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digitalisation
digitalisation**

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The Patent-Eligibility of Blockchains in Europe and the United States

PASCAL FAVROD-COUNE*

KEYWORDS	Patents – Blockchain – Innovation – European Patent Convention – United States Patent Law
ABSTRACT	Whether in the field of economics, law or information technologies, the rise of blockchains appears to be a revolution. Is it therefore no surprise that a great number of companies are studying the benefits that blockchain technology can provide them, and seek protection when they make an invention in this field. Accordingly, the number of patent applications related to blockchain technology has skyrocketed all over the world in the last few years. This article analyzes whether a blockchain, or an improvement thereof, is patent-eligible by examining the applicable law under the European Patent Convention and in the United States. To tackle this question and to show that an improvement of a blockchain is in itself patent-eligible, the relevant legal framework and the developments of blockchains are explored, before taking the example of an actual patent application that relates to the invention of a new consensus method. However, this article argues that even though a patent could in certain circumstances be obtained, it is not always desirable for the inventors to apply for such a protection.
ZUSAMMENFASSUNG	Ob im Bereich Wirtschaft, Recht oder Informationstechnologie, der Aufschwung von Blockchain scheint omnipräsent zu sein. Es ist daher nicht verwunderlich, dass eine grosse Anzahl von Unternehmen die Vorteile der Blockchain-Technologie prüft und Schutz sucht, wenn sie eine Erfindung auf diesem Gebiet machen. Dementsprechend ist die Zahl der Patentanmeldungen im Zusammenhang mit der Blockchain-Technologie in den letzten Jahren weltweit in die Höhe gestiegen. Dieser Beitrag analysiert, ob eine Blockchain oder eine Verbesserung derselben patentfähig ist, indem er das anwendbare Recht gemäss dem Europäischen Patentübereinkommen und in den Vereinigten Staaten analysiert. Um diese Frage anzugehen und zu zeigen, dass eine Verbesserung einer Blockchain an sich patentfähig ist, werden der entsprechende Rechtsrahmen und die Entwicklungen der Blockchain untersucht, bevor am Beispiel einer konkreten Patentanmeldung aufgezeigt wird, wie dieser Prozess vonstatten geht, welcher auf der Erfindung einer neuen Konsensmethode beruht. Wir kommen jedoch zum Schluss, dass es nicht immer wünschenswert ist einen solchen Schutz zu beantragen, obwohl grundsätzlich ein Patent erlangt werden könnte.
RÉSUMÉ	Que ce soit dans le domaine de l'économie, du droit ou des technologies de l'information, l'essor des chaînes de blocs semble être une révolution. Il n'est donc pas surprenant qu'un grand nombre d'entreprises étudient les avantages que la technologie des chaînes de blocs peut leur apporter, et cherchent une protection lorsqu'elles font une invention dans ce domaine. En conséquence, le nombre de demandes de brevets liées à la technologie des chaînes de blocs a grandement augmenté partout dans le monde au cours des dernières années. Cet article analyse si une chaîne de blocs, ou une amélioration de celle-ci, est brevetable en examinant la loi applicable en vertu de la Convention sur le brevet européen et aux États-Unis. Pour répondre à cette question et montrer qu'une amélioration d'une chaîne de blocs est en soi brevetable, le cadre légal pertinent et l'évolution en matière de chaînes de blocs sont exposés, avant de prendre l'exemple d'une demande de brevet réelle liée à l'invention d'une nouvelle méthode de consensus. Toutefois, cet article conclut que même si un brevet pourrait dans certaines circonstances être obtenu, il n'est pas toujours désirable pour les inventeurs de demander une telle protection.

I. Introduction

In recent years, it has become rare to open a newspaper or a journal without finding an article devoted to blockchains. Whether in the field of economics, law or infor-

mation technologies, the rise of blockchains appears to be a revolution. Moreover, blockchain technology is often referred to as a groundbreaking innovation and the harbinger of a new economic era¹. Hence, a great number of

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¹ ROMAN BECK/CHRISTOPH MÜLLER-BLOCH/JOHN-LESLIE KING, *Governance in the Blockchain Economy: A Framework*

companies are studying the benefits that blockchain technology can provide them², and seek protection when they make an invention in this field. Accordingly, the number of patent applications related to blockchain technology has skyrocketed all over the world in the last few years. In September 2018, Alibaba counted 90 patent applications, while IBM filed one less application. At the same time, MasterCard applied for 80 blockchain-related patents and Bank of America for 53³. From a legal point of view, a legitimate question therefore arises: is a blockchain, or an improvement thereof, patent-eligible? In this paper, I will address that question by examining the applicable law under the European Patent Convention (EPC) and in the United States (US).

This paper adheres to the following structure: since a blockchain is a software-based technology that allows the transfer of data in certain divided blocks which are all encrypted⁴, part one of this paper contains an analysis of the legal framework applicable to software patents in Europe for contracting countries of the EPC and in the US (I.). This section examines the legal framework as such before reviewing how the legal institutions have interpreted it. Secondly, I explain the notion of blockchain in a chronological way (II.): to begin with, I describe the functioning of the first blockchain, i.e. the Bitcoin blockchain, and I then explain how it has been improved, and how it might be improved in the future. Thirdly, I analyze the patentability of blockchains by taking the example of a blockchain-related patent application (III.). I apply the EPC and the US patent law before comparing the result of their application and determine what elements must be taken into account while drafting the patent. The fourth part of this paper will discuss challenges related to the patentability of blockchain inventions (IV.). Finally, a conclusion will summarize the main findings of the essay.

II. Patenting Software

Patenting software poses considerable problems. Firstly, patent laws regularly exclude computer programs from their application scope. Secondly, the notion of a computer program itself, i.e. software, is not entirely unambiguous. Software might describe a vast array of phenomena⁵, from algorithms capable of basic applications to a great amount of more specific and highly complex uses⁶. Basically, a software will provide instructions to a computer regarding the performance of a task and how to execute it. For instance, a software can be a system software that directly operates the computer hardware or it can be an application software that uses the computer system to perform special functions. Such diversity has led to difficulties in interpreting and applying the law and to diverse opinions among authors in the legal scholarship whether software *per se* is patentable as a matter of public policy and, if so, to which extent⁷.

A. Legal Framework and Current Situation under the EPC

1. Legal Framework

Pursuant to art. 52(1) EPC, European patents shall be granted for any inventions, in all fields of technology, provided that they are new, involve an inventive step and are susceptible of industrial application. Hence, a patent could be granted for an invention if it meets three conditions: the invention shall (i) be novel, (ii) involve an inventive step and (iii) be capable of industrial application. Nevertheless, the substantive law of validity of patents⁸ requires a fourth condition, which is that the invention does not fall within any of the categories of subject-matter specifically excluded or made subject to an exception⁹. A certain number of subjects are excluded by art. 52 (2) EPC. *Inter alia*, this article provides that schemes, rules and methods for performing mental acts, playing games or doing busi-

and Research Agenda, 19/10 Journal of the Association for Information Systems 2018, 1020 et seqq., 1020. See also MARCO IANSITI/KARIM R LAKHANI, The Truth About Blockchain, Harvard Business Review, January-February 2017, available at <<https://hbr.org/2017/01/the-truth-about-blockchain>> (all websites accessed 11 June 2019), 4.

