EXPLORING THE POTENTIAL OF BLOCKCHAIN TECHNOLOGY IN INTELLECTUAL PROPERTY RIGHTS

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Submitted by

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SUPERVISOR CERTIFICATE

It is to certify that **MR. SUBHAM DAS** is pursuing Master of Laws (LL.M.) from National Law University and Judicial Academy, Assam and has completed his dissertation titled **"EXPLORING THE POTENTIAL OF BLOCKCHAIN TECHNOLOGY IN INTELLECTUAL PROPERTY RIGHTS"** under my supervision. The research work is found to be original and suitable for submission.

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DECLARATION

I **SUBHAM DAS**, do hereby declare that the dissertation titled "**EXPLORING THE POTENTIAL OF BLOCKCHAIN TECHNOLOGY IN INTELLECTUAL PROPERTY RIGHTS**" submitted by me for the award of the degree of MASTER OF LAWS of National Law University and Judicial Academy, Assam is a bonafide work and has not been submitted, either in part or full anywhere else for any purpose, academic or otherwise.

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1.	&	And
2.	§	Section
3.	AI	Artificial Intelligence
4.	API	Application Programming Interface
5.	ASCAP	American Society of Composers, Authors and Publishers
6.	BPF	Byzantine Fault Tolerance
7.	BTC	Bitcoin
8.	CAD	Computer Aided Design
9.	CMO	Collective Management Organisation
10.	DAS	Digital Access Service
11.	DID	Digital Identities
12.	DLT	Distributed Ledger Technology
13.	EPO	European Patent Office
14.	EUIPO	European Union Intellectual Property Office
15.	FIPS	Federal Information Processing Standard
16.	FTP	File Transfer Protocol
17.	HC	High Court

18.	IBM	International Business Machines
19.	IBREA	International Blockchain Real Estate Association
20.	IP	Intellectual Property
21.	IPR	Intellectual Property Rights
22.	IRDAI	Insurance Regulatory and Supervisory Agency
23.	KYC	Know Your Customer
24.	LoA	Level of Assurance
25.	NDA	Non-Disclosure Agreement
26.	OMI	Open Music Initiative
27.	P2P	Peer to Peer
28.	PBFT	Practical Byzantine Fault Tolerance
29.	PCT	Patent Corporation Treaty
30.	PoA	Proof of Authority
31.	PoS	Proof of Stake
32.	PoW	Proof of Work
33.	PRS	Performing Rights Society
34.	QR	Quick Response
35.	RBI	Reserve Bank of India

36.	RIFD	Radio Frequency Identification
37.	SACEM	Society of Authors, Composers and Publishers of Music
38.	SC	Supreme Court
39.	SEBI	Securities Board of India
40.	SHA	Secure Hash Algorithm
41.	TCCPR	Telecom Commercial Communications Customer Preference Regulations
42.	TMDS	Transition Minimised Differential Signalling
43.	TPS	Transactions per second
44.	TRAI	Telecom Regularities Authority of India
45.	UCC	Unsolicited Commercial Communications
46.	UK	United Kingdom
47.	USA	United States of America
48.	v.	Versus
49.	WCT	World Copyright Treaty
50.	WIPO	World Intellectual Property Organisation

1. INTRODUCTION

As of 2023 most of us have already come across the term ‘Blockchain’ at least once. It is the technology that is at the base of the ‘bitcoin’ which needs no introduction. Bitcoin started the era of cryptocurrency which has taken the world by storm. The world was first introduced to bitcoin in the late 2000s by an anonymous person or group of persons with a pseudonym Satoshi Nakamoto. A paper was published by this person which introduced the world to bitcoin. It was through the introduction of cryptocurrencies that the world came to realise the potential of blockchain technology. Blockchain technology can be used to revolutionize many sectors like finance, banking, healthcare and law especially intellectual property rights.

Intellectual Property Rights (hereinafter IPR) includes patents, copyright, trademarks, designs, trade secrets, etc. It is broadly a right given mainly to individuals or organisations as a protection for their intellectual labour and creativity. These rights are mainly given a for a limited period of time, like 20 years for patents and lifetime of the author plus 60 years for copyright. However, some these rights like trademarks do not have any specific protection period but normally have to be renewed from time to time.

The protection of the IPR through the well-established traditional methods have sometimes proved to be ineffective and time consuming for the protection of the rights of the rightsholders. Blockchain technology can be used to provide for better protection of IPR in various stages like registration, management (including transfer and licensing) and enforcement. In the enforcement phase, it can be used to counteract the menace of counterfeiting of goods which has plagued the rightsholders, customers and law enforcement agencies alike.

The decentralised platform provided by blockchain technology along with the use of smart contracts can provide a new ray of light for the better registration, management and enforcement of IPR. The present traditional system being used in all the stages is a centralised system with governmental offices at the centre which is prone to errors, costly and time consuming. The integration of blockchain can potentially result in a secure and transparent system thus doing away or reducing the dependence on the central authorities. One of the main benefits of this technology is the use of distributed ledged which can be utilised to track and verify the ownership, transfer, assignment and

licensing of the rights. Since blockchain technology is immutable in nature the errors also can come down significantly. It can also significantly reduce the instances of infringement and time consuming and never-ending litigations.

Blockchain technology can be used along with smart contracts which are basically contracts which can be automatically executed if the prerequisite conditions are met thus making the output way faster. Smart contracts can be hugely beneficial in cases of transfer, royalty collection, assignment and also licensing of these rights.

Although the potential of blockchain technology is very huge, there are certain challenges like social, legal, privacy, technological and regulatory that need to be overcome for it to reach its complete potential. One of the challenges is that currently there is a acute dearth of investment in the technology, however it is gradually getting better as the international organisations and governments throughout the world are realising the huge potential of blockchain. The biggest challenge regarding this is the presently there is no dedicated legal framework to regulate blockchain in India which results in a lot of difficulties. The legal framework should be adapted such a manner that blockchain technology can be easily integrated into the current intellectual property legislations. It would require the governments of the countries, international organisations, right holders to work in collaboration to make it a success.

In this research the researcher tries to understand the technology associated with blockchain. The researcher also tries to analyse the absence legal framework related to blockchain in India and the need for a law to be framed in this regard. The next chapters also takes a look at the potential uses of blockchain in different sectors like healthcare, banking, real estate, etc. Finally, the researcher looks into the benefits and challenges associated with the utilization of blockchain technology for the registration, management and enforcement of IPR.

1.1. STATEMENT OF PROBLEM

The researcher has undertaken this research in order to explore the problems associated with the various stages of intellectual property (hereinafter IP) protection including registration, management and enforcement. The registration process of IPR is often complex and expensive and the rights granted are typically limited to enforcement within the country where the IP right is registered. Given the global nature of commerce

and the fast-paced modern economic system, this limitation fails to meet the needs of right holders. Within the contemporary IP system, various tasks related to IP rights management, such as licensing, assignment, identifying right holders, and conducting infringement investigations, are typically outsourced to third parties, resulting in significant expenses. The enforceability of an IP right is its most crucial aspect. In order for IP rights to hold legal significance, it is essential for right holders to be able to effectively enforce their rights through collaboration with law enforcement agencies, such as the police and customs officers. However, there is a specific challenge in terms of counterfeiting that imposes substantial costs on the IP industry from the viewpoint of enforcement authorities. Customs and police officers lack the necessary tools and resources to accurately determine whether a product is genuine or counterfeit. The present research seeks to find out the potential of blockchain technology in trying to solve the problems associated with the registration, management, and enforcement of IP rights.

1.2. REVIEW OF LITERATURE

The research has gone through a lot of books, articles, reports, etc which conducting this research. Some of the literature which has helped the researcher to complete the dissertation are given below: –

- Dr. VK Ahuja in his book[1] has brilliantly explained in depth about the different forms of IPR. The author of this book has covered all the relevant and important topics related to the various rights present in IPR. The book has been of immense help to the researcher to understand the concepts related to Patents, Copyright, Trademark etc. In this current book chapter 73 is specially dedicated to the licensing aspect of management of IPR. The researcher has been able to get a good grasp of the different forms of IPR after reading this book.

- Gonenc Gurkaynak and others in their paper[2] have explained the concepts related to blockchain technology and the potential of smart contracts. The paper

[1] V.K. Ahuja, *Law Relating to Intellectual Property Rights* (3rd edn., Lexis Nexis 2017).
[2] Gonenc Gurkaynak and others, 'Intellectual Property Law and Practice in the Blockchain Realm' [2018] CLSR 847.

also looks into the potential legal status of blockchain as an asset, intermediary and as a payment system. The researcher has found this paper to be of great aid in understanding the various phases of IPR protection. The paper explains the potential of blockchain technology in copyright management by licensing with the integration of smart contracts into the blockchain. The problem of counterfeiting in the enforcement phase has also been analysed in this paper by the four authors in a detailed manner. The researcher is also grateful to the authors of this paper for making him understand the various challenges associated with blockchain technology and their potential solutions.

- Jitasha Bahl in her paper[3] starts with a general overview of the different types of IPR. The paper has also very well explained the process of registration, management and enforcement of various IPRs. The researcher has found the paper to be helpful in understanding the present challenges that traditional IPR regime faces and also the challenges that might arise if blockchain technology is integrated with IPR for its protection. Overall this paper has helped the researcher to get a proper understanding of the concepts required to conduct this research.

- The report Blockchain Technology Overview[4] published by NISTIR has explained the various concepts related to blockchain technology in an easy manner. The researcher has benefitted greatly from this report as it has suitably explained the types of blockchain along with its pros and cons. It also explains the different types of consensus models like PoW, PoS, etc. Moreover, the report has helped the researcher to develop an understanding of the unique characteristics of blockchain technology. This report is a must read for anyone who is trying to understand the concepts and working of smart contract and blockchain technology.

[3] Jitasha Bahl, 'Blockchain and its Application in the Field of Intellectual Property Rights' (2021) 2 Law Essentials J 302, 303.
[4] National Institute of Standards and Technology, *Blockchain Technology Overview* (Report, Cm 8202, 2018).

- Seda Fabian in her paper[5] has explained the origins of blockchain technology and also explains about the cryptocurrency bitcoin. The researcher has found this paper to be of great help in understanding the relationship between blockchain technology and patent, trademark, copyright. It also gives an overview of smart contracts and its integration with the blockchains in order to protect the different types of IPR. This paper also has a section that gives the potential uses of blockchain technology for the protection of different IPRs including trade secrets.

- Shamima Nasrin Mukta in her paper[6] has given an outline of the blockchain technology and its different types. The researcher has found this paper to be helpful as it explains different applications of blockchain in different sectors like e-governance, power sector, healthcare, banking and IPR. The author has also expertly explained the different challenges that may arise with the integration of IPR with blockchain technology and its probable solutions.

- Shatakshi Singh in her paper[7] has given an overview of the existing legal framework regulating the area of blockchain technology in India as well as in the global stage. The author has also briefly explained about the nexus between IPR and trademark and other rights. The main advantages of using blockchain for the protection of IPR along with its cons have also been dealt with in this paper. The researcher has studied this paper and it has greatly help him to complete the current research.

- The white paper published by WIPO[8] has given an in depth research on the relation between the disruptive blockchain technology and IPR. This white paper expertly explains everything related to IPR and its integration with blockchain. The researcher has been able to get a grasp on the affects of integration of blockchain for the protection of IPR. It gives detailed analysis of

[5] Seda Fabian, 'Blockchain and Intellectual Property Rights' (2021) 25 Intell Prop & Tech L J 147.
[6] Shamima Nasrin Mukta, 'Blockchain Technology: An Overview' (Chittagong University of Engineering and Technology Conference, Chittagong, March 2023).
[7] Shatakshi Singh, 'IPR and Blockchain Technology' (2022) 5 IJLMH 692.
[8] World Intellectual Property Organization, *Blockchain Technologies and IP Ecosystems: A WIPO White Paper* (White Paper, Cm, 2022).

the need of integration of blockchain in various phases like licensing, transfer, registration of IPR. It also explains the problems related to counterfeiting of products comprehensive. The researcher has also found this white paper to be helpful in understanding the various challenges associated with blockchain like privacy issues, need for a regulatory framework, interoperability issues, sustainability, to name a few. Along with explaining the challenges it also analyses the potential solutions to each problem.

1.3. AIM(S)

The main aims of this research undertaken by the researcher are to understand the technology behind the working of blockchain. The researcher mainly aims to find if there is a need for a regulatory framework to regulate blockchain. It also aims to understand the benefits of utilizing blockchain technology in the registration, management and enforcement of IPR.

1.4. OBJECTIVE(S)

This research tries to highlight the following objectives: –

- To know the meaning and the functioning blockchain technology along with its types.
- To analyse the challenges associated with integrating blockchain technology for the protection of IPR.
- To explore the potential benefits that blockchain technology can provide in the registration process of various IPR.
- To analyse the positive impacts that blockchain technology can have on the management of IPR with a special reference to the transfer and licensing of the same
- To analyse the affect that blockchain technology can have on counterfeiting during the enforcement phase of IPR.

1.5. SCOPE AND LIMITATIONS

The main scope of the study undertaken by the researcher to form an understanding of the underlying principles of blockchain technology and analyse its potential uses in the registration, management and also the enforcement of intellectual property rights. The study mainly looks at the transfer and licensing aspects during the management and the problem of counterfeiting during the enforcement phase of IPR. Additionally the scope of the research also includes the challenges that may arise from the use of blockchain technology during various phase of IPR protection. The scope of the present research is limited to studying the impact of blockchain technology only on IPR and does not include its impact on any other sector of law and also on any other area apart from IPR.

1.6. RESEARCH QUESTIONS

For the purposes of this research the following research questions have been framed.

- How can the implementation of blockchain technology benefit the registration process of Intellectual Property Rights?
- What are the benefits of utilizing blockchain technology in intellectual property rights transfer and assignment in the management phase?
- What are the possible methods of utilizing blockchain technology to counteract counterfeiting in the enforcement phase of Intellectual Property Rights?

1.7. RESEARCH HYPOTHESIS

The following hypothesis has been formulated for the study –

- Blockchain technology can help to overcome the challenges associated with the expensive and time-consuming registration and the increased expenses due to third parties in management of IPR. It also has a huge potential to deal with the problems like counterfeiting which arise during the enforcement of intellectual property rights.

1.8. RESEARCH METHODOLOGY

In this research the researcher has used the doctrinal form of research. It is a form of research where the sources available in the library are used. The researcher has taken help from reading materials available from books, journal, reports. In conducting the present research, the researcher has also used material from internet sources like blogs and articles. Primary as well as Secondary sources of data have been used in this research.

The researcher has used the OSCOLA 4th edition for citation in this research.

1.9. RESEARCH DESIGN

Blockchain technology has the potential to change the various phase of IPR protection completely. It can of benefit to all the stakeholders at all the stages of protection. In the current research the researcher has divided the dissertation into five main chapters. A brief summary of the chapters has been given below.

Chapter 1

The first chapter of this Dissertation gives a brief introduction to the topic of the dissertation. It gives a brief overview of blockchain technology as a concept and its potential uses in the registration, management and enforcement of IPR. In this introductory chapter the researcher has also included the aims, objectives, scope and the limitation of the research. The main research problem due to which the research has been undertaken has also been explained in this chapter. The research questions and research hypothesis based on which this research has been conducted has also been added in this chapter. A review of the existing literature on the topic which has helped the researcher to understand and write the various parts of this dissertation has also been given. The type of research being conducted, citation method used and sources referred to have been in the research methodology part of this chapter. A sub chapter of this chapter provides the research design of the dissertation which gives brief overviews of each chapter of the dissertation.

Chapter 2

The second chapter of this dissertation given an overview of the blockchain technology and its working methods. It also tries to give the different types of blockchains along

with its various components as well as characteristics. The concept of smart contracts has also been dealt with briefly in this chapter.

Chapter 3

The chapter gives an overview of the current legal framework regulating blockchain technology. In this chapter the researcher has also tried to highlight the potential legal status of blockchain. This chapter also takes a look into the relationship between blockchain and other laws like banking, real estate, criminal, jurisdiction etc.

Chapter 4

In this chapter of the dissertation the researcher has given the relation and various uses of blockchain with different IPRs like patents, trade secrets, trademark and copyright. This chapter also explains the benefits of utilizing blockchain technology in the registration, management and enforcement of IPR and the challenges associated with it.

Chapter 5

In the fifth and concluding chapter of the dissertation the researcher has given a brief conclusion of the study conducted. It also gives the findings of the research and here the researcher tries to provide answers to the research questions and also examine the research hypothesis. At the end of this chapter the researcher has tried to lay forth some suggestions related to the research conducted.

2. BLOCKCHAIN AS A TECHNOLOGY

The fundamental concepts underpinning blockchain technology were first introduced during the latter part of the 1980s and the early 1990s. The Paxos protocol was developed by Leslie Lamport in 1989, and subsequently submitted to ACM Transactions on Computer Systems in 1990 in the form of a paper titled "The Part-Time Parliament". The paper was eventually published in a 1998 issue. The present study outlines a consensus framework aimed at achieving unanimity on an outcome within a computer network, which may exhibit unreliability either in terms of its constituent computers or the network infrastructure itself. Various academic disciplines, including mathematics, have explored decentralized solutions as an alternative to traditional banking intermediaries for facilitating value exchanges among individuals and entities.[9]

In 2009, several scandals involving the world of banking, together with the terrible economic crisis that hit virtually all industrialized nations, caused a significant number of people to lose the trust they had previously possessed that their money was being protected in a secure manner. In addition to this, the severity of the economic crisis affected virtually all of the wealthy countries. The identity of the individual or organization behind the pseudonym Satoshi Nakamoto has not been established as of yet. Together with other specialists in technology and mathematics (among other subjects), he started looking for a decentralized solution, which is to say, one that did not require an intermediary in the form of a financial institution, so that people or entities may make and conduct value exchanges through it. Because of this, bitcoin was able to come into being. Blockchain technology has gained widespread recognition primarily due to its association with Bitcoin. However, it is important to note that blockchain is an enabling technology with a much broader scope beyond Bitcoin. It is imperative to comprehend the genesis of Bitcoin, not solely as a means of currency, but also as a technological and protocol-based mechanism for the transfer of digital assets.[10]

[9] National Institute of Standards and Technology, *Blockchain Technology Overview* (Report, Cm 8202, 2018) 2.
[10] World Intellectual Property Organization, *Blockchain Technologies and IP Ecosystems: A WIPO White Paper* (White Paper, Cm, 2022) 14.

The inception of blockchain technology was initiated by Satoshi Nakamoto's publication of a 9-page paper entitled "Bitcoin: A Peer-to-Peer Electronic Cash System."[11] The aforementioned seminal paper introduced a novel approach for conducting peer-to-peer (hereinafter P2P) transfers of value that are both traceable and dependable, as proposed by Satoshi Nakamoto.[12]

The definition of blockchain technology can be articulated as follows: Blockchain is a decentralized system that enables the recording of various types of data, such as financial transactions and asset dispositions, in a continuously encrypted and irreversible ledger.[13] The technology in question is a decentralized database consisting of records or a publicly accessible ledger documenting all digital transactions or events that have been completed and disseminated among involved entities. The verification of every transaction in the public ledger is achieved through the consensus of a majority of the participants involved in the system. Once data has been inputted, it cannot be permanently deleted. The blockchain maintains an immutable and auditable ledger of all past transactions. Using a rudimentary analogy, it is comparatively effortless to steal a biscuit from a jar that is situated in a secluded location as opposed to escaping with a cookie from a cookie jar that is situated in a bustling marketplace, where it is under scrutiny of a multitude of individuals.[14]

2.1. WORKING OF A BLOCKCHAIN

The functionality of blockchain is based on a generalized process. The initiation of the process involves a transaction request from a user (node) within a P2P network. Subsequently, the transaction is disseminated to all the participants within the network. Subsequently, the verification procedure occurs, whereby all nodes within the P2P network authenticate the transactions through the use of hashes. Upon completion of the verification process, the transaction data is subsequently stored within a newly created block. Ultimately, the latest block is linked to the blockchain through a hashed representation of the data contained in the preceding block, thereby rendering it

[11] Satashi Nakamato, 'Bitcoin: A Peer-to-Peer Electronic Cash System'(*Bitcoin*) <https://bitcoin.org/bitcoin.pdf> accessed 10 April 2023.
[12] Gonenc Gurkaynak and others, 'Intellectual Property Law and Practice in the Blockchain Realm' [2018] CLSR 847.
[13] ibid.
[14] Berkeley University of California, *Blockchain Technology Beyond Blockchain* (White Paper, Cm, 2015) 3.

immutable and enduring. In each blockchain, the initial block is commonly referred to as the Genesis block, serving as the fundamental building block of the entire chain. Each recently generated block is subsequently linked to the antecedent blocks within the chain, thereby establishing a connection between every block and the genesis block eventually. Furthermore, a cryptographic hash is present in conjunction with the information encapsulated within each block. Each block within the blockchain contains its own unique hash as well as the hash of the preceding block.[15] The hash function serves as a distinctive identifier, akin to a fingerprint, that uniquely characterizes every block and its associated contents. Consequently, any alteration made to the content of the block will lead to a modification in the related hash.[16]

The utilization of hashes is of utmost importance in the functioning of blockchain technology, as it serves as a primary safeguard for ensuring the security of the blockchain. The utilization of this methodology renders the blockchain technology as one of the most impregnable alternatives currently available within the industry. In instances where the data within a block is altered, the corresponding hash of said block will be modified, while the hash in the subsequent block will remain unaltered. Consequently, this leads to the classification of all subsequent blocks as invalid blocks. Consequently, any modification made to a solitary block within the blockchain leads to the dismissal of all subsequent blocks in the chain.

