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Blockchain and Its Potential Real-World Applications: Implications on Discovery Procedures

Ross Keiser[1*]

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Bitcoin has become a ubiquitous household name in the past ten years.[2] Its value has been wildly volatile.[3] In December of 2017, Bitcoin hit nearly $20,000 a coin, making those who had the stomach to weather the storm fabulously rich (or richer).[4] Just this past year, Bitcoin returned to its meteoric highs.[5] Its success has launched it into the spotlight, sparking both fervent

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1 * Ross Keiser is a third-year law student at the Elisabeth Haub School of Law at Pace University. Special thanks to his colleagues, family, and friends, many of them computer programming professionals, for their help forwarding sources and answering many questions.

2. Elizabeth Schulze, *Bitcoin Turns 10: The Obscure Technology that Became a Household Name*, CNBC (Jan. 4, 2019, 10:03 AM), https://www.cnbc.com/2019/01/04/bitcoin-turns-10-the-obscure-technology-that-became-a-household-name.html.

3. Jay Adkisson, *Why Bitcoin Is So Volatile*, FORBES (Feb. 9, 2018, 11:40 PM), https://www.forbes.com/sites/jayadkisson/2018/02/09/why-bitcoin-is-so-volatile/#36011a3b39fb.

4. *See* Ali Montag, *Why Cameron Winklevoss Drives an "old SUV" Even Though the Twins Are Bitcoin Billionaires*, CNBC (Jan. 12, 2018, 3:33 PM), https://www.cnbc.com/2018/01/12/winklevoss-twins-are-bitcoin-billionaires-yet-one-drives-an-old-suv.html.

5. Nathaniel Popper, *Bitcoin Hits New Record, This Time with Less Talk of a Bubble*, N.Y. TIMES (Nov. 30, 2020), https://www.nytimes.com/2020/11/30/technology/bitcoin-record-price.html.

criticism[6] and tremendous praise.[7]

Although many can now recount a story within their lives regarding Bitcoin (or any other of the more than 1,600 various cryptocurrencies that exist[8]), many still do not understand it. Even those with careers in economics or finance find it puzzling.[9] More specifically, many do not understand what tangible value Bitcoin has and why it has had such a wild ride.

Many resources exist for those who wish to learn more about cryptocurrency. This Comment, however, seeks to demystify what is at the center of every cryptocurrency—its underlying technology—blockchain, its numerous applications to real world market sectors, and the effect it can impose and has imposed on the legal landscape. In order to understand the value of blockchain technology, one must first understand the environment in which it emerged. Bitcoin is famous for being the first application of this technology, but *why* was it created?

I. THE BIRTH OF BITCOIN: BLOCKCHAIN ORIGINS

The idea for a trustless, decentralized banking ledger originated from the mistrust of banks following a global recession. In 2008, the financial crisis was in full effect.[10] The world had previously seen a number of respected institutions fall at the hands of risky financial derivatives trading.[11] Banks had,

6. Kate Rooney, *Warren Buffett Says Bitcoin Is a 'Delusion' and 'Attracts Charlatans*,*'* CNBC (Feb. 25, 2019, 12:50 PM), https://www.cnbc.com/2019/02/25/warren-buffett-says-bitcoin-is-a-delusion.html.

7. Aaron Hankin, *Bitcoin Boosted by IMF Chief Christine Lagarde's Praise*, MARKETWATCH (Apr. 17, 2018, 3:14 PM), https://www.marketwatch.com/story/bitcoin-gets-boost-from-imf-head-2018-04-17.

8. Reza Jafery, *New to Cryptocurrency? Start Here: A Cryptocurrency, Bitcoin, and Blockchain Crash Course*, MEDIUM (July 3, 2019), https://medium.com/swlh/new-to-cryptocurrency-start-here-44cc5a6d6626.

9. Kai Sedgwick, *People Who Don't Understand Cryptocurrency Should Probably Stop Writing About It*, BITCOIN.COM (Feb. 26, 2018), https://news.bitcoin.com/people-who-dont-understand-cryptocurrency-should-probably-stop-writing-about-it/.

10. Sher Verick & Iyanatul Islam, *The Great Recession of 2008-2009: Causes, Consequences and Policy Responses* (Inst. for the Study of Labor, Discussion Paper No. 4934, 2010).

11. Kimberly Amadeo, *AIG Bailout, Cost, Timeline, Bonuses, Causes, Effects*, THE BALANCE (Aug. 16, 2020), https://www.thebalance.com/aig-bailout-cost-timeline-bonuses-causes-effects-3305693; Editorial Staff, *Bear Stearns*

deservedly, become the derided pariah of society, due to essentially gambling with their customers' mortgage premiums, pensions, retirement funds, and IRAs.[12] People were feeling the burn of a record number of foreclosures[13] and a widespread effect on the global economy.[14] People lost trust in banks and various governments' ability to oversee and regulate them.[15]

Enter "Satoshi Nakamoto."[16] In October of 2008, Nakamoto published a paper titled "Bitcoin: A Peer-to-Peer Electronic Cash System."[17] His paper outlined the underlying deficiencies and inefficiencies of the current banking system.[18] Namely, as consumers, banking customers are required to "trust" banks to act as middlemen for the majority of daily financial transactions.[19] Unless one runs an all cash business, consumers and businesses are required to store money in the bank and rely on the banking system to facilitate and "verify" the transactions as they occur.[20] As only a relatively small number of banking institutions exist, the facilitation of these transactions are

Collapses, Sold to J.P. Morgan Chase, HISTORY (Mar. 13, 2020), https://www.history.com/this-day-in-history/bear-stearns-sold-to-j-p-morgan-chase; Virginie Montet, *'Lehman Weekend': the Biggest Bankruptcy in American History*, PHYS.ORG (Sept. 2, 2018), https://phys.org/news/2018-09-lehman-weekend-biggest-bankruptcy-american.html.

12. Kimberly Amadeo, *The Stock Market Crash of 2008*, THE BALANCE (Apr. 20, 2020), https://www.thebalance.com/stock-market-crash-of-2008-3305535.

13. Les Christie, *Foreclosures Up a Record 81% in 2008: Filings Continued to Soar Through the End of the Year—and There's No Relief in Sight for 2009*, CNN MONEY (Jan. 15, 2009, 3:48 AM), https://money.cnn.com/2009/01/15/real_estate/millions_in_foreclosure/.

14. JEAN-YVES HUWART & LOÏC VERDIER, ECONOMIC GLOBALIZATION: ORIGINS AND CONSEQUENCES 126–45 (2013).

15. Peter Thal Larsen, *Banks Were First to Fall in Decade of Lost Trust*, REUTERS (Sept. 21, 2018), https://www.reuters.com/article/us-financial-crisis2008-breakingviews/breakingviews-banks-were-first-to-fall-in-decade-of-lost-trust-idUSKCN1M1191.

16. Olga Kharif, *John McAfee Vows to Unmask Crypto's Satoshi Makamoto, Then Backs Off*, BLOOMBERG (Apr. 23, 2019, 6:06 PM), https://www.bloomberg.com/news/articles/2019-04-23/john-mcafee-vows-to-unmask-crypto-s-satoshi-nakamoto-within-days. It is unknown whether "Satoshi" is a real person or merely a pseudonym of an individual or a group of individuals.

17. Satoshi Nakamoto, *Bitcoin: A Peer-to-Peer Electronic Cash System*, BITCOIN 1 (Oct. 31, 2008), https://bitcoin.org/bitcoin.pdf.

