Defining Smart Contracts

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Abstract

Smart Contracts are the bedrock of the emerging blockchain, and cryptocurrency market valued at approximately $1T. But while much legal literature explores and discusses smart contract technology, the scholarship is completely naked in addressing the various definitions of smart contracts proposed across other disciplines. Moreover, academic writing on the subject also fails to focus on the importance of and the need for real world use and its relationship to the underlying technical innovation.

This Paper makes three main contributions. First, this Paper explores the definition of smart contract, examines the debates, and offers a decisive victor. Second, this Paper explores the real-world use of smart contracts and their handlings from a legal perspective. Third, this Paper reflects the convergence of clarity in defining smart contracts for purposes of technical and legal development with the symmetry of use for legal practice and application.

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Introduction

Alexander Hamilton wrote in Federalist No. 30, "Money is, with propriety, considered as the vital principle of the body politic; as that which sustains its life and motion, and enables it to perform its most essential functions." [2] More than two centuries later, in the year 2008, an unknown person with the pseudonym Satoshi Nakamoto sent an email to a cryptography mailing list to announce he had produced a "new electronic cash system that's fully peer-to-peer, with no trusted third party."[3] Hamilton's work during the revolutionary period lay the rails for the modern economy. Similarly, Nakamoto's work paves the road for the next generation in economics – in the digital world.

Perhaps the most important use and mechanism relating to this technology is the smart contract. A smart contract is a logical transaction between parties on the blockchain. First theorized by computer scientist, Nick Szabo in the 1990s, smart contracts have grown to be a vital element of Web 3.[4] But, it wasn't until blockchain technology become more widespread that smart contracts had a robust growth trajectory. In fact, smart contracts already form the bedrock for the approximately $1T blockchain and cryptocurrency market.[5] The critical importance of this technology, what it is and how we talk about it, are addressed in this paper with an emphasis on appreciating the broad scope of this innovation and the impact it will have on the future through real world use.

The purpose for this Paper is laying a foundation for defining smart contract and explaining the key requirements for widespread adoption according to existing legal principles and rules in contract law. This Paper proceeds in two parts. Part I explores the definition of smart contract, examines the debates, and observes the decisive victor. Part II explores the real-world use of smart contracts and their handlings from a legal perspective.

[2] Alexander Hamilton, Concerning the General Power of Taxation, Federalist No. 30, New York Packet (December 28, 1787). Hamilton is known to be the founding father most largely responsible for America's economy because his work during the revolutionary period laid the framework for the American economic system.
[3] SAIFEDEAN AMMOUS, THE BITCOIN STANDARD xv (2018). Later that year, Nakamoto published the Bitcoin White Paper, which serves as the foundation for a new economic system spawning today, the blockchain.
[4] Nick Szabo, The Idea of Smart Contracts (1997).
[5] CoinMarketCap (2023) https://coinmarketcap.com/.

I. The Definition

Fundamentally, common law establishes that physical contracts have three components.[6] First, the parties must intend to exchange something of value. Second, there must be a meeting of the minds as to the exchange of value.[7] Third, there must be a physical representation for the value exchange.[8] Contract laws and theories have evolved through the ages[9] and still a complete theory remains evasive.[10]

Indeed, a smart contract is a new type of technology at the confluence of contracts and blockchains. The term smart contract is defined in wide variance among blockchain developers and professionals. Throughout the past decade some confusion has developed regarding the true definition of smart contract. Some argue that a smart contract isn't a contract at all, but rather a logical execution on a blockchain. This Part will explore the debate, examine the original definition, the loose definition, the hard definition and declare the winner with the final definition.

