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BLOCKCHAIN TECHNOLOGY: AN INTERCONNECTED LEGAL FRAMEWORK FOR AN INTERCONNECTED SYSTEM

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ABSTRACT

In 2018, someone hiding behind the pseudonym Satoshi Nakamoto created Bitcoin, the first decentralized cryptocurrency operating without a central bank or authority. However, the true revolution seems to be its underlying technology; blockchain. Today, a lot of discussion is taking place around the legal issues of this nascent technology. This paper focuses on blockchain and the law. After exploring blockchain's basic features, it will propose an international regulatory framework suitable for this technology's characteristics and its borderless nature.

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INTRODUCTION

On October 31, 2008, Satoshi Nakamoto, following his vision to create a purely peer-to-peer version of electronic cash, published a paper[1] developing a protocol for digital cash that used Bitcoin. Bitcoin is a digital cryptocurrency; however, the underlying technology Bitcoin uses is the Blockchain.[2]

Now, Blockchain is considered the technology most likely to have the greatest impact on the world in the next decades.[3] It gives the opportunity to move to the second generation of the Internet, evolving from the Internet of information to the Internet of value.[4]

> "Just as decentralization communication systems lead to the creation of the Internet, today … the blockchain has the potential to decentralize the way [people] store data and manage information, potentially leading to a reduced role for one of the most important regulatory actors in our society: the middleman."[5]

Indeed, this technology seems to be able to revolutionize and disrupt a whole range of industries, from "financial services to manufacturing, supply chain management, and to health care records, by infusing transparency and trust in traditionally closed systems."[6]

As this technology develops, the main concern, and even drawback, in its evolution is the absence of an official regulatory framework. The uncertainty and instability around the Blockchain and the legal issues it creates could obstruct its evolution. On the other hand, a severe regulatory environment could also have the same result.

This paper will discuss the issues associated with Blockchain, and ultimately propose a regulatory approach. In Part I, it will simply present this new technology, the way it works, and its main features. Then, in Part II, after reviewing other regulatory frameworks of industries with similar characteristics, it will argue that the optimal choice at this point in time, is to

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[1] SATOSHI NAKAMOTO, BITCOIN: A PEER-TO-PEER ELECTRONIC CASH SYSTEM 2 (2009), https://bitcoin.org/bitcoin.pdf [https://perma.cc/MW6Y-WSCR].
[2] Don Tapscott, How the Blockchain is Changing Money and Business, TED*Talks*. YouTube, 16 Sept. 2016. Web. < https://www.youtube.com/watch?v= Pl8OlkkwRpc >.
[3] *Id*.
[4] *Id.*
[5] Aaron Wright & Primavera De Filippi, *Decentralized Blockchain Technology and the Rise of Lex* Cryptographia 1 (Mar. 12, 2017) (unpublished manuscript), *available at* https://perma.cc/K7 HM-4GG7.
[6] The Disrupter Series: Digital Currency and Blockchain Technology: Hearing before the Subcommittee on Commerce, Manufacturing, and Trade of the Committee on Energy and Commerce, House of Representatives, One Hundred Fourteenth Congress, second session, 1 (Washington, 2016), *found* at https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg20322/pdf/CHRG-114hhrg20322.pdf.

establish an international legal framework of principles and standards for the Blockchain.

PART A
OVERVIEW OF BLOCKHAIN TECHNOLOGY

A. How do Blockchains work

The decentralized ledger technology or Blockchain[7] is a "decentralized database that stores a registry of assets and transactions across a peer-to-peer network." [8] It is "a global spreadsheet, an incorruptible digital ledger of economic transactions that can be programmed to record not just financial transactions but virtually everything of value and importance to humankind," [9] including "birth and death certificates, marriage licenses, deeds and titles of ownership, educational degrees, financial accounts, medical procedures, insurance claims, votes, transactions between 'smart' objects, and anything else that can be expressed in code." [10] At its most basic, it is simply "a public registry of who owns what and who transacts what."[11]

Blockchain technology "combine[s] peer-to-peer networks, cryptographic algorithms, distributed data storage, and a decentralized consensus mechanisms"[12] empowering "people to agree on a particular state of affairs and record that agreement in a secure and verifiable manner." [13] Decentralized ledger technologies build "online lists, maintained by no one and available to everyone, [that] are maintained by a consensus protocol." [14] A blockchain is a chronological database of transactions shared by all nodes[15]

