear the most suitable level of regulation, practically it is unlikely that an agreement will be reached and that, if reached, the rules will be fit for the blockchains or for the particular use that will be taken into consideration.[7]

In conclusion, no regulation is better than bad regulation. More evidence is needed to clarify whether existing regulations suffice when it comes to the blockchains. Should existing regulations be found insufficient, only then could a serious discussion around new regulations be started, and it should take into account the necessity of not stifling innovation, the level of development of the relevant technologies, the importance of involving all the stakeholders, and of placing the discussion at a supranational level. Only in this way can legal certainty be achieved and the blockchains unleash their disruptive potential.

The disruptive potential of blockchain on copyright law

Having defined blockchain technology and set out the technical and regulatory essentials, the rest of this chapter will concern the disruptive potential that

blockchain may have upon the legal sphere of intellectual property, using music copyright as a use case.

This section is focused on intellectual property and, in particular, copyright, i.e., the body of law that protects aesthetic and artistic creations such as literary, musical, dramatic, and artistic works.[8] Blockchain technologies can affect copyright in manifold ways, as recognised by the European Parliament's resolution of 3 October 2018 on distributed ledger technologies and blockchains: building trust with disintermediation. The EU resolution underscores that distributed ledger technologies can be used to track and manage intellectual property, thus facilitating copyright and patent protection.[9] It further acknowledges the technology's potential to develop artists' ownership through an 'open public ledger that can also clearly identify ownership and copyright''. It is then recognised that in collaborative and open innovation contexts (e.g., 3D printing), blockchain's capability to link creators to their works is of the utmost importance. Finally, authors can benefit from transparency and traceability in the use of their works as well as the smoothening of royalty distribution and increase in revenues that can be expected by cutting down on intermediaries. On the last point, it is important to critically note that blockchain's promise to eliminate traditional intermediaries is unlikely to be fulfilled (O'Dair, 2016). Evidence of the trend towards re-centralisation is the investment of traditional intermediaries in the blockchain (PRS for Music, 2018) and the rise of permissioned blockchains, where the disintermediation is only partial (Bacon, 2018).

Although it is still unclear whether blockchains will revolutionise copyright, it can be argued that they can resolve some of the issues that affect this body of law and the relevant industries, with particular regards to copyright registration, infringement, management,[10] and transactions.[11] For the sake of brevity, this section will focus on how, if at all, the type of blockchain described earlier can resolve some of the problems of copyright registration and infringement (popularly known as 'piracy').

Blockchains for a privacy-friendly, agile, tamper- and censorship-resistant registration

One of the main innovations brought by the Berne Convention[12] has been that copyright arises with the creation of the work (e.g., once a book has been written) without the need for any formalities, i.e., systems of public registration (Berne Convention, art 5(2)). Such formalities enabled governments to control ex ante the contents of the books, thus enabling them to censor those works that went against the governmental policies or the dominant ethical values (Mann, 2016). The abolition of registration formalities is positive because it favours the authors by making copyright easily obtainable and by reducing the opportunities for governments to censor them. However, without registration there are evidentiary problems in copyright infringement proceedings, because it is hard to prove who created what and in which moment in time.[13] For example, if John shares without Jerry's permission a picture the latter had

posted on Instagram, how does Jerry prove that he created said work (the picture), that he did it before John, and that he is the sole legitimate author and owner? To resolve these kinds of problems, some countries such as the US effectively sidestepped the Berne Convention and *de facto* reintroduced the copyright registration. Indeed, even if copyright arises with the creation of a work, in infringement proceedings, statutory damages and attorney's fees will not be awarded in the absence of registration.[14] In the UK, there is no such limitation, but without registration said evidentiary issues remain. Therefore, new registration mechanisms have been introduce to ensure evidence; however, they often are a burden for the author (e.g., they are expensive and not user friendly), and they can be forged; particularly with paper ledgers there is a 'high level of forgery' (UK Government Chief Scientific Adviser (n 11) 7). Alongside the problems of censorship, forgery, and lack of user friendliness, existing registration systems are open to criticism from a privacy perspective. This is the case in the US, where rules of procedure of the Copyright Office and attitudes of the US District Courts make it very hard for pseudonymous and anonymous authors to be successful in infringement lawsuits (Bell, 2016).