A. The Original Definition

The traditional conception of contracts is a legal obligation between parties, representing an exchange of promises.[11] Traditionally, smart contracts were thought of as a computational mechanism for making a binding legal agreement in digital form.[12] Thus, in the original sense, smart contracts build upon this initial conception; a smart contract is a computer program which automatically executes, moving cryptocurrency or some other digital asset.[13]

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[6] Oral contracts are still recognized in at least some states, but extremely difficult to enforce with legal validity.
[7] Restatement (Second) of Contracts § 17 (1979).
[8] Hugh E. Willis, Restatement of the Law of Contracts of the American Law Institute, 7 Ind. L. J. 429, 430 (1932). ("The legal relation which exists in a contract is a right-duty relation, and a contract, therefore, should be defined either as a right in *personam* or as a legal obligation.")
[9] S.J. Stoljar, A History of Contract at Common Law, 4 (1975). ("It is first mentioned by Bracton but not yet by Glanvill, which makes the year 1201, the date of its earliest recorded instance, an accurate enough indication of its time of origin.") *See also* Morton J. Horwitz, The Historical Foundations of Modern Contract Law, 87 Harv. L. Rev. 917, 917 (1974). ("Beginning with the first English treatise on contract, Powell's Essay Upon the Law of Contracts and Agreements (1790), a major feature of contract writing has been its denunciation of equitable conceptions of substantive justice as undermining the "rule of law."")
[10] Alan Schwartz and Robert E. Scott, Contract Theory and the Limits of Contract Law, 113 Yale Law Journal 1, 2 (2003). ("Contract law has neither a complete descriptive theory, explaining what the law is, nor a complete normative theory, explaining what the law should be.")
[11] Hugh E. Willis, Restatement of the Law of Contracts of the American Law Institute, 7 Ind. L. J. 429, 430 (1932). ("A contract is the legal obligation created by the law as the result of a promise or set of promises for the breach of which the law gives a remedy, or the performance of which the law in some way recognizes as a duty.")
[12] However, as Justice Oliver Wendell Holmes wrote, it is a fallacy to think "the only force at work in the development of the law is logic."[12] Consider not much has changed about contract law in over a Century since Justice Holmes sat on the Court. Of course, at least some things have change since the late 19th Century. Perhaps most significantly, digital systems of communication and information transfer[12] have spawned a new global economy.
[13] They allow for automation and law to be written in transactional programs. Specifically, smart contracts on the blockchain avoid the high transaction and legal fees.

Therefore, the original definition of smart contract is, "A set of promises, specified in digital form, including protocols within which the parties perform on these promises."[14] This was the definition proposed by Szabo and adopted by Gary Gensler, one of the most influential thinkers, writers, and leaders in the cryptocurrency space.[15] By and large, this original definition has held strong through the new millennium. However, more recently some have proposed both new and altering definitions for the term.

B. The Loose Definition

Some argue that a smart contract isn't a contract at all, but rather a logical execution on a blockchain. More recently, arguments have been made by Silvio Micali for example, that smart contracts are merely logical code that lives on a live public ledger.[16] Micali has dawned the loose definition of smart contracts, "Algorand Smart Contracts (ASC1) are small programs that serve various functions on the blockchain and operate on layer-1."[17] But while the loose definition has gained some traction, it will not hold because it is largely the product of a Micali's own commercial interest.

Indeed, Micali is a co-founder of the Algorand blockchain. And his team is attempting to declare that all other smart contracts are inferior to smart contracts written in a new software language he created called TEAL. However, the market and academics have not responded well. Indeed, TEAL is now notorious for hacks and the Algorand asset ALGO is down over 67.00% in the calendar year 2023 alone and is rapidly losing popularity in the blockchain space.[18]

Moreover, this definition completely ignores the transactional nature of smart contracts. Under Micali's definition, there is mechanism to validate that smart contracts can perform transactions. This makes it extremely difficult for real world use, technical development, and business innovation to occur because the code itself is merely logical sequences without a logical purpose. Thus, Micali's loose definition has already been rejected by major players in the blockchain space. For example, Coinbase rejects the Algorand definition in favor of the hard definition, "A smart contract, like any contract, establishes the terms of an agreement."[19]

C. The Hard Definition

The Hard Definition is proposed by The Founder of Ethereum, Vitalik Buterin, defining a smart contract as, "systems which automatically move digital assets according to arbitrary pre-specified rules."[20] In other words, a smart contract is a computer program which automatically