[7] In this paper the terms blockhain, blockchain technology, decentralized ledger technology or decentralized ledger technologies are being used interchangeably.
[8] Bettina Warburg, How the blockchain will radically transform the economy, TED*Talks*. YouTube, 8 Dec. 2016. Web. <https://www.youtube.com/watch?v=RplnSVTzvnU>.
[9] Tapscott, Don and Alex Tapscott, What's the Next-Generetion Internet? Surprise: It's All About the Blockchain!" *Blockchain Revolution*. 01 July 2016. Web. <http://blockchain-revolution.com/2016/07/01/whats-next-generation-internet-surprise-blockchain-2/>.
[10] *Id.*
[11] Warburg, *supra* note 8, at 3:38.
[12] Wright & De Filippi, *supra* note 5, at 4-5. *See id.* at note 15 ("[B]lockchain technology is not a huge technological advance [but]…an incremental improvement. Public-private key encryption was developed in the late 1970s…Peer-to-peer networks have also been used since late 1970s, and gained mainstream acceptance in the early 2000s…Consensus mechanisms, such as Proof of Work…have been around since the late 1990s... Decentralized, distributed data storage…has been used for nearly a decade.").
[13] *Id.* at 6.
[14] Carla L. Reyes, *Moving Beyond Bitcoin to an Endogenous Theory of Decentralized Ledger Technology Regulation: An Initial Proposal*, 61 VILL. L. REV. 191, 197 (2016) (quoting Joshua Fairfield, *Smart Contracts, Bitcoin Bots, and Consumer Protection,* 71 WASH. & LEE L. REV. ONLINE 35, 36 (2014)).
[15] The term "nodes" refers to the computers participating in a certain blockchain network. They are the clients that operate on the same node via the copy each one holds. Konstantinos Christidis & Michael Devetsikiotis, *Blockchains and Smart Contracts for the Internet of Things*, 4 IEEEACCESS 2292, 2293 (2016).

participating in a system,[16] whereas every blockchain is encrypted and divided into smaller parts known as "blocks."[17] Each block, often described as "a container data structure,"[18] consists of information about recent transactions, a reference to the previous block in the blockchain[19], a timestamp,[20] and a unique answer to a challenging mathematical puzzle,[21] used to validate the data and the transactions included in that block. A new block will only be added to the ledger if the network verifies that its transactions are legitimate and valid, and do not contradict previous transactions.[22] In other words, "[a] new block of data will be appended to the end of the blockchain *only* after the computers on the network reach *consensus* as to the validity of the transaction."[23] Finally, every node of the network stores a copy of the blockchain and all nodes periodically synchronize to ensure the consistency of their shared database.[24]

In other words, "[t]hink of the blockchain as a log whose records are batched into timestamped blocks. Each block is identified by its cryptographic hash. Each block references the hash of the block that came before it. This establishes a link between the blocks, thus creating a chain of blocks, or blockchain"[25] See Figure 1.

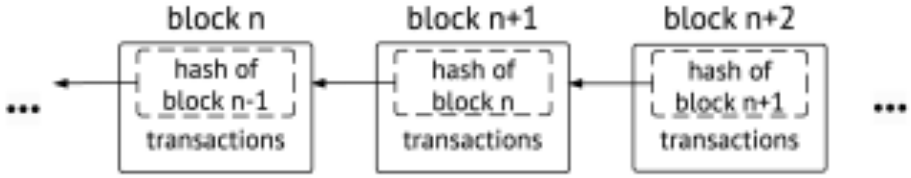

Figure 1: Each block in the chain contains information about the transactions and the hash of the previous block. [26]

To begin with, a pair of private/public keys is essential in order to interact with the network.[27] The first (private) is used to sign transactions that are addressable to the network using the public key.[28] Authentication, integrity,

[16] Wright & De Filippi, *supra* note 5, at 6 (citing *Blockchain,* BITCOIN FOUNDATION WIKI, https://en.bitcoin.it/wiki/Block-chain).
[17] Reyes, supra note 14, at 197.
[18] *Id.* at 197 (quoting ANDREAS M. ANTONOPOULOS, MASTERING BITCOIN 160 (2015)).
[19] The term itself describes the procedure; blocks are organized in a linear sequence over time, consecutively connected to one another creating ultimately a chain of blocks (the blockchain). *See also*, Hearing, *supra* note 6, at 38 ("The 'block' is the record and the 'chain' is the collection of blocks that populate the ledger.").
[20] Nakamoto, *supra* note 1, at 2. ("The timestamp proves that the data must have existed at the time, obviously, in order to get into the hash. Each timestamp includes the previous timestamp in its hash, forming a chain, with each additional timestamp reinforcing the ones before it.")
[21] *Blocks*, *supra* note 17.
[22] Wright & De Filippi, *supra* note 5, at 7.
[23] *Id.* (Emphasis added.)
[24] *Id.* at 8.
[25] Christidis & Devetsikiotis, *supra* note 15, at 2293.
[26] *Id.*
[27] *Id.*
[28] *Id.*