18. *Id.*

19. *Id.*

20. *Id.* at 2.

centralized to a small number of global players, allowing them to essentially monopolize via their market share and, therefore, have free reign over consumers' money.[21] The unwitting consumer, with no option but to utilize these "transaction facilitators," is at the whim of these large global companies, trusting they will not misappropriate the funds in self-dealing transactions.[22] In addition, the centralization of transaction facilitators creates a weak point that hackers and bad actors can exploit.[23] When there is only one server, these actors need only gain access to that one server to do whatever they will with the information they find.[24] This has led to numerous security breaches in the financial sector, with millions of customer accounts impacted and compromised.[25]

Satoshi invented Bitcoin as an "electronic payment system based on cryptographic proof instead of trust, allowing any two willing parties to transact directly with each other without the need for a trusted third party."[26] Satoshi sought to recreate the positive aspects of banking, such as being relatively cheap, reliable, and verifiable, while leaving the negative aspects of necessary trust and centralization behind.[27] The system Satoshi created to meet these goals is called "blockchain." Based on cryptography and Peer-to-Peer networking, blockchain utilizes the same Peer-to-Peer structures as "BitTorrent," a

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21. *Id*. at 1.

22. *Id*.

23. Justin Pritchard, *How Blockchain Is Changing Banking and Financial Services*, THE BALANCE (Sept. 17, 2020), https://www.thebalance.com/how-blockchain-is-changing-banking-and-financial-services-4174354.

24. Deborah Bodeau & Richard Graubart, *Cyber Resiliency Design Principles: Selective Use Throughout the Lifecycle and in Conjunction with Related Disciplines* 10 (MITRE Corp. Technical Report No. MTR17001, Jan. 2017), https://www.mitre.org/sites/default/files/publications/PR%2017-0103%20Cyber%20Resiliency%20Design%20Principles%20MTR17001.pdf ("Assets that are common to multiple missions or business functions are potential high-value targets for cyber attackers, either because those assets are critical or because their compromise increases the attackers' options for lateral motion or persistence.").

25. Ellen Zhang, *The Top 10 FinServ Data Breaches*, DIGITAL GUARDIAN (May 8, 2019), https://digitalguardian.com/blog/top-10-finserv-data-breaches.

26. Nakamoto, *supra* note 17, at 1.

27. *See id.*; *see also Frequently Asked Questions: What Are the Advantages of Bitcoin?*, BITCOIN, https://bitcoin.org/en/faq#what-are-the-advantages-of-bitcoin (last visited Aug. 9, 2021).

decentralized network of computers which contains information that can be shared with other computers on the network.[28] Much to the chagrin of publishers and distributors, some readers may recall using or still use "BitTorrent" today to download movies, music, books, or anything else.[29] Many media copyright holders have brought legal actions against infringers using the BitTorrent Network, presenting a slew of new issues courts must handle.[30] The BitTorrent technology may be an easier medium to illustrate how blockchain and Peer-to-Peer systems work and why it can have a transformative effect on all ledgering applications.

II. BLOCKCHAIN ILLUSTRATION

To illustrate, let's say an individual wants to download a movie. In a traditional download, one would only connect to a single entity-owned centralized server which contains the information.[31] For example, if one downloads a movie from iTunes, their computer would connect to Apple's centralized server network, and the information would be copied off the single server to their computer.[32] In a Peer-to-Peer (commonly, "P2P") download, the information is taken from various servers or computers.[33] To facilitate a Peer-to-Peer download, the user installs a program which allows them to connect to other computers on the Peer-to-Peer network.[34] After browsing the catalog of "torrent files," which are available for download, the

28. Dylan Love, *Everything You Need to Know About BitTorrent, the Legal (And Illegal) Way to Download Anything You Want*, BUS. INSIDER (Apr. 23, 2012, 11:28 AM), https://www.businessinsider.com/what-is-bittorrent-2012-4.

29. Adam Pash & David Murphy, *A Beginner's Guide to BitTorrent*, LIFEHACKER (July 11, 2019, 4:00 PM), https://lifehacker.com/a-beginners-guide-to-bittorrent-285489.

30. Sean B. Karunaratne, Note, *The Case Against Combating BitTorrent Piracy Through Mass John Doe Copyright Infringement Lawsuits*, 111 MICH. L. REV. 283 (2012).

31. *TCP (Transmission Control Protocol)—The Transmission Protocol Explained*, IONOS (Feb 3, 2020), https://www.ionos.com/digitalguide/server/know-how/introduction-to-tcp/.

32. *TCP and UDP Ports Used by Apple Software Products*, APPLE (Aug. 27, 2019), https://support.apple.com/en-us/HT202944.

33. *See* Rüdiger Schollmeier, *A Definition of Peer-to-Peer Networking for the Classification of Peer-to-Peer Architectures and Applications*, 1 INT'L CONF. ON PEER-TO-PEER COMPUTING 101, 101–02 (2002).

34. Love, *supra* note 28.

user can find the movie they wish to watch.[35] Once the download begins, the user's computer will connect to other computers on the network (called "nodes") which contain the file the end-user wants.[36] Hypothetically, with a Peer-to-Peer network, a user could connect to thousands of nodes.[37] The user's computer would then only request and transfer an extremely small amount of raw data from each individual node.[38] Once all the information that a user needs to recreate the file on their computer is downloaded from the multitude of individual nodes, the user's computer then recompiles the information into a usable file on their computer.[39] The download is finished and the user can enjoy "The Notebook,"[40] compiled from thousands of nodes, in the comfort of their own home.

Blockchain uses a Peer-to-Peer network to verify and record transactions.[41] Similar to the above, in a traditional centralized financial transaction, when a consumer swipes their debit card at a store, the transaction is relayed to a centralized server at their bank.[42] The bank then recognizes the amount the consumer wants removed from their account, verifies they have that amount in their account, verifies the account that the money is being paid to is receptive, and transfers the amount.[43] The bank then records the transaction on its internal ledgers, with the money being subtracted from the consumer's account and added to the receiving account.[44]

III. HOW BLOCKCHAIN WORKS

Blockchain transactions are also facilitated and verified by

35. *Id.*

36. *Id.*

37. *See* Xiangying Yang & Gustavo de Veciana, *Service Capacity of Peer to Peer Networks,* 4 IEEE INFOCOM 2242 (2004).

38. Love, *supra* note 28.

39. *See* Manoj Parameswaran et al., *P2P Networking: An Information-Sharing Alternative*, 34 COMPUT. 31 (2001).

40. THE NOTEBOOK (Gran Via 2004).

41. Irani Acharjamayum et al., *Blockchain: A Tale of Peer to Peer Security*, 2018 IEEE SYMP. SERIES ON COMPUTATIONAL INTEL. (2018).

42. Susan Herbst-Murphy, *Clearing and Settlement of Interbank Card Transactions: A MasterCard Tutorial for Federal Reserve Payments Analysts*, FED. RSRV. BANK OF PHILA. (2013).

43. *Id.*

44. *Id.*

several decentralized computers on a Peer-to-Peer network. When a transaction occurs, the transaction is uploaded into a general blockchain transaction pool.[45] The node then pulls a group of transactions from the pool and compiles a number of these transactions into a block.[46] The data contained within the block is then converted into a cryptographic string of numbers and characters (known as a "hash").[47] Once a block is created, the individual node tasks itself with solving a "cryptographic puzzle."[48] The speed it takes to solve this puzzle is directly correlated with the amount of processing power that an individual node supplies to the server.[49] In order to incentivize node owners (known as "Miners") to supply processing power and energy to the system, the blockchain algorithm rewards a random miner who has solved the cryptographic puzzle with "cryptocurrency," either Bitcoin or whichever currency is tied to the specific blockchain the miner is mining for.[50] It is important to note that, for a large swath of blockchains, only a fixed amount of cryptocurrency can be mined.[51] After that fixed amount is

45. Greg Walker, *Blocks: Collections of bitcoin transactions*, LEARN ME A BITCOIN (Feb. 26, 2015), https://learnmeabitcoin.com/beginners/blocks.