² See MARY C. LACITY, Addressing Key Challenges to Making Enterprise Blockchain Applications a Reality, 17:3 MIS Quarterly Executive 2018, 201 et seqq., 201.

³ EMMA LEE, China takes 57 of 100 spots in global top 100 blockchain patent ranking, 3 September 2018, available at <<https://technode.com/2018/09/03/blockchain-patent-china-tech/>>.

⁴ FRITZ WETZEL, Blockchain Technology – Patent Eligible Subject Matter or Just a Business Model?, Legal Intelligencer, 4 April 2018.

⁵ ADAM MOSSOFF, A Brief History of Software Patents (and Why They're Valid), 56:4 Arizona Law Review Syllabus 2014, 66 et seqq., 70 et seqq.

⁶ WILLIAM CORNISH/DAVID LLEWELYN/TANYA APLIN, Intellectual Property: Patents, Copyrights, Trademarks & Allied Rights, 8th edition, London 2013, N 5-60.

⁷ See MOSSOFF (fn. 5), 66.

⁸ From a procedural point of view, the specification must satisfy the requirement of adequate disclosure, see CORNISH/LLEWELYN/APLIN (fn. 6), N 5-01.

⁹ REEVE NICK, Westlaw Insight on Non-patentable inventions, 7 December 2017, N 9; CORNISH/LLEWELYN/APLIN (fn. 6), N 5-01.

ness, and *programs for computers* shall not be regarded as inventions within the meaning of art. 52(1) EPC.

Despite this exclusion of computer programs of patentable subject-matters, the European Patent Office (EPO) has had over a thousand applications for computer-implemented inventions (CIIs) over the last 30 years¹⁰. Some of these applications were successful. This is because of the way how the competent authorities have interpreted the exclusion of art. 52(2) EPC.

2. The Approach of the EPO

Some scholars have gone as far as stating that art. 52 EPC is now an insignificant bar to patentability¹¹. This is the consequence of the approach followed by the EPO, sometimes referred to by commentators as the «any hardware» approach¹². It has been developed by the Technical Board of Appeal (TBA) in the *Pension Benefits* decision¹³ and then expanded in the *Hitachi* decision¹⁴, in which the TBA had to assess the patentability of an online Dutch auction method¹⁵.

As its name suggests, the «any hardware» approach is mainly concerned with how the invention is characterised¹⁶. Under this approach, an invention will not fall under the CIIs exclusion (or any exclusion of art. 52(2) EPC) if it embodies or is implemented by some technical means, even if these are used in relation to a non-techni-

cal activity¹⁷. In other terms, the exclusion does not apply to computer programs having a technical character¹⁸. In practice, the EPO will have to stand back from the invention and determine whether it can be classified as a form of technology or not¹⁹.

In the case that an invention is implemented by a computer, the EPO will consider that it uses technical means and, hence, that it has a technical character²⁰. Indeed, the European Board of Appeal (EBA) stated that a «claim to a computer implemented method or a computer program on a computer-readable storage medium will never fall within the exclusion of claimed subject-matter under art. 52(2) and (3) EPC»²¹. In the same sense, the TBA held that the fact that the method was implemented in a computer system amounts to a technical means and is sufficient to escape the prohibition in art. 52(2) EPC²².

Afterwards, the test to be applied by the EPO looks into whether the CII provides a technical solution to a technical problem²³. As no definition of the «technical problem» can be found in the EPC, it must be defined negatively. A technical problem is a problem that does not lie solely in commercial, administrative or organisation fields²⁴.

Overall, the «any hardware» approach allows any invention that enhances the internal operations of a computer to have technical character as long as it goes beyond the elementary interaction of hardware and software of data processing²⁵. The TBA requirements for software patentability are as follows²⁶:

1. The invention must be new, innovative and industrially applicable.
2. The notion of «invention» must be construed as «subject-matter having technical character».

¹⁰ WILLIAM CHANDLER, Patentability of Computer-Implemented Inventions (CIIs): State of Play and Developments, Supplementary Publication - Official Journal EPO, 5/2015, 73.

¹¹ See LIONEL BENTLY/BRAD SHERMAN/DEV GANGJEE/PHILIPP JOHNSON, Intellectual Property Law, 5th edition, Oxford 2018, 505; DAVID BOOTON, The Patentability of Computer-Implemented Inventions in Europe, Intellectual Property Quarterly 2007, 92 et seqq., 102; JUSTINE PILA, Dispute over the Meaning of «Invention» in Article 52(2) EPC - The Patentability of Computer-Implemented Inventions in Europe, 36(2) IIC: International Review of Industrial and Copyright Law 2005, 173 et seqq., 173 et seqq.

¹² See for example BENTLY/SHERMAN/GANGJEE/JOHNSON (fn. 11), 485 et seqq.; BRAD SHERMAN, Computer Programs As Excluded Patentable Subject Matter, WIPO Standing Committee on the Law of Patents: Fifteenth Session, October 2010, available at <http://www.wipo.int/edocs/mdocs/scp/en/scp_15/scp_15_3-annex2.pdf>, 29.

¹³ *Pension Benefit Systems Partnership*, T 931/95 [2001] OJ EPO 441.

¹⁴ *Hitachi/Auction method*, T 258/03 [2004] OJ EPO 575.

¹⁵ See REEVE (fn. 6), N 39; ANDREW MURRAY, Information Technology Law - The Law and Society, 3rd edition, Oxford 2016, 267.

¹⁶ SHERMAN (fn. 12), 29.

¹⁷ BENTLY/SHERMAN/GANGJEE/JOHNSON (fn. 11), 485; PHILIPPE GILLIÉRON, Propriété intellectuelle et Internet, Lausanne 2003, N 476.

¹⁸ EUROPEAN PATENT OFFICE, Guidelines for Examination in the European Patent Office, November 2018, available at <<https://www.epo.org/law-practice/legal-texts/guidelines.html>>, Section G-II-3.6. On the notion of technical character, see also REEVE (fn. 6), N 37 et seqq.; BOOTON (fn. 11), 93; GILLIÉRON (fn. 17), N 476 et seqq.

¹⁹ BENTLY/SHERMAN/GANGJEE/JOHNSON (fn. 11), 485.

²⁰ *Infineon Technologies/Circuit simulation I*, T 1227/05 [2007] OJ EPO 581; BENTLY/SHERMAN/GANGJEE/JOHNSON (fn. 11), 505; BOOTON (fn. 11), 102.

²¹ *President's Reference/Patentability of programs for computers*, G 3/08 [2011] OJ EPO 10.

²² *Microsoft/Clipboard formats I*, T 424/03 [2006].

²³ REEVE (fn. 6), N 35.

²⁴ REEVE (fn. 6), N 40.

²⁵ *Microsoft/Clipboard formats I*, T 424/03 [2006]. See also BENTLY/SHERMAN/GANGJEE/JOHNSON (fn. 11), 506.

²⁶ See MURRAY (fn. 15), 267.

3. The verification that the claimed subject matter is an invention must be done before performing the three other tests (novelty, inventive step and industrial applicability tests).