and non-repudiation are the goal of this asymmetric cryptography.[29] The first step for a transaction in a blockchain is a message to the Blockchain network by one of the stakeholders describing the terms and conditions of the underlying transaction. Thereafter, the other party needs to signal its acceptance to the network. In fact, transacting parties must broadcast their transaction to the entire network since operations in a blockchain are effectively validated by network participants. Therefore, the acceptance by the second party acts as the trigger point for the rest of the network nodes to authenticate and verify the validity of the transaction through a "proof-of-work" system.[30] This validation system is essentially a competition among network participants, who, by exercising computational power, aim to validate transactions.[31] In Bitcoin, this proof-of-work became known as "mining." Miners compete and the first miner who validates the block is rewarded in digital currency.[32] After this validation, the public ledger and each separate user are updated *en masse* with the status of the recently added transaction.[33] "The transaction history gets locked in blocks of data that are then cryptographically linked together and secured. This creates an immutable unforgeable record of all these transactions across this network, which is replicated on every computer that uses the network."[34] In other words, the network must agree that each transaction is valid and no single entity can modify the record. This provides security against hacking because, by linking each block to the previous one and that block to the chain of block, someone would, effectively, need to hack every single computer in the system at the same time to hack the blockchain.

B. Dividing deeper into the blockchain (Principles and Characteristics)

One of the core problems of human transactions is uncertainty.[35] People, who constantly try to lower uncertainty between each other in order to exchange value, use—for that purpose—institutions that act as middlemen.[36] According to the Nobel economist Douglass North, "institutions have been devised by human beings to create order and reduce uncertainty in exchange."[37] It seems, though, that a new era of how human beings interact and trade, is starting. A "new technological institution" can change the way people exchange value, since for the first time, technology alone seems capable of lowering the threat

[29] *Id.* Other types of consensus mechanisms are being explored too, such as Proof of Stake. *See Proof of Stake*, BITCOIN FOUNDATION WIKI, https://en.bitcoin.it/wiki/Proof_of_Stake (last accessed Mar. 13, 2017).
[30] *See generally*, VINCENZO MORABITO, BUSINESS INNOVATION THROUGH BLOCKCHAIN: THE B3 PERSPECTIVE 64 (Springer, 2017).
[31] Trevor I. Kiviat, *Beyond Bitcoin: Issues in Regulating Blockchain Transactions*, 65 DUKE L.J. 579 (2015) (explaining the technical details of blockchain)..
[32] Don Tapscott, *supra* note 2.
[33] MORABITO, *supra* note 28, at 23.
[34] Bettina Warburg, *supra* note 8.
[35] *Id*.
[36] *Id*.
[37] North, Douglass C. 1991. "Institutions." *Journal of Economic Perspectives*, 5(1): 97-112. [https://www.aeaweb.org/articles?id=10.1257/jep.5.1.97]

of uncertainty without the need of any traditional institution, economic or political.[38]

The first key point to understand is that blockchain technology creates, in fact, "a distributed peer-to-peer network where *non-trusting* members can interact with each other *without a trusted intermediary*, in a verifiable manner (emphasis added)." [39] That is why it is also described as the "trustless" technology,[40] which implies that transactions and exchanges of value can be performed without a centralized ledger, without the presence of an intermediary or a trusted third party, and also without the threat of the double spending problem.[41] In fact, the main principle of decentralized technologies is the elimination of the third trusted party, where people can transact peer to peer and trust each other. For the first time in human history, trust is not established by some big institution or middleman. Trust, in the blockchain, is established "by collaboration, by cryptography and by some clever code."[42]

Therefore, since there is no central database, each blockchain is *distributed publicly* since it is located in the network and *encrypted* as it uses encryption mechanisms, including public and private keys, to ensure security of the system.[43] Briefly, decentralization, trust, provenance, resilience, and irreversibility summarize the key attributes of the blockchain technology.[44] Decentralization is based on the idea of creating a public ledger (the blockchain) that includes a complete record of past transactions and is shared amongst all nodes of the network, instead of relying on a centralized ledger.[45] People can use this value network to interact peer to peer and exchange value by conducting transactions and exchanging ownership without any intermediaries.[46] Moreover, the way the technology is designed—the information each block contains and the way they are all linked to each other and to the chain—provides an indisputable mechanism of verifying the data and the history of ownership. This, combined with the fact that once the blocks are validated by the network they cannot be altered, neither in content nor in position; and the distributed network structure, where each node stores a copy of the entire chain, provides resilience and irreversibility, and ultimately, provenance and trust in the system.