46. *Id.*

47. *Id.*

48. *See* Shijie Zhang & Jong-Hyouk Lee, *Analysis of the Main Consensus Protocols of Blockchain*, 6 ICT EXPRESS 93, 94 (2020) (explaining the process known as a "Proof-of-Work" consensus protocol). Other methods of consensus exist, such as Proof-of-Stake or Practical Byzantine Fault Tolerance.

49. APPLIED CRYPTOGRAPHY AND NETWORK SECURITY CONFERENCE, PROCEEDING NOTES FROM THE 5TH INTERNATIONAL CONFERENCE 407 (Jonathan Katz & Moti Yung eds., 2007).

50. Melvin Draupnir, *What Is the Bitcoin Mining Block Reward?*, BITCOINMINING.COM (May 6, 2016), https://www.bitcoinmining.com/what-is-the-bitcoin-block-reward/ (explaining the process of selecting a random miner every ten minutes on the bitcoin blockchain); Alyssa Hertig, *Can Ethereum Scale?*, COINDESK (Dec. 3, 2020, 1:52 PM), https://www.coindesk.com/learn/ethereum-101/will-ethereum-scale (providing an example of another blockchain, Ethereum, which awards a miner every fifteen seconds).

51. The fixed amount depends on the algorithm of each blockchain. James K. Darlington III, *The Future of Bitcoin: Mapping the Global Adoption of World's Largest Cryptocurrency Through Benefit Analysis* 9 (Apr. 21, 2014) (B.A. thesis, University of Tennessee, Knoxville) (on file with the author). The limited supply is intended to mimic currency which was previously tied to the price of precious metals to reduce the possibility for rampant deflation when the supply rises (which is where the term "mining" originates). Demelza Hays & Andrés Coronado, *Why Bitcoin Is Technically an Inflationary Currency—Even Though Its Purchasing Power Is Increasing*, FEE (Sept. 8, 2018),

reached, miners will be rewarded with fees that are associated with each individual transaction.[52]

The transaction that the rewarded miner verified becomes a part of the next verified block on the chain, and the ledger is updated with that information.[53] That updated blockchain, which includes all previous transactions and the new transactions, becomes the accepted ledger and all following transactions will only be verified if they contain that most recent block.[54] This process removes the possibility of "double spending," an issue which arises when multiple computers on the system have outdated ledgers.[55] Double spending allows a person to spend an amount multiple times before the transaction is verified by a number of nodes on the network.[56] Nodes on the network must reach consensus with other nodes on the network that they too have the most recently updated block and have seen that transaction occur.[57] The new block becomes the "standard" which all nodes must comply with.[58] If a node receives a transaction which does not include the most updated block, it must reject the transaction and restart the process.[59] This eliminates the risk of double spending.[60] All the computers on the network receive the new block and verify that its log is accurate to the new block it received.[61] In this way, the blockchain can then confirm the information it received and

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https://fee.org/articles/why-bitcoin-is-technically-an-inflationary-currency-even-though-its-purchasing-power-is-increasing/.

52. Melvin Draupnir, *How do Bitcoin Mining Fees Work?*, BITCOINMINING.COM (Apr. 29, 2016), https://www.bitcoinmining.com/bitcoin-mining-fees/.

53. Draupnir, *supra* note 50.

54. Walker, *supra* note 45.

55. Usman W. Chohan, *The Double-Spending Problem and Cryptocurrencies* (University of New South Wales, Discussion Paper Series: *Notes on the 21st Century*, Discussion Paper, Jan. 6, 2021), https://ssrn.com/abstract=3090174.

56. *Id.*

57. Zhang, *supra* note 48.

58. Ameer Rosic, *Blockchain Consensus: A Simple Explanation Anyone Can Understand*, BLOCKGEEKS, https://blockgeeks.com/guides/blockchain-consensus/ (last visited, Aug. 10, 2021).

59. *Id.*

60. Chohan, *supra* note 55.

61. Chris Hammerschmidt, *Consensus in Blockchain Systems. In Short.*, MEDIUM (Jan. 27, 2017), https://medium.com/@chrshmmmr/consensus-in-blockchain-systems-in-short-691fc7d1fefe.

ensure the reliability of the information by sharing consensus with the majority of the nodes.[62]

The consensus the blockchain requires ensures the reliability of the information in the blockchain.[63] In order for the information to be altered in any way, a hacker or bad actor would need to alter the information on the previously verified blocks, and then it must have enough computing power (51%) to override the consensus of all nodes that currently exist to ensure the altered transaction would have consensus and be verified.[64] In addition to the astronomical amount of processing power and capital required to control that amount of processing power, a hacker would require to alter the blockchain, hackers are disincentivized from hacking the system as the value of the cryptocurrency is correlated to the "immutable" characteristic of the blockchain.[65] If it were found in the general population that the blockchain could be or was compromised, the value of the currency would plummet, making the large capital investment in processing power essentially worthless by leaving the hacker with valueless currency.[66]

While hacking the blockchain requires an immense amount of processing power, it must be noted that smaller blockchains with less miners and nodes are more greatly susceptible to hacking.[67] In addition, tangential cryptocurrency marketplaces are still susceptible to hacking due to the fact that these tangential companies utilize traditional centralized servers.[68] The marketplace is currently working on solutions to create a

62. *Id.*

63. *Id.*

64. Congcong Ye et al., *Analysis of Security in Blockchain: Case Study in 51%-Attack Detecting*, 5 INT'L CONF. ON DEPENDABLE SYS. & THEIR APPLICATIONS (DSA) 15 (2018).

65. Venkata Marella et al., *Understanding the Creation of Trust in Cryptocurrencies: The Case of Bitcoin*, 30 ELEC. MKTS. 259 (2020).

66. Jiarun Hu et al., *The Fluctuations of Bitcoin Price during the Hacks*, 3 INT'L J. APPLIED RSCH. MGMT. & ECON. 10 (2020).

67. *How Blockchain Can Be Hacked: The 51% Rule and More*, CIPHER, https://cipher.com/blog/how-blockchain-can-be-hacked-the-51-rule-and-more/ (last visited, Aug. 10, 2021).

68. Rohit Gupta, *Hacking Into Blockchain: Is Blockchain Security a Concern?*, PLUGANDPLAY (Apr. 30, 2019), https://www.plugandplaytechcenter.com/resources/hacking-blockchain-blockchain-security-concern.

more robust and secure cryptocurrency and blockchain space.[69]

In summation, blockchain can create a paradigm shift in the way transactions are facilitated between consumers. Instead of requiring a consumer to trust a bank with their information and funds, blockchain users can utilize blockchain as an alternative to the traditional banking service.[70] Because blockchain does not rely on the centralization of the ledgering process and instead spreads the ledger among all nodes within the system, users may feel their information and/or funds are more secure and less vulnerable to hacks or bad actors who have control of these ledgers.[71] This gives a user solace in the belief that they no longer must "trust" centralized banks, a fear which was spawned out of the mistrust of banks during the 2008 recession.[72] A completely digital currency based on blockchain has other desirable factors, such as fungibility, divisibility, portability, and durability.[73] Fiat currency has always drawn criticism,[74] but the motivation for Satoshi was cutting out the untrustworthy banking system middleman and putting the control back into the hands of consumers.[75]

IV. PUBLIC, PRIVATE, AND PERMISSIONED BLOCKCHAINS

At this stage in the technology's evolution, most blockchain users are familiar with public blockchains.[76] These blockchains

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69. Press Release, *The Future of Crypto-Commerce and Cybersecurity: AnChain.AI to Present at DEF CON 2019*, BUS. INSIDER (July 16, 2019, 12:00 PM), https://markets.businessinsider.com/news/stocks/the-future-of-crypto-commerce-and-cybersecurity-anchain-ai-to-present-at-def-con-2019-1028357609.

70. *How Blockchain Could Disrupt Banking*, CB INSIGHTS (Feb. 11, 2021), https://www.cbinsights.com/research/blockchain-disrupting-banking/.