The notion of «technical character» mentioned here above in the second requirement means that a computer program must produce a «further technical effect» when run on a computer²⁷. Such a notion signifies that the invention produces a technical effect going beyond the «normal» physical interactions between the program, i.e. the software, and the computer, i.e. the hardware²⁸. As a result, the normal physical effects of the execution of a program are not sufficient to confer technical character to a software²⁹. Furthermore, the additional technical effect may be known to the prior art, which also limits the patentability of the invention³⁰.

B. Legal Framework and Current Situation in the US

1. Legal Framework

In the terms of Title 35 of the United States Code Section 101 (35 U.S.C. § 101), «whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title». The substantive requirements³¹ are set forth by 35 U.S.C. § 101, 102 and

103: to be patentable, an invention must be (i) novel, (ii) useful, (iii) non-obvious and (iv) fit within statutory defined subject matter³².

The tough question with software is usually whether it meets the last requirement of fitting within statutory defined subject matter or not. Even though the US Supreme Court has stated that statutory defined subject matter is meant to «include anything under the sun that is made by man»³³, there are judicial exceptions to the patent-eligible subject matter under 35 U.S.C § 101, such as laws of nature, natural phenomena and abstract ideas³⁴. Regarding software patentability, the US case law has evolved significantly since inventors began to apply for software patents.

2. The Approach of the US Supreme Court

Since the first software was created, courts in the US, in particular the United States Court of Appeals for the Federal Circuit (Federal Circuit) and the US Supreme Court, have had different views about the patentability of software and business methods. After years of fluctuations in the US case law³⁵, the year 2014 marks a turning point with the decision of the US Supreme Court in *Alice Corp. v. CLS Bank International*³⁶. Indeed, in the year following *Alice*, the Federal Circuit invalidated over 90 % of the patents brought before it for being directed to ineligible subject matter³⁷.

In *Alice*, the US Supreme court had to determine whether the claims of Alice Corp. about a computer-implemented electronic escrow service built to ease financial transaction by calculating settlement risks covered

²⁷ *Computer program product/IBM*, T 1173/97 [1998]. See also EUROPEAN PATENT OFFICE (fn. 18), Section G-II-3.6; REEVE (fn. 6), N 13; GILLIÉRON (fn. 18), N 480.

²⁸ EUROPEAN PATENT OFFICE (fn. 18), Section G-II-3.6. To be more concrete, any computer program that runs on a computer will cause physical transformation of bit patterns by modifying electrical charges with the aid of electrical voltage and currents. These phenomena as such are not patentable, because they do not produce the further technical effect. If this would be the case, either all computer programs or no computer programs would be patentable, in contradiction with the law. A clear and concrete example of such technical effect can be illustrated with the functioning of a washing machine. In the past, the operations of washing machines (such as pumping, soaking or tumbling) were performed by a mechanical control unit that had a technical effect on the whole process. Nowadays, this process is completed by a combination of software and hardware that have the same technical effect. It is therefore logical that if it has a further technical effect unknown to the prior art, it is equally patent-eligible as a sole mechanical effect is.

²⁹ EUROPEAN PATENT OFFICE (fn. 18), Section G-II-3.6.

³⁰ WETZEL (fn. 4).

³¹ With regards to the formal requirement, the invention must be adequately disclosed (35 U.S.C. § 112).

³² See SHELDON W. HALPERN/SEAN B. SEYMORE/KENNETH L. PORT, *Fundamentals of United States Intellectual Property Law, Copyright, Patent, and Trademark*, 4th edition, Alphen aan den Rijn 2012, 154. See also GILLIÉRON (fn. 18), N 464 et seqq.

³³ *Diamond v. Chakrabarty*, 447 U.S. 303, 309 (1980).

³⁴ ANTONIO M. DiNIZO JR., *From Alice to Bob: the Patent Eligibility of Blockchain in a Post-CLS Bank World*, 9 *Journal of Law, Technology & the Internet* 2018, 1 et seqq., 13; FABIO E. MARINO/TERI H. P. NGUYEN, *From Alappat to Alice: The Evolution of Software Patents*, 9 *Hastings Science & Technology Law Journal* 2017, 1 et seqq., 3; MAGNUS GAN, *Before Mayo & After Alice: The Changing Concept of Abstract Ideas*, 22 *Michigan Telecommunications & Technology Law Review* 2016, 287 et seqq., 291.

³⁵ For an overview, see GAN (fn. 34), 293 et seqq.; MARINO/NGUYEN (fn. 34), 3 et seqq.

³⁶ *Alice Corp. v. CLS Bank International*, 573 U.S. 208, 134 S. Ct. 2347 (2014).

³⁷ GAN (fn. 34), 291; JASPER L. TRAN, *Two Years After Alice v. CLS Bank*, 98 *Journal of the Patent & Trademarks Office Society* 2016, 1 et seqq., 3.

abstract ideas, which are ineligible for patent protection. According to the US Supreme Court, those claims were invalid because they were drawn to an abstract idea and merely required to be implemented in a computer, which the US Supreme Court held as not enough to be patent-eligible³⁸. Even though the US Supreme Court did not explicitly mention software as such in its decision, commentators interpreted *Alice* as a death sentence for business method and software patentability³⁹.

The US Supreme Court reasoning is based on the one developed in *Mayo Collaborative Servs. v. Prometheus Labs, Inc.*⁴⁰. It applied the so-called «*Mayo Framework*» and held that such a framework must be applied in any cases that require the Court to decide whether any business method and software are patent-eligible⁴¹. Indeed, the Court held that *Mayo* explained how to address the issue of determining whether a patent claimed an abstract idea or a potentially patentable practical implementation of an idea⁴². In order to determine this, the Court used a two-step analysis⁴³.

In *Alice*, the US Supreme Court explained the «*Mayo Framework*» as follows:

First, we determine whether the claims at issue are directed to one of those patent-ineligible concepts. If so, we then ask, «[w]hat else is there in the claims before us?» To answer that question, we consider the elements of each claim both individually and «as an ordered combination» to determine whether the additional elements «transform the nature of the claim» into a patent-eligible application. We have described step two of this analysis as a search for an «'inventive concept'»—i.e., an element or combination of elements that is «sufficient to ensure that the patent in practice amounts to significantly more than a patent upon the [ineligible concept] itself»⁴⁴.

In other terms, the first step allows the Court to determine whether the patent claim in question contains an abstract idea. If not, the claim is potentially patentable, as long as the other requirements of 35 U.S.C. § 101, 102

and 103 are met⁴⁵. On the contrary, if the answer to that question is affirmative, a claim can still be deemed patent-eligible and the Court has to proceed to step two⁴⁶. In this second step, the Court must determine whether the patent adds something extra to the abstract idea that embodies an «inventive step». If not, then the Court should find the patent invalid; if yes, the invention might be patentable⁴⁷.