Decentralized ledger technology brings other benefits too. As already discussed, it reduces uncertainty and facilitates trust between market

[38] *supra* note 8.
[39] *supra* note 15, at 2292.
[40] *supra* note 29, at 574. *See* also, SATOSHI NAKAMOTO, *supra* note 1, at 8. ("We have proposed a system for electronic transactions without relying on trust").
[41] SATOSHI NAKAMOTO, *supra* note 1, at 8; *see also,* Trevor I. Kiviat, *supra* note 29, at 578; *see also*, *Double-spending*, BITCOIN FOUNDATION WIKI, https://en.bitcoin.it/wiki/Double-spending (last accessed Mar. 1, 2017). ("Double-spending is the result of successfully spending some money more than once. Bitcoin protects against double spending by verifying each transaction added to the block chain to ensure that the inputs for the transaction had not previously already been spent.").
[42] Don Tapscott, *supra* note 2.
[43] DON TAPSCOTT, & ALEX TAPSCOTT, *BLOCKCHAIN REVOLUTION: HOW THE TECHNOLOGY BEHIND BITCOIN IS CHANGING MONEY, BUSINESS, AND THE WORLD*, 6-7, Penguin (2016).
[44] MORABITO, *supra* note 28, at 23.
[45] Kiviat, *supra* note 29, at 578.
[46] MORABITO, *supra* note 28, at 23.

participants. By eliminating intermediaries, it empowers users to be in control[47] and also reduces inequality of access, as it enables more people to participate in interactions. For example, according to the World Bank, a big part of the world's population today does not have access to financial services, as 2 billion adults worldwide are unbanked. 59% of those 2 billion cite lack of enough money as the key reason.[48] However, this is not a problem in the blockchain, where people can still interact with each other even if they do not have access to big institutions. The elimination of the middleman increases speed and reduces costs.

In addition, parties' control over transactions and personal information combined with the underlying cryptography, ensure privacy protection. Blockchain processes any kind of transaction and value exchange in minutes rather than days. That vastly reduces the amount of capital which must be set aside until transactions are settled. For example, industries such as health care, supply-chain management, and mining are also experimenting with the software to improve efficiency or ensure the provenance of diamonds.[49] Moreover, the structure of the system increases transparency and immutability, since it is a public ledger across non-trusting entities where participants can monitor and validate the chains.[50]

Cryptography and decentralization also establish security. Although there is no system that is unhackable, this technology's design makes hacking much more difficult. In a blockchain, every single computer in a network would need to be hacked in real time, contrary to a centralized framework where hacking the center of the system is enough.[51] A blockchain becomes even stronger with the probabilistic approach of the decentralized ledger technology.[52] According to Nakamoto, when honest nodes control a blockchain, "the honest chain will grow the fastest and outpace any competing chains. To modify a past block, an attacker would have to redo the proof-of-work of the block and all blocks after it and then catch up with and surpass the work of the honest nodes," [53] and "the probability of a slower attacker catching up diminishes exponentially as subsequent blocks are added."[54] Furthermore, potential errors, frauds, or cybercrime occur less frequently within a blockchain since the other nodes monitor and check the actions before they validate changes

[47] *Id*. at 26.

[48] The World Bank, *UFA2020 Overview: Universal Financial Access by 2020* (Apr.20, 2017), http://www.worldbank.org/en/topic/financialinclusion/brief/achieving-universal-financial-access-by-2020 (last accessed February 26, 2018).

[49] Matthew Leising, *Blythe Masters Unveils Fix for Blockchain Privacy Concerns*, BLOOMBERG TECHNOLOGY (Dec. 7, 2016, 8:00 AM), https://www.bloomberg.com/news/articles/2016-12-07/blythe-masters-unveils-fix-for-blockchain-privacy-concerns.

[50] Warburg, *supra* note 8.

[51] *Quick Guide to Blockchain: All You Need to Know – Expert Interview with Alex Tapscott*., YOUTUBE (Jan.17 2017), https://www.youtube.com/watch?v=CsR2livCdAw.

[52] Wright & De Filippi, *supra* note 5, at 6.

[53] SATOSHI NAKAMOTO, *supra* note 1, at 3.

[54] *Id.*

to the data, and any mistaken alteration would need to be effected on all nodes.[55]

On the other hand, blockchain is a nascent technology, and therefore its effects can be questionable. Although the elimination of intermediary institutions seems positive, it could create problems too. The absence of a central authority can generate difficulties in monitoring or, in case of violations, determining sanctions and enforcing compliance. Furthermore, in more complex transactions, the verification process with the consensus mechanism can become hard or even impossible, raising questions about the speed or even the viability of transactions. Last but not least, security and privacy concerns are fundamental too. Software vulnerability, such as bugs in the code or poorly written software, could create huge problems, particularly since the integrity of the software and network are crucial to a blockchain. [56] Imagine the impact, for example, of a bug in a decentralized ledger technology that is implemented in every major financial system internationally.[57] The threat of systemic risk and total collapse would be real. Therefore, cybersecurity and possible ways of protecting a blockchain need to be thoroughly examined. The same applies to issues of transparency versus privacy, as well as to the establishment of limits, if necessary, for the protection of participants' privacy.