The utilization of cryptographic hash functions confers a heightened level of security within the blockchain system. Assisted by high-speed computing systems, hackers possess the capability to modify data within a solitary block, subsequently enabling them to swiftly recalculate all subsequent blocks' hashes within the blockchain. In order to address this matter, a number of algorithms have been developed, commonly referred to as the consensus.[17] The consensus process involves the validation of transactions prior to their incorporation into the blockchain. The aforementioned mechanism enables the expansion of the blockchain network while mitigating the risk of tampering with the blocks or the data they contain. The process of consensus occurs within predetermined and distinct time intervals. The

[15] Shamima Nasrin Mukta, 'Blockchain Technology: An Overview' (Chittagong University of Engineering and Technology Conference, Chittagong, March 2023).
[16] Roman Beck, 'Beyond Bitcoin: The Rise of Blockchain World' (2018) 51 Computer 54, 55.
[17] Joanna Moubarak, Eric Filiol and Maroun Chamoun, 'On Blockchain Security and Relevant Attacks' (IEEE Middle East and North African Communications Conference, April 2018).

aforementioned intervals denote the duration between the commencement of the transactions and their subsequent inclusion in the blockchain. The duration required for confirmation is contingent upon various factors such as the size of the block, the volume of transactions, and the consensus algorithms employed. Currently, there is a prevalent utilization of consensus algorithms that possess variable properties within the industry. The four widely recognized consensus mechanisms are Proof of Work (hereinafter PoW), Proof of Stake (hereinafter PoS), Proof of Authority (hereinafter PoA), and Practical Byzantine Fault Tolerance (hereinafter PBFT).[18]

2.2. MAIN CHARACTERISTICS OF BLOCKCHAIN

Some of the main characteristics of blockchain are as follows.

2.2.1. DECENTRALISATION

The defining feature of blockchain technology is the lack of a central intermediary to facilitate transactions among parties who may not possess mutual trust. Within a blockchain network, all participants share a common protocol that is governed by predetermined regulations that must be adhered to by all parties involved.[19] The property of decentralization confers numerous benefits within the context of a blockchain network. The fault-tolerant and fully organized nature of a blockchain network stems from its independence from human calculations. The decentralized structure of the blockchain network renders it less susceptible to failure. The cost of executing a system attack is relatively high for hackers, which consequently reduces the probability of failure. As there is no involvement of a third-party, the system does not entail any additional risk. The decentralized architecture of blockchain technology enables the establishment of a transparent profile for each participant within the network. Hence, each alteration can be traced and is more tangible. Individuals are currently empowered to exercise authority over their properties, thereby eliminating the need for external entities to oversee and regulate their assets.[20]

[18] NERA Economic Consulting, *Blockchain in Electricity: a Critical Review of Progress to Date* (Report, Cm, 2018).
[19] World Intellectual Property Organization (n 10) 15.
[20] Tanuja Joshi, 'Features of Blockchain' (*Geeks for Geeks*) <https://www.geeksforgeeks.org/features-of-blockchain/> accessed 23 April 2023.

2.2.2. DISTRIBUTED LEDGER

The blockchain technology is a decentralized system of identical ledgers that are shared and synchronized across various locations, organizations, or regions. This system has the capability to record transactions that occur simultaneously in multiple locations.[21] The distributed ledger (hereinafter DLT) is a crucial aspect of blockchain technology for various reasons, including: The process of monitoring ledger activity in a DLT is facilitated by the rapid propagation of modifications throughout the network. Each individual node within the blockchain network is required to uphold the ledger and actively engage in the validation process. Modifications made to the ledger are promptly reflected within seconds or minutes. The blockchain's absence of intermediaries expedites the validation process for any alterations. In order to add a new block to the blockchain, it is necessary for the other nodes in the network to authenticate the transaction. In order for a novel block to be added to the blockchain network, it necessitates the endorsement of a prevailing number of nodes present on the network. Within a blockchain network, all nodes are treated equally without any preferential treatment or bias from the network. Adherence to the established protocol is mandatory for any individual seeking to attach a new block to the network.[22]

2.2.3. CONSENSUS

Consensus algorithms are utilized to govern the process by which the accurate state of the network is achieved, given that the accounting book or ledger database is maintained autonomously by each system node in a stored copy. The aim is for consensus to be reached among all nodes regarding the next block to be integrated, followed by the mining of said block. Numerous consensus algorithms exist, each possessing its own advantages and disadvantages.[23] The presence of a consensus algorithm is imperative for the preservation of a blockchain's value.

[21] World Intellectual Property Organization (n 10) 15.
[22] Joshi (n 20).
[23] ibid.

2.2.4. ENCRYPTION

Each record within the blockchain is encrypted on an individual basis. The utilization of encryption introduces an additional stratum of security to the entirety of the process within the blockchain network. The absence of a centralized governing body does not imply that individuals can arbitrarily add, modify, or erase information on the network. The participation in a blockchain network is founded on public key cryptographic protocols. This implies that each user on the network possesses a distinct identifier that is linked to their public key. It is plausible that these identifiers could be correlated with digital identity solutions that are based on blockchain technology.[24] Any endeavor to alter the data entails altering all the hash IDs, a task that is exceedingly difficult to accomplish.

2.2.5. IMMUTABILITY

Once a transaction has taken place, its record becomes immutable as it is linked to all preceding transactions through a chain.[25] Upon the inclusion of a block at the terminus of the chain, it is irrevocably preserved within the blockchain, precluding any potential for alteration. The incorporation of data into the blockchain is safeguarded by ensuring its integrity. The process of conflict resolution within a network is regulated by a set of predetermined regulations that are outlined within the smart contracts. The smart contracts ensure the integrity and deterministic execution flow.[26] Each individual node within the network possesses a duplicate of the digital ledger. In order to add a transaction, each node conducts a validation check to ascertain its legitimacy. If a consensus is reached among the majority of nodes that the transaction is indeed valid, it is subsequently incorporated into the network. Consequently, the addition of transaction blocks to the ledger is contingent upon the endorsement of a majority of nodes. Once records have been validated, they become immutable and any modifications to them are not possible. Consequently, any user within the network will be precluded from modifying, altering, or erasing the aforementioned data.[27]

[24] World Intellectual Property Organization (n 10) 15.
[25] Mukta (n 15).
[26] World Intellectual Property Organization (n 10) 15.
[27] Joshi (n 20).

2.2.6. SMART CONTRACT

The integration of smart contracts is one of the potential methods to enhance the functionality of blockchain technology. The concept of a "smart contract" was initially introduced by Nick Szabo. It pertains to a software system that automates the conditions of a contract, which is represented by a digitally specified agreement. The protocol executed by the involved parties in the agreement is also encompassed within this definition. The blockchain technology facilitates the automatic replication of idempotent logic execution across machines. These machines execute code extracts that specify actions to be performed upon meeting predetermined conditions.[28]

One of the primary objectives of smart contracts is to enable self-execution of contracts. The software incorporates the contractual obligations, including the registration of IP and property agreements, once all requirements have been satisfied and all criteria have been met. Subsequently, the smart contracts may be activated to execute the stipulated contractual duties, encompassing the allocation of a property entitlement, trade of a property, or transfer of funds.[29] Smart contracts are particularly advantageous in situations where the involved parties lack mutual trust in fulfilling their contractual obligations. In such instances, smart contracts serve to guarantee the implementation of the contractual terms. Consequently, the implementation of smart contracts can instill confidence and dependability in the blockchain network for all parties involved in the contractual agreement.[30] Upon activation of any clause within a contract, the smart contract is capable of initiating self-execution, which cannot be halted unless the contract's terms specify mechanisms within said clauses to terminate the contract.[31] The utilization of smart contracts holds the potential to bring about a significant transformation across diverse industries through the provision of a secure and transparent mechanism for executing contracts.

[28] World Intellectual Property Organization (n 10) 15.
[29] Zibin Zheng and others, 'An Overview on Smart Contracts: Challenges, Advances and Platforms' (2015) 105 Future Gener Comput Syst 475.
[30] Gurkaynak (n 12).
[31] Zheng (n 29) 5.

2.3. BLOCKCHAIN CLASSIFICATION

Blockchains can be categorized into various types, such as public, private, consortium, or hybrid, based on their intended use. [32] It is noteworthy that each type of Blockchain fundamentally comprises a group of nodes that operate on a P2P network architecture. Each node within the network possesses a duplicate of the communal ledger, which is regularly updated and to facilitate the initiation and receipt transactions.[33]

2.3.1. PUBLIC BLOCKCHAIN

Public blockchains are characterized by their lack of a singular owner, their accessibility to all users, their open consensus process, and their complete decentralization.[34] A public blockchain serves as an accessible platform that enables individuals from diverse backgrounds and organizations to participate in transactions and mining activities. There are no limitations imposed on any of these variables. As such, these particular types of blockchains are commonly referred to as "permissionless blockchains."[35] This particular type of Blockchain technology enables computer networks to be readily accessible to individuals who are interested in conducting transactions. The validated individual is the recipient of transaction rewards, contingent upon successful validation. Additionally, two distinct models, namely PoW and PoS, are employed. The Public Blockchain is a decentralized and DLT system that does not require authorization, allowing anyone with access to become an authorized user and retrieve data or a portion of the Blockchain. This type of blockchain confers authorization with respect to the verification of present and past records. Furthermore, this technology is being utilized for the purpose of extracting and trading digital currencies. The prevalent blockchains in this particular segment are Bitcoin and Litecoin. Strict adherence to security protocols and methodologies can significantly enhance the overall security of the system.[36]

The exposure of the ledger to attacks is a potential risk in public blockchain systems due to its public availability. The deficiency in question is counteracted by the

[32] Karim Sultan, Umar Ruhi and Rubina Lakhani, 'Conceptualizing Blockchains: Characteristics & Applications' (11th IADIS International Conference on Information Systems, Lisbon, April 2018).
[33] P.K. Paul and others, 'Blockchain Technology and its Types – A Short Review' [2021] IJASE 189.
[34] Sultan (n 32).
[35] Deepak Puthal and others, 'Everything you Wanted to know about the Blockchain' (2018) 7 IEEE Consum. Electron. Mag 6.
[36] Paul (n 33).

amalgamation of the resilient PoW mechanism with cryptographic verification of the complete blockchain upon the addition of a new block.[37] This particular Blockchain variant prioritizes a range of features, including but not limited to robust security and privacy measures, an open and adaptable framework, anonymous transactions, a lack of stringent regulations and policies, complete transparency and system accessibility, and a distributed architecture.[38]

2.3.2. PRIVATE BLOCKCHAIN

A private blockchain is a type of permissioned blockchain that operates within a confined environment, specifically a closed network. Private blockchains are commonly employed in organizational settings, restricting access to a blockchain network to a select group of members. The degree of security, authorizations, permissions, and accessibility is under the purview of the governing entity.[39] The involvement of nodes is determined either through a prescribed set of regulations or by the network administrator in order to regulate access. The aforementioned phenomenon tends to shift the network towards centralization, thereby diminishing the fundamental characteristics of blockchain technology, namely complete decentralization and openness, as originally conceptualized by Satoshi. In a private blockchain system, nodes that join the network participate in the operation of a decentralized network. Each node is responsible for maintaining a copy of the ledger and working collaboratively to achieve consensus for updates. However, unlike public blockchains, write permissions are limited.[40]

This particular blockchain variant is equipped with adequate security measures, authorization protocols, permission structures, and accessibility features. As per the analysis of specialists, private blockchains are utilized for various purposes such as voting, supply chain management, digital identity management, asset ownership, and other related functions. Several widely-used private blockchain platforms include Multichain, Hyperledger projects, and Corda.[41]

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[37] Puthal (n 35).
[38] Paul (n 33).
[39] Mukta (n 15).
[40] Puthal (n 35).
[41] Paul (n 33).

Private blockchains exhibit superior transaction processing speed compared to public blockchains, resulting in a higher transactions per second (hereinafter TPS) throughput. Additionally, the limited number of nodes visible in this context results in increased speed.[42] The increased speed of the process results in greater scalability. The process of adding nodes to pre-existing ones is facilitated and expedited. Private blockchains exhibit high scalability and flexibility. The addition or removal of nodes does not significantly impact existing systems. Notwithstanding, private blockchains exhibit certain drawbacks in comparison to public blockchains. Specifically, the susceptibility of private blockchains to security breaches in the event that an external party gains entry to the central management system. As a result, the potential for a node to compromise the entirety of the private blockchain system is heightened. The concept of public blockchain pertains to an openly accessible ledger, thereby necessitating the assurance of security and legitimacy for each user. Conversely, private blockchain is restricted to a select group of users, thereby necessitating the establishment of trust.[43]

2.3.3. HYBRID BLOCKCHAIN

A hybrid blockchain is a blockchain architecture that combines elements of both public and private blockchains. This implies that it amalgamates the advantages of privacy in a private blockchain and the advantages of security and transparency in a public blockchain. The hybrid network architecture enables users to exercise control over the access privileges of the data stored in the blockchain.[44] Hybrid blockchains are perceived to offer significant advantages in terms of maximum customization, by combining a private permission-based system with a public permission-less system.[45] In this particular blockchain system, users are granted access to specific sections while the remaining sections are recorded and securely stored, thereby leveraging the advantages of ledger records.

Typically, verification of a transaction within a hybrid blockchain's private network occurs internally. However, individuals have the option to publish it on the public blockchain for the purpose of verification. It is possible to selectively disclose a portion

[42] Watanna Viriyasitavat and others, 'Blockchain Technology for Applications in Internet of Things – Mapping from Syatem Design Perspective' (2019) 6 IEEE Internet Things J. 99.
[43] Puthal (n 35).
[44] Mukta (n 15).
[45] Puthal (n 35).

of the data or records contained within a blockchain to the public, while maintaining confidentiality for the remaining information within the private network. Dragonchain is an instance of a hybrid blockchain.[46] The Alastria network in Spain serves as a prominent illustration of a hybrid blockchain that utilizes Quorum technology. This network enables companies across diverse industries to execute their network applications in a distinct manner from other members. This is facilitated through a licensing system that is administered by the consortium's administrators.[47]

2.3.4. CONSENSUS BLOCKCHAIN

The Consortium Blockchain is a semi-decentralized blockchain model that facilitates the management of the blockchain network within an organisation. This particular blockchain variant is capable of executing operations within a solitary entity.[48] It is possible to restrict blockchain access to a specific user group for the purposes of viewing, verifying, or contributing to the blockchain. Hence, the control mechanism is restricted solely to authorised nodes. The primary distinction between private blockchain and consortium lies in the fact that the latter is administered by a collective rather than an individual entity. Multiple entities have the ability to function as a node within this particular blockchain framework, facilitating the exchange of data or engaging in mining activities. Consortium blockchains are commonly employed by financial institutions, governmental entities, and other similar organisations. Instances of entities that can be cited as examples are Marco Polo, Energy Web Foundation, and IBM Food Trust.[49]

2.4. COMPONENTS OF BLOCKCHAIN

The intricacies of blockchain technology may appear daunting at first glance; nonetheless, a comprehensive analysis of each constituent element can facilitate its comprehension. At a conceptual level, blockchain technology incorporates established computer science mechanisms and cryptographic primitives, including cryptographic hash functions, digital signatures, and asymmetric-key cryptography, in conjunction with record-keeping principles such as append-only ledgers. This section provides a

[46] Mukta (n 15).
[47] World Intellectual Property Organization (n 10) 18.
[48] Paul (n 33).
[49] Mukta (n 15).

comprehensive analysis of the primary constituents of the subject matter, namely cryptographic hash functions, transactions, asymmetric-key cryptography, ledgers, blocks, and the interlinking of blocks.

2.4.1. CRYPTOGRAPHIC HASH FUNCTION

A hash function is a mathematical function that transforms an input string of variable length into a fixed-length output string. The resultant value of a fixed length is commonly referred to as the hash value. The hash function is a mathematical function that operates on input data of varying sizes and produces output values of a consistent size. Cryptographic hash functions utilise input transactions to produce an output of a predetermined size through the use of a hash algorithm.[50] The process enables individuals to autonomously input data, apply a hashing algorithm to the data, and subsequently obtain an identical output, thereby demonstrating the absence of any modifications to the original data. Modifying even a single bit of the input data will yield a wholly distinct output digest.

The Secure Hash Algorithm (hereinafter SHA) with an output size of 256 bits (SHA-256) is a cryptographic hash function that is commonly employed in numerous blockchain implementations. A considerable number of computer systems provide hardware support for the algorithm, thereby enabling efficient computation. The SHA-256 algorithm produces a 32-byte output, which is equivalent to 256 bits. This output is typically represented as a string of 64 hexadecimal characters. The aforementioned calculation yields a total of $2256 \approx 1077$, which is equivalent to 115,792,089,237,316,195,423,570,985,008,687,907,853,269,984,665,640,564,039,457,584,007,913,129,639,936 possible digest values. The Federal Information Processing Standard (hereinafter FIPS) 180-4 specifies the algorithm for SHA-256, among others.[51] Given the infinite set of potential input values and a finite set of possible output digest values, the occurrence of a collision, whereby hash(x) = hash(y) (i.e., the hash of two distinct inputs yields the same digest), is theoretically possible albeit improbable. According to scholarly sources, SHA-256 is considered to possess collision resistance properties. This is due to the fact that in order to identify a collision in SHA-256, an

[50] Ritesh Nehru, 'Blockchain Hash Function' (*Geeks for Geeks*) <https://www.geeksforgeeks.org/blockchain-hash-function/> accessed 25 April 2023.
[51] Mukta (n 15).

individual would need to perform the algorithm approximately 2^{128} times on average. To contextualise, the aggregate hash rate, which refers to the number of hashes computed per second, of the complete Bitcoin network during the year 2015 amounted to 300 quadrillion hashes per second, or 300,000,000,000,000,000/s. Based on the given rate, it can be inferred that the Bitcoin network would require approximately 35,942,991,748,521 years, which is equivalent to roughly 3.6 x 1013 years, to produce a collision. It is noteworthy that the estimated age of the universe is 1.37×10^{10} years. Although the possibility exists for two inputs, x and y, to generate an identical digest, it is improbable that both inputs would be deemed valid within the parameters of the blockchain network.[52]

2.4.2. TRANSACTIONS

A transaction denotes an exchange or communication between two or more parties. In the context of cryptocurrencies, a transaction denotes the exchange of the digital currency between users of the blockchain network. In certain blockchain implementations, a consistent influx of fresh blocks, even in the absence of transactions, is imperative to uphold the security of the blockchain network. This measure ensures that malicious actors are unable to overtake the network by fabricating a longer, modified blockchain. Although the specifics of transaction data may vary across different blockchain implementations, the fundamental mechanism for conducting transactions remains largely consistent. A user of a blockchain network transmits data to the said network. The transmitted data may comprise of the sender's identifying information, such as their address or other pertinent identifier, the sender's public key, a digital signature, as well as the inputs and outputs of the transaction. [53]

2.4.3. ASYMETRIC KEY CRYPTOGRAPHY

The utilisation of asymmetric-key cryptography, also known as public key cryptography, is a fundamental aspect of blockchain technology. Asymmetric cryptography employs a dual set of keys, namely a public key and a private key, which are mathematically correlated. The dissemination of the public key does not compromise the security of the cryptographic process, whereas the confidentiality of

[52] National Institute of Standards and Technology (n 9) 8.
[53] ibid.

the private key is imperative for the preservation of the cryptographic security of the data. [54] Despite the existence of an association between the two cryptographic keys, it is not feasible to efficiently ascertain the private key by relying solely on the knowledge of the public key. It is possible to perform encryption using a private key and subsequently decrypt the message using the corresponding public key. Alternatively, it is possible to perform encryption using a public key and subsequently decrypt using a private key. Public-key cryptography, also referred to as asymmetric cryptography, is a commonly employed technique for the distribution of secret keys in symmetric cryptography. Nevertheless, the execution of the task demands a substantial amount of processing time.[55]

Asymmetric cryptography facilitates a trust association among users who lack mutual familiarity or confidence by furnishing a means to authenticate and ensure the genuineness of transactions, while simultaneously permitting transactions to be publicly accessible. In order to accomplish this task, the transactions undergo a process of digital signature. The process involves utilizing a private key to encode a transaction in such a manner that it can only be decoded by an individual in possession of the corresponding public key. The availability of the public key allows for the encryption of the transaction using the private key, thereby serving as evidence that the transaction signer possesses the private key. Alternatively, data can be encrypted using a user's public key, thereby restricting decryption access to only those users who possess the corresponding private key. One limitation of asymmetric-key cryptography is its tendency to exhibit slow computational performance. This stands in contrast to the methodology of symmetric-key cryptography, wherein a solitary confidential key is employed for both encryption and decryption purposes.

In the context of cryptography, symmetric-key encryption requires a pre-existing trust relationship between users in order to facilitate the exchange of the shared key. In a symmetric cryptographic system, the decryption of encrypted data is only possible with the use of a pre-shared key. The successful decryption of the data serves as confirmation that the sender possessed the pre-shared key. Conversely, any user who lacks access to the pre-shared key will be unable to decipher the encrypted data. In contrast to

[54] ibid.