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[14] MIT OpenCourseWare, Session 6: Smart Contracts and DApps, https://ocw.mit.edu/courses/15-s12-blockchain-and-money-fall-2018/resources/session-6-smart-contracts-and-dapps/
[15] *Id.*
[16] Silvio Micali, Efficient Smart Contracts at Scale: Algorand's Stateful TEAL Contracts (2019).
[17] Introduction, Algorand Developer Portal (2023), https://developer.algorand.org/docs/get-details/dapps/smart-contracts/.
[18] Coinmarketcap, Algorand (2023), https://coinmarketcap.com/currencies/algorand/.
[19] Coinbase, Crypto Basics, What is a smart contract? (2023), https://www.coinbase.com/learn/crypto-basics/what-is-a-smart-contract.
[20] Vitalik Buterin, Ethereum Whitepaper (2014).

executes, transferring cryptocurrency.[21] In fact, Ethereum's blockchain is tailored for the execution of smart contracts.[22] This definition has been most largely adopted by industry as Ethereum is the main smart contract platform in the world.[23]

The Hard Definition mirrors analysis from Lessig who wrote, code is law.[24] According to the Hard Definition, computable contracts are a better way to do business, removing the inherent attenuation between syntax and semantics in legal analysis. Indeed, smart contracts are transactional programs that are logically executed on a blockchain without a central oversight.[25]

D. The Final Definition

As the definitions widely ascribed to smart contracts continue to evolve, we see certain patterns sticking as true. Over time it is clear, that smart contracts do have properties like that of traditional contracts – being a transactional nature – and that this technology carries an advancement onto the blockchain. It is critical that any definition of smart contract encompasses the broad range of transactional technologies associated with the word. This Paper offers a final definition upon review of the existing definitions of smart contract.

> **Original Definition.** "A set of promises, specified in digital form, including protocols within which the parties perform on these promises."[26]
>
> **Loose Definition.** "… Smart Contracts are small programs that serve various functions on the blockchain and operate on layer-1."[27]
>
> **Hard Definition.** "Systems which automatically move digital assets according to arbitrary pre-specified rules."[28]
>
> **Final Definition.** "Systems of promises which automatically execute, moving digital assets."

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[21] Fabrice Benhamouda, et al., Supporting Private Data on Hyperledger Fabric with Secure Multiparty Computation, IBM Journal of Research and Development (April 2019), DOI: 10.1147/JRD.2019.2913621. ("Nearly all blockchain architectures support the notion of smart contracts, namely a programmable application logic that is invoked for every transaction.")

[22] Larissa Lee, New Kids on the Blockchain: How Bitcoin's Technology Could Reinvent the Stock Market, 12 HASTINGS BUS. L.J. 81, 115 (2016). Indeed, Ethereum developed a method of creating stages of execution in a contract within its blockchain, as opposed to Bitcoin's binary execution method.

[23] Ethereum includes a platform for application development which is becoming increasingly popular.

[24] Lawrence Lessig, Code is Law (January 1, 2000). ("This regulator is code--the software and hardware that make cyberspace as it is. This code, or architecture, sets the terms on which life in cyberspace is experienced.")

[25] Massimo Bartoletti, A formal model of Algorand smart contracts, 1 (2021), https://arxiv.org/abs/2009.12140v3. ("Smart contracts are agreements between two or more parties that are automatically enforced without trusted intermediaries.")

[26] MIT OpenCourseWare, Session 6: Smart Contracts and DApps, https://ocw.mit.edu/courses/15-s12-blockchain-and-money-fall-2018/resources/session-6-smart-contracts-and-dapps/

[27] Introduction, Algorand Developer Portal (2023), https://developer.algorand.org/docs/get-details/dapps/smart-contracts/.

[28] Vitalik Buterin, Ethereum Whitepaper (2014).