71. Marella, *supra* note 65.

72. Nakamoto, *supra* note 17.

73. John P. Kelleher, *Why Do Bitcoins Have Value?*, INVESTOPEDIA (June 30, 2020), https://www.investopedia.com/ask/answers/100314/why-do-bitcoins-have-value.asp.

74. Detlev S. Schlichter, *The Case Against Fiat Money*, WALL ST. J. (updated Apr. 4, 2012, 12:01 AM), https://www.wsj.com/articles/SB10001424052702303816504577319610353583998.

75. Nakamoto, *supra* note 17.

76. Jamie Ballard, *Four Out of Five Americans Are Familiar with at Least One Type of Cryptocurrency*, YOUGOV (Sept. 24, 2019), https://today.yougov.com/topics/finance/articles-

are open to any member of the public to supply processing power to the system.[77] Anyone with the will and investment capital can purchase machines[78] that supply raw processing power to the system ("mine"), giving them a chance to be awarded with cryptocurrency. Additionally, public blockchains allow members of the public to view all transactions that occur on the blockchain ("explore").[79] Any individual may also view the various transactions that occur on the blockchain using an "explorer."[80]

Depending on which blockchain is being explored, the information that can be obtained generally is the "account information"[81] associated with both the transferor and transferee, the amount being transferred, and a timestamp of the transaction and information associated with the mining of the transaction (i.e. hash and miner).[82] In this way, any person who knows an "account holder's cryptographic key" (known as a "digital wallet address") can see all transactions associated with that key.[83] This gives the transactions that occur on a blockchain a huge amount of transparency to the public.[84]

While the information associated with the *transfer* is public,

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reports/2019/09/24/cryptocurrency-bitcoin-americans-millennials-poll.

77. Toshendra Kumar Sharma, *Public vs. Private Blockchain: A Comprehensive Comparison*, BLOCKCHAIN COUNCIL, https://www.blockchain-council.org/blockchain/public-vs-private-blockchain-a-comprehensive-comparison/ (last visited Aug. 10, 2021).

78. Although Bitcoin began with miners using their home personal computers to mine, new machines, created with the sole purpose of mining cryptocurrency (called Application Specific Integrated Circuits, commonly, ASICs), are the gold standard for mining. Individuals are still welcome to mine with their home PCs; however, the likelihood that a PC miner would be awarded cryptocurrency is much lower as they do not have comparable speed in solving the "cryptographic puzzles." Gareth Jenkinson, *GPUs And ASICs—A Never Ending Battle For Mining Supremacy*, COINTELEGRAPH (Apr. 18, 2018), https://cointelegraph.com/news/gpus-and-asics-a-never-ending-battle-for-mining-supremacy.

79. Sharma, *supra* note 77.

80. Harsh Agrawal, *What Is a Block/Blockchain Explorer?*, COINSUTRA (updated Aug. 15, 2020), https://coinsutra.com/blockchain-explorer/.

81. "Accounts" on a blockchain are not typically the same as an account number in traditional banking transactions. Access to an "account" is a function of having a "Cryptographic Key" which corresponds to a transaction participant.

82. Agrawal, *supra* note 80.

83. *Id.*

84. Amera Ibrahim, *Does Blockchain Mean Higher Transparency in the Financial Sector?*, 27 REVISTA DE CONTABILIDAD Y DIRECCIÓN 71, 79 (2018).

information regarding the *account holder* is not.[85] To identify who specifically is transferring or receiving the currency, one must know the "public key hash" associated with the "account."[86] This information is not publicly available, which requires businesses to have first-hand knowledge and registration of personal information.[87] Cryptocurrency companies are only in the beginning stages of requiring such personal information to be registered, if at all.[88] The lack of requiring this "account holder information" has led to the use of cryptocurrencies for illicit purposes.[89] One of the most infamous examples is the use of Bitcoin by users of the Silk Road marketplace, an online black market where users could purchase drugs, fake driver's licenses, stolen credit card information, child pornography, or a hitman, amongst other things.[90]

Such illicit uses of cryptocurrency have implicated concerns regarding "Know Your Customer Requirements," which stem from the USA Patriot Act of 2001.[91] Legislators are encountering difficulties in reigning in the "Wild West" period of Cryptocurrencies.[92] These difficulties have slowed the adoption

85. *Understanding Bitcoin Traceability*, BITCOIN.ORG, https://bitcoin.org/en/protect-your-privacy#traceable (last visited Aug. 10, 2021).

86. Mike Orcutt, *Criminals Thought Bitcoin Was the Perfect Hiding Place, but They Thought Wrong*, MIT TECH. REV. (Sept. 11, 2017), https://www.technologyreview.com/2017/09/11/149211/criminals-thought-bitcoin-was-the-perfect-hiding-place-they-thought-wrong/.

87. *See, e.g.*, *Blockchain Privacy Policy*, BLOCKCHAIN.COM (last updated Jan. 5, 2021), https://www.blockchain.com/legal/privacy.

88. Kai Sedgwick, *6 Cryptocurrency Exchanges That Don't Require KYC*, BITCOIN.COM (Mar. 17, 2020), https://news.bitcoin.com/6-cryptocurrency-exchanges-that-dont-require-kyc/.

89. Sean Foley et al., *Sex, Drugs, and Bitcoin: How Much Illegal Activity Is Financed Through Cryptocurrencies?*, 32 REV. FIN. STUD. 1798 (2019).

90. David Kushner, *Dead End on Silk Road: Internet Crime Kingpin Ross Ulbricht's Big Fail*, ROLLINGSTONE (Feb. 4, 2012, 2:00 PM), https://www.rollingstone.com/culture/culture-news/dead-end-on-silk-road-internet-crime-kingpin-ross-ulbrichts-big-fall-122158/.

91. Dan Ryan, *FinCEN: Know Your Customer Requirements*, HARV. L. SCH. F. ON CORP. GOVERNANCE (Feb. 7, 2016), https://corpgov.law.harvard.edu/2016/02/07/fincen-know-your-customer-requirements/.

92. Darryn Pollock, *The Immutable and Unhackable Blockchain Still Falling Prey to Cryptocurrency Wild West*, FORBES (Mar. 20, 2019, 7:57 AM), https://www.forbes.com/sites/darrynpollock/2019/03/20/the-immutable-and-un-hackable-blockchain-still-falling-prey-to-cryptocurrency-wild-west/.

of cryptocurrency among general consumers and the Financial Services industry at large.[93] In 2015, the New York Department of Financial Services ("NYDFS") began issuing "BitLicenses."[94] These licenses are granted once an applying company in the cryptocurrency market is within compliance with the statute.[95] The statute requires, *inter alia*, companies seeking licenses to maintain records of "the identity and physical addresses of the party or parties to the transaction that are customers or account holders of the Licensee . . .,"[96] bringing the anonymity of the user of cryptocurrency to an end. As of yet, there have only been a limited number of "BitLicenses" issued.[97] At least one court case has been filed challenging the NYDFS's authority to regulate Bitcoin; however, the case did not reach the merits, as the petitioner did not have standing to file the suit.[98]

A number of blockchains exist, which claim to more closely protect the anonymity of the "account holder."[99] When viewing an explorer of these "Privacy-Oriented" blockchains, information that would regularly be available to a user of an explorer of other blockchains is obscured.[100] While not publicly viewable, this account information is still stored on the chain and is within the purview of information which can be subpoenaed.[101] While "Privacy-Oriented" blockchains utilize anonymity protocols to

93. Clint Boulton, *Blockchain Adoption in Banks Coming, but Slower than Expected*, CIO (Nov. 14, 2016, 6:39 AM), https://www.cio.com/article/3140713/blockchain-adoption-in-banks-coming-but-slower-than-expected.html.

94. Press Release, New York State Dep't of Fin. Servs., NYDFS Announces Approval of First Bitlicense Application from a Virtual Currency Firm (Sept. 22, 2015), https://www.dfs.ny.gov/reports_and_publications/press_releases/pr1509221.