All these problems can be resolved through a blockchain-enabled copyright registration. Indeed, a blockchain platform could issue a token, which would serve as proof of authenticity, in which a timestamped copyright registration is contained. Arguably, such a disruptive system would enable a cheaper, more transparent, and more user-friendly registration (Buntinx, 2018) – as noted by Savelyev (2018), 'blockchain can introduce long-awaited transparency in matters of copyright ownership chain'. Thus, the problem of forgery also would be addressed, considering that the blockchain is tamper resistant.[15] Moreover, one of the key features of permissionless blockchains is that they have no single point of failure. Therefore, if an author deposited a work to register it and a government wanted to take it down for censorship purposes, this would be practically impossible[16] because '(e)ven if several nodes failed, the network would still continue to function' (Bacon, 2018), and the work would still be available, since all data is maintained by all nodes.[17] Finally, moving on to anonymous and pseudonymous authors' privacy, a public, permissionless blockchain distributed across a peer-to-peer network may resolve their problems by providing robust digital pseudonyms, 'a mask that, while hiding (the author's) real identity, would nonetheless be unique to him or her' (Bell, 2016).

A blockchain registration would be optional, thus complying with the Berne Convention, and it would ensure the benefits of traditional registration in terms of evidence in infringement proceedings whilst preventing its drawbacks in terms of costs, forgery, censorship, and privacy.

Blockchains and copyright infringement: an ambiguous relationship

Copyright infringement, popularly known as 'piracy', is a widespread issue, as exemplified by the fact that 53 percent of young users access music illegally[18]

and by the fact that new intermediaries such as Spotify often make available music without its owners' consent, allegedly because they do not know who the owners are.[19] Copyright infringement thrives for a number of reasons, two of which can be addressed by blockchain. The first one is that it is difficult for copyright owners to track the use of their works. Once a song is published, the owners currently have limited or no means to know who is accessing it and how. The problem is exacerbated by the sharing practices that are becoming commonplace in the time of social media. Indeed, it can be said that we live in the sharing society,[20] where sharing copyright material is easy, particularly on social networking sites, e.g., by retweeting someone's tweet which, in turn, had retweeted someone else's tweet.[21] This means not only that many people infringe copyright, possibly without being aware of it, but also that after repeated sharing and linking it is difficult to track back who was the original owner. Ultimately, the difficulty for copyright owners to track the use of their contents decreases the incentives to access contents legally, since end users have the reasonable expectation that the owners cannot track the consumption of their content, and therefore, they cannot enforce their rights.

The second reason why copyright infringement is so common, particularly in the music industry, is that it is often impossible to know who the author and owner is.[22] This is because there is not a requirement to register copyright, and, more importantly, because of the lack of a single updated database of music metadata. Music metadata are data about who did what in music. Music metadata are fragmented in databases that do not sync and that are owned by corporations with conflicting views about what should be public and what should, in turn, be kept private (DA Wallach, 2014). Music ownership is extremely complex for legal and business reasons. On the one hand, under the Copyright, Designs and Patents Act 1988[23] – the main UK statute on copyright – a single song has at least three owners, i.e., the author of the lyrics, the author of the music, and the producer of the sound recording. From a business point of view, music is a collaborative enterprise; indeed, most 'recorded music is a collaboration between songwriters, singers, musicians, producers, recording engineers, mastering specialists' (DA Wallach, 2014). All these subjects and other new intermediaries such as Spotify and iTunes have a stake in the industry and some expectations in the distribution of music's revenues. For these reasons, the artists receive only a limited share of the revenues and only after a long time (Heap, 2016). If artists are finally paid a slice of the 'royalties cake', this reaches them between six and eighteen months after the publication (Heap, 2016). The problem of music's attribution and royalty distribution are not new, but they are made worse by new technologies and new ways of consuming musing. While at the time of vinyl records and CDs it was easy to understand who contributed and how, iTunes, Spotify, etc., create a credits conundrum where the listener knows only who the singer is and nothing else. A final reason why identifying copyright owners (and rewarding them) is difficult is that even though there is a presumption the author (of the music, of the lyrics, etc.) is the owner of the relevant work,[24] this is often not

the case, either because the work had been made in the course of employment and therefore is owned by the employer or because ownership has been transferred to third parties by means of a contract of copyright assignment. These contracts are often accompanied by the so-called paternity waiver, whereby the author gives up their right to be acknowledged as the author.[25] If copyright paternity can be waived, it is likely that it will be, because the relevant relationships in many creative industries are often characterised by an imbalance of bargaining power (one needs to keep in mind that the industry tends to 'oblige authors and artist to enter standard-form contracts that require them to waive their integrity rights' (Lionel Bently and Brad Sherman, *Intellectual Property Law* (4th ed, OUP 2014) 290)). For all these reasons, music is often consumed without the owners' permission, and the system does not reward artists sufficiently and in a timely manner, if at all.