After the above analysis, it is important to note that when it comes to blockchain technology, often the same features seem to be both advantages and challenges too. As a consequence, regulating the blockchain becomes even more challenging. If there is too much regulation, it is highly probable that its advantages will be suppressed too, ultimately preventing the technology from flourishing as it could.

PART B
REGULATORY ISSUES

A. Functional approach

Blockchain is a new technology, however, the types of actions which are performed by using it, are not new.[58] Although it has the potential to disrupt a wide range of industries and common practices, it will not necessarily be the genesis of completely new operations. Instead, it will be integrated with the technology that is already used for the purpose of facilitating the operations that are already conducted. As Alex Tapscott frames it, "blockchain technology is going to integrate itself into all the technology that we use today."[59]

Therefore, while thinking about the regulatory and legal issues of decentralized ledger technologies, it is necessary to make a distinction between the actions performed in a blockchain and the underlying technology itself. This

[55] Gregory Brandman & Samuel Thampapillai, *Blockchain – Considering the Regulatory Horizon*, OXFORD BUS. L. BLOG (Jul. 7, 2016), https://www.law.ox.ac.uk/business-law-blog/blog/2016/07/blockchain-—-considering-regulatory-horizon.
[56] MORABITO, *supra* note 28, at 27.
[57] *Id*.
[58] Hearing, *supra* note 6, at 71.
[59] Expert Interview with Alex Tapscott, *supra* note 48.

leads to two key questions, "1) are [these operations] governed by existing regulatory frameworks, and 2) is new regulation needed to regulate the underlying Blockchain protocol itself?"[60]

Using a functional approach[61] that focuses on the operations of a blockchain, it would be accurate to support that, for all of these functions which pre-existed the blockchain technology even if performed via different means or technologies, the regulators have already set the necessary legal frameworks. In other words, existing legal provisions for anti-money laundering, tax evasion, fraud, intellectual property, individuals' privacy rights, etc., take care of the transactions and generally interactions between parties. The fact that a new technology is now being used to perform these actions should not change their legal framework. Since blockchain does not create a new set of operations, the existing framework is sufficient, at least at this starting point of this technology. Specific actions performed in a blockchain should be regulated by the legal rules for the same actions when performed outside of a blockchain, since "[e]ven when the technology is not specifically mentioned in a law or regulation, an activity or use of a new technology can be covered by existing laws or regulation."[62] Moreover, companies that perform certain activities, even if they use only the blockchain technology, should be considered as companies of the relevant sector and comply with the relevant regulations. For example, when a company uses blockchain for money transfers, it should comply with financial services regulations and not be considered as just a tech company. Indeed, the Treasure Department's Financial Crimes Enforcement Network (FinCEN) has found that "companies in the business of transmitting value over the Bitcoin network, or exchanging dollars for Bitcoins, must register as money transmitters and comply with Bank Secrecy Act, including requirements to identify customers and file suspicious activity reports."[63] On the other hand, if an activity or function which is performed by a blockchain is not traditionally regulated, it could be an unequal burden to regulate it just because it is effectuated through the blockchain.[64]

This theory solves a big part of the regulatory concerns and uncertainty expressed against blockchain. Money laundering, for instance, can be regulated adequately under the existing money transmission regimes.[65] In fact, a case where a Texas man was charged with fraud in New York for a Ponzi scheme involving Bitcoin[66], which operates in a blockchain, proves that the functional theory approach is already judicially implemented.

B. Blockchain: the "new" Internet?

[60] Hearing, *supra* note 6, at 71.
[61] *Id.*
[62] Brito, Jerry, *Is Bitcoin Regulated*?, Coin Center, (Jan. 13, 2015), https://coincenter.org/entry/is-bitcoin-regulated.
[63] Hearing, *supra* note 6, at 15.
[64] Hearing, *supra* note 6, at 71.
[65] *Id.* 33
[66] Brito, *supra* note 58 (quoting TIME, Nov.6, 2014).