95. N.Y. COMP. CODES R. & REGS. tit. 23, § 200.3 (2020).

96. N.Y. FIN. SERV. LAW § 200.15(e)(1)(i) (McKinney 2019).

97. Press Release, New York State Dep't of Fin. Servs., DFS Grants Virtual Currency and Money Transmitter Licenses to SoFi Digital Assets, LLC (Dec. 3, 2019), https://www.dfs.ny.gov/reports_and_publications/press_releases/pr1912031.

98. Chino v. N.Y. Dep't of Fin. Servs., 100 N.Y.S.3d 1, 1–2 (App. Div. 2019).

99. *See* MONERO, https://www.getmonero.org (last visited Aug. 10, 2021). The most well-known "Privacy-oriented" blockchain is Monero.

100. *See, e.g.*, Malte Möser et al., *Empirical Analysis of Traceability in the Monero Blockchain*, 3 PROC. ON PRIV. ENHANCING TECHS. 1 (2018).

101. *See* United States v. Gratkowski, 964 F.3d 307 (5th Cir. 2020) (holding the Third-Party Doctrine applicable to records of Bitcoin transactions).

ensure user anonymity, they are under the umbrella of "Public" blockchains as the mining is still controlled by public users.[102]

"Private" and "Permissioned" blockchains differ because access to both mining and exploring are given to a limited number of partners within a consortium.[103] This has the advantage of quickening the verification of transactions and giving greater control to the members of the consortium.[104] However, the heightened degree of centralization of Private blockchains creates a heightened risk of having a singular weak point for attack.[105] Also, Private blockchains produce less incentive to supply a greater amount of processing power to the system, making it possible for a hacker or bad actor with control over a great amount of processing power to overwhelm the system and alter records.[106] Private and Permissioned blockchains trade off the "immutability" of the system for a greater degree of control of the verification of transactions.

In 2019, Facebook announced its move into the cryptocurrency space.[107] Facebook intends to create a cryptocurrency, named "Libra," hosted on a Private blockchain mined by a consortium it established called the "Libra Association."[108] Although Libra will not technically use blockchain as the basis of its cryptocurrency, its verification

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102. Paul de Havilland, *The Best Privacy Coins: Crypto Briefing's Top 10*, CRYPTOBRIEFING (Apr. 13, 2020), https://cryptobriefing.com/best-privacy-coins-crypto-briefings-top-10/.

103. *See* Shermin Voshmgir, *Blockchains & Distributed Ledger Technologies*, BLOCKCHAINHUB BERLIN, *as excerpted from the book* SHERMIN VOSHMGIR, TOKEN ECONOMY (2019), https://blockchainhub.net/blockchains-and-distributed-ledger-technologies-in-general/.

104. Joe Coburn, *Public vs. Private Blockchains: Understanding the Differences*, BLOCKS DECODED (Sep. 17, 2018), https://blocksdecoded.com/public-private-blockchains/.

105. John Hintze, *Blockchain May Have Weaknesses that Proponents Overlook*, ASS'N FIN. PROS. (Mar. 12, 2018), https://www.afponline.org/ideas-inspiration/topics/articles/Details/blockchain-may-have-weaknesses-that-proponents-overlook.

106. *Id.*

107. Josh Constine, *Facebook Announces Libra Cryptocurrency: All You Need to Know*, TECHCRUNCH (June 18, 2019, 5:01 AM), https://techcrunch.com/2019/06/18/facebook-libra/.

108. Katie Paul & Anna Irrera, *Factbox: Facebook's Cryptocurrency Libra and Digital Wallet Calibra*, REUTERS (Oct. 23, 2019, 10:49 AM), https://www.reuters.com/article/us-facebook-cryptocurrency-facts-factbox/factbox-facebooks-cryptocurrency-libra-and-digital-wallet-calibra-idUSKBN1X21Y0.

algorithm still retains some resemblance to traditional blockchain systems.[109] Facebook initially retained a large number of global players within the association, but many of them backed out, citing a lack of regulatory structure and feasibility.[110] It is likely that Private blockchains will become more prominent as mainstream adoption progresses. Financial Service institutions, desiring greater control over all aspects of their transaction facilitation, will likely utilize Private blockchains, allowing them to claim the benefits of blockchain while simultaneously retaining full control over their systems.

V. ALTERNATE USES FOR BLOCKCHAIN TECHNOLOGY

At this point, this Comment has only discussed blockchain in the context of financial systems and ledgering of transactions. However, the raw processing power that miners supply to the system need not be used *only* for financial transactions of the currency that the blockchain rewards. There are multiple potential applications, as blockchain is merely a technologically advanced form of ledgering and record keeping.[111] We may see a time when all record-keeping systems utilize either Public or Private blockchains, but adoption is still in its infancy, even as we see some of the largest tech companies make their foray into the blockchain space.[112]

One of the applications already underway is "Smart Contracts."[113] In 1994, prior to the formal introduction of

109. Rajarshi Mitra, *What is Facebook Libra Cryptocurrency? [The Most Comprehensive Guide]—Part 1*, BLOCKGEEKS, https://blockgeeks.com/guides/understanding-facebooks-cryptocurrency-libra/ (last visited Aug. 10, 2021).

110. Jeff John Roberts & Robert Hackett, *Facebook's Libra Coalition Craters, as Visa, Mastercard, eBay, and Stripe Exit the Crypto Partnership*, FORTUNE (Oct. 11, 2019, 4:56 PM), https://fortune.com/2019/10/11/facebook-libra-partners-quit/.

111. *See The Growing List of Applications and Use Cases of Blockchain Technology in Business and Life*, BUS. INSIDER (Mar. 2, 2020, 12:24 PM), https://www.businessinsider.com/blockchain-technology-applications-use-cases.

112. Michael del Castillo, *Big Blockchain: The 50 Largest Public Companies Exploring Blockchain*, FORBES (July 3, 2018, 8:46 AM), https://www.forbes.com/sites/michaeldelcastillo/2018/07/03/big-blockchain-the-50-largest-public-companies-exploring-blockchain/#5e68fba2b5b2.

113. Nick Szabo, *Smart Contracts: Building Blocks for Digital Markets*,

Bitcoin, a computer scientist, legal scholar, and cryptography expert named Nick Szabo conceptualized and wrote an article outlining the theory that computers can be used to execute contracts.[114] He described smart contracts as "a set of promises, specified in digital form, including protocols within which the parties perform on these promises."[115] Szabo viewed everyday contractual obligations as being well within the realm of computer processing systems.[116]

For example, let's say a general and subcontractor have an agreement on a payment schedule. Payment is made as the work progresses. With a smart contract, the obligations of both parties can be coded within a separate program that runs on the blockchain.[117] Once certain obligations are met, the contract will self-execute and automatically make a payment to the subcontractor.[118] The money held in escrow is automatically released into the subcontractor's account without the need to write checks, verify payment information, or even create a tax form. All of the contract necessities will be executed upon completion of the performance of the contract.

Theoretically, the decentralized and immutable nature of the contract will leave little room for "human error" in executing the contract, making non-payment or late payment a thing of the past. However, issues may arise during the coding of the contract, which is analogous to today's traditional contract drafting.[119] The "rigidity" of the coded contracts may lead to a relatively undesired effect; however, courts generally will be

16 EXTROPY (1996), http://www.fon.hum.uva.nl/rob/Courses/InformationInSpeech/CDROM/Literature/LOTwinterschool2006/szabo.best.vwh.net/smart_contracts_2.html (partially rewritten).

114. *See id*; Nathanial Popper, *Decoding the Enigma of Satoshi Nakamoto and the Birth of Bitcoin*, N.Y. TIMES (May 15, 2015), https://www.nytimes.com/2015/05/17/business/decoding-the-enigma-of-satoshi-nakamoto-and-the-birth-of-bitcoin.html.