In other words, a smart contract is an automatic transaction on the blockchain. This Final Definition captures the essence of the Original Definition and Hard Definition, while simultaneously acknowledging the Loose Definition, but regarding its general obsolete nature. As such, the Final Definition should govern discourse on the topic going forward. Ultimately, the purpose of smart contracts to work toward real world use and application, rather than cryptocurrency speculation and financial investment.[29]

II. Real World Use

A. Legal Merits

Specific requirements for smart contracts may vary depending on the legal and regulatory frameworks in different jurisdictions. Additionally, smart contracts can be highly versatile and adaptable, allowing for complex conditions and actions beyond simple value transfers.[30] As such, they can be applied to a wide range of use cases beyond just the exchange of assets, including supply chain management, voting systems, and more. Generally, to have real world use, smart contracts must have three things: 1) an exchange of value; 2) a meeting of the minds between parties; and 3) a representation of an exchange.

First, the parties must intend to exchange something of actual value, such as digital assets or cryptocurrency. Smart contracts, like traditional contracts, are typically used to facilitate some form of value exchange. This value exchange can take various forms, such as digital assets, cryptocurrencies, or even physical goods and services. Smart contracts are designed to automate and secure these exchanges by executing predefined actions once certain conditions are met.[31] This ensures that parties can trust that the agreed-upon value will be exchanged as specified in the contract.

Second, there must be a meeting of the minds as to the exchange of value, meaning the parties must intend to agree to the terms.[32] In contract law, the meeting of the minds refers to a mutual understanding and agreement between the parties involved. In the context of smart contracts, this means that the parties must clearly understand and consent to the terms and conditions encoded

[29] This is a problem in the industry that has led to many compliance failures. *See* Securities and Exchange Commission v. Bittrex, Inc. (2023). *See also* New York v. Mashinsky (2023). *See also* SEC v. Terraform Labs and Do Kwon (2023). *See also* New York v. KuCoin (2023).

[30] Dr. Thibault Schrepel, Collusion by Blockchain and Smart Contracts, 33 Harv. J. L. & Tech. 118, 118 (2019). ("Blockchain may transform transactions the same way the Internet altered the dissemination and nature of information.")

[31] Dr. Thibault Schrepel, Collusion by Blockchain and Smart Contracts, 33 Harv. J. L. & Tech. 118, 118 (2019). *See also* Massimo Bartoletti, A formal model of Algorand smart contracts, 1 (2021), https://arxiv.org/abs/2009.12140v3. ("Smart contracts are agreements between two or more parties that are automatically enforced without trusted intermediaries.") *See also* Jeanne C. Fromer, *Machines as the New Oompa-Loompas: Trade Secrecy, the Cloud, Machine Learning, and Automation*, N.Y.U. L.R., 706, 720 (2019), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3359746. ("In recent years, these techniques have been among the most successful and prominent ways of imbuing computers with artificial intelligence, or human-like cognitive abilities.")

[32] Restatement (Second) of Contracts § 17 (1979).

within the contract. Smart contracts are typically transparent and self-executing, which can help ensure that all parties are on the same page and that there is a shared understanding of the contract's terms.

Third, there must be a physical representation for the value exchange, meaning a record on the ledger digitally signed between and naming the parties.[33] Smart contracts often rely on blockchain technology or distributed ledger systems to record and verify the terms and execution of the contract. These digital records serve as a representation of the value exchange, providing a tamper-resistant and transparent ledger of all transactions and contract executions. Each party's digital signature on the blockchain can confirm their agreement and participation in the contract.

Overall, the legal merits are valuable insofar as they guide real utility or use for smart contracts. In other words, businesses and everyday people need to be able to trust in the validity of the transaction, financially, legally, and technically. This will allow smart contracts to scale as a technology for the purpose of decentralization and economic transparency.