In the early 1990s, the Internet emerged as a promising new tool. "The Internet is a global network connection of computers. It is a public network, neither controlled nor owned by any single person or entity." [67] This development created new regulatory concerns and uncertainties, which policymakers confronted with a framework that managed to acknowledge the new technology's great potential and also balance its risks.[68] The U.S. and the European Commission developed similar legal frameworks, which established "clear, predictable, and globally-coordinated rules"[69] that crucially helped its expansion. In fact, as the Presidential Directive on Electronic Commerce of 1997 promulgated, "[t]he Internet is emerging as a global marketplace. The legal framework supporting commercial transactions on the Internet should be governed by consistent principles across State, national, and international borders that lead to predictable results regardless of the jurisdiction in which a particular buyer or seller resides."[70]

Moreover, the transnational character of the Internet, with no national borders and jurisdictions, [71] led to the rise of a new legal trend, the *lex informatica*; an aftermath innovation in the legal sphere, which established the core concept of code regulation or, said differently, that from now on, "technology itself can be regarded as a parallel form of regulation."[72] According to its definition, *lex informatica* is "a particular set of rules spontaneously and independently elaborated by an international community of Internet users, which constitutes today an alternative normative system consisting of a particular set of rules and customary norms arising directly from the limitations imposed by the design of the infrastructures subtending the network."[73] In other words, it sets up a system of self-regulation consisting of "customary rules (or standards) and technical norms" [74] that operate "transnationally, across borders, independent of national boundaries and domestic laws"[75] and ultimately permit the desired interoperability of the Internet. [76]

Broadly conceived, Internet standards include any standard adopted for the Internet.[77] Their legal character ranges from legally binding, when found in the international treaty of the International Telecommunications Regulations, to a quasi-legal character like the ITU Telecommunications Sector's ("ITU-T") Recommendations, or even to a voluntary character, as is the case with IETF

[67] DANIEL B. GARRIE & FRANCIS M. ALLEGRA, PLUGGED IN: GUIDEBOOK TO SOFTWARE AND THE LAW § 3.1, at 89–90 (2013).
[68] Hearing, *supra* note 6, at 107.
[69] *Id*.
[70] Memorandum for the Heads of Executive Departments and Agencies. Presidential Directive on Electronic Commerce, THE WHITE HOUSE: Office of the Press Secretary (July 1, 1997), https://clinton4.nara.gov/WH/New/Commerce/directive.html.
[71] Wright & De Filippi, *supra* note 5, at 45
[72] *Id.* at 46.
[73] *Id.*
[74] *Id*.
[75] *Id.* at 46-47.
[76] Biel Company, *A Public Law Approach to Internet Standard Setting*, 7 GOETTINGEN J. INT'L L. 49, 76 (2016).
[77] *Id*.

and W3C standards.[78] Although this voluntary character signifies that there is no international legal obligation to adopt them, the network effects or externalities, which describe network systems, elevate them to effective legal instruments.[79] The network effect is a phenomenon where the value of a good or service increases as more people use it.[80] Thus, the value of technologies implementing a standard increases as this standard is widely adopted. Nonetheless, the costs of not implementing the standard become higher.[81] Indeed, "[e]ven protocols that are formally voluntary may become effectively mandatory when network effects neutralize any exit option."[82]

Returning to the decentralized ledger technology, its characteristics are strongly reminiscent of the early Internet.[83] Shared core traits that simply describe decentralized, public, open networks where anyone can connect without needing a central authority[84], make it essential to look at the early Internet regulatory actions when considering regulatory policies for the new technology. In fact, it is clear that, *inter alia*, the main legal challenge for blockchain technology at the moment is regulatory uncertainty, similar to the early Internet era. Internet innovation exploded only after governments declared their light-touch regulatory approach.[85] Thus, following the Internet example, regulatory policies need to promote the innovation of this infant technology while balancing its risks.

C. Base(l) the Blockchain

Inspired from the first and main operation of blockchain today, Bitcoin and other financial services, it is worth taking a look at the Basel Committee on Banking Supervision, "a club of central bankers who meet to develop international banking capital standards and to develop supervisory guidance."[86]

The Basel Committee was established in 1974 as a response to the international banking crisis, and set up a forum for regular cooperation on banking supervisory matters. Over the years, it has developed standards and sophisticated guidelines for banks and depository institutions.[87] Focusing just on The Core Principles for Effective Banking Supervision ("Core Principles") originally issued in 1997 as the "de facto minimum standard for sound

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[78] *Id.* at 78, 83. For more information around "The Development of Technical Standards for the Internet" *see Id*. at 76-84.

[79] *Id.* at 89.

[80] *Id.*

[81] *Id*.

[82] *Id*. at 90.

[83] *The Disrupter Series: Digital Currency and Blockchain Technology: Hearing Before the Subcomm. on Commerce, Manufacturing, & Trade of the H. Comm. on Energy and Commerce,* 114th Cong. 2 (2016). found at https://www.gpo.gov/fdsys/pkg/CHRG-114hhrg20322/pdf/CHRG-114hhrg20322.pdf.

[84] *Id.* at 10.

[85] *Id.* at 9.