115. Szabo, *supra* note 113.

116. *See id*.

117. *Id*.

118. *Id*.

119. Stuart D. Levy & Alex B. Lipton, *An Introduction to Smart Contract and Their Potential and Inherent Limitations*, HARV. L. SCH. F. ON CORP. GOVERNANCE (May 26, 2018), https://corpgov.law.harvard.edu/2018/05/26/an-introduction-to-smart-contracts-and-their-potential-and-inherent-limitations/.

able to view the obligations of a contract with more clarity.[120] The only remaining issue is whether the smart contract's code truly reflects the parties' intention when it was memorialized rather than a lapse in execution which leads to a breach.

In addition to smart contracts, other legal services may be served by the decentralization, visibility, immutability, and trustless nature of blockchain technology. One industry that may be on the chopping block due to the disruptive nature of blockchain is the title insurance industry.[121] As it stands today, real property title searches require an insurance reporter to scour thousands of land records contained in County Clerk offices across the country.[122] The industry is huge, raking in billions every year by ensuring buyers are buying what the seller owns, rather than what they *might think* they own.[123] In recent years, the title insurance industry has drawn the ire of consumer protection agencies and even some governmental authorities.[124] In fact, the state of Iowa created its own public title guarantee service.[125]

With blockchain, a parcel of land can be added to the blockchain ledger land registry. This blockchain would most likely be a government entity with public access, meaning that the government will control the mining process while allowing the public the ability to explore.[126] Every transaction, repair,

120. Max Raskin, *The Law and Legality of Smart Contracts*, 1 GEO. L. REV. 305, 325 (2017) (citing CARL A. GUNTER, SEMANTICS OF PROGRAMMING LANGUAGES: STRUCTURE AND TECHNIQUES 4 (1992)) ("When lawyers or the programmers they hire write contracts in code, there is less of a chance for ambiguity than in natural language if only for the simple fact that artificial language must be complete and predefined, whereas natural language is infinite.").

121. Marc Shaw, *Will the Power of Blockchain Mean the End of Title Insurance Companies in 20 Years?*, FORBES (June 22, 2018, 8:30 AM), https://www.forbes.com/sites/forbesrealestatecouncil/2018/06/22/will-the-power-of-blockchain-mean-the-end-of-title-insurance-companies-in-20-years/#6d58108d342a.

122. *Id.*

123. American Land Title Association, *State Summary Market Share*, 2016 TITLE INS. INDUS. DATA BOOK 1, 6 (2017), https://www.alta.org/industry-research/data-book/2016-title-industry-data-book.pdf.

124. *See* FED. INS. OFF. U.S. DEP'T TREASURY, ANN. REP. ON THE INS. INDUS. 70 (2015).

125. *See generally* IOWA FIN. AUTH., http://www.iowafinanceauthority.gov/TitleGuaranty/Index (last visited Aug. 10, 2021).

126. Laura Shin, *The First Government to Secure Land Titles on the*

and capital improvement can be listed on the blockchain. If the land registry blockchain is public, any individual will be able to look up a property and see all important occurrences related to the property. Public access to these registries will bring efficiency and clarity to all transfers of property. When a long-running, searchable log of every transaction which occurred exists, and the validity of the log cannot be questioned due to the nature of blockchain, the need for an industry to conduct in-depth title searches will dissipate. The massive improvements to efficiency that can result from applying blockchain to title registries will have a significant effect on land title disputes.

At this point, the crux of this Comment has been reached. When something occurs on the blockchain, whether it is contractual obligations, title, or other potential applications such as logistical tracking, how will individuals prove it in court? Will blockchain ledger events require belabored discovery and confirmation of the validity and accuracy of the event and underlying processes which allow the blockchain to be explored? Or will it be as simple as a judge taking judicial notice that such an event occurred, or such obligation was met because of its presence on a particular blockchain that is widely understood as self-authenticating?

VI. DISCOVERY PROCEDURES FOR BANKING TRANSACTIONS

In 1976, the Supreme Court decided *United States v. Miller*, primarily holding that individuals have no legitimate "expectation of privacy" with respect to banking records.[127] The Court reasoned that by utilizing banking systems, "the depositor takes the risk, in revealing his affairs to another, that the information will be conveyed by that person to the Government."[128] This holding affirmed the ability of banking records to be subpoenaed and subject to traditional discovery by adversarial parties in a proceeding.[129]

While *Miller* directly dealt with criminal proceedings and

Bitcoin Blockchain Expands Project, FORBES (Feb. 7, 2017, 9:52 AM), https://www.forbes.com/sites/laurashin/2017/02/07/the-first-government-to-secure-land-titles-on-the-bitcoin-blockchain-expands-project/.

127. United States v. Miller, 425 U.S. 435 (1976).

128. *Id.* at 443 (citing United States v. White, 401 U.S. 745, 751–52 (1971)).

129. *Id.* at 444.

Fourth Amendment concerns,[130] the Federal Rules of Evidence do not exempt banking records as privileged.[131] Analogously, when a user engages in a transaction via blockchain, they similarly "reveal their affairs" to a third party, bringing the information within the scope of traditional discovery and subpoena procedures.[132] While such information, which has been transacted through a third party, can be used as evidence at trial, the party moving for entrance of the evidence must still lay a foundation for its admissibility.[133]

Generally, this requires a representative from the bank to determine that the record sought to be entered is authentic and falls within the purview of the business records exception to hearsay.[134] The necessity for this exists because chain of custody issues are abound when dealing with a bank that has humans who maintain the systems and compile reports.[135] This problem could be avoided by using blockchain technologies, which automatically report transactions to the public by their blockchain explorer sites.

Insofar as admissibility is concerned, blockchain has not reached a point where the general population is aware of the immutability that is inherent in blockchain systems. As such, admission of blockchain explorer sources may be challenged on an authentication basis. Today, authentication of Electronically Stored Information ("ESI") is covered in the Federal Rules of Evidence ("FRE").[136] In December of 2017, Rule 902 of the FRE, which governs the admissibility of "Evidence that is Self-Authenticating," was amended to add two new subsections: 13 and 14.[137] Rule 902(13) allows for the admissibility of "Certified Records Generated by an Electronic Process or System."[138] The rule allows the admission of "record[s] generated by an electronic process or system that produces an accurate result, as *shown by*

130. U.S. CONST. amend. IV.

131. FED. R. EVID. 803(6).

132. United States v. Gratkowski, 964 F.3d 307 (5th Cir. 2020).

133. FED. R. EVID. 901.

134. *Id.*

135. Charles A. Wright & Arthur R. Miller, *Foundations and Confrontations: Certifications and Custodial Witnesses*, *in* 30 FED. PRAC. & PROC. EVID. § 6637 (2d ed. 2021).

136. FED. R. EVID. 902(13)-(14).

137. FED. R. EVID. 902.

138. FED. R. EVID. 902(13).

certification of a qualified person . . . [also subject to] the notice requirements of Rule 902(11)."[139] Rule 902(14) allows copies of such data to be admitted as long as the underlying process which creates the copy is similarly certified by a qualified person.[140]

The amendment is intended to simplify procedures by allowing certification to be made by affidavit rather than lengthy testimony. Without this amendment, if one sought to introduce evidence which was pulled from a blockchain ledger, the party seeking admission would be obligated to produce an expert who could succinctly explain to the judge and jury how the inherent structure of blockchain processes secure and verify both the transaction and the "exploring" of that transaction.[141] The expert would have to explain that there is no third party who must "vouch" for the validity of the information because the system itself creates logs by such processes.[142] After all, blockchain information is merely electronically stored information, but what makes it different is how the stored information is secured and how the public has the ability to write new information and view the information without having the ability to alter any information previously written.[143]

While blockchain technology is still in its infancy, this process of hiring an expert to certify the process to lay a foundation for the admissibility of the information contained on the blockchain is necessary. However, there may come a time where the technology itself, or individual blockchains, will become so pervasive as to allow the court to merely take judicial notice of the authenticity of the information on the blockchain.