Permissionless blockchains could tackle both issues. A blockchain-based music platform such as Mycelia can allow artists to issue a token that can be transferred only when the owner signs off on the transaction with their private key. This disincentivises end users from accessing music illegally. As to the music metadata's conundrum, a public, permissionless blockchain distributed across a peer-to-peer network may resolve the problems of copyright infringement by enabling the creation of a global updated database of music metadata. The blockchain could be the backbone of a decentralised, open-source global platform, *controlled* by no single entity, and with the potential to contain accurate, real-time, global data encompassing credits and rights ownership (Wallach (n 85)). As noted by some scholars, most copyright registry are territorial, but the creation of a global registry would not require governments to trust other government or third parties, '(r)ather, trust can be placed in the mathematical certain provided by blockchain technology' (Wright, 2015). Moreover, blockchain could be a technological means to practically nullify the practice of imposing paternity waivers, thus contributing to fixing the structural imbalance of power of the creative industries, music included. Once recorded in a blockchain platform, no one could contest the authorship and ownership.

In making it easier to access copyright content legally, the blockchain can prevent copyright infringement. At the same time, however, it can constitute a problem because, in light of the distributed nature of the blockchain and its lack of single point of failure, infringing content cannot be taken down: once it is on the blockchain, it is stored in every node, potentially forever.[26] In recent years, the prevailing way that copyright owners react to copyright infringement is not bringing lawsuits against the end users or the actual infringer but targeting the intermediaries that enable said infringement (e.g., the Internet service providers, such as BT or Sky).[27] However, in permissionless blockchains, in principle, there are no intermediaries or, better, the latter have a different, more elusive identity. The virtual impossibility of removing a file once on the blockchain and the inherent disintermediation is likely to make it difficult to

enforce copyright. However, the disruptive potential of the blockchain may manifest itself in preventing infringement altogether by allowing copyright owners to track the use of their works and by powering a global updated database of music metadata, which will make royalty distribution smoother and fairer.

Conclusions

The blockchain, at least in its permissionless form, has the potential to disrupt copyright law by resolving two of its problems, namely registration and infringement.

Currently, there are no reliable registers of copyright ownership, which creates problems of evidence, because it is difficult for claimants to prove the link between them and the infringed work, as well as to prove the time of creation. Current registration systems are prone to forgery, can be used as a means of censorship, are cumbersome, and are unfavourable to anonymous authors. A blockchain-based registration mechanism would resolve this problem by providing the means for a tamper-resistant, censorship-resistant, user-friendly, and privacy-friendly platform.

As to copyright infringement or piracy, this is on the rise because owners cannot track the use of their works and because it is often difficult to know who the owners are, which in turn makes it virtually impossible to seek a license and pay the royalties. However, using the blockchain, artists could decide to transfer music by transferring a token signing off on the transaction with their private key. No unauthorised use would be possible. The blockchain, moreover, would allow the creation of global, constantly updated music metadata that would make it easier to find and reward the copyright owners.

It is too early to assess whether blockchains will disrupt the music industry and fix all the problems of copyright, a body of law whose inadequacy for the digital age is striking (on the compatibility of the blockchain with some copyright principles see Bodó, B., Gervais, D., and Quintais, J. P. (2018). Blockchain and smart contracts: the missing link in copyright licensing? *International Journal of Law and Information Technology*, *26*(4), 311–336). From this analysis, however, it would seem that blockchains could contribute to the resolution to some problems encountered by copyright owners and authors. In order to succeed, these potential solutions must be accompanied by a twofold caveat. First, the immature blockchain technology must overcome its technical issues to prove, beyond doubt, that it is a better proposition than the technology it is replacing. Second, it will have to appease the current regulatory framework to allow these technological advancements to achieve large-scale adoption. Whilst new regulations are not necessarily the best way forward, regulators should work closely with law academics and industry stakeholders to clarify how existing laws apply to this new technology. Indeed, without legal certainty, the blockchains are unlikely to unleash their disruptive potential.