With regards to software patents, there are two ways to overcome the *Alice* analysis⁴⁸:

1. The first one is to show to what extent the patent claims are a significant inventive concept that is added to an abstract idea. While examining this, the Court looks for an element (or a combination of elements) in the claims that would amount to significantly more than the patent-ineligible subject matter itself⁴⁹. In practice, the invention must provide something more beyond than simply «well-understood, routine, conventional activity»⁵⁰ and cannot merely recite claims that are already known and used by those in the field of activity⁵¹. With regard to the computing field, the invention must work to overcome a problem arising in a specific area of computer technology⁵². As the US Supreme Court puts it in *Alice*, merely taking an abstract idea and then implementing it onto a computer will not be sufficient to show an inventive concept⁵³.
2. The second one is to show that the claims themselves are not outside the scope of patent-eligible subject matter. Courts will look whether the patent claims are directed toward an abstract idea or to a specific improvement in the prior art⁵⁴. A software patent is likely to be found patent-eligible if three cumulative conditions are met, i.e. if (i) the patent claims purport to improve the function of a computer itself, (ii) the invention does more than merely instruct the practitioner to implement an abstract idea onto a generic computer and (iii) it offers a meaningful limit beyond

³⁸ DiNIZO JR. (fn. 34), 18.

³⁹ DiNIZO JR. (fn. 34), 18.

⁴⁰ *Alice Corp. v. CLS Bank International*, 134 S. Ct. 2347 (2014). See GAN (fn. 34), 300 et seqq.

⁴¹ DiNIZO JR. (fn. 34), 17.

⁴² *Alice Corp. v. CLS Bank International*, 134 S. Ct. 2355 (2014).

⁴³ See GAN (fn. 34), 298.

⁴⁴ *Alice Corp. v. CLS Bank International*, 134 S. Ct. 2355 (quoting *Mayo*), *Mayo Collaborative Servs. v. Prometheus Labs, Inc.*, 132 S. Ct. 1289, 1294-98 (2012). See also MARINO/NGUYEN (fn. 34), 13; GAN (fn. 34), 301.

⁴⁵ For an example in which the Federal Circuit applied this step and concluded that there was no need to proceed to the second one, see *Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1334 (2016).

⁴⁶ DiNIZO JR. (fn. 34), 18.

⁴⁷ For an example in which the Federal Circuit applied this step and found an inventive concept, see *BASCOM Global Internet Serv. v. AT&T Mobility LLC*, 827 F.3d 1343 and 1344 (2016).

⁴⁸ See DiNIZO JR. (fn. 34), 18 et seqq.

⁴⁹ *DDR Holdings, LLC v. Hotels.com, L.P.* 773 F.3d 1255 (2014).

⁵⁰ *Genetic Techs. Ltd. v. Merial L.L.C.*, 818 F.3d 1376 (2016).

⁵¹ DiNIZO JR. (fn. 34), 19.

⁵² *DDR Holdings, LLC v. Hotels.com, L.P.* 773 F.3d 1257 (2014).

⁵³ *Alice Corp. v. CLS Bank International*, 134 S. Ct. 2352 (2014).

⁵⁴ *Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1335 (2016).

generally linking the use of a particular technological method⁵⁵.

III. The Notion of Blockchain

The first blockchain was the technology underlying the cryptocurrency Bitcoin. It is necessary to understand how Bitcoin functions in order to intrinsically understand how a blockchain works. Thus, the development of the Bitcoin will be portrayed in the upcoming section (A.). I will then explore how the original blockchain in Bitcoin has been improved by other developers (B.) and explore possibilities for further improvements, for which the inventor might apply for a patent (C.).

A. Early Developments

As stated above, the first time a blockchain was conceived was to enable the functioning of the cryptocurrency Bitcoin. It was developed by a programmer known as Satoshi Nakamoto⁵⁶, who released a white paper titled «Bitcoin: A Peer-to-Peer Electronic Cash System» presenting and explaining his concept at the end of October 2008⁵⁷. His goal was to create a currency without the need of a trusted third party as a central authority to verify the currency's authenticity and to prevent that the owner double-spends his money⁵⁸.

Bitcoin is a decentralized digital cryptocurrency that relies on a peer-to-peer network and on cryptography to function⁵⁹. These two notions are central to the functioning of Bitcoin and need to be further explained.

Traditionally, transactions are recorded by a single central bookkeeper, for example a bank. This third party has the role of maintaining a list of transactions and balances, and it also validates or orders the transactions someone requests⁶⁰. With Bitcoin, there is no central bookkeeper, as the ledger recording transactions is distributed through-

out all the peers⁶¹. Accordingly, any individual who wants to be part of the Bitcoin ecosystem can download a software allowing to access the ledger⁶², connect to the peer-to-peer network and become a bookkeeper himself⁶³. All bookkeepers, called «nodes», maintain the same complete books and are peers of equal seniority: there is no hierarchy between them⁶⁴. All these reasons are why such a technology is called «distributed ledger technology».

A problem is how all the peers acting as bookkeepers can stay in sync with one another. To keep the order of transactions correct with every peer wherever they are located in the world (and hence verify that a person does not double spend a certain amount of money), Satoshi Nakamoto provided a solution involving blocks of transactions⁶⁵. No matter how many transactions are created, their data entry into the distributed ledger is made by batches, called blocks⁶⁶. These blocks are created less frequently than transactions, which are pending during the creation of the blocks, so it enables the whole network to access the blocks before another one is created⁶⁷. In Bitcoin, blocks are created every ten minutes on average⁶⁸. The genesis block, i.e. the first block of transactions, was created in 2009 and the network has continued to grow ever since⁶⁹.

Creating these blocks is a process called mining⁷⁰. In order to mine a block, a peer has to play a game of chance (or trial and error⁷¹), in which the winner gets the permission to mine the next block⁷². The game used by Satoshi Nakamoto for Bitcoin is called «proof-of-work»⁷³. In short, the winner is the one who is the first to solve

⁵⁵ DiNIZO JR. (fn. 34), 19. See also MARINO/NGUYEN (fn. 34), 22 et seqq.

⁵⁶ The person or people behind this pseudonym remains unknown to date, see ANTONY LEWIS, *The Basics of Bitcoins and Blockchains*, Coral Gables 2018, 249 et seqq.

⁵⁷ LEWIS (fn. 56), 151; IANSITI/LAKHANI (fn. 1), 5. The original white paper can be found at <www.bitcoin.org/bitcoin.pdf>.

⁵⁸ See DiNIZO JR. (fn. 34), 6 et seqq.

⁵⁹ DiNIZO JR. (fn. 34), 6; GINA PIETERS/SOFIA VIVANCO, *Financial regulations and price inconsistencies across Bitcoin markets*, 39 *Information Economics and Policy* 2017, 1 et seqq., 2.

⁶⁰ LEWIS (fn. 56), 159.

⁶¹ PRIMAVERA DE FILIPPI/AARON WRIGHT, *Blockchain and the Law – The Rule of Code*, Cambridge, Massachusetts/London 2018, 20.

⁶² DE FILIPPI/WRIGHT (fn. 61), 21.

⁶³ LEWIS (fn. 56), 161.

⁶⁴ LEWIS (fn. 56), 160.

⁶⁵ NEAL KOBLITZ/ALFRED J. MENEZES, *Cryptocash, cryptocurrencies, and cryptocontracts*, *Designs, 78 Codes and Cryptography* 2016, 87 et seqq., 95.