As it stands now, courts are versed in procedures that allow for certain electronically stored information to be produced in admissible form through "eDiscovery Software."[144] These programs, however, are numerous, and each individual program which produces, collects, or reports ESI, will require certification by an expert who is versed on the processes of each individual

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139. *Id.* (emphasis added).

140. FED. R. EVID. 902(14).

141. FED. R. EVID. 803(6).

142. *Id.*

143. *See* Discussion, *supra* Part III.

144. *See* DEP'T JUST. & ADMIN. OFF. U.S. CTS., RECOMMENDATIONS FOR ELECTRONICALLY STORED INFORMATION (ESI) DISCOVERY PRODUCTION IN FEDERAL CRIMINAL CASES (Feb. 2012), https://www.uscourts.gov/sites/default/files/finalesiprotocolbookmarked.pdf.

program being used.[145] The sheer volume of programs and the quickly evolving landscape surrounding the ESI sector do not currently provide enough specificity for a judge to take judicial notice of the processes of all the programs. The programs differ enough in their processes to require that an expert certify why this program should be trusted to do what it does. If an adversary wishes to oppose admission of the evidence, they will be obligated to present an expert witness to testify to the underlying technical information regarding the processes which report the information.[146]

Individual blockchains, however, are different from the numerous programs that a digital forensic investigator might use in their suite of programs to get ESI to the judge and jury. Throughout the years, programs come and go, processes are changed or updated, and there may always be a different way these programs function, requiring continual authentication of the processes which lead to the production of ESI evidence.[147] There may come a time, however, where certain blockchains, such as Bitcoin or Ethereum, become so ubiquitous that certification of the processes becomes unnecessary due to its pervasiveness. At some point in the future, the phrase "Bitcoin transaction (or whichever blockchain is predominant at the time) and exploring is secured and verified" may become as common as the old standard "the sky is blue." How likely is that? Time will tell, but if every sci-fi movie ever created is to be believed, the future will be a strange place where today's cutting-edge technology is as taken for granted as the color of the sky.[148] Once we get there, will facts that exist on the blockchain be subject to the concept of judicial notice?

VII. JUDICIAL NOTICE

Most lawyers are familiar with the concept of judicial notice. Judicial notice has a long history within the courts.[149] The

145. FED. R. EVID. 902 (advisory committee notes to 2017 Amendments).

146. *Id.*

147. Bill Crane, *Digital Forensics: A Decade of Changes*, POLICE (Nov. 11, 2013), https://www.policemag.com/374406/digital-forensics-a-decade-of-changes.

148. *See generally* BACK TO THE FUTURE PART II (Universal Pictures 1989).

149. JAMES BRADLEY THAYER, A PRELIMINARY TREATISE ON EVIDENCE AT THE COMMON LAW 279 (1898).

concept allows the court to take notice of readily accessible or publicly known information as adjudicative facts. The old common law precepts of the rule were codified into the Federal Rules of Evidence when they were put into effect in 1975.[150] Federal Rule 201 governs the ability of a judge to take notice of certain adjudicative facts of two kinds: (1) facts "generally known within the trial court's territorial jurisdiction" (i.e., that a street leads to a different street); or (2) facts that "can be accurately and readily determined from sources whose accuracy cannot reasonably be questioned" (i.e., the sky is blue).[151] Notice of transactions which occur on a blockchain would fall within the scope of the second category.

A judge may take notice at any stage of the proceeding,[152] either (1) of its own volition; or (2) if a party requests that notice be taken and supplies the necessary information required.[153] A party is entitled to be heard regarding the propriety of the judge's notice.[154] In civil cases, facts judicially noticed must be accepted by the jury as conclusive, while in criminal cases the court "must instruct the jury that it may or may not accept the noticed fact as conclusive."[155] The presumption of the facts judicially noticed allows for a streamlining of the process in laying the foundation for conclusive facts. To determine whether "a source proffered as worthy of judicial notice is one whose 'accuracy cannot reasonably be questioned,' courts should look to three factors: (1) the source's knowledge of the subject matter, (2) the source's independence from relevant bias, and (3) the source's motivation to ensure accuracy of the posted information."[156]

In their application to blockchain, these factors lead one to believe that information stored on a certain blockchain is within the purview of judicially noticeable fact. The first factor analyzes the source's knowledge of the subject matter.[157] With

150. Act of Jan. 2, 1975, Pub. L. No. 93-595, 88 Stat. 1926 (1975) (establishing the Federal Rules of Evidence).

151. FED. R. EVID. 201(b).

152. FED. R. EVID. 201(d).

153. FED. R. EVID. 201(c).

154. FED. R. EVID. 201(e).

155. FED. R. EVID. 201(f).

156. Jeffrey Bellin & Andrew Guthrie Ferguson, *Trial by Google: Judicial Notice in the Information Age*, 108 NW. UNIV. L. REV. 1137, 1140 (2014).

157. *Id.*

blockchain, it cannot be questioned whether a blockchain has knowledge of the transaction in issue.[158] Blockchain explorers directly reflect the transaction that occurred.[159] The blockchain has intimate knowledge of which public key holders the transaction occurred between, what transaction or sums were transferred, and when the transaction occurred.[160]

Seemingly, this is only possible on a purely public blockchain where all information is freely available to the public. Privacy-Oriented, Private, and Permissioned blockchains all have an additional layer of protection which guards the public key holder's information.[161] As such, the ability of the court to take judicial notice of transactions on these blockchains is significantly diminished. A Private or Permissioned blockchain may still allow public exploration,[162] if not, however, transactions which occur on these blockchains will generally require the third party which controls such information to be subpoenaed. At this point, we are left solely with blockchains that allow for public exploration of its transactions. Luckily, at the present time, the majority of financial blockchain transactions (cryptocurrency) are taking place on public blockchains umbrella and are still subject to analysis of the remaining factors.[163]

The second factor is the source's independence from relative bias.[164] This factor again brings the remaining blockchains within judicial notice purview. Explorer outputs are merely a function of reporting the transactions which occurred on the blockchain.[165] The blockchain is unable to output information in a misleading way.[166] This technology is not subjected to prejudice or bribery. Blockchain has no implicit biases. Indeed,

158. *See supra* Part IV.

159. *Id.*

160. *Id.*

161. *Id.*

162. Similar to our example of a Governmental Blockchain Land Title Registry, *see supra* Part V.

163. In the future, this is likely to change. *Deloitte's 2019 Global Blockchain Survey*, DELOITTE INSIGHTS 30 (2019), https://www2.deloitte.com/content/dam/Deloitte/se/Documents/risk/DI_2019-global-blockchain-survey.pdf.

164. Bellin, *supra* note 156.

165. Agrawal, *supra* note 80.

166. *See supra* Part IV.

the explorer is merely a reported representation of the transactions which occurred on the blockchain and is outputted as a matter of course.[167] This factor weighs in favor of allowing judicial notice.

The third factor, the source's motivation to ensure accuracy, also militates toward judicial noticeability.[168] The entire premise of blockchain technology is underpinned by its immutable characteristics. Consortiums which design and engineer blockchains have the sole motivation to ensure the accuracy of the information which is contained on the blockchain.[169] Indeed, the invention of this technology in 2008 was directly motivated by the market manipulation and disingenuous practices that the centralized global players were partaking in.[170] The engineering of this technology arose directly out of a backlash for the inaccurate reporting done by centralized financial institutions.[171] The creators of blockchains and those who participate in the blockchain market by transacting in cryptocurrency utilize blockchain for its immutable characteristics.[172] Cryptocurrencies are not subject to the control of "banking cartels" that many tinfoil hat wearing conspiracy theorists believe exist.[173] The rising value of cryptocurrencies over the long term show that many are seeking alternatives to a banking and economic system they believe is rigged.