Notes

1 The authors are grateful to the anonymous reviewers for their helpful comments. Nonetheless, the responsibility for any errors and opinions rests with the authors. This chapter has been a collaborative enterprise, but Guido Noto La Diega is responsible for the legal sections and James Stacey for the technical ones.
2 These are the computers that are connected to the blockchain network. All blockchain-based applications are made up of nodes. However, who can become a node and the level of involvement that is permissible by each node will differ depending on the type of blockchain application deployed. Nodes store a local copy of the blockchain. 'Full' nodes store a copy of the blockchain in its entirety, while 'light' nodes only hold a portion of the blockchain needed to verify transactions (Bacon (n 14) 11).
3 Yaga (n 2) 38 underlines, however, that trust is needed even in supposedly trustless systems, e.g., trust in the cryptographic technologies and that users are not colluding in secret. For other critical remarks, see Carl, Uggla, and Hallström Carl-Johan, 'Is It as Trustless as They Say?: A Functional Analysis of the Blockchain and Trust' (2018).
4 Consensus mechanisms, however, do not always lead to correct execution results, because participants may be affected by economic interests in the smart contracts, as pointed out by Chen, L., Xu, L., Gao, Z., Lu, Y., & Shi, W. (2018). 'Tyranny of the Majority: On the (Im)possibility of Correctness of Smart Contracts'. *IEEE Security & Privacy*, 16(4), 30–37.
5 In the UK, for example, the Financial Conduct Authority believe that most initial coin offerings (ICOs) are unregulated, but they take a case-by-case approach to decide whether ICOs fall within their remit – Financial Conduct, Consumer warning about the risks of Initial Coin Offerings ('ICOs') (FCA, 2017).
6 Peter Yeoh, 'Regulatory Issues in Blockchain Technology' (2017) 25 *JFRC* 196, 200.
7 On the problem of 'legal hysteresis', i.e., the delay with which innovation is necessarily regulated, see Roberto Pardolesi, '"Software", "property rights" e diritto d'autore: il ritorno dal paese delle meraviglie'. (1987) 3, II *Foro it*., 300. The idea was applied to copyright regulation by Guido Noto La Diega, 'In Light of the Ends. Copyright Hysteresis and Private Copy Exception after the British Academy of Songwriters, Composers and Authors (BASCA) and others v Secretary of State for Business, Innovation and Skills Case'. (2015) no. II *Diritto Mercato Tecnologia* 1–16.
8 Charlotte Waelde, Abbe Brown, Smita Kheria, and Jane Cornwell, *Contemporary Intellectual Property* (OUP 2016), 3.
9 2017/2772(RSP), para 22.
10 The blockchain can smoothen royalty distribution by decreasing the role of traditional intermediaries, though one can doubt that the middleman will actually be eliminated. There are a number of reasons that suggest that the blockchain will not get rid of intermediaries. These include the fact that traditional intermediaries are substantially investing in the blockchain and the fact that the enforcement of copyright online tends to target the intermediaries rather than the end users; therefore, lawmakers and courts have a strong interest in keeping the middlemen in the loop.
11 Copyright transactions can be secured thanks to blockchain-based smart contracts. However, it can be argued that these self-executing protocols are neither 'smart' nor 'contracts', and this has practical legal consequences. The fact that contracting parties using smart contracts (and smart licenses) do not have the flexibility to breach the contract risks limiting the practical impact of this application of the blockchain to very simple and routinary transactions. The efficient breach doctrine is evidence that, in most jurisdictions, the legal systems protect the fundamental right of contracting parties to change their mind and reallocate the resources in a more efficient way by breaching the contract. Society and law are built upon the assumption that individuals can change their mind, and this does not seem to be reflected in the lack of flexibility of this new technology.