B. Utility

A financial transaction communicates to a network an authorized money movement has occurred.[34] The essential elements are a network of parties, an asset moved among those parties, and a process defining the procedures and obligations associated with the movement. In other words, transactions are data structures encoding the value transfer between participants in a system.[35] While costly financial institutions have policed such transactions in the past, blockchain supports a decentralized network to perform this function itself. As such, one of the most interesting aspects of blockchain technology is that a central authority does not need to verify transactions.[36]

Smart contracts offer unparalleled efficiency by automating various processes that traditionally required time-consuming manual intervention.[37] Sometimes self-executing contracts automatically trigger actions when predefined conditions are met, eliminating the need for intermediaries or third parties. This not only reduces the risk of errors but also speeds up transactions. For instance, in the realm of finance, smart contracts can automate complex tasks like loan approvals, ensuring that borrowers receive funds instantly once they meet the necessary criteria. Similarly, in supply chain management, they can automate the tracking and payment processes, streamlining the entire supply chain and reducing delays.

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[33] Hugh E. Willis, Restatement of the Law of Contracts of the American Law Institute, 7 Ind. L. J. 429, 430 (1932). ("The legal relation which exists in a contract is a right-duty relation, and a contract, therefore, should be defined either as a right in *personam* or as a legal obligation.")
[34] Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System 1 (2008).
[35] Nick Webb, *A Fork in The Blockchain: Income Tax and The Bitcoin/Bitcoin Cash Hard Fork*, 19 N.C. J.L. & TECH. ON. 283, 284 (2018).
[36] Riley T. Svikhart, *Blockchain's Big Hurdle*, 70 STAN. L. REV. ONLINE 100, 101 (2017).
[37] Larissa Lee, New Kids on the Blockchain: How Bitcoin's Technology Could Reinvent the Stock Market, 12 HASTINGS BUS. L.J. 81, 114 (2016).

One of the core strengths of smart contracts lies in their transparency and trustworthiness.[38] These contracts are recorded on a blockchain, a distributed ledger technology that is immutable and tamper-proof. Every participant in the network has access to the same, unalterable contract, ensuring that there is a single version of the truth. This transparency reduces the potential for disputes and fraud, as all parties can independently verify the terms and conditions of the contract. In the legal field, smart contracts can be used for property transfers, where the history of ownership is transparently recorded, mitigating disputes over property rights.[39] In this way, smart contracts foster trust and accountability in various industries.

Smart contracts significantly cut down on costs associated with intermediaries, paperwork, and manual record-keeping. Businesses can streamline their operations and reduce overhead expenses. Additionally, because smart contracts are executed on blockchain networks, they inherit the robust security[40] features of blockchain technology. These contracts are highly resistant to hacking and fraud due to their decentralized and cryptographic nature. Financial institutions can benefit from this enhanced security when handling sensitive transactions, and insurance companies can use smart contracts to automate claims processing, ensuring that claims are settled securely and promptly. Overall, smart contracts not only enhance security but also offer cost-effective solutions in numerous sectors.

C. Blockchains

In short, blockchains are decentralized databases, maintained by distributed networks of computers. Scholars, industry leaders, and commentators rave about blockchain technology. For example, Primavera De Filippi asserts, "blockchain technology constitutes a new infrastructure for the storage of data and the management of software applications, decreasing the need for centralized middlemen."[41] As an architecture, a blockchain is a distributed ledger which records transactions between parties. In other words, blockchain technology is both an infrastructure for data storage and management.

Blockchain technology is the main mechanism of action for enabling smart contracts. Indeed, the open and distributed ledger underlying blockchains allows for anyone anywhere in the world to gain access to a network for financial transactions. This is both an invention enabling innovation,

[38] Scott J. Shackelford, Steve Myers, Block-by-Block: Leveraging the Power of Blockchain Technology to Build Trust and Promote Cyber Peace, 19 Yale J. L. & Tech. 334, 349 (2017).
[39] Yossi Gilad, et al., Algorand: Scaling Byzantine Agreements for Cryptocurrencies, 53 (2017).
[40] Aleksey K. Fedorov, et. al., Quantum Computers Put Blockchain Security at Risk, 563 NATURE INT'L J. SCI. 465, 466 (2018). *See* Konstantinos Chalkias, et. al, Blockchained Post-Quantum Signatures 8 (2018) https://eprint.iacr.org/2018/658.pdf.
[41] PRIMAVERA DE FILIPPI, AARON WRIGHT, BLOCKCHAIN AND THE LAW 33 (2018).