[86] Michael S. Barr & Geoffrey P. Miller, *Global Administrative Law: The View from Basel* 17 EUR. J. INT'L L. 15, 15 (2006).

[87] *Id.* at 16.

prudential regulation and supervision of banks and banking systems,"[88] it is interesting to see how propounding a framework of minimum standards allowed the Committee to put forth a baseline level of supervisory practices.

The Basel Committee has instituted a special process for the highly technical banking sector, as it develops non-binding international standards that need to be implemented through domestic processes on the national level.[89] Indeed, the Core Principles are seen as a voluntary framework that promulgates the primary objectives for banking supervision. At the same time, the national authorities are free to implement any additional necessary measures to be compatible with the Core Principles.[90]

The Core Principles are considered universally applicable and aim to strengthen the global financial system.[91] Nevertheless, they do not create legally binding international obligations for the states—unlike treaties, for instance—but rather concentrate on harmonizing states' practices and national rules. In other words, the states do not undertake a legal obligation to comply, so there cannot be a breach for lack of compliance. Nonetheless, states seem to comply anyway, since taking into account the interconnectedness of the banking sector and the threat of its global system risk, it is mostly in their common interest. Hence, even if the Basel standards do not bind the states directly, each participant of the Committee determines how to implement them domestically and ensure their legally binding character on the national level, with the goal of harmonizing the rules and setting at least a minimum legal framework globally.

D. Blockchain Principles

In an effort to determine the suitable legal framework for the blockchain technology, it is useful to analogize situations with similar characteristics and needs. Following the functional approach, it is clear that this would refer only to the underlying technology, since the regulatory and legal issues with respect to the operations in a blockchain are, as already shown, governed by relevant, existing frameworks. Indeed, the uncertainty of the decentralized technology today, as well as the interconnectedness and interoperability of the network, might be indications that actions similar to the response to the early Internet or the Basel Committee could create an analogous, effective framework. Their main premise should be followed first on an international level, and second, using standards and principles.

In this kind of setting, global coordination is fundamental to ensure the realization of the benefits and the expansion of the blockchain technology, as well as to set any necessary protections for the system. Thus, taking ideas from frameworks that already have been tested on the international plane could end up being valuable when building a consistent framework. In fact, as the Internet

[88] BASEL COMMITTEE ON BANKING SUPERVISION, BANK FOR INT'L SETTLEMENTS, CORE PRINCIPLES FOR BANKING SUPERVISION 1 (2012), https://www.bis.org/publ/bcbs230.pdf [hereinafter CORE PRINCIPLES].
[89] Barr & Miller, *supra* note 82, at 18.
[90] CORE PRINCIPLES, *supra* note 84, at 4-5.
[91] *Id.* at 9.

case has proven, "[g]lobal coordination has a successful track record of enabling other technology breakthroughs to develop safely." [92] Indeed, international coordination appears to be the key for effective policy. [93] In this interoperable system, policy interoperability is necessary too, as "[a]ny level of regulatory arbitrage, whether between U.S. states or from an international perspective will increase risks and not allow the technology to flourish."[94] The relevant policies need to follow an agreed common policy in order to establish confidence, certainty, and predictability with all transacting parties of any possible jurisdiction in this borderless network. The argument for global coordination becomes stronger when thinking of jurisdiction in this decentralized technology, where "there is no issuer, no central authority, and there is no company, no building, no server."[95]

On the other hand, the regulation needs to be flexible enough to allow for innovation. [96] This can be achieved by choosing a minimum standards/principles voluntary framework, as in Basel. Since such an agreement will not legally bind the parties, the likelihood of acceptance by more states rises, especially in an area highly technical with such high uncertainty. The compliance mechanism, instead, would be based on the common interest that all states and participants in the network would have to comply. Moreover, as the International Monetary Fund argues, "[t]he establishment of international standards that take into account the specific features of […distributed …technologies] may promote harmonization in regulation across jurisdictions, and facilitate cooperation and coordination across countries over questions such as the sharing of information and the investigation and prosecution of cross-borders offenses."[97]

Thus, the development of international blockchain standards appears to be the first essential step for blockchain technology. According to Perianne Boring, founder and president of the Chamber of Digital Commerce, "it's important that the associations and stakeholders working with these public policymakers have some type of coordination to their efforts." [98] As a consequence, despite the non-binding, voluntary legal character of these principles, their approval by the major actors in the system— accompanied by the interoperability and the network effect—will result in an effective compliance mechanism; blockchain platforms that follow this set of principles would enjoy greater reputation and acceptance in an international system, and ultimately using the exit provision in the network effect, they will only survive.