12 Berne Convention for the Protection of Literary and Artistic Works of September 9, 1886, completed at Paris on May 4, 1896, revised at Berlin on November 13, 1908, completed at Berne on March 20, 1914, revised at Rome on June 2, 1928, at Brussels on June 26, 1948, at Stockholm on July 14, 1967, and at Paris on July 24, 1971, and amended on September 28, 1979.
13 It should be kept in mind that copyright is not a monopoly; therefore, the independent creation of identical works does not constitute infringement. For infringement to occur, the claimant needs to prove that the defendant carried out a restricted act (e.g., made a copy of the book, picture, etc.) with regards to the whole or a substantial part of the work, and there is a causal connection between the claimant's work and the defendant's one. The latter requirement means that either there is direct evidence of copying or this can be inferred from the similarities between the works and the opportunity to copy. See the UK Copyright, Designs Patents Act 1988, s 16.
14 US Copyright Office, Circular 1, *Copyright Basics*, section 'Copyright Registration'.
15 Nonetheless, the blockchain is not absolutely immutable, as proved by the DAO breaking the rules of their blockchain in order to react to some hackers exploiting a bug in the code. On this matter and its implications see O'Hara, K. (2017). 'Smart contracts-dumb idea'. *IEEE Internet Computing*, 21(2), 97–101.
16 This circumstance, coupled with the disintermediation that may come with the adoption of the blockchain, would make copyright enforcement very complicated, since the trend in recent years has been to target intermediaries rather than end users. The most obvious example of this is constituted by the injunctions against ISPs, for instance, in the event of illegal download of music or videos.
17 This depends on the type of blockchain; for instance, it does not apply to permissioned blockchains.
18 'Share of Global Internet Users Who Access Music Through Copyright Infringement as of 2017, by Age Group'. *Statista* (2018) <www.statista.com/statistics/609114/music-copyright-infringement-by-age/> accessed 5 December 2018. A more general empirical analysis of intellectual property infringement can be found in European Intellectual Property Office, *Synthesis Report on IPR infringement 2018* (EUIPO 2018). This is not to say that copyright infringement is always and necessarily a negative thing, as proved by ECORYS, *Estimating displacement rates of copyrighted content in the EU* (European Commission 2017).
19 Therefore, Spotify had to pay $112 million USD to songwriters in the settlement of *Ferrick, et al. v. Spotify USA Inc., et al.*, No. 16-cv-8412 (AJN) United States District Court, S.D. New York.
20 'All Eyes on the Sharing Society'. *World Intellectual Property Review* (March/April 2015) <www.rightsdirect.com/wp-content/uploads/sites/6/2015/04/WIPR-Kim-Zwollo-04-2015.pdf> accessed 30 May 2018.
21 On the matter of copyright on 'tweets' and infringement by retweeting see R. Haas, 'Twitter: New Challenges to Copyright Law in the Internet Age'. (2010) *J Marshall Rev Intell Prop L*, *10* i.
22 In principle, the author is the first copyright owner of the relevant work, but there are some exceptions, the main one being works created by employees in the course of employment. See the UK Copyright, Designs and Patents Act 1988, s 11.
23 Copyright, Designs and Patents Act 1988, ss 3(1), 5A, and 10A.
24 Copyright, Designs and Patents Act 1998, s 9.
25 Copyright, Designs, and Patents Act 1988, s 87(2). In many civil law jurisdictions such waivers are not enforceable; see French *Code de la propriété intellectuelle*, art L. 121–1 and *Huston v TV5, Cour de Cassation, Chambre civile* 1, 28 May 1991, 89–19.522 89–19.725 [1991] RIDA 149, 197, where the French Supreme Court stated that moral rights are a matter of public policy, and therefore, waivers that were lawful under US copyright law were not enforceable in France.

26 The difficulty of taking down content is likely to have significant consequences even beyond copyright. One need only think of the research that found child porn links on a blockchain which begs the question whether all participants can be held liable for illegal content on the blockchain (Matzutt, R., Hiller, J., Henze, M., Ziegeldorf, J. H., Müllmann, D., Hohlfeld, O., and Wehrle, K. (2018). A Quantitative Analysis of the Impact of Arbitrary Blockchain Content on Bitcoin. In *Proceedings of the 22nd International Conference on Financial Cryptography and Data Security* (FC) (Springer).

27 In the UK, the trend of addressing copyright infringement by targeting Internet service providers and other intermediaries, as opposed to the end user or the primary infringer, can be seen in Dramatico v BSkyB (2012) EWHC 268 (Ch); Paramount & Others v British Sky Broadcasting (2013) EWHC 3479; 1967 Ltd v BSkyB, BT and others (2014) EWHC 3444. In the EU, see e.g. UPC Telekabel Wein v Constantin Film Verleih (C-314/12) (2014) EC.D.R. 12; Svensson & others v Retriever Sverige AB (C-466/12) (2014) All ER 609 (EC); GS Media BV v Sanoma Media Netherlands (C-160/15) (8 September 2016).