but also financial inclusion[42] and opportunity. Three main blockchains for smart contracts are Bitcoin,[43] Ethereum,[44] and Algorand.[45]

In the Bitcoin White Paper Satoshi Nakamoto presents a problem, "Commerce on the Internet has come to rely almost exclusively on financial institutions serving as trusted third parties to process electronic payments."[46] Nakamoto defines a need for an electronic payment system based on cryptographic proof, allowing any two willing parties to transact directly without the need for a trusted third party.

However, for such transactions to be valid there must be a way in which to verify electronic coins are only spent once. In other words, there must be a way for the receiver to know the previous owners did already spend the electronic coin. Thus, Nakamoto proposes a peer-to-peer distributed ledger generating a computationally proof to validate transactions.[47] To this day, no one has validated Nakamoto's identity.

The Bitcoin White Paper makes clear there are no central coordinators who can change the network rules. The principle is vital to the blockchain economy because it offers a decentralized mechanism by which parties may transact. So, blockchain networks are described as peer-to-peer, a network structure in which all members have equal privileges and obligations toward one another. Blockchain users each have a unique address for identification on the network, like an email address.[48] However, many complain that Bitcoin is too slow and expensive, thus a new blockchain was born to provide improvements.[49]

For example, the central innovation for the Ethereum[50] network is a software stack for smart contracts. The Ethereum software is implemented in the new programming language, Solidity – which was constructed with influence from C++, JavaScript, and Python.[51] Ethereum created

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[42] Wei Mei Wong, Consumer Preferences Between Hypermarkets and Traditional Retail Shophouses: A Case Study of Kulim Consumers, 43 Asia Profile 6, 559, 559 (December 2015), http://d-scholarship.pitt.edu/39780/. ("Most data relating to retail choice in Malaysia is from surveys taken in urbanized areas of Malaysia.")

[43] Vitalik Buterin, Ethereum Whitepaper (2013). Created in the year 2013, Ethereum is a blockchain, which uses its own cryptocurrency to reward miners.

[44] Ananda Badari and Archie Chaudhury, An Overview of Bitcoin and Ethereum White-Papers, Forks, and Prices, SSRN Paper No. 3841827 (2021). ("Ethereum's primary focus is to provide a protocol for building decentralized applications (dApps) deployed on the Ethereum Virtual Machine. Ethereum proposes a different protocol than Bitcoin in which the above limitations are addressed. Just to be clear, this is a huge difference to Bitcoin.") *See also* Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System 2 (2008). ("We need a way for the payee to know that the previous owners did not sign any earlier transactions. For our purposes, the earliest transaction is the one that counts, so we don't care about later attempts to double-spend.")

[45] Yossi Gilad, et al., Algorand: Scaling Byzantine Agreements for Cryptocurrencies, 53 (2017).

[46] Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System 1 (2008).

[47] Riley T. Svikhart, Blockchain's Big Hurdle, 70 STAN. L. REV. ONLINE 100, 101 (2017).

[48] ANDREAS M. ANTONOPOULOS, MASTERING BITCOIN 65 (2017).

[49] Liana Badea, The Environmental and Economic Impact of Bitcoin (March 2021), DOI:10.1109/ACCESS.2021.3068636. *See also* Lucas Girard, Environmental Impacts of Cryptocurrency Mining (2018). *See also* Heidi Samford. Lovely-Frances Domingo, The Political Geography and Environmental Impacts of Cryptocurrency Mining (July 10, 2019).

[50] Vitalik Buterin, Ethereum Whitepaper (2013). Created in the year 2013, Ethereum is a blockchain, which uses its own cryptocurrency to reward miners.