⁶⁶ LEWIS (fn. 56), 163; NICOLAS HOUY, *The Bitcoin Mining Game*, 1 *Ledger* 2016, 52 et seqq., 53.

⁶⁷ LEWIS (fn. 56), 163.

⁶⁸ DE FILIPPI/WRIGHT (fn. 61), 27; LEWIS (fn. 56), 165.

⁶⁹ IRA SCHAEFER/TED MLYNAR, *The Bitcoin Patent – Only A Matter of Time?*, *Coindesk* 25, August 2016, available at <<http://www.coindesk.com/bitcoin-patent-matter-of-time/>>; KOBLITZ/MENEZES (fn. 65), 96.

⁷⁰ DE FILIPPI/WRIGHT (fn. 61), 24.

⁷¹ DE FILIPPI/WRIGHT (fn. 61), 24.

⁷² LEWIS (fn. 56), 166.

⁷³ DE FILIPPI/WRIGHT (fn. 61), 23; HESS MARTIN/SPIELMANN PATRICK, *Cryptocurrencies, Blockchain, Handelsplätze & Co*, in : *Kapitalmarkt - Recht und Transaktionen XII* (THOMAS U. REUTTER/THOMAS WERLEN, ed.), Zurich/Basel/Geneva 2017,

a mathematical problem⁷⁴. To incentivize peers to play the game and to mine blocks, it is planned that the winner who mines the next block is rewarded with a certain amount of bitcoins. This amount consists on the one hand of a variable reward depending on fees associated with the transactions that are contained in the block and on the other hand of a fixed reward⁷⁵.

In order for the blocks to be mined in the right order and to prohibit miners from mining a block in advance and by doing so cheat at the game, the miner needs to include the cryptographic hash⁷⁶ of the previous block in the block he or she creates⁷⁷. Thus, the previous block needs to be mined before the next can be. Accordingly, a chain of blocks is created, which is the reason why such a mechanism is called a blockchain.

In Bitcoin, cryptography is also used to make transactions as an encryption technique. More accurately, Public-Key cryptography is used to verify transactions⁷⁸. Indeed, the Bitcoin software uses a complex encryption system, i.e. asymmetric encryption using a system of public and private keys to secure transactions⁷⁹. The public key is shared with all users of the Bitcoin network, as a number of a bank account would be, whereas the private key must be kept secret, as a password to access a bank account would be⁸⁰. To make a transaction, the sender transmits a message to the blockchain that is signed with its private key and includes the recipient's public key. The transaction can be verified by looking at the public key of the sender⁸¹. The transaction and the transfer of ownership can then be recorded on the blockchain, time-stamped and displayed when the blocks are mined, as we have seen above.

For a patent law analysis, it is interesting to note that Satoshi Nakamoto did not file any patent application for Bitcoin or for the blockchain technology that he invented⁸². He also did not claim a patent for any software relat-

ing to Bitcoin. While releasing the white paper in October 2008, Satoshi Nakamoto has made Bitcoin and the basic concept of blockchain available to the public. Therefore, such a technique is from this date considered as being part of state-of-the-art. Any individual who would want to patent the technology underlying Bitcoin would lack novelty, and therefore would not be granted a patent both in the US or in the contracting countries of the EPC, as novelty is a condition of both 35 U.S.C. § 102 and of art. 52(1) EPC.

Commentators in the US argue that Satoshi Nakamoto could have obtained a patent if he had filed an application before releasing the white paper⁸³. At the time, the US case law (*State Street Bank & Trust Co. v. Signature Fin. Group, Inc.*⁸⁴) allowed people to rather easily obtain patents directed to implementing business methods with a computer connected to the Internet⁸⁵. Even though Satoshi Nakamoto acknowledged that hashing, digitally signing, time-stamping and solving a proof-of-work problem were all known processes when the white paper was published in October 2008, Satoshi Nakamoto cites no precedent for the particular combination of processes the white paper describes, such as specifically using a hashed chain of transaction blocks as a currency transaction ledger⁸⁶.

B. Improvements of the Original Blockchain

As Bitcoin was never patented and as it relies on an open-source software⁸⁷, many individuals used the source code in order to create other blockchains and improve the original idea⁸⁸. A notable improvement was made by Vitalik Buterin, who published a white paper in December 2013 explaining his project called Ethereum. It was effectively launched in July 2015.

Ethereum builds on the concepts developed by Satoshi Nakamoto for Bitcoin in order to create an «unstoppable, censorship resistant, self-sustaining, decentralized, world computer»⁸⁹. Bitcoin is «only» a distributed storage of transaction data, whereas Ethereum provides for distributed storage and the processing of data and logic⁹⁰. With

145 et seqq., 157; MIGNON VINCENT, Le «[B]itcoin», un nouveau défi pour le juriste suisse ?, Jusletter 4 May 2015, N 14.

⁷⁴ MIGNON (fn. 73), N 14. For more details, see LEWIS (fn. 56), 167 et seqq.; HOUY (fn. 66), 54 et seqq.

⁷⁵ DE FILIPPI/WRIGHT (fn. 61), 25; LEWIS (fn. 56), 171 et seqq.; NICOLA DIMITRI, Bitcoin Mining as a Contest, 1 Ledger 2016, 31 et seqq., 31. See also MIGNON (fn. 73), N 14.

⁷⁶ On the notion of cryptographic hash function, see DE FILIPPI/WRIGHT (fn. 61), 22 et seqq.; LEWIS (fn. 56), 136 et seqq.

⁷⁷ LEWIS (fn. 56), 177.

⁷⁸ DiNIZO JR. (fn. 34), 8.

⁷⁹ MIGNON (fn. 73), N 9. See also HESS/SPIELMANN (fn. 73), 159 et seqq.

⁸⁰ DiNIZO JR. (fn. 34), 8.

⁸¹ DiNIZO JR. (fn. 34), 8.

⁸² DiNIZO JR. (fn. 34), 12; SCHAEFER/MLYNAR (fn. 69).

⁸³ SCHAEFER/MLYNAR (fn. 69).

⁸⁴ *State Street Bank & Trust Co. v. Signature Fin. Group, Inc.*, 149 F.3d 1368 (1998).

⁸⁵ See SCHAEFER/MLYNAR (fn. 69). See also MURRAY (fn. 15), 265.

⁸⁶ SCHAEFER/MLYNAR (fn. 69).

⁸⁷ See GERALD P. DWYER, The economics of Bitcoin and similar private digital currencies, 17 Journal of Financial Stability 2015, 81 et seqq., 82.

⁸⁸ DE FILIPPI/WRIGHT (fn. 61), 27.

⁸⁹ LEWIS (fn. 56), 254 et seqq.

⁹⁰ LEWIS (fn. 56), 255.

Ethereum, it is possible to submit transactions that create so-called smart contracts, which are short computer programs that are stored on Ethereum's blockchain and then replicated across all the nodes⁹¹. In the words of Vitalik Buterin, «a smart contract is a mechanism involving digital assets and two or more parties, where some or all of the parties put assets in and assets are automatically redistributed among those parties according to a formula based on certain data that is not known at the time the contract is initiated»⁹².