Bibliography

Case law

1967 Ltd v BSkyB, BT and others [2014] EWHC 3444.

Dramatico v BSkyB [2012] EWHC 268 (Ch).

Ferrick, et al. v Spotify USA Inc., et al., No. 16-cv-8412 (AJN) United States District Court, S.D. New York.

GS Media BV v Sanoma Media Netherlands (C-160/15) ECLI:EU:C:2016:644.

Huston v TV5, Cour de Cassation, Chambre civile 1, 28 May 1991, 89–19.522 89–19.725 [1991] RIDA 149.

Paramount & Others v British Sky Broadcasting [2013] EWHC 3479.

Skatteverket v David Hedqvist Skatteverket v David Hedqvist (Case C-264/14) ECLI:EU:C:2015:718.

Svensson & others v Retriever Sverige AB (C-466/12) [2014] All ER 609 (EC).

UPC Telekabel Wein v Constantin Film Verleih (C-314/12) [2014] EC.D.R. 12.

Books

Pilkington, M., 'Blockchain Technology: Principles and Applications.' In Olleros, F. and Zhegu, M. (eds.), *Research Handbook on Digital Transformations* (Edward Elgar 2016).

Reed, C. and Murray, A., *Rethinking the Jurisprudence of Cyberspace* (Elgar 2018).

Swan, M., *Blockchain: Blueprint for a New Economy* (1st edn, O'Reilly & Associates 2015).

Waelde, C., Brown, A., Kheria, S., and Cornwell, J., *Contemporary Intellectual Property* (OUP 2016).

Reports and white papers

Commission nationale de l'informatique et des liberté, *Blockchain. Premiers éléments d'analyse de la CNIL* (CNIL 2018).

ECORYS, *Estimating Displacement Rates of Copyrighted Content in the EU* (European Commission 2017).

European Intellectual Property Office, *Synthesis Report on IPR Infringement 2018* (EUIPO 2018).

European Securities and Markets Authority, *Report the Distributed Ledger Technology Applied to Securities Markets* (ESMA 2017).

Financial Conduct Authority, *Consumer Warning About the Risks of Initial Coin Offerings ('ICOs')* (FCA 2017).

Financial Industry Regulatory Authority, *Distributed Ledger Technology: Implications of Blockchain for the Securities Industry* (FINRA 2017).

Mills, D., Wang, K., Malone, B., Ravi, A., Marquardt, J., Chen, C., Badev, A., Brezinski, T., Fahy, L., Liao, K., Kargenian, V., Ellithorpe, M., Ng, W., and Baird, M., 'Distributed Ledger Technology in Payments, Clearing, and Settlement.' *Finance and Economics Discussion Series 2016–095* (Washington: Board of Governors of the Federal Reserve System, 2016) <https://doi.org/10.17016/FEDS.2016.095>.

O'Dair, M. et al., *Music on the Blockchain* (Blockchain For Creative Industries Research Cluster, Middlesex University 2016).

Telpner, J., *The Lion, the Unicorn, and the Crown: Striking a Balance Between Regulation and Blockchain Innovation* (Blockchain Research Institute 2018).

UK Government Chief Scientific Adviser, *Distributed Ledger Technology: Beyond Block Chain* (Government Office for Science 2017).

Yaga, D., Mell, P., Roby, N., and Scarfone, K., *Blockchain Technology Overview* (NIST 2018).

Journal articles

Bacon, J. et al., 'Blockchain Demystified.' Queen Mary University of London, School of Law Legal Studies Research Paper No. 268/2017 (2018) <https://ssrn.com/abstract=3091218> accessed 29 January 2018.

Bell, T.W., 'Copyrights, Privacy, and the Blockchain' (2016) 42 *Ohio Northern U L Rev* 439, 464.

Berberich, M. and Steiner, M., 'Blockchain Technology and the GDPR – How to Reconcile Privacy and Distributed Ledgers.' (2016) 2 *Eur Data Prot L Rev* 422, 426.