[51] Ethereum, Solidity Documentation (March 20, 2021).

smart contracts to improve the transaction protocol on the Bitcoin Network.[52] A platform for applications development and financial transactions, Ethereum is the second largest blockchain in the world. Indeed, Ethereum is home to more than 400,000 smart contracts for novel tokens assets within its ecosystem.

However, Solidity contracts come at the expense of expensive transaction fees. Moreover, in certain circumstances, Solidity contracts may take days to execute a transfer. And the negative environmental effects of mining are also a disadvantage of Ethereum.[53] As such, Algorand constructed a new blockchain, solving several problems associated with Ethereum, offering more efficient and environmentally friendly smart contracts using proof-of-stake technology.[54] Still more complain that Ethereum is too slow and expensive, and as a result many new blockchains are popping up to solve problems in security, scale and decentralization.

One such blockchain is Algorand, which uses Algorand Smart Contracts (ASCs), programs serving various functions on the Algorand Blockchain. Specifically, ASCs are software systems that can be used for transactions and applications development.[55] The cryptographic architectures making ASCs possible include several functions and methods encrypted within the Algorand Network. Generally, ASCs are separated into two main categories, Stateful Smart Contracts and Stateless Smart Contracts.

One of the main drawbacks with Algorand Smart Contracts is security. Developed by the Choice Coin Decentralized Autonomous Network (DAN), Algogeneous Smart Contracts are the next generation in both transactional and computable contracts on the Algorand Network. Start by assuming Stateful and Stateless are arbitrary terms, there are *n* number of ways to logically polarize smart contracts on Algorand.[56] But, Stateful and Stateless are still helpful to the extent they help to explain smart contract functionality.

Between Algorand, Bitcoin, and Ethereum, each have millions of users world-wide and their own benefits and drawbacks. As such, many speculate great opportunity exists in cross-chain

[52] Ananda Badari and Archie Chaudhury, An Overview of Bitcoin and Ethereum White-Papers, Forks, and Prices, SSRN Paper No. 3841827 (2021). ("Ethereum's primary focus is to provide a protocol for building decentralized applications (dApps) deployed on the Ethereum Virtual Machine. Ethereum proposes a different protocol than Bitcoin in which the above limitations are addressed. Just to be clear, this is a huge difference to Bitcoin.") *See also* Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System 2 (2008). ("We need a way for the payee to know that the previous owners did not sign any earlier transactions. For our purposes, the earliest transaction is the one that counts, so we don't care about later attempts to double-spend.")

[53] Liana Badea, The Environmental and Economic Impact of Bitcoin (March 2021), DOI:10.1109/ACCESS.2021.3068636. *See also* Lucas Girard, Environmental Impacts of Cryptocurrency Mining (2018). *See also* Heidi Samford. Lovely-Frances Domingo, The Political Geography and Environmental Impacts of Cryptocurrency Mining (July 10, 2019).

[54] Ethereum, as well as Bitcoin are proof-of-work blockchains, which require miners to compete for rewards by producing massive amounts of computing power. Proof-of-stake blockchains are more efficient, with blocks validated using cryptographic proofs and rewards being distributed to asset holders. *See* Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System 3 (2008). ("The proof-of-work involves scanning for a value that when hashed, such as with SHA-256, the
hash begins with a number of zero bits.")

[55] Massimo Bartoletti, A formal model of Algorand smart contracts 1, arXiv:2009.12140 (2021). ("Smart contracts are agreements between two or more parties that are automatically enforced without trusted intermediaries.")

[56] Massimo Bartoletti, A formal model of Algorand smart contracts, arXiv:2009.12140 (2021).

capability and smart contract development. Over time, interchain protocols may also add significant value to the market.

Conclusion

The goal for this Paper was to reflect the convergence of clarity in defining smart contracts for the purpose of technical and legal development toward use for legal practice and application. Part I explored the definition of smart contract, examines the debates, and observes the decisive victor. Part II examined the real-world use of smart contracts and their handlings from a legal perspective.