Along with certain technical aspects, the main difference between Bitcoin and Ethereum is that the blockchain of the latter can store computer programs, i.e. smart contracts, instead of only being able to store transaction data⁹³. However, they share a fair number of similarities. They are both protocols written as code which is run as software and that creates transactions containing data about coins recorded on a blockchain⁹⁴. Both have an inbuilt cryptocurrency, are a public (or permissionless) blockchain and have a «proof-of-work» mining process⁹⁵.

If Ethereum was a major development in the field of blockchains, many other blockchains have been built the last few years. Without being exhaustive, we can cite the creation of private (or permissioned⁹⁶) blockchains, to which only a certain number of individuals have access thanks to an authorization issued by the organisation that controls the blockchain⁹⁷, or the creation of hybrid blockchains, whose consensus process is controlled by predetermined nodes but which everyone can read and using and on which everyone can make transactions⁹⁸. These are different from public (or permissionless) blockchains such as Bitcoin or Ethereum because anyone can read the information stored on such blockchains and they allow

everyone to make transactions and participate in the consensus.

C. Possible Further Improvements

The evolutions of blockchain technology are manifold and varied, but are always more or less always relating to (i) the speed at which data can be registered in the blockchain, (ii) the ecological efficiency, because the validation by proof-of-work is tremendously energy-consuming, (iii) costs and (iv) governance of the blockchain, i.e. who controls it and how⁹⁹.

If someone invented a new, more efficient way to mine blocks, could he or she be granted a patent and therefore obtain protection for this invention? For the upcoming analysis in this regard I will use the example of someone who manage to invent a new way of validating transactions, instead of the proof-of-work or proof-of-stake methods which are commonly used at present¹⁰⁰. In particular, I will use the example of the patent application filed in the US in 2016 by Keir Finlow-Bates for a «consensus system and method for adding data to a blockchain», which claims are as follows:

A method and apparatus is presented for reaching consensus on adding data to a distributed ledger system in which no central trusted authority is available, comprising sending an announcement message by a network connected device to a plurality of network connected devices over a peer-to-peer network, said message providing an identification of the network connected device using a public key of a public/private key pair, a unique address identifier, and a hash. Subsequently, after a waiting period measured in, for example, time or blocks of data, the network connected device may submit data for inclusion in the distributed ledger. If the announcement message and preceding data in the distributed ledger satisfy a predetermined condition, the plurality of network connected devices may include the data in the distributed ledger. If the network connected device fails to submit the data when the predetermined condition is satisfied, the announcement message may be cancelled¹⁰¹.

⁹¹ LEWIS (fn. 56), 255 and 275; XIAOQI LI/PENG JIANG/TING CHEN/XIAPU LUO/QIAOYAN WEN, A survey on the security of blockchain systems, *Future Generation Computer System* 2017, available at <<http://dx.doi.org/10.1016/j.future.2017.08.020>>, 3 et seqq.

⁹² BUTERIN VITALIK, DAOs, DACs, DAs and More: An Incomplete Terminology Guide, 6 May 2014, available at <<https://blog.ethereum.org/2014/05/06/daos-dacs-das-and-more-an-incomplete-terminology-guide>>.

⁹³ DE FILIPPI/WRIGHT (fn. 61), 28.

⁹⁴ LEWIS (fn. 56), 255.

⁹⁵ LEWIS (fn. 56), 256 et seqq.

⁹⁶ DE FILIPPI/WRIGHT (fn. 61), 31.

⁹⁷ DE FILIPPI/WRIGHT (fn. 61), 31; ALEXANDER SAVELYEV, Copyright in the blockchain era: Promises and challenges, 34 *computer law & security review* 2018, 550 et seqq., 551.

⁹⁸ VITALIK BUTERIN, On Public and Private Blockchains, 6 August 2015, available at <<https://blog.ethereum.org/2015/08/07/on-public-and-private-blockchains>>.

⁹⁹ See OLIVIER DEPIERRE, Vers la fin des blockchains et de l'open source ?, *Le Temps* 30 November 2018

¹⁰⁰ For other examples of less common consensus methods, see LI/JIANG/CHEN/LUO/WEN (fn. 91), 2.

¹⁰¹ <<https://patents.google.com/patent/US20170075941?q=blockchain+consensus>> and <<http://appft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&u=%2Fnetacgi%2FPTO%2Fsearch-adv.html&r=11&p=1&f=G&l=50&d=P>>

IV. The Patentability of Blockchain Inventions

A. Application and Comparison of the Approaches of the EPO and of the US Supreme Court

The question arises whether a patent application regarding an improvement to a blockchain would be successful under the EPC and in the US. Furthermore, it will be of interest whether the answer to that question is identical in both jurisdictions.

1. Patent Application under the EPC

To examine whether a blockchain invention is patent-eligible, the EPO will apply its well-established CIIs practice¹⁰² as a blockchain is a software-based technology¹⁰³. A new consensus system for a blockchain would be deemed patent-eligible if the invention embodies technical character («any hardware» approach). This technical character is necessary to contribute to the inventive step that has to provide a solution to a problem, in line with the «problem-solution» approach. Accordingly, the analysis of technicality is crucial in the patentability assessment¹⁰⁴.

As one commentator notes, the «technical character» of a software can be found for example in the internal functioning of the computer itself or its the interfaces under the influence of the program and could affect the efficiency or security of a process, the management of computer resources required or the rate of data transfer¹⁰⁵. In light of these examples, an ameliorated consensus system reveals without a doubt the further technical effects that are necessary to receive a patent. Indeed, due to a technical effect, the software increases both the efficiency of the blockchain, for example by reducing the amount of time necessary to mine blocks, and its security, by cancelling the risk of the so-called 51 % attack¹⁰⁶. It therefore provides a technical solution to a technical problem, as required by art. 56 EPC.

In conclusion, as long as the improvement of a blockchain, such as a new consensus system, introduces a tech-

nical solution to a technical problem, it is patent-eligible under the EPC.

2. Patent Application According to US Patent Law

In order to be patent-eligible in the US, an improved blockchain will have to succeed in the *Alice* two-step test¹⁰⁷.

To pass the first step, the inventor has to show that the claims are not directed at an abstract idea. When the first blockchain was created, Satoshi Nakamoto attempted to solve issues previously known with virtual currencies, notably the need for a trusted third-party intermediary. The solution he found was to use the proof-of-work consensus to mine blocks to create a tamper-proof blockchain¹⁰⁸. This solution, however, is far from perfect, and presents a fair number of drawbacks, notably from an ecological viewpoint¹⁰⁹. As Keir Finlow-Bates explains in his patent application, other consensus systems, such as proof-of-stake, proof-of-elapsed-time or practical Byzantine fault tolerance, all present shortcomings¹¹⁰. In my opinion, a consensus system which would solve a problem of the prior art would not be considered as an abstract idea merely implemented in a generic computer. It would rather be directed towards a specific improvement over previous blockchain technologies. Accordingly, it should pass the first *Alice* step¹¹¹.