Bodó, B., Gervais, D., and Quintais, J.P., 'Blockchain and Smart Contracts: The Missing Link in Copyright Licensing?' (2018) 26 (4) *International Journal of Law and Information Technology* 311–336.

Brent, L., Jurisevic, A., Kong, M., Liu, E., Gauthier, F., Gramoli, V., Holz, R., and Scholz, B., 'Vandal: A Scalable Security Analysis Framework for Smart Contracts.' arXiv preprint arXiv:1809.03981 (2018).

Carl, U. and Carl-Johan, H., 'Is It as Trustless as They Say?: A Functional Analysis of the Blockchain and Trust.' Thesis (2018).

Chen, L., Xu, L., Gao, Z., Lu, Y., & Shi, W., 'Tyranny of the Majority: On the (Im) Possibility of Correctness of Smart Contracts.' (2018)16 (4) *IEEE Security & Privacy* 30–37.

DA Wallach, 'Bitcoin for Rockstars' (Wired, 12 October 2014) <http://www.wired.com/2014/12/bitcoin-for-rockstars> accessed 1 June 2018.

Fairfield, J., 'Bitproperty.' (2015) 88 (4) *SCL Rev* 805.

Finck, M., 'Blockchain and Data Protection in the European Union.' Max Planck Institute for Innovation and Competition Research Paper No. 18–01 2 (2017) <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3080322> accessed 22 March 2018.

Finck, M., 'Blockchain Regulation.' Max Planck Institute for Innovation and Competition Research Paper No. 17–13 (2017) <https://ssrn.com/abstract=3014641> accessed 26 March 2018.

Haas, R., 'Twitter: New Challenges to Copyright Law in the Internet Age.' (2010) 10 *J Marshall Rev Intell Prop L* i.

Herian, R., 'Regulating Disruption: Blockchain, GDPR, and Questions of Data Sovereignty.' (2018) 22 (2) *Journal of Internet Law* 1.

Ibáñez, L.-D., O'Hara, K. and Simperl, E., 'On Blockchains and the General Data Protection Regulation.' (2018).

Imogen Heap and Don Tapscott, 'Blockchain could be Music's next Disruptor' (*Fortune*, 22 September 2016) <http://fortune.com/2016/09/22/blockchain-music-disruption> accessed 1 June 2018.

Kenney, M. and Zysman J., 'The Rise of the Platform Economy.' (2016) 32 (3) *Issues in Science and Technology*.

Kevin, W., 'The Song Remains the Same: What Cyberlaw Might Teach the Next Internet Economy.' (2017) 69 (3) *Florida Law Review* 887.

Li, J., 'Data Transmission Scheme Considering Node Failure for Blockchain.' (2018) *Wireless Personal Communications*.

Mann, A.J., 'The Anatomy of Copyright Law in Scotland Before 1710.' In Alexander, I. and Tomás Gómez-Arostegui, H. (eds.), *Research Handbook on the History of Copyright Law* (Elgar 2016), 99.

Matzutt, R., Hiller, J., Henze, M., Ziegeldorf, J. H., Müllmann, D., Hohlfeld, O., and Wehrle, K., 'A Quantitative Analysis of the Impact of Arbitrary Blockchain Content on Bitcoin.' In *Proceedings of the 22nd International Conference on Financial Cryptography and Data Security (FC)* (Springer 2018).

Maupin, J., 'Mapping the Global Legal Landscape of Blockchain Technologies.' (2017) 149 *CIGI Papers*.

Mik, E., 'Smart Contracts: Terminology, Technical Limitations and Real World Complexity.' (2017) 9 (2) *Law, Innovation and Technology* 269–300.

Noto La Diega, G., 'In Light of the Ends. Copyright Hysteresis and Private Copy Exception After the British Academy of Songwriters, Composers and Authors (BASCA) and others v Secretary of State for Business, Innovation and Skills Case.' (2015), no. II *Diritto Mercato Tecnologia* 1–16.

Noto La Diega, G., 'Uber Law and Awareness by Design. An Empirical Study on Online Platforms and Dehumanised Negotiations.' (2016) no. II *Revue européenne de droit de la consommation/European Journal of Consumer Law* 383–413.

O'Hara, K., 'Smart Contracts-Dumb Idea.' (2017) 21 (2) *IEEE Internet Computing* 97–101.