Additionally, the tangible value of blockchain and cryptocurrency assets is based upon the premise that the information on the blockchain is immutable.[174] The engineers which create blockchains are directly motivated to ensure that the information stored on the blockchain is reliable and accurate.[175] If this was not the case, the time, money, and effort

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167. *See id.*

168. Bellin, *supra* note 156.

169. *See supra* Part III.

170. Nakamoto, *supra* note 17.

171. *See supra* Part I.

172. *See supra* Part III.

173. Kimberly Amadeo, *Who Really Owns the Federal Reserve?*, THE BALANCE (Feb. 7, 2020), https://www.thebalance.com/who-owns-the-federal-reserve-3305974.

174. *See supra* Part III.

175. Amiangshu Bosu et al., *Understanding the Motivations, Challenges, and Needs of Blockchain Software Developers: A Survey*, 24 EMPIRICAL

that went into the creation of the blockchain would be destroyed. Traditionally, the programmers which create blockchain technology are also the first miners of the currency.[176] When they started mining, the value of the currency was so low that many were rewarded with huge lots of cryptocurrency.[177] The value of their labor in programming and mining was paid in cryptocurrency.[178] Many of these originators have amassed huge amounts of cryptocurrency.[179] They are incentivized to not have the value of cryptocurrency fall precipitously, which it would, if it were found that the blockchain was unreliable.[180] The creators of each individual blockchain have a huge motivation to ensure the information which is stored on the blockchain is accurate, as long as they are not engaged in their own fraudulent conduct, which the cryptocurrency space is currently rife with.[181] However, as the sector matures and large institutions enter the space, these types of scheming opportunists should be eliminated by the market forces of laissez faire capitalism and government regulations of the American mixed economy.

Accordingly, *some*, but not all, blockchains may allow for the information which it contains to be judicially noticed. What will be important in determining whether a particular blockchain is subject to judicial notice is (1) the pervasiveness of the particular blockchain, (2) whether the particular blockchain is public and can be explored, and (3) the particular blockchain's adherence to the fundamental motivations of blockchain technology. Not all uses of blockchain technology will be subject to judicial notice.

SOFTWARE ENG'G 2636 (2019).

176. *The Satoshi Fortune*, WHALE ALERT (July 20, 2020), https://medium.com/@whale_alert/the-satoshi-fortune-e49cf73f9a9b (estimating the value of Satoshi's bitcoin holdings at $10.9 billion).

177. *Id.*

178. *Id.*

179. Mike Dalton, *Whale Watching: Which Crypto Wallets Have the Biggest Balances?*, BITRATES (June 19, 2020, 9:39 PM), https://www.bitrates.com/news/p/whale-watching-which-crypto-wallets-have-the-biggest-balances.

180. Ziyao Liu et al., *A Survey on Blockchain: A Game Theoretical Perspective*, 7 IEEE ACCESS 47615 (Apr. 2019).

181. Paul Vigna & Eun-Young Jeong, *Cryptocurrency Scams Took in More than $4 Billion in 2019*, WALL ST. J. (Feb. 10, 2020), https://www.wsj.com/articles/cryptocurrency-scams-took-in-more-than-4-billion-in-2019-11581184800.

However, one can imagine a future where blockchain technology is so pervasive that judicial notice of such transactions will lead to a more cost-effective way to admit such evidence.

VIII. PUBLIC POLICY OF COST SAVING

The judiciary does not stand as an inflexible institution condemned to hand down authoritative proscriptions from on high. The judiciary strives for flexibility and the ability to adapt to the ever-changing landscape of its jurisdiction. This is important because as a process or function in society becomes standardized, courts are not resigned to remain blind to the ongoing evolution. Processes change, become cheaper, and more readily accessible to the common person. Courts regularly cite public policy to update their principles to the realities of modernity.[182] As social norms and technologies evolve, courts hope to be a part of that evolution.

One of the most prolific examples of the desire for technological adaptation is the Public Access to Court Electronic Records ("PACER") (also known as Case Management/Electronic Case Files ("CM/ECF")). In response to the invention and proliferation of the internet, courts took the opportunity to streamline and update their procedures.[183] Today, litigants no longer must run to the courthouse before the eve of the expiry of the statute of limitations. Filing an action is as simple as uploading a PDF and making an online purchase. The federal court revels in the new availability, cost effectiveness, efficiency, and archivability the expansion of CM/ECF has created.[184] Most importantly, the public policy of efficiency of the judicial economy is well served by this transition. Not only does the court require less clerks to receive the filings, but also less backend work of organizing and

182. Judicial Conference of the United States, 28 U.S.C. § 331 (codifying the establishment of the Judicial Conference, the judicial rulemaking authority tasked with "promot[ing] simplicity in procedure, fairness in administration, the just determination of litigation, and the elimination of unjustifiable expense and delay").

183. *See 25 Years Later, PACER, Electronic Filing Continue to Change Courts*, U.S. CTS. (Dec. 9, 2013), https://www.uscourts.gov/news/2013/12/09/25-years-later-pacer-electronic-filing-continue-change-courts.

184. *See About Us*, PACER, https://www.pacer.gov/about.html (last visited Aug. 10, 2021).

delivering the filings to the specific court part. Parties upload their information directly to the case files which are available to the court.[185] Courts can even set alerts to learn when a new filing has been uploaded.[186]

Courts are not concerned only with management of the public purse. Courts also desire to ensure that litigants are not throwing their money away in protracted litigation. Fee shifting, dismissal and sanction of frivolous case files, a desire for and implementation of settlement conferences, *inter alia*, all stand as evidence of the courts' desire to save litigants money. The use of judicial notice also serves this goal. Judicial notice allows the court to avoid the cost of a litigant to procure the testimony of someone with knowledge. Judicial notice allows streamlined procedures permitting litigants to focus on the actual issues in contest.

In this context, judicial notice of transactions which occur on the blockchain will allow for more streamlining of the procedure. This may be extremely important in a future where blockchain is the underlying structure of many of the ledgering systems. One can imagine a case where information on various blockchains is necessary to the outcome of the trial. With the court taking judicial notice of the propriety of the information, which was pulled from the blockchain, the court could avoid numerous days of foundation laying, cut through the procedural red-tape, and get directly to the issues at hand.

IX. CONCLUSION

Blockchain is considered a disruptive technology. The widespread use of blockchain will usher in a paradigm shift in how our society stores, retrieves, logs, and interacts with huge swaths of data. We are recording more information than ever before, and because of the sheer mass of these databases, the courts should look to ways to streamline the processes as it relates to presenting the information contained on these

185. *See Electronic Filing (CM/ECF)*, U.S. CTS., https://www.uscourts.gov/court-records/electronic-filing-cmecf (last visited Aug. 10, 2021).

186. *See FAQs: Case Management / Electronic Case Files*, U.S. CTS., https://www.uscourts.gov/court-records/electronic-filing-cmecf/faqs-case-management-electronic-case-files-cmecf (last visited Aug. 10, 2021).

databases.

Blockchain was born out of a simple motivation—to make the ledgering of our transactions transparent, immutable, trustless, and decentralized. The ideal of blockchain is similar to the ideals of the American founding fathers. Consolidation and centralization can lead to corruption and a lack of accountability, leaving victims with no recourse. The blockchain system was created to bring the power to the masses as an alternative to the massive, unwieldy financial system we have today.

As the technology carries into differing ledgering systems, the ideals which spawned the creation of the technology will follow, hard coded into the processes. The technology itself is a reflection of its invention. So much so that the accuracy of the information that it produces cannot be questioned. While ESI currently requires certification from an expert for the underlying processes of the software that organizes information and reports it, soon enough all information will be ESI, and the courts will have the opportunity to streamline procedures again. Judicial notice can be one of the tools the court has at its disposal to streamline litigation, saving the litigants and the court time and money.