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[92] *Hearing*, *supra* note 6, at 107.
[93] *Id.*
[94] *Id.* at 62.
[95] *Id.* at 8.
[96] Laura Shin, *Bitcoin Technology Organizations Launch Global Blockchain Forum To Address*, FORBES (Apr. 12, 2016), https://www.forbes.com/sites/laurashin/2016/04/12/bitcoin-technology-organizations-launch-global-blockchain-forum-to-address-international-policy/#b612ff728775.
[97] *Hearing*, *supra* note 6, at 108.
[98] Shin, *supra* note 92.

Standards can relate both to regulatory and software code[99], however this decision needs to be taken *ad hoc* for each specific standard, after their effective adoption. Thoughts around the crucial elements in a common standards agreement have already been expressed; on the one hand "[i]ndustries need to have an agreement on the design issues of blockchain such as its openness (open or permissioned-base access systems)" [100], or "common grounds on how to operate and manage blockchain infrastructure, which includes its governance, updates and responsibilities." [101] Furthermore, appropriate standards with respect to "privacy, security, identity, smart contract, governance and other matters related to blockchain technology," [102] as well as "interoperability and risk" [103] may also contribute to the flourishing of the blockchain and the development of market confidence in its use and application.

Thus, an international agreement of the main blockchain principles/standards should include:

1. Guiding principles for policy-making as a main provision. For example, promoting clarity and innovation as the main objectives, following the challenge that all emerging technologies face of eliminating the risks while avoiding any harm to the innovative potential of the technology.[104] Clarity is a matter of defining the new technology, its range of applications if any, as well as the relevant regulatory and legal approach. Innovation means mandatory balancing tests between new policies and their impact of innovation and also securing the road for innovators seeking to operate in this field. [105]
2. Principle verifying the functional regulatory approach. The functional regulatory approach is an essential provision for the success of the international blockchain standards framework, since without it many questions and conflicts of national regulations with respect to each operation on a blockchain will occur. In other words, setting a principle which ensures that the relevant existing laws of each state (when this state has jurisdiction) apply for such an action in a blockchain as well. For example, if a fraud is found in the blockchain, the laws for fraud outside of a blockchain, will apply there too.
3. Principle for establishment of jurisdiction and choice of law rules.
4. Principle with respect to definitions, legal power, legal rights, and results of every feature/action in the blockchain.
5. Architecture standards for blockchain as guidance to both developers

[99] Hearing, *supra* note 6, at 46.
[100] MORABITO, *supra* note 28, at 35.
[101] *Id*.
[102] VARANT MEGUERDITCHIAN, STANDARDS AUSTRALIA, ROADMAP FOR BLOCKCHAIN STANDARDS (2017), http://www.standards.org.au/OurOrganisation/News/Documents/Roadmap_for_Blockchain_Standards_report.pdf [hereinafter ROADMAP FOR BLOCKCHAIN STANDARDS].
[103] *Id.* at 10.
[104] Hearing, *supra* note 6, at 17.
[105] *Id*.

and users.[106]

6. Privacy and security standards. For example, "[w]hereas Bitcoin is an anonymous network, blockchain can be used to set up trusted networks to handle interactions between *known* parties (emphasis added)."[107] Therefore, it is a matter of choice and agreement on how the parties prefer to set the relevant standards after balancing transparency, security, and privacy issues. On this subject, specific principles for identification, public and private keys can be used to provide the desired security and privacy framework.
7. Establishing the principle of interoperability. "Blockchains must be open and interoperable. For the blockchain to fulfill its full potential, it must be based on non-proprietary technology standards to assure the compatibility and interoperability of systems."[108] "Only with openness will blockchain be widely adopted and will innovation flourish."[109]
8. Mechanisms for international dispute resolution. In the self-contained regime that seems to be initiated concerning the decentralized ledger technology, there is a huge uncertainty about, *inter alia*, jurisdictional matters. Therefore, setting up a specific, international dispute mechanism can greatly promote its expansion by reducing the risks without undermining its benefits.

CONCLUSION

While entering into this second era of the Internet, it is crucial to take careful steps in order to make the essential regulatory moves, yet leave the necessary space for blockchain technology to flourish. This could be achieved with the establishment of a voluntary international legal framework. The idea is inspired by connecting elements from other international legal instruments.

The international interconnectedness of the blockchain illustrates the fundamental necessity for international cooperation and the establishment of common minimum standards. Of course, this would not limit the ability of each state to further regulate this new technology separately. Nevertheless, it seems that at least for the beginning, a functional approach combined with an international legal framework would answer the major legal issues concerning blockchain and at the same time, promote its development. In fact, this balancing test should be the central approach when thinking about regulating any promising yet disruptive new technology.

[106] ROADMAP FOR BLOCKCHAIN STANDARDS, *supra* note 96, at 15.
[107] Hearing, *supra* note 6, at 37.
[108] *Id.* at 38.
[109] *Id*.