Pardolesi, R., '"Software", "property rights" e diritto d'autore: il ritorno dal paese delle meraviglie.' (1987) 3, II *Foro it*. 300.

Savelyev, A. 'Copyright in the Blockchain Era: Promises and Challenges.' (2018) 34 (3) *Computer Law & Security Review* 550–561.

Sermpinis, T. and Sermpinis, C., 'Traceability Decentralization in Supply Chain Management Using Blockchain Technologies.' arXiv preprint arXiv:1810.09203 (2018).

Werbach, K. and Cornell, N., 'Contracts Ex Machina.' (2017) 67 (2) *Duke Law Journal* 313.

Yeoh, P., 'Regulatory Issues in Blockchain Technology.' (2017) 25 JFRC 196.

Yeung, K., 'Regulation by Blockchain: The Emerging Battle for Supremacy Between the Code *of* Law and Code *as* Law.' (2019) 82 (2) *Modern Law Review* 207 (33).

Newspapers, websites and blogs

Arvelo, F., 'RESIST – Uber and Subverting Regulations.' *The Bespoke Lawyer* (10 March 2017) <www.bespokelawyer.com/resist-uber-and-subverting-regulations/> accessed 28 March 2018.

Buntinx, J.-P., 'Future Use Cases for Blockchain Technology: Copyright Registration.' *Bitcoin News* (4 August 2015) <news.bitcoin.com/future-use-cases-for-blockchain-technology-copyright-registration> accessed 30 May 2018.

'E-Estonia – We Have Built a Digital Society and So Can You.' *e-Estonia* <https://e-estonia.com/> accessed 7 February 2018.

Garber, J., 'Bitcoin Spikes After Japan Says It's a Legal Payment Method.' *Business Insider* (3 April 2017) <http://uk.businessinsider.com/bitcoin-price-spikes-as-japan-recognizes-it-as-a-legal-payment-method-2017–4?r=US&IR=T> accessed 22 March 2018.

Lopp, J., 'Bitcoin and the Rise of the Cypherpunks.' *CoinDesk* (9 April 2016) <www.coindesk.com/the-rise-of-the-cypherpunks/> accessed 22 March 2018.

Maas, T., 'Blockchain: The 3 Core Components.' *LinkedIn* (24 October 2017) <www.linkedin.com/pulse/blockchain-3-core-components-thijs-maas> accessed 29 January 2018.

Maas, T., 'What Is Blockchain Technology?' *Lawandblockhain.eu* (21 June 2017) <www.lawandblockchain.eu/post-template/> accessed 29 January 2018.

Popper, N., 'Understanding Ethereum, Bitcoin's Virtual Cousin.' *The New York Times* (2 October 2017).

Rosic, A., 'What Is Blockchain Technology? A Step-By-Step Guide for Beginners.' *Blockgeeks* (2016) <https://blockgeeks.com/guides/what-is-blockchain-technology/> accessed 3 February 2018.

'Share of Global Internet Users Who Access Music Through Copyright Infringement as of 2017, by Age Group.' *Statista* (2018) <www.statista.com/statistics/609114/music-copyright-infringement-by-age/> accessed 5 December 2018.

Stankovic, S., 'An Introductory Guide to Cryptocurrency Regulation.' *Unblock* (15 January 2018) <https://unblock.net/cryptocurrency-regulation/> accessed 22 March 2018.

Wright, A. and De Filippi, P., 'Decentralized Blockchain Technology and the Rise of Lex Cryptographia.' *SSRN* (10 March 2015) <ssrn.com/abstract=2580664> accessed 1 June 2018.

Press releases

'An Update on Insurance.' *Uber Newsroom* (1 March 2018) <www.uber.com/newsroom/an-update-on-insurance/> accessed 26 March 2018.

'Insurance Aligned.' *Uber Newsroom* (24 March 2015) <www.uber.com/newsroom/introducing-the-tnc-insurance-compromise-model-bill/> accessed 26 March 2018.

'PRS for Music, ASCAP and SACEM Initiate Joint Blockchain Project.' (*PRS for Music*, 7 April 2017) <www.prsformusic.com/press/2017/prs-for-music-ascap-and-sacem-initiate-joint-blockchain-project> accessed 4 December 2018.

Legal encyclopaedias

'Blockchain – Key Legal and Regulatory Issues.' *Lexis PSL TMT* <LexisPSL> accessed 23 March 2018.