[55] Vivek Gupta, 'Cryptography in Blockchain' (*Geeks for Geeks*) <https://www.geeksforgeeks.org/cryptography-in-blockchain/> accessed 25 April 2023.

asymmetric-key cryptography, symmetric-key cryptography exhibits a higher degree of computational efficiency. As a result, it is common practice in asymmetric-key cryptography to encrypt data using symmetric-key cryptography and subsequently encrypt the symmetric-key using asymmetric-key cryptography. This technique has the potential to significantly enhance the efficiency of asymmetric-key cryptography. [56]

2.4.4. LEDGER

A ledger is a system for maintaining records that enables the tracking of value as it circulates, thereby providing the viewer with a precise account of the location of value at any given time. Conventional financial institutions such as banks employ ledgers to record all transactions conducted during a given timeframe. Blockchains are a type of electronic DLT that authenticate and retain all transactions occurring within their system. The Bitcoin blockchain is responsible for documenting all bitcoin transactions through the utilization of cryptography-secured blocks. The blockchain technology is a proficient ledger system owing to its immutable and autonomous record-keeping network. This implies that any data stored on the blockchain cannot be altered. [57]

The concept of distributed ownership of the ledger is gaining increasing attention in contemporary discourse. The utilization of blockchain technology allows for the implementation of a decentralized ownership model and a distributed physical infrastructure. Blockchain networks typically employ a distributed physical architecture that involves a significantly larger number of computers compared to the conventional centrally managed distributed physical architecture. The increasing attention towards distributed ownership of ledgers can be attributed to the potential apprehensions regarding trust, security, and dependability that are associated with ledgers that have centralized ownership. [58]

Blockchain is a variant of distributed ledger that employs an immutable cryptographic signature, known as a hash, to record transactions. The nomenclature of blockchains is frequently attributed to DLT. DLT revolves around a decentralized and

[56] National Institute of Standards and Technology (n 9) 11.
[57] 'Ledger' (Ledger) (Ledger, 9 December 2022) <https://www.ledger.com/academy/glossary/ledger> accessed 30 April 2023.
[58] National Institute of Standards and Technology (n 9) 12.

cryptographically secured database that stores transaction records. A DLT refers to a database that is geographically dispersed across multiple computers, nodes, institutions, or countries, and can be accessed by a diverse range of individuals worldwide. [59]

2.4.5. BLOCKS

The blockchain technology comprises multiple nodes, commonly referred to as blocks, which are effectively governed by the block header. The block header is typically comprised of several elements, including the Timestamp, Version, Merkle Root, Difficulty Target, Nonce, and Previous Hash. [60] The process of adding transactions to the blockchain occurs upon the publication of a block by a publishing node. A fundamental component of a blockchain is a block, which comprises a block header and block data. The block header encompasses metadata pertaining to the corresponding block. The block data comprises a roster of verified and genuine transactions that have been presented to the blockchain network. The assurance of validity and authenticity is established through the verification of the transaction's proper formatting and the cryptographic signature of each provider of digital assets involved in the transaction, as indicated in the transaction's 'input' values. This serves as confirmation that the individuals or entities responsible for supplying digital assets for a given transaction possessed the necessary private key to authorize the transfer of said digital assets. [61] The veracity and legitimacy of every transaction within a published block will be scrutinized by the remaining full nodes, who will decline any block that includes fraudulent transactions. It is noteworthy that each implementation of a blockchain has the ability to establish its own distinct data fields.

2.4.6. CHANGING BLOCKS

The blockchain is formed by linking blocks together, with each block containing the hash digest of the previous block's header. In the event of a modification to a pre-existing block, the corresponding hash value would be altered. Consequently, all subsequent blocks would exhibit distinct hashes due to their incorporation of the hash

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[59] Wvaibhava, 'Blockchain and Distributed Ledger Technology' (*Geeks for* Geeks) <https://www.geeksforgeeks.org/blockchain-and-distributed-ledger-technology-dlt/> accessed 2 May 2023.

[60] Atul Kumar, 'Blockchain and Block Header' (*Geeks for Geeks*) <https://www.geeksforgeeks.org/blockchain-and-block-header/> accessed on 3 May 2023.

[61] National Institute of Standards and Technology (n 9) 15.

of the preceding block. This enables effortless identification and dismissal of modified blocks.

2.5. CONSENSUS MECHANISM

The Blockchain safeguards and verifies its stored data through a consensus mechanism. Consensus algorithms pertain to the various mechanisms employed to achieve consensus and guarantee security in a distributed system. [62] The security of a blockchain is established by a consensus mechanism that ensures consistency throughout the network. This mechanism fosters reliability and engenders trust among nodes, while also safeguarding the security of the system.[63] A crucial element of blockchain technology involves the identification of the user responsible for generating the subsequent block. This issue can be resolved by implementing any of the available consensus models.[64]

As is typical in distributed systems lacking a centralized authority, there exists a potential vulnerability in ensuring the security of the system. Consensus mechanisms are utilized by blockchain technology to achieve agreement and uphold the coherence of communal data. Blockchain is commonly regarded as a trust mechanism that relies on consensus algorithms to bolster security in the midst of untrusted nodes. The algorithms employed in the Blockchain network serve the purpose of safeguarding it from malicious attacks by verifying transactions and generating fresh blocks that are disseminated and embraced by all participating nodes. The subsequent sections delve into various consensus models and the predominant conflict resolution methodology.[65]

2.5.1. PROOF OF WORK (PoW)

The concept of PoW was first introduced by Dwork and Naor in 1993[66] as a means to address the issue of unsolicited email and regulate the utilization of communal resources. The PoW protocol was initially introduced by Satoshi as a decentralized

[62] Kebira Azbeg and others, 'An Overview of Blockchain Consensus Algorithms: Comparison, Challenges and Future Directions' in Faisal Saeed (eds.) and others, *Advances on Smart and Soft Computing*, (Springer 2021).
[63] World Intellectual Property Organization (n 10) 16.
[64] National Institute of Standards and Technology (n 9) 19.
[65] Azbeg (n 62).
[66] Cynthia Dwork and Moni Naor, 'Pricing via Processing or Combatting Junk Mail' (12th Annual International Cryptology Conference, Santa Barbara, August 1992).

method to establish consensus and ensure the integrity of the Bitcoin network. The PoW consensus algorithm is the initial and pioneering mechanism employed by the Blockchain technology.[67]

The act of publishing a block in a blockchain network is achieved through the successful resolution of a computationally demanding puzzle, which is accomplished by the user who is the first to solve it. The resolution to this enigma is the evidence that they have executed labor. The puzzle has been intentionally crafted in a manner that renders the process of solving it arduous, while the verification of the validity of a solution is comparatively effortless. This mechanism facilitates the validation of proposed subsequent blocks by all other complete nodes, and any proposed block that fails to meet the puzzle requirements would be declined.[68] Upon acceptance, the individual who submits the accurate solution to the puzzle is duly compensated or motivated for their efforts by appending a fresh block to the blockchain. Individuals who engage in the task of adding a new block onto the chain by solving the puzzle are commonly known as "miners." Similar to Bitcoin, an increase in the incentive or reward value results in a corresponding increase in the complexity of the puzzle, necessitating a greater amount of computational power to successfully mine the new block. When examining the PoW model, it is crucial to take into account the expenses associated with computational resources and energy usage.[69]

2.5.2. PROOF OF STAKE (PoS)

The PoS consensus algorithm was initially introduced by King and Nadal in 2012 through the Peercoin cryptocurrency.[70] The PoS paradigm operates under the premise that the degree of investment a user has made in the system is directly proportional to their inclination towards the success of the system, and inversely proportional to their inclination towards undermining it. The term "stake" typically refers to a quantity of cryptocurrency that a user of a blockchain network has committed to the system as an investment. The PoS mechanism operates on a distinct selection process that considers

[67] Azbeg (n 62).
[68] National Institute of Standards and Technology (n 9) 19.
[69] World Intellectual Property Organization (n 10) 16.
[70] Sunny King and Scott Nadal, 'PPCoin: Peer-to-Peer Crypto-Currency with Proof-of-Stake' (*Decred*) <https://decred.org/research/king2012.pdf> accessed 10 May2023.

the stake of validators, as opposed to a competitive process that relies on energy consumption.

In a PoS system, the validators hold a similar role to that of miners in a PoW system. The process of selection enables the network to designate the node responsible for validating the newly generated block through the verification of its possession of a specific quantity of coins, as determined by the "coin age" metric. In essence, the concept of coin age can be defined as the product of the quantity of currency held and the length of time it has been held. Upon selection, a validator proceeds to validate the block by placing a wager on it, and subsequently receives a reward commensurate with the amount of the wager. Although Peercoin is the first cryptocurrency to implement the PoS mechanism, it does not exclusively rely on PoS and instead employs PoW to facilitate the initial creation of the currency. Peercoin is a system that combines both PoW and PoS mechanisms, resulting in a hybrid approach. ‘Next’ is an instance of a cryptocurrency that employs a pure PoS consensus mechanism, without integrating it with PoW.[71]

2.5.3. PROOF OF AUTHORITY (PoA)

The PoA consensus mechanism is designed to exclusively permit pre-established authorities to authenticate transactions and add blocks to the Blockchain. The algorithm entails the selection of a specific group of nodes to serve as validators, granting them the power to both safeguard the Blockchain and modify the ledger. This results in a form of agreement centralization that is controlled by a limited group of identifiable entities. Private and consortium blockchains frequently employ PoA, with trusted nodes being regarded as authorities.

The PoA consensus mechanism relies on an individual's identity and reputation as a form of stake, rather than utilizing coins. Due to their established identity, the authorities are constrained from engaging in malicious behavior in order to safeguard their reputation.[72] The concept entails that the publishing node is committing its identity and reputation to produce and disseminate fresh blocks. The reputation of a publishing node in a blockchain network is determined by the behavior of the node, which is

[71] Azbeg (n 62).
[72] ibid.

subject to the influence of the network's users. The reputation of publishing nodes within a blockchain network is subject to fluctuation based on their adherence to the preferences of network users. Specifically, nodes may experience a loss or gain in reputation contingent upon their actions that are either in disagreement or agreement with the expectations of network users, respectively. There is a negative correlation between reputation and the probability of successfully publishing a block. Hence, it is advantageous for a publishing node to uphold a commendable reputation.[73]

2.5.4. PRACTICAL BYZANTINE FAULT TOLERANCE

Castro and Liskov introduced the PBFT algorithm in 1999 as a means of achieving Byzantine fault tolerance (hereinafter BFT).[74] The PBFT algorithm was introduced as a resolution to the Byzantine Generals problem, a theoretical dilemma concerning the effective execution of an assault on an opposing city by the Byzantine military. In order for the Byzantine military forces to achieve victory, it is imperative that all of the faithful generals collaborate on a unified strategy and launch a coordinated assault. Furthermore, regardless of the actions of the disloyal individuals, the faithful commanders ought to adhere to the predetermined strategy, while a limited faction of traitors has the potential to disrupt the plan. Analogously, within the context of blockchain technology, the PBFT protocol operates to facilitate the attainment of a shared agreement among the nodes involved in the network. Nodes possess a present state that is utilized in conjunction with received messages for computational purposes, thereby facilitating the decision-making process. Subsequently, this determination is disseminated throughout the network. The network's consensus is primarily established through the majority of decisions. Hyperledger, an organization dedicated to the development of consortium blockchain systems for businesses, employs the PBFT as its fundamental consensus mechanism.[75]

[73] National Institute of Standards and Technology (n 9) 23.
[74] Migel Castro and Barbara Liskov, ‘Practical Byzantine Fault Tolerance’ (Proceedings of the 3rd Symposium on Operating Systems Design and Implementation, Los Angeles, February 1999).
[75] Puthal (n 35).

2.5.5. ROUND ROBIN MODEL

The Round Robin consensus model is implemented by certain permissioned blockchain networks. In this consensus model, blocks are created by nodes in a sequential manner. It has a significant historical background that is rooted in the architecture of distributed systems. In order to address scenarios wherein a publishing node is unable to publish a block during its designated turn, such systems may incorporate a temporal constraint to facilitate the publication of blocks by available nodes, thereby preventing unavailability of nodes from impeding block publication. This particular model guarantees that no single node is responsible for generating the majority of the blocks. The aforementioned system is advantageous due to its simplistic methodology, absence of cryptographic enigmas, and minimal power consumption. The consensus model in question is better suited for a permissioned blockchain, wherein the nodes' identities are established and authenticated off-chain. The utilization of round robin in permissionless blockchain networks, which are predominantly employed in various cryptocurrencies, is not optimal due to the requirement for trust among nodes.[76] The reason for this is that malicious nodes have the capability to persistently append supplementary nodes to amplify their likelihood of disseminating fresh blocks. In the event of a highly unfavorable scenario, this could potentially be utilized to undermine the accurate functioning of the blockchain network.

[76] National Institute of Standards and Technology (n 9) 23.

3. BLOCKCHAIN AND ITS RELATIONSHIP WITH LAW

The advent of blockchain technology has initiated a transformative impact on virtually every sector across the globe. The significance of blockchain technology in various domains of societal and commercial existence cannot be underestimated. The technology known as blockchain, which underpins digital currencies such as bitcoin and has various other applications, has gained widespread adoption among professionals beyond the realm of information technology. Blockchain technology has been applied to various sectors, including data management, supply chain management, mobility services, banking and financial services, capital markets for trade settlement, the insurance industry for underwriting, and healthcare and life sciences. These applications and initiatives are among the many examples of the utilization of Blockchain technology. The aforementioned has had a noteworthy influence on the foremost legal sector, pertaining to the manner in which firms cater to their clientele and the administration of legal practices.

The implementation of Blockchain Technology has proven advantageous for both the legal and judicial frameworks. Blockchain technology has had an impact on various aspects of the legal domain, including but not limited to smart contracts, corporate filings, criminal cases, dispute resolution, document notarizations, industry organizations, IPR, land registries and property deeds, law firm operations, and public service records.[77]

Although blockchain technology lacks legal authority at present, it poses several intriguing legal inquiries that warrant examination. Broadly speaking, the examination of the legal ramifications of blockchain technology in a non-specific context is a more complex task than conducting a similar assessment of Bitcoin. The reason for this is that Bitcoin represents merely a singular instance of blockchain technology, whereas the potential applications of blockchain technology are virtually limitless.[78]

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[77] Shivani Singh, 'Blockchain Technology and its Impact on the Legal System' (*Legalbots*, 25 June 2021) <https://legalbots.in/blog/blockchain-technology-and-its-impact-on-the-legal-system-part-i> accessed 12 May 2023.

[78] Nitesh Desai Associates, '*The Blockchain Industry Applications and Legal Perspectives*' (Report, Cm, 2018).

3.1. EXISTING LEGAL FRAMEWORK RELATED TO BLOCKCHAIN

The utilization of blockchain technologies may potentially subject the operator of the blockchain network and/or its participants to legal and regulatory ambiguity. This is due to the fact that numerous governments and regulatory bodies are still in the process of comprehending the intricacies of blockchain technology and determining whether existing laws require revision to effectively account for decentralization. Although certain governments are leading the way in the implementation of blockchain technology, several national and regional regulatory bodies are taking a cautious stance by opting to observe and comprehend the potential consequences of blockchain prior to advancing any supplementary legal or regulatory obligations or directives. The absence of definitive regulatory guidelines and the dynamic nature of the legal and regulatory landscape pose a formidable obstacle for stakeholders in the market. Consequently, it is imperative that they consistently evaluate their involvement in blockchain networks.[79]

At present, there exists no regulatory framework in India to oversee and monitor the implementation of blockchain technology and its multifarious use cases. The utilization of blockchain-related technologies may fall under the jurisdiction of sector-specific regulators, contingent upon the various applications within each sector. In India, the utilization of blockchain technology in capital markets is overseen by the Securities Exchange Board of India (hereinafter SEBI), whereas the regulation of cryptocurrency is under the purview of the Reserve Bank of India (hereinafter RBI). Additionally, the Insurance Regulatory and Development Authority of India (hereinafter IRDAI) is responsible for regulating applications related to insurance. The utilization of technology within the legal profession has evolved over the course of history.[80] The legal industry has experienced a gradual but undeniable growth in technological advancements, resulting in enhanced efficiency, reduced errors, and improved comprehensibility of judicial procedures. The legal industry underwent digitization for the first time amidst the unprecedented pandemic. The legal industry has embraced various technological advancements, such as transitioning from traditional paper filings

[79] World Economic Forum, 'Legal and Regulatory Compliance' (*Weforum*) <https://widgets.weforum.org/blockchain-toolkit/legal-and-regulatory-compliance/index.html#common-legal-and-regulatory-issues-with-blockchain-use> accessed 15 May 2023.
[80] Singh (n 77).

to virtual court hearings, despite certain constraints. The accomplishment was made feasible by the e-committee of the Supreme Court, which was under the leadership of the Honorable Justice DY Chandrachud. The e-committee's contingency plan enabled the courts to maintain their operations uninterrupted during the pandemic. Nevertheless, the blockchain technology remains underutilized.[81]

The legal sector's focus has been drawn to DLT, which serves as the fundamental foundation of cryptocurrencies such as bitcoin and dogecoin, following the Hon'ble Supreme Court of India's ruling[82]. The judiciary determined that the RBI possessed the requisite authority to oversee digital currencies in its capacity to safeguard the economic stability of India. Financial institutions, including banks, that are under the regulatory purview of the RBI are now permitted to provide services related to the trading of cryptocurrencies, as the previous prohibition has been lifted. The SC declared the restrictions on cryptocurrency to be unenforceable due to the RBI's inability to accurately assess the potential economic damages that could result from a ban on cryptocurrency.

The National Strategy on Blockchain was revised and subsequently released in December of 2021. The proposed approach entails the establishment of a nationwide blockchain framework that is dispersed across various locations within the country, with the aim of facilitating the provision of "blockchain as a service". In terms of legal and regulatory considerations, the aim is to incorporate blockchain technologies into the foundational layers while ensuring adherence to legal statutes and jurisprudence for enforceability. The 'Strategy' document outlines prominent blockchain platforms and models, and provides a roadmap for the adoption of blockchain technology in the country. The document also identifies specific outcomes that are targeted to be achieved within the next five years.[83] The Ministry of Electronics and Information Technology (hereinafter MeitY) has recognized Blockchain technology as a significant research

[81] ibid.
[82] *Internet and Mobile Association of India v. Reserve Bank of India*, 2020 SCC OnLine SC 275.
[83] Akash Kumar, 'Blockchain and Cryptocurrency Laws and Regulation India' (*Global Legal Insights*) <https://www.globallegalinsights.com/practice-areas/blockchain-laws-and-regulations/india#_edn3> accessed 19 May 2023.

area with potential applications in various domains, including governance, banking and finance, and cybersecurity.[84]

France has become the first jurisdiction to establish regulations pertaining to the utilization of blockchain technology in the documentation and transaction of equities. In April 2016, the French government granted authorization for legislation pertaining to "mini bonds." The initial specification of a prevalent digital storage medium or a digital documentation system that facilitates accreditation was delineated in the directive. In 2018, a court in Hangzhou, China acknowledged the validity of proof based on blockchain technology. The SC of China upheld in 2019 that blockchain-based evidence is admissible in legal proceedings.[85]

3.2. POTENTIAL LEGAL STATUS OF BLOCKCHAIN

As we have seen that blockchain as a technology has not been yet subjected to standardisation in the legal sense and does not have a concrete legal definition as such. This section would delve into the aspects of the various legal definitions that blockchains can fall under and its possible uses as a legal tool in legal disputes and other legal matters.

3.2.1. BLOCKCHAIN AS AN ASSET

This section pertains to the inquiry of whether blockchains can be classified as assets. The blockchain technology has surfaced as an open-source innovation that is not proprietary to any particular individual, corporation, or entity. Consequently, it is not feasible to assert a legal claim or title on the blockchain technology per se. Instead, one may only assert a right on a patentable invention or copyrightable work that is generated through, founded on, or derived from blockchain technology, provided that the work or invention satisfies the relevant legal requirements. It is imperative to acknowledge that blockchain-based applications have garnered heightened significance in contemporary times and are poised to assume even greater importance in the times ahead. Currently,

[84] Ministry of Electronics & Information Technology, *National Strategy on Blockchain Towards Enabling Trusted Digital Platforms* (Report, Cm 2021).
[85] Shatakshi Singh, 'IPR and Blockchain Technology' (2022) 5 IJLMH 692, 696.

there is a significant conflict over patents pertaining to advancements utilizing blockchain technology.[86]

Blockchain services rely on algorithms that are based on mathematical theory and/or computer programs. The classification of algorithms and computer programs as inventions under Section 3(k) of the Indian Patents Act[87] (hereinafter IPA) may not be applicable. The statement reads as follows: "*A mathematical or business methodology, a computer programmer in and of itself, or algorithms.*" The precise definition of the term 'per se' has been a subject of debate. Recent observations suggest that the Indian Patent Office has granted patents for computer-related inventions under Section 3(k) on the condition that they offer a technical solution to a technical problem, either by providing a practical application or an enhanced technical impact of the underlying software. The patentability of a blockchain-based service invention is contingent upon a comprehensive analysis of its claims, which must demonstrate a technical solution to a technical issue and a substantial improvement to the underlying technology.[88]

In the case[89], the Delhi High Court rendered a verdict that any innovation that encompasses a technical contribution or has a technical effect and is not exclusively a computer programme per se is eligible for patent protection. The aforementioned analysis was reaffirmed by the solitary adjudicator of the Delhi High Court in a different case.[90]

In the US, the patentability of a blockchain innovation is contingent upon its compliance with Section 101 of the Patent Act[91], as construed by the judiciary subsequent to the Supreme Court's ruling[92] in 2014. The criterion of subject matter eligibility necessitates that a significant proportion, if not the majority, of patentable innovations pertaining to blockchain technology will pertain to the operational mechanics of the blockchain and the dynamics of its interaction with external systems,

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[86] Gonenc Gurkaynak and others, 'Intellectual Property Law and Practice in the Blockchain Realm' [2018] CLSR 847.
[87] § 3 (k) The Patent Act, 1970 (Act 39 of 1970).
[88] Anuja Saraswat, 'Patent Applications for Blockchain Technology: A Comparative Study between Indian and USA' (Mondak, 31 March 2022) <https://www.mondaq.com/india/patent/1178006/patent-applications-for-blockchain-technology--a-comparative-study-between-india-and-usa> accessed 25 May 2023.
[89] *Telefonaktiebolaget Lm Ericsson v. Intex Technologies*, 2015 SCC OnLine Del 8229.
[90] *Ferid Allani v. Union of India and Others,* 2019 SCC OnLine Del 11867.
[91] 35 U.S.C. §101.
[92] *Alice Corp. Pty. Ltd. v. CLS Bank Intern*, 134 S. Ct. 2347 (2014).

including other blockchains, in relation to the data stored on the blockchain. Microsoft's US Patent No. 10,938,548[93] pertains to a blockchain-based "event interface system" that facilitates the transmission of events between distinct blockchains and objects, such as smart contracts, that are situated on a separate blockchain. Square Network possesses the patent US 10,108,938[94], which pertains to the interplay between a payment system that operates outside the blockchain (such as Square's proprietary payment system) and cryptocurrencies that are managed by a buyer on the blockchain.[95]

3.2.2. BLOCKCHAIN AS A PAYMENT SYSTEM

The initial application of blockchain technology was observed within the domain of digital currencies. Since 2009, these cryptocurrencies have been prominently featured in public discourse regarding blockchain technology. Notably, a transaction involving the exchange of 10,000 bitcoins (BTC) for two pizzas occurred, which would presently amount to approximately 100 million USD[96]. At present, the cryptocurrency market exhibits a total valuation that oscillates around 1.3 trillion USD. This renders cryptocurrencies a noteworthy asset category and partially elucidates the rationale behind the preponderance of attention that these platforms have received since the advent of blockchain technology. For nearly a decade, various markets have embraced and utilised Bitcoin and other cryptocurrencies as viable forms of payment. The utilisation of cryptocurrencies for payments raises a fundamental inquiry regarding the legality of such a payment system from a legal standpoint.

The primary matter to be addressed pertains to the determination of whether a cryptocurrency can be categorised as a form of currency. Currently, discussions surrounding this intricate matter persist within diverse legislative bodies, as well as among scholars and other professionals. There exist varying perspectives regarding the fundamental inquiry of whether cryptocurrencies can be classified as a form of currency. As an illustration, Japan has already implemented regulations pertaining to cryptocurrencies as a means of payment. Bitcoin is currently recognised as a legal

[93] US Patent No. 10938548.
[94] US Patent No. 10108938.
[95] Bitlaw, 'Blockchain Patents' (*Bitlaw*) <https://www.bitlaw.com/blockchain/blockchain-patents.html#blockchain-inventions-are-patentable> accessed 27 May 2023.
[96] Rob Price, 'Someone in 2010 bought 2 pizzas with 10,000 bitcoins —which today would be worth $100 million' (*Business Insider*, 28 November 2017) <http://uk.businessinsider.com/ bitcoin- pizza-> accessed 27 May 2023.

tender in only two countries, specifically El Salvador and the Central African Republic. At present, the utilisation of blockchain-based cryptocurrencies as a means of payment does not fall within the purview of any payment system as per the Turkish legal framework.[97]

An additional consideration that warrants attention is that the utilisation of blockchain technology facilitates the exchange of diverse types of assets within the blockchain network. Consequently, it may be necessary to establish or revise regulations to enable such asset exchanges to be recognised as "payments" in exchange for "transfers of ownership or a right to use." The present legal framework does not encompass the electronic exchange or transfer of ownership pertaining to assets such as land, vehicles, or patents, as it falls outside the purview of conventional electronic storage and record-keeping mechanisms. The aforementioned records lack the capacity to respond automatically in scenarios where the payment for the land's value is made. Conventional systems typically employ a practise of modifying the title of the proprietor in lieu of a direct transfer of ownership to the buyer, as necessitated. The utilisation of blockchain technology enables the processing of said transactions, thereby facilitating the exchange of the title for payment, as opposed to a mere alteration of the title in response to payment information provided. Hence, it is imperative to establish regulations for blockchains that encompass not only monetary transactions but also the transfer of other assets on the blockchain. Under such circumstances, it is plausible to conduct transactions pertaining to IPR assets and their transfer through the utilisation of blockchain technology in a digital setting. [98]

3.2.3. BLOCKCHAIN AS AN INTERMEDIARY SERVICE

The purpose of blockchain technology is to make P2P asset trading easier. Platforms that use blockchain technology might therefore be considered intermediate service providers.

Under EU Directive 2000/31/EC[99] intermediary service providers are defined and subject to regulation in the European Union. One must first determine if the services

[97] Gurkaynak (n 86).
[98] ibid.
[99] EU Directive 2000/31/EC of 8 June 2000 on certain legal aspects of information society services, in particular electronic commerce, in the Internal Market [2000] OJ L 178/1.

supplied or anticipated to be provided by the platform are consistent with the description of these services in the Directive in order to determine whether the usage of blockchain may be deemed to fall under the purview of Directive 2000/31/EC. The definition of "information society services" in Article 3(a) of the aforementioned Directive is based on Article 1 of Directive 98/34/EC, [100] which defines a service as "any information society service, that is to say, any service normally provided for remuneration, at a distance, by electronic means, and at the individual request of a recipient of services."

The services that are currently offered through blockchain technology, such as asset transfers, smart contract executions, storage services, etc., or those that will be offered in the future, such as license agreements, voting services, management of the ownership of property, etc., may be regarded as information society services under the aforementioned definition. Let's move on to an evaluation of whether anyone could be held legally liable for the services provided through such blockchain platforms and, if so, who the liable party might be. This is because blockchain technology may very well fall under the scope of this definition; taking into account the current and potential services provided via this technology. Any natural or legal person who offers an information society service is referred to as a service provider in Article 3 of Directive of 2000. Therefore, it is clear that any individual—natural or legal—providing such services on a blockchain platform would be included in the purview of this term, and would therefore be regarded and dealt with as a provider. However, Section 4 of the Directive 2000/31/EC, which governs the responsibility of intermediate service providers, must be followed when determining liability. According to this rule, service providers of services provided through blockchain technology generally qualify as intermediary service providers and should not be held accountable for the information transmitted through the nodes involved in the blockchain as they serve only as conduits for such information, though there may be exceptions in certain situations. This evaluation eliminates any doubt over whether certain service providers, including the

[100] EU Directive 1998/34/EC of the European Parliament and the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations [1998] OJ L 204/37.

Ethereum Foundation, would be accountable for the data they communicated while providing their services.[101]

It is noteworthy that the implementation of blockchain technology has the potential to significantly reduce reliance on conventional intermediaries such as clearing houses and banks. The potential for blockchain to function as an intermediary is rooted in its capacity to engender trust among individuals and facilitate transparency and decentralization. The emergence of blockchain technology raises a significant inquiry regarding the necessity of diminishing or eliminating the involvement of conventional intermediaries such as banks, given that blockchain inherently functions as an intermediary. In order to address this matter, it is imperative to comprehend that the utilization of blockchain as an intermediary can yield a multitude of benefits in contrast to its conventional equivalent. Several advantages can be enumerated, including increased transparency, cost-effectiveness, speed, efficiency, security, and accessibility. Furthermore, the decentralized nature of blockchain technology has the potential to mitigate the risk of singular point manipulation, thereby enhancing trust and security.

3.3. BLOCKCHAIN AND ITS USES IN LAW

The unique attributes of blockchain technology, such as its ability to ensure data integrity, facilitate verification, and provide public transparency of transactions, have the potential to either impede or facilitate the resolution of legal disputes. This is due to the fact that blockchain technology can be leveraged to establish proof, confirmation, or validation of legal transactions. The records on a blockchain possess the characteristics of being time-stamped, immutable, and traceable. The distinctive attributes of blockchain records are commonly cited in discourse surrounding blockchain technology as they constitute the fundamental elements that establish and signify the reliability of said records. The veracity of records is a paramount concern for legal professionals when presenting arguments or making decisions in legal proceedings. In this regard, blockchain technology assumes a pivotal role from a legal standpoint. The impact of blockchain technology on the field of law is potentially significant. In the foreseeable future, there is a likelihood that blockchain records will

[101] Gurkaynak (n 86).

be regularly presented in courts as evidence, thereby offering a unique and dependable means of substantiation.[102] The legal community has shown significant interest in the legal and quasi-legal aspects of blockchains. However, there has been a growing recognition among legal professionals and academics of the technology's potential for transformative change. [103]

3.3.1. REAL ESTATE

The transfer of land in India has been observed to be a highly intricate process, involving multiple steps that necessitate repeated visits to government offices responsible for overseeing the procedure, which may appear to be superfluous. [104] A number of states have initiated an inquiry into the feasibility of employing blockchain technology for the purpose of land registration and record-keeping. This technology facilitates a comprehensive transformation of the land registration process for state governments. It enables the processing and preservation of information pertaining to the chain of title and land use, which was previously an intricate procedure. [105]

The current land registry system is characterised by a significant number of intermediaries, which results in an elevated risk of fraudulent activities, prolonged time delays, and an excessive degree of human intervention. The application of blockchain technology in land registration has the potential to address the aforementioned issues.[106]

The blockchain's decentralised and trustless nature holds promise for eliminating intermediaries, disrupting current identity verification procedures via digital IDs, mitigating fraud risk by generating immutable digital ownership certificates for each property, and monitoring property regulatory compliance.[107] The International Blockchain Real Estate Association (hereinafter IBREA) has observed that *"the*

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[102] ibid.
[103] Eric Alson, 'Blockchain and the Law – Legality, Law-like Characteristics, and Legal Applications' in Dr. Liew Voon Kiong, *Blockchain Handbook: A Beginner's Guide to Blockchain* (Independently Published 2021).
[104] NITI Aayog, 'Blockchain the India Strategy: Towards Enabling Ease of Business, Ease of Living, and Ease of Governance (Report, Cm, 2021) 31.
[105] Shivani Singh, 'Blockchain Technology and its Impact on the Legal System- Part II' (*Legalbots*, 25 June 2021) < https://legalbots.in/legal-blog/blockchain-technology-and-its-impact-on-the-legal-system-part-ii> accessed 12 May 2023.
[106] Shamima Nasrin Mukta, 'Blockchain Technology: An Overview' (Chittagong University of Engineering and Technology Conference, Chittagong, March 2023).
[107] Nitesh Desai Associates (n 78) 11.

blockchain technology provides a universally accessible protocol for various real estate transactions such as property acquisition, conveyancing, recording, escrow, crowdfunding, and other related activities. The implementation of blockchain technology has the potential to decrease expenses, eliminate fraudulent activities, accelerate transaction processing, enhance financial confidentiality, globalise markets, and transform real estate into a fluid asset." [108] Several developed nations, such as the US, Netherlands, UK, and Sweden, have implemented measures to incorporate blockchain technology into their respective land registration systems, owing to its advantageous features.

3.3.2. BANKING

The implementation of blockchain technology in the financial-services industry has been observed to enhance transparency. The utilisation of a public ledger for conducting transactions facilitates the identification and resolution of inefficiencies and fraudulent activities. A significant issue associated with digital transactions pertains to the potential vulnerability to hacking or fraudulent activities. The implementation of blockchain technology has the potential to enhance the security of transactions. Blockchain-based transfers exhibit superior speed and traceability compared to conventional banking transactions. The removal of intermediaries has the potential to reduce expenses, thereby facilitating global fund transfers. [109]

Currently, financial institutions are conducting trials on the blockchain platform for transactional purposes. The integration of blockchain technology in the banking sector offers several benefits in comparison to traditional methods, including decentralised trust, heightened security, reduced expenses, and improved efficacy. Several prominent banking institutions, including Goldman Sachs, J.P Morgan, Citi bank, and Wells Fargo, have established their own blockchain laboratories in partnership with various blockchain platforms. Standard Chartered Bank leverages the enterprise-level blockchain platform "Ripple" to facilitate its inaugural cross-border transactions.[110] The

[108] ibid 12.
[109] Nick Oberdeiden, 'How Blockchain Impacts the Legal Profession' (JDSUPRA, 21 February 2023) < https://www.jdsupra.com/legalnews/how-blockchain-impacts-the-legal-6422930/> accessed 30 May 2023.
[110] Ye Guao and Chen Lang, 'Blockchain Application and Outlook in the Banking Industry' [2016] Finan Innov 2, 16.

implementation of blockchain technology has facilitated the expeditious processing of transactions by banks, reducing the time required from two days to a mere ten seconds. This has resulted in a significant enhancement of the efficiency of clearing and settlement of financial assets subsequent to transactions. Furthermore, the implementation of blockchain technology has the potential to assist financial institutions in expediting cross-border transactions and instantaneous payments through the consolidation of nodes within a blockchain network, as opposed to relying on a centralised banking authority to manage payment processing. Additionally, it facilitates round-the-clock processing of transactions.[111]

The utilisation of a tamper-proof format for storing information in blocks facilitates enhanced data mobility and reduced Know Your Customer (hereinafter KYC) processing time. Furthermore, it facilitates completely automated transactional procedures, encompassing payment and settlement, while eliminating any documentation delays resulting from redundancy. The data stored on a blockchain is characterised by its robust security, comprehensive nature, precision, and dependability. In addition, the utilisation of a singular, publicly accessible ledger eradicates the confusion and intricacy that arises from the existence of multiple ledgers.

3.3.3. HEALTHCARE

The healthcare industry stands to benefit significantly from the implementation of blockchain technology, which is characterised by its decentralised and distributed nature. The implementation of blockchain technology has been shown to improve the calibre of healthcare services through the frequent storage and sharing of medical information among pertinent stakeholders, including patients, physicians, healthcare providers, pharmacies, insurance companies, and researchers. The utilisation of medical chain, a blockchain framework, has been implemented in the UK for the purpose of preserving patient information. The utilisation of blockchain technology in clinical trials and the administration of trial subject consent has the capacity to enhance transparency, auditability, and accountability of medical professionals and researchers.[112] The implementation of blockchain technology in the pharmaceutical

[111] Mukta (n 106).
[112] ibid.

sector has the potential to mitigate the growing concerns pertaining to the proliferation of spurious and unauthorised medications. Furthermore, blockchain technology has potential applications in the healthcare industry, such as facilitating the global sharing of patient data for international medical services, managing medical history, controlling access to healthcare data, and managing drug supply chains.[113]

3.3.4. CRIMINAL CASES

Blockchain technology has the potential to provide advantages to the criminal justice system. In criminal proceedings, an extensive array of documents and records are typically involved, necessitating the need for proper authentication, recording, and secure storage. Accurately tracking the chain of custody for documents or items is deemed crucial in certain instances. In a hypothetical scenario, it is possible to record case information onto a blockchain from the point of citation or arrest of a defendant. The implementation of blockchain technology for logging cases and their records would potentially improve the accessibility of information to the public, while simultaneously ensuring the security and reliability of record keeping. The potential establishment of blockchain-based records as a benchmark for assessing the admissibility of crucial evidence in legal proceedings is a matter of reliability.[114]

3.3.5. TELECOM

In July 2018, the Telecom Regulatory Authority of India (hereinafter TRAI), which serves as India's telecommunications regulator, issued a notification regarding the Telecom Commercial Communications Customer Preference Regulation, 2018 (hereinafter TCCPR Regulations). Although blockchain and DLT are not always interchangeable terms, the TCCPR Regulations require telecom operators to employ DLT in order to address the issue of unsolicited commercial communication. The TCCPR Regulations mandate that telecommunication "access providers" must integrate DLT into their systems, specifically permissioned and private DLT networks, in order to facilitate regulatory compliance checks for the transmission of commercial communications. Additionally, these providers must utilise smart contracts to manage the flow of commercial communications between entities. The press release

[113] Deloitte, Blockchain: An Enabler for Life Sciences and Healthcare (Report, Cm, 2016) 12.
[114] Oberdeiden (n 109).

acknowledges that DLT is a viable option for the implementation of Regulatory Technology in order to regulate and manage the Unsolicited Commercial Communication (hereinafter UCC) ecosystem.[115] The TCCPR Regulations emphasise that DLT has the capability to facilitate the requirements of telecom service providers, telemarketers, and mobile users in terms of enhanced supervision and administration of UCC, when compared to conventional record keeping systems.

3.3.6. ENFORCEMENT AND JURISDICTION

The incorporation of blockchain technology poses a challenge regarding jurisdictional matters in the event of transactional disputes, as the validation process may be executed by a node situated in a distinct jurisdiction. Nodes refer to the individuals or entities that participate in a blockchain network by means of various computer or electronic software connections. Determining a court's jurisdiction over a blockchain dispute and the enforcement of its judgement may hinge on the placement of nodes or the topic of transactions. The unification and synthesis of all parties involved in litigation, such as lawyers, experts, and investigative agencies, onto a single blockchain platform has the potential to establish a secure and safe digital environment for efficient and cost-effective document exchange across multiple agencies. The utilisation of blockchain technology will provide a secure and immutable means of accessing information, as the responsibility of verifying the reliability of data blocks will fall upon the miners, who are the participants tasked with validating the authenticity of newly created blocks. The proposed measure has the potential to optimise the court's efficiency by reducing the time spent on minor concerns, thereby enabling the court to concentrate solely on the adjudication of the case.[116]

The relevance of Section 65B of the Indian Evidence Act, 1872[117], cannot be overstated in terms of its significance for the enforcement and jurisdiction of transactions carried out via a blockchain network in India. Given that the data is stored within the blockchain network. The admissibility of electronic evidence in courts of law is regulated by Section 65B. This section stipulates that computer-generated records are admissible as evidence without the need for additional proof or presentation of the

[115] Mukta (n 106).
[116] Singh (n 105).
[117] § 65 B, The Evidence Act, 1872 (Act 1 of 1872).

original, provided that they comply with the restrictions outlined in the relevant subsection of section 65B.[118]

3.3.7. ELECTRONIC CONTRACTING

The Information Technology Act[119] (hereinafter IT Act) permits the utilisation of digital signatures for the purpose of document authentication. The IT Act encompasses regulations pertaining to the jurisdiction of certifying entities, protocols for the issuance of licences, and corresponding accountabilities. Digital signatures are utilised by smart contracts to enable authentication and restricted access. Notwithstanding the aforementioned approach of utilising self-generating digital signatures, the IT Act does not unambiguously proscribe the utilisation of self-generating digital signatures through blockchain technology. Nonetheless, due to the absence of a provision for prompt acknowledgement of the aforementioned, any agreement established utilising blockchain technology that necessitates a signature for verification purposes is rendered null and void.[120] Although there is no legal obligation for blockchain networks to ensure the protection of data privacy and security, they may be subject to compliance with the overarching principles and regulations governing cybersecurity and privacy in India. The decentralised nature of blockchains is anticipated to give rise to enforcement challenges.

3.3.8. CORPORATE FILINGS

It is plausible that blockchain platforms will be utilised for the maintenance of corporate filings and other related records in the near future. From a certain perspective, it can be argued that a corporation is essentially comprised of its documented records. The implementation of blockchain technology enables the recording of all corporate documents and transactions, thereby establishing an unalterable record of all corporate activities. The state of Delaware made a modification to its legislation in 2017, which permits corporations to uphold their corporate records through the utilisation of

[118] Chandan Goswami, 'Effective use of Blockchain in the Legal Sector – A Near Future or A Distant Possibility?' (*India Legal*, 20 December 2020) <https://www.indialegallive.com/special/effective-use-of-blockchain-in-the-legal-sector-a-near-future-or-a-distant-possibility/> accessed 1 June 2023.
[119] The Information Technology Act, 2000 (Act 21 of 2000).
[120] Rachit Bahl and Aparajita Rana, 'India: Data Protection and Cyber Security' (*AZB Partners*, 13 May 2013) <https://www.azbpartners.com/bank/india-data-protection-cyber-security/> accessed 1 June 2023.

blockchain technology. The amendment in question represents a noteworthy advancement towards the broad adoption of blockchain technology for corporate records, particularly in light of Delaware's status as a prominent location for corporate incorporation. It is plausible that governmental entities may ultimately furnish blockchain-based platforms for enterprises to furnish their corporate registrations and pertinent documentation. The implementation of this process will result in the establishment of an enduring, unalterable, and easily verifiable documentation of all modifications. In order to provide counsel to their clients regarding the intricacies, advantages, and potential drawbacks of utilising blockchain for corporate record-keeping purposes, it may be necessary for corporate attorneys to acquire knowledge of blockchain technology.[121]

[121] Oberdeiden (n 109).

4. BLOCKCHAIN AND ITS RELATIONSHIP WITH INTELLECTUAL PROPERTY RIGHTS

The relationship between Blockchain and IPR is mutually beneficial. On one hand, it can be observed that Blockchain technology is safeguarded by IPR. On the other hand, it can be argued that Blockchain has the potential to augment the existing IPR framework.[122]

As the global community prepares to adopt blockchain technology to unlock untapped potential across diverse sectors, IP is poised to assume a pivotal position in the years ahead. The quantity of organisations seeking to obtain patents for technology utilising blockchain as a foundational framework has exhibited a consistent increase. A robust IP framework necessitates the existence of sturdy, auditable, and confirmable documentation of IP entitlements. In the current context, where IP records are being stored separately at individual IP offices, there exists a potential for data inconsistency. In this scenario, the verification of data accuracy and the maintenance of its ongoing currency present a significant obstacle. The utilisation of blockchain technology can provide significant advantages to IP offices worldwide in managing their IP registries. The blockchain's characteristics of immutability, reliability, security, efficiency, and federated features have the potential to be applied in various stages of IPR, including registration, licencing, contractual agreements, and enforcement.[123]

The regulation of IPR is presently overseen by third-party authenticators, such as government agencies and ministries operating within the relevant jurisdiction. The advent of online media and global digitalization has given rise to physical constraints. The primary concerns regarding copyright law in the digital realm pertain to the absence of transparency and easily accessible information regarding the legal status of copyrighted material, the potential for piracy and infringement of intellectual property rights, and the challenges faced by authors in receiving just compensation. The utilisation of blockchain technology presents a viable solution that is well-suited to address the challenges associated with enforcing IPR. The technology in question facilitates the facile establishment and verification of a product's authenticity and

[122] Shatakshi Singh, 'IPR and Blockchain Technology' (2022) 5 IJLMH 692, 697.
[123] BP Singh and Anand Kumar Tripathi, 'Blockchain technology and Intellectual Property Rights' (2019) 24 JIPR 41, 42.

originality, thereby rendering it equally facile for law enforcement authorities to detect spurious merchandise. Blockchain's unique value proposition lies in its enhanced level of trust and potential for scalability. The primary purpose of a digital fingerprint is to facilitate liability exemption for online intermediaries, which is heavily dependent on the policies and infrastructure of a given online platform. From a prolonged temporal viewpoint, the aforementioned system could potentially exhibit greater dependability and sustainability. Moreover, in the event that the registry is constructed using blockchain technology, duplicates of it can be obtained by all users. It is imperative to ensure the preservation of copyright ownership records in the event of the dissolution of the entity responsible for maintaining the corresponding database.[124]

The approval processes of patent authorities and other regulatory bodies are often characterised by their protracted duration. The potential occurrence of this event could pose a threat to various sectors wherein established entities are required to promptly take measures to protect their innovations and sustain their competitiveness. The implementation of decentralised registration platforms has the potential to streamline the process of enrolling new intellectual property, revising filings, and exchanging title. This is achieved by replacing centralised certification systems with a more efficient and effective alternative. The utilisation of blockchain technology by regulatory bodies has the potential to enhance their operational efficiency and effectiveness, particularly in situations where resources are constrained.[125]

It has been observed that several intellectual property offices have initiated efforts towards addressing this issue. The European Union Intellectual Property Office (hereinafter EUIPO) has initiated a "blockchain hackathon" with the objective of exploring proof-of-concept initiatives to determine the potential applications of blockchain technology by enforcement agencies in developing advanced anti-counterfeiting infrastructure. It is noteworthy that blockchain technology can be utilised in conjunction with another promising technological advancement, namely Artificial Intelligence (hereinafter AI), specifically in the context of domain-specific AI. In the context of IPR, such collaboration has the potential to facilitate the registration procedure to be fully automated, with minimal human intervention or contribution. The

[124] Jitasha Bahl, 'Blockchain and its Application in the Field of Intellectual Property Rights' (2021) 2 Law Essentials J 302, 303.
[125] Singh (n 122) 697.

utilisation of AI and blockchain technology may be exclusively employed to manage the patent registration process and opposition to designs and trademarks. In prospective scenarios, the uploading of Computer Aided Design (hereinafter CAD) files pertaining to patents, designs, and trademarks onto a public or private blockchain would render the stored data accessible for utilisation by the pertinent parties. AI software has the potential to conduct specific IP evaluations, such as the assessment of the likelihood of confusion in trademark cases or the determination of the existence of an inventive step in a patent application.[126]

An instance of such utilisation can be observed in the blockchain-oriented platform Mycelia, which offers a distributed musical database for artists to exchange music and obtain remuneration for the utilisation of their creations. In 2018, Kodak made an effort to introduce a blockchain-powered platform for photographers named KODAKOne, which aimed to manage image rights. However, the initiative did not yield the desired outcome. Various governments across the globe are currently undertaking experimental initiatives to evaluate the potential utility of blockchain technologies in facilitating their intellectual property operations. The U.S. Customs and Border Protection declared in March 2020 that it had successfully executed a proof-of-concept of a blockchain platform aimed at safeguarding American enterprises against IP infringement. The proposed platform has the potential to facilitate communication among various stakeholders such as manufacturers, retailers, rights holders, and importers with the aim of mitigating the importation of counterfeit products into the US. The platform facilitated the process of product identification and licencing linkage, thereby reducing the need for physical inspections.[127]

4.1. BLOCKCHAIN AND DIFFERENT IPR

In the context of the Internet, the likelihood of infringement occurring at every stage of the IP system is significantly heightened. The high cost of preventing infringement can be attributed to various factors such as the elusive nature of IPR, the difficulty in detecting and prosecuting infringements due to their dispersed and concealed nature,

[126] Gonenc Gurkaynak and others, 'Intellectual Property Law and Practice in the Blockchain Realm' [2018] CLSR 847, 855.
[127] Nick Oberdeiden, 'How Blockchain Impacts the Legal Profession' (JDSUPRA, 21 February 2023) < https://www.jdsupra.com/legalnews/how-blockchain-impacts-the-legal-6422930/> accessed 30 May 2023.

and the need for specialised expertise and technical know-how in enforcing these rights. The implementation of blockchain technology can facilitate the establishment of registration time that is resistant to tampering, as well as attribution of ownership and other property rights certificates for the rightful owners. Additionally, it can enhance the verification of the identity of obligees, thereby leading to an improvement in the efficiency of safeguarding rights.[128]

4.1.1. PATENT AND BLOCKCHAIN

As per the WIPO, *"A patent is an exclusive right granted for an invention, which is a product or a process that provides, in general, a new way of doing something, or offers a new technical solution to a problem. To get a patent, technical information about the invention must be disclosed to the public in a patent application."*[129] A patent is a legal right bestowed by the government to an inventor for a specific duration, which allows them exclusive rights to their invention while preventing others from using it. The implementation of a patent system serves various beneficial functions.

The term "patent" originates from the Latin word "patere," which connotes the act of exposing or revealing, specifically to render something accessible for public scrutiny. The Indian Patent Act of 1970[130] applies to the legal framework governing patents within the jurisdiction of India. Section 2 (m)[131] of the aforementioned act, defines patent as *"patent means a patent for any invention granted under this Act"*. Additionally, Section 2 (j)[132] provides a definition for invention as *"invention means a new product or process involving an inventive step and capable of industrial application"*. The Allahabad HC held that *"an invention is not a property right unless it has been patented."*[133] There exist three fundamental criteria that an invention must meet in order to qualify for patent protection. Initially, it is imperative that the invention is deemed novel, indicating that it does not currently exist. The SC held that[134] *"The fundamental principle of patent law is that a patent is granted only for an invention*

[128] Fan Yang and others, 'The Survey on Intellectual Property Based on Blockchain Technology' (IEEE International Conference on Industrial Cyber Physical Systems, Taipei, May 2019).
[129] WIPO, 'Patents' (*WIPO*) <https://www.wipo.int/patents/en/> accessed 20 May 2023.
[130] The Patent Act, 1970 (Act 39 of 1970).
[131] § 2 (m) The Patent Act, 1970 (Act 39 of 1970).
[132] § 2 (k) The Patent Act, 1970 (Act 39 of 1970).
[133] *Shinning Industries v. Shri Krishna Industries*, AIR 1975 All 231.
[134] *Bishwanath Prasad Radhe Shyam v. Hindustan Metal Industries*, (1979) 2 SCC 511.

which must be new and useful." The second requirement for patentability is non-obviousness, which entails that the invention must represent a substantial advancement over prior art. The Bombay HC held that *"If the invention was obvious, there could be no inventive step whatsoever."*[135] Similarly the SC held that *"A necessary factor is that such invention should make it non obvious to a person skilled in the art."*[136] It is not sufficient for the invention to merely incorporate a new technology in order for the inventor to be granted patent rights. Thirdly, it is imperative that the invention is deemed useful in a legitimate manner, signifying that it should not be exclusively utilised for any unlawful purposes and must serve a genuine purpose to the global community. The Delhi HC stated that *"Section 2 (1) (ac) necessitates that an invention must have commercial use or manifestation."*[137]

The codification of US patent laws is found in Title 35 of the U.S. Code[138]. The enactment of the law also resulted in the establishment of the United States Patent and Trademark Office (hereinafter USPTO), which is vested with the exclusive authority to grant patents. Patents are a type of IP that safeguard innovations with the aim of incentivizing inventors to allocate resources towards the advancement of novel concepts. According to the legal provisions of patent law, the proprietor of a patent is granted the exclusive right to prevent third parties from engaging in the manufacture, utilisation, commercialization, or importation of the patented invention within the jurisdiction of the country in question. The temporal scope of the power to exclude is restricted; in the US, utility patents are safeguarded for a period of twenty years commencing from the date of the application submission.[139]

The implementation of blockchain technology has the potential to enhance the existing patent system through various means. At present, the authority to scrutinise and disclose innovations is vested in the patent offices of various nations, such as the USPTO in the US and the Office of the Controller General of Patents, Designs and Trademarks (CGPDTM) in India. The offices in question serve as the focal point of the patent system within their respective nations, and as such, are tasked with a significant

[135] *Press Metal Corporation Limited v. Noshir Sorabji Pochkhanwalla*, AIR 1983 Bom 144.
[136] *Bajaj Auto Ltd. v. TVS Motor Company Ltd.*, 2009 SCC OnLine SC 1647.
[137] *F. Hoffman-La Roche Ltd. v. Cipla Ltd.*, 2015 SCC OnLine Del 13619.
[138] 35 U.S.C.
[139] Seda Fabian, 'Blockchain and Intellectual Property Rights' (2021) 25 Intell Prop & Tech L J 147, 151.

workload and level of responsibility. This can result in an overwhelming volume of work, potentially leading to a decline in the quality of patents issued. Consequently, numerous initiatives have been implemented in the US to address concerns related to patents of inferior quality. Numerous endeavours have given rise to various novel developments, with AI being frequently cited as a prospective approach to alleviate the administrative workload imposed on the USPTO.[140]

A highly innovative application of blockchain technology is the development of a decentralised patent system. This system would enable inventors to submit their patent applications to a shared patent record, rather than to the national patent offices. This would significantly reduce the administrative workload currently borne by these offices. After a predetermined period of time, the shared record would be made available to the public. The implementation of such a system could enhance the efficiency of patent application and examination procedures by means of reducing bureaucratic hurdles. Additionally, it has the potential to enhance the quality of patents as the involved parties would be responsible for certain tasks that are presently carried out by patent offices. The implementation of decentralisation, heightened transparency, and distribution may result in the establishment of an international patent database.[141] This could potentially mitigate the necessity of filing for patents in various countries, which is a laborious and costly process. Moreover, this approach may prove to be more advantageous than patents filed under the Patent Corporation Treaty (hereinafter PCT).

In jurisdictions that employ the "first to file" system, such as the US, the date of patent filing holds significant importance. In this regard, the employment of blockchain's timestamping mechanism can prove to be highly advantageous in establishing and verifying the date of filing. Blockchain technology can offer additional advantages to patents by enabling the integration of smart contracts to automate the licencing process. This could potentially enhance the commercialization phase for inventors.

[140] ibid.
[141] Gaetan de Rassenfosse and Kyle Higham, ‘Decentralizing the Patent System’ (2021) 38 Gov. Inf. Q. 1, 11.

4.1.2. COPYRIGHT AND BLOCKCHAIN

The legal concept of copyright pertains to the IPR granted to individuals who have created original literary, dramatic, musical, artistic, cinematographic, and sound recording. This principle is also applicable to architectural creations and computer programmes or software. The concept can be interpreted as a collection of entitlements that encompass the privileges of duplicating, disseminating, modifying, and translation of the IP. The SC held that *"The primary objective of copyright is not to reward the labour of authors, but to promote the progress of science and useful arts."*[142] The concept of copyright is designed to safeguard the IPR of authors and creators, with the ultimate goal of incentivizing and compensating innovative endeavours.[143] The term "copyright" pertains to a collection of exclusive privileges granted to the copyright holder under Section 14 of the Act.[144] The aforementioned entitlements are exclusive to the copyright proprietor or any other individual who has been lawfully authorised by the copyright proprietor. The Andhra Pradesh HC held that *"The copyright law is developed by the nations to assure the creator who risk their capital in putting their works before the public, the right to their original creation."*[145] The aforementioned rights encompass a range of privileges, such as the ability to adapt, reproduce, publish, translate, and communicate to the public.

Section 13 of the Indian Copyright Act, 1957 (hereinafter ICA) copyright subsists in the following works – *"(a) original literary, dramatic, musical and artistic works; (b) cinematographic films; and (c) sound recording."*[146] The SC observed that *"Section 13(a) protects original work, whereas section 23(b) and (c) protect derivative works."*[147] For original literary works the following non exhaustive list have been deemed to be capable of being copyrighted through various court decisions – school

[142] *Eastern Book Company v. D.B. Modak*, (2008) 1 SCC 1.
[143] Hana Onderkova, 'Copyright Protection in India – Overview and Recent Developments' (*European Commission IP Helpdesk*, 2 March 2022) <https://intellectual-property-helpdesk.ec.europa.eu/news-events/news/copyright-protection-india-overview-and-recent-developments-2022-03-02_en> accessed 3 June 2023.
[144] The Copyright Act, 1957 (Act 14 of 1957).
[145] *Holy Faith International v. Dr. Shiv K. Kumar*, AIR 2006 AP 198.
[146] V.K. Ahuja, *Law Relating to Intellectual Property Rights* (3rd edn., Lexis Nexis 2017) 19.
[147] *Entertainment Network (India) Ltd. v. Super Cassette Industries Ltd.*, 2008 SCC OnLine SC 951.

textbooks[148], question papers set for examination[149], business letter[150], short notes on cases[151], editorial comments[152], research theses and dissertations[153], compilation of a book on household accounts and domestic arithmetic[154] etc.

Across the course of IPRs' history, governments have mandated that authors fulfil a range of formal requirements in order to safeguard their works. In contrast to patents or trademarks, copyright safeguard is presently established inherently upon fixation of the original work of authorship in a concrete medium. The imposition of compulsory registration would contravene legal statutes, specifically Article 5 of the Berne Convention[155], which has been integrated into the Agreement on Trade-Related Aspects of Intellectual Property Rights (hereinafter TRIPS)[156] and the WIPO Copyright Treaty (hereinafter WTC)[157]. It is important to acknowledge that the registration of copyright offers numerous benefits, as failure to register may preclude one from pursuing infringement claims.

The implementation of blockchain technology has the potential to simplify the copyright process by providing a time-stamp for each copyrighted work, similar to the aforementioned description. Furthermore, the implementation of blockchain technology could potentially address the issue of insufficient transparency and restrict the capacity of online platforms functioning as intermediaries for copyright information to unilaterally modify regulations or guidelines pertaining to platform usage. It is possible for a user to register their work on the blockchain, which would result in the creation of immutable evidence of ownership at the time of recording. This evidence may also include specific details, such as the percentage of ownership. The implementation of a hashed and time-stamped record could potentially serve as a valuable tool in addressing prevalent copyright concerns, such as establishing the

[148] *Ghafur v. Jwala*, AIR 1921 All 95.
[149] *Aggarwala Publishing House v. Board of High School and Intermediate Education, UP*, AIR1957 All 9.
[150] *British Oxygen Co. v. Liquid Air Ltd.*, (1925) Ch 383.
[151] *N.T. Raghunathan v. All India Reporter*, AIR 1971 Bom 48.
[152] *Taxmann Allied Services Pvt. Ltd. v. Casansaar Web Solutions Pvt. Ltd.*, 2016 (65) PTC 127 Del.
[153] *Fateh Singh Mehta v. Singhal*, AIR 1990 Raj 8.
[154] *Manohar Lal Gupta v. State of Haryana*, (1977) 79 Punj LR 181.
[155] Article 5, The Berne Convention for the Protection of Literary and Artistic Works (signed 9 September 1886, entered into force 5 December 1887).
[156] The Agreement on Trade-Related Aspects of Intellectual Property Rights (signed 15 April 1994, entered into force 1 January 1995).
[157] The World Copyright Treaty (signed 20 December 1996, entered into force 6 March 2002).

precise moment of creation or documenting the contemporaneous transactions related to copyrights, licences, and assignments. Enabling authors to register their copyright would not pose a risk to them; rather, it could safeguard even anonymous authors by offering a form of digital identification that preserves author anonymity while safeguarding their IP. The blockchain has the potential to address a matter pertaining to orphan works and the public domain. The utilisation and availability of orphan works are restricted due to their safeguarding under copyright legislation. The implementation of a decentralised blockchain-based registry system could potentially be facilitated by blockchain technology. Additionally, the implementation of blockchain technology has the potential to lessen the occurrence of orphan works in the future, as it can significantly increase the difficulty of disassociating authors from their respective works.[158]

A significant limitation pertains to the veracity of online content, as not all information uploaded can be deemed accurate. However, once data is recorded on the blockchain, it becomes arduous to substantiate any inaccuracies. The veracity of data stored in a blockchain may be compromised as the inputs are sourced externally, rendering the blockchain incapable of independently validating the reliability of information.

The utilisation of the anti-tampering mechanism inherent in blockchain technology enables the safeguarding of the forensic and traceability aspects of IPR. The utilisation of smart contract technology can efficiently facilitate the execution of copyright transaction operations, thereby fostering the advancement of copyright content commercialization. In order to address concerns related to data integrity and privacy protection, it is recommended that digital fingerprints of electronic data be pre-stored on the blockchain. This will enable efficient verification in the event of disputes. In contrast to conventional copyright protection methods, blockchain technology offers a more efficient, lightweight, and cost-effective solution for achieving traceability, certificate storage, and anti-counterfeiting requirements.[159]

The benefits of utilising blockchain technology for safeguarding copyright are succinctly outlined as follows: The deposit certificate's credibility is ensured by its

[158] Fabian (n 139) 158.
[159] Tao Jiang and others, 'Research on the Application of Blockchain in Copyright Protection' (International Conference on Culture-oriented Science & Technology, Beijing, October 2020).

multi-centre nature and the inability to tamper with the information contained within it. All data related to transactions and copyright is recorded on the blockchain with temporal information, allowing for precise tracking. The digital fingerprint of the work can be uploaded at the creation stage of the work, and the copyright of the work is protected throughout the creation cycle. Each individual node within the system has the capability to possess its own ledger, thereby increasing the level of transparency of the data. Smart contracts facilitate streamlined digital copyright transactions and enable multiple distributions. Based on the technology of alliance chains, it facilitates communication with both the upstream and downstream sectors of the industry, thereby enabling convenient monitoring and greater openness. The system is automatically executed, and the decentralization of some links greatly reduces the cost of copyright protection.[160]

4.1.3. TRADEMARK AND BLOCKCHAIN

A trademark is defined as any element, such as a word, name, symbol, device, configuration, shape of goods, packaging, combination of colours, or combination of any of these, that is utilised by an individual or entity to differentiate their goods or services from those offered by others.[161]

The Trademark Act, (hereinafter TMA) 1999[162] governs trademarks in India and section 2 (1) (zb) of the said Act defines trademark as *"trade mark means a mark capable of being represented graphically and which is capable of distinguishing the goods or services of one person from those of others and may include shape of goods, their packaging and combination of colour."* The SC held that *"Mark includes among other things name or word also. Name includes any abbreviation of a name."*[163] The fundamental aspects of a trademark can be identified as follows: firstly, it must constitute a distinctive mark; The Calcutta HC in 1977 held that *"Distinctiveness means some quality in the trade mark that earmarks the goods so marked so distinct from those of other producers of such goods."*[164] Secondly, it must possess the quality of being

[160] Roman Beck and others, 'Blockchain – The gateway to Trust-Free Cryptographic Transactions' (Twenty-Fourth European Conference on Information Systems, Istanbul, June 2016).
[161] Ahuja (n 146) 279.
[162] The Trade Marks Act, 1999 (Act 47 of 1999).
[163] *Laxmikant V Patel v. Chetanbhat Singh*, AIR 2002 SC 275.
[164] *The Imperial Tobacco Co. of India Ltd. v. The Registrar of Trade Marks*, AIR 1977 Cal 413.

graphically represented; and thirdly, it must possess the ability to distinguish one's goods and services from those of others. The Delhi HC stated that *"The trademark legislation is to protect the trader and consumer against dishonest adoption of one's trademark by another with the intention of capitalizing on the attached reputation and goodwill."*[165]

The present procedure for registering a trademark is characterised by a significant investment of time and resources, as well as a substantial reliance on manual labour. In addition, the expenses associated with the upkeep and modernization of IP systems are significant due to the multitude of tasks involved in trademark registration, renewal, and management. These tasks include conducting preliminary trademark searches, investigating instances of IP infringement, obtaining licences and certifications, among others. Moreover, the existing procedure for trademark registration solely empowers the proprietor of the trademark to uphold their entitlements within the jurisdiction where the IPR was officially registered. Trademark applicants who desire international protection and recognition of their mark must undertake several measures before filing the trademark in a foreign jurisdiction. These measures include determining the countries in which they may wish to register their trademark based on the availability of their goods or services or potential availability in the future, conducting individual investigations of any trademark agreements or treaties that their country has with other countries, and conducting a thorough search of the trademark databases in these foreign jurisdictions. The requirement to register IP in multiple jurisdictions, coupled with the intricate registration process, places significant procedural, financial, and enforcement-related burdens on IP owners. A significant issue confronting the trademark system pertains to the verification of the genuineness of tangible trademark records and detecting instances of infringement and misuse of IP.[166]

The integration of blockchain technology has the potential to significantly enhance the value proposition of trademark law. The utilisation of blockchain technology has the potential to facilitate the registration and utilisation of trademarks, manage the resolution of disputes and applications, and mitigate the issue of counterfeiting by

[165] *Cadbury India Limited v. Neeraj Food Products*, 2007 (35) PTC 95 Del.
[166] Girish J. Showkatramani and others, 'A Secured Permissioned Blockchain Based System for Trademarks' (IEEE International Conference on Decentralized Applications and Infrastructures, Newark, April 2019).

preserving pertinent information, such as the identity of genuine products throughout their supply chain, within the blockchain. Enhancing the safeguarding of authentic trademarks could be achieved by implementing a comprehensive tracking system for goods bearing the mark, which would trace their journey from the point of origin, through customs, and up to the storage facility. The implementation of blockchain technology has the potential to maintain a comprehensive log of previous applications of a trademark.[167] The utilisation of blockchain technology could potentially serve as a means to demonstrate the relinquishment of a trademark, thereby resulting in the forfeiture of the associated trademark entitlements. Blockchain technology has the potential to be utilised in the combat against counterfeit products. The implementation of supply chain tracking can facilitate more precise verification of the legitimacy of branded merchandise upon its arrival at the ultimate destination. The authentication of branded products can be facilitated through a database established by authorised manufacturers, distributors, and sellers. The implementation of blockchain technology can effectively distinguish between counterfeit and authentic products.

The implementation of blockchains has the potential to mitigate the prevalence of counterfeit goods in the consumer market, thereby providing luxury brand trademark owners with a sense of assurance regarding the authenticity of their products.[168] As an illustration, individual luxury branded items are assigned a distinct identifier, such as a QR code. Upon purchasing the product, an individual may utilise the QR code to obtain access to its online certificate. This certificate has been cryptographically signed by the brand and all intermediaries in the supply chain, thereby confirming the product's authenticity. The utilisation of blockchain technology for the purpose of verifying authenticity can also prove advantageous for resellers dealing in luxury goods.[169]

Self-executing smart contracts have the potential to be utilised in the licencing of trademarks. Smart contracts possess the capability to autonomously track and compute the occurrence of royalty payments in accordance with the contractual provisions, and subsequently, transfer the payment to a designated wallet that is owned by the

[167] Fabian (n 139) 158.
[168] Julie Tolok. 'The Use of Blockchain in Trademark and Brand Protection' (*JDSPURA*, 22 June 2021) <https://www.jdsupra.com/legalnews/the-use-of-blockchain-in-trademark-and-1929008/>accessed 5 June 2023.
[169] Katerina Mansour, 'Luxury Brands using Blockchain to fight Counterfeiting' (*Early Metrics*, 13 November 2020) <https://earlymetrics.com/luxury-brands-using-blockchain-to-fight-counterfeiting/> accessed 8 June 2023.

proprietor of the trademark. This results in a trademark licencing agreement that is uncomplicated and readily enforceable.[170] The implementation of blockchain technology can provide assurance regarding the immutability of data, however, it does not inherently validate the authenticity or reliability of the information that was originally recorded. Hence, it is crucial to establish a fundamental level of trust among the involved entities, be it the complete supply chain or two distinct parties engaged in a smart contract. Moreover, the absence of a universally recognised and globally adopted framework for application in safeguarding brand identity and IPR could impede the integration of blockchain technology and its associated benefits, resulting in incongruity and complexity.[171]

4.1.4. TRADE SECRET AND BLOCKCHAIN

A Trade Secret is classified as confidential information that possesses an inherent commercial value and is exclusively known to a limited number of individuals (ideally a small group of people, as this facilitates monitoring and control). It is imperative that individuals who possess the aforementioned data maintain its confidentiality. Typically, such information pertains to data that is deemed confidential and not intended for disclosure to competitors. Feasible safeguarding measures may encompass securely storing sensitive information, executing non-disclosure agreements in instances where proprietary information is to be shared with business associates, and incorporating non-disclosure provisions into contractual agreements, such as licencing agreements, employment contracts, and consortium agreements.[172] The Cour of Appeal in England held that *"Trade secret must not be something which is public property or public knowledge."*[173] The list of customers in a shop can also be a trade secret.[174]

[170] Jake Frankenfield, 'What are Smart Contracts on the Blockchain and How they Work' (*Investopedia*, 31 May 2023) <https://www.investopedia.com/terms/s/smart-contracts.asp> accessed 12 June 2023.
[171] Tolok (n 150).
[172] CADchain, 'Trade Secrets are Highly Valuable Assests. How Can Digital technologies help to Protect Them?' (*cadhacks medium*, 6 April 2021) <https://cadhacks.medium.com/trade-secrets-are-probably-the-most-valuable-assets-how-can-digital-technologies-protect-them-d2f735cb3feb> accessed 14 June 2023.
[173] *Saltman Engineering Co. Ltd. v. Campbell Engineering Co. Ltd.*, (1948) 65 RPC 203.
[174] *Hi-Tech Systems & Services Ltd. v. Suprabhat Ray*, 2015 (63) PTC 479 Cal.

According to Article 39 of the TRIPS[175], the fundamental criteria for a trade secret are as follows: firstly, the information must be confidential, meaning that it is not commonly known or easily available to those who typically handle such information. This was also stated by the Chancery court as *"The ease or difficulty with which the information could be properly acquired or duplicated by others is an important factor."*[176] Secondly, the information must possess actual or potential commercial value due to its confidential nature. Lastly, the rightful owner of the information must have taken reasonable measures to ensure its confidentiality, such as through the implementation of confidentiality agreements.

The extrapolation of potential applications of blockchain technology for safeguarding and implementing trade secrets is readily apparent. By registering a trade secret within blockchain technology, a business can ensure the secrecy of the information. This is achieved through encryption, which renders the information unreadable and secure. As a result, the critical aspect of trade secret confidentiality is preserved. The sole data that would be accessible to the public would be the hash and timestamp. This would function as evidence that the data was present at a particular moment, thereby verifying the timing of a transaction, without disclosing any confidential information.

Furthermore, the implementation of blockchain technology has the potential to furnish substantiation of appropriate precautions taken to safeguard aforementioned confidential business information, in the event of any associated conflict. The pertinent conserved information would encompass the individuals who were granted authorization to the data, as well as the specific timeframes during which they were granted such access. This would serve as a more streamlined mechanism for substantiating instances of misappropriation of the proprietary information. The implementation of blockchain technology has the potential to facilitate the tracking of misappropriation and identification of theft, as the chain inherently generates a traceable record of information upon download.

The origin of the unauthorised download may serve as substantiation of the act of theft. In contrast, it is probable that blockchain technology would not be efficacious in

[175] The Agreement on Trade Related Aspects of Intellectual Property Rights (signed 15 April 1994, entered into force 1 January 1995).
[176] *Coco v. A.N. Clark (Engineers) Ltd.*, (1969) RPC 41.

furnishing evidence of proprietorship of the confidential information, as the blockchain ledger solely exhibits possession at the moment the entitlement is documented. However, substantiating ownership may necessitate additional measures akin to those encountered in the context of copyright and blockchain. The fundamental requirements for trade secrets are the maintenance of data integrity and confidentiality, both of which can be effectively ensured through the utilisation of blockchain technology.[177]

4.2. PROTECTION OF INTELLECTUAL PROPERTY RIGHTS THROUGH BLOCKCHAIN

IPR can be protected in a better manner than the traditional methods by making use of the blockchain technology. In this section we would look into how blockchain can be used for the registration, management and enforcement of IPR.

4.2.1. REGISTRATION OF IP THROUGH BLOCKCHAIN

The majority of IPR, including trademarks, patents, and designs, require registration in order to pursue legal recourse for any instances of infringement. Although it is not a legal requirement, registering one's copyright is strongly recommended due to its numerous advantages. Registration facilitates the provision of evidence of ownership and authorship, thereby simplifying the enforcement of one's rights in cases of infringement. The Bombay HC held that *"Registration of a trade mark gives to the registered proprietor therof exclusive right to use the same in relation to the goods in respect of which it has been registered."*[178] The conventional procedure for registration is a laborious and expensive undertaking. In many instances, the proprietor is only able to exercise their rights following registration within a particular jurisdiction rather than on a global scale. Consequently, the proprietor must register their intellectual property in each country, resulting in significant economic implications. Given the worldwide scope of business, this constraint is insufficient and inappropriate for the requirements of proprietors, particularly in view of the swift tempo of commercial activity in the present-day commercial framework. The use of blockchain technology has the potential to simplify the registration process of IPR, thereby reducing the associated procedural and enforcement-related challenges encountered by IPR holders. This could be

[177] Fabian (n 139) 159.
[178] *N.R. Dongre v. Whirlpool Corporation*, AIR 1995 Delhi 300.

achieved through the provision of a more efficient, expeditious, and cost-effective means of registration.[179]

Blockchain technology is likely to facilitate the development of a shared and decentralised IP registry. This registry would aim to streamline the registration process for applicants and legal representatives, while also enabling secure and synchronised data exchange between interconnected IP offices. At present, IP registries are geographically dispersed across various nations. The construction of a DLT, as opposed to conventional centralised databases, has the potential to transform the IP industry into a ledger that integrates rights without any geographical limitations, thereby interlinking offices and their respective data. The proposed solution aims to establish an unalterable documentation of all occurrences related to the existence of a registered IPR on a worldwide scale. The complete lifespan of an IP asset can be encompassed, including the point of filing an IP application, registration, initial use in trade, licencing or assignment of an IPR, such as a patent, trademark, or industrial design. It would additionally address the logistical aspects of compiling, retaining, and furnishing such evidence.[180]

IPRs are required to be registered in both civil and common law jurisdictions. Whilst the protocols and prerequisites for the registration of IPR may vary across different legal jurisdictions, such discrepancies are unlikely to impede the transformative impact of blockchain technology on the conventional registration procedures. The subsequent segment will delve into the matter of whether the blockchain technology can effectively revolutionise the conventional registration process. Blockchain technology can facilitate autonomous registration of IPR. It is important to acknowledge that the efficacy of this novel methodology varies depending on the specific category of IP being registered.

In order for an invention to meet the criteria for patentability, it must satisfy three primary requirements: novelty, non-obviousness, and utility. Specifically, the invention must be novel, possess an “inventive step”, and demonstrate “industrial applicability”. The utilisation of blockchain technology shows great potential in automating the

[179] Gurkaynak (n 126) 855.
[180] World Intellectual Property Organization, *Blockchain Technologies and IP Ecosystems: A WIPO White Paper* (White Paper, Cm, 2022) 105.

evaluation of these prerequisites, and conceivably eliminating the necessity for human intervention altogether. The utilisation of secure blockchain technology, accessible to all relevant patent offices, for the databases consulted during the assessment process could potentially facilitate the determination of an invention's compliance with the novelty requirement through the collaborative efforts of AI and blockchain technology. The utilisation and practicality of blockchain technology in the registration and implementation of IPR can be further exemplified through the implementation of CAD. Capturing a design through photography from three distinct perspectives is deemed adequate for the generation of a CAD. A CAD has the potential to be integrated into a blockchain-powered application that can efficiently search through a comprehensive database of trademark designs. This database may encompass all registered designs throughout the history of the trademark regime. An AI based assessment tool can be utilised to determine whether the design right should be granted or denied.[181]

In addition, the utilisation CADs for the storage of patent records would enable AI software to conduct a comprehensive search of the database and provide an evaluation of patent applications. While it is unlikely that a completely automated system utilising blockchain technology and AI software will be widely adopted in the near future, it is conceivable that these technologies may be utilised to streamline the human assessment process. Storing all previously granted patents as CAD files on the blockchain would provide an AI software tool with comprehensive information to facilitate the patentability assessment process. The tool would be able to demonstrate to the patent officer the level of similarity between the invention and other patented products within the relevant field.

The employment of blockchain technology is likely to enhance the efficiency of the registration process for designs and trademarks by streamlining certain procedures. In certain cases of trademark applications, it may be imperative to establish the acquired distinctiveness of the mark through usage, particularly in instances where the inherent distinctiveness of the trademark cannot be demonstrated. In the event that legal modifications were implemented to permit the practical utilisation of a trademark, it could be included and documented in the official registry. The substantiation and particulars of the factual application of a trademark in commerce, along with its

[181] Gurkaynak (n 126) 855.

frequency, could be readily disseminated and accessible to all parties via a blockchain. The provision of trademark information by trademark owners in a free and open manner would result in substantial savings in terms of both time and expenses. WIPO is currently engaged in facilitating a discourse on the subject of blockchain technology, with the aim of comprehensively comprehending its potential applications in the realm of IP.[182]

In contemporary times, computer-based tools are predominantly utilised for the creation and enhancement of designs. Consequently, the evaluation of the similarity or identity between a design in a trademark application and an already registered one may be executed through automated means. Similarly, the evaluation of the probability of confusion pertaining to trademarks could conceivably be executed devoid of any human intervention or contribution.[183] The EUIPO has implemented a functional system known as the "IP Register in Blockchain" to support TM DS View. This blockchain based solution, which utilises Hyperledger Fabric, has successfully recorded over 3.5 million intellectual property rights. Collective Management Organisations (hereinafter CMOs), including Access Copyright and a partnership consisting of the American Society for Composers, Authors and Publishers (hereinafter ASCAP), the Society of Authors, Composers and Publishers of Music (hereinafter SACEM), and PRS for Music, have conducted an analysis and developed a conceptual definition of potential IP registers utilising blockchain technology.[184] These systems have the potential to assist in the assessment of the resemblance between a specific trademark or patent and an already existing one. The existence of disparate databases in distinct informational silos can be addressed through the implementation of blockchain technology, which are likely to establish a singular, integrated database for designs. The implementation of a database would additionally promote and streamline the handling of objections. The database's CAD files, as previously mentioned, could be subject to software-based searching, thereby enabling a more efficient and autonomous handling of the opposition process.

[182] Anne Rose, 'Blockchain: Transforming the Registration of IP Rights and Strengthening the Protection of unregistered IP Rights' (*WIPO*, July 2020) <https://www.wipo.int/wipo_magazine_digital/en/2020/article_0002.html> accessed 14 June 2023.
[183] Gurkaynak (n 126) 855.
[184] World Intellectual Property Organization (n 180) 106.

As per the existing regulations, intellectual property rights can be registered either at the national or regional level, such as the EU, or can have global coverage through the WIPO. However, it is worth noting that they are frequently included in a nationwide repository and consolidated (with a restricted range of characteristics) in transnational and global databases like TMview or DesignView. Contemporary procedures necessitate that candidates input identical data across multiple platforms, which may not always be integrated. Concurrently, IP offices have the capability to transfer documents through the utilisation of File Transfer Protocol (hereinafter FTP) tools and services, including the WIPO Digital Access Service (hereinafter DAS). However, there is a lack of a universal registry for the dissemination of information submitted by the applicant, and a dearth of standardisation in common procedures. This particular service serves as a supplementary offering to the existing services such as WIPO DAS. The aim is to streamline the registration procedures for applicants and enhance the interconnectivity between various offices. This will be achieved by integrating the offices with a shared instrument and optimising the exchange of data. It predominantly exemplifies a crucial measure towards the realisation of the "Once Only" Principle in the IP value chain. Essentially, it involves the provision of various data by citizens and businesses during their interaction with public administration bodies, with the expectation that such data will be shared and reused internally by these bodies, even across national borders. However, it is imperative that these actions are carried out in compliance with data protection regulations, which necessitates the implementation of effective data governance. When applied to the IP value chain, this approach enables applicants and legal representatives to input data just once, potentially utilising blockchain technology. In cases where the holder of intellectual property rights chooses to seek protection across multiple jurisdictions, there exists a lack of harmonisation among the respective legal frameworks. Consequently, the information contained within each jurisdiction's registry may vary. Furthermore, the expenses incurred by applicants are substantial, not only during the initial filing of the intellectual property right but also throughout its upkeep. This phenomenon can be attributed to the requirement of providing documentation for each process, which must be repeated for every country selected, and entails payment of a distinct fee for each. The

implementation of a decentralised IP registry has the potential to reduce redundancy and improve operational efficiency.[185]

The conventional offices are insufficient in promoting the fundamental objective of IP law, which is to inspire “innovation and creativity”. This fact is evident. The expenses associated with the registration and renewal of an IPR are contingent upon the factors mentioned above. As the procedures become increasingly intricate and protracted, the expenses also escalate. Undoubtedly, the facilitation of innovation and creativity through IP laws could be achieved more efficiently and effectively by reducing the expenses linked to these endeavours via the implementation of a streamlined and expeditious registration procedure. As previously stated, the acquisition and upkeep of an IPR incurs significant costs. The primary rationale behind the tendency of right holders to register their rights with a limited number of registries, or even a single one, is due to this factor. Consequently, the IP of the holder may remain unprotected in jurisdictions where they have not been registered. In such a situation, it is common for the holder of IPR to initiate and pursue a claim of "unfair competition" in the event of infringement. The parameters of a claim for unfair competition are distinct in nature and may frequently entail greater complexity than a claim for infringement of IP. This can result in additional legal and financial challenges for the individual seeking to safeguard their rights.[186]

The utilisation of blockchain technology may prompt a re-evaluation of the necessity for an IP registry as the foundation of the intellectual property system, deviating from the conventional approach. The proposal involves the establishment of a shared registry utilising DLT, which would be overseen by the IP offices. The registry would operate on the basis of a mutually agreed consensus model, and would enable applicants and legal representatives to submit data on a one-time basis. The implementation of a shared IP registry serves as an initial measure towards establishing interoffice connectivity and facilitating the exchange of data. This approach minimises the replication of information. Furthermore, various services could be developed in conjunction with this solution, with the most apparent ones being the ability to exchange data in real-time and maintain an unalterable record of data history. The proposed system aims to

[185] ibid.
[186] Gurkaynak (n 126) 856.

establish a permanent and unalterable ledger of intellectual property rights applications on a blockchain platform. This ledger will comprehensively monitor all actions taken in relation to each application throughout the entire process of granting IP rights. Furthermore, the system will record each transaction and employ trust-based data sharing mechanisms among all relevant stakeholders.[187] A smart contract is a self-executing agreement that can be utilised throughout the entire IP value chain, ranging from the primary filing of an application for an IP right to the following commercialization of the right.

The implementation of decentralised registration systems facilitates the recording of information pertaining to the registration of a new IPR in a singular instance. This includes the complete application grant process, encompassing the filing application date, as well as the various activities conducted during the "search and examination processes", along with their respective outcomes. The aforementioned registry serves as a repository for IP right attributes that are commonly shared among various IP offices. This enables the applicant to furnish the requisite information only once, following which it can be securely shared among the concerned IP offices. This statement is also relevant to the documentation that has been provided. There are numerous benefits associated with the utilisation of registries based on blockchain technology. Initially, it is imperative to note that records are unalterable in nature, meaning that once a record is made public, it cannot be deleted or modified. The information is readily accessible to the general public for retrieval and reference. There is a comprehensive ability to track and document the history of records. Furthermore, the system is entirely digitised, thereby eliminating the necessity for physical documents and manual signature verification. The process of transferring ownership of records can be accomplished with ease, akin to the act of sending an email.[188] The absence of a singular point of failure is attributed to the decentralised nature of the infrastructures. Thirdly, it is worth noting that blockchain technology leverages cryptographic algorithms, thereby conferring a heightened level of security to all transactions.

[187] World Intellectual Property Organization (n 180) 111.
[188] ibid.

This technological advancement presents the potential to enhance the efficiency, precision, and expediency of intellectual property registration. The enhanced registration procedure is applicable not solely to industrial designs but also to copyright. The latter can be registered by means of a distinctive hash block that serves as proof of the creation and establishes a connection to the authorship of a particular creative work.

Notwithstanding, there exist certain obstacles with respect to the utilisation of blockchain technology for safeguarding intellectual property rights. While certain courts in various jurisdictions, including China and Italy, permit the use of blockchain as evidence, its complete integration into the legal system remains distant. Consequently, the involvement of IP experts remains imperative for legal proceedings and assessments. The task of establishing a mechanism for interconnecting global registries via a unified DLT is a complex undertaking. The effective administration of IPR through blockchain technology necessitates a universally recognised and globally endorsed framework. The challenge at hand pertains to the alignment of diverse national and regional judicial frameworks and traditions, which has been and will continue to be a persistent issue. An additional obstacle pertains to the requirement for the creator to adhere to the formalities mandated by the relevant governing body in order to possess their complete set of entitlements, notwithstanding the registration of the formation on the blockchain. The issuance of a patent is contingent upon the jurisdictional authority responsible for such bestowal, and the inventor's entitlement to patent privileges is dependent upon the possession of a valid patent.[189]

However, registering the invention on the blockchain can provide protection to the inventor in case of a dispute where another individual asserts to have created the same invention. The inventor shall be capable of demonstrating that the invention of the other party lacks novelty. One of the current obstacles faced by IP registries, particularly in relation to creative works, pertains to the verification of ownership authenticity during the registration process on the blockchain platform. This issue is already prevalent in conventional registries.

[189] World Intellectual Property Organization (n 180) 11.

4.2.2. MANAGEMENT OF IP THROUGH BLOCKCHAIN

The utilisation of blockchain technology holds noteworthy implications for certain facets of IPR management. Within the contemporary IP system, specific actions pertaining to the administration of IPR are predominantly carried out by external entities. The implementation of blockchain technology can potentially offer a solution in this scenario by eliminating the necessity for intermediaries and reducing the expenses associated with the administration of IPR. The beneficial impact of blockchain technology pertains to copyright management, whereby blockchains generate novel markets for rights holders and facilitate direct collection of royalties from users, as elaborated in the subsequent section.[190]

The effective administration of IP is imperative for the maximisation of their advantages; however, it necessitates extensive research, substantial resources, and a comprehensive comprehension of IP legislation. Due to insufficient resources or limited knowledge, a significant number of artists fail to assert their entitlement to compensation for their rights. In order to mitigate such circumstances, numerous writers opt to enlist the services of agents, commonly referred to as CMO, to manage this aspect. The equitable allocation of benefits resulting from these rights is occasionally disputed by authors who perceive the compensations to be imprecise or protracted in their acquisition.[191] The implementation of blockchain technology has the potential to eliminate the intermediary and associated expenses involved in the protection of IPR, particularly within the realm of copyright.

Several significant concerns regarding the present system of managing IPR can be comprehended as follows: The present system for managing IP lacks a cohesive mechanism that can be relied upon to guarantee genuineness. Frequently, obtaining records can be challenging due to the protracted procurement process. Consequently, innovators encounter difficulties in commercialising their intellectual property as a result of inadequate documentation. In India, IP offences are not accorded equal treatment as other economic offences and are frequently overlooked by the authorities responsible for safeguarding IP rights. This conduct has frequently discouraged

[190] Gurkaynak (n 126) 857.
[191] Marie-Francoise Mbaye, 'The Application of Blockchain for the Intellectual Property Protection' (Masters thesis, Lund University 2020).

innovators, thereby resulting in a deceleration of the pace of innovation. The act of plagiarism is a significant concern within the IPR sector. Plagiarism refers to the unauthorised appropriation of someone else's intellectual property, including but not limited to ideas, inventions, original works of authorship, words, slogans, designs, and proprietary information, without proper attribution to the original author or inventor. IPR are applicable in the realm of the Internet, however, their enforcement is often inadequate. The replication of digital content and the subsequent production of inexpensive duplicates for dissemination is a straightforward process. Publishers contend that the Internet poses a threat to their IP as it significantly alters the character and methods of publishing, thereby rendering their works highly susceptible to online piracy. The IP system facilitates the transfer and commercialization of IP ownership. However, the system is often plagued by inefficiencies that impede the accurate reporting of such transactions. This phenomenon gives rise to uncertain ownership of specific intellectual properties, creating potential for legal disputes that may impede progress and advancement within that particular field.[192]

One of the primary concerns pertaining to IPR pertains to the significant temporal gap that ensues subsequent to the submission of an application. The primary cause of this issue stems from the significant backlog present at the IP granting authority, where manual verification and validation procedures are conducted. In India, the patent application undergoes a period of dormancy lasting approximately one or one and a half year it is subjected to examination by a patent officer. Following this initial examination, the process of obtaining a patent is protracted, taking an additional four to six years.

The phase of IP Management pertaining to "industrial property" encompasses various management activities that the holder of IP rights may undertake to enhance and augment the value of their IP rights portfolio. These activities include “IP audit, IP portfolio analysis, IP life cycle analysis, competitive technology intelligence, and IP landscape analysis”. In the realm of copyright and related rights, the management of rights is typically carried out either on an individual basis by the respective right holders, or collectively through a CMO. The initial three sub-phases, comprising of "IP

[192] Atharv Chandrate and Abhinav Pathak, ‘Blockchain Based Intellectual Property Management’ (*SSRN*, 10 December 2019) < https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3800734> accessed 15 June 2023.

audit, IP portfolio analysis, IP life cycle analysis," are predominantly conducted internally by the organisation. The remaining two categories, namely "competitive technology intelligence and IP landscape," primarily pertain to external factors. It is noteworthy that the phase of IP Management encompasses additional types of IP management activities. The management of copyright and related rights can be carried out through individual efforts of the respective right holder(s) or through the collective efforts of a CMO.[193]

Upon the creation of a copyrighted creation or work, a set of IPR is automatically generated, which can be possessed by distinct legal entities. The establishment of these rights poses a significant test for both the right holders and the licensees of the copyrighted work due to the complexity involved in identifying the rightful owners and determining the appropriate payment amounts for each right holder when the creation is utilised. Presently, pertinent documentation is under the custody of either public institutions, corporate entities, or proprietors' associations. Nonetheless, the majority of these databases lack interoperability and are not consistently accessible to the public. Some organisations may not have sufficient resources to maintain a public and interoperable database, leading to cost overruns. The safeguarding of these records is also a matter of concern, and the IP are predominantly overseen by external entities. Consequently, the administration of these entitlements incurs significant expenses, intricate procedures, and demands a substantial investment of time. The resolution to the previously mentioned issues could potentially be attained through the implementation of a blockchain-based registration system, whereby the entitlements pertaining to the copyrighted material would serve as a block within the chain. Developing a structure from the ground up would likely prove to be a more cost-effective and feasible approach in addressing its technical obstacles, as opposed to the conversion of the existing system into a publicly accessible and compatible one. Furthermore, the data stored in the blockchain would be accessible to all individuals. To clarify, each individual who possesses the blockchain application would function as a node within the network. This would enable them to view the entirety of the blockchain while simultaneously contributing to the system's security by serving as both a node and a server, all without suffering any associated server expenses.

[193] World Intellectual Property Organization (n 180) 76.

Consequently, the expenses related to the identification of rightful owners would be significantly diminished, given that the processing time for this data could be as brief as a few minutes, as all the pertinent records would be housed within a digital platform such as a smartphone or computer program. Additionally, the security of the system could be upheld at a substantially lesser cost.[194]

The implementation of blockchain technology presents a potential avenue for enhancing the rights of owners in relation to their management and exploitation activities. The technology of blockchain has the potential to serve as a means for the storage of data pertaining to the ownership or work in question. Upon the storage of work-related information on the blockchain, rightsholders are enabled to utilise a smart contract mechanism to monitor its usage. Whenever an AI software, such as Oracles or IoT, detects the implementation of its functions, it has the capability to transmit a notification to its proprietor.[195]

The implementation of this technology can potentially yield the first set of advantages for the music industry. The majority of music is currently distributed in a digital format. This novel method of distribution served as a precursor to a fresh model of consumerism, whereby music can be procured through music downloading services and subsequently accessed on-demand via streaming platforms. While the utilisation of music online has undoubtedly been a significant innovation for the music industry, it has also resulted in a surge of copyright infringements. Despite the mandate of the EU's InfoSoc Directive[196] for copyright harmonisation, which necessitates the acquisition of a licence for every use, the identification of users by owners and the subsequent collection of licencing fees for their music remains a challenging task. This issue is exacerbated if the holders of rights opted to utilise a CMO. CMOs frequently aspire to disseminate the music they oversee across all feasible markets. Consequently, they frequently utilised online platforms to disseminate the music across various regions. As delineated by the Commission, numerous collective management organisations are currently ill-equipped to handle the processing of data from service providers such as "Spotify, Gaana, or Jio Saavn" pertaining to music downloads and streaming, as well

[194] Gurkaynak (n 126) 858.
[195] Mbaye (n 191).
[196] EU Directive 2001/29/EC of the European Parliament and of the Council of 22 May 2001 on the harmonisation of certain aspects of copyright and related rights in the information society [2001] OJ L 167/10.

as the matching of this data with their song repertoire. The technological limitations in monitoring vast amounts of information have been identified as a contributing factor to the lack of transparency, inaccurate invoicing, and challenges in collecting fees associated with music exploitation. The discourse surrounding music royalties has prompted numerous artists to voice their opposition to the current distribution model. Certain artists have taken the initiative to establish their own streaming platform that is linked to a smart contract. The tendency in question is exemplified by the PeerTracks and Soundac blockchain. PeeTracks is a digital platform that provides music streaming services. In contrast to other online platforms, Soundac's smart contract ensures that artists receive compensation for each instance of their songs being streamed. This system empowers music proprietors to assume authority over the administration of their musical compositions, obviating the need to rely on CMOs or prominent streaming corporations. An additional benefit of this particular smart contract is its capacity to enable the proprietor to implement an alternative pricing mechanism based on the utilisation of their IP. Consequently, the cost of the royalties shall be modified in the event that the work is utilised for commercial, private, or public objectives.[197]

4.2.2.1. TRANSFER/ASSIGNMENT

IP assignment refers to the process of transferring ownership of IP rights from the assignor to the assignee. This legal mechanism results in the assignee becoming the new holder of the IPR.[198] The Delhi HC observed that *"The assignor cannot possibly transfer more rights to the assignee than what he himself has."*[199] The process of transferring registered IPR involves the registration of the transfer agreement, which is subject to varying rules across jurisdictions based on the relevant legislation. The matter at hand is governed by Chapter III of the European Patent Convention[200] with regards to patents within the EU. As per the contents of this section, it can be inferred that the European Patent Office (hereinafter EPO) is authorised to record the transfer or licencing of a patent upon receipt of a formal request from a concerned party.

The transfer of IPR is a fundamental and essential function within the realm of intellectual property rights management. Following the submission of an IP application,

[197] Mbaye (n 191).
[198] ibid.
[199] *John Applications (P) Ltd. v. H.E. Industries*, 2016 (68) PTC 247.
[200] Convention on the Grant of European Patents [1973] 76/76/EEC.

or subsequent to the granting of the IPR, the proprietor of said application or right retains the option to transfer ownership to a third party. The Delhi HC held that *"Before a work comes into existence the assignment does not have any effect. It will take effect and come into operation only after the work has come into existence."*[201] The proposed modification ought to be executed via the IP registry, which would authenticate the legitimacy of the involved parties and the ownership of the IP. The present systems necessitate numerous human interventions, which are laborious and frequently necessitate the guidance of IP experts, thereby rendering the process more costly. In addition, it is imperative that the parties engage in the exchange of confidential information prior to the acquisition, and implement safeguarding measures to prevent the loss of critical strategic data. Prior to initiating the transfer of IPR to the IP registry, the assignee may wish to conduct an IP due diligence assessment to ascertain the authenticity and ownership of the IP rights, as well as to ensure compliance with legal prerequisites related to the assignment of the relevant IPR. This undertaking necessitates pertinent information concerning the rights, encompassing antecedent assignment accords, employment arrangements, registration status, and record chronicles. Presently, it is incumbent upon the IPR possessor to securely maintain all relevant information, and when disseminated, it becomes beyond the assignee's purview. The parties are presently utilising a written signature of a Non-Disclosure Agreement (hereinafter NDA) as a means of safeguarding the confidentiality of the data. Additional issues concerning the present transfer procedures of IPR pertain to the requirement of a written agreement or contract duly executed by both parties by several IP offices. Failure to comply with this prerequisite renders the agreement null and void, lacking legal force and effect.[202]

Blockchain technology has the potential to improve the process through the implementation of digital identity mechanisms. It is imperative that the agreement clearly denotes the application number or registration number. In order to complete the registration process for the transfer of IPR, certain IP offices mandate that the assignee register the new ownership. In case this fails it might result in the loss of the transferred

[201] *Time Warner Entertainment Company, L.P. v. RPG Netcom*, 2007 AIR 2007 Delhi 226.
[202] World Intellectual Property Organization (n 180) 164.

rights. The utilisation of blockchain technology in the IP transfer process is facilitated by the time-stamping feature, which serves as a critical component.

The utilisation of blockchain technology presents promising opportunities for facilitating the management of IPR, such as patents, copyrights, trademarks, and designs, by enabling functionalities such as time stamping, digital identity, and trust data sharing to benefit all parties involved in the process. The implementation of blockchain technology has the potential to create a unified platform for numerous IP owners and customers to efficiently manage and authenticate their digital identities, thereby facilitating diverse IPR transactions. Blockchain-based trust mechanisms offer novel and flexible means for conducting IPR transactions. Through the use of publicly accessible smart contracts, transaction clauses can be managed in a transparent, automated, and auditable manner. The proposed system is designed to enable comprehensive monitoring and assessment of the complete lifespan of IPR. Additionally, the implementation of smart contracts can facilitate the process of ensuring adherence to regulatory requirements. There is potential for enhancing transfer or assignment procedures by incorporating blockchain technology to document all pertinent information regarding IPR, as well as the associated transactions. The application of blockchain technology has the potential to optimise the validation process of an assignment by offering a range of functionalities, such as the authentication of IP ownership, the identification of the involved parties (i.e. assignor and assignee), the application of digital signatures, and the time-stamping of relevant documents. Furthermore, it is possible to track and archive all operations carried out on the data through the utilisation of blockchain technology. This provides the IP holder with an additional mechanism to safeguard sensitive information. Blockchain technology will be utilised as a DLT for the transfer and assignment of various intellectual property assets. Each transfer of ownership of the IPR will be executed via a blockchain transaction, thereby altering its ownership status. The utilisation of smart contracts is a viable option for the automation of specific procedures, such as the authentication of adherence or the creation of an application for the purpose of recording the alteration of IP ownership.

This will facilitate complete data transparency for the purposes of audit and oversight conducted by both organisations and individuals. This presents a favourable occasion

for the assignor and assignee to execute dependable operations, finalise an agreement regarding the transfer of IPR, and subsequently authenticate the agreement via the online intellectual property register in a nearly instantaneous manner, while circumventing the requirement for significant expenditures of resources and time. It is imperative to verify the legal mandates pertaining to the obligation of furnishing written and signed evidence of agreements during the transfer of IPR for every category of IPR involved. In certain jurisdictions, there exists a legal stipulation mandating a written instrument for the transfer of a trademark, while no such requirement is imposed for the transfer of copyright. The utilisation of blockchain technology for the purpose of IP management may present certain technical challenges in terms of regulatory compliance, acceptance of smart contracts as evidence of commercial transactions between the assignor and assignee, and business-related challenges associated with the adoption of this technology for the specific use case.[203]

4.2.2.2. LICENSING

The registration of licencing agreements for registered IP rights is subject to jurisdiction-specific regulations that are contingent upon the governing legislation. Chapter III of the European Patent Convention governs the regulation of patents pertaining to this matter within the European Union.[204] As per the provisions outlined in this section, the EPO is mandated to register a patent licence upon receipt of a formal request from a concerned party. Regarding the licence. Article 32/4 of the EU Regulation (EC) No. 6/2002[205] has established a comparable provision with respect to licence agreements for designs.

In the realm of IP, a licence refers to the authorization granted by the proprietor of said property (known as the licensor) to a third party (the licensee) for the purpose of utilising the intellectual property in question, typically in exchange for monetary compensation or other forms of valuable consideration, such as a reciprocal licence agreement. The Delhi HC observed that *"The rights of licensee are not the same as those of the owner and there is a fine distinction between the limited rights of the*

[203] Ibid.
[204] Convention on the Grant of European Patents [1973] 76/76/EEC.
[205] Twenty Fourth Commission Directive 2000/6/EC of 29 February 2000 adapting to technical progress Annexures II, III, VI, and VII to Council Directive 76/768/EEC on the approximation of the laws of the Member States relating to Cosmetic Products [2000] OJ L 178/1.

licensee and those of the owner."[206] A licence agreement may involve multiple licensors or licensees. Within the realm of copyright, licences are executed by the proprietor of the creative work and either the CMO or end user. The contractual information pertaining to the licenced content, the authorised users of the intellectual property rights and the associated terms and conditions, the duration of the agreement, and the economic considerations are all encompassed within each licence.

A significant IPR concern pertains to the insufficiency of safeguarding measures in the digital scene. The application of blockchain technology can offer reliable and trustworthy data pertaining to matters of ownership, licencing, and the monitoring of digital content usage. This, in turn, could lead to more equitable and just remuneration for content creators. The implementation of blockchain technology has the potential to provide a distributed transaction processing system that is secure, dependable, and scalable for licencing works. The implementation of a traceable and confirmable ownership system could facilitate an precise distribution of royalties, potentially enabling direct payment to the rightful owners and minimising reliance on intermediaries. The implementation of blockchain technology has the potential to enable creators or collectors to establish and validate the genuineness of digital content, thereby safeguarding its economic worth. The objective of this use case is to ascertain a situation in which the IPR holder can efficiently oversee a clear, equitable, and expeditious licencing of their IPRs through automated means, thereby reducing transaction costs. In addition, the implementation of blockchain technology may yield advantages not only for the right holder, but also for the licensee, as it can potentially enhance the licencing process by providing greater precision and transparency.[207]

An additional facet of licencing via smart contracts that warrants consideration pertains to the evaluation of "distance contracts." The aforementioned matter is likely to arise in scenarios where individuals obtain licences for copyrighted materials such as music via smart contracts. A 1997 EU Directive[208] governs the regulation of distance contracts in the EU with regards to the protection of consumers. The term "Distance Contract" refers to a contractual agreement between a supplier and a consumer, pertaining to

[206] *John Wiley & Sons Inc. v. Prabhat Chander Kumar Jain*, 2010 (44) PTC 675 (Del).
[207] World Intellectual Property Organization (n 180) 166.
[208] Directive 97/7/EC of the European Parliament and of the Council of 20 May 1997 on the protection of consumers in respect of distance contracts - Statement by the Council and the Parliament re Article 6 (1) - Statement by the Commission re Article 3 (1) [1997] OJ L 144/19.

goods or services, that is established through a structured scheme for remote sales or service provision, exclusively utilising one or more forms of distance communication until the point of contract finalisation.[209]

Blockchain technology can be used to establish a reliable and auditable repository for licences pertaining to creative works. This repository would contain the terms and conditions of use, and could facilitate the issuance of "certificates of trust" between the IPR holder and the CMOs responsible for authorising commercialization of the creations. Furthermore, the use of blockchain technology would ensure the permanence and inalterability of the content for each user. The utilisation of a smart contract in the registration process has the potential to facilitate the automatic enforcement of clauses that are established under transparent and mutually agreed-upon circumstances. The utilisation of blockchain technology presents a viable solution for the management and storage of intellectual property licences on a DLT. This approach facilitates efficient tracking of the status and usage of safeguarded work. The implementation of blockchain technology provides a framework for trust, accountability, and transparency, enabling the verification of licence validity and the management of clauses pertaining to proper licence usage. The utilisation of smart contracts has the potential to facilitate the automation of licencing terms' execution and enforcement. A potential outcome may be the diminution of the quantity of intermediaries engaged in the commercialization of artistic productions. The utilisation of smart contracts can facilitate the management of digital rights and the equitable distribution of shares among contributors, thereby enabling a more transparent and accessible payment system for creators, which can be advantageous for CMOs. The utilisation of smart contracts has the potential to facilitate the automation of licencing term execution and enforcement. A potential outcome may involve a decrease in the quantity of intermediaries engaged in the commercialization of artistic creations. The utilisation of smart contracts has the potential to facilitate the management of digital rights and the allocation of shares to various contributors, thereby enabling a more transparent and equitable payment system for creators, which could be of particular benefit to CMOs.[210]

[209] Gurkaynak (n 126) 858.
[210] World Intellectual Property Organization, (n 180) 167.

Several initiatives have already been launched in this regard. The Open Music Initiative (hereinafter OMI), which was shown by the Berklee College of Music in Boston, Massachusetts, is a substantial undertaking that warrants consideration. The objective of this incentive is to construct a platform that is open-sourced and features a shared protocol. The platform will be centred on cryptography, distributed consensus, and will be interoperable with both forthcoming and present systems. OMI aims to establish a self-reliant framework that accommodates open and proprietary data sources, rather than developing a basic repository for ownership and attribution. OMI's objective is to construct a blockchain-based database. OMI aims to address the issue of accurately identifying the rightful owners. The fundamental premise and tenet of this endeavour is that the application of blockchain technology can be used to create a record that could subsequently be leveraged for the purpose of ascertaining the rightful proprietors. OMI intends to construct a proprietary Application Programming Interface (hereinafter API) to facilitate the utilisation of the repository by other products and services. This would mean that the repository can be used in a more resourceful manner in IP transactions and enforcement endeavours.[211]

One of the distinctive features of blockchain technology is that once a transaction has been validated by the network, any attempt to modify or delete the block would have significant repercussions on the entire blockchain. The non-reversible payment mechanism inherent in smart contracts appears to preclude consumers from seeking reimbursement in the event of a dispute over the execution of the contract code on the blockchain or any infringement of their rights.[212]

The unresolved issue of smart contracts pertains to the selection of applicable law from a legal standpoint. In the case of conventional databases, the issue of jurisdiction is comparatively straightforward as these databases are typically situated within a singular nation. The complexity of the aforementioned matter increases with the implementation of blockchains, as the execution of a smart contract results in a modification of the status of all nodes within the system, irrespective of their geographical distribution. The implementation of smart contracts requires a meticulously crafted choice-of-law provision, which mandates the parties involved to ensure that any court that may preside

[211] Gurkaynak (n 126) 859.
[212] Mbaye (n 191).

over a disagreement arising from a smart contract will uphold the regulations of the pre decided law recognized and executed by the parties.[213]

The implementation of blockchain technology in the process of IPR licencing has the potential to enhance transparency by facilitating streamlined tracking and management of licences. In addition, the implementation of this solution would streamline the process by reducing the involvement of intermediaries and automating the revocation and payment procedures.

4.2.3. ENFORCEMENT OF IP THROUGH BLOCKCHAIN

The efficacy of IPR is primarily contingent upon the capacity of the proprietors to effectively enforce their rights, particularly in instances of counterfeit production of their merchandise. It is imperative that the proprietors of IP are enabled to efficiently implement their entitlements in collaboration with law enforcement agencies and customs officials. From the standpoint of an enforcement agency, counterfeiting incurs substantial expenses for the intellectual property realm. Customs and law enforcement officials may lack the requisite resources or methodologies to ascertain the genuineness of a commodity.[214] The Allahabad HC stated that *"The infringement of patent may be done in a number of ways, one of which is by using the patent or any colourable imitation thereof in the manufacture of patented articles."*[215]

In addition to conventional business models, online marketplaces are enabling convenient availability of counterfeit merchandise. These marketplaces provide a way for counterfeiters to distribute their products without direct communication with the customer who may be unaware that they are purchasing counterfeit merchandise. Most of these items also infringe the trademarks of reputed brands by being deceptively similar; The House of Lords held *"No trader had a right to use a trade mark so nearly resembling that of another trader as to be calculated to mislead incautious purchasers."*[216] According to the report[217] released by the European EUIPO on the

[213] Gurkaynak (n 126) 859.
[214] ibid.
[215] *Laxmi Dutt Roop Chand v. Nankau*, AIR1964 All 27.
[216] *Orr Ewing v. John Orr Ewing*, (1882) 7 AC 219.
[217] European Commission, 'Report on EU Customs Enforcement of Intellectual Property Rights: Results at EU Border 2016' (European Union, 2017) < https://op.europa.eu/en/publication-detail/-/publication/5d6eb531-6b63-11e7-b2f2-01aa75ed71a1> accessed 15 June 2023.

enforcement of IPR within the EU, it was found that from 2013 to 2017, around 438 million items were detained with an estimated market value of twelve billion euros. It was observed that forty percent of these confiscations were made at the borders, while the remaining sixty percent were made inside the borders.

The utilisation of blockchain technology has the potential to enhance the efficacy of IPR enforcement through the mitigation of counterfeit goods and content. The utilisation of blockchain technology enables the storage of comprehensive data pertaining to a brand, product, or service, encompassing details such as the item's origin, historical background, and transfer of ownership. This information can be transmitted to various parties, including the product owner, purchaser, and customs authorities responsible for combating the importation of counterfeit goods. In addition to its function as a database, smart contract technology has the potential to serve as a supply-chain management solution that enables the tracking of goods throughout their lifecycle, including post-sale ownership transfers. The implementation of this application is expected to facilitate the mitigation of IPR violations, thereby promoting economic growth and development across various stakeholder groups.[218]

The advancement of the anti-counterfeiting system necessitates progress in the area of promoting and enhancing information exchange between IP right holders and enforcement authorities. The implementation of a blockchain-based system would enable the documentation of the path taken by products and the actors involved in their transport and delivery. This would ensure that the stated route by the right holder matches the route taken in reality, thereby providing transparency to stakeholders with an interest in the goods prior to the commencement of the delivery process. In the event that law enforcement agencies detect any alterations to the information furnished by the proprietor, a validation procedure may be instigated with the proprietor prior to the goods reaching their ultimate destination. Finally, the end user will have the ability to verify whether the purchased product adheres to the protocol established by the proprietor and has received certification from all relevant parties.[219]

Typically, existing supply-chain systems lack interoperability with the databases of retailers. Typically, retailers are required to engage in ongoing monitoring and

[218] Mbaye (n 191).
[219] World Intellectual Property Organization (n 180) 167.

management of their inventory levels. Upon depletion or anticipated depletion of stock, the retailer must initiate a requisition for replenishment.[220] The development of an anti-counterfeiting platform that can track the pathways and actors involved in the transportation of goods would facilitate the identification of potential counterfeit items and the locations of their discovery and confiscation by law enforcement agencies. The proposed system operates in a decentralised manner and utilises the data contained within the IP registries maintained by IP organisations. Moreover, the data that is stored in the systems of enforcement agencies, along with the additional information that will be exchanged between IPR holders and enforcement authorities, will be utilised. The implementation of blockchain technology has the potential to enhance the sharing of information among stakeholders and across international boundaries. This can facilitate informed decision-making based on the data available within the blockchain, while also safeguarding the confidentiality of shared data. The information will pertain to the IPR that have been duly registered.

The utilisation of blockchain technology can offer several advantages in combating counterfeiting. These benefits include the establishment of end-to-end traceability for IP assets, which generates immutable records of all transactions and creates digital clones of the assets with a unique identifier. Additionally, blockchain technology provides a single source of truth, which prevents conflicts with evidence in the event of litigation by ensuring that all parties have access to the same data. Furthermore, blockchain technology enhances security and protection by implementing surveillance measures to take proactive action in the event of illegal activities. It also improves operational efficiency by reducing administrative costs, efforts, time, and management performance related to paperwork procedures. Moreover, blockchain technology ensures the sharing and trust of paperwork and information between all stakeholders using international standards, and governs the interpretability between the bodies involved in the process.[221]

The absence of a consolidated database system can be attributed to the preference of brands to retain their proprietary data and keep them in isolated information storage units, rather than sharing them with other brands or the general public. Consequently,

[220] Gurkaynak (n 126) 859.
[221] World Intellectual Property Organization (n 180) 128.

the absence of interoperability among distinct inventory databases precludes the possibility for consumers to conveniently utilise a smartphone application to scan a product's barcode and verify its authenticity. The absence of interoperability, in fact, results in adverse consequences for brands as it leads to the proliferation of counterfeit products. This is primarily due to the challenges faced by customs officers in identifying such products.[222] In numerous instances, the data intended for dissemination is of a confidential nature and supplementary to the information already contained within the IP registries. Blockchain technology is considered a crucial tool for safeguarding IP due to its ability to facilitate common consensus, integration, interoperability, and security. It is imperative that law enforcement agencies possess the capability to verify the genuineness of disseminated data and recorded proof. Blockchain has enabled numerous brands and IP holders to store data in a DLT without being scared of losing it. This development could prove advantageous for both retailers and consumers. Various types of IPRs have the potential to be registered on the blockchain, accompanied by corresponding authorizations for their use. The recorded data can be scrutinised by enforcement authorities and other designated actors for the purpose of detecting potential instances of fraudulent use or counterfeit products. Furthermore, blockchain technology provides a means to securely associate digital identities (hereinafter DIDs) with a tool for identification that offers a high level of assurance (hereinafter LoA), while also adhering to data privacy and personal data regulations.[223]

Moreover, it is imperative to examine blockchain technology within the framework of other technological advancements. Currently, diverse tagging technologies are undergoing rapid development. One potential application involves the incorporation of Radio Frequency Identification (hereinafter RFID) technology with blockchain. In the aforementioned situation, the utilisation of RFID technology to label goods and subsequently recording this information on a blockchain platform could potentially streamline the identification and confiscation of fraudulent merchandise. The technology employed for toll collection has the potential to serve as a means for counterfeit detection. By integrating the RFID scanner on a road with a blockchain

[222] Gurkaynak (n 126) 860.
[223] World Intellectual Property Organization (n 180) 128.

system, it is possible to promptly verify the authenticity of the contents of a container that is in transit, thereby detecting any counterfeit items.[224]

Hyperledger Fabric, a type of consortium blockchain, is often suggested due to its feature of providing controlled access to data to its members rather than granting complete access. This implies that solely individuals with authorization will possess unrestricted access, thereby resolving privacy concerns and mitigating the risk of exposing confidential information belonging to the brands. An additional instance pertains to the VeChain blockchain framework, which features a binary token system. The tokens in question can be categorised into two distinct types: a public token, which is utilised for transactions, and a private token, which grants access and enables the execution of smart contracts. This practise facilitates the preservation of necessary transparency and fulfils the objective of safeguarding the confidential information of the respective brands.

In order to achieve effective enforcement of IPR through the reduction of counterfeiting, blockchain technology must surmount a number of challenges associated with its implementation, including: Blockchain solutions designed to prevent counterfeiting must adhere to both domestic and international customs enforcement regulations. The global standardisation of copyright laws facilitates enhanced legal compatibility in comparison to trademark and patent regulations. In either scenario, the primary legal obstacle entails adhering to the minimal legal prerequisite of utilising digital certification as evidence of entitlement within a court of law. Various nations acknowledge electronic evidence, albeit with varying degrees of efficacy and enforceability. Currently, IP organisations, including WIPO and EUIPO, are actively engaged in the implementation of solutions that seek to establish a communication platform facilitating the interaction between IP rights holders and enforcement authorities. In addition to this, numerous industries, including footwear, fashion, and other sectors with high levels of IP, are leveraging blockchain technology to safeguard their IP rights, trace the origin of their products, and facilitate anti-counterfeiting measures.[225]

[224] Gurkaynak (n 126) 860.
[225] World Intellectual Property Organization (n 180) 131.

4.3. CHALLENGES

Numerous challenges are encountered by any revolutionary technology during its early stages of development, as it transitions from the research and development phase to its initial applications and eventual large-scale deployment. One of the issues at hand is that these technologies are initially designed to address a particular range of challenges. With the rise of Bitcoin, the potential of the underlying blockchain technology began to gain traction. Notwithstanding, certain initial design characteristics that contributed to the widespread adoption of Bitcoin, such as restricted availability and pseudonymity, have emerged as possible impediments to the extensive application of blockchain technology. The developmental trajectory of blockchain technology can be likened to that of the World Wide Web.[226]

The implementation of a blockchain system for safeguarding IPR on a global scale has been posited to necessitate substantial initial expenditures. The primary obstacle impeding the broad implementation of blockchains for enforcing IPR relates to the intricacies associated with blockchain technology, which pose a challenge in terms of comprehension and explication. Currently, in the majority of nations, the enforcement authorities have not thoroughly investigated or fully grasped the complexities and obstacles associated with online counterfeiting. Given this circumstance, it can be inferred that convincing enforcement authorities to employ a state-of-the-art technology like blockchain for safeguarding IPR will necessitate a significant amount of convincing and instruction. The design of the applications should prioritise simplicity and user-friendliness. The possession of this attribute is of utmost importance for such applications, given the diverse user base and their varying degrees of technological proficiency. Not all individuals possess the volition, aptitude, or inclination to acquire coding skills for the purpose of developing a smart contract. Hence, it is imperative to have user-friendly interfaces in this domain, wherein the utilisation of AI based blockchains can prove to be advantageous.[227]

The regulation of blockchain technology is perceived as the most arduous obstacle to its implementation in the realm of IP practise and enforcement. Given the swift

[226] NITI Aayog, 'Blockchain the India Strategy: Towards Enabling Ease of Business, Ease of Living, and Ease of Governance (Report, Cm, 2021) 28.
[227] Gurkaynak (n 126) 860.

adoption and potential transformative impact of blockchain technology, there exist certain domains that necessitate regulatory oversight to pre-empt any untoward consequences. Nevertheless, the task of regulating the technology during its nascent stage poses a considerable challenge due to the uncertain trajectory of blockchain's future. In addition to the social and technical obstacles, the legal challenges associated with blockchain technology are expected to pose a significant hindrance to its advancement and widespread acceptance. This issue has not been disregarded by international organisations. Consensus exists among experts that the development of blockchain-based technology ought to be predicated on a legal framework that is comprehensible, foreseeable, and pertinent. The identification of the responsible entity for a network or a network-related action, as well as the determination of the applicable law for ensuring compliance, can be a complex undertaking. Although these issues are present, it is important to avoid exaggerating their significance. In contrast, private-permissioned blockchains typically feature a legal entity as their foundation and incorporate established mechanisms within their governance frameworks to authenticate nodes and users. The scenario pertains to blockchains that are managed by an intermediary online platform, such as “Kleros” or “Jur”, or by a private conglomerate of stakeholders in the IP environment. Another possibility is the utilisation of blockchains by IP offices, either independently or collectively. In instances of this nature, the determination of the responsible party for ensuring legal adherence of the blockchain ought not to pose a challenge.[228]

The inherent characteristics of blockchain technology may give rise to a noteworthy obstacle. According to critical analysis, the implementation of blockchain technology for copyright management would result in a substantial volume of data, should this vision be actualized. As we know that the members of the blockchain also act as nodes within the said system, it is imperative that each individual node is equipped to store a substantial volume of data. The resolution to this quandary could potentially be found in the expeditious advancement and enhancement of the extant blockchain technology. The exponential increase in the storage capacity of hard discs in recent times has been observed.[229] Nevertheless, it is anticipated that the utilisation of contemporary

[228] World Intellectual Property Organization (n 158) 55.
[229] Gurkaynak (n 126) 860.

technologies, such as the increased adoption of the PoS algorithm, will enhance energy efficiency in the future.[230]

In order for blockchain technology to effectively facilitate IPR protection, it is imperative that private-public partnerships be established. The Intellectual Property Offices of various countries and international organisations must collaborate to develop a comprehensive framework that can be universally implemented. The matter of interoperability encompasses the compatibility among diverse blockchain platforms as well. The integration of the aforementioned system into the existing IPR protection framework must be subjected to meticulous analysis to ensure compliance with national laws, regional regulations, and international treaties.

Currently, there exists a deficiency in the standardisation of blockchain technology. The absence of interoperability, be it between technologies, legal frameworks, or regions, poses a significant obstacle to the widespread adoption of DLT. The absence of standardisation is evident in several of these aspects. Regarding governance and processes, the transparency of discussions and leadership is inadequate and falls short of representing society or the broader global interests. The process of adopting standards in the field is challenging due to its intricate nature and varied applications. Currently, there are multiple endeavours underway to standardise various aspects of blockchain technology. The blockchain industry now relies on market-driven strategies, as shown in the use of the Hyperledger toolset under the Linux Foundation's umbrella or the Ethereum Foundation's Ethereum Improvement Proposals. Regarding blockchain standards, the Global Blockchain Business Council has identified a few major obstacles. At first, it is crucial to harmonize standards and codes of behavior throughout different legal systems and businesses. It is also critical to guarantee that all stakeholders have an equal chance to voice their ideas. It is important that all parties participating in blockchain and/or other DLT be together in order to enable the growth and implementation of consistent technical protocols. To encourage the use of technology and avoid fragmentation, it is crucial to achieve synchronization and cohesiveness across all initiatives.[231]

[230] NITI Aayog (n 226) 28.
[231] World Intellectual Property Organization (n 180) 131.

The antithesis to the legal concerns stemming from the use of pseudonyms on blockchain is that the privacy of participants may be compromised due to the publicly accessible nature of the DLT, which precludes complete anonymity.[232] Hyperledger Fabric, a consortium blockchain, is a recommended option due to its controlled access to data, limiting member access to specific information rather than complete access. This implies that solely individuals with authorization will possess unrestricted access, thereby resolving privacy concerns and preventing the disclosure of sensitive information pertaining to the brands. An additional instance pertains to the VeChain blockchain framework, which features a binary token system. One the one hand, there exists a publicly accessible token that facilitates transactions, while on the other hand, a privately held token is utilised to gain access and execute smart contracts. This practise facilitates the preservation of requisite transparency and fulfils the objective of safeguarding confidential information.

[232] Nitesh Desai Associates, '*The Blockchain Industry Applications and Legal Perspectives*' (Report, Cm, 2018) 25.

5. CONCLUSION

In the present study the researcher has tried to understand the if blockchain technology can be used for providing better protection to IPR mainly in the registration, management and enforcement phase. The researcher has in the beginning explained the basic concepts related to blockchain technology including its working mechanisms, components as well as classification. The current study further explores the existing legal framework of the technology, its potential legal status. The researcher also gives a brief overview of the use of blockchain in various sectors apart from IPR including criminal cases. The researcher goes on to study the link of blockchain technology with different IP rights such as patents, trademark and copyright. The huge potential of blockchain technology to solve the various problems associated with the current IP registration process like being expensive and time consuming have been dealt with in detail in the fourth chapter of the dissertation. The third parties associated with the licensing and assignment of IPR makes the management process very expensive and the integration of blockchain can greatly reduce this expense. The problems of counterfeiting and the potential of blockchain in tackling that has also been dealt with in the penultimate chapter of the study. Moreover the challenges associated with the use of blockchain technology for the protection of IPR has been dealt with in detail in the research. This concluding chapter of the study has been divided into two parts. The first part of this chapter tries to give the summary of the research undertaken by the researcher. In the second part of this chapter the researcher tries to put forward some suggestions related to the research.

5.1. FINDINGS

Blockchain was first introduced to us by through his paper on Bitcoin by Satoshi Nakamoto through his paper on Bitcoin in 2009. In the years after this blockchain has become a household name throughout the world. Apart from taking the world by storm through its application in cryptocurrencies like Bitcoin and Ethereum to name a few, it has shown its huge potential in various industries like healthcare, education, banking, telecom etc. Now a days all industries are trying to incorporate blockchain into their systems in order to reap the advantages provided by this powerful technology. Here law especially IPR is no bystander. Blockchain technology has many key characteristics like distributed ledger, immutability, decentralisation to name a few. The different types

of blockchain with its own set of distinct characteristics have also been discussed in this research.

If we discuss the application of blockchain in law, it offers unique advantages like transparency, reliability etc which can be of great use in many fields of the law. One of the key uses that comes into the mind is that of blockchain's ability to improve the record keeping through DLT in both civil and criminal cases.

However, there is no concrete legal framework to regulate the use of blockchain as of now in India. This causes various legal challenges in the uses of blockchain due to the ambiguity that surrounds it. The need to incorporate blockchain technology into the existing legal framework or making a law specific for regulation of blockchain is essential to utilise the potential of blockchain in providing protection to the IP in its various stages like registration, enforcement and management including transfer and licensing. In this regard the steps taken by the central government like the National Strategy on Blockchain India is a step in the right direction. This shows that the world is optimistic about the benefits that blockchain can provide in various sectors including the field of IPR.

The protection of IPR can be revolutionised by the use of blockchain technology. It can be used in the protection of patents, copyright, trademark, industrial designs etc.

For the **Registration stage** of protection this technology can provide numerous benefits by creating a decentralised registry. This would result in simplification of the process of registration making it cost effective thus benefitting all the parties involved in the process. In the present process one has to file for registration in different countries or regions, this issue can be solved by filing one application which could work throughout the jurisdiction. However, for this to happen the stakeholders have to come together to make sure that the system can work throughout the jurisdictions and comply with the national, regional and international treaties. Blockchain with the help of smart contracts can be used to automate similarity tests and decrease the probability of confusion for trademark registration. During the phase of registration, it can also be helpful for the verification of ownership.

In answer to the first research question, it can be stated that yes, blockchain technology does provide numerous benefits in the registration phase of IPR.

For the **Management phase** of IPR, blockchain can indeed do wonders. It can be also helpful in the transfer and licensing aspects of these rights. As of now the management phase is heavily dependent on third parties, the use of blockchain can remove these middle men or intermediaries thus bring down the costs and time taken for transfer and licensing. The copyright owners would be able to directly collect royalties from users. Since blockchain can provide a transparent and accessible database for the parties it can solve the problems related to management of IP. One of the major problems in copyright management is that it is very difficult to guarantee the authenticity and also to access the records. The use of smart contracts can help the copyright holders by directly informing them when their creation is being used which would help them to collect revenue more easily. The transfer and licensing aspects of management can also benefit from the use of blockchain technology in a way as it can simplify the processes currently required. It would be able to record changes in ownership in nearly real time as it has time stamping which would also ensure that the legal provisions are complied during the transfer of ownership or issuing licences.

In answer to the second research question, it can be stated that yes, blockchain technology would be of enormous benefit in the management phase including for transferring and licensing of IPR for all the stakeholders.

For the **Enforcement phase** of protection of IPR can also similarly benefit from the integration of blockchain technology. In the end the main aim of these rights is to ensure that they can be enforced and no one can get away with the infringement of patent, copyright or any other IPR. As of today, counterfeiting is a major issue plaguing the right holders, end users as well as the enforcement agencies. Blockchain can be of great help on this regard. One thing has to be again emphasised that collaboration between all the parties involved including law enforcement agencies is crucial for this to work. The booming of the internet has made the problem of counterfeiting even worse with the mushrooming of online market places with the customers also suffering from economic losses due to counterfeit goods. Blockchain can help to fight this menace of counterfeiting by providing data storage and also by information exchange among all the participants of the chain. It would result in improved traceability, data integrity and thus improving security and reducing counterfeiting. The integration of AI with Blockchain can pave way for an even better form of protection for these rights as smart

contracts work can be said to be a code used to implement algorithms which can be enhance with the AI backed blockchains.

In answer to the third research question, it can be stated that yes, blockchain technology can indeed be of great significance in the enforcement stage of protection of IPR and it can be an effective tool to overcome the menace counterfeiting plaguing the all the stakeholders.

It has to be stated that the hypothesis formulated by the researcher that blockchain technology can overcome the challenges in the registration, management and enforcement (specially counterfeiting) phases of IPR has been found to be true after the researcher has conducted the research.

5.2. SUGGESSTIONS

It is also to be noted that there are indeed various challenges like educating people, privacy, scalability, sustainability that have to be overcome in order to truly utilise the potential of blockchain for IPR. These challenges and their potential solutions have tried to be dealt with in the Chapter 4. Moreover, the flaws can be improved in the future and it should not impede this technology from being applied. It has to be said that the benefits provided by blockchain technology which would assure protection in a reliable, efficient and automated manner cannot be understated as it can pave the way for an unified IP protection system in the world. In this section the researcher tries to provide some suggestions.

- The establishment of regulatory framework for blockchain which is uniform throughout the world is very essential. The framework should be framed in such a way that all the legal issues are taken care of including cross border enforcement and comply with the national, regional and international treaties. All the stakeholders including the right holders and the government agencies or IPOs should come together for collaboration for maintaining interoperability and uniform standards throughout the world.
- All the stakeholders should be sensitised and educated about blockchain technology and its potential in the protection of IPR as it would lead to better understanding of this technical technology.

- To tackle with the issue related to privacy concerns steps should be taken to utilise private blockchains or consensus blockchains in the areas where its application is possible and beneficial. Moreover, to deal with the issue related to sustainability blockchains working on the PoS model (instead of the high energy consuming PoW models) should be given preference in areas where possible. This would result in allowing to utilize the benefits of blockchain technology thus allowing for better protection of IPR.
- There should be an effort to integrate blockchain into the current IPR framework of the countries and also at the international level as it would allow for a smooth transition.
- The researchers should be encouraged to work on blockchain technology and make it better. It is even better if research focusing on blockchain technology and AI can be encouraged as it would be more beneficial for the better registration, management and enforcement of IPR.

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