A meaningful illustration of a patent granted for an improvement of an existing technology is *Enfish, LLC v. Microsoft Corp.*¹¹². In said case, the Federal Circuit had to focus on an invention that functioned differently from a conventional database system. The database was more sophisticated because it allowed increased flexibility, faster search time and smaller memory requirements¹¹³. The improvements to the database system made by Enfish, LLC, were found not generically implemented by a computer and, hence, the invention passed the first step of the *Alice* test¹¹⁴. Applying this reasoning to our example of a new, better consensus system, the Court should reach the same conclusion because it would enhance the performance of

G01&S1=finlow-bates.IN.&OS=in/finlow-bates&RS=IN/finlow-bates>.

¹⁰² EUROPEAN PATENT OFFICE, Talking about a new revolution: blockchain, Conference report, 4 December 2018, 21.

¹⁰³ See WETZEL (fn. 4).

¹⁰⁴ EUROPEAN PATENT OFFICE (fn. 102), 13 et seqq.

¹⁰⁵ WETZEL (fn. 4).

¹⁰⁶ Regarding the 51 % attack, see DE FILIPPI/WRIGHT (fn. 61), 25; LI/JIANG/CHEN/LUO/WEN (fn. 91), 4 et seqq.

¹⁰⁷ In this sense, DiNIZO JR. (fn. 34), 21.

¹⁰⁸ DiNIZO JR. (fn. 34), 22.

¹⁰⁹ See, *inter alia*, ANDREW TAYO, Proof of work, or Proof of waste?, 14 December 2017, <<https://hackernoon.com/proof-of-work-or-proof-of-waste-9c1710b7f025>>.

¹¹⁰ See <<https://patents.google.com/patent/US20170075941?q=blockchain+consensus>>, N 0007 to 0010.

¹¹¹ For a different example, see DiNIZO JR. (fn. 34), 21 et seqq.

¹¹² *Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1327 (2016).

¹¹³ *Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1338 (2016); DiNIZO JR. (fn. 34), 22.

¹¹⁴ *Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1338 (2016).

the blockchain by solving problems encountered by the prior art consensus systems.

In the event that the invention does not pass the first step of the test, would it likely pass the second? To that end, the invention would have to show an inventive concept¹¹⁵. In particular, to pass the second step, the new consensus system would have to add enough to the patent-ineligible subject matter in order to show inventive concept. This is assessed by the Court in determining whether the elements of the claim amount to significantly more than the patent-ineligible subject matter¹¹⁶.

By providing a solution to issues known in the field of blockchains, I argue that a new consensus method would probably pass the second step of the *Alice* test. Indeed, the three necessary conditions¹¹⁷ to that end are met. Such a consensus system improves the function of the whole blockchain by overcoming problems previously encountered. It does so not only by implementing an abstract idea onto a generic computer, but by presenting a new, developed concept than will be executed by miners. Lastly, it does not link the use of a technology to a blockchain, but is developed specifically to solve problems in the field of a blockchain. It therefore constitutes the «inventive step» necessary to pass the second step of the *Alice* test.

As a result of this analysis, the improvement made to a blockchain in the form of a different, more efficient consensus method, the *Alice* framework would allow to grant a patent to the inventor under US patent law.

3. Comparison

We have seen above that an improved blockchain with a better consensus system that would resolve problems of prior used consensus systems would be patent-eligible both in contracting countries of the EPC and in the US, despite the differences existing in the two approaches. This finding is to be welcomed, as an inventor in the US or in Europe would possibly be granted protection. There is no need for a blockchain startup active in one of both regions to relocate itself in the other region in order to obtain protection for its invention in the place it operates. Whereas a patent is only valid in the country it is made in and patents are not automatically of international effect¹¹⁸, it is nevertheless possible to obtain protection in multiple jurisdictions by following the provisions of the Patent Cooperation Treaty (PCT) and file an international

application pursuant to art. 3 et seqq. PCT¹¹⁹. However, the inventor must undertake a lengthy, complex and expensive process in order to be granted a patent in different jurisdictions¹²⁰. It is therefore difficult for any company other than wealthy multinational companies to create a new type of blockchain or improve one and then have it protected in different countries.

That being said, this conclusion is valid for the example of an improved blockchain from a technical point of view. With the current success of blockchains, it is likely that blockchain patent applications will continue to proliferate¹²¹. Nonetheless, it is also probable that many will not be able to overcome the requirements of the law for at least two reasons.

The first reason is the overgrowing existing prior art. As blockchains become more mainstream and the benefits that such a technology provides are more and more well-known, there is a growing number of scholars, researchers, startups and leading global corporations that will innovate in this field, making it more difficult to be the first to discover a patentable invention.

The second reason is that the invention must consist of a technical improvement of a blockchain, and not just a new use of it. I argue that merely finding another use of an existing blockchain technology would not be patent-eligible¹²², neither under EPC law nor US law. In contracting countries of the EPC, it would lack the necessary further technical effect, whereas in the US, the *Alice* test would not be passed because it would be equivalent to taking an abstract idea and implementing it in the blockchain.

B. Drafting a Blockchain Patent

In practical terms, this section focuses on the most important elements that an inventor should pay particular attention to. Even though an improved blockchain is theoretically patent-eligible, the way that the patent application is drafted is also crucial. I argue that the drafting strategy should be slightly different depending on whether the EPO or the US Patent and Trademark Office (USPTO) is to review it.

On the one hand, the draft of a patent destined to be examined by the EPO should focus on how the invention brings a technical solution to a technical problem.

¹¹⁵ DiNIZO JR. (fn. 34), 21.

¹¹⁶ *DDR Holdings, LLC v. Hotels.com*, L.P. 773 F.3d 1255 (2014).

¹¹⁷ See *supra* Section I.B.2.

¹¹⁸ MURRAY (fn. 15), 227.

¹¹⁹ For a brief overview, see NATHALIE TISSOT/DANIEL KRAUS/VINCENT SALVADÉ, *Propriété intellectuelle*, Bern 2019, N 763 et seqq.

¹²⁰ MURRAY (fn. 15), 227.

¹²¹ Same opinion, WETZEL (fn. 4).

¹²² See also WETZEL (fn. 4).

The inventor must explain what the problem is and why the implementation of the technical means in the blockchain is the solution. To that end, the EPO guidelines are a valuable tool to use. Indeed, they show in detail what the requirements are and how the EPO will examine the application. Given the importance of blockchain at present, it is somewhat regrettable that the newest version of the guidelines (November 2018) does not provide any example relating to blockchain patents, even though examples in different fields of computing are presented. The TBA will without a doubt have cases to examine in the near future that will provide precious information.

On the other hand, when the USPTO is called upon to examine the patent application, the inventor should focus on the elements that allow his or her invention to fit in the *Alice* framework. To pass the first step, the inventor should argue that the claim is limited to use in a particular blockchain environment, or that the invention is directed toward specific improvements over previously understood and used blockchain technologies¹²³. It is not sufficient to recite claims that are already well-known by experts¹²⁴. To pass the second step of the *Alice* test, the inventor should demonstrate that he engineered the invention in order to overcome a specific problem in a blockchain in order to show the required inventive step in the field¹²⁵. The aim is to avoid that the USPTO considers the invention as an abstract idea.

What is common to patent applications to the EPO and the USPTO, or even to any patent application, is to demonstrate that the invention goes further than what is already known in the prior art. The application should make clear that prior art has shortcomings, and that the invention resolves these. As we have previously seen¹²⁶, this is a delicate task since many researchers are working on the subject on every continent. Moreover, terms used in the field of blockchain are not always uniformly used by everyone, which makes it even more complicated to find the prior art and be absolutely certain that the invention does not lack novelty. A striking example is that even though Satoshi Nakamoto invented the concept of blockchain, the respective white paper does not call the technology «blockchain». Surprisingly, the word «blockchain» does not appear in any part in the white paper. It was only later, when the technology had already become part of the prior art, that this neologism appeared. Interestingly, the concept of blockchain itself might make the research

of the prior art slightly easier, as companies are currently working to develop a new distributed ledger containing all patents in the world¹²⁷, which would mightily facilitate the research of the prior art.

V. Challenges

The analysis above has shown that some technical improvement to a blockchain could be patented and that certain important elements deserve to be observed when drafting the patent application. It does not, however, give a response to the questions whether an inventor should try to obtain a patent, and whether all blockchains should be patented. The upcoming section seeks to provide some answers to those questions.

A. Not All Inventors Should Apply for a Patent

I argue that not all inventors should apply for a patent for three main reasons.

Firstly, obtaining a patent means that the organisation that invented the improved blockchain will face less interoperability¹²⁸. It will hence lead to less innovation. Patenting blockchains will prevent anyone not involved in the organisation and holding a patent from innovating on the improved blockchain itself. Likewise, the patent will also prevent reverse engineering. Implementing ideas that use blockchain to enhance practice in a specific field will therefore be harder¹²⁹. The blockchain technology has become such a groundbreaking technology because Satoshi Nakamoto did not apply for a patent and let other like-minded individuals draw on his invention. If Bitcoin would have been patented, it is likely that the multiple revolutionary uses of the blockchain nowadays would not have been possible.

Secondly, having a patent of a blockchain technology leads to less leeway regarding modifications of the blockchain. For a distributed technology such as a blockchain, it might not be desirable. Indeed, many events can happen

¹²³ In the same sense, DiNIZO JR. (fn. 34), 23.

¹²⁴ DiNIZO JR. (fn. 34), 24.

¹²⁵ DiNIZO JR. (fn. 34), 24.

¹²⁶ See *supra* Section III.A.3.

¹²⁷ See the project of IPwe at <<https://ipwe.com>>. See also GÖNENÇ GÜRKAYNAK/ILAY YILMAZ/BURAK YESİLALTAY/BERK BENGI, Intellectual property law and practice in the blockchain realm, 34 Computer Law & Security Review 2018, 847 et seqq., 854 et seqq.

¹²⁸ INAYAT CHAUDHRY, The Patentability of Blockchain Technology and the Future of Innovation, March/April 2018, available at <https://www.americanbar.org/groups/intellectual_property_law/publications/landslide/2017-18/march-april/patent-ability-blockchain-technology-future-innovation/>.

¹²⁹ CHAUDHRY (fn. 128).

during the life of a blockchain. For example, someone can successfully hack the blockchain, resulting in a theft of a fair amount of money, for instance the hack of The DAO on the Ethereum blockchain. In view of such an unfortunate event, it might be useful to be able to restore the old blockchain in order to erase transactions and correct the software code containing the flaw. If the patented blockchain software needs to be modified, its new version will not be protected by the patent. In addition, an open source blockchain can be forked in order to ameliorate the original blockchain. Such a fork can take two different forms: a fork of a codebase, which creates an entirely new ledger, or a fork of a live blockchain (also called chainsplit), which create a new coin that has a shared history with an existing coin¹³⁰. If a blockchain is patented, it might not be possible to fork it, even though the majority of users finds improvements to make to the blockchain, because acting as such might infringe the patent. Patenting the blockchain results in losing the use of potentially talented developers to improve the blockchain.

Lastly, patenting a blockchain might be risky from an economical point of view. As users of blockchains are in majority favorable to the open source idea, many influential individuals might refuse to use a patented blockchain, despite enhanced functionalities. This would result in a very small community using the blockchain, and hence limit its usefulness.

In conclusion, the inventor will have to weigh the advantages and the disadvantages to determine whether applying for a patent is the right decision or not. No definitive answer can be provided and the right solution will always depend on the circumstances. An element that the inventor has to take into account is not only whether the invention requires protection, but which type of protection is more convenient: a patent or another type of intellectual property protection, such as copyright.

B. Not All Types of Blockchains Should Be Patented

I also argue that patents are not useful for all types of blockchain. I have discussed under Section II.B. that there are three main types of blockchains: public, private and hybrid blockchains. In my opinion, patents are only genuinely useful for private blockchains because they are the only ones that will be used on a private level and not be truly distributed.

Private blockchains can be usefully exploited by companies to solve problems that traditional businesses

have¹³¹. They aim to increase the quality as well as the security of business-to-business communications¹³², or even communication within a company. Such blockchains allow digital assets to move reliably between or within companies without the need of a third party acting as a record keeper¹³³. Developing a private blockchain for one's own company or group of companies can provide a competitive advantage compared to competing companies, and it might hence be a smart move to patent it. In that situation, the open source benefits that we explored in this essay do not exist and patenting the improved blockchain makes more sense than patenting a public blockchain. Accordingly, choosing to develop a public or private blockchain, which is sometimes a tough choice to make¹³⁴, could also be decisive with regard to how the invented blockchain should be protected.

VI. Conclusion

This paper began with a question: are blockchain-related innovations patent-eligible? In seeking to answer this question, I have reviewed the applicable law and found that both in Europe and in the US, an invention in the field of blockchains is patent-eligible under certain conditions. These are detailed by the well-established practice of the EPO, and since 2014, by the two-step test developed by the US Supreme Court in *Mayo* and then in *Alice*. Some improvements of a blockchain would without doubt be patent-eligible, notably when they are technical and are not an abstract idea. On the contrary, merely a new use for a blockchain would probably not be patentable. Some elements must be taken into consideration when drafting the patent claims, which are slightly different in Europe and in the US. A common difficulty is to find the relevant prior art, as the blockchain-related language is not always uniform among experts.

Since an analysis of the legal framework shows that inventions that are blockchain-related are unequivocally patent-eligible, the challenges in patent law are not on a

¹³⁰ See LEWIS (fn. 34), 291.

¹³¹ See the examples of LEWIS (2018), 339 et seqq.

¹³² LEWIS (fn. 56), 342.

¹³³ LEWIS (fn. 56), 342.

¹³⁴ See recently the development of the cryptocurrency Libra, for which the white paper left uncertain on the long term whether the blockchain underlying the cryptocurrency should be public or private (permissionless or permissioned). The white paper states that «Libra will start as a permissioned blockchain. To ensure that Libra is truly open and always operates in the best interest of its users, our ambition is for the Libra network to become permissionless», see the official Libra White Paper, available at <<https://libra.org/en-US/white-paper/>>, 4.

policy level, but rather on two other levels. The first one is whether the mindset of the inventor is in line with the one behind the invention and the original aim of the blockchain. The second is the type of blockchain that the invention relates to: if it enables a new private blockchain, it might be advantageous to patent it, whereas if it relates to a public blockchain, the distributed character of the ledger suggests the opposite. In any case, the question must be carefully examined before